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THE

ELECTRICAL WORLD

A REVIEW OF CUR PROGRESS IN ELECTRICITY
AND ITS P CAL APPLICATIONS

VOLUME LI

JANUARY 4 to JUNE 27, 1908

46724
21/6/09

NEW YORK
ELECTRICAL WORLD

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Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, JANUARY 4, 1908. No. 1.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, Pres.; CURTIS E. WHITTLESEY, Sec. and Treas.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE AODRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Schofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
SAN FRANCISCO OFFICE....................601 Atlas Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico	per year, $3.00
Dominion of Canada	4.50
Other Foreign Countries within the Postal Union	6.00

25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

During 1907 ELECTRICAL WORLD *printed and circulated* 951,250 *copies, an average of* 18,294 *copies per week. Of this issue* 26,000 *copies are printed.*

NEW YORK, SATURDAY, JANUARY 4, 1908.

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ELECTRICAL GROWTH IN 1907-8.

The past year was one of extraordinary conditions, with unparalleled prosperity at one end, unsurpassed depression at the other, and a sharp return to normal average conditions as it closed and became history. On the surface, business was brisker than ever throughout the first half of the year, but it was increasingly difficult to finance industry, and the high price of materials and labor drove many consumers into a policy of retrenchment that came none too soon to mitigate the strain of the last three months. It is difficult to tell how far purchases and consumption fell off after June, but it is well known that in many quarters the process of restriction began then, and has prevailed up to the present moment. Hence, one of the best and brightest aspects of the situation is the very general absence of overproduction. We know of no instance in the electrical field where goods have been forced on the market because of glut or in an endeavor to realize; and this appears to be equally true of practically every other field of manufacture. On the contrary, there are instances where a return to average, standard prices, as in the case of copper, has been followed by an immediate stimulation of demand. Some day copper, when scarcer, may be actually worth 25 cents a pound, but no man in his senses wanted to buy it at that figure last year unless he had to have it, cost what it might. In like manner, labor had reached a point of costliness and inefficiency that was positively appalling to anybody trying to earn a return on his business by prudent management.

All this has necessarily complicated and confused any attempt at review and survey, but the effort may be made along lines that are familiar to our readers. The following table is offered as an approximation to the electrical sales and earnings of 1907, as compared with 1906:

	1906.	1907.
Electrical apparatus	$250,000,000	$275,000,000
Street railways	360,000,000	385,000,000
Electric lighting	175,000,000	225,000,000
Telephony	165,000,000	200,000,000
Telegraphy and cable	50,000,000	55,000,000
Isolated plant supply	100,000,000	110,000,000
Miscellaneous	40,000,000	50,000.000
	$1,140,000,000	$1,300,000,000

With regard to some of these figures there is no element of doubt, because the statistical bases are well established and the percentages of growth are well known. Thus, land telegraphy is stagnant, but submarine cables do a larger business every year. Telephony has been expanding at a rate of 40 or 50 per cent annual increase, but it got a check last year. Street railway increase has settled down to a 7 to 10 per cent gain, depending apparently on the growth of population and the extension of facilities as the dominant factors, but checked by all kinds of assault on the 5-cent flat fare. It is probable that the real earnings per passenger to-day do not exceed 3 cents, if they reach it. Central station earnings, on the other hand, have gone forward tremendously, partly as a result of the greater availability of circuits and electricity, and partly because of the energetic business-getting campaigns of the last three years. A rate of increase of 30 per cent has been reached in a great many instances, but would not apply all over the country.

Our readers are themselves "sitting in the game," to use a colloquialism, and can check up our statistics and estimates as to the past. What 1908 has in store no one knows. But judging the future by the past, believing in the steady evolution of the arts, realizing the larger place that electricity plays all the time in human affairs, we predict that 1908 will see new standards attained and new high-water marks. Reducing faith and hope and evidence of growth to values, we place total electrical earnings in 1908 at $1,500,000,000.

The Arrival of the Tungsten Lamp.

The beginning of the year 1908 will probably mark the coming of the American-made tungsten lamp on the American market. Foreign-made tungsten lamps have been regularly on the market for the past nine months, but in quantities too limited to supply the general demand. American makers now claim to be turning out tungsten lamps in quantities which make them available for every-day use. Methods of manufacture and shipment have been improved so that breakage of filaments in shipment is not the serious obstacle it was some months ago. American manufacturers have adopted for the present three standard sizes, consuming 100, 60 and 40 watts, and giving, respectively, 80, 48 and 32 mean horizontal candle-power; or, in other words, taking 1.25 watts per mean horizontal candle.

So far, the tendency of manufacturers has been to put out these lamps with clear glass bulbs. This is a rather illogical proceeding in view of the common practice of sending out carbon-filament lamps of similar candle-power with frosted tip bulbs. To be sure, one can order whatever he wishes, but the majority of users take what the manufacturer supplies regularly. It is certain that the tungsten lamp of 32 candle-power and over is entirely too powerful an illuminant to be placed around promiscuously without diffusing glass between it and the eye. By frosting the tips of these lamps and putting them in bowl-shaped reflectors which cover all but the tip of the lamp, they are made more bearable, but are still decidedly too powerful for eye comfort when placed in small rooms at ordinary chandelier heights. After all, perhaps the practice of the manufacturers in sending out these lamps with clear bulbs may not be without benefit, because thereby users will be impressed with the importance of putting lamps high up out of range of vision and placing them behind diffusing ceiling hemispheres or in large diffusing globes which will reduce the glare. The tungsten lamp being three times as efficient as the carbon-filament lamps in common use, it is not necessary, for the sake of economy, to place lamps as low as formerly or to have them so near the work. It is also possible to light a small room sufficiently for reading or close work with no greater amount of current than before without going to the trouble and inconvenience of providing small lamps in different parts of the room. It is not, however, to be expected that the tungsten lamp will be "easily domesticated" as long as it is made in such high candle-powers. In residences there are many places where lamps of 8 candle-power or 4 candle-power are entirely adequate, and it is only in some of the more important rooms of the house that higher candle-power lamps can be used to the best advantage.

In the illumination of larger interiors like stores and offices, the candle-powers in which tungsten lamps are being made are well suited. It is safe to predict that there will be some reduction in the maximum demand of stores due to the use of tungsten lamps, although the ultimate effect will be that more light will be used and the electrical energy consumed per year will, on the whole, be greater. The shrewd central-station manager will attempt to draw advantage from the incentive which the increased economy of the tungsten lamp will have toward causing customers to use artificial lighting more hours per day, with perhaps a reduced maximum demand. For example, a merchant who has been closing up his store and turning off all lamps at 6 o'clock may be induced to keep his window lighting turned on during the evening or even the whole interior of his store as an advertisement. He may not be paying the central station much more in dollars and cents, but his maximum demand has been reduced and his hours of consumption increased. The station and distribution system capacity thus set free can be sold to other customers and the revenue per dollar invested in a central station enterprise can be increased. This is what the advent of the tungsten lamp will mean to the live central-station manager. To the one who is not alive to his opportunities, it will simply mean that the rate of increase of his load will be slowed down for a few years without any change in the earning capacity of the plant per dollar invested.

Electric Energy Transmissions.

The year past has been like several previous ones, unproductive of sensational work, but, nevertheless, full of substantial activity. Of new plants there have been many described in our columns. The scene of the greatest activity has perhaps been in the Piedmont region, in the southern Appalachian district, and the Great Falls plant, which we recently described, is, with its 40,000 horse-power, the most considerable of recent hydro-electric installations. There has been a noteworthy extension of the distribution system dependent upon the Niagara group of plants, and that great power is now beginning to assume something of the general industrial importance that is its due. Its development has been along conservative lines, albeit on a very large scale, and its far-reaching circuits are becoming a very important factor in the growth of enterprise in northern New York. The distances covered have not even now become so great as to demand phenomenal voltage, and the voltage record, now a little above 70,000 volts, belongs to the enterprising Michigan plant that has gradually been pushing its pressure into a region hitherto untouched. The success of this year's work at 70,000 volts makes it certain that higher figures will be tried ere long with good operative results. It is, after all, a mere question of insulators, since there is no doubt that transformers can be made thoroughly reliable for voltage considerably above anything yet attempted in commercial practice.

Perhaps the solution of the high-voltage problem will be found in the new suspension insulators, which have this year been put into tentative use and are soon to be applied on a considerable scale. The ordinary forms of insulator, while excellent for voltages now in use, become, when of adequate dimensions for the higher pressures, decidedly troublesome to support, owing to their necessarily considerable height over the cross-arm. Even on the steel towers often used to support high-voltage lines, the requisite strength is not always easy to secure. The suspension insulator supports the wire flexibly, it is very easy to give the striking distance needed for safety even at very high voltage, and a comparatively small number of anchor points gives the requisite strength against longitudinal stresses. Whether the insulators will stand up well against the grinding due to motion of the wires is another matter. Only protracted experience can answer this question, like many another regarding the performance of insulators. The suspension insulators take up a large amount of vertical space on the pole or tower, so much, indeed, as to be almost impracticable save with tower construction. The majority of high-voltage lines of recent building are on towers with spans of 500 ft. or so. The plan has generally worked well, but some weaknesses have been disclosed. Lines with two complete circuits per tower are now looked on askance by cautious engineers, for it has quite usually happened that a failure of one circuit from lightning or other violent cause has at once involved the other. Whether suspension insulators will improve matters in this respect remains to be seen.

Protection against lightning seems to be improving. Grounded steel cable stretched over the circuits has, on the whole, given a pretty good account of itself the past season. It is by no means a panacea, but it often proves a valuable palliative. The electrolytic lightning arrester also, while not in use to a sufficient extent to give ground for a final judgment, has given promise of great usefulness. For the line, the very high price of copper during most of the year has been a tribulation, and has given a strong impetus to the already growing use of aluminum. The weak point of this metal, as is well known, is its low elastic limit, and to meet this difficulty a steel-cored aluminum wire is now being produced, the latter metal forming a complete continuous sheath. It offers a remarkable combination of lightness and strength, but has not yet been used enough to disclose any latent difficulties. In general methods of transmission there has been no change. The character of apparatus and the prevailing frequency remain unaffected by any present tendencies. There is, however, an increasing disposition to adopt European practice and to use three-phase transformers instead of groups, and to use them in units of very large capacity—a striking proof of the confidence inspired by the present methods of transformer construction. Abroad there is still much talk of constant-current transmission, inspired by the undoubted success of the recent Thury plants. While individual generators of this system remain as at present of a maximum output seldom reaching 500 kilowatts, the multiplicity of units will continue to repel most engineers, although this complication is in no small measure compensated by the extreme simplicity of the switching apparatus, which in American practice has become very burdensome. No projects on foot in this country yet involve distances so great as to make the use of constant current a really live issue. Nor has the use of alternating current in railway motors yet progressed far enough to raise seriously the question of a lowered frequency in general transmission practice.

The Year in Electric Railroading.

Nineteen hundred and seven has been a year of very satisfactory progress in electric traction. While the amount of new work has not been extraordinary, much of it has been of a character bearing more and more closely upon the general use of electricity for transportation. This problem has been approached in this country by a steady growth upward from ordinary interurban work rather than by any startling leap. In our leading issue for 1907 mention was made of the single-phase equipments which were then being installed for the Erie Railroad and for the New York, New Haven & Hartford Railroad. During the past year these two equipments were placed in service, the former in January, and the latter in August. In each case the designers' estimates have proved correct, and success has attended the operation of both motor-cars and locomotives receiving energy directly at 11,000 volts. Those who have examined these equipments closely seem favorably impressed, and the feeling is that such troubles as have been encountered have been subsidiary and incidental rather than vital. Material trouble, now for the most part overcome, has been reported from inductive action on the telephone and telegraph wires, and the necessary conditions of safety and good insulation of the high-voltage conductors have proved difficult to secure. These should, however, be regarded as of a temporary nature. The New Haven system is undoubtedly handicapped by the necessity for a double service with both alternating and direct currents, which causes needless complications, so far as the general system is concerned. It is rather discouraging to the friends of single-phase traction to find steam locomotives still doing the work after months of exasperating delays, yet the general sentiment seems to be that the system will pull through all right in due season.

Considerable development has taken place during the year in the line of commutating-pole, direct-current railway motors for operation at high voltage. In most of the cases in America each motor has been designed for 600 volts, and two have been connected in series at 1200 volts, although the 1200-volt motor has been produced and used successfully. In one case, that of the Albuquerque Traction Company in New Mexico, a 1200-volt, three-wire railway system has been in service, standard 600-volt motors being used. Although direct-current railways in this country have not yet employed motors at greatly increased e. m. f., high-voltage motors of the commutating-pole type have been introduced on some of the foreign roads. On an experimental line of the Vienna railroad an e. m. f. of 2 x 1500 has been used, the motors being wound for 750 volts. At a German blast furnace a small railway has been operated at a direct e. m. f. of 2000 volts, while a trolley e. m. f. of 3000 volts with 1500-volt, direct-current, commutating-pole motors has been seriously considered for railways in Switzerland. There can be no doubt whatsoever that armature and field coils can be thoroughly insulated for 1500 volts. Moreover, in large-size commutators, sparking can be eliminated by the use of auxiliary commutating poles, and flashing can be prevented by the use of compensating windings and by completely isolating each brush in its own compartment. It seems probable, therefore, that the near future will witness the rapid introduction of high-voltage, direct-current railway motors for interurban service where the rotary converter sub-stations necessary with a 600-volt trolley may be omitted by using a direct

e. m. f. not exceeding 1500 volts. The problem assumes a different aspect, however, when the distance becomes so great that substations must be used, because the extra initial cost and maintenance of the 1500-volt motors and converters may then equal the saving incident to their use.

An installation of more than usual interest to American engineers is the three-phase locomotive equipment that has been selected for the Great Northern Railway, as noted elsewhere in this issue. This installation represents the first substitution of three-phase locomotives for steam locomotives in this country. Certain advantages of simplicity and economy were found for the three-phase equipment as compared with the direct-current or the single-phase, as frequently claimed by the advocates of this type of motor for traction. Moreover, the constant-speed characteristics of the induction motor, which has often been held as one of its greatest disadvantages in railway work, were found in this case to be an element in its favor from the standpoint both of recuperation and of automatic speed limitation. In this connection, it is well to draw attention to the fact that the problem of energy recuperation and electric braking has been solved in a satisfactory manner for both the single-phase and the direct-current equipments. The advantage possessed by the polyphase equipment in this respect relates largely to simplicity, since complicated change-over apparatus must be employed with single-phase and direct-current series motors in order to give them shunt-motor characteristics. The operating features of induction motors are so thoroughly understood by designing engineers that it is absolutely safe to predict for the Great Northern three-phase equipment equally as good agreement of operation with the designers' estimates as was true of the direct-current equipment of the New York Central or of the single-phase equipment of the New Haven. Abroad, the three-phase locomotive has done excellent work, having been adopted for the Simplon tunnel and other important installations, but hitherto has made no progress in this country, due to the not unnatural dislike of a double trolley and apparently a certain studied disinclination on the part of most of the manufacturing companies. The Cascade tunnel plant will furnish an excellent demonstration of the system which may prove fruitful. There is no doubt, however, that the single-phase system on a number of medium-sized roads has been doing excellent work, and the simplicity of the overhead work is a strong commendation. We are far yet from having a high-voltage traction system which shows conspicuous superiority for heavy railway service.

From the theoretical side the heavy railway problem has received considerable attention and some valuable papers have been the result. The weak point of all such discussions is that undue stress has generally been laid upon the mere motive power side of the question, while the most troublesome feature of the problem is the relation of electric traction to operating conditions during the necessarily considerable period during which steam and electric locomotives must work side by side or in close relation. Could one start afresh with electric equipment throughout, the situation would be greatly simplified. Electric railroading has been worked out on the basis of passenger traffic, which is on most steam roads altogether subsidiary in earning capacity to the freight traffic. No large electric road has yet taken up freight haulage on a scale sufficient to solve the problems connected with it. On the ordinary electric lines there has been the usual growth in traffic, and considerable progress has been made, especially in the Middle West, in the establishment of through service on interconnecting lines. Opportunities for this are numerous and too frequently neglected. Rolling stock and general equipment remain on the basis already familiar, the chief noticeable tendency being towards the more extensive use of capacious "semi-convertible" cars. The pay-as-you-enter car is being tried to some extent, but it seems very doubtful whether the public will tolerate it, being in nowise the gainer from its use and subjected to considerable inconvenience. In generating stations new equipment, when with alternating current, has been pretty uniformly with turbo-generators, but the direct-current turbo-generator is still upon the dubious list. On one important interurban line running northward from Milwaukee, a striking innovation, for this country, has appeared in a generating plant operated wholly by gas engines worked from producer gas. Results will be eagerly watched for, and ought to prove very satisfactory. Some admirable economy records have been made with turbo-generators during the year, so that gas engines will be harder pushed than heretofore. The increasing number of gasoline-driven cars for branch line service adds, however, another feature to the competition which is liable to upset some previous calculations.

THE YEAR IN TELEPHONY.

The art telephonic has made notable progress during the past year, and 1907 would stand out conspicuously if only for the achievements of De Forest, Poulsen and others in wireless telephony. The recent advices from Europe indicate that Poulsen has attained remarkable results over long distances, while the equipment of the American Navy with De Forest apparatus is matter of recent record. We are now promised further achievements in the same direction, and Poulsen is understood to look with serene hopefulness on Atlantic wireless telephonic transmission of speech. After what Marconi has done, anything really seems possible of this nature; at least no one cares to gainsay such bold prophecy.

Turning to the more accepted order of telephonic things, there is little new to note, outside one important event. There was, indeed, somewhat of a slowing down in the rate of growth during 1907 as compared with the years immediately preceding, when an increase of 50 per cent over the preceding annual figures seemed nothing out of the way. It is by no means to be believed that the point of saturation has nearly been reached in the adoption of the telephone, but on the other hand such a pace was evidently too rapid to be maintained very long. It is probable that a gain of 25 per cent was reached throughout the field, and as estimated elsewhere in these editorial pages, the total income or earnings of the industry are placed at not less than $200,000,000. At $30 earned per station, that would give nearly 7,000,000 stations. The figures are probably somewhere in that vicinity, but will be brought out with exactitude by the United States census to be taken this year of the industry, for the second time.

The important industrial event to which we have referred is the abandonment of the old restrictive policy of the Bell management as to sale of apparatus, and the placing of telephones at the disposal of everybody. Under the régime of monopoly, as is well known, no one but a licensee could even hire a telephone set from the parent company, and every set was tagged and earmarked with all manner of ownership identification. This had much to do with the old and still continuing bitterness against the "monopoly," which has been pounded with more vindictive, savage rhetoric than even Standard Oil itself. But it is obvious that a great change is effected when Bell telephones are sold freely over the counter, that other conditions must also change, and that a great step forward has been taken toward standardization. We observe that the "independent" bodies announce their intention to oppose the Bell system just as before, but those who have witnessed the wars in the telegraph, lighting and traction fields find it hard to believe that the process of unification has not been most appreciably stimulated in telephony. Such economic simplification is, indeed, one of the most irresistible tendencies of our times.

One other feature of telephonic work on this side of the Atlantic must be noted even in such a brief review as this, although the new development has taken place in Canada. We refer to the purchase by the government of the Province of Manitoba, of the territorial Bell system for $3,300,000, payable in 40-year 4 per cent bonds, payable at par. The system is taken over bodily with the officials, as was done in England with the telegraphs. This is one of the results of the anti-Bell agitation in Canada, and may be followed by other unfortunate ventures of the same kind in the Dominion. It is indeed one of the most striking socialistic moves made on this side of the water, and follows a prolonged period of "government ownership" controversy. It will be interesting to see what efficacy and expansion the system enjoys under the new régime, but we make bold to assert that the free, individualistic, private ownership methods of the United States will prove, as hitherto, incomparably superior, and that such growth as we have just discussed, for 1907, can only be attained with a service free to change its front and its methods so quickly. We look for prosperous times in American telephony during 1908, because every incentive to development remains unimpaired

THE STORAGE BATTERY.

The end of the year 1906 found the storage battery with its auxiliary apparatus in a high state of development, and it is therefore not surprising that the situation in this field has undergone little change during the past year. The most noteworthy event has been the active entry into the field of one of the large electric manufacturing companies, which has placed on the market a new storage battery together with the usual booster auxiliary. The plates are both of Planté formation while the booster is of the externally controlled type. One of the older companies has also brought out a new negative plate subjected to a special treatment after formation which, it is claimed, prevents any diminution in capacity even after years of arduous service, thus confining renewals to the positive element only. A new company has just entered the field with an element consisting of a lead core with active material on each surface held in place by porous earthenware plates. It is claimed that this construction results in a cell of relatively light weight and one practically indestructible. The general business for the year was good, and better than would naturally have been expected when the rapid use in the increase of steam turbine generating units is considered. The ability of the steam turbine to deliver power largely in excess of its normal rating, and also at a fraction of its rating, with but small changes in steam economy, diminishes the saving that a storage battery may be able to effect when working as a load regulator; and the preponderance of alternating-current over direct-current systems in recent installations, has prevented the battery business from keeping full pace with the growth and extension of the electrical industry generally.

The fact that the majority of the electrical equipments, and by far the greater kilowatt rating, installed in recent years, are alternating current, coupled with the desirability of having an electrical reservoir connected to the system, has led to the development of apparatus and devices, whereby storage batteries may be worked on alternating-current circuits. Some of these are highly ingenious and have proven successful. The current to charge the battery is received from the alternating-current mains and transformed into direct current, while the direct-current battery discharge is converted back to alternating current. Rotary converters adapted to work "inverted" are used in some systems, being interposed between the line and the battery; while in other systems, motor-generator sets are used, made up of an alternating-current machine coupled to a direct-current machine. In the latter case the alternating and the direct-current machine take turns in acting as the motor, depending on whether charge is going to the battery or a discharge from it to the line is taking place. Obviously when one of the two machines works as a motor, the other works as a generator, and the change from one condition to the other may take place almost instantaneously. Automatic field-controlling devices responding to the load changes of the system, cause the charge and discharge to take place with load variations, as in the case of externally controlled boosters with direct-current systems having regulating batteries connected to them.

It may be predicted that the use of storage batteries will be greatly increased in the next few years. This prophecy is predicated on the belief entertained by many engineers that the steam turbine marks only a transition period in prime movers which must give way to the internal combustion engine because of the superior economy of the latter. The characteristics of these two prime movers are practically antithetical. The gas engine has no overload capacity; it operates best when delivering a steady amount of power, and is liable to give trouble when worked on light loads. The storage battery affords the required flexibility in respect to variations in the external load while maintaining a constant load on the generating equipment, or as one writer on the subject has phrased it, "the storage battery is the natural consort of the gas engine." There is no question that an extended use of gas engines for driving electric generators will be attended by a correspondingly increased volume of business in storage-battery work.

PRIME MOVERS.

The experience of the year 1907 in power plant practice for central station work has served rather to confirm lines of development indicated during the past few years than to bring forward anything essentially new either in principle or mode of application. The general situation as regards fuels and steam generators remains unchanged. Advancing prices of coal in various parts of the country and local coal famines have had the effect of increased attention to the problems connected with the economical use of low-grade or residual fuels, while in certain sections of the country the same conditions have caused a change of fuel from coal to oil. As already noted in these columns, the combustion of fuel oil has now become merely an economic problem, and if coal becomes more difficult to obtain than oil, or if its price rises above the margin for economic competition with oil, then the latter will naturally be adopted for steam generation; and during the past year exactly this change has occurred in certain parts of the country and especially on the Pacific Coast, where oil fuel has largely established itself as the standard fuel for steam generation. With regard to superheated steam, the status remains much as it has for the past few years. Steam superheated by 100 to 150 deg. has been accepted as a definite part of the program for turbine operation, and the leading makers of steam boilers now provide either specially designed superheating boilers or specially fired superheaters for the provision of steam superheated to such degree. On the other hand, the use of superheated steam in reciprocating engines is making but slight advances and the mechanical difficulties connected with lubrication and high temperature expansion appear to limit the use of superheat in such form of prime mover to an amount not often exceeding 20 to 40 deg.

With regard to the prime mover, the experience of the year has served the more definitely to establish the turbine as the typical steam prime mover for large units and for standard power plant practice. At the same time it is perhaps equally clear that this general status of the turbine has been reached not by virtue of any one characteristic alone, but as a result of the general summing up of its points of relative advantage and disadvantage. It has not demonstrated any superior thermal efficiency and its uniformity of rotative speed is met by quite satisfactory guarantees on this point by builders of reciprocating engines. The floor space required is distinctly less than for reciprocating engines, though the difference for the main turbine as compared with the main engine is to some extent offset by the larger space required for condenser and air pump. There still remains, however, some saving in space, and this feature, high and uniform rotative speed, resultant saving in size and cost of generator, excellent thermal economy, natural adaptation to overload conditions and general adaptation to the varied special conditions of electrical service, have together given to the turbine the status which it now occupies in the estimation of central station engineers. In point of size the past year has witnessed the advance to units of 10,000-kw rating, the dimensions for the turbine for such units being only 25 ft. x 15 ft. x 12 ft. or 27 kilowatts per square foot of prime mover floor area or 2.2 kilowatts per cubic foot of prime mover volume occupied. In small plants and for various special conditions, however, the reciprocating engine is holding its own, and until the present business depression began to make its influence felt, no industrial establishments were perhaps busier than the steam engine builders through the country. An interesting trend of practice may be noted in the matter of rotative speeds with Corliss or detaching valve gears. A few years ago a speed of about 100 r. p. m. was considered the maximum for engines with valve gears of this type. With the demand for higher speeds, especially in central station work, came first the four-valve engine with sacrifice of the distinctive features of the detaching gear and some consequent loss in economy. This move in large measure has been met by the designers and builders of detaching valve gear engines, who have shown that such gear may be operated with entire satisfaction at speeds of 120 r. p. m. as evidenced by large numbers of such engines in all parts of the country running at this speed. Still more recently, and especially within the past year, advances have been made to 150 r. p. m. and already a few engines with detaching valve gear are in operation at this speed.

In various parts of the country where municipal steam heating is in vogue, installations of specially interesting character have been made in which the heating and power plant are combined in one, the power unit serving as a reducing valve for the steam on its way from boilers to distributing mains, while at the same time toll is taken in the form of heat transformed into mechanical work and thence into electrical energy. It may be noted that in this manner the entire output of the boiler is sold, part in the form of heat energy in steam and part in the more highly specialized form of electrical energy. It may also be pointed out that in such case only so much fuel is chargeable to the power account as may correspond to the heat actually transformed into electrical energy; or in other words, an amount representing the actual fuel equivalent of the energy delivered to the switchboard. The remainder of the fuel charge must go to the heating account, thus making possible the development of power alone on the same financial basis as though we were possessed of an engine with 100 per cent thermal efficiency. With ordinary good practice the fuel thus chargeable to one kilowatt at the switchboard might be about one-third pound of coal instead of some two pounds as would be the case with the best practice of the day where the exhaust cannot be so utilized. Under circumstances permitting the sale in this manner of the entire boiler output of energy (except, of course, transmission and other secondary losses) the possibilities of saving so far as the fuel account is concerned are plainly apparent.

Regarding the internal combustion engine the situation has not changed in marked degree during the year. The prices of alcohol, gasoline and all such high-grade fuels rule them out of the field at once for all cases where the cost of power is an important item in the cost of the selling product. In the larger sizes, engines with ratings from 1000 to 4000 horse-power in small numbers are at work and much valuable experience is being acquired. Such engines are operating either on some form of produced gas or on gas derived from fuel oil. The chief difficulties have resulted from problems of speed control when driving alternators in parallel, and from difficulties inherent in the type of engine, especially in large sizes, such as internal deposits of carbon on valves and ignition apparatus, back firing, etc. The internal combustion engine in these large sizes seems, however, to be slowly making good, or in any event data are being very carefully gathered upon which further study may be made looking to the correction of the present difficulties; and with such further improvement this type of prime mover will acquire a status which will place it in most active and serious competition with existing forms of steam prime movers.

THE CENTRAL STATION.

While the past year has witnessed nothing revolutionary in the field of the central station, the retrospect brings out two features of importance which have characterized it—the increasing strength of the new business movement and the establishment of the principle of state regulation of electric lighting corporations as a public policy, which promises soon to become fixed in the statutes of all of the states. Happily there is as yet no indication that such regulation will seriously menace the real interests of the central station, and the example of Massachusetts shows that proper regulation can have the effect of safeguarding central station properties both from ruinous competition and from operations of high finance so fatal to the interests of the legitimate investor. While this journal has always viewed with askance propositions which would hamper the conduct of central stations as business enterprises, it has not been blind to the fact that the policy of withholding from the public all knowledge of central station finances has been largely responsible for the growth of the municipal ownership movement, and entirely so for the instances of property wrecked or their development checked, through improper financial manipulation. In so far as state commissions shall require the publication of accounts and a proper showing prior to new issues of stock and bonds, they will undoubtedly serve an excellent purpose; and while rendering the field less inviting to financial ability of a certain stamp, will undoubtedly make it more attractive for legitimate investment.

The recent awakening of the central station to the fact that it is not only a manufacturing concern but also a commercial retailer of its product, which should put forth every effort to overcome competition and extend the sale of its wares into new avenues, has already had an excellent effect, both financially and in increased electric lighting activity along all lines. The day should not be far distant when every central station will have been reorganized to accord with this new spirit, and the managements that will not heed its promptings will simply be inviting Fate to their undoing. To encourage this movement, during the past two years we have devoted a special department to it under the head "Central Station Sale of Current." This we shall continue, but as the use of this specific head has been misleading in that perhaps the matter printed elsewhere in an issue relating directly or indirectly to the commercial side of the central station exceeded that printed under the head, it will be dispensed with beginning with this issue. Owing to the vast preponderance numerically in this country of the central stations of smaller capacity, this journal has endeavored to print a correspondingly large amount of information of value in the management and operation of this class. Owing to lack of space here, a review of the situation with respect to the smaller central station is printed elsewhere, together with a discussion of immediate and remote prospects.

The outlook for these companies is by no means discouraging if they are in the proper hands. If they are not in the proper hands, there is good opportunity for young men who understand the business to take hold of them. To be sure, small companies do not offer to young men the same opportunities as the large ones, but we venture the opinion, based on past observation, that men making good records as managers of small companies do not go unnoticed when larger undertakings are on foot. The all-round experience gained in smaller companies is of the greatest value as a foundation for larger work. One of the greatest difficulties besetting the small company of to-day which is owned by local capitalists is to get the right kind of a man in the management. A manager should be judged by the results he can produce; and as the results produced by some of the successful small companies are now well known to all who regularly read these columns, there should be no rest until a property is in charge of a man who can duplicate these records.

THE FLAMING ARC LAMP IN AMERICA.

Up to the present writing, the flaming arc lamp in America seems to have occupied the place assigned to it by electrical prophets when it was first introduced in this country; that is, it has been principally used for advertising purposes, a few here and a few there. In the aggregate the number in use is considerable. They have been of such high candle-power in comparison with all other illuminants used on the street as to attract attention on this account, and also on account of their color. They have been extensively used for lighting the fronts of buildings, such as theatres and other places where it is desired to attract attention by the light. The flaming arc has also demonstrated its usefulness in billboard lighting. On account of its high efficiency, its downward light distribution, and the fact that the area of billboard covered by one lamp need not be very great, it is well adapted to this class of work. When it comes to the complete lighting of thoroughfares, however, the flaming arc has made little progress in this country, although we learn that it is receiving serious consideration in various quarters for special spectacular street lighting, and that before long we will doubtless have some notable installations in this country. For ordinary street lighting, however, the flaming arc is too large, and so much of its light is thrown downward that spaces between posts are dark by contrast. But there is a special class of street lighting for which it is fairly well adapted, and that is in the special lighting of down-town streets, where it is desired to produce an illumination enough out of the ordinary to be attractive, and where the property owners are willing to pay a relatively high price for striking results. In such cases, with lamp posts placed at very frequent intervals, and the lamps hung high up, the flaming arc, on account of its high efficiency, can undoubtedly produce a spectacular effect not obtainable at the same cost from any other illuminant now available. The downward distribution of light from the flaming arc is not so objectionable when lamps are placed close together as when they are placed one or two per block, provided the lamps are hung considerably higher than is usual with arc lamps. Could means be devised for spreading out the rather concentrated light distribution of the flaming arc lamp, the limitations accompanying its use would not be nearly so narrow. This problem is now being taken up, and it is to be hoped some successful practical methods can be worked out to accomplish this, and so increase the well-illuminated area that can be obtained from a flaming arc lamp. Apparently the only other method of solving the problem of securing even illumination from flaming arcs spaced 100 or more feet apart is to hang them at heights far in excess of any that are common in this country. Lamp posts 40 ft. to 60 ft. high may be very well for large areas, but for crowded down-town streets are excessively high. Hanging lamps on brackets from buildings do not seem destined ever to become popular in this country, although on many down-town streets the necessary height could be secured in that way.

To Lord Kelvin.

Peace and the grace of God abide with thee,
Fallen with weight of over-ripened days!
Thou canst not hear how men forbear to praise
For grief the world has lost thy majesty.

How shall we more exalt thy fame's degree,
Or to thy memory enduring raise
More lofty tribute than thy Learning lays
Upon thy tomb? What words of eulogy

Are needed more to save thy cherished name
From unremembered annals of the dead?
But with the great of every land we bow
In sorrow, while with loftiest acclaim
Thou to thine everlasting rest are laid
With crown of noble works upon thy brow.

Wilbur Morris Stine.

Burial of Lord Kelvin in Westminster Abbey.

Upon the initiative of the Royal Society, of which he was so long a member, Lord Kelvin was buried in Westminster Abbey on Dec. 23. A cable dispatch describes the event as follows:

England honored herself to-day in giving the last and greatest honor in her power to the mortal remains of her greatest scientist. With a ceremonial of a character never seen except at the funerals of her greatest men, Lord Kelvin's body was buried at noon in the nave of Westminster Abbey in a grave at the foot of Sir Isaac Newton's monument and close to the spot where a quarter of a century ago Charles Darwin was laid to rest. The coffin arrived from Scotland early yesterday morning and was placed in St. Faith's Chapel, where a short memorial service was held. The inscription on the coffin ran: "William Thompson, Baron Kelvin, of Largs, P. C., O. M., G. C. V. O., F. R. S., LL. D., D. C. L. Born June 26, 1824. Died Dec. 17, 1907."

During the first hours of to-day London lay in the darkness of night from an overhead fog, which drifted away, giving place to a gloomy, drizzling morning by 11:30, when the Abbey was filled to overflowing with ticketholders. Rarely has such a remarkable assembly of scientists and persons of distinction been gathered within its walls. Representatives of the various universities were there, wearing their academic robes. Representatives of foreign scientific bodies wore their decorations. Outside the Abbey stood a large gathering of the public. As the mourners assembled within Purcell's and Chopin's funeral marches were played. At noon the coffin was borne in procession through the cloisters, the choir singing. Twelve of the Abbey clergy were in the procession. The dean of Westminster, assisted by Canon Duckworth, officiated. The pallbearers were Lord Rayleigh, Admiral Sir E. H. Seymour, John Morley, Gaston d'Arboux, secretary of the Academy of Sciences of France; Sir Archibald Geikie, president of the Geological Society; Lord Strathcona, Prof. Crum Brown, of the Royal Society, Edinburgh; Prof. Sir George Darwin, University of Cambridge, master of Peterhouse College, Kelvin's old college; Dr. MacAlister, principal of the University of Glasgow; Sir J. Wolfe Barry, of the Institute of Civil Engineers, and Dr. R. T. Glazebrook, of the Institution of Electrical Engineers.

The Duke of Argyll represented the king. The Prince of Wales and the Duke of Connaught were also represented. Of the innumerable wreaths and other floral pieces only three were placed on the coffin, a cross from Lady Kelvin, a wreath from the Royal Society, and a bunch of flowers inscribed "A. and M." A delegation from Glasgow University included Sir W. Bilsland, vice-chancellor of the university and the bedellus of the university, bearing the mace, draped.

Cambridge was represented by Vice-Chancellor Sir John Gavey, Sir Henry C. Mance and W. H. Pierce. Alexander Siemens and other past presidents of the Institution of Electrical Engineers were present. Prof. Sylvanus Thompson represented the Italian Electrical Association, and H. F. Parshall and Joseph Wetzler the American Institute of Electric Engineers. Secretary John Ridgely Carter represented Ambassador Reid. The Russian and Italian Ambassadors were present in person. The German and Japanese Ambassadors were represented.

The Princess Louise, Lords Tweedmouth, Kinnard, Cecil and Manners, Sir John Bell, Lord Mayor of London, and Sir W. Crookes were present, together with representatives of the scientific societies of all the European capitals and of the great British engineering firms.

Additional Single-Phase Equipment for the New Haven.

The New York, New Haven & Hartford Railroad Company has decided to change the equipment of its New Canaan Branch from 600-volt direct current to 11,000-volt single-phase. This branch, which is about 7½ miles in length, extends from Stamford, Conn, on the main line, to New Canaan. It was equipped with direct-current apparatus about seven years ago. The service will be conducted by two motor-trains, each consisting of a 60-ton motor car and a 30-ton trail car. The motor car will be the standard 78,000-lb. coach of the New Haven Company, reinforced to carry the electrical apparatus, which is attached to the car body, and equipped with four General Electric motors of 125-hp nominal rating, of a recently developed type. No provision is being made for operating these motors with direct current, so that the equipment will be purely single-phase. The company is changing over the overhead construction of the line to a 11,000-volt single catenary, which will be used instead of the double catenary employed on the main line.

Mussoorie, India, Hydro-Electric Plant.

An interesting function was celebrated on Oct. 4 last when the foundation stone of the new power house for the hydro-electric scheme in progress at Mussoorie, Upper Punjaub, India, was laid in the presence of a distinguished company of military and civil residents. The stone was suspended from the center of a structure resembling an old battlemented keep, beautifully decorated with evergreens and ferns and emblazoned with the motto "Success to the Mussoorie Hydro-Electric Scheme," and the lowering tackle was so arranged that it could be set in motion by pulling a red, white and blue ribbon. The Hon H. W. Reynolds, government commissioner for the Meerut division, then spread the mortar with a silver trowel—a replica of the trowels used by the native workmen—and lowered the stone into position. The visitors inspected the works under the guidance of Mr. J. S. Pitkeathly, the representative of Messrs. Bruce, Peebles & Co., Ltd., of Edinburgh, who are the main contractors. The primary object of the scheme it to provide a plentiful and reliable water supply for the "Station." Springs which can be depended on for a quarter of a million gallons per day have been utilized by the municipality, but these are located at a level of 1500 ft. below Mussoorie itself, so that a powerful pumping plant was required. Owing to the abundance of water power in the district, a hydro-electric scheme was the obvious inference, and the contract was awarded to Messrs. Bruce, Peebles & Co., Ltd., about a year ago. A stream known as the Bhatta is being dammed and a duplicate pipe line 4500 ft. long runs down the hill to the power house, supplying water to the three 300-hp Pelton wheels, under 890 ft. head. Each Pelton wheel is direct coupled to a Peebles 150-kw high-tension alternator, the unit running at 500 r. p. m. Electrical energy is to be transmitted at 6600 volts by two overhead transmission lines, one running to the pumping station direct, and the other to the town of Mussoorie and then on to the pumping station, thus providing a loop system. The pumping station is being equipped with two 150-hp high-lift pumps, each driven by a Peebles induction motor and either unit being sufficient for the work; the second being a reserve. The remainder of the load which the station can carry will be furnished by public and private lighting and motor applications. The public lighting by means of arc lamps in the main streets, and incandescent elsewhere is also already arranged, and there is no doubt that the remainder of the available power will early be taken up for private use There is ample scope for further developments.

Three-Phase Equipment for the Great Northern Railroad.

In addition to the three-phase locomotives which the General Electric Company will supply to the Great Northern Railroad, this company will build the entire electrical apparatus for the Cascade Tunnel equipment. The generating station, which will be located on the Manatchee River, 30 miles from the tunnel, will contain two 2000-kw, three-phase, 25-cycle generators driven by hydraulic turbines. It is interesting to note that arrangements will be made to take care of energy returned from three-phase locomotives on the down-grade.

Each locomotive will be designed for hauling a 500-ton train load up a 2 per cent grade at a speed of 15 miles per hour. The constant-speed characteristic of the three-phase induction motors will serve for controlling the train down-grade, as intimated above. By this means the possibility of break-down due to overheated wheel tires and brake shoes will be eliminated. Each locomotive will be equipped with three 325-hp motors mounted on articulated bogie trucks. The total weight will be 100 tons, all of which will be on the drivers.

The tunnel is approximately 2¾ miles in length with no ventilating shaft. There is a uniform grade east of 1.6 per cent in the tunnel section, making the difficulties of ventilation with steam locomotive operation a very serious factor, both from the standpoint of safety and operating efficiency. Aside from danger of poisonous gases of combustion, the interior of the tunnel has become so fouled with soot as to reduce the tractive effort of the steam locomotives now used by reason of the slippery condition of the rails.

The entire installation is under the supervision of Dr. Cary T. Hutchinson, who acts as consulting engineer to the Great Northern Railway. It is expected to have the road in operation in about one year, and work is already well under way on the water-power development, as well as the electrical apparatus.

Resuscitation from Electric Shock.

At the annual convention of the Society of German Electrical Engineers, held at Hamburg last year, the following rules for resuscitation from electric shock were adopted which were formulated with the co-operation of the Imperial Sanitary Council. These rules are practically identical, aside from the section relating to burns, with a set prepared for this Journal in 1894 by Dr. Augustus H. Goelet, and reprinted with revisions in 1901. A copy of these, suitable for posting or framing will be sent to any reader upon application.

1. If the subject is still under the influence of the source of electric shock, the first step is to withdraw him from the action of the current. In doing so, the following points should be observed:

a. The current, if possible, should be shut off by means of the nearest switch, or by disconnecting the wire in contact, or by withdrawing the wire by means of a dry, non-metallic substance, such as a piece of wood or by means of a rope.

b. The person performing this action should stand on a dry wooden board, dry cloth, or similar non-metallic support; or he should wear rubber shoes.

c. The person helping should insulate his hands by means of rubber gloves, a dry cloth, wearing apparel, or similar wrappings, and avoid any contact of his body with surrounding metal.

d. Efforts should be made to lift the victim from the ground and thus remove him from connection with the circuit. He should be carried by his clothing, touching of uncovered parts of the body being avoided as far as possible. If the victim is grasping the wire, the rescuer should loosen finger after finger with his hand, which should be insulated by means of rubber gloves or otherwise. In some cases it is sufficient to lift the victim from the earth, as the path of the current is thus interrupted.

e. In case of e. m. f.s not materially greater than 500 volts. an unskilled person may apply the preceding rules without risk to himself, but in the case of accidents from contact with wires of higher voltage, the power house or nearest sub-statiton should be notified as quickly as possible, and a doctor should be sent for.

2. If the victim is unconscious, a doctor should at once be summoned, and the following measures taken pending his arrival:

a. The room in which the victim lies should be well ventilated.

b. All close-fitting articles of clothing (collar, shirt, belt, trousers, underwear, etc.) should be loosened and the subject placed on his back, with a pillow made of blankets rolled under the head and shoulders, the head being allowed to lie somewhat lower.

c. If the breathing is regular, the subject should be carefully watched and not left alone. Fluids are not to be administered until consciousness has returned.

d. If respiration is absent or is very weak, artificial respiration should be produced. Before doing so it is necessary to remove any foreign substance (tobacco or artificial teeth) that may be in the mouth. Artificial respiration should be produced in the following manner: Kneel behind the head of the victim, with the face turned toward him, and grasp both arms at the elbow, drawing them backward over the head, and keeping them two or three seconds in that position. Then move them downwards, bend, and with the weight of the body, press the elbows against the sides of the victim's chest. After two or three seconds stretch out the arms again over the victim's head, repeating the stretching and pressing of the arms as regularly as possible about 15 times a minute. The movements should be executed slowly, counting in a loud voice between the intervals: 101, 102, 103, 104, etc.

e. If another helper is available during these exercises, he should grasp the victim's tongue with a handkerchief, draw it out forcibly and hold it fast. If necessary, the mouth should be forcibly opened with a piece of wood, the handle of a pocket knife, or similar means.

f. If several helpers are available, the exercises described under paragraph *d* should be carried out by two persons, each of them taking one arm and both executing the movements at the same time, counting in the intervals 101, 102, 103, 104, etc.

g. Artificial respiration should be continued until regular natural respiration has been restored; but even then the victim must be carefully observed for a time. Artificial respiration should not be abandoned for at least three hours.

h. If there have been injuries, such as broken bones, special care is needed in the care of the subject.

i. The lower part of the ankles and the feet should be rubbed from time to time with a rough, warm cloth or a brush.

j. After the return of consciousness, the victim should be left in a recumbent or semi-recumbent position and restrained from moving.

3. If the body of the victim has been burned, the following measures should be taken pending the arrival of a physician:

a. Before the person helping touches the burns he should most carefuly wash and brush his hands and the lower part of his arms with warm water and soap. It also recommended to rub them with a clean cloth saturated in alcohol, subsequent drying being omitted.

b. Red and swollen places should be covered with borax ointment on bandage-wadding, or with a bismuth bandage for burns, wrapped in turn with a soft bandage. Blisters are not to be broken, but pricked with a needle which has been heated over an alcohol flame, and then covered with a bismuth banage, bandage-wadding and a loose outer bandage. In case of charring and scabs, the wounds should be covered with several layers of bandage mull, over which wadding should be applied, the whole to be fastened by means of an outer bandage.

Transformer Litigation.

Justice Dyer, of the United States District Court of the Eastern District of Missouri, on Dec. 24 handed down a decision practically cancelling a previous award for damages in the transformer patent infringement suit of the Westinghouse Electric & Manufacturing Company against the Wagner Electric Manufacturing Company. Mr. Henry H. Dennison, special master in the patent infringement suit, has made an award in favor of the former company of $132,433.35, and this Justice Dyer reduced to $1 and costs. The court held that the plaintiffs in the suit had not shown that the infringement of the transformer at issue had produced the profit shown.

This litigation originated in 1900 by the institution of suit against the Union Carbide Company, of Niagara Falls, as users of certain transformers supplied by the Wagner Electric Manufacturing Company. Two patents were involved, one being a Westinghouse patent, which expired July 12, 1904, pertaining to details for cooling the working parts of a transformer, and the other a patent by Elihu Thomson pertaining to details of a water-cooling coil in the oil transformer. The court did not uphold the claim of infringement of the Thomson patent, but held that one claim of the Westinghouse patent was infringed. Prior to this decision, the Wagner Company discontinued the use of the details of construction covered by the claim sustained in the Westinghouse patent, and consented without contest to an injunction. Some months later, however, contempt proceedings were brought against the Wagner Company in the United States Court on the grounds that a modified construction employed by that company in its transformers still infringed the claim which had been held valid, but the court decided that the new construction was not covered by this claim.

CURRENT NEWS AND NOTES.

THE KELVIN ESTATE.—A cable dispatch from England states that the will of Lord Kelvin bequeaths all his real and personal estate to his wife. The exact amount is not given, but appears to be about $5,000,000.

BOSTON PREMIUM.—The Boston Elevated Railway Company has distributed to the 4000 employees who have been in the company's service for six months or longer the sum of $60,000. This is the fifth distribution of this nature by the company.

ELECTRICAL CONTRACTORS.—The Electrical Contractors' Association, of San Francisco, is to have a banquet at the Fairmont Hotel, on Jan. 18, and proposes to make the affair one of more than ordinary interest. The contractors of the city have had an unusually busy time during the past year.

TIDAL ENERGY IN GERMANY.—U. S. Consul-General Richard Guenther, of Frankfort, reports that a Hamburg joint stock company has purchased a large tract of land along the mouth of the Elbe at Cuxhaven, where power works are to be erected. The action of the ebb and flow of the tide is to be employed in generating electric energy to be used in factories. The works will also furnish electrical energy, it is said, to the town of Cuxhaven and other places in the vicinity. The capacity of the plant is put at 14,000 horse-power.

WIRELESS PHOTOGRAPHY.—A cable dispatch from Paris of Dec. 29, says: "Pascal Berjonneau, an inventor, exhibited to-day before the Postmaster-General and a number of persons interested in scientific investigation a new telephotography apparatus which can be adapted to the wireless system or to the ordinary telegraph wire system. He transmitted the picture of the postmaster without the aid of wires from one end of the hall to the other. The inventor says that distance does not interfere with the effectiveness of his method, and that it could even be used over submarine cables."

KELVIN EXERCISES.—It is proposed by the American Institute of Electrical Engineers to hold special exercises in honor of the memory of the late Lord Kelvin. This interesting meeting will probably be held in the Engineering Societies Building on Sunday afternoon, Jan. 12. President Stott has appointed a committee, with Mr. Percy H. Thomas as chairman, which is now arranging for speakers, music, etc. A great deal of interest is being manifested in this memorial meeting and the attendance is likely to be large, the hour being also a very convenient one for members living in the suburbs.

BELGIAN EXPOSITION.—An international exposition is to be held at Brussels in 1910 under the patronage of the King and the presidency of Prince Albert of Belgium. It will open in April, and will include 22 groups, one being electricity. A separate palace will be devoted to retrospective and modern exhibitions of lighting appliances of all kinds. In the machinery hall special attention is to be given to the use of small motors, and such as will assist in developing household industries. The exposition will occupy 200 acres adjoining the beautiful Bois de Cambre. The awards to exhibitors will be allotted by an international jury. The burgomaster of Brussels, Emile de Mot, is president of the executive committee, and Leon Janssen, general manager of the Brussels Tramways, is a member of it, while Albert Janssen, of the same system, is an assistant secretary-general of the Belgian section.

A. I. E. E. MEETING.—The next meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineering Societies Building, 33 West Thirty-ninth Street, New York City, Friday, Jan. 10, at 8 o'clock p. m. The following papers will be presented for discussion: 1. The New Haven System of Single-Phase Distribution, with Special Reference to Sectionalization. By W. S. Murray, electrical engineer, New York, New Haven & Hartford Railroad. 2. A Single-Phase Railway Motor. By E. F. Alexanderson, electrical engineer, General Electric Company, Schenectady. A special meeting of the institute will be held in the same auditorium Friday, Jan. 24, 1908, at 8 o'clock p. m. At this meeting the following papers will be presented for discussion: 1. Electrical Engineering Education. By Charles P. Steinmetz, chief electrician of the General Electric Company. 2. The Best Engineering Education. By Charles F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Company.

THE JUNGFRAU TROLLEY.—The electric railway up the Jungfrau appears to have become already the most popular mountain road in Switzerland. The highest station at present, the Eismeer (10,345 ft. above sea level), is still 3325 ft. below the summit. During the past summer and autumn 71,914 passengers were carried. This is somewhat less than the number in 1906, which was 74,545, but the difference was due to unfavorable weather. Work has just been begun on the tunnel, which is to continue the road to the Jungfraujoch, 700 metres below the summit. The time needed is estimated at four years. From the Jungfraujoch it was proposed to establish a service of coasting sleighs down the Aletsch glacier to the railway station at Fiesch, thus providing a highly romantic short cut from Interlaken to the Matterhorn region. It now seems probable that this part of the project will be carried out by another company, which has just applied for a concession to ascend the Jungfrau on the south side. Its plan is to have an electric railway from Brigue to the Aletsch glacier, and thence a sleigh service, with wire rope and electric power up the Jungfraujoch. The cost is estimated at only 3,650,000 francs, whereas the Jungfrau railway cost 7,000,000 up to the Eismeer station.

CHINESE TELEPHONY.—Active construction work has been begun on the telephone lines which are to connect Amoy with the other two cities of this prefecture, Tsuen-chou-fu, 50 miles to the north, and Chang-chou-fu, 30 miles to the west. The construction and operation of these lines are entirely under the control of the Chinese Government.

ILLUMINATING VARIABLES.—At a meeting of the Illuminating Engineering Society, Boston, on Dec. 10, the meeting was called to order by Chairman Campbell at 8:20 p. m. The chairman, after calling attention to the fact that the next session will be the annual meeting of the society, introduced Prof. Puffer, who presented an interesting paper on "The Variables of Illuminating Engineering." Considerable discussion followed, participated in by Prof. Puffer, Prof. Clifford, Dr. Bell, Messrs. Campbell, Codman, Hatch, Ware, Curry and others.

WIRELESS IN ALASKA.—Arrangements are being made by the army signal officers to purchase material for use in installing wireless telegraphy in Alaska. A 10 kilowatt station will be located at Nome and another of the same power at Fort Gibbon, where the Tanana joins the Yukon. At Fort Gilbert a three kilowatt station will be established, and the wireless stations at Fairbanks and Circle will be increased to the same power. Towers 175 ft. high will be erected in each place. It is expected to have the materials as soon as navigation opens. Lieut. E. A. Jeunet, Thirteenth Infantry, now in Cuba, will have charge of the wireless installation in Alaska next summer.

GLASS POLES.—It is stated that at Grossalmerode, a town near Cassel, Germany, a factory has recently been established for the manufacture of glass telegraph and telephone poles. The glass mass of which the poles are made is strengthened by interlacing and intertwining with strong wire threads. One of the principal advantages of these poles, it is said, would be their use in tropical countries, where wooden poles are soon destroyed by the ravages of insects and where climatic influences are ruinous to wood. The imperial post department, which has control of the telegraph and telephone lines in Germany, has ordered the use of these glass poles on one of its circuits.

FOREST DENUDATION.—At the recent meeting of the Boston Section of the American Institute of Electrical Engineers, Mr. M. O. Leighton, chief hydrographer of the U. S. Geological Survey, discussed the relation of forests to the development of water power. Mr. Leighton spoke in particular of the southern Appalachian region. He declared that a conservative estimate of the water power available in the region was at least 7,000,000 horse-power, that one-fifth of this sold at an annual rent of $20 per horse-power would yield to the government, if a national preserve should be made of the region, the equivalent of 3 per cent interest on a capital of $933,000,000. The denudation of the hills of their forest covering, which, he affirmed, is ever on the increase, costs the government every year several million dollars merely by the destruction wrought, besides the depreciation in land values. Prof. William L. Puffer presided.

CANADIAN POSTAGE RATES.—Newspaper publishers in the Province of Quebec have petitioned the Dominion postoffice department to restore the old rates on newspapers and magazines between the United States and Canada, a six months' trial of the new rates having proved the injurious effects to the Canadian press and people. The Montreal French Chamber of Commerce has also urged the repeal of the new regulations, and its committee appointed to look into the matter has reported that any restriction placed on the circulation of Canadian papers in the United States and in other foreign countries would prevent the country from being known and appreciated; that it would tend to neutralize the patriotic efforts of the Canadian press, and that it would unfavorably affect immigration to Canada as well as the repatriation of French Canadians. Persuaded that in the interests of colonization and commercial prosperity the country needed far more advertising than was given to it in the press, the Chamber of Commerce has requested the federal government to further such advertising by the creation of a commercial museum and the distribution of explanatory guides on the resources of Canada. The committee states also that the circulation of American magazines is of great advantage to trade and industry, both from a scientific and from a news standpoint, this having particular reference to the technical and trade press.

NEW YORK SUBWAYS.—It is understood that private ownership of new subways and the construction of them by private capital is regarded by the New York City Public Service Commission as the only means by which the city can obtain new transit lines within the next few years. The commission will recommend a change in the existing law that will allow of this in its annual report, which will be sent to the Legislature on Jan. 13. The change in the law which the commission will recommend is radical and may meet with considerable opposition The recommendation has been decided upon only after long discussion among the commissioners and conferences between Gov. Hughes and Chairman Willcox. It is generally believed by all these men that no subways can be built in New York for some time to come unless the recommendation is carried out Confident that the law will be amended as they suggest and within a short time after the Legislature meets, the commissioners will at once begin the preparation of plans for a new Manhattan subway, probably one up Lexington Avenue with a west side connection downtown. They will be ready to advertise for bidders for this and for the Fourth Avenue subway in Brooklyn very soon after the change in the law is made. It is probable, too, that they will suggest in their report that steps be taken at once to amend the constitution so as to exempt rapid transit bonds, to the end that the situation which now confronts them may not arise in the future.

AMERICAN WIRELESS TELEGRAPHY.—A correspondent of the New York *Evening Post* intimates that the U. S. Navy has no use for foreign wireless systems, having found one good enough at home. He says: "It would perhaps surprise the public to learn that, while practically every vessel of the United States Navy is equipped with wireless, there is not one installation of the Marconi system; nor is there a shore station on the Atlantic or Pacific Coast, or in the Philippines (belonging to the United States Government), equipped with this system, and yet the United States Government is to-day operating 43 wireless land stations. Now, in addition to the foregoing, if the public, when told that the system most largely used by the United States Navy was the Shoemaker, probably 99 out of 100 would ask, who is Shoemaker? This inventor is American born, and to-day under 30 years of age, and yet his system, though not publicly known, is held in the highest esteem by our government, which has tested every known wireless system. Of the 16 battleships making the Pacific voyage 11 were equipped with the Shoemaker system. The Bureau of Equipment of the Navy Department, in its published list last August of telegraph stations of the world, gives the following vessels as using the Shoemaker system: *Baltimore, Birmingham, Buffalo, California, Charleston, Chattanooga, Chester, Chicago, Connecticut, Denver, Des Moines, Don Juan de Austria, Elcano, Glacier, Indiana, Kearsarge, Kentucky, Louisiana, Maine, Maryland, Milwaukee, Montana, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Dakota, St. Louis, Tacoma, Virginia, Washington* and *Whipple*. And on land: Cape Cod, Cape Henlopen, St. Augustine, Jupiter Inlet, Culebra, W. I.; Farallon Islands, California; Point Arguello, Cal.; Island of Oahu, Hawaii, and others. In addition to these, numerous orders have been placed for the Shoemaker system from the Navy, War, and Treasury Departments, the latter for the revenue cutters."

ILLUMINATING ENGINEERING SOCIETY.—The next meeting of the New York Section of the Illuminating Engineering Society will be held in the United Engineering Societies Building, at 8:15 p. m., Thursday, Jan. 9. A paper by Dr. H. H. Seabrook, on "Light and the Eye," will be presented and discussed. A general invitation is extended to all interested in this subject to be present.

PANAMA CANAL POWER.—The Panama Canal Commission has asked bids for the construction of a central electric power plant and its equipment, which will be used to furnish power for eight cable ways. The latter are to be utilized in the excavations for and construction of the immense Gatun Dam. It is estimated that the total cost of the plant and the cable ways will be at least $800,000.

WIRELESS IN BURMA.—The Government of India has sanctioned the opening of wireless telegraphic communication for Burma between Margui and Victoria Point, with a station between Victoria Point and Maliwun. An annual guaranty of $13,823 will be given from the provincial revenues of Burma with respect to the combined system. The guaranty will be subject to reconsideration at the end of 10 years.

SECOND SIMPLON.—Advices from Berne, Switzerland, state that the construction of a second Simplon tunnel will be begun as soon as practicable, the National Council having approved the plan which already had passed the State Council. The construction will be undertaken by the administration of the Federal Railroads. The first Simplon tunnel, which was opened in 1906, cost $14,000,000. Electricity is to be the motive power.

MUNICIPAL OWNERSHIP.—The report of the National Civic Federation on "Municipal Ownership" has been issued by that body in three large volumes, bound in cloth, at a price of $10 for the set. These volumes contain a total of 2487 pages, and are undoubtedly the most complete record extant of data on this burning question, the facts, evidence and arguments having been laboriously collected on both sides of the Atlantic.

ST. JOSEPH MUNICIPAL SCANDAL.—At St. Joseph, Mo., on Dec. 17, a serious sensation was sprung when the grand jury of the Criminal Court inserted a probe into the affairs of the city electric light plant. It is alleged that "dummies" have been carried on the pay roll for the last three years, and during the past year the city has thus lost more than $16,000. In one department, where seven men were actually employed, a witness before the grand jury testified that 20 men had been charged for.

INDUSTRIAL SCHOOLING.—At Boston, on Dec. 19, some 200 men and women were present when the state commission on technical and industrial education began a public hearing at the state house on the expediency of the establishment of technical schools or industrial colleges. A large number of persons addressed the commission, and frequent applause attested the deep interest in the subject. Mr. Frank Parsons, representing the Breadwinners' Institute, was the first speaker, and he favored industrial colleges, as he believed that something must be done if the United States is to retain its position among the other nations of the world. Pres. Michael F. Sullivan, of the Lawrence board of trade, declared that labor is the worst paid branch of industry in the state, and he said that with industrial training there would be many a Lord Kelvin where to-day there is a $10-a-week clerk. John F. Crocker, president of the Boston Chamber of Commerce, was one of those who favored the establishment of a training school for workmen. Mr. M. W. Alexander, instructor in the trade school of the General Electric Company, favored school for workingmen, but he did not want it called a college. Henry Sterling of the Boston Typographical Union said the idea would have no warmer supporters than the members of trades unions if it can be shown beyond doubt that such schools will not result in a reduction of wages.

COPPER PRODUCTION.—The U. S. Geological Survey reports the production of copper in the United States in 1906 as 917,805,682 pounds. The production of 1905 was exceeded by 15,897,839 pounds, and the apparent rate of increase in 1906 was accordingly 1.76 per cent. This is an abnormally low increase, the gain in 1905 over 1904 having been 11 per cent, and in 1904 over 1903 nearly 16.40 per cent. The mine production for 1906 was 916,971,387 pounds. The bulk of the copper of domestic origin turned out by the smelters in 1906 was derived from approximately 19,743,000 tons of ore. Of the total ore tonnage approximately 5,021,000 tons, or about 26 per cent, were of sufficient richness or of so favorable metallurgical character as to be smelted without concentration. The remaning 14,722,000 tons were concentrating ores, from which were produced 2,085,000 tons of concentrates, the average concentration being slightly under 5 into 1. Of the 917,805,682 pounds of copper produced in 1906 by the smelters, 15,132,562 pounds were derived from the re-treatment of materials which had been subjected to reduction in previous years—namely, old slags, tailings, furnace linings, and the cleanings from old smelter sites. A great part of this material was slags and tailings, being consequently of low grade and profitable to treat only because of metallurgical advances.

CANADIAN LABOR LAW.—Last week at the notable banquet in New York of the National Civic Federation, President Eliot of Harvard University, in the course of an address, styled the Canadian industrial disputes investigation act, which went into effect on March 22, "the best piece of legislation ever adopted to promote industrial peace." As a result of the operation of this law several disputes between labor and capital, involving the operation of railroads, coal mines and steamship companies, which would have resulted in strikes or lockouts disastrous to the interests of the public, as well as causing losses to both capital and labor, have already been settled, in a number of cases without the cessation of operation for a single moment. The act is novel in that no settlement is compulsory, and strikes or lockouts are permitted only at the end of a given period. The methods by which results are obtained are conciliation, investigation and publicity. The industries to which the act applies are all mining properties and all agencies of transportation or communication, including railways, however operated; steamships, telegraph and telephone lines, gas, electric light, water and power works; in other words, public utilities and industries whose continuance in operation is a public necessity. The Minister of Law for the Domainion of Canada has the general administration of the act, and the Governor appoints a registrar of boards of conciliation and investigation, who conducts correspondence and keeps records of proceedings under the act. Any employer who declares or causes a lockout contrary to the provisions of the act is liable to a fine of not less than $100 nor more than $1,000 a day while the lockout exists. Any employee who goes on strike under the same conditions is liable to a fine of not less than $10 nor more than $50 a day while on strike. And any person who incites, encourages or aids an unlawful lockout or strike is liable to a fine of not less than $50 nor more than $1,000. "The main points covered by this act are, therefore," says President Eliot, "no change in wages or hours without thirty days' notice; no lockout or strike without a previous investigation of causes and demands by an impartial public authority, which secures complete publicity; and therefore no lockout or strike unless it has been carefully considered by the parties most nearly concerned through a period which can hardly be less than two months, and has been publicly debated for a period which, under ordinary circumstances, will not be less than one month, and may easily be more."

Municipal Conduit System of the City of Baltimore, Md.

When, in 1890, the city of Baltimore undertook to force the removal of poles and overhead wires from the streets of the city, its experience was such as to indicate that the only way to control the situation was to provide the necessary conduits and require all wire-using companies to place their wires underground, all under the same conditions. After some preliminary skirmishing before the legislature of the state, an act was finally secured by the city in 1892 empowering the Mayor and City Council to appoint an Electrical Commission; but it was not until 1896 that an act was passed authorizing the city to issue its credit to the amount of $1,000,000. The ordinance submitting this appropriation to a vote was approved in the general election of November, 1897.

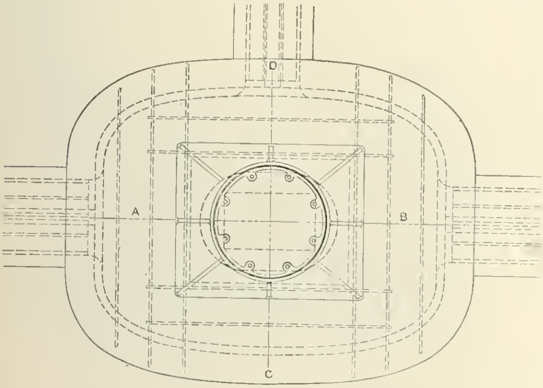


FIG. 1.—PLAN OF TYPICAL FORM OF BRICK MANHOLE.

The organization for the work was begun by the appointing of a chief engineer on Oct. 1, 1898, and from then to March 1, 1899, the time was consumed in the preparation of plans and the necessary details preliminary to the beginning of actual work. The ordinances were so framed that it was obligatory upon the commission to complete the conduits in certain defined districts of the city before notices could be issued for the removal of poles and wires from the streets. It was not, therefore, until Feb. 18, 1901, that the commission was in a position to issue the necessary notices of removal. The progress of the underground system was temporarily checked by the great conflagration in February, 1904. This, to a very large extent, affected the natural expansion of the system for a time, both by reason of the loss of service to the various companies involved and also of the rebuilding of conduit lines in the burned district, caused by changes in grade and street lines made by the Burned District Commission.

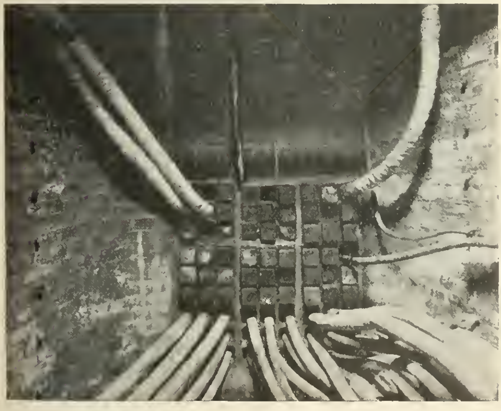


FIG. 2.—INTERIOR OF MANHOLE, SHOWING ARRANGEMENT OF HIGH-TENSION AND LOW-TENSION CABLES.

CHARACTER OF WORK.

The accompanying illustrations show the different classes of work in general. The conduit system as a whole is divided into two general parts; the trunk conduits, which are built for the purpose of carrying trunk lines and feeders, whether for telephone, telegraph, electric light, street railway, or other service, located generally in thoroughfares, feeding different sections of the city. These trunk lines are laid out to serve these several territories by the most direct and feasible route. The second part comprises the central or congested district of the city. As originally designed, this section was laid out to be served entirely underground with underground connections in each separate building. Extensions to this territory were afterward necessary by reason of the scattering of business houses after the fire and also by reason of the natural growth of the business district. Throughout the construction an effort has been made to follow the standard of that character of construction used in this country.

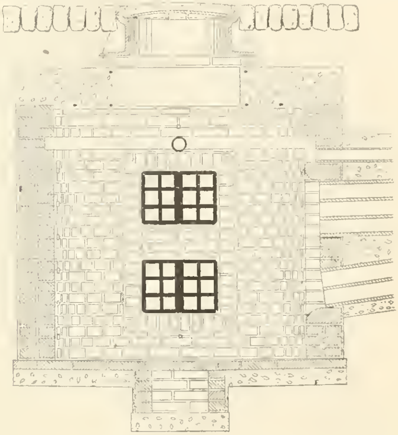


FIG. 3.—SECTIONAL ELEVATION OF BRICK MANHOLE.

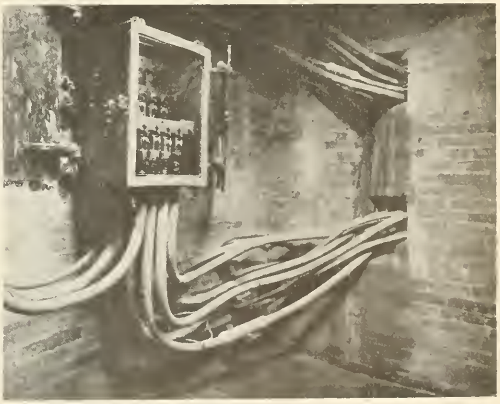


FIG. 4.—INTERIOR OF MANHOLE, SHOWING ARRANGEMENT OF FEEDER CABLES AND ALSO FEEDER BOX.

Vitrified terra-cotta conduit material has been used in all conduit lines. The conduit is enveloped in concrete. At first Rosendale cement was used exclusively, but now the concrete is mixed with American Portland cement. In 1899 the uniform thickness of the concrete envelope was 3 ins., except in the down-town streets, where the thickness was 4 ins. As the work progressed and experience was gained, the thickness of the protecting envelope was increased, the minimum sides and top being 4 ins., while the bottom varies from 4 ins. to 6 ins., and in numerous instances is reinforced with steel rods.

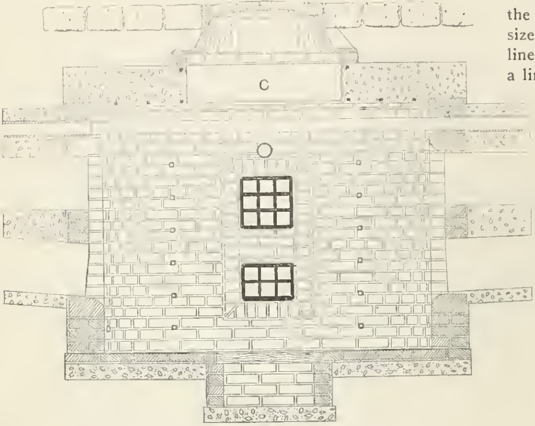


FIG. 5.—SECTIONAL ELEVATION OF BRICK MANHOLE.

At the beginning of the work the joints in the conduit line were wrapped with burlap 6 ins. wide and saturated in liquid asphaltum compound. The commission recognized the difficulty of making air and gas tight joints and while a continued effort was made to secure such joints, the best that could be done was to minimize the entrance of gas into the conduit system. After some experimental work a composition of North Carolina pitch tar, refined asphalt and wax tailings was adopted and this has proven very serviceable. Cheese cloth has been substituted for burlap and the method of applying the wrapping to the joint is to paint the end of the conduit pieces with the hot compound where the wrapper is to be applied, saturate the wrapper with the hot compound and apply it to the joint while it is still hot. While a joint made in this manner is somewhat expensive, it is believed that the results obtained have more than justified its use.

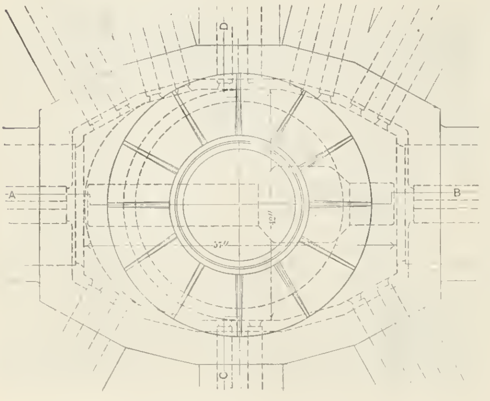


FIG. 6.—CONCRETE DISTRIBUTION BOX FOR ROADWAY OR SIDEWALK.

In the construction of all lines of conduit, fiber pipes, the number depending upon the importance of the line, are laid in the top layer of concrete for the purpose of providing ready means for arc lamp or similar connections from a point of the line remote from a manhole, without building an extra manhole or breaking the line of vitrified conduit. Manholes on trunk lines are all constructed of large size. A small conduit line of 12 ducts would have a manhole, elliptical in plan, of a minimum size of 5 ft. x 8 ft. and of a depth depending on the grade of the conduit, the minimum depth being 6 ft. The size of the manholes increases with the size of the conduit line up to a plan section of 7 ft. x 14 ft., which is suitable for a line of 81 ducts. On many important lines of conduit, where operations of workmen in the streets may possibly result in damage, the practice is to construct manholes of standard form but of larger proportionate width, building one-half of the manhole a distance in advance of the other half along the line of conduit as shown in Fig. 15, so that lateral connections may be made from either half of the manhole either way, without the necessity of crossing cables. The entire system is constructed so that no obstructions such as pipes, etc., pass through the manholes, which thus contain nothing except the cables for which they are built.

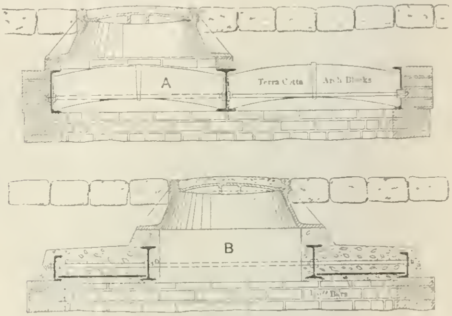


FIG. 7.—TWO FORMS OF ROOF CONSTRUCTION ON BRICK MANHOLE.

In the central districts of the city practically all lines of conduit were under-drained during construction and the presence of tide water and poor condition of the small house drains in the street necessitated special drainage provision to be made. The system of public sewers being somewhat limited in extent, and the storm water drains being on such shallow grades, it has rarely been possible to drain manholes by gravity. All manholes in the central districts are drained by means of ejectors operated by water pressure from the city mains. The practice is to construct a sump in the center of the floor in each manhole of sufficient size to contain a valve operated by a float which controls the supply of water into the ejectors. This is necessary to lift the water to a grade where it can flow by gravity.

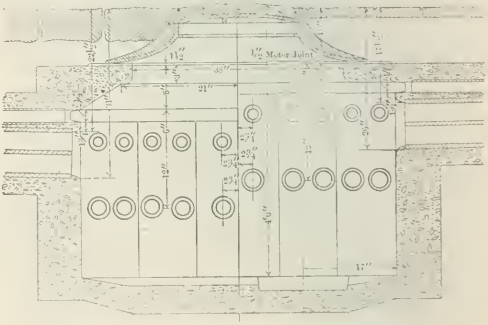


FIG. 8.—CONCRETE DISTRIBUTION BOX FOR ROADWAY OR SIDEWALK.

The distributing conduits are uniformly made up of 10 ducts. The house connections are made with fiber pipe, each connection consisting of two 2-in. and two 3-in. pipes. In some of the original work 1½-in. pipes were used for service connection but the increase in size of service cables made it unwise to continue the use of this pipe. The system is ventilated throughout so that the conditions with respect to the presence of gas in the system are exceptionally good.

The manholes as constructed are roomy, admitting of cables being properly laid up and providing sufficient space for efficient splicing of new or repairs to old cables. The upper part of the manhole is reserved for electric light and power cables and the lower part for telephone and telegraph cables. The trunk conduits in the congested district are laid with an earth cover of from 2 ft. to 10 ft., depending upon the subsurface conditions during construction. The brick work of the manholes is brought up to within 22 ins. of the street surface and is covered with a roof composed of 10-in. I-beams and channels spaced 32 ins. center to center, except the span under the cast-iron frame, which is 40 ins. Special terra cotta arch blocks are sprung between the beams and are held by 1-in. tie rods. After setting the frame the whole roof is covered with concrete. Smaller size manholes are built with 9-in. walls and the larger size manholes are built with 13-in. walls laid in Portland cement mortar. The trunk manholes vary in roof area from 5 ft. x 8 ft. to 6 ft. x 14 ft.; the plan of the manholes being elliptical in form.

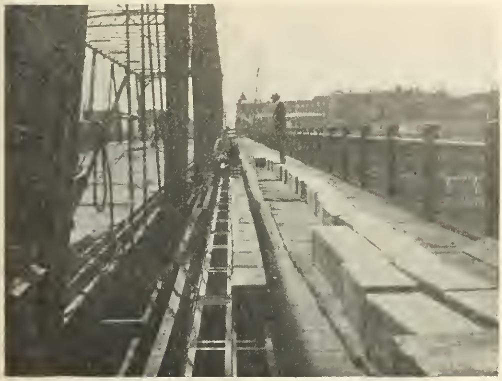


FIG. 9.—VIEW SHOWING METHOD OF PLACING CONDUITS ON GUILFORD AVENUE BRIDGE.

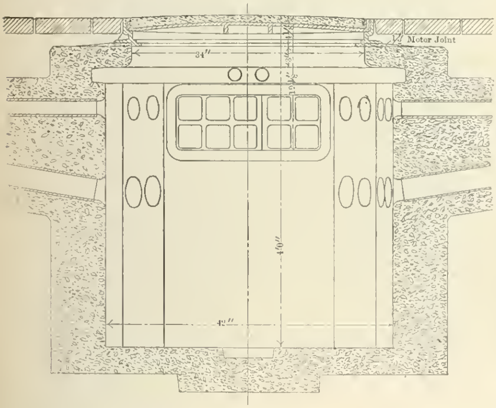


FIG. 10.—CONCRETE DISTRIBUTION BOX IN SIDEWALK.

The conduit lines of the distributing system are laid as closely to building lines as practicable; sometimes in sidewalks on a shallow grade, having an earth cover generally of only 19 ins. and broken every 60 to 70 ft. by service boxes with street covers. The distributing system consists of a 10-duct line laid 2 ducts deep and 5 ducts wide, encased in 4-in. Portland cement concrete. The service boxes in the sidewalks are circular in form and 36 ins. in diameter, having walls 2½ ins. thick and a cast-iron frame 5 ins. in depth to allow for side walk paving.

The service boxes in the street proper are built of brick with 9-in. walls and are elliptical in form. These boxes have a frame casting similar to that used on manholes, but smaller and lighter. At intersections of distributing lines, junction boxes are built similar to the brick service boxes, but of larger size. On service and junction boxes of all types the frame casting is set directly on the walls, no special roof construction being required.

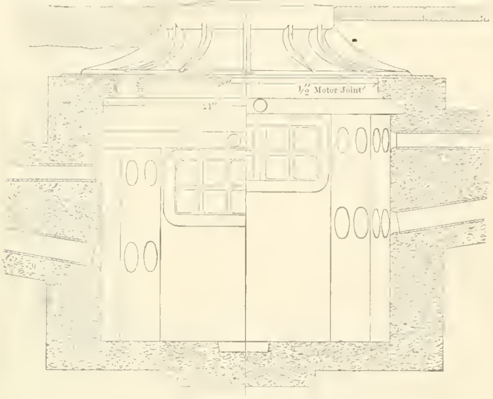


FIG. 11.—CONCRETE DISTRIBUTION BOX FOR ROADWAY OR FOR SIDEWALK.

Duct space is leased to the following companies: Baltimore & Ohio Railroad Company, Baltimore National Automatic Fire Alarm Company, Baltimore Electric Light & Power Company, Bartlett-Hayward Company, Chesapeake & Potomac Telephone Company, Consolidated Gas, Electric Light & Power Company; Crook-Horner Company, the Crown Cork & Steel Company, Jacob Epstein, Holmes Electric Protective Company, Maryland Telephone & Telegraph Company, Postal Telegraph-Cable Company, United Railways & Electric Light Company, United States Hydrographic Survey, University of Maryland, Western

FIG. 12.—MANHOLE DURING CONSTRUCTION.

Union Telegraph Company; conduits being also set apart for the municipal lines. Five of these concerns operate isolated plants and use the conduit system for electric light and power wires. The rate for the use of conduit space covered by lease and payable semi-annually is as follows:

1 to 5000 duct ft. inclusive	7 cents per duct ft. per annum
5001 to 25,000 duct ft. inclusive	6½ cents per duct ft. per annum
25,001 to 50,000 duct ft. inclusive	6 cents per duct ft. per annum
50,001 to 100,000 duct ft. inclusive	5½ cents per duct ft. per annum
100,001 duct ft. and over	5 cents per duct ft. per annum

No limit is placed upon the voltage of conductors to be used in the duct space. All cables are properly tagged with the name of the owner, the number of amperes, the character of the current, and the potential at which they are operated. The cables, no matter what the service, are fitted with proper protective devices where they connect to overhead lines or leave the conduits.

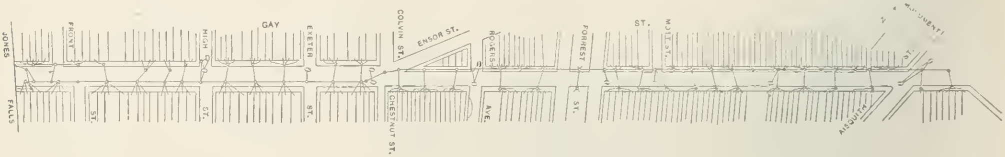


FIG. 13.—ARRANGEMENT OF DISTRIBUTING CONDUITS.

For continuous service, cables with a carrying capacity not greater than 1500 amperes per sq. in. of conductor for paper insulation, and 1200 amperes per sq. in. for rubber insulation are used. Voltmeter tests are made to determine in which manholes it is necessary to bond cables to the street railway return system in order to prevent electrolytic action. The conductors are divided into five classes; Class I, conductors carrying a very low potential, such as telephone, telegraph and signalling wires; Class II, conductors carrying a current at potentials up to 220 volts, including the commercial 110-volt, 3-wire system of distributing mains; Class III, conductors operating under a potential of between 220 and 1200 volts; Class IV, conductors operating under a potential between 1200 and 6600 volts; Class V, conductors operating under a greater potential than 6600 volts. Insulation resistance for the various classes in megohms-per-mile is given in the accompanying table. These, however, are only relative values, for while high resistances may be obtained in dry paper-insulated cables, an equally good or better commercial cable is often used having saturated paper insulation, the effect of which is to reduce the initial insulation resistance.

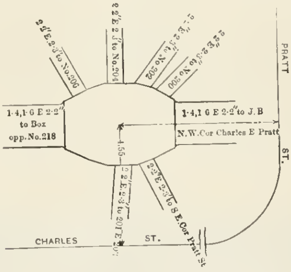


FIG. 14.—CONCRETE DISTRIBUTION BOX.

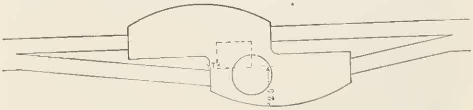


FIG. 15.—CONCRETE MANHOLE FOR PARTIAL SEPARATION INTO TWO HALVES.

	Class 2.	Class 3.	Class 4.	Class 5.
1. Good	350	400	800	1200
2. Fair	175	200	500	800
3. Bad	70	100	300	500

A cable having an insulation resistance greater than the maximums given is considered in good order. Below the minimum as given, the cable must be given attention, and if the deterioration has been rapid the fault must be found and corrected at the point so found, the use of the cable being discontinued until the fault is corrected. In any event, below the limits noted above, the cable is considered as being defective and repairs must be made. Should the insulation resistance drop below an amount equal to three megohms per mile per 100 volts, the cable is not considered safe, and its use is ordered discontinued until the efficiency shall have been brought up to the standard of the requirements already noted.

Before allowing any of its employees to enter a manhole, the lessee must first make sure that there is no danger due to the presence of gas in the manhole. A sufficient number of hand-blowers must be provided to keep up the circulation of air while men are in the manhole. While the work is in progress, should there be danger of driving gas into other manholes in which work is not being done, such manholes must be opened and suitably protected by a guard at least 3 ft. high surrounding the opening.

In order to prevent the sifting of dust into the opening a sheet-iron combing is provided by the electrical commission for holes in which repairs are being made. The commission requires each lessee to provide a watchman on the surface at each manhole opening to protect traffic on the street. No lamps requiring flames are permitted in the manholes. Spelter used for wiping joints of the lead covers of cables is not permitted to be lowered into a manhole when the spelter is excessively hot.

The separation of the two classes of cables by a horizontal rather than a vertical partition was adopted for two reasons. In the first place, a vertical longitudinal division wall would be satisfactory for through manholes. As, however, the city's conduits are interconnected at every available point, it would be a matter of difficulty to provide an outlet for cables in order to secure an entrance into a branch conduit. There is no difficulty from this, however, when the manhole is divided into an upper and a lower compartment. Splices and connections on electric light cables are much simpler and more quickly made than splices on telephone cables, which, being composed of 100 to 400 separate conductors require more time and care. It was principally for this reason that the latter class of cables were assigned to the lower ducts and the whole manhole floor on which to handle them in splicing or repairing. The practical result of this method of separating the two classes of cables is the same as would be the case with two separate manholes, secured at less cost, occupying less street room and reserving the total head room for the more difficult work on heavier cables.

The system as now constructed comprises 6,661,000 duct-feet, the average number of ducts in the conduit lines being about 12. There are underground connections into 4154 separate buildings and the number of feet of cable of all kinds installed is 1,704,628.

Mr. Charles E. Phelps, Jr., is the chief engineer of the Electrical Commission, which is composed of the mayor, city register and president of the Board of Fire Commissioners.

Lighting of the New Plaza Hotel.

By H. Thurston Owens.

THE latest addition to New York City's list of magnificent hostelries is the Plaza Hotel, which represents an outlay of nearly $13,000,000. The hotel stands upon the west side of the square known as "The Plaza" at the intersection of Fifth Avenue and Fifty-ninth Street. It occupied the entire block between Fifty-eighth to Fifty-ninth Streets, and is surrounded on the west and south by residences, the most prominent being the one owned by the Vanderbilts; to the east is the Hotel Savoy and the Hotel Netherlands, and on the north is Central Park. The building is of early French Renaissance style of architecture. Its height is 19 stories, including basement and sub-basement. It was erected in about two years, which is considerably less time than is usual for buildings of its size and character.

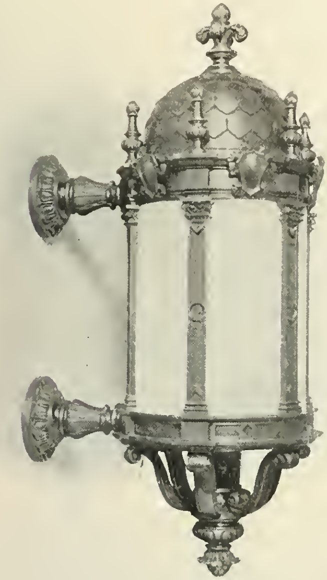


FIG. 1.—OUTSIDE BRACKET LANTERN.

The electric plant consists of four units, with a rating of 1100 kilowatts. The installation consists of 320 horse-power in motors and the equivalent of 17,000 16-cp lamps. The full load ranges from 3900 to 4900 amperes, and the day load is about 2600 amperes. The voltage used is 120.

Electricity is used for lighting, ventilating, driving machinery and for cooking in the grill-room. Gas is used for cooking, lanudry irons, gas logs; all of the corridors are piped for gas for emergency use, the equipment consisting of open-flame burners. The entire fixture installation, exclusive of wiring and piping, cost approximately $105,000, and over one-half of this amount was spent upon the fixtures on the ground floor, and outside of the building.

That the lighting installation has unique features is apparent before one enters the building, for instead of lamp posts there are 27 bracket lamps hung upon the building. These lamps, which are shown in Fig. 1, are made of bronze with clear glass sides, and are equipped with "Meridian" 40-cp lamps placed upright, with prismatic reflectors at the base of the bulb. The reflectors are to be removed, as they are not necessary and do not look well. If frosted glass were used in these lanterns the effect would be greatly improved.

There is a carriage entrance on Fifty-eighth Street, and one on the Fifth Avenue side, and just inside of these entrances there are two bracket lamps, as shown in Fig. 2. These are copied from an old-style English coach lamp, and are made of bronze, with clear glass and etched border, and equipped with "Meridian" 20-cp lamps.

Between the columns of the Fifth Avenue entrance there are five pendant frosted ball fixtures, enclosing ten 16-cp clear lamps. Upon the balcony over this entrance there are six bronze standards, each equipped with five frosted ball globes enclosing one 32-cp clear lamp. These standards were installed solely for architectural reasons, and a very successful result has been attained. They are shown in Fig. 3.

Over the main entrance, on Fifty-ninth Street, is a magnificent bronze and glass marquise, from which are suspended nine handsome lanterns of bronze and frosted glass, as shown in Fig 4, each being equipped with one Gem 100-cp clear lamp. In addition to the lanterns there are 27 16-cp clear lamps placed pendant under the same. The effect here would be much improved were frosted instead of clear bulbs used.

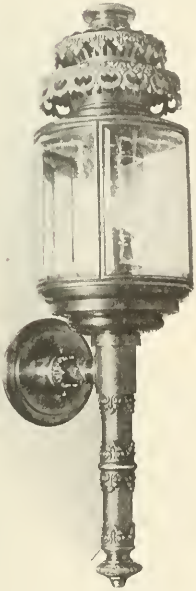


FIG. 2.—LAMP AT CARRIAGE ENTRANCE.

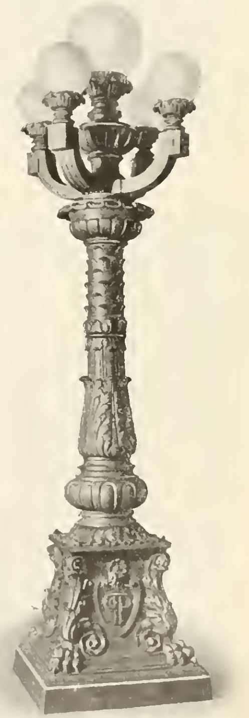


FIG. 3.—OUTSIDE STANDARD ABOVE PORTICO.

This entrance opens directly into the reception hall or lobby. This room, which is shown in Fig. 9, is 54 ft. wide, 32 ft. deep and has a height of 22 ft.. It is finished with marble walls of white and gray tints, the ceiling being white. These colors are somewhat relieved by the gold capitals of the pilasters, the gold fixtures, and the soft colors of the upholstering and rugs. The fixtures, of which there are 14, are chandeliers, with all of their ornamental features above the light source, which consists of five 20-cp "Meridian" lamps pendant, the lower half of the bulbs being frosted. The most impressive feature of this room is the illumination, which is brilliant, but well diffused and pleasing. It is possible to read anywhere in the room, which is rarely true of hotel lobbies.

The corridor which extends around the building is 10 ft. wide and of the same height and general character as the lobby. The chandeliers are similar in design and identical in equipment with those in the lobby. This fixture is shown in Fig. 7, excepting that the beaded ball lamps were not used in the installation.

The principal rooms on the ground floor in addition to the lobby are the dining rooms, of which there are two; the tea room, café and bar. The corridor leads to all of these rooms, and the general effect is large and commodious. At the west end of the corridor is the bar. This is an interior room 52 ft. x 40 ft. and 24 ft. high, and has dull-colored panelled walls with yellow painted ceiling. The lighting equipment consists of one central bronze chandelier, five brackets and eight ceiling clusters. The chandelier has 15 16-cp frosted ball lamps, and each of the brackets and the clusters five 16-cp lamps of the same pattern. In addition to the above a most pleasing effect is produced by the illuminated mural paintings in the alcoves over the bar. The lamps used are of the silvered reflector type.

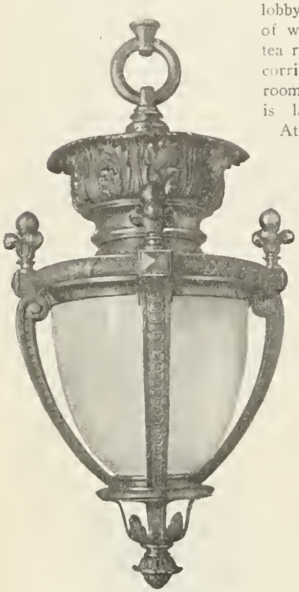


FIG. 4.—MARQUISE LANTERN.

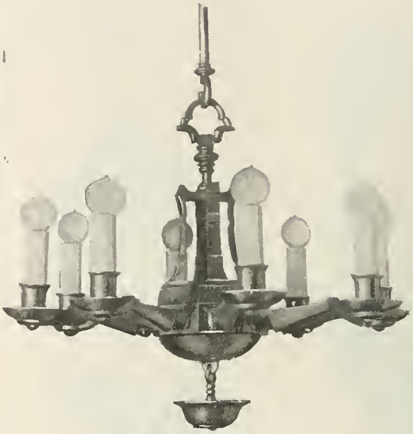


FIG. 6.—GRILLE CHANDELIER.

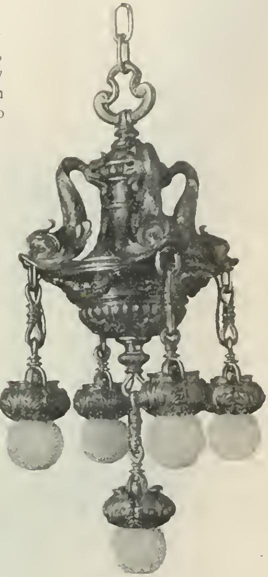


FIG. 7.—CORRIDOR CHANDELIER.

The main dining room, which is on the Fifth Avenue side, is 68 ft. x 48 ft., and the same height as the corridor. It is exquisitely finished in pure Louis Sieze style, the colors being cherry, gold and white. The only lighting fixtures are ten chandeliers, finished in old gold, trimmed with crystals, the lamps being entirely enclosed. In each chandelier there are five 16 and 11 4-cp clear tubular pattern bulbs. This room is shown in Fig. 10, but no photograph could reproduce with justice the beautiful result. The Fifty-eighth Street dining room is slightly smaller, being 48 ft. x 54 ft., but the design and equipment are identical. The chandeliers in this room number eight. These rooms are divided by means of a temporary glass-partitioned hallway 14 ft. wide, in which there are two more chandeliers. By removing these partitions a room approximately 50 ft. x 130 ft. is formed, which is lighted by means of 20 chandeliers.

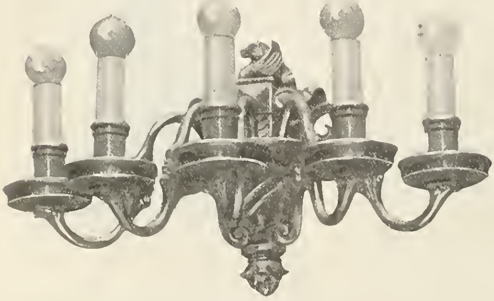


FIG. 5.—CAFÉ BRACKET.

Across the corridor from the main dining room is the tea room, or, as it is sometimes appropriately called, "Lounge," for it is agreeably informal in contrast with the dining room. It is 70 ft. x 48 ft., of the same height as the adjacent corridor except for the central glass dome. This room, which is in the center of the building, is finished in marble of dull gray color, the glass dome being of soft green and yellow tints. Above the dome are 120 16-cp clear lamps. There is a profusion of plants and flowers here, which, unfortunately, hide the lighting standards, of which there are eight. These are particularly worthy of notice, as they are Italian Renaissance candalabrum, being an exact reproduction of the original at the National Museum, at Florence, Italy, by the celebrated sculptor, Valerio Cioli. The original is about 5 ft. high, while the copies are 8 ft. They are equipped with 12 16-cp 3⅛-in. frosted ball lamps. These fixtures were cast by means of the "Cire Perdu"

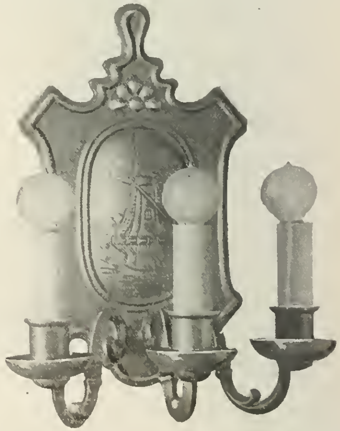


FIG. 8.—GRILLE BRACKET.

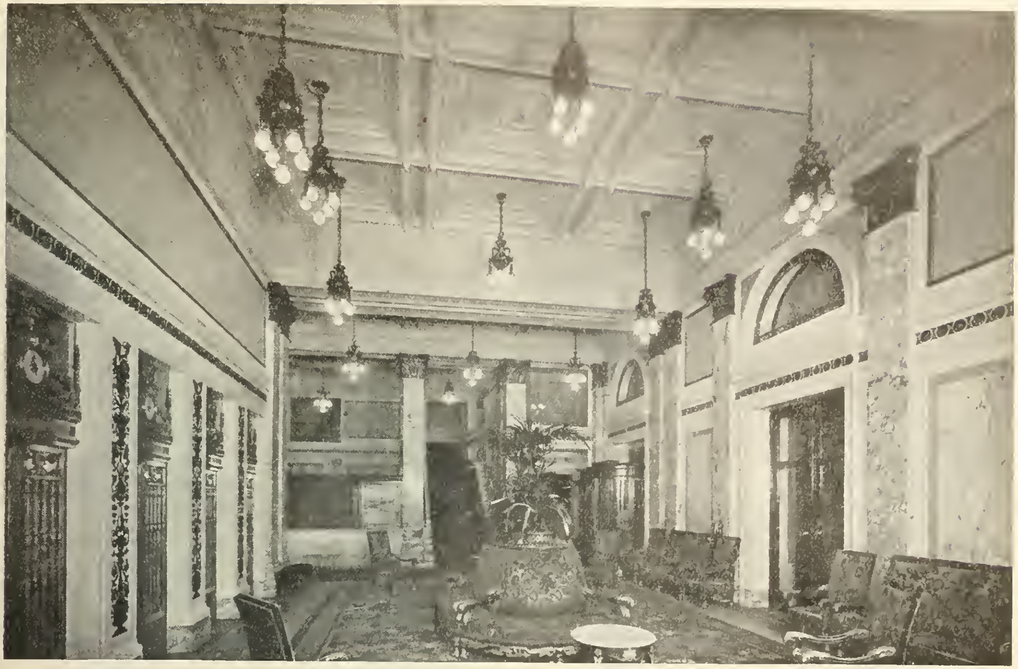


FIG. 9.—LOBBY OF THE NEW PLAZA HOTEL.

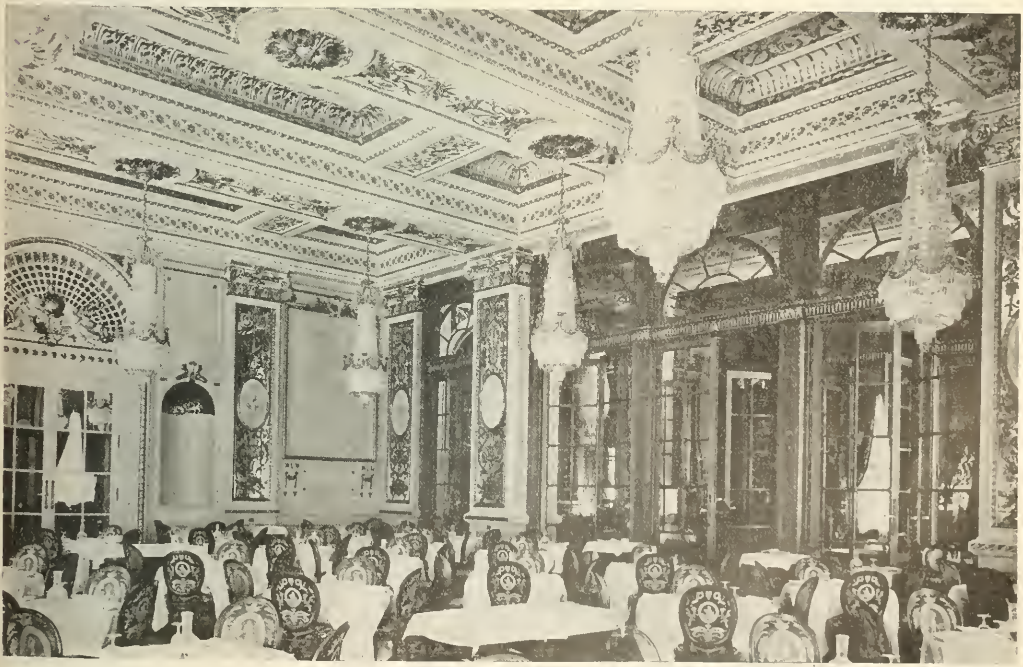


FIG. 10.—MAIN DINING ROOM OF THE NEW PLAZA HOTEL.

ILLUMINATION IN ONE OF NEW YORK'S LARGEST HOTELS process, which is used extensively in Italy, and are evidence of the fact that this class of work can be done successfully in America. They are of antique patina finish and are shown in Fig. 18.

Diagonally across the corridor from the tea room is the café, with windows on Fifth Avenue and of Fifty-ninth Street. It is wainscoted in dark oak, with tapestries and olive-green curtains, its dimensions being 69 ft. x 38 ft. The room has a dark, barrel ceiling, across which are four heavy beams, their height from the floor being 20 ft. and the height between the beams 24 ft. 6 ins. There are two dark bronze chandeliers suspended from each of the beams, making eight in all, and 13 bracket lamps of similar finish. Each of the chandeliers is equipped with 20 16-cp frosted ball lamps, and the brackets with five lamps of the same style. These fixtures are illustrated in Figs. 5 and 11. That the height and color of the rooms affect the illumination is very striking if one compares this room with the grille room, which is directly underneath and of practically the same dimensions in square feet. The grille room is 72 ft. x 38 ft. x 12 ft., with an alcove 66 ft. x 12 ft. x 8 ft. It has white enameled painted walls, white ceiling, and white enameled chairs upholstered in black leather. The lighting installation consists of ten chandeliers equipped with eight 16-cp frosted ball lamps and ten brackets with three 16-cp frosted ball lamps. These are shown in Figs. 6 and 8. Further comparisons between these rooms give the following results, the alcove of the grill room not being included:

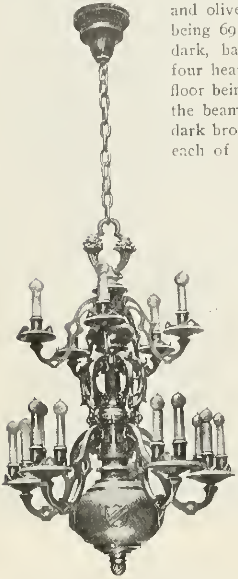


FIG. 11.—CAFÉ CHANDELIER.

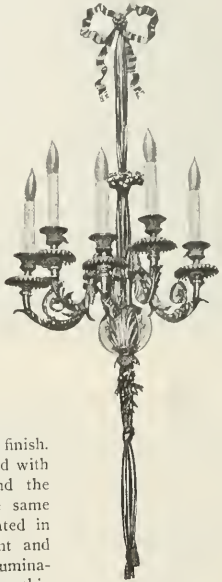


FIG. 12.—BANQUET ROOM BRACKET.

	Cp.	Sq. ft.	Cu. ft.	Sq. ft. per cp.	Cu. ft. per cp.
Café	225	2622	60,306	11	268
Grille room	110	2736	32,832	24	298

Since the above comparison was made, orange-colored silk shades have been added to the fixtures in the grill room, as the illumination was too glaring and brilliant.

The other public rooms are located upon the second floor, and are the ballroom, banquet room and the state suite. The ballroom is Louis Quatorze style in white and gold, and is the largest room in the hotel, being 74 ft. x 65 ft. x 30 ft. There are balconies on three sides of the room, leaving an open space 60 ft. x 40 ft. The central balcony can be lowered to the floor level and used as a platform. There are two crystal chandeliers equipped with 150 16-cp lamps, (see Fig. 17), and 14 brackets with eight 16-cp frosted ball lamps. When the platform is used as a balcony the effect is very bad, as there is very little clearance between it and one of the chandeliers.

The banquet room is directly over the main dining room, but is naturally much smaller, being 48 ft. x 18 ft. x 14 ft., finished in light green. The only lighting fixture here are 12 "Regence" brackets equipped with five 8-cp frosted flame lamps, as shown in Fig. 12. The size of the brackets is not in keeping with the size of the room, being too small, and the amount of illumination insufficient, making table lamps necessary.

The furnishings of the private rooms are in keeping with the public rooms already described, but as the size, finish and equipment of these rooms are of such great variety, only a general description is possible in an article of reasonable length. The parlors and bedrooms of the expensive suites are equipped with chandeliers, candelabra, brackets and table lamps. Two styles of these parlor chandeliers are shown in Figs. 14 and 15, the former being equipped with nine 8-cp frosted flame lamps and the latter with eight 16-cp clear lamps. In all of the bedrooms for transients there are chandeliers and brackets, the former usually being pendant, as shown in Fig. 13, and the latter always upright. In all bathrooms there is one bracket, equipped with two 8-cp clear lamps and frosted shades. All other brackets have 16-cp lamps, as have nearly all of the chandeliers. The frosted shades are all sand-blasted inside, with polished exterior. The distance between the lowest point of all chandeliers and the floor is 6 ft. 4 ins. The chandeliers shown in Fig. 13 are the only pendant fixtures that are installed in the private rooms. Table lamps have silk shades and are equipped as follows: Parlor lamps with three 16-cp clear bulbs, and bedroom lamps with only one 16-cp clear bulb. All the corridors throughout the building are equipped with chandelier lanterns, with frosted glass. The floor above the ground floor, on which the ballroom and other public rooms are located, is used to a much greater extent than the guests' floors and there is one Gem 50-cp lamp in each lantern, the others being equipped with one 16-cp clear lamp. These lanterns are placed about 20 ft. apart and are shown in Fig. 16.

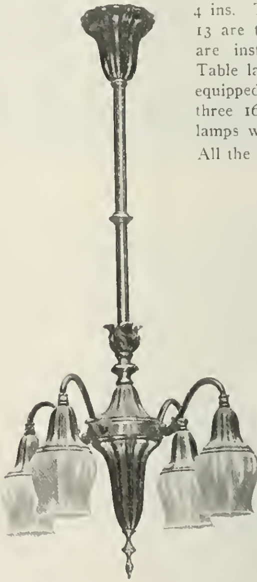


FIG. 13.—BEDROOM CHANDELIER.

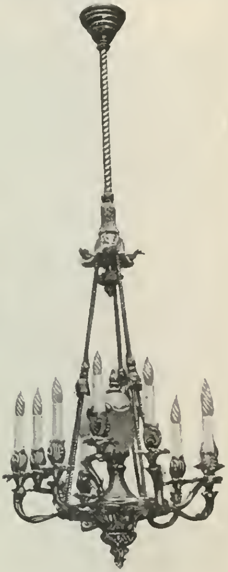


FIG. 14.—PARLOR CHANDELIER.

The engine room and laundry, which are located in the subbasement, are equipped with arcs and incandescents. The former, which furnish the general illumination, are 5-ampere arcs, with dense, milky outer globes, and the latter, which are placed at points where additional light is necessary among the machinery, are clear 16-cp lamps. The kitchens are equipped with Gem lamps, 50, 75 and 100-cp, with prismatic reflectors. The other service portions of the hotel are equipped with clusters of clear 16-cp lamps, horizontal, with white porcelain reflectors.

FIG. 15.—PARLOR CHANDELIER.

FIG. 16.—CORRIDOR LANTERN.

The stage and the ceiling above the lounging room are lighted by the Frink system of concealed lamps.

Increased knowledge of illuminating engineering has had much to do with the successful lighting of this modern palace, and those interested in other illuminants must work along similar lines or be hopelessly outdistanced. The success achieved is due to the progressive attitude of those who so aggressively advance the interests of that illuminant.

FIG. 17.—GENERAL VIEW OF BALL ROOM.

The photographs for this article were furnished by the manufacturers of the fixtures; the lobby, dining rooms, tea room, grille room and the outside of the building having been equipped by The Sterling Bronze Company and the other fixtures supplied by The Enos Company.

Single-Phase Motors for Central Station Service.

Whatever may be the source of energy, in the electric lighting industry as it exists to-day, lamps are always connected between two terminals, so that a lamp load is essentially "single-phase." The use of "single-phase" circuits is therefore necessary in some portion of the distributing system, although polyphase circuits may be employed in transmission. Thus the prevailing use of "single-phase" circuits by central stations is attributable to the character of the receivers rather than to any small economies that may be obtained by its use. However, it is believed that the disadvantages of single-phase circuits have often been over-estimated, and the advantages have sometimes been ignored.

Although numerous text books contain elaborate discussions of the relative amounts of copper required for single-phase and polyphase transmission systems, and almost invariably the conclusion is reached that of all systems the three-phase is the most economical in conducting material, yet the fact remains that the single-phase system under present operating conditions is the exact equivalent of the three-phase system as to the cost of copper and is preferable to it with respect to the cost of insulators for the line.

If the transmission lines could be so erected that the weakest point in the insulation becomes the air-space between two wires, then the various systems could be compared on the basis of the equality of e. m. f. between wires, on which basis the three-phase system requires only three-fourths as much copper as either the single-phase or the two-phase system. When, however, as is actually the case, the weakest point is found in the insulators themselves, then the various systems must be compared on the basis of the equality of the e. m. f. to the neutral point, on which basis all symmetrical transmission systems are equal in the cost of conducting material, while the single-phase is the cheapest to erect on account of requiring the least number of insulators. For example, if each insulator is designed, with the proper factor of safety, for a working e. m. f. of 10,000 volts, then on a transmission line using metallic poles (or with grounded neutral) the e. m. f. between wires in a three-phase system could be 17,300 volts, while in a single-phase system the e. m. f. could be 20,000 volts—the former system requires equally as much conducting material as, and 50 per cent more insulators than, the latter system.

FIG. 18.—TEA ROOM STANDARD.

The superiority of the three-phase over other transmission systems resides in the smaller cost for insulators as compared with the two-phase system, and in the less cost for generators and motors as compared with the single-phase system. In central-station work where the generating equipment is of the alternating type, polyphase alternators are frequently used, although the energy is distributed to the customers over single-phase or direct-current circuits. With almost no exception, central-station companies would find it more convenient to supply energy to single-phase rather than to polyphase or direct-current motors, provided the services were equally satisfactory from the several types of machines. It is evident, therefore, that from the very nature of the problem, central-station companies are favorably inclined toward single-phase motors. It is the object of the present article to discuss briefly the constructive features and operating characteristics of such types of single-phase motors as have been employed successfully in central-station service.

As intimated above, the single-phase motor has as its competitors the direct-current and polyphase motors. It may fairly be stated that there has never yet been produced a single-phase motor equally as simple in construction and as robust in performance as the polyphase induction motor, or equally as flexible and efficient in operation as the direct-current motor involving the same outlay for constructive material. It should not be inferred from this statement that the single-phase motor is excessively expensive, or in any respect unsatisfactory, but rather that its competitors have been developed to a high degree of perfection. Each of the many types of single-phase motors that have been produced possesses constructional details resembling either a poly-induction motor, a direct-current motor or a combination of the two. The writer is unaware of the existence of any single-phase motor the performance of which could not be improved by operating it as an ordinary direct-current or polyphase induction motor, after slight alterations are made to convert it into a machine of the proper type. However, from the standpoint of central-station service, single-phase operation is so far superior to polyphase or direct-current that the comparatively small disadvantages residing in the use of single-phase motors may be ignored in most cases.

In comparison with its polyphase competitors, the induction type of single-phase motor is less efficient in operation, and it requires auxiliary starting devices. The commutator type of single-phase motor is not so efficient as the corresponding direct-current machine and commutating difficulties are encountered under starting conditions. The early designers of single-phase motors found that the disadvantages in these machines are less prominent the smaller the rating, and hence the early single-phase motors were limited to low ratings. In fact, almost all of the early types of single-phase motors that attained success were used for driving fans. The plain series type of single-phase commutator motor as used for fans differs immaterially from the direct-current series motor except that the magnetic circuit is laminated. This type of motor operates better the lower the frequency, reaching the best performance when the frequency is zero—that is, with direct current. The higher the frequency, the greater is the iron loss, the lower is the power factor, and the poorer is the commutation. The fact that single-phase series fan motors have been used successfully with a frequency of 60 cycles per second, shows that the disadvantages mentioned are not insurmountable when the design problems are placed in competent hands.

The most difficult problem connected with the design of the induction type of single-phase motor resides in the lack of starting torque of this machine. Although perhaps not the most efficient, yet certainly the simplest, device for rendering a single-phase induction motor self-starting is the "shading coil," which consists merely of a single uninsulated turn of copper surrounding a certain portion of each field pole. This coil serves to retard the initial production, and the subsequent removal, of flux within the area which it surrounds, and thereby gives to the resultant magnet flux around the air gap an irregular forward motion in the direction from the "unshaded" to the "shaded" portions of the field poles. The weak revolving field thus produced gives to the short-circuited rotor a torque sufficient to accelerate it to such a speed that the "quadrature" field produced by current in the rotor becomes of sufficient strength to augment the acceleration until the speed reaches a value slightly below synchronism. Since the load torque on a fan motor has zero value at starting, the "shading-coil" motor possesses the requisite torque-speed characteristic for fan motor service, and it has proved thoroughly reliable in this connection.

A refinement as to detail, with an accompanying increase in efficiency and decrease in simplicity, was found in building each "shading-coil" of several turns properly insulated, and aranging to open the shading-coil circuit under full-load speed. An additional improvement in the starting torque was obtained by connecting the shading-coil circuit in parallel with the main-field circuit during the starting periods. The maximum starting torque is obtained when the main coils and the starting coils are placed in electrical space-quadrature and are supplied with equal magnetomotive forces in electrical time-quadrature. The attempt to obtain the maximum torque at starting has resulted in the "split-phase" motor in which the current in the starting coil is displaced in time-phase from the current in the main coil by the introduction of resistance in the starting-coil circuit. This motor, which has been adopted for duty much more exacting than that of driving fans, will be discussed fully below.

One of the most interesting, and probably the most ingenious, of the schemes used for rendering a single-phase motor self-starting and simultaneously giving it excellent operating characteristics, was embodied in the type of machine constructed with projecting field-poles like a direct-current motor, and with both a direct-current commutator winding and an induction motor short-circuited secondary on the rotor, which was supplied with single-phase current and operated with certain synchronous motor characteristics. The sationary winding and the commutator winding were connected permanently in series. The machine started as a series motor and accelerated almost to synchronous speed as an induction motor. As the speed approached synchronism, the rectifying effect of the commutator winding, combined with a damping effect of the short-circuited winding, caused definite magnetic poles to be formed on the rotor, and the machine assumed many of the advantageous operating characteristics of a synchronous motor with a revolving field-magnet.

An interesting form of self-starting, single-phase motor was the single-brush commutator machine which was used by many manufacturers in the early days of the fan industry. The stationary field winding had no electrical connection to the revolving armature winding. The latter winding was similar in all respects to the armature of a direct-current motor, while the former resembled the primary winding of a single-phase induction motor. A single brush served to short-circuit an armature coil in such a position with respect to the field poles that the secondary current gave a torque to the rotor. As only a small portion of the armature winding was in use at any one instant, this machine required an excessive amount of constructive material for each unit of effective output.

A machine which differs immaterially in constructive details from the one just described, but which represents an enormous improvement in operating characteristics, is the so-called "repulsion motor" which is provided with two brushes (per pole-pair) short-circuited upon themsleves. It is a curious fact, easily verified experimentally, that the torque of the latter machine is in a direction reversed from that of the former; that is to say, the repulsion motor possesses as a disturbing feature the one feature that makes the other machine operative. However, the brushes on the repulsion motor are made narrow to minimize the negative torque, while on the other machine the brushes were made wide to obtain a good operating torque.

Seldom indeed are the repulsion motor characteristics, which are quite similar to those of a series motor, employed for continuous service; a single-phase machine which is started from rest as a repulsion motor is converted into an induction motor obviating the necessity for a heavy base with pedestals for bearings. One collector ring is mounted on each side of the field element, which makes the machine very short and compact and reduces vibration to a minimum. Each generator has belted to it a Crocker-Wheeler 1.25-kw, 125-volt, 1570-r. p. m. exciter.

The engines are of the twin-cylinder, two-stroke cycle Mietz & Weiss type, using a low-priced fuel oil, and constitute a very economical source of power. The main bearings of the engine are ring-oiling, and force feed lubrication is used for all other parts. The engines are very easily started by the use of compressed air furnished by a small compressor belted to one of the engines in connection with a storage reservoir. The absence of electrical ignition and the general ease and simplicity of handling render expert help unnecessary and greatly reduces the running expenses of the plant.

Two 6000-gal. horizontal steel tanks are provided for the storage of fuel oil. They are located in the rear of the power house sufficiently below the level of the railroad siding so that the oil flows into them from the tank car by gravity, suitable piping being provided for the purpose. From the storage tanks the oil flows by gravity into a feed tank located under the power house floor, and is drawn thence by pumps with which each engine is provided.

The switchboard consists of two generator panels and one feeder panel, built by the Fort Wayne Electric Company. Each generator panel contains an exciter ammeter, a voltmeter, three generator ammeters, two field regulators, and a two-throw, three-pole oil switch. The feeder section of the board consists at present of one panel arranged for two single-phase, 2300-volt feeders controlled by two-throw oil switches. Two sets of bus-bars are provided and each generator and feeder may be thrown on either bus. All instruments are operated from transformers. The series arc system is regulated by means of a General Electric air-cooled, constant-current transformer, giving a secondary current of 6.6 amperes. The arc circuits are controlled on a small panel independent of the main switchboard. The arc lamps are 430-watt General Electric enclosed, and are hung from 10-ft. mast arms. The 2300-volt feeders are provided with lightning arresters, both inside the station and at various points on the poles. The customers' services are operated in groups from Fort Wayne transformers varying in rating from 600 watts to 10 kilowatts. The three-wire system is employed for all services in excess of 600 watts, and Westinghouse watt-hour meters are used throughout.

The Opportunities of the Small Central Station.

It has been thought sometimes by owners of small electric generating stations that there have been no opportunities for such companies of which advantage has not been taken. It is true that there are a few small central station companies which have been remarkably active in taking advantage of their opportunities and in securing a high gross revenue per capita of population served, but in the case of the great majority of small central station companies, there are many neglected opportunities. Small central stations are probably not any worse underdeveloped than many of the large ones. The smaller companies have before them, however, more numerous practical examples of what can be done in the way of making the most of a plant than have the very large companies.

In a general way, it can be said that the prospects of the small central station company are to-day brighter than ever before. There are two reasons for this. One of them is a physical or engineering reason, and the other is the result of commercial development. The engineering reason is that in a great many instances the small, struggling plant can be economically supplied with energy over a transmission line from a generating station in some neighboring and larger town. Even if there is no large, neighboring town the consolidation of a number of stations in small towns, if supplied from one transmission network, is conducive to many economies in operation and management. In some other cases, energy can be purchased from electric interurban railway companies, and with proper automatic voltage regulating appliances, this energy can be used for electric lamps and motors in a small town.

The commercial reason why the chances for the small plant are better than ever, is that the every-day uses of electricity have been increasing and the number of men trained in the work of introducing central-station service more extensively into a community is daily increasing. There is thus a better chance to secure the necessary business management to make small central-station enterprises commercially successful.

PREPARATIONS FOR GROWTH.

As no two small plants are situated or equipped alike, no general statements can be made which will apply to the possible physical changes necessary in various stations to fit them for earning dividends. It is possible, however, to take up some of the conditions which are met most commonly in small American central stations. Considering each case by itself, the things required of the plant are that it shall be in a position to give 24-hour service and to supply any kind of industrial load available; to expand in size; to handle various loads without the operation of greatly underloaded engines, and to be provided with reserve machinery.

A condition frequently met with in small central stations is that 125-cycle distribution is used for incandescent lamp circuits and a direct-current series arc machine supplies energy for the arc lamps. There is little or no motor load and oftentimes no day service. The first thought should be to put the plant in shape to take care of motor load economically. It is possible to secure satisfactory single-phase, 125-cycle motors. It may be advisable if the field is exceedingly limited and there is no possibility that the plant will ever be connected up with a 60-cycle transmission system to retain the 125-cycle generators and have customers purchase 125-cycle motors. This policy is not to be recommended, however, except in some isolated cases. As a general rule, it will be better to change the system over to 60 cycles as rapidly as it can be done without too great a financial sacrifice. The 60-cycle system has the advantage that it can be operated with standard three-phase or single-phase generating apparatus, and should the opportunity come of purchasing energy in bulk or consolidating with other companies, the system under consideration will be in a position to make the change with little expense. Should the 125-cycle system be retained, in a growing plant it would mean simply putting off the change a few years, making it more expensive when it becomes necessary; or it would necessitate the use of belt-connected motor-generator sets for supplying the 125-cycle from the 60-cycle system. Another advantage of the 60-cycle system is that practically all the three-phase and two-phase generating apparatus now made is designed for 60 cycles or a lower frequency. Should the load grow to such an extent that large motors are called for and three-phase generators seem desirable for taking care of the motor load, the existing 60-cycle single-phase apparatus could be operated from these generators.

Assuming that it has been decided to change to 60 cycles from the higher frequency, the first apparatus to be looked after is the transformers. It is possible to operate old 125-cycle transformers on 60-cycle circuits, provided the transformers are not fully loaded. When fully loaded, they are likely to overheat. As a matter of fact, many companies operating 125-cycle systems now have their circuits fairly well loaded with 60-cycle transformers, as practically all modern transformers are built for the lower frequency. As far as the transformers are concerned, the change to 60 cycles comes in the natural development of the plant. The old 125-cycle transformers can be used underloaded and additional 60-cycle transformers purchased. If the generating plant is to be shut down and the supply is to be obtained from a 60-cycle transmission line, the question of changing the generating plant is not troublesome. If the generating equipment is to be changed from 125 to 60 cycles, there is a more serious financial proposition for a small station, as it practically means the purchasing of new generators and getting nothing but scrap value for the old ones. Very often the plant is in a position to require extra apparatus anyway, so that the purchase of 60-cycle generators with an output to take care of both the new and the old load involves but little more than the original cost of the existing high-frequency generators. Most high-frequency alternators have been in use from 15 to 20 years, and are so approaching the end of legitimate life. It may be said that there are some small companies which cannot afford to make even this change. That is, they are operating in towns of 1000 to 1500 inhabitants, where the only load available is a lighting load. This is true of many towns in the West where there is little or no manufacturing. About the only hope for plants in such small towns is to consolidate them with others in order to make it possible to supply energy economically.

As to the direct-current arc dynamo in the 125-cycle plant, there are a number of needs to be considered before changes are made. A few years ago, if the incandescent lighting system was to be changed to 60-cycles, the natural course would have been to change the street arc lighting system to a 60-cycle, constant-current system supplying enclosed carbon arc lamps from tub transformers. Just at present it might be advisable to change the street lighting system to one using series tungsten incandescent lamps or to await the development of a luminous arc system suitable for 60-cycle alternating current. With either of these changes made, the station can be put in a position to generate its entire output in 60-cycle current or to take its entire supply from a 60-cycle transmission line.

Probably one of the most difficult situations to handle economically is found in the large number of small central stations which have 125-cycle, single-phase lighting circuits, direct-current motor circuits of 500 or 220 volts and possibly also, as a further complication, a direct-current series arc lamp system. Where such a separate motor and lighting distribution system exists, there is, of course, considerable industrial business for which customers have already installed direct-current motors. In such towns a change to a 60-cycle single-phase or three-phase system involves not only the lighting, but the motor distribution systems. Customers' direct-current motors would have to be displaced by either single or three-phase alternating current motors. If single-phase motors are used, their cost will be much greater than direct-current motors of the same output. To supplant the customers' motors at the lighting company's expense would, therefore, be a great financial burden in addition to the cost of changing the generating equipment. It has been done in numerous cases and somtimes may be justified, especially if the generating plant is to be abandoned and energy is to be supplied from a sub-station connected to a high-tension transmission system. In the latter case, a continuance of direct-current motor circuits would necessitate rotary converters or motor-generators in the sub-station, whereas if an alternating-current distributing system were used for all purposes, there need be no rotating machinery in the sub-station. In the latter case the sub-station could be left without attendants certain portions of the day. This depends very much on the size of the town. A sub-station which supplies energy to a village needs little attention save replacing fuses, and a blown fuse is a rare occurrence in such small places. The voltage regulation of such a sub-station is taken care of at the main generating station. Considering the infrequency of short circuits, it is usually justifiable in villages to depend on a trouble man located somewhere in the village to replace fuses and clear up line troubles in emergencies, and it is not necessary that he be in constant attendance at the sub-station. This question of the necessity or the absence of necessity for a constant sub-station attention has a vital bearing on the future policy of a company about to take hold of a plant of the kind under consideration where there are direct-current motor circuits and alternating-current lighting circuits. No general rule can be laid down as to what the policy should be, because in some cases the cost of replacing a few customers' motors with 60-cycle alternating-current motors would not justify the expense of putting in a motor-generator or rotary converer to supply the direct-current circuits for a number of years and maintain an attendant at the sub-station constantly. When, however, the supply is to be continued from a generator plant rather than from a sub-station, the best course to pursue may be altogether different, because it is necessary to keep men at the generating station constantly in any event. The maintenance of two separate sets of dynamos may be an inconvenience and add somewhat to the operating and maintenance expense, but in many cases its cost is not enough to justify a wholesale change. The course usually followed by many of the larger companies in a case of this kind is to install 60-cycle lighting equipment as rapidly as possible, and whenever a new motor load is secured to feed it from the 60-cycle service. This will usually enable a small station to obtain a motor load some distance from the plant, which it was not able to get before. In the meantime, the direct-current motor load is not allowed to grow, no new customers being taken on direct-current service. Customers with motors that are nearly worn out are persuaded to buy new alternating-current motors. As the alternating-current load gradually increases and the direct-current load decreases, it may be advisable to install a motor-generator or rotary converter set to supply the direct-current circuits during hours when it would not be economical to run an engine driving a direct current generator. This, of course, depends on the units that are in the plant. In small stations with mixed service, there is usually a small direct-current generator which can be belted to the smallest engine for use during light load. It is only when the station reaches such a size that large alternating-current generators with economical engines are in use that the motor-generator proposition is worth consideration.

A small proportion of the small electric-light stations of the country have direct-current, 110-volt systems. Where the stations are in very small towns and have been giving night service only, there is no motor load to consider. It is sometimes advisable to connect the station up with some neighboring town by means of a transmission line, and it is a simple matter to change from 110-volt direct-current service to 110-volt alternating-current service. Very often by some inexpensive changes, a system can be changed from 110-volt two-wire to three-wire, the whole town receiving energy from a central transformer. If the town covers considerable area, however, it might pay to take down a large part of the feed wire installed for the direct-current system and put in an alternating-current distribution system with 2000-volt primaries, retaining a part of the old feeders for 110-volt secondaries.

There are a number of 220-volt, two-wire central stations throughout the country. These present a situation just the reverse of that found in the stations having nothing but 125-cycle alternating-current distribution. The 220-volt, direct-current, two-wire system, while it is well adapted to the motor load in a very small town, is not well suited for lighting circuits. Its unsuitability for the latter purpose is becoming daily more pronounced as the new higher efficiency incandescent lamps are brought out. These are not made for 220 volts. As far as lighting is concerned, the direct-current, 220-volt plant is tied down to very inefficient incandescent lamps and very inefficient, unsteady arc lamps. To be sure, the new incandescent lamps, like the tantalum and tungsten, can be operated two in series from 220-volt circuits, but this is a rather unsatisfactory makeshift. If a two-lamp series cluster is used, it frequently has the lamps pointed at such an angle that it makes it difficult to procure reflectors giving the desired distribution of light. On the other hand, if the wiring is to be changed so as to put two lamps in series, the arrangement can only be applied with economy to large lighting customers. It is practically unsuited to residences. Fortunately the way out of the difficulty which confronts 220-volt direct-current stations is in many cases very easy, provided there is no motor load. If the apparatus is to be continued in operation, a neutral feeder can be installed and customers' services can be changed from 220 to 110 volts. At the power house a small balancer set will serve to balance the system if the load is properly connected on the two sides. If the operation of the power house is to be discontinued and the system is to be changed to alternating current, the change would consist of the installation of a neutral wire and connection of the system to a three-wire transformer at the station or to transformers located in each block.

COMMERCIAL POSSIBILITIES.

The foregoing portion of this article has outlined some of the changes which must be made in various types of plants to enable them to economically take care of a greater output. Of course, in all cases of this kind, if the net earning capacity were not to be considerably improved no changes would be justified. The changes are not suggested because of any fancy engineering ideas, but simply to point out how central-station companies may expand with some assurances of success. In the case of very small plants, too much emphasis cannot be placed on the importance of consolidation of generating stations. The Electrical World has from time to time published data on the cost of operating small central-station steam plants as compared with the cost of operating them in conjunction with some neighboring plant. In a general way it may be said that the load of a station operating in a rural community of about 1000 inhabitants can be carried by a plant operating in a town of 2000 to 4000 inhabitants at a reduction in regular operating expenses of at least 75 per cent of the cost of operating the smaller plant, and frequently more than this.

There is, of course, no object for a company to increase its investment in a central-station enterprise unless by so doing the percentage earned on the investment can be increased. It is not, therefore, simply a question of getting more business, but a question of getting business of a kind which will increase the kilowatt-hours sold per dollar invested. With a plant in operation 24 hours per day, any increase in output which does not require increase in generating equipment and consequent increase in investment is tolerably sure to increase the net earnings on the investment. The operating expenses for the larger output will not increase in the same proportion as the output; and even if they did increase in the same ratio, the percentage earned on the investment with a large output would be greater than with the small.

The central-station company should aim to be the sole energy producer for the community, except as regards intermittent work which is unprofitable because of the large investment involved in apparatus mostly idle. Looking over a small community for the opportunities for the sale of energy, the waterworks system if there is one, comes in for first consideration as a desirable load. Numerous small central-station companies have pumped water for the city at a profit both to the city and to the company. If a company is about to embark in 24-hour service where it has previously given only night service, the securing of a city water-pumping load is very important. Where there is a stand-pipe or provision for water storage in connection with the water works, this city pumping offers an ideal load for a central station, because it can be shut off during the principal lighting hours from 5 to 9 p. m. It is difficult to understand why more central-station companies do not get this business. In many cases cities have feared that the central station would not be sufficiently reliable, such fears having been justified by the irregular performance of the apparatus in years past and by its generally dilapidated and run-down condition. Until a company can inspire confidence in a community by its service and the general appearance of its property, it cannot expect to get such pumping contracts. In any event the existing steam plant of the waterworks can usually be kept as a reserve with fires ready to kindle and the electric pumps simply installed in addition to the steam pumps already in use. Centrifugal pumps are coming into favor for use in city water pumping of this kind. For deep-well pumping, where it is possible to remount the well to a diameter of about 14 ins., vertical-shaft deep-well centrifugal pumps can be obtained. Another method is to gear a motor to a properly counterbalanced deep-well plunger pump. If the water is raised from the well by compressed air instead of by deep-well pumps, the motor can, of course, be used to operate the air compressor.

In the average small town there are many more places requiring motors than the average man thinks of offhand.

Besides the small factories, there are the blacksmith shops, machine and repair shops, printing offices, railroad water pumps, drug store carbonators and laundries to be found in nearly all towns of 1500 inhabitants and over. Besides this, there are frequently stone crushers and brickyards to supply. By judicious soliciting on the part of the manager, two or three refrigerating machines ought to be equipped electrically in every town of over 4000 inhabitants. The use of electric fans can be greatly increased by getting after this business.

The fan is useful both in summer and in winter. With its uses in summer all are familiar. Its winter uses are not so well known. It is proving especially valuable to increase the air circulation in hot-air appliances, as described a number of times in these columns. When so installed, it will be used every morning in cold weather to hasten the heating of the house, as it is possible with forced circulation to heat the house in the morning in about half the time that is usually required to raise the temperature to a comfortable point and to reduce the length of time which the furnace must be run at maximum heat, thus saving fuel. For drying clothes in laundries, for hairdrying in barber shops and elsewhere, the fan has so far been little used, but should find wide application in the future.

A number of small central stations have met with remarkable success in the introduction of motors of about one-quarter or one-eighth horse-power for general household purposes such as driving a washing machine, meat grinder, coffee grinder and polishing wheels. For such use, the motor is usually belted to a short length of line shaft from which any of these appliances can be driven.

In the average small town only a small percentage of the residences which should use electricity are connected to the company's lines. This is another chance for increasing load of the right kind. It should be noted that everything mentioned so far as is in the direction of increased revenue without requiring increased station equipment in proportion. Along with residence lighting comes the use of the electric flatiron and various light cooking appliances, with occasional complete ranges, all of which add to the profitable nature of a company's load.

In towns where there is no waterworks service, many of the owners of the larger residences may be induced to put in electric pumping outfits and in this way the absence of a waterworks pumping load can to some extent be counteracted.

In most small towns show-window lighting has not been developed to any extent. This is a class of lighting which a central station can always encourage to its profit.

Mention so far has only been made of some of the principal classes of business which can and have been developed by a number of small companies and which ought to be developed by many more. In general, it may be said that no company has worked up its business to anywhere near its possibilities until its earnings reached $6 per annum per capita of population served. How much more than this can reasonably be expected as an average, only the present great activity in getting central-station business can prove. Over $8 per capita has been reached in some cases so far. It is not possible in an article of this kind to go into the details of how these various classes of business are obtained. Thoroughly reliable service, at rates which encourage the use of energy at other than peak load periods, are fundamental requirements. Persistent solicitation is necessary. One peculiarity of the electric lighting business is that the class of business which grows most rapidly and with the least effort is that which is least desirable for the company; namely, the lighting load which is on only a short time each day. Such business as it grows calls for an increased station equipment. If a small station is working very much under its rated output this business is temporarily desirable. If the apparatus is working up near its rating, so that an increase in peak load means an increase in investment, it is still valuable because this increased load can be usually taken care of without a proportionate increase in investment and operating expenses, but it is not as desirable as many other classes of business calling for less investment in proportion to the revenue they yield.

The Central Station Situation in New England.

THE outlook of the New England central-station industry for 1908 is bright, with the prospect of continued progress in both the business and technical administrations of electric lighting and power properties. Evidences are not lacking of a closer cooperation between the companies and the public which they serve, and the engineering side of the central station practice constantly tends towards better methods of operation, more permanent forms of construction and more far-sighted analyses of future needs. Investigation of the hazards of municipal ownership has several times resulted in the dismissal of the problem, at least for the time being, on the part of municipal governmental committees and boards; and it is now squarely up to the companies to increase public confidence in their work to the point that shall make private ownership and operation under the broad regulative control of public commissions universally preferable to municipal administration and ownership.

There is no question that the aggressive new business campaigns which many of the companies in New England have carried on within the past two or three years are indirectly responsible for a growing sentiment of fair appreciation of the central station business by the general public. In some centers socialistic agitation no doubt tends to increase, but on the whole, the central station policy of meeting the public face to face in the exhibition department, or vigorously seeking new business which shall be mutually profitable to the public and the companies, of frankly answering reasonable inquiries as to commercial methods and limitations, has gone far to disarm hostility and to bring the consumer to the point of active friendliness. It is clear that these aspects of the exhibition and convassing phases of the business have worked untold good in the matter of public relations, and great credit is due to the companies which early saw the wisdom of spending money to bring themselves into direct and vital touch with the public. The policy of having nothing to conceal reaps a rich reward in these days of publicity and investigation.

The maintenance of a dignified, conciliatory attitude in which the desire of a company to meet an inquiry squarely and clearly, and even to go to large expense to satisfy the public that sound and equitable methods are its practice, always tends towards the preservation and increase of mutual friendliness. Perhaps the best illustration of this during the past year in New England was in connection with the rate inquiry of the Boston Public Franchise League in relation to the charges of the Edison Electric Illuminating Company of that city Through the investigation, lasting many months, and which at this writing remains to be adjudicated, the company spared no pains to get at the actual facts bearing upon its cost of production, although many of the inquiries were couched in indefinite phraseology, uncertain in their meaning and at times exasperatingly insinuating in their suggestions of deliberate unfairness. Expert advice was secured, unusual cost analyses made, and in particular the demand system of charging was explained with reasons for its use in a pamphlet generally distributed to all interested parties at the company's expense. Questions that were of uncertain interest were re-stated by the company as it understood their general sense, rather than answered literally, and at all times in the investigation the company favored the holding of conferences with the petitioners. Whatever may be the decision of the Gas and Electric Light Commission regarding the existing rates of the Boston Edison Company, it is significant that but a mere handful of its customers out of thousands of consumers in its 400 square miles of territory in and around Boston appeared in opposition at the hearings, and there is no question that the company's tolerant and frank policy of open handed co-operation served it well in the metropolitan territory which it supplies. Co-operation is the secret of a successful central station policy, and in New England there is a growing sense of this in every branch of the industry.

In the matter of new business getting, the companies whose agents have shown prospective customers that they can actually save money by the installation of electric motors are the ones which are making the most rapid strides in increased connected load which stays connected and satisfied. The rate problem is really one of secondary importance if the customer can be shown positive economy by the use of electricity. There is no question that the skill required to work out such economics in the face of inadequate methods of previous cost-keeping is of a high order. In the granite industry at Barre, Vt., for example, the stone quarries and cutting sheds often had no accurate idea of their steam power costs prior to the introduction of electricity by the local central station. It was a hard problem to show companies of this kind economy in monthly power bills of two or three hundred dollars when they were formerly accustomed to paying for fuel, repairs, supplies, wages, taxes and replacements in smaller sums at irregular times. The question had to be solved along just these lines, however, and the successful extension of the connected load has rested directly upon the company's ability to figure these elusive costs in relentless detail.

The novelty of the exhibition room plan has undoubtedly worn off now, from the standpoint of the central-station manager. Some of the apparatus exhibits now made at the offices of certain companies look a little the worse for wear, and the early enthusiasm shows signs of lagging in some places. Obviously no company can expect to display each week a bewildering succession of novelties and new inventions, and keep it up indefinitely. Observation shows, however, that it pays to keep every exhibition of apparatus clean and in working order, and an occasional change in window setting is possible even with the same equipment. The passing of the seasons affords an excellent opportunity to call special attention to some one or two articles, and to leave the others for more timely occasions. The electric flatiron, for example, is a strong summer topic, as is the fan motor, while the electric chafing dish, the bathroom heater and other equipment are peculiarly adaptable to winter conditions. While no hard and fast line can be drawn between the seasonal and the perennial apparatus, variety can be secured by paying some attention to the time of year; and as increasing use of appliances, motors and lamps creates new data, it ought not to be difficult to show the standard products in new lights. It is a positive injury to the good name of electrical appliances to allow exhibits to get into slack condition. Fortunately most of the New England companies appear to observe that cleanliness and trimness in their exhibition quarters which is so conspicuous a feature of domestic life in that section of the country.

Direct personal solicitation of new business appears to have largely taken the place of extensive mail advertising campaigns in New England central station work. In the small community, and even in the city of 50,000 to 100,000 population, the local company manager has so extensive an acquaintance, as a rule, that the personal touch is worth far more than the letter advertisement. In the larger cities the companies specialize more with respect to the soliciting of lighting and power contracts, and the solicitor simply carries the personal element into the field where he works, subdividing the duties of the new business man in the smaller town. There is a tendency in the smaller communities for the local public to view any extensive systematic mail campaign as extravagance on the part of the company, whereas judicious newspaper advertising, even in the small town, is never regarded as an undue expense. Circumstances arise where follow-up letters produce good results, but in the small community the distances are short, time is taken more leisurely than in the great cities, and the personal visit is the natural custom which produces the best results. Somewhat the same conditions apply to the use of electric signs by operating companies. The larger the city, the more it pays to spend on effective sign practice, but even in the small town one or two attractive illuminated signs in the vicinity of the company's office are undoubtedly worth while.

Free renewals of 3.5-watt incandescent lamps are given throughout New England generally, but there is considerable difference of opinion as to the wisdom of renewing the high-efficiency lamps free of charge. Most of the companies in New England appear to realize that the public demand for high-economy lamps is bound to be satisfied, and that now is the time to prepare for more extended uses of electricity on the basis of low watt consumption for a given illumination. The advent of a 20-cp lamp consuming about 25 watts, would, in commercial quantities, stimulate the lighting business in the East wonderfully in competition with gas. There is no denying that gas, and even kerosene, have a pretty strong hold in New England households, but when the community is fortunate enough to obtain energy from water power, the question of gas competition is relatively much less important. With coal as the basis of energy generation, and high-economy lamps in small sizes available for general use, the gas company will find it hard to compete in illumination with the central station, even with gas at $1 to 85 cents per 1000 cu. ft. The value of electricity on the score of greater cleanliness and no vitiation of the atmosphere, is, perhaps, as generally appreciated in New England as in the West; but the central station is sure, ere many years pass, to feel the benefits of the fresh air campaign indirectly in the increased demand for electric lighting in old residences and buildings. The flaming arc is rapidly coming into use in New England, chiefly in connection with entrance lighting of hotels, theatres and large stores; the mercury vapor lamp is in use to some degree in the power house, notably at the New Haven's Cos Cob station, and in the shop department, conspicuous, for example, in the Graton & Knight tannery installation in Worcester. The Nernst lamp has been installed to a large extent in New England, and with most satisfactory results to both central station and consumer.

The central-station motor business in New England seems to be in a remarkably healthy condition, judging by the increasing connected loads evident in the different states. During the year between the last two reports of the Massachusetts Gas and Electric Light Commission, Attleboro increased its motor-connected load from 848 to 947 horse-power; Cambridge, from 1640 to 2327 horse-power; Boston Edison, 26,416 to 30,431 horse-power; Fitchburg, 948 to 1447; Lynn, 1479 to 2266, and Salem, 670 to 850. Gratifying growth in the use of motors is also a feature of recent central-station work at Bangor, Lewiston, Auburn and Portland, Manchester and Franklin, N. H., Montpelier, Rutland, Burlington, Providence, Hartford and New Haven. The special applications of motors in New England are very largely in connection with manufacturing industries, and in some companies an electric railway load is an important feature of the motor business. The amount of steam power in small units used in New England, however, is so large, and so much of it is used inefficiently, that there is no question that a very attractive field for central-station motor service exists here. In one of the chief manufacturing cities of the New England territory the motor-connected load increased last year but 1 per cent, and there is no question that this particular central station might increase its motor load several times over with energetic cultivation of the new business field. In the New England climate a large amount of the exhaust steam is used for heating during the months from November to May, but the scattered installations of motors are attractive problems for attack on the commercial side. It is interesting to note that the motor load in some of the New England cities is greatly in excess of the lighting maximum, even during the winter months. The outlook in the motor field is unquestionably promising at this time, but it is a serious problem whether the rates charged by some of the companies are not too low, considering the increased cost of operation which public service corporations are facing all along the line.

No general discussion of the rates can be of much value to specific central station conditions, but it is worth the while of every manager who is selling energy at rates of 2 or 3 cents per hp-hour to investigate the actual cost of producing that energy, allowing as far as possible for fixed charges and administrative expenses. The cost of generation is one matter and the cost of distribution another, sometimes adding 50 per cent to the former. More definite knowledge of all the costs is highly desirable at the present time.

In physical equipments, the New England central stations are making progress, largely in the direction of enlarging the capacity of established plants with improved machinery. Worcester is installing a turbo-alternator equipment which will supersede belt-driven alternators and Brush arc machines driven from line shafting, and all the street arcs in that city are now magnetites. About 800 of these lamps are in service, with mercury-vapor converters at the station supplying direct current to the lamps at 4 amperes and from 300 to 320 watts at the lamp terminals. Fall River is also committed to the magnetite system in its street service. A new central station is practically completed at Fall River, and the new plants at Lowell and Portland are also notable additions to the modern equipment of the New England stations. Pittsfield is getting some good records in generating economy from a Diesel oil engine plant. In the hydro-electric plants of Maine, New Hampshire and Vermont, expansion of facilities is constantly necessary to meet the demands of the motor market. The single-phase motor is coming more generally into service, and it is safe to state that the suburban power problem is no longer unsolved, with this type of motor available for service at the ends of long feeders.

The tendency of generating plants to consolidate their services into 2300-volt energy supply for all their distributing lines continues to act as a standardizing force in power station design. The steam turbine has grown in favor in many of the latest installations of New England, though the reciprocating engine is far from driven from the field in established plants. In the design of a new lighting plant for steam generation, however, in New England, the use of reciprocating engines instead of turbines would be something of a surprise.

Recent changes in ownership among the New England central stations have been mainly along the lines of securing properties with the idea of improving their physical and commercial conditions to the end of bettering the earnings and profits of the companies. Among these are several suburban extensions of the Boston Edison teritory, the purchase of the Leicester, Mass., system by the Worcester Electric Light Company, the centralization of control by E. W. Clark & Company, of Philadelphia, of the Bar Harbor and Union River Power Company and the Bangor Railway & Electric Company; the sale of the Amesbury Electric Light Company to the banking house of Geo. A. Fernold & Company, of Boston; the control of the Dover and Brattleboro companies by A. H. Bickmore & Company, of New York; the sale of the Andover Electric Light Company to the Lawrence Gas Company; the change of management of the Woonsocket and Pawtucket companies to the supervision of the Stone & Webster interests; and the transfer of the Portland interests to the Seligman banking house, of New York. The Ayer, Mass., company is now controlled by the Massachusetts Lighting Companies, of Boston Practically all the commercially successful central stations of New England are now receiving careful and progressive management, and the interest displayed in the scientific administration of these properties is a certain indication of substantial progress to be expected in the coming year.

Special Lighting for Chicago Streets.

The Commonwealth Edison Company, of Chicago, has recently closed contracts whereby certain portions of Halsted and Twelfth Streets will be brilliantly illuminated. These are not down-town streets, but are important business streets on the west side, about two miles from the business district. On Halsted Street, from Taylor to Fourteenth Street, a distance of 2200 ft., this special lighting will be installed, and also from Halsted to Jefferson Street on Twelfth Street, a distance of 1400 ft. The plan is to place 300-watt enclosed carbon arc lamps operating on 110-volt, constant-potential, direct-current circuits with posts about 50 ft. apart. This matter has been handled by making contracts with individual owners at $1.35 per week per post on a two-year basis. The lamps are controlled by the company, and are to be used from dusk until 10 p. m., five nights in a week, and until midnight one night per week. The design of post to be used is shown in the accompanying engraving. The lamp globe is 10 ft. 6 ins. above the ground. On North Avenue, one of Chicago's outlying business streets on the north side, about two miles from the down-town district, special spectacular lighting has been employed on several occasions. In this case incandescent lamps are hung from the side of the street to a wire placed high above the center of the street.

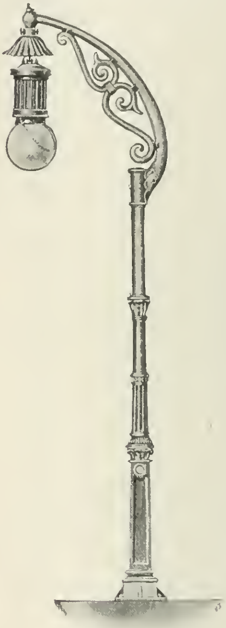
Recent Power Developments at Montpelier.

During the past few years a number of comprehensive power improvements have been under way at Montpelier, Vt., with reference to the supply of electricity in a growing territory of about 27,000 population. About six miles south of Montpelier lies the thriving city of Barre, which is the immediate center of the Vermont granite industry, and which is a large consumer of energy for lamps and motors. Montpelier, the capital of the state, is a noted business and residential center, famous as the birthplace of distinguished men, and one of the most substantial and conservative communities in New England. The supply of electricity throughout this territory is now in the hands of two companies under common management, the Consolidated Lighting Company, and the Vermont Power & Lighting Company. Messrs. Sanderson & Porter, of New York, are the consulting and constructing engineers of the companies.

The Consolidated Company has been in operation since 1885, and the Vermont Power & Lighting Company since the spring of 1907. The latter organization is the successor of the J. S. Viles Electric Light Company, and has been leased to the Consolidated Company for a term of 25 years. The officers of the Consolidated are: President, Jas. E. Davidson; vice-president, J. C. Tomlinson; treasurer, A. D. Bennett; secretary, C. S. Davidson, and superintendent, E. O. Wedge. Mr. Geo. G. Moore is president of the Vermont company, the vice-president, treasurer and superintendent being those of the Consolidated, with Mr. J. E. Davidson as secretary and general manager.

At the present time the generating plants of the companies are operated separately, but the systems are temporarily provided with a tie line on their low-tension sides, so that one can help the other in case of emergency. The transformers of the old Viles plant were wound for 15,000 volts on the line side, while those of the Consolidated system are wound for 12,000 volts. It has not been found feasible to operate these two outfits together, but it is probable that changes will sooner or later be made with the object of more closely harmonizing the operation of the generating stations. The Viles plant is not of the same modern degree of construction as the plants of the Consolidated company, and until this station is either rebuilt or superseded by a new plant on the same general site, it is a question just how much would be gained by a radical change in operating policy.

In the accompanying illustration (Fig. 1) a sketch is shown of the high-tension systems of the two companies, not drawn to scale, however. The Consolidated company operates a hydro-electric station at Bolton Falls, 18 miles down the Winooski River below Montpelier, and a reserve steam plant in the outskirts or "Pioneer" section of Montpelier. Sub-stations are located in Waterbury, Montpelier, Barre and Graniteville. From Bolton Falls to Montpelier 3 three-phase circuits of bare copper are run, the sizes of two circuits being No. 4 and the third No. 1. From Montpelier to Barre, 6 miles, a single three-phase No. 1 line is run, and from Montpelier to Graniteville, 9 miles, a No. 4 line is carried. At Graniteville are centered some 39 granite quarries, the stone sheds where the monument production takes place being mainly in Barre. The Consolidated company also serves East Barre, South Barre and Williamstown. The Vermont company has a single water-power generating plant at Middlesex, 6 miles north of Montpelier. This supplies energy to a sub-station in Montpelier by a No. 4 line, and one in Barre by a No. 1 line about 12 miles long. About 200 stone-cutting firms are in business in the vicinity of Barre, with a payroll of $285,000 per month. The power market in Barre and Graniteville calls for upwards of 5000 horse-power, with a possible maximum development of 10,000 horse-power. Independent steam plants with coal costing about $6 a ton are here displaced with electricity selling at from 4 to 2 cents per kw-hour. The total connected power load of the two companies aggregates 3300 horse-power, making 8.2 inhabitants per horse-power in the territory—an unusually high development. The growth of the Consolidated company's power business has been over 200 per cent since May 1, 1905. At that time the connected load was 758 horse-power, and it is now 2500. The company has about 800 electric flat-irons in service and six complete electric kitchens. Last winter it moved into a new office on the street level at 20 Langdon Street, near the center of the business district of Montpelier. The old office was unfavorably located with respect to the exhibition of heating appliances, cooking and sign equipment, small motors and lighting appurtenances, but the new headquarters is thoroughly modern in this respect.



CHICAGO LAMP POST.

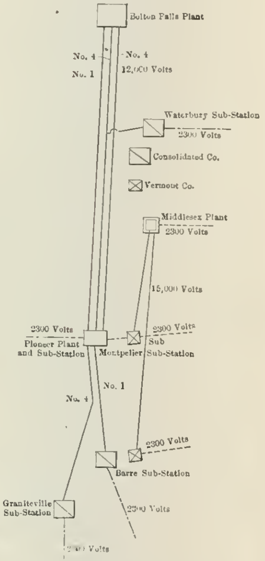


FIG. 1.—SYSTEM OF THE CONSOLIDATED LIGHTING COMPANY.

The Consolidated company has about 1321 lighting customers and a connected lighting load of 25,987 16-cp lamp equipments. The motor load is distributed among 96 motors. The maximum capacity of the Bolton Falls plant is 2300 kilowatts, and of the Pioneer steam plant 2200 kilowatts, making a total of 4500 kilowatts. The Vermont company's Middlesex plant has a maximum capacity of 1200 kilowatts, serving about 1000 lighting customers and supplying 1100 horse-power connected load.

Power is used in the quarries for the driving of air compressors, drills, operation of derricks and hoists, and the haulage of grout cars. The largest single installation in a quarry is at Websterville, in the establishment of Wetmore & Morse. This outfit uses six motors aggregating 274 horse-power, consisting of a 150-hp, three-phase, 440-volt induction motor driving a horizontal air compressor; a 55-hp hoist; a 30-hp hoist;

a 20-hp grout car motor; a 15-hp swing derrick motor and a 4-hp derrick motor.

In the stone sheds the power requirements include the driving of a considerable variety of special machinery used in the manufacture of monuments and mausoleums. The most representative installation of this kind is at the sheds of Barclay Brothers, Barre. The following data of a test made this fall upon the motors in this installation illustrates the variety of machinery driven and the power demands of the work:

MOTOR TEST, BARCLAY BROS. GRANITE SHED, BARRE, VT.

BLACKSMITH SHOP

Five-hp, 220-volt, 1200 r.p.m. induction motor, driving 4 grindstones, 4 to 5 ft. in diameter, and 5-in. face, and one 15-in. fan supplying air foi 8 forges.

	All running free	Four men grinding tools
Volts	223	226
Amps.	7	7.9
KW	1.38	1.78

TURNING DOWN ONE STONE

	Average power	Maximum power
Volts	229	221
Amps.	9.67	14.2
KW	2.62	4.55

During test none of the forges was in use.

CUTTING LATHES

7.5-hp, 220-volt, 1200 r.p.m. induction motor, driving 2 cutting lathes, 1 grindstone and 24 ft. of shafting.

ONE LATHE RUNNING WITH STONE COLUMN 22 IN. DIAMETER

	Roughing	Smooth cut ½ in. deep
Volts	216	229
Amps.	14.3	14.85
KW	3.47	3.97

BOTH LATHES RUNNING

No. 1, cutting 22-in. column; No. 2, roughing stone 16-in. diameter. Volts, 221; amps, 16.75; kw, 4.96.

SHAFT LOAD, INCLUDING GRINDSTONE

Volts, 234; amps, 11.28; kw, 2.03 (grindstone running).

CRANES

20-hp, 220-volt, 1200 r.p.m. induction motor, driving 50 ft. of shafting, and two 1000-ft. ropes from which are driven two traveling cranes. The ropes can be slipped off the shafting by means of loose pulleys.

SHAFTING LOAD

Volts, 223; amps, 23.5; kw, 3.97.

	Shipping on 1st rope	Shipping on 2d rope
Volts	205	205
Amps.	80	115
KW	25.45	37.5

BOTH CRANES IDLE, ROPES RUNNING

Volts, 215; amps, 56.5; kw, 18.1.

ONE CRANE AT WORK—12-TON LOAD

	Hoisting	Traveling
Volts	212	208
Amps.	91.8	92.2
KW	29.8	29.8

Average load for several hours was about 21 kw.

SHARPENING MACHINE

5-hp, 220-volt, 1200 r.p.m. induction motor, driving trip hammer, bucket chain, plate chain, brine pump and two small emery wheels.

ALL RUNNING EXCEPT HAMMER

Volts, 221; amps, 6.73; kw, 1.56.

ALL RUNNING

	Average power	Maximum power
Volts	221	222
Amps.	10.65	12.42
KW	3.35	3.98

POLISHING MACHINES

15-hp, 220-volt, 1200 r.p.m. induction motor driving 40 ft. of shafting and 3 polishing machines. All three machines buffing; two with 20-in. wheels, one with 6-in. wheel.

ONE LATHE, 20-IN. WHEEL

Volts, 241; amps., 21.25; kw, 5.64.

TWO MACHINES RUNNING, 20-IN. AND 6-IN. WHEELS

Volts, 241; amps., 22; kw, 6.32.

THREE MACHINES RUNNING

	Average power	Maximum power	Shafting load
Volts	231	236	236
Amps.	29.6	33.2	19
KW	10.16	11.48	66

BLOWER

5-hp, 1200 r.p.m., 220-volt, induction motor driving 72-in. blower. Pulley ratio, 3.75 to 1. Average power, volts, 221; amps., 32; kw, 10.8.

GANG SAW

20-hp, 1200 r.p.m., 220-volt, induction motor driving 1 gang saw, 1 polishing machine and 70 ft. of shafting. Gang saw making 5 cuts through a stone 8.5 ft. long and polishing machine was buffing with 20-in. wheel.

SAW ALONE RUNNING

Volts, 260; amps, 43.9; kw, 16.78.

SAW AND POLISHING MACHINE RUNNING

	Average power	Maximum power	Shafting load
Volts	236	262	260
Amps.	54.9	59.3	25
KW	21.6	23.95	4.9

60-LB. AIR COMPRESSOR (Drives 40 pneumatic tools)

35-hp, 900 r.p.m., 220-volt induction motor driving a 12-in. by 14-in. air compressor, double-acting, 60-lb. pressure, 141 r.p.m.

	Intake closed	Full load
Volts	225	225
Amps.	62.2	85.9
KW	20.2	27.5

90-LB. AIR COMPRESSOR

50-hp, 900 r.p.m., 220-volt induction motor driving one 90-lb. compressor, 12 in. by 14 in., double-acting, 143 r.p.m.

	Intake closed	Full load
Volts	208	223
Amps.	59.5	118
KW	15.2	39.3

This compressor is used with two surfacers, two plug drills and one pneumatic polishing machine. Motor ran 66 per cent of the time fully loaded.

POLISHING LATHES

10-hp, 1200 r.p.m., 220-volt induction motor driving one double-header polishing lathe, one single-header polishing lathe, one 12-in. buzz saw and 60 ft. of shafting.

DOUBLE-HEADER RUNNING WITH 22-IN. COLUMN OF STONE

Volts, 226; amps., 17.64; kw, 5.63.

	Shafting load
Volts	224
Amps.	10.7
KW	4.6

DOUBLE-HEADER AND SAW RUNNING; SAW NOT IN USE

Volts, 226; amps., 19; kw, 6.35.

During the month of August the total power consumption of this shed was 15,020 kw-hours. The blower motor was a temporary installation, to be replaced by a larger one.

The above installation is supplied with power through three 40-kw, 1200 to 220-volt transformers.

The Bolton Falls plant is located in a rocky gorge of the Winooski River in the heart of the Green Mountain range and near Camel's Hump Mountain. The river is dammed at this point and below the dam it widens into a broad channel. The original development was about nine years ago, in the shape of a timber cribbed dam 48 ft. high, with stone filling. This was reconstructed a few years ago by building a coffer dam across the river about on a line with the draft tubes of the waterwheels in the power station. The water was pumped out and all loose material removed to the ledge. Channels were cut to prevent sliding on the bottom and shore ends, and a masonry dam was constructed below and against the timber work, bonding the masonry into the cribbing. In this reconstruction of the dam no apron could be used without closing the tail race. As a result, the water had a sheer fall of 50 ft. into the channel forming the tail race. The stone dam was not designed to withstand a static pressure of 50 ft. head, but was built with openings to relieve it. The up-stream slope of the dam was reinforced in the second construction by additional planking

The present development, which is illustrated in the accompanying drawing, consists of a solid masonry dam 60 ft. high and 200 ft. wide, with a capacity of 3000 horse-power. The drainage area is well timbered, with much swamp and pond surface, tending to equalize and improve the flow of the river. The Consolidated Company owns the water rights in perpetuity. The first installation required a power house 135 ft. long by 25 ft. wide, with masonry foundations, brick walls, and a timber-trussed and sheeted roof. There were two 450 kilowatt units in this layout. Water was supplied to the wheels by a penstock passing from a forebay through a masonry bulkhead wall, the gates and rocks being located on the river side of the forebay. Two pairs of 27-in. Hercules wheels were installed, each pair being direct-connected to a 450-kw, 12,000-volt, three-phase, 60-cycle General Electric revolving-field alternator, making 360 r. p. m. normal speed. Two Lombard governors and two exciters were provided. The latter machines consist of a 25-kw belted unit and a 20-kw, direct-connected, 125-volt outfit. The switchboard for these two machines contained five panels, two for each generator, two line service panels and one exciter panel. The station building was located below and at right angles to the bulkhead wall. The draft tubes of the first two sets of wheels pass diagonally through the foundation walls of the building into the tail race pits, which are excavated out of the solid rock, and are just below the overfall of the dam.

Increased capacity was evidently essential at this plant in

1906, and a careful study of the flowage of the river was made to determine the capacity which could be secured. It was assumed that the daily flowage for 1904 was a fair average of the hydraulic conditions. It was found that 1200-kw unit could be operated simultaneously with the original equipment 123 days per year on the 1904 flowage curve and 156 days at the 1905 rate. The following table gives the maximum and minimum flowage of the Winooski River at Bolton Falls during eight months of 1904. The drainage area is 796 sq. miles.

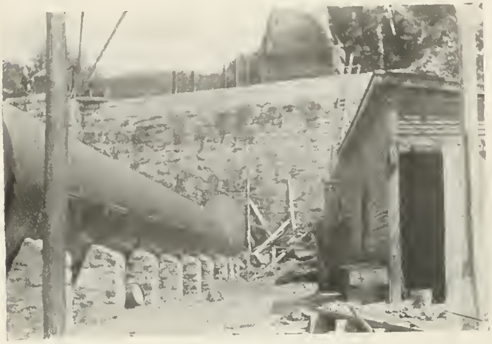


FIG. 2.—11-FT. PENSTO

	Cu. Ft. per Second. Max.	Min.
1904.		
April	5900	1700
May	6600	1000
June	1100	200
July	800	160
August	2500	170
September	2600	170
October	6900	665
November	1000	350

Full load upon three units (figuring the new machine at 1000 kilowatts) calls for 665 cu. ft. per second. The available head at the Bolton Fall plant is 51 ft. with flashboards, and 48 ft. without them.

To house the 1200-kw unit, the station building was extended about 50 ft. at an angle of about 50 degrees from the longitudinal axis of the original plant. A new penstock 11 ft. in diameter was installed on granite saddles parallel to the original penstock, and a 2200-hp, 277-r. p. m., 39-in. Allis-Chalmers horizontal twin turbine erected in June, 1907. This was direct-connected to a General Electric 12,000-volt alternator, and to handle the discharge water a 7 ft. 11 in. draft tube was installed, with an offset 8 ft. 5½ ins. maximum diameter, discharging into the tail race, as illustrated, 14 ft. from the vertical center line of the turbine. This tube is of 5/16 in. steel plate and is surrounded by concrete beyond the wheel pit. The power house addition is 38 ft. 4 ins. wide outside and is served by a 10-ton hand-power crane of 34 ft. 4 ins. span, carried on 50-lb. rails resting on 15-in. I beams. The addition is 28 ft. high from the floor to the bottom of the roof truss. A test of the generator showed a full load commercial efficiency of 95.37 per cent; three-quarters load, 94.3 per cent; half load, 92.10 per cent. The regulation was 4 per cent at full load and 100 per cent power-factor. The governor characteristic is as follows:

Load Variation.	Speed Variation.	Time, Secs.
25 per cent	2 per cent	1.5
50 "	4 "	2.
75 "	6 "	2.5
100 "	8 "	3.

A 30-kw direct-coupled exciter, wound for 125 volts, was installed with the 1200-kw unit at one end of the shaft.

The wiring and switchboard arrangement at Bolton Falls are shown in the accompanying sketch and cross-section. Flexibility of operation is here secured without sacrifice of space. Two sets of high-tension bus-bars are provided. Each generator circuit is provided with an automatic oil switch. Beyond this switch, the generator loads connect with selector switches by which each unit can be thrown upon either set of bus-bars. The two bus-bar sets can be tied together with an automatic bus junction oil switch. The outgoing feeder circuits are each provided with selector switches connecting with the two sets of busses, and in each outgoing line is an automatic oil switch to protect the station against external overloads. The switchboard is 15 ft. 6 ins. long over all, containing two exciter, three generator, one bus junction and three line panels. Two sets of exciter bus-bars are provided, and watt-hour meters are inserted in each generator and feeder circuit. Field rheostats are mounted in the basement, and the oil switches are mounted in concrete compartments installed 4 ft. behind the operating switchboard. The

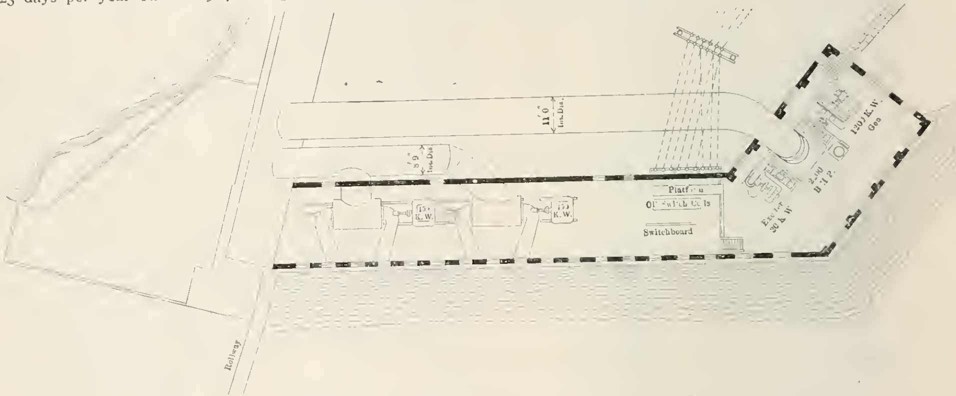


FIG. 3.—HYDRAULIC DEVELOPMENT AT BOLTON FALLS, VT.

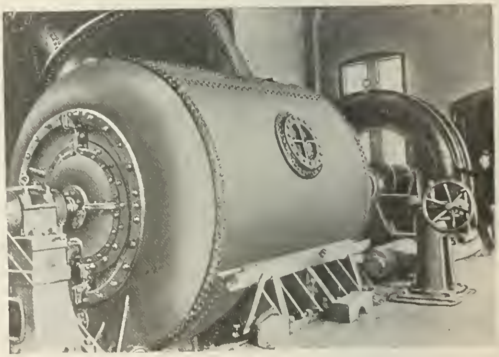


FIG. 4.—1200-KW WATER-WHEEL AND GENERATOR.

bus-bars are carried horizontally on insulators supported on a pipe frame 9 ft. 6 ins. above the floor. The selector switches are all of the knife-blade type, and these are mounted between insulating barriers supported just below the bus-bars on the pipe framing. The lightning arrester equipment is installed on the wall, well away from the bus-bars, and it is accessible by means of a special platform supported on the bus-bar framework. The outgoing circuits pass through porcelain and rubber bushings centered between two glass plates set in a wooden casing with cement. Angle-iron brackets fastened to the outside wall with lag bolts carry 6 in. x 8 in. cross-arms upon which the line insulators are supported, the inside insulators being mounted upside down on similar cross-arms bolted with angle irons to the roof-truss members. The lightning arrester, No. 4-0, ground is carried through the brick wall in a porcelain tube connected with the penstock by a brass plug.

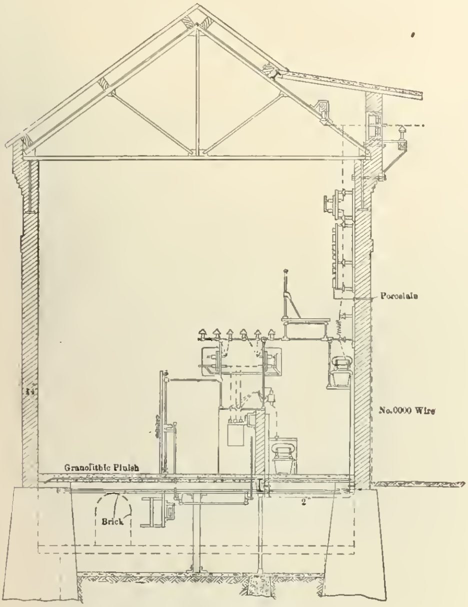


FIG. 5.—SWITCHBOARD LAYOUT, BOLTON FALLS.

A typical daily load curve of the Bolton Falls plant is reproduced herewith, the size of the log sheet being 12 ins. x 14⅜ ins. The total output for the day shown, Nov. 19, 1907, was 26,000 kw-hours, making an average load of 1082 kilowatts. The maximum load was 2050 kilowatts from 7 to 11:45 a. m.; the load-factor expressed by the ratio of average load to maximum load ran about 98 per cent, and from 1 to 3 p. m. the output was about 100 per cent of the maximum. The load at the granite quarries and sheds, 25 to 30 miles distant, is exceedingly even during the day. The lighting load, from 5 to 7 p. m., reached its maximum in time to bring the total plant load to 700 kilowatts, or but one-third the maximum during the day. The street lighting load of the company includes 105 arcs at 7.5 amperes in Montpelier; in Barre, 110 6.6 ampere arcs, and 275 series incandescents in the small towns.

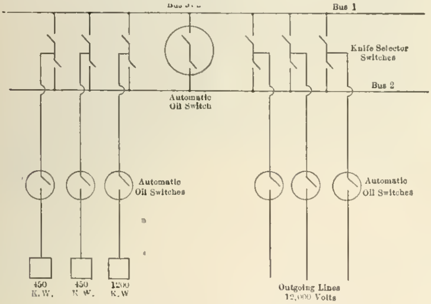


FIG. 6,—BOLTON FALLS WIRING SCHEME.

The Pioneer steam plant at Montpelier is a steel-frame and brick structure about 80 ft. x 60 ft. It was started about four years ago, and is located on the banks of the Winooski 1.5 miles south of the center of the city. Except at times of low water the station is not operated unless an emergency arises, but one or more attendants are constantly on duty. This plant is the Consolidated sub-station for Montpelier distribution. It contains one 400-hp and two 300-hp Stirling boilers, and 1500 kilowatts in generating units. One unit is a 500-kw, 12,000-volt, three-phase alternator of General Electric make, direct-driven by a cross-compound horizontal McIntosh & Seymour engine; and the other, a 1000-kw, 1800-r. p. m., 2300-volt Westinghouse-Parsons turbine. The operating steam pressure is 150 lbs. without superheat. A Wheeler condenser is used in connection with the turbine, and a Bulkley barometric condenser on the engine exhaust. There is a 25-kw exciter, 125 volts, belted to the engine flywheel, and also a 40-kw motor-generator exciter set. The boilers discharge into a horizontal smoke flue leading into a brick stack 125 ft. high and 6 ft. inside diameter. The boilers deliver steam through 8-in. risers to a 10-in. header running lengthwise of the room, the engine and turbine being supplied

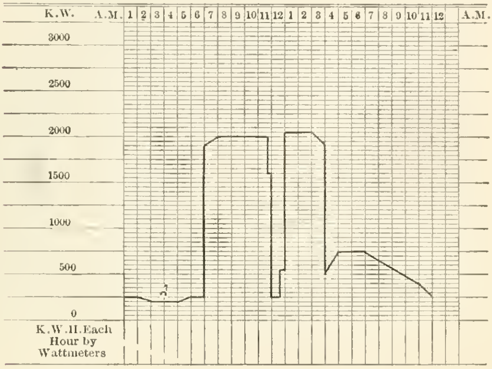


FIG. 7.—TYPICAL DAILY LOAD CURVE.

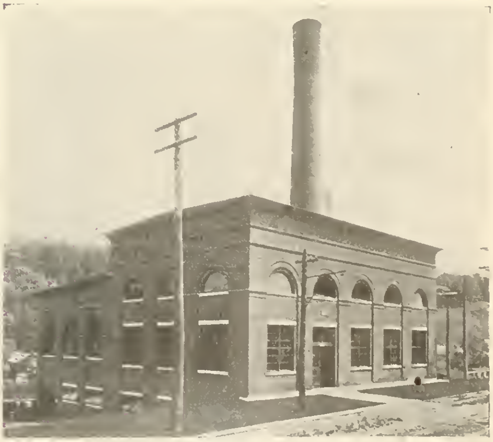


FIG. 8.—STEAM POWER PLANT, MONTPELIER.

with steam in the usual manner. A cross-section through engine and boiler rooms is shown, but the 750-kw turbine indicated has been replaced by the 1000-kw machine before mentioned.

The Barre & Montpelier Traction Company's 6-mile line between the two cities named is operated by energy from the Consolidated Company's plants. A 150-kw motor-generator set wound for 600 volts on the direct-current side is installed at the Pioneer plant for this purpose. The motor-generator is started in the morning by direct current from a storage battery located in the car house of the railway company. The transformer equipment at the Pioneer plant includes three 375-kw, 12,000 to 2300-volt Westinghouse oil-cooled units, six 100-kw air-blast General Electric, and two 150-lamp constant-current transformers. These are so connected that the turbine can supply energy to the local 2300-volt Montpelier load and the railway motor-generator direct, and so that the engine unit can feed energy to the 12,000-volt lines in times of low water. The 375-kw units can be used to help out any sub-station as portable spare units in case of a serious brakedown. The following table gives the results of an economy test on the 1000-kw steam turbine:

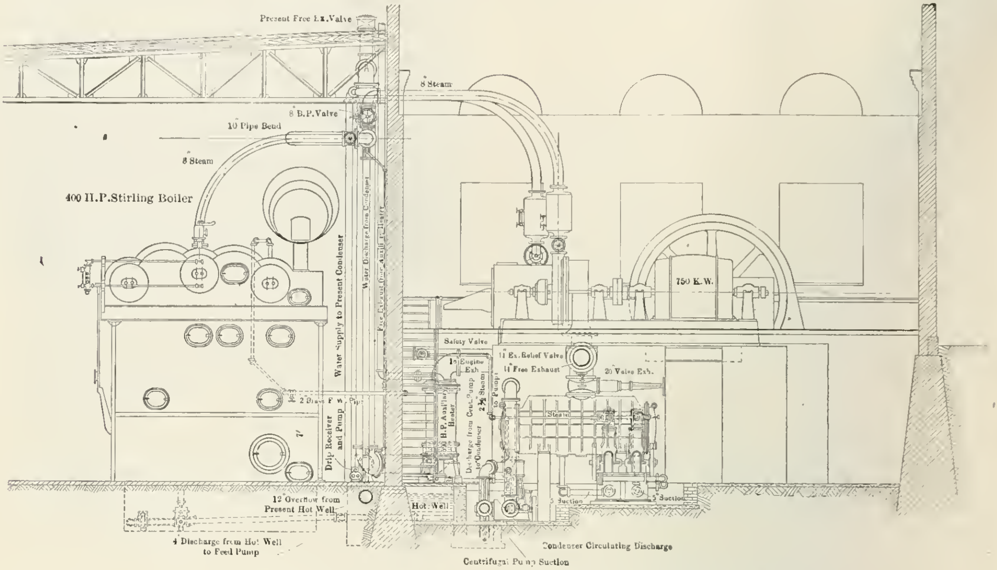


FIG. 9.—CROSS SECTION THROUGH ENGINE AND BOILER ROOMS OF PIONEER STEAM PLANT.

B. H. P.	Lbs. steam per hp-hour.
800	16.6
900	16.1
1000	15.8
1100	15.5
1200	15.25
1300	15.0
1400	14.9
1500	14.75
1600	14.7
1700	14.8
1800	15.1
1900	15.5
2000	16.0
2100	16.5
2200	17.0

Whaley & Company, of Boston, were the engineers for the Pioneer plant.

The equipment of transformers in the sub-stations of the Consolidated and Vermont systems is as follows:

Sub-station	Number.	Kw.	Company.
Waterbury	2	50	Consolidated
Montpelier	6	100	"
"	3	375	"
"	4	125	Vermont
Barre	3	200	"
"	2	250	"
"	6	200	Consolidated
"	2	300	"
Graniteville	6	100	"

Distribution from all these sub-stations is at 2300 volts, three and single-phase. A cross-section of the Consolidated substation in Barre is shown, with the spacing and general arrangement of transformers and high-tension wiring. Incoming high-tension circuits are carried through the sub-station on bus-bars 18 ft. above the floor, and taps are brought downward from these through knife switches to the transformers on the floor level. The 2300-volt secondary lines are carried to the constant-current transformers and to the outgoing distribution circuits well cleared from the high-tension leads.

The Vermont Company's plant, at Middlesex, operates on 50-ft. head, and has a drainage area estimated at 500 sq. miles. The ultimate development is about 4000 horse-power. The equipment of this station consists of three water-wheels built by the Platt Iron Works, and aggregating 2400 horse-power; these drive two Stanley 600-kw, 2300-volt alternators and a Westinghouse 350-kw generator. Seven step-up transformers, aggregating 1550 kilowatts, raise the voltage to 15,000 for transmission over a 50-ft. right of way to Montpelier and Barre. This plant also has a 450-hp steam auxiliary generating unit, and a 200-kw spare transformer.

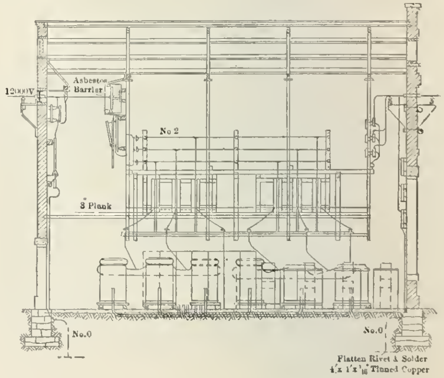


FIG. 10.—SUB-STATION AT BARRE, VT.

The transmission lines are carried on cedar poles from 35 ft. to 50 ft. in height, with 100-ft. spans. Locke glass insulators are used, and the wire spacing was 14 ins. The transposition scheme used is illustrated in the accompanying sketch, the insulators being fastened to the upper or lower side of the cross-arms as conditions require. Acknowledgments are due to the management of the Consolidated and Vermont Companies for many courtesies extended in connection with this article.

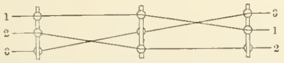


FIG. 11.—TRANSPOSITION SCHEME.

The Law of Electric Light Companies.

By John E. Brady.

ONE of the earliest questions propounded to the courts in regard to electrical companies was whether or not such companies could be regarded as manufacturing industries within the meaning of various state statutes. And a satisfactory answer to the question was made none the less easy to render by the fact that the courts were more or less at sea as to the real nature of what they referred to as the "mysterious force." A certain frankness pervades the opinions of the judiciary given in cases involving electrical questions. In one English case where the right to use the word "Electric" as a trade-mark was at issue the following confession of lack of knowledge is found: "'Electric' suggests a meaning. I do not mean to say that it has a meaning. The more one knows of electricity, perhaps, the less meaning it has. . . . The act of Parliament (relative to a trade-mark) is for an ordinary Englishman. What does the ordinary Englishman know of 'Electric' as applied to velveteen? He knows what 'Electric' is more or less, perhaps rather less than more, and he associates it with electricity. The word is obviously not meaningless, and is not in my judgment a meaningless word." In re Van Duzer's Trade-Mark, 34 Ch. Div. 623.

In the state of Colorado it has been decided that an electric lighting company is a manufacturing company within the meaning of a provision of the Constitution of that state, which bestowed upon manufacturing corporations the right to acquire property by the exercise of the power of eminent domain. Lambarn vs. Bell, 18 Colo. 346. The section of the Constitution referred to provided that property might be taken by eminent domain for "mining, milling, domestic or sanitary purposes." In this case in passing on the question the court said: "While from its derivation the primary meaning of the word 'manufacture' is making with the hand, this definition is too narrow for present use. Its meaning has expanded as workmanship and art have advanced; so that now nearly all artificial products of human industry, nearly all such products as have acquired changed conditions or new and specific combinations, whether from the direct action of the human hand, from chemical processes devised and directed by human skill, or by employment of machinery, which, after all, is but a higher form of the simple implements with which the human hand fashioned its creations in ruder ages, are now commonly designated as manufactured."

An Alabama statute provided that "any two or more mining, quarrying or manufacturing corporations may unite or consolidate their capital stock, property and business." The question was brought up whether electric light companies were manufacturing corporations so as to be entitled, under the statute, to consolidate. The case was that of Beggs vs. Edison Electric Illuminating Company, 96 Ala. 295, and it was held that the statute was intended to cover such companies. In reaching this conclusion, the producing of electricity was compared to the manufacture of gas for illuminating purposes, and Stone, C. J., who delivered the opinion of the court said: "When it is attempted to establish the proposition that the gas which lights one room is a manufactured product, and the electricity which lights another room is not, one is obliged to rely more on the definition of terms and the distinctions of scientists than on the actual, practical processes and productions, by means of which results in all respects, or at least substantially, the same are produced. When we take into consideration that the electricity now used and supplied in the ordinary business of life is essentially the product of skill and labor, we can find no difficulty in reaching the conclusion that a corporation engaged in generating, storing, transmitting, and selling such electricity is a manufacturing corporation." And further, "the electricity that exists in nature is of a very different quality than that produced by means of machinery. The mysterious power generated by machinery is transmitted and lights streets and private houses. The electric current that brings about these results cannot be said to be 'the free gift of nature, gathered from the air or the clouds.' It is the production of capital and labor, and in this respect cannot be distinguished from ordinary manufacturing operations. The collection, storage, preparation for market, and the transportation of ice, is not manufacturing; but the production of ice by artificial means is." People vs. Knickerbocker Ice Co., 99 N. Y. 181. As well say that a gas company, organized under the corporation laws, is not a manufacturing corporation because both gas and the electricity generated are the result of artifice."

In New York it has been held that an electric company was exempt from taxation under a statute exempting manufacturing corporations from the payment of taxes. People vs. Wemple, 129 N. Y. 543. The effect of this decision, however, has since been nullified by statute. A different result has been reached by the courts of Maryland, where it was decided that an electric light company could not claim the benefit of a statute exempting manufacturing corporations from taxation. In the case of the Frederick Electric Light Co. vs. Frederick City (84 Md. 599), the Court of Appeals did not deem it necessary to attempt a scientific discussion of what electricity is, and placed no reliance upon encyclopædias, dictionaries or other books attempting to define it. The court proceeded upon the theory that the ordinance at issue was passed for the purpose of encouraging the establishment and development of manufactures and manufacturing industries and decided that the electric light company did not come within the meaning of the ordinance. The ordinance was held to refer only to such companies as manufactured articles for sale and which might, from a very small beginning, develop into a very large concern, resulting in great benefit to the community, through the extensive employment of labor and the distribution of considerable sums of money. A company organized to manufacture armatures, lamps or other electrical appliances, it is said, might fall within the purview of the exemption, but as the plant of the electric light company was one which could be operated by a few men, it was held not to be entitled to the exemption.

A Pennsylvania statute (Sec. 20, Act of June 30, 1885), provided for the exemption from taxation of the capital stock of manufacturing corporations, not engaged in the manufacture of liquors or of gas. The Northern Electric Light & Power Company, which was engaged in the business of furnishing electric energy to consumers for private use, claimed to be thereby exempted from tax. In deciding the question whether the electric light company was a manufacturing industry, the following facts were found by the court: "The electricity which furnishes the light does not exist until the armature revolves. The revolution of the armature brings into being something that did not exist before; that is, this electric energy or energy in this electrical form. But its source, in the philosophic sense, is the latent energy of the coal. If the coal is not burned, we cannot have the engine move, nor the dynamo, and, therefore, we cannot get the electricity; and the electricity is derived, as its prime origin, from the coal, but not, however, extracted from the coal. It was not there, but created by utilizing the latent energy of the coal." It was held, nevertheless, that the electric light company was not a manufacturing concern, such as was intended for exemption by the statute. The apparent object of the statute was to coax manufacturing corporations within the boundaries of the state, and one reason given for not including electric light companies within the general invitation implied in the statute was that exempting them from taxation would probably not bring capital into the state, and taxing them would certainly not drive it out. It was ingeniously argued in behalf of the company, that, if it was not engaged in the "manufacture of electricity," it could not be denied that it was engaged in the "manufacture" of light. But the court, after citing authority to the effect that light is not a substance, concluded that light could not be the subject of manufacture. "It might, with the same reason, be claimed," said the court "that, in the use of the telephone, sound is manufactured, as that, in the use of electric lighting apparatus, there is a manufacture of light." With reference to electricity, as a manufactured commodity, it was said: "Whatever electricity may be, it seems to be absolutely within the power, and under the control of the company that brings it into being. Its manifestations are both seen and felt. It moves with incredible velocity and power. It carries the tones and inflections of the human voice, or moves loaded cars. It may be in the hands of a physician a soothing remedial agent, and, in the hands of the law, an instrument of execution, swifter and surer than the headsman's axe. It may be too early (1891) to say just what it is." Commonwealth vs. Northern Electric Light & Power Company, 145 Penn. St. 105.

REGULATION AND CONTROL.

The regulation and control of electric lighting companies, in respect to their use of the streets, is generally delegated by the state to the municipal corporations within its borders. Such companies are always subject to reasonable regulations by the proper authority. Thus they have been compelled to transfer their wires from poles to conduits, and to supply electric energy to premises within a certain distance of their wires.

The question of the validity of section 58, chapter 405, Laws of New York, 1899, which authorized the city of Geneva to require electric wires to be removed from poles and placed in conduits, came up in the case of City of Geneva vs. Geneva Telephone Company, 62 N. Y. Supp. 172. Under the statute mentioned, the board of public works had passed a resolution directing various electrical companies to place their wires in conduits constructed by the city, and the defendant company refused on the ground that the high-tension wires, which were also ordered into the conduits, would impair the operation of the defendant company's system. The statute was attacked by the counsel for the company on the theory that it was unconstitutional in that it resulted in depriving the company of its property without due process of law. On the trial it was shown that the city had constructed suitable six and nine-duct conduits, with manholes, laterals and distributing points, and that the change would not impair the defendant company's service. And it was held that the right to order the removal was within the police power of the state, which power the state had, in this instance, delegated to the municipality. It is generally the police power which the governing body invokes when it desires to compel electrical or other companies to change the established order of things. This power is incapable of exact definition, but its existence is essential to every well-ordered government. By the exercise of it the legislature maintains a supervision over matters involving the common weal, and enforces the observance by each individual member of society of the duties which he owes to others and to the community at large. It may be exercised whenever necessary to secure the good order or the general welfare of the community; and the propriety of its invocation within constitutional limits is purely a matter of legislative discretion, with which the courts cannot interfere. The rule is that where one devotes his property to a use in which the public has an interest, he must submit to be controlled by the public for the common good to the extent of the interest he has thus created. The public is interested in the safe and proper construction and maintenance of electric wires, and hence the Legislature may make rules and regulations for their proper management and operation.

While electric lighting companies may be required by statute to furnish energy to any premises within a certain distance of their wires, or to forfeit a penalty to the aggrieved party for a failure to do so, a statute, so providing, will always be construed, so far as is possible, in favor of the company. The Laws of New York, 1890, chapter 566, section 65, provided that an occupant of premises located within 100 ft. of the wires of any electric light company might require the company to supply him with energy, and established a penalty for a failure on the part of the company to act within ten days. An action was brought against the Champlain Electric Company to recover the penalty made by the statute by one whose property was within 100 ft. of a wire of the company which carried electricity for street lighting purposes only, and which could not be used for the purpose of supplying electricity for the lighting of houses or other domestic purposes. The nearest wire of the company from which the party could have been supplied with electric energy was about 1700 ft. distant from his premises. It was held in this case that the statute was for the benefit of persons whose premises were within 100 ft. of wires of the company, from which the energy required could be supplied, and that the penalty could not be collected. Moore vs. Champlain Electric Company, 85 N. Y. Supp. 37.

In another case, involving the same legislative enactment, the person desirous of being accommodated with electric energy informed the company by letter that if he did not hear from the office thereof with reference to his request within 48 hours he would start suit. To this he received the following terse reply: "If you wish to do business with us, you know where our office is." He then made a formal request, referring in his letter to the statute, but he did not state how many lamps he wished, and he failed to respond to the company's subsequent letter of inquiry as to how much energy and how many lamps were required. On the trial of the action brought for the penalty it was held that the company was entitled to know what amount of energy and how many lamps were wanted and that, not having been furnished with that information, the company could not be held for the penalty. Andrews vs. North River Electric Light & Power Company, 53 N. Y. Supp. 810.

In the case of Electric Improvement Company vs. City of San Francisco, 45 Fed. Rep. 593, it was held that the city authorities, by virtue of the police power, could enact and enforce an ordinance prohibiting electric companies from stretching wires over and upon the roofs of buildings. The court, having reference to the ordinance which contained the prohibition, in a statement which now suggests the recent conflagration in San Francisco, said: "I do not think that it violates any provision of the National Constitution. I regret to be obliged, by this decision, to affect so seriously the interests of the enterprising parties who are endeavoring to supply our citizens with electricity for the various purposes to which it is now applied. But I cannot decline to administer the law as I find it, for the safety and security of the lives and property of the citizens of San Francisco."

It cannot now be questioned that municipal corporations may make all reasonable regulations for the location and use of electric wires in their streets, and require all reasonable safeguards for the protection of the general public; and, in pursuance of this power, municipal governing bodies may require electric lighting companies to put up guard wires at certain specified places. Wisconsin Telegraph Company vs. Janesville, 87 Wis. 73. In Monongahela Electric Light Company vs. Monongahela, 12 Pa. County Ct. Rep. 529, it was decided that the City Council had the right to require an electric light company to change the location of its poles, although the poles had been located where they were by permission of the city under a legislative grant. The change in the location of the poles was made necessary by the widening of the street along which they were erected. It was held that the City Council could not grant a privilege that would in any way curtail the city's power to make future necessary improvements in the streets. It was said by the court: "To say that because the city had directed the poles, when first erected, to be placed on a certain line, it could never direct their location changed, in order to improve a street, according to a plan duly agreed upon for the public convenience, would be to say that, where a local private corporation once placed its poles upon a street under a legislative grant, the street could never be improved so as to require a change of the location of these poles."

CONSTRUCTION OF CHARTER.

The charter of a company engaged in the manufacture or sale of electricity for lighting will be strictly construed against the incorporators in reference to the powers secured to the company by the charter, the exclusiveness and the perpetuity of the franchise, and the performance of the conditions upon which the privilege is conferred. 15 Cyc. 467; Empire City Subway Company vs. Broadway Company, 33 N. Y. Supp. 1055; Scranton Electric Light Company vs. Scranton Illuminating Company, 3 Pa. County Ct. 628—both cases holding that the rule that the grant of a franchise will be construed rigidly against its supposed exclusiveness applies to companies engaged in the manufacture or sale of electricity with the same force as to other corporations. It has been held that a company organized before electricity was generally used for lighting will not be regarded as possessing the power of furnishing light by this means, even though the words used in the articles of incorporation are broad enough to be construed otherwise, had this method of lighting been in common use at the time of the granting of the charter. Carthage vs. Carthage Light Company, 97 Mo. App. 20. In the case cited the city of Carthage, by an act of the Legislature of that state, passed in 1875, was authorized to provide for lighting its streets, either by erecting a plant itself, or by granting to some one else the right to do so. The Kansas City Court of Appeals decided that the city did not thereby gain the right of granting a franchise to a company organized to supply electric light, the reason being, as stated, that the Legislature could not have contemplated the granting of such a power, as street illumination by electricity was not regarded as a feasible plan at the time the statute was enacted. In Brush Electric Light Company vs. Jones Brothers Electric Company, 10 Ohio Dec. (Reprint) 767, it was held that the authority to engage in the business of electrical illumination must be clear and explicit, and will not be implied from authority in the charter of a company to manufacture and operate dynamos, motors and other electrical appliances, or to manufacture, buy and sell telegraph and electrical appliances and engage in "general light manufacturing."

If certain acts, or the compliance with certain conditions, are made necessary for the acquirement of the privileges secured to an electric light company by its charter, then the company must fully perform the conditions imposed before claiming the benefits of its franchise. The ordinance by which the city of Philadelphia authorized the Kensington Electric Company to occupy the streets of the city for the erection of its poles, and to pursue the business of supplying electricity, required the company, as a condition to the enjoyment of the privileges conferred, to supply electric light to all public buildings within a certain territory used as police and fire stations, without charge to the city. At the time of the adoption of the ordinance there were three buildings within the territory used as police and fire stations. Shortly thereafter a new building was erected to take the place of one of the old ones. The city requested the company to wire and light the new building, but the company refused to comply, claiming that it was required by the ordinance to light only such buildings as were used at the time of the enactment of the ordinance for police and fire stations. The ordinance was construed against the company, and held to apply to all city buildings used as such stations, whether erected before the passage of the ordinance or after; and it was also held that the city officers might refuse to sign the orders necessary to enable the electric light company to obtain warrants for the bills for lighting the streets of the city, in accordance with the contract between the city and the company, until the company should comply with the provisions of the ordinance, as construed by the court. Kensington Electric Company vs. City of Philadelphia, 41 Atl. Rep. 309.

Direct-Current Motors, Their Action and Control—III.

By F. B. Crocker and M. Arendt.

SHUNT MOTOR STARTING BOXES.

In starting shunt and compound-wound motors, no trouble is likely to occur in connecting the field coils to the circuit because their resistance is high. The difficulty is with the armature, its resistance being very low in order to obtain high efficiency and good speed regulation, as already shown. If a low resistance winding be directly connected across the line terminals, the "inrush current" would be so excessive that it would tend to injure or destroy it. When standing still an armature generates no c. e. m. f. so that the entire voltage must be consumed in the armature resistance $(I_aR_a + D_b)$. To prevent this injury and at the same time to obtain gradual acceleration, an adjustable rheostat commonly called a "starting box," is inserted in series with the armature, the resistance of which is gradually reduced as the speed increases. As a rule, starting

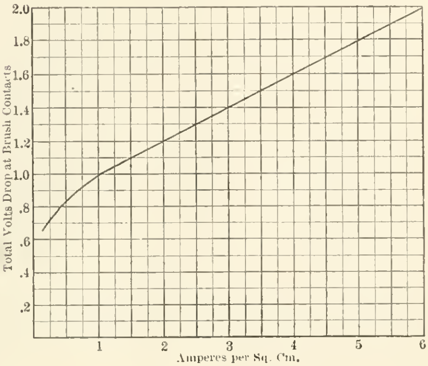


FIG. 1.—VOLTAGE DROPS AT CONTACTS FOR CARBON BRUSHES.

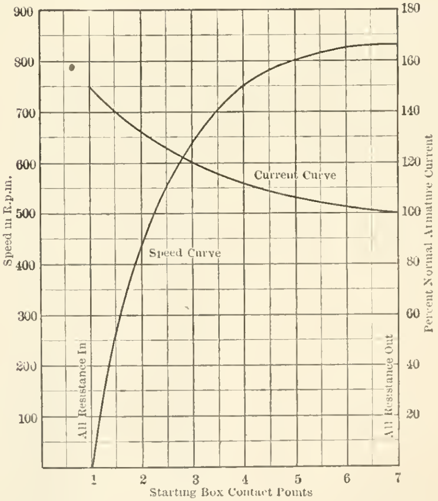


FIG. 2.—SPEED AND CURRENT STARTING-BOX CURVES.

boxes, unless otherwise specified, are designed to allow the motor to draw an initial current about 50 per cent greater than the normal value, so that the machine may develop ample torque to start under load. The following example indicates the method of determining the various values of the resistance required in the starting box. Assume that the 10-hp motor, the data of which have been given, is to be started from rest under load, that the current and "speeding up" curves desired are those shown in Fig. 2. The current curve gives the current values desired at the various positions of the contact arm of the starting box, seven in all, decreasing gradually from 50 per cent above normal at start to rated current at rated speed. The speeds at the corresponding points are obtained from the speed curve in Fig. 2. These values, obtained from the curves, are tabulated as follows:

STARTING 10-HP MOTOR UNDER LOAD.

Position of Contact Arm.	Armature Current Per Cent of Rated Value.	Armature Amperes.	Speed in R. p. m.
1 All resistance in	150	55.5	0
2	133	49.3	450
3	120	44.5	640
4	112	41.7	750
5	106	39.5	800
6	102	37.75	820
7 All resistance out.	100	37.00	825

The motor speeds at the various contact points being assumed as above, the c. e. m. f. corresponding to these speeds can be readily determined by substituting them in equation VIII. Knowing the c. e. m. f. and taking the corresponding values of armature drop, also the brush contact drop from the curve in Fig. 1, the voltage drop (I_aR_x) in the external resistance R_x can be calculated from the following equation giving the relation between action and reaction in the armature circuit of a direct-current shunt motor:

$$V = \text{c. e. m. f.} + I_aR_a + D_b + I_aR_x \qquad \text{(IX)}$$

V volts.	$\frac{\text{R. p. m.}x}{\text{R. p. m.}r}$ c. e. m. f.r c.e.m.f.x volts	Armature drop. Ia Ra. volts.	Brush drop. Db volts	External drop. Ia Rx. volts.	External resistance Rx ohms.	Starting Box. Position of Arm
230	$\frac{0}{825}218.2 = 0$	55.5 × .281 = 15.6	1.71	212.7	3.83	1
230	$\frac{450}{825}218.2 = 119$	49.3 × .281 = 13.8	1.60	95.6	1.94	2
230	$\frac{640}{825}218.2 = 169$	44.5 × .281 = 12.2	1.50	47.3	1.06	3
230	$\frac{750}{825}218.2 = 198.5$	41.7 × .281 = 11.7	1.45	18.35	.44	4
230	$\frac{800}{825}218.2 = 212$	39.5 × .281 = 11.1	1.43	5.50	.14	5
230	$\frac{820}{825}218.2 = 217$	37.75 × .281 = 10.6	1.41	1.00	.027	6
230	$\frac{825}{825}218.2 = 218.2$	37 × .281 = 10.4	1.40	0	0	7

Motor starting boxes are not designed with large radiating surfaces, because the box is supposed to be in use only for very short periods (15 to 30 seconds at one time). The chief precaution is to have the resistor units of such current-carrying capacity that they do not become injured by a momentary overload current of 50 per cent above the rated value. Practically the box should be designed to act a certain number of times per hour, without injury. If the contact arm of the starting box is moved too rapidly over the resistor points, the armature current would be excessive and injury might result, hence the starting period of 15 to 30 seconds as stated.

In case a motor is to be started without load, the starting resistances calculated before would not bring up the speed gradually, because the initial I'_aR_x drop would be only 3.83 × 2.3 or 8.8 volts, so that the c. e. m. f. with total box resistance in circuit and at no load current, would be 230 — 10.2 = 219.8 volts and the corresponding motor speed would be (219.8 ÷ 218.2) 825 = 832 r. p. m. Hence the motor would almost instantly run at a speed greater than at rated load. For this reason, to start a motor without load, it is sometimes the practice, especially in Europe, to use a special box, the resistance of which is much higher than in the preceding design. For instance, if it were desired to have the "speeding up" curve at no load of the same shape and corresponding values as that in Fig. 2, the required external resistance would be those given in the accompanying tables.

R. p. m. at no load.	Armature Current amperes.	C. e. m. f.x = $\frac{\text{R. p. m.}x}{\text{R. p. m.}r}$ c. e. m. f.r volts.	Armature Drop I'a Ra. volts.	Brush Drop D'b. Volts	External Drop I'a Rx. Volts.	External Resistance Rx. Ohms.	Starting Box Points No.
0	2.3	0	.56	.84	228.6	99.4	1
450	2.3	$\frac{450}{825}218.2 = 119.$	.56	.84	109.6	47.6	2
640	2.3	$\frac{640}{825}218.2 = 169.$	.56	.84	59.6	25.9	3
750	2.3	$\frac{750}{825}218.2 = 198.$	.56	.84	30.6	13.3	4
800	2.3	$\frac{800}{825}218.2 = 212.$	.56	.84	16.6	7.2	5
820	2.3	$\frac{820}{825}218.2 = 217.$	.56	.84	11.6	5.0	6
865	2.3	$\frac{865}{825}218.2 = 228.2$	.56	.84	0	0	7

A comparison of the low resistances of the first starting box with the high values of R_x, shows the great difference between the two types and makes it evident that one should not be used indiscriminately for the other. If the latter type of box were employed to start a motor under load (for example at rated torque), the armature current would be far less than the rated value until next to the last contact point was passed, when the armature would suddenly jump to rated speed, a change much too sudden and likely to injure the motor or the machine driven by it. For this reason, and to have the starting box adapted to all load conditions, the American practice is to use a box designed to start the motor under load. Thus, while the speed may rise rather suddenly without load, no injury will result, because the initial (*i. e.*, total) resistance is sufficient to limit the armature current to a reasonable value and the speed does not rise more than about 3 per cent above rated value. Rapid acceleration without load is not objectionable, provided neither current nor speed is excessive. On the other hand, the motor is fully protected when started under load, the armature current having sufficient strength to gradually bring the armature up to speed.

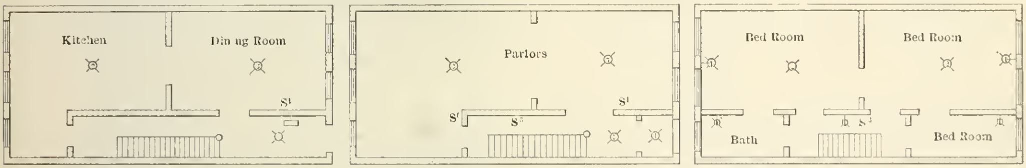
Wiring of Residences at Small Cost.

By Thomas W. Poppe.

One of the chief drawbacks to the introduction of electricity in the residential sections of cities is the cost of installing the wires, etc. This of itself would not be serious were it not for the fact that after the ordinary wireman has finished his work, the owner has decorations, plastering and flooring to repair owing to the bungling work of the electrician. This necessitates oftentimes having a painter, a plasterer and a carpenter. If an owner is assured that a system of wiring can be installed that does not entail these after expenses and which will not inconvenience the occupants of the house to any appreciable extent, the chances are that the house will be wired if the advantages of so doing are properly presented.

A residence can be wired in this manner by using practical knowledge and skill, but to perform the work at a low price it must be done on an extensive scale, as many original material units must be used and these must be made in quantities to keep the cost as low as possible.

The following explains how a seven-room dwelling can be wired at little cost and without damage to walls, decorations or floor. Figs. 1, 2 and 3 show plans of the basement, first floor and second floor of an ordinary city house. The service wires should enter the building in the cellar and should the electric light company's mains be overhead this can be done cheaply by running a line of conduit up to the second story outside the building, as shown in Fig. 4. The reason the conduit should be fastened to the house is that it avoids cutting through any grass plot or flower garden which might be on the front of the property, and does not necessitate a permit to open the street. Again, an owner might object to the cutting of holes through the front of his building for the entrance of wires. The service being in the cellar, the meter would also be there, thus forestalling any objection the owner might raise should it be set in a room, though housed in a cabinet. The mains should be drawn through the conduit into the cellar, where the meter is to be placed. The strain should be taken from the conduit by means of a fitting, as shown in Fig. 4. This is made in two pieces and can be placed in position after the wires are drawn in. The conduit should then be painted the same shade of color as the building, so as to render it less conspicuous.



FIGS. 1, 2 AND 3.—PLAN VIEWS OF BASEMENT, PARLOR AND TOP FLOORS.

From the meter a two or three-conductor steel-armored cable, as the system of the electric light company may require, should be brought up through the basement floor to a panel box in the basement hall. The location of the box is shown in Fig. 1. Damage can be avoided in doing this by boring through the basement floor close to the baseboard and through the cellar ceiling with a small-diameter gimlet bit. From the hole thus made in the cellar ceiling measure three inches toward the partition in the basement. A hole of sufficient diameter to allow the cable to slip through it easily should be bored up through the ceiling and through the flooring into the middle of the partition. This hole should be bored plumb. If this precaution is not taken the auger bit might find an exit through the plaster of the partition. The plaster where the panel box is to rest should be cut the exact size of the box with a compass saw and the box should be exactly over the hole bored through the floor. The armored cable should not be drawn in until the box is set, as the weight of it resting on the plaster will chip the plaster, and this is to be avoided. The box when set should be flush with the plaster.

There are three circuits; one for the basement, one for the first floor and one for the second floor. In the basement, which includes the kitchen and dining room, there are four outlets: one for an electrolier in the dining room, one for a switch to control the electrolier, one for an electrolier in the kitchen, which is controlled at the lamps by key sockets, and one in the hall, which is also controlled at the socket. If the ceiling is low the electrolier in the hall should be placed on the side wall. If the ceiling is high, the sockets should have a chain pull to operate them.

To prepare for the installation of the circuit conductors it is necessary to take up a pocket in the floor directly over the panel box, and bore directly downward through the partition plate. This will bring the auger in a hollow place formed by the two upright studdings and the lath and plaster. Should a bridging be encountered when drawing in the cables a hole can be bored through it by using an extension piece in addition to the auger. Fig. 5 shows a bridging, being bored in this way. As an ordinary extension piece has a clutch attached which would be too large to pass through the size of hole necessary (about ⅞ in.) it is a good plan to fit the auger into one end of a piece of ¾-in. (inside measurement) gas pipe and bore a hole through both the pipe and bit. Then remove the auger and tap the hole in it for a standard machine screw; enlarge the holes in the gas pipe so the machine screw will pass through them, replace the auger, and put the screw in place. The other end of the gas pipe can be shaped to fit the chuck on the brace.

While boring the hole on this floor, it is advisable to bore for the entire number of tubes going upwards. In the dining room carefully remove the old picture moulding and in its place install picture moulding grooved for the insertion of electric wires. This moulding can be purchased at any reliable supply house. The same kind of moulding should be placed in the kitchen. Fig. 6 shows a side view of electrical picture moulding with the capping removed. It is necessary to install the grooved picture moulding only where the wires are to be carried, as solid picture moulding of a like design can be obtained to finish the room. In the moulding directly over the panel box, but on the opposite side of the partition, an oblong hole should be cut so a box as shown in Fig. 7 can be placed therein. This hole should continue through the plaster and lath. This box has a flexible tubing connector already attached and is fastened at an angle to point upwards or downwards as the case may require so as to be used as a pull box, the rules of the underwriters requiring this when the system of wiring is changed. A steel-armored twin-conductor cable should be installed between this point and the panel box. The pull box, Fig. 7, has a cover to avoid danger from fire and the wooden capping is fastened over it showing no part of the box. The cable can be installed by pushing a "snake" through the oblong hole in the moulding, directing it downward to the opening made for the panel box. The cable should then be attached and drawn upward through the oblong hole. The steel armor of the cable should be removed for a distance of about six inches and the wire drawn into the pull box through the connector before setting the box. The cable should be fastened in the connector by means of the set screw.

For the hall outlet a hole should be cut in the ceiling the exact size of the box, which is about three inches in diameter and two inches deep, and which is equipped with clips which grip the cable and hold it fast. Between this box and the moulding in the dining room a steel armored cable should be drawn between the beams above the plaster, to a point where another pull box (Fig. .7) is placed in the moulding. To do this it is necessary to bore through the ceiling partition plate from, above, taking up a pocket. It is better if two pockets will come close together to extend one so as to make it serviceable for both. The cable may be drawn in as before, leaving about four or five inches excess to facilitate connecting it to the outlet box; it being only necessary for the workman to fasten it by means of the clips mentioned and push it into the opening made for it in the ceiling, allowing the surplus cable to curl up in the space above the plaster. As most residences are piped for gas the box may be fastened by slipping a proper-sized collar over the gas pipe after the box is placed in position and fastening it there by tightening the set screw in the collar. This box should be flush with the plaster. Fig. 8 shows the box in position.

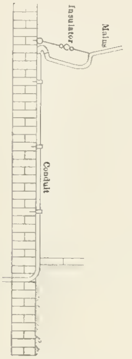


FIG. 4.—SERVICE ENTRANCE.

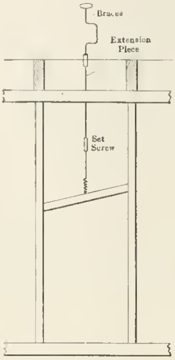


FIG. 5.—BORING BRIDGING.

The outlet box for the electrolier in the dining room is set in a similar manner. The switch to control this electrolier is set by cutting a hole in the plaster the size of the switch box and placing a mat around the hole and two pieces of wood inside. The mat is screwed to the two pieces of wood, which serve as a clamp. The wooden strips should be vertical, as they clamp more strongly to the lath running horizontally. Fig. 9 shows the switch box set and connected. In the kitchen the oblong hole is cut in the moulding on the side of the room the same distance from the rear wall of the building as the center of the room. This allows the cable to be drawn between the beams to the center of the room where a box is set as in the hall and dining room. It is necessary to take up a pocket directly over the oblong hole in the moulding. These pockets can be taken up very easily by using a sharp, thin, fine-toothed compass saw. When replaced, the pocket fits neatly, owing to the small amount of wood removed by the saw. Most wiremen carry, if they have one at all, a thick-bladed saw with a large set in the teeth. This, as a rule, is very dull. When a pocket is cut by a saw of this kind and replaced, it leaves an opening between the ends which is objectionable.

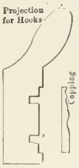


FIG. 6.—MOLDING.

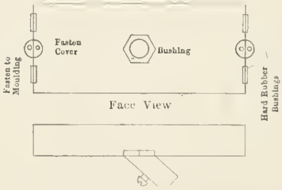


FIG. 7.—PULL BOX IN MOLDING.

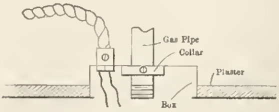


FIG. 8.—BOX IN POSITION.

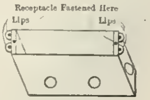


FIG. 11.—BASE-BOARD BOX.

At the pocket in the hall directly over the panel it may be found necessary to cut the floor partition plate, and to do this it may be necessary to bore upwards between the beams using a ratchet similar to that used by iron workers for drilling holes in a beam. The auger can be placed in a chuck of the ratchet and the screw of the ratchet placed against the partition plate of the ceiling below. By using the ratchet it is an easy matter to bore upwards through the floor partition plate. These plates consist of 2 in. x 4 in. joists which are placed on the floor and against the beams overhead with the uprights wedged between them. They are also nailed in position. The ceiling plate on this floor is bored in the same manner as the one below; a pocket being taken up overhead. A snake consisting of a piece of heavy rattan, with a small hook fastened to the end, is pushed downward. The rattan is used because it is strong and while being somewhat flexible does not coil up like a steel snake, and is more convenient for finding the hole in the bridging and floor plate. The object of attaching the hook to the rattan is so it can be "fished" by using a steel spring or snake should it be difficult to find the hole in the floor with the rattan snake. It is also useful for fastening a sash cord preparatory to drawing in the steel-armored cable. The necessary circuit feeders can be drawn in this manner. The electrolier outlets on each floor are set in the same manner as those in the basement.

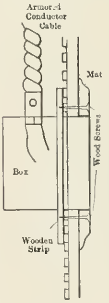


FIG. 9.—SWITCH BOX

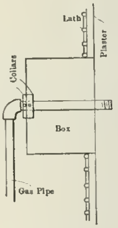


FIG. 10.—BOX AT BRACKET.

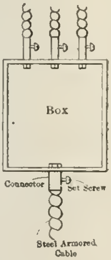


FIG. 12.—PANEL BOX.

Where a bracket is desired an extra deep box may be installed and the connection made as shown in Fig. 10. The box is fastened by means of a collar on the gas pipe behind and one inside the box. Any slight opening around the box may be filled with plaster of Paris. This should be done with all the outlet boxes. The cable is drawn into the box from a pull box placed in the moulding directly over it.

Where a base receptacle is required it is usually most convenient to place it under a bracket outlet. In such a case the conduit is continued from the bracket outlet to the receptacle. A small oblong hole is cut in the baseboard and a box similar to one shown in Fig. 11 inserted therein and fastened with wood screws passing through the lips shown.

If it is necessary to carry the wires through a partition as between the parlor and rear parlor, two boxes (Fig. 7) can be installed in the moulding, one on each side of the partition, and a piece of steel-armored cable used to connect them. The cable is held fast by means of set screws in the connectors attached to the' box.

The panel box in the basement hall is fastened to projections from the upright studdings on each side of the box. The trim and door of the panel are fastened to the box and the trim extends four inches beyond it to cover any crevice between the box and plaster or any damage done to the decorations.

The steel-armored cable is fastened to the panel box by means of long-necked connectors as shown in Fig. 12.

With the above system installed as outlined, no damage is visible and to the average person this is equivalent to no damage being done. If a solicitor, when seeking new business among the unwired residences, can show a house thus wired to a prospective customer it will greatly aid him in getting a signature to a contract.

The Operation of a Small Electric Plant.

By W. H. Wakeman.

DIRECT-CONNECTED DYNAMOS.

In many manufacturing plants where it has been decided that the introduction of electricity will prove a good investment, it is a wise plan to install a direct-connected dynamo in order that the electric lighting service may not be dependent on the main engine. The high-speed engine drives the dynamo at an almost constant number of revolutions, resulting in a uniform voltage, because the centers are passed so quickly that the speed does not drop enough to make the lamps flicker. Taking for a standard a speed of 300 r. p. m., ten centers are passed a second, therefore the speed is very steady and satisfactory as long as the machinery is kept in first-class order.

Another reason for the adoption of direct-connected dynamos is that it is possibly to obtain electricity without starting up the main engine for this purpose, or keeping it in motion when otherwise it might be shut down. This is very convenient when repairs must be made at night, when new machinery must be installed while the main shafting is not in motion, or at any other time when light alone is needed. In the case of mills' and factories located in small villages, the dynamo is run during the evening to supply electricity to some of the houses, and perhaps a few arc lamps on the main street.

The intelligent engineer who has been running an engine that revolves 60 or 75 times per minute will find it a different proposition to care for one that runs four or five times as fast. Still there is no reason for apprehension, as it is only necessary to use about five times as much oil on the high-speed engine as on the low-speed engine, and give it attention in about the same proportion. This does not necessarily mean that the expense of oil will be increased in this proportion, as the oil can be filtered and used over again. The oil, however, must be fed rapidly to the bearings in order to keep them cool Some persons consider it economical to buy a cheap oil, use it once and then throw it on the coal pile; but that this is uneconomical the following comparison shows. If oil that costs 15 cents a gallon is used once, the cost represents the expense of one lubrication of the parts. Using an oil costing 50 cents a gallon ten times, reduces the cost per single lubrication to 5 cents, and this is within reasonable limits.

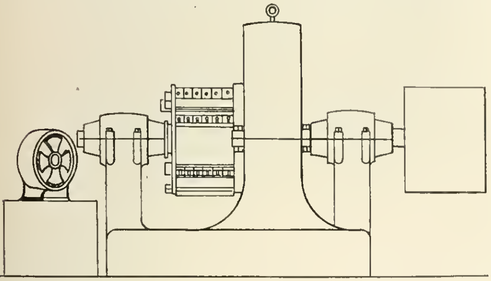


FIG. 1.—ARRANGEMENT FOR COOLING BEARINGS.

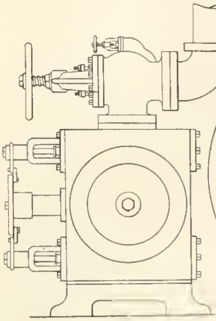


FIG. 2.—ANGLE THROTTLE VALVE.

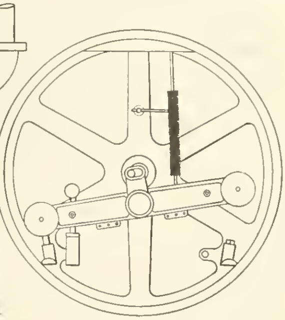


FIG. 3.—FLY-WHEEL GOVERNOR.

One of the best ways to cool a bearing that has commenced to heat is illustrated in Fig. 1. It represents a desk fan blowing air into the bearing, and although this is comparatively hot air taken from the warm engine room, the fact that it circulates rapidly causes it to carry off much heat. At the same time the supply of oil must be increased to a stream, and it may become necessary to use cylinder oil, although this is to be avoided if possible, because cylinder oil is so much thicker that it ought to be kept separate. Some high-speed engines are designed with the babbitt metal of the main bearings in separate pieces; therefore, if one of them is accidentally melted out, another can be inserted at short notice.

More cylinder oil is generally used in high-speed engines than in the low-speed engines, partly because wear on the valve gear is excessive at high speed. When the smallest number of drops of oil per minute that will thoroughly lubricate the internal parts of an engine is determined, it is only a waste to use more. If the valve of a high-speed engine works hard, it makes the fact known by small knocks and pounds, and if more cylinder oil reduces this noise, it ought to be used as a measure of comfort and economy.

A certain plant contains an old-fashioned low-speed engine of substantial design that has proved satisfactory for 14 years, except that it does not govern perfectly under changes of load. The piston of this engine contains 28 pieces, preventing leakage of steam, and making it possible to keep the piston rod in the center of the cylinder. The piston of a comparatively new high-speed engine in the same plant contains three pieces, namely, the spider and two packing rings. If the joints in these rings remain at the bottom of the cylinder they do not leak steam. If they move around to the top, they leak, and there is nothing to prevent it. There is no way to center the piston rod, hence when the spider wears on the bottom the only remedy is to get a new piston.

When a dynamo is new the armature is concentric with reference to the field magnets. If the bearings wear until the armature is nearer the lower poles the attraction may cause excessive pressure on the lower halves of the bearings, causing them to heat without apparent cause. If a pasteboard air-gap gauge is used once a month, any excessive wear can be detected. Dynamos are usually fitted with a device by means of which the armature may be kept central.

Fig. 2 illustrates the cylinder of an engine that is fitted with an angle throttle valve, containing a smaller valve constituting a by-pass. This is convenient to use when warming the cylinder before starting up, as a little steam can thus be admitted and the resulting water will pass out through the drip pipes without starting the flywheel. It will also admit enough steam when wide open to run the engine at full speed with no load, and it is intended for this purpose. Care should be taken, however, to open the main throttle valve before throwing on the load. While such a mistake may do no special harm, with only one dynamo in use, if another generator is already in full operation, and this one is to be run in parallel with it, trouble will result. In paralleling dynamos, one being in operation, the second is brought up to speed and its voltage made equal to, or slightly higher than that of the other. All this may be done with only the by-pass open, but when the full load is thrown on, it will not supply enough steam to maintain full speed, hence as soon as it becomes less than the standard the voltage drops allowing energy to pass over from the first machine and drive the second as a motor, unless it is properly protected.

Sometimes it is impossible to secure full voltage on a compound-wound dynamo until a partial load is put on amounting to, say, 25 per cent of the full load. This is often inconvenient with only one engine in service, as but a few lamps may be required at times, although full voltage is wanted for them.

In one case this objection was overcome by increasing the tension on the helical spring shown in Fig. 3. Three revolutions on the large screw which holds it gave a speed resulting in an increase of five volts, thus securing the required e. m. f. This plan is recommended where it is desired to allow the brush holder to remain stationary.

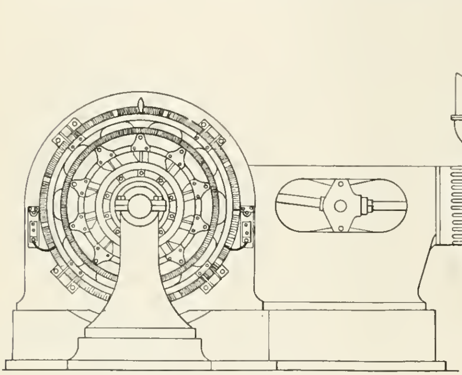


FIG. 4.—DIRECT-CONNECTED GENERATOR.

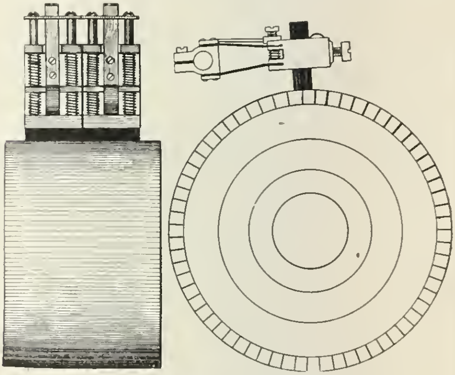
Oftentimes the substitution of new brushes will cause a dynamo to spark and heat badly where such was not the case before. In one instance this was cured by moving the brush holder shown in Fig. 4 in the direction in which the engine ran. As this is a 10-pole machine with peculiar brush holders having a special brush, it required several hours to change the brushes and when the new ones were unsatisfactory and the movement of the brush holder as above described proved a remedy for the trouble it was a source of much satisfaction; although there was no apparent reason for the difference in results.

In another case shifting of the brush holders made no difference in the behavior of the brushes, as they continued to spark and heat badly until removed, but the next set used was entirely satisfactory. The plan illustrated in Fig. 1 for cooling a warm bearing proved valuable in keeping the commutator cool enough to complete the run, thus preventing the chagrin and annoyance of a shut-down during working hours. The principal cause of sparking in the writer's experience has been chattering brushes. This does not mean that the defect was bad enough to attract special attention, but the brushes failed to remain steadily on the commutator, and whenever the contact was not perfect sparking resulted.

Brush holders may be classed under two heads, those that are given a certain tension by the makers which cannot be changed without substituting new parts, and those whose tension can be varied by the engineer. The former is illustrated in Fig. 5, which shows two brushes that are held in contact with the commutator by helical springs. While it is possible to change the tension of these holders by the substitution of other springs or something similar, the fact that they are made in this form does not encourage the engineer to make a change, as it is evident that the makers consider this the best tension for general service, and it is generally assumed that they have practical knowledge on the subject.

Fig. 6 illustrates the adjustable brush holder, and it is only necessary to loosen a binding screw in order to give the holder more tension: then by tightening the same screw the brush is held firmly in place. The lightest tension that will prevent chattering is best, because it wears the commutator less.

Application of commutator compounds or lubricants may prevent further sparking of a dynamo, but the writer has seen the potential drop 15 volts as soon as a certain compound was put on the commutator, because the thin film of compound increased the resistance between the brushes and commutator. Too much of any compound is detrimental to good service, as it collects on the commutator bars and causes chattering of the brushes where only a light tension is used. This can be removed with sandpaper, but if some of the compound is needed, a few drops of kerosene oil carefully applied will soften it and make it less troublesome.



FIGS. 5 AND 6.—BRUSH HOLDERS.

When stopping the dynamo in the plant with which the writer is connected, the switches are pulled out before steam is shut off from the direct-connected engine, or the clutch is thrown out on the belted dynamo, consequently when started the next day the dynamos always generate electricity readily. While visiting another plant where electricity is used the writer noticed that the engineer did not disturb the switches when it was time to shut down, but simply stopped the engine, allowing the lamps to grow dim and finally become extinguished as the armature ceased to revolve. All switches were in when this plant was left for the night.

This does not necessarily mean that the switches ought to be left in at all times, but, on the contrary, the fact that this dynamo frequently fails to generate when it is started in the morning shows that something is wrong with the machine or else it is improperly used. By using a piece of insulated copper wire, removing the insulation from both ends of it, and holding one end on a positive brush and the other on a negative the machine may be made to pick up.

Dynamos in small plants should ordinarily be covered with a waterproof cloth or rubber blanket at night to protect them from dampness. If a dynamo is accidentally wet it may generally by dried by running it at full speed for some time without load.

Inside the frame of a dynamo seems to be a favorite place for some engineers to keep waste, but this is a bad and dangerous practice, because any dynamo or motor is liable to throw down sparks that will ignite this and cause the machine to be scorched or burned before the fire is discovered.

LETTERS ON PRACTICAL SUBJECTS.

SOME ENGINE-ROOM PIPING.

"How not to do it" seems to be of fully as much importance as "how to do it," judging by some piping recently overhauled in an engine room; a few lessons in the laying-out of pipe connections were badly needed. In one instance, a trap had been installed to take the drip from a large heating coil. The arrangement was as shown by Fig. 1, with the exception of the unions *a* and *b*, which were left out of the original arrangement, but which had been put in by the engineer. Without the unions in question, it is impossible to disconnect the trap without taking down a lot of piping, and if anything went wrong with either of the valves, it was also necessary to take down the piping to get at the defective valve. The valve *d* was also conspicuous by its absence when the job was originally piped, the valve *e* being closed when it was desired to use the by-pass instead of the trap.

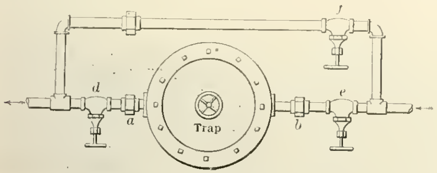


FIG. 1.—CLOGGED BY-PASS CONNECTIONS.

One day something went wrong with the trap and the engineer attempted to open it for inspection. The drip was turned into the by-pass, but with little effect, for as soon as the cover was removed from the trap, out came steam and water which backed up from the outlet pipe. It was found necessary to close down the entire heating system before the trap could be adjusted, so badly did the steam and water blow back into the discharge. The valve *d* was then cut into the piping and the unions *a* and *b* were added to permit the trap to be removed bodily when desired, without interrupting the flow of condensed water from the heating coils.

At another time the engineer opened the by-pass to cut out the trap for inspection, but the by-pass wouldn't pass, and again the steam coil had to be shut down to the great discomfort of everybody in the building. Inspection revealed the fact that the constant flow of water past the by-pass openings had deposited some dirt in those pipe openings and the dirt had become so baked and hardened that not a drop of water or steam could get through the by-pass pipes. At the very first opportunity the engineer took down the trap connections and replaced them as shown in Fig. 2. In this arrangement the trap is virtually in the by-pass, while the actual by-pass is through the straight pipe connection containing valve *f* and union *c*. The engravings show the arrangement so plainly that little description is necessary, save to note that the elbows employed in the by-pass connections, as shown in Fig. 1, have been replaced in Fig. 2 by crosses and plugs, thus permitting the pipes to be opened and a wire introduced for removing any deposit which may become lodged in the pipes. It is practically impossible to clog this piping, as the arrangement is such that a rod or wire may be run into any pipe in the system, and by removing the bonnets of the valves, every inch of the connections may be cleaned.

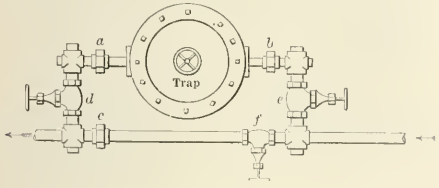


FIG. 2.—RECONSTRUCTED BY-PASS CONNECTIONS.

In the same engine room it was noted that the drip from the cylinder of a small engine had been piped in a very neat and pleasing manner, and upon remarking the fact to the engineer, he remarked with a smile that it certainly was an improvement over the piping in use when he took charge of the plant. The engineer then drew a sketch to show the original arrangement of the drips from the engine. This lay-out, as shown by Fig. 3, consisted of three single pipes, each fitted with a valve, and terminating on the floor just above the mouth of an open drain into which the water found its way.

The condition of things around the mouth of that drain could well be imagined when the valve was opened to drain the steam pipe from just above the throttle valve. A few gallons of water, some steam and a little grease from the lubricator diffused itself over that portion of the engine room adjacent to the sewer opening.

The new drip connections were all brought together and tapped into the exhaust pipe as shown by Fig. 4. In addition to the valves *a*, *b* and *c*, as shown by Fig. 3, three unions were placed as shown by Fig. 4 at *d*, *c* and *f*. By means of the tees *g* and *h*, the three drip pipes were brought into the pipe from the throttle, which in turn was screwed into the exhaust pipe, thus making tight connections and a clean job.

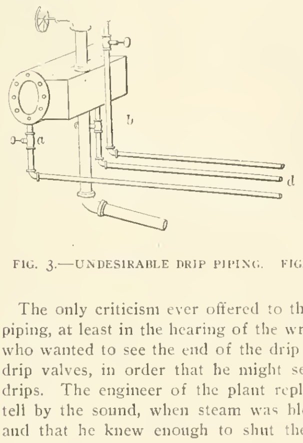


FIG. 3.—UNDESIRABLE DRIP PIPING.

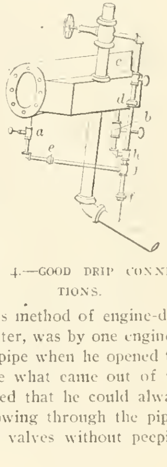


FIG. 4.—GOOD DRIP CONNECTIONS.

The only criticism ever offered to this method of engine-drip piping, at least in the hearing of the writer, was by one engineer who wanted to see the end of the drip pipe when he opened the drip valves, in order that he might see what came out of the drips. The engineer of the plant replied that he could always tell by the sound, when steam was blowing through the pipes, and that he knew enough to shut the valves without peeping into the pipes.

NEW YORK CITY. JAMES FRANCIS.

AN OPPORTUNITY FOR INVENTION.

There is a chance for the inventive man to work up an electrical oiling device which will relegate to obscurity many of the elaborate oiling systems in use at the present time. The principle upon which the device is to operate is very simple and requires little machinery for its application to almost any bearing. Bearings are acknowledged to run to the best advantage when supplied regularly with a certain amount of oil fresh from the source of supply. The flooded method of oiling has its advantages, and, where it can be applied, leaves little to be desired, but it cannot be used for exposed bearings the surroundings of which must be kept clean.

The principle upon which the new oiler is to work is as follows: A tube filled with oil is heated and the expansion causes some of the oil to pass into the bearing. The heating of the oil in the tube is to be done by means of a wire or a coil of wire suspended in the oil, a current of electricity sent periodically through the wire, furnishing the heating power. The application of electricity is to be continued until the required volume of oil has passed over into the bearing. After the circuit is opened, the cooling of the oil tube by the atmosphere causes the oil contained therein to contract and another portion of oil is drawn into the tube, which is then ready for another heating from the enclosed wire.

The time of heating and cooling can be determined by a revolving commutator which carries a contact for each bearing, or for each group of bearings found to require the same amount of electricity. The entrance and exit of oil might be governed, in the tube, by slight clapper valves, or by metal disc valves, according to the kind of oil handled. The writer is not aware of any patents covering such a device and gives the idea to the public for whatever it is worth.

Scranton, Pa. John Scott.

MODERN STEAM ENGINES FOR ELECTRICAL SERVICE.

The successful steam engineer must keep in touch with the continual change and progression in the field of prime movers for driving electric generators. Steam turbines are already dangerous rivals of the large multiple-cylinder, reciprocating engines until quite recently so common in large power stations. In fact turbines have almost crowded this type of reciprocating engine out of the market.

Producer gas engines are clamoring loudly for proper, and doubtless, entitled recognition, and yet with it all, the thoroughly "up to date" reciprocating type of engine for medium and high speeds for direct connection to generators, especially in sizes ranging from 100 to 500 kilowatts, undoubtedly retains its prestige, and equals both the turbine and the gas engine for particular kinds of service.

The vital characteristic requirements of a prime mover for isolated electric lighting and power plants, can be grouped under the following half hozen headings in the order of importance named:

1. Reliability: Uninterrupted service of the engine is paramount and is obtained as the direct and logical result of correct design, the very best material and workmanship throughout, intelligently proportioned bearings and wearing surfaces, and a simple method of positive, continuous automatic lubrication free from trappy and uncertain devices.

2. Economy: This is obtained only by the happy combination of several elements, embracing correct design and construction, perfect regulation, the use of improved speeds, steam-tight valves and pistons, multiple steam ports, permitting rapid and properly timed steam admission and free exhaust, and the economical use of steam at variable loads, especially the underload, a condition which often prevails in an isolated plant, In addition to this, the engine must be designed for a system of positive automatic lubrication, which permits copious oil circulation through the bearings and pins, and consequent elimination of frictional losses.

3. Quiet Running: As evidenced by the many glaring failures this is a feature exceedingly difficult to accomplish, and the engine must be especially designed for such service, the greatest of care being given to a correct governing device, perfect balancing throughout, and the valve gear constructions, which, while without complications, will meet the peculiar demands of extreme load variations. The main shaft and crank construction must ensure the preservation of the original perfect alignment, which has led to the almost universal rejection of the center-crank multiple bearing design, in favor of the side-crank two-bearing construction to ensure quiet running after the engine has been in service for any length of time.

4. Compactness: The accomplishment of this necessarily demands medium or high speeds, thus permitting moderately short strokes, thereby reducing the overall dimensions, and resulting not only in a saving of valuable floor space, but effecting as well a large saving in the cost of foundations and of the building, and a saving of labor of the attendant.

5. Cleanliness: The reciprocating parts must be enclosed and protected wherever practicable, but without the sacrifice of convenience of operation and thorough accessibility to the working parts; then, too, the elimination of a score or more of sight-feed oil cups, which require frequent attention and adjustment by the operator, has made it possible for the engine to be arranged so as to make it almost entirely free from the common fault of "oil slinging."

6. First Cost: Cheap offerings will always attract a certain class of inexperienced buyers and thereby frequently prohibiting attainment of their best interests by limiting the price, at which really competent builders are forced to withdraw from competition, and a trifling sum is saved in the first cost at a disastrous ultimate cost, almost sure to result in expensive repairs sooner or later, coupled with interrupted service and consequent serious loss thereby, as well as extravagant waste of steam; many such installations are in evidence as a warning against buying "too cheap."

Chicago, Ill. A. M. Morse.

VACUUM CLEANING APPARATUS IN THE POWER HOUSE.

A vacuum cleaning outfit should be made a part of the equipment of every power station, steam plant and factory. There is hardly an operation so destructive to machinery as the ordinary process of removing dirt by sweeping. It is to the use of vacuum cleaning in the power house that these lines are particularly directed. For many years, the wood worker has recognized the value of vacuum cleaning, and his shops have all been equipped with vacuum systems for removing shavings, sawdust and other refuse from the various machines. But the wood worker has continued to use the vacuum cleaning system in its crudest and mose rudimentary form.

In the power house it is dust which causes most of the wear to machinery bearings, and it is dust which causes much damage to generators and other appliances. In his efforts to counteract the effects of dust, the station man spends hours with bellows and brush, carefully blowing the dust deposited out of generators, motors and switchboards, and he has spent other hours cleaning lamp mechanisms and instruments.

With a brush fitted to a perforated hollow handle to which the vacuum hose is connected, dust troubles would vanish like magic and dust itself would cease to be a station bug-a-boo. The vacuum floor broom takes up every speck of dust from the floor, wall or ceiling, and in central stations that appliance should be a part of the regular equipment.

How many engine pulleys are to be found plentifully coated inside with dust which is suffered to remain undisturbed because the engineer does not wish to subject the entire power house to a coating of dust particles. See the coating of many varieties of refuse material inside of the other pulleys and note the deposits on and above every electric wire. Especially when carried close to a wall or ceiling, wires seem to cause a heavy deposit of dust upon the adjacent surface.

Vacuum cleaning apparatus is not expensive to install. Its cost is little and its efficiency is great. About all that is necessary is the exhaust blower, the hose, the dirt-settling chamber and the brush or cleaner by means of which the dust is gathered and directed into the hose.

Boston, Mass. John Jackson.

TESTING WATT-HOUR METERS.

Every electric light and power company should have a department for testing watt-hour meters, the benefit derived from the careful handling of a meter system warranting the necessary expenditure to obtain the required equipment.

The testing department should be located in a place as dry and free from vibration as possible.

As watt-hour meters are expected to operate under varying conditions, when installed, this should be taken into consideration when selecting a location for a testing board, and an effort should be made to establish conditions as near as possible to those under which the meter is to operate. If vibration is excessive, the meter may be suspended, or it may be placed on an air cushion, which will tend to neutralize the vibration. To this testing board should be connected potential leads from the system. When the line voltage fluctuates, storage batteries are used.

The bank of lamps to be used should be arranged so as to permit any desired load to be easily applied. For extra heavy loads, a water rheostat is very convenient.

To obtain the best results a suitable equipment of instruments is essential. For alternating-current work an indicating wattmeter is always to be preferred. Two instruments should be provided, one to check the watt-hour meter at full-load, and the other to check the meter at light load with sufficient degree of accuracy. The use of this small range instrument avoids observation errors when reading an instrument at the lower end of the scale.

For direct-current work, a portable ammeter and voltmeter are required. In addition, a reliable stop-watch is essential for taking the speed. Too much care cannot be used in the handling of these watches, and in checking them with some standard. In doing this it is advisable to check them at different points of the dial.

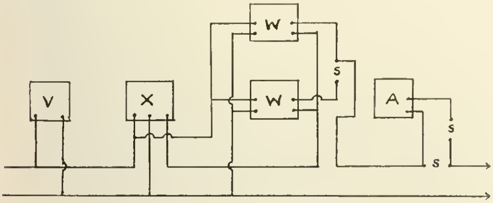


FIG. 1.—METER CONNECTIONS.

In order to insure accuracy independent of the change of room temperature, it is necessary that the temperature resistance coefficient of the materials of the disc and that of the potential or shunt circuit, should be the same. For this reason a watt-hour meter should be connected to the circuit for about 20 minutes before any test is made. In testing meters a mark should be made on the outer edge of the disc, in order that the time required to make a certain number of revolutions of the disc may be noted. The following formula is used for testing General Electric watt-hour meters $(3600 \times K \times R) \div S = W$, in which R is the number of revolutions, S the number of seconds required to make this number of revolutions; K, the calibrating constant marked on dial face of non-direct reading meters and on the disc of direct-reading watt-hour meters; 3600, is the number of seconds in an hour.

The number of revolutions should be such that the time of observation will be from 30 to 60 seconds. If materially less than 30 seconds, errors in the measurement of time are probable, and observations of longer than 60 seconds are generally unnecessary.

Whatever instrument may be used, the tester should be particularly cautioned not to allow the instrument to indicate the loss in the potential circuit, as this will cause an error of appreciable magnitude in light-load operation.

Fig. 1 shows the wiring of the instruments to the testing board, which should be closely followed in testing General Electric instruments. The upper wattmeter has a range of 25 amperes and the lower one has a range of 5 amperes. The watt-hour meter under test is represented at X. For direct-current measurements, the voltmeter and ammeter, or the indicating wattmeter, should be used,, and for alternating-current measurements the wattmeter and voltmeter.

Three-wire watt-hour meters can readily be tested as a two-wire meter by connecting the two current coils in series and using the instruments as shown in Fig. 1. For two-wire circuits, the calibrating constant K must then be divided by two. For a three-wire meter two sets of instruments are necessary, the calibrating constant used being found marked on the disc.

In testing polyphase watt-hour meters it is easier to check the instrument as a single-phase meter by connecting the current coils in series and the potential coils in parallel, and dividing the constant by two. To check either side separately connect one potential circuit only at a time and use the constant as marked on the disc.

When it becomes necessary to change the frequency, the central station manager will find it to his advantage to have the meters arranged by the manufacturer or by an expert who thoroughly understands the theory and operation of the meter, for should these duties be left to an inexperienced person very unsatisfactory results will be obtained.

The writer can recall an experience he had a few years ago while out changing a number of instruments that had been adjusted by an inexperienced person. These were found to be 8 per cent slow, although they had been tested by the city inspector. This meant a direct loss sufficient in amount to warrant the necessary expenditure to obtain the services of an expert.

An expert will make a report on each instrument that will show its exact condition under various loads, and, as a rule, will leave a chart for the tester that will show the number of seconds required to make a required number of revolutions under various loads, which will enable the tester to keep the meters up to the standard. The formulas used with various makes of watt-hour meters are as given below. For Westinghouse type "A," single-phase, two-wire watt-hour meters used without transformers, watts $= (R \times K) \div S$. In this formula K equals volts times amperes, as marked on the counter, multiplied by 1.2. For example, a 5-ampere, 100-volt meter will have a value of K equal to $5 \times 100 \times 1.2$, or 600. For meters used with series transformers, but checked without them, K equals the volts marked in counter multiplied by 6. In checking watt-hour meters that are used with potential and series transformers without the transformers, K equals 600. When testing the Westinghouse single-phase, three-wire meter K equals volts times amperes as marked on the counter times 2.4. Type "C" single-phase, three-wire meter may be checked by the same formula.

Fort Wayne watt-hour meters are checked by the following formula: $(R \times 100 \times K) \div S = \textit{watts}$. The value of K will be found marked on the cup.

Gutmann, or Sangamo Electric Company, meters are tested by the formula: $(\textit{watts indicated} \times S \times \textit{train ratio}) \div 3600 = R$ $(K \times R) \div S = \textit{watts}$; in which K equals the watt-seconds per revolution for the type of meter under test (marked on each instrument by a label), and is equal to the watts-seconds per revolution of the disc. Thus, a 5-ampere, 100-volt meter will have a train ratio of 4, and its disc makes four revolutions for every watt-hour it records, or it will make ten revolutions in 18 seconds, with a load of 500 watts.

Duncan meters may be checked by the formula, $(R \times 3600 \times K) \div S = \textit{watts}$. K is equal to the value marked on the disc.

For alternating-current instruments, connect as shown in Fig. 1. If it is desired to use the upper indicating wattmeter open the single-pole switch, and when using the lower instrument close the single-pole switch. By connecting a rheostat in series with the lower bus a constant potential can be maintained. For direct-current meter the connections are made as shown in Fig. 2, switches being provided for cutting out instruments.

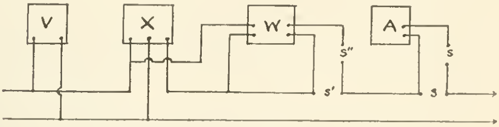


FIG. 2.—ARRANGEMENT FOR DIRECT-CURRENT METERS.

Example: Given a 10-ampere, 110-volt meter with a testing constant K of one-half that makes 20 revolutions in 60 seconds with a load on the indicating wattmeter of 600 watts, by applying the formula we find $(20 \times 3600 \times \frac{1}{2}) \div 60 = 600$ watts, showing that the meter under test records correctly; but should the disc have made only 19 revolutions in 60 seconds, then the watts would be $(19 \times 3600 \times \frac{1}{2}) \div 60 = 570$ watts, and the meter is 5 per cent slow.

Duluth, Minn. Fred Dubell.

MORE ABOUT AN INTERESTING PROBLEM.

Since the publication in the December issue of the Electrical World of the letter, "An Interesting Problem," the writer has received several letters from engineers who would like further particulars concerning the conditions to be met in redesigning the Willoughby, Ohio, municipal electric light plant and pumping station. To begin with, all communications relating to the proposed changes in this plant should be addressed to Mr. Sam Low, chairman of the Board of Public Service, Willoughby, Lake County, Ohio. All questions, either engineering or financial, should be taken up with that gentleman, direct, instead of through the writer.

Additional data are as follows: The pumping station is located about 10 ft. above a low-water source of water supply and a dam 4 ft. or 5 ft. raises the supply surface of the water that amount, so that there is never more than 6 ft. or 7 ft. draft to the pumps, even when the filter tunnel is empty, or nearly empty. The filter tunnel is about 100 ft. long and runs parallel with the east branch of the Chagrin River, and water intended for the pumps must seep through the gravel between the river and the tunnel—something very readily accomplished 15 years ago when the tunnel was first built.

But lately the gravel bank of the river seems to have become pretty thoroughly impregnated with silt, and when the water is high, just after a storm, the filter bank will not let through enough water to supply the pump, so that an intake has to be opened directly into the river. Then, the water in town resembles that at the junction of the Mississippi and Missouri Rivers. The East Branch rises a very few miles away in a pretty hilly country, and it jumps up several feet in a very few hours after a rain at its source, hence the silt question is a very serious one. When the water recedes after one of the little freshets, every bit of shale rock along the bed of the river, and every bit of driftwood, and even the gravel bed of the river itself, is covered with a silt deposit from ⅛ in. to ¼ in. thick.

A 12-in. main runs from the tunnel filter to the pump, and a 12-in. main leads from the pump to the reservoir, about a half mile distant, and about 180 ft. above the level of the pumps. The pumping station is at the foot of a bluff 100 ft. high, a line from the top of the bluff to the coal bunkers falling to an angle of about 45 deg. At least, that seems to be about the angle of the present steel coal chute which leads from the highway on top of the bluff to the coal bunkers of the power house.

The 12-in. water main leading to the village intersects, near the top edge of the bluff, the 12-in. main leading from the pumping station to the reservoir, and a valve placed at that point in the pipe leading to the reservoir on the side of the pipe junction next to the reservoir permits the system to be made at will to act upon the Holly principle by closing the valve in the reservoir main, above mentioned. The pressure in the village, due to static head of water in the reservoir, is now about 56 lbs. gauge, and by closing the reservoir valve there is readily given all the fire pressure necessary to throw water direct from hydrant attached hose over the highest buildings in the village. With but very little assistance from the Holly principle, water can be readily thrown entirely over every church steeple in the village.

The present pump is a 10-in. duplex, and at least double its capacity in water will be required upon completion of the sewer system now being installed and which will be completed within two years. The natural increase in consumption due to population growth must also be allowed for, and a 12-in. pump which could be run 24 hours a day, if necessary, seems about right to fill the bill in place of the present 10-in. pump, which cannot be run more than eight hours a day in winter, at full power, and 12 to 14 hours at partial capacity. In summer, the pump can run about 14 hours at full capacity, and about four hours at partial capacity.

The reason for this queer and somewhat complex arrangement of possible running hours lies in the fact that the boilers which operate the water pump must also be used to drive the electric generators, of which at present there are two—one alternating current, supplying the incandescent lamps, and the other generator delivering direct current to the arcs, of which, at this writing, there are about 27 burning, while at least 40 should be in use. These lamps are switched into circuit at dark and run until 12 o'clock, midnight. The incandescents are turned on at dark each afternoon, and run until turned off by users, say, 10 o'clock to 12 o'clock each night. There are also a number of incandescent street lamps, which burn from dark to daylight, all night and every night.

The station is supplied from a natural gas well with about one-half enough fuel to run the plant, and, in addition to the gas, the boilers use about three tons of coal a day, pretty steadily the year around, there being more light and less water in winter, and more water and less light in summer.

The present need of the people seems to be the replacing of the present equipment entirely by a plant of modern efficiency, and radically different from what is now in use. The present static pressure of gas in the well is about 25 lbs. to the sq. in. and the well has only decreased a little more than one-half its flow in 16 years. It is stated that the well was not properly driven in the beginning. It has been demonstrated that anywhere in Lake County gas can be obtained by sinking a well 700 ft. at a cost of 50 cents a foot. It has also been demonstrated that after a well weakens in its flow, another well may be driven only a short distance, say, 100 ft. or more from the failing well, and a full force and flow of gas secured from the new well. This can be repeated indefinitely.

It seems as though the solution of this interesting problem, for a reasonable amount of money, would be to put in new and larger filter tunnels along the river bank, giving plenty of surface so that none of the tunnels need be overworked when high water, which means dirty water, is at hand. The old tunnel, 15 or 16 years in use, now probably passes one-third or one-half the amount of water taken by the pump, and a larger outfit of filter tunnels would answer for another dozen years undoubtedly.

As for the electrical plant, that should be modernized, and generators of 85 per cent to 95 per cent efficiency substituted for the present outfit of only 45 per cent to 50 per cent efficiency. There should also be a rearrangement of the system whereby a higher voltage than 110 volts could be used, and a rearrangement of the arc and incandescent circuits so as to simplify the present arrangement.

The power plant should be completely reorganized, the boilers and engines discarded, and gas engines installed instead. A system of wells should be driven as found necessary along the valley for a mile or more, and each casing properly packed at the ledge found just above the oil-bearing strata, the packing being done in such a manner that there will be no loss of gas in the upper strata; as wells are now arranged in this vicinity there is doubtless a loss of 50 per cent to 75 per cent of the gas in the upper and porous strata.

A gas engine should be installed for each machine, or pair of machines, as the best engineering practice may decide after a thorough study of the matter. There is gas enough now taken from the single old well at the plant to drive all the machinery if the gas be used in an internal combustion engine instead of being burned under a boiler as at present. With a line of wells down the valley, and a judicious use of each from time to time, shutting off some and cutting in other wells, there will be no lack of gas for 15 or 20 years to come—judging from the behavior of the wells in Lake County for the past 15 years.

With the exceedingly flexible gas engine arrangement, a single pump can be used to work 24 hours a day, instead of as at present, having to be shut down when the electric load is large. At present, should a large fire occur at night, it would be necessary to cut out all, or a large part, of the electric lamps in order to cut in the Holley system of water supply for fire purposes.

A 24-hour service through a 12-in. main will supply a good deal of water under a 50-lb. to 60-lb. pressure, and a continuous service pump, even with the present pump held as a reserve, will prove ample for time to come until the village has outgrown a 12-in. main. When this has to be duplicated, the pump should also be duplicated, and mains and pumps put in suitable for the new needs, holding the present proposed improvements as a reserve for another 20 years. The situation is such that the tunnel filter system can be extended indefinitely, and the population in the East Branch Valley is such that no case of typhoid has yet been traced to the water supply, and probably will not for 15 years to come. After that period, germ filtering may be found necessary instead of gravel-tunnel methods as at present.

To recapitulate, the present solution of this very interesting problem seems to be:

1. Building new and larger filter tunnels similar to the present one.
2. Putting in a 12-in. pump, gas-engine driven.
3. Putting in a new electric generating outfit, also gas-engine driven and independent of the pump.
4. Sinking new gas wells, as required, as units of a well-designed system.
5. Holding the present plant in reserve until the gas-driven machines shall be duplicated.
6. Designing the new plant so that a producer-gas plant may be added easily when natural gas eventually fails.
7. Take the plant out of politics and place it in the hands of an efficient manager, who shall not be changed upon each election day, as at present.
8. Extend the present service, both of water and of electricity, and establish a day service and encourage the sale of energy for motors and for cooking and heating.

Willoughby, Ohio. James F. Hobart.

CAUSES OF SMOKE.

In the report upon smoke abatement prepared by the Syracuse Chamber of Commerce is a short chapter devoted to the causes of smoke which should make interesting reading for your practical letters department, since that department has contained other interesting facts bearing on this subject contributed by various persons. The following abstracts from the report which was made by a committee made up for the most part of technical men, are worthy of careful attention in the boiler room of many central stations.

The amount and quality of smoke discharged from a chimney may vary all the way from a dense cloud of jet black smoke which may be carried by a light wind for a distance of a mile or more before it is finally dispersed into the atmosphere, to a thin cloud which becomes invisible a few feet from the chimney. Often the same chimney will for a few minutes after firing give a dense black cloud and then a few minutes later the smoke will have entirely disappeared.

The quantity and density of smoke emitted from a chimney depend upon many variable causes. Anthracite coal produces no smoke under any conditions of furnace. Semi-bituminous, containing 12.5 to 25 per cent of volatile matter in the combustible part of the coal, will give off more or less smoke, depending on the conditions under which it is burned, and bituminous coal, containing from 25 to 50 per cent of volatile matter, will give off great quantities of smoke with all of the usual old-style furnaces, even with skilful firing, and this smoke can only be prevented by the use of special devices, together with proper methods of firing the fuel and of admission of air.

Smoke may be prevented from forming if each particle of smoky gas, as it is made by distillation from coal, is immediately mixed thoroughly with hot air, and if smoke is formed by the absence of conditions for preventing it, it may afterwards be burned if it is thoroughly mixed with air at a sufficiently high temperature. The essential conditions for preventing smoke in boiler fires may be enumerated as follows: (1) The gases must be distilled from the coal at a uniform rate; (2) the gases, when distilled, must be brought into intimate mixture with sufficient hot air to burn them completely; (3) the mixing should be done in a fire-brick chamber; (4) the gases should not be allowed to touch the comparatively cold surfaces of the boiler until they are completely burned. This means that the gases shall have sufficient space and time in which to burn before they are allowed to come in contact with the boiler surface.

Every one of these four conditions is violated in the ordinary method of burning coal under a steam boiler. (1) The coal is fired intermittently and often in large quantities at a time, and the distillation proceeds at so rapid a rate that enough air cannot be introduced into the furnace to burn the gas. (2) The piling of fresh coal on the grate in itself chokes the air supply. (3) The roof of the furnace is the cold shell, or tubes of the boiler, instead of a fire-brick arch, as it should be, and the furnace is not of a sufficient size to allow the gases time and space in which to be thoroughly mixed with the air supply.

In order to obtain the conditions for preventing smoke it is necessary: (1) That the coal be delivered into the furnace in small quantities at a time. (2) That the draft be sufficient to carry enough air into the furnace to burn the gases as fast as they are distilled. (3) That the air itself be thoroughly heated by passing through a bed of white-hot coke or by passing through channels in hot brickwork, or by contact with hot fire-brick surfaces. (4) That the gas and the air be brought into the most complete and intimate mixture, so that each particle of carbon in the gas meets, before it escapes from the furnace, its necessary supply of air. (5) That the flame produced by the burning shall be completely extinguished by the burning of every particle of the carbon into invisible carbon dioxide.

If a white flame touches the surface of a boiler, it is apt to deposit soot and to produce smoke. A white flame itself is the visible evidence of incomplete combustion.

The first remedy for smoke is to obtain anthracite coal. If this is not commercially practicable, then obtain, if possible, coal with the smallest amount of volatile matter. Coal of from 15 to 25 per cent of volatile matter can easily be obtained and it makes much less smoke than coal containing higher percentages. Provide a proper furnace for burning coal. Any furnace is a proper furnace which secures the conditions named in the preceding paragraphs. Next, compel the firemen to follow instructions concerning the method of firing.

It is impossible with coal containing over 30 per cent of volatile matter and with a water-tube boiler, with tubes set close to the grate and vertical gas passages, as in an anthracite setting, to prevent smoke, even by the most skilful firing. This style of setting for a water-tube boiler should be absolutely condemned. A Dutch oven setting, or a longitudinal setting with fire-brick baffle walls is highly recommended as a smoke-preventing furnace, but with such a furnace it is necessary to use considerable skill in firing.

Mechanical mixing of the gases and the air by steam jets is sometimes successful in preventing smoke, but it is not a universal preventive, especially when the coal is very high in volatile matter; when the firing is done unskilfully, or when the boiler is being driven beyond its normal capacity. It is essential to have sufficient draft to burn the coal properly and this draft may be obtained either from a chimney or a fan. There is no especial merit in forced draft, except that it enables a larger quantity of coal to be burned and the boiler to be driven harder in case of emergency, and usually the harder the boiler is driven the more difficult it is to suppress smoke.

Down-draft furnaces and mechanical stokers of many different kinds are successfully used for smoke prevention, and when properly designed and installed and handled skilfully, and usually at a rate not beyond that for which they are designed, prevent all smoke. If these appliances are found giving smoke, it is always due either to over-driving or to unskilful handling. It is necessary, however, that the design of these stokers be suited to the quality of the coal and the quantity to be burned, and great care should be taken to provide sufficient size of furnace with a fire-brick roof and means of introducing air to make it completely successful.

Syracuse, N. Y. B. K. Tuttle.

QUESTIONS AND ANSWERS.

Can a 125-cycle generator be caused to give a 60-cycle current? We have a 90-kw, 1100-volt alternator and would like to change it to a 60-cycle machine, if possible. C. L. CO.

If the alternator be run at half speed, it will give a 60-cycle current, but the output will be only 45 kilowatts. It would be best to sell the alternator and purchase a 60-cycle machine.

What effect has the power-factor of a circuit upon automatic motor starters? G. J. J.

None. The solenoid depends for its strength upon the ampere-turns, and as long as the current is not changed, its operation is not affected by any change in the power-factor of the circuit.

Is it possible to hurry the charge of a battery? If so, how is it done? H. C. G.

If, in case of emergency, it is desired to charge a storage battery more quickly than usual, or in other words to hurry the charge, the early part of the charge should be given with extra high current; the completion of the charge being accomplished at the low final rate, the same as in normal charging.

The polyphase meter attached to our motor circuit runs sometimes in one direction and sometimes in another. Why should the meter behave in this manner? O. K. C.

The potential circuits are doubtless incorrectly connected. Disconnect the motor and use instead a bank of lamps as a load. Then open one potential circuit at a time and note if the meter runs forward. Should the meter run backward reverse either or both potential leads as the case might be. It is possible on a three-phase circuit of very low power factor for a single-phase meter to run backward even when connected correctly.

It is desired to ring four bells from three single push buttons as follows: Push button No. 1 to ring bell No. 1; push button No. 2 to ring bells No. 2 and No. 3, and push button No. 3 to ring all four bells at once. No switches other than the three single push buttons are to be used. How may this be done? B. R.

It is not possible to ring the bells in the combination stated if only single push buttons are used. The bells may be rung as desired by using a single push button to ring all the bells at once, and by using double-contact buttons for the other two combinations; the springs normally resting on the contact should be connected to the wire from the single push button circuit.

Electrical energy for lamps and motors is supplied from a three-phase turbo-alternator. The motor circuits are three-wire and the lamp circuits two-wire. The lamps are in circuit all the time and the three-phase motors are used only as required. The motors being fed from three busbars and the lamps from two, why should this not result in an unbalancing of the load on the alternator? H. M. S.

If synchronous motors are used the load will be almost balanced, as a synchronous motor would have a tendency to take all of its energy from the unloaded phases. With induction motors the same tendency exists, only to a lesser extent, and the usual practice is to install a voltage regulator on the lighting circuit, the motors looking after themselves. Any unbalancing is only slight at most, and induction motors never give trouble from this cause.

Kindly give answers to the following questions: (1) A conductor is charged to a potential difference of 200,000 volts by one-fifth of a coulomb. What is its capacity in microfarads? (2) What is the impedance of a 6 m. f. condenser on a 60-cycle, 2000-volt circuit, and how much current does it receive? (3) What advantage do paper-insulated cables possess over rubber-insulated cables and those having other forms of insulation? H. C. McI.

A condenser of capacity C assumes a charge of C coulombs under a continuous e. m. f. of 1 volt. When the e. m. f. is E volts, the charge will be EC coulombs. When the e. m. f. is 200,000 volts, the charge will be $200{,}000C$ coulombs. As stated by you the charge is one-fifth of a coulomb; hence $200{,}000C = 0.2$, whence $C = 0.1 \div 100{,}000$ farads, or 1 microfarad. (2) Impedance $= 1 \div (2\pi fC) = 1 \div (2 \times 3.1416 \times 60 \times C) = 1 \div 377C = (1 \times 1{,}000{,}000) \div (377 \times 6) = 447$ ohms. $I = (E \div X_c) = 2000 \div 447 = 4.524$ amperes. (3) The paper-insulated cable has less specific inductive capacity and hence less coulombs for charging and less shunted condensive impedance.

Some time ago you published instructions for painting electric signs so as to keep them always white. We have tried your suggestion with excellent results. If you can suggest some way of preventing the paint from peeling you will render a great service to the industry. J. T. C.

It is a difficult matter to get paint to stay on galvanized iron for any length of time. This is attributed by some to the greasy nature of the surface and it has been suggested that if the surface be treated with an alkaline wash the paint will stick. We question the efficacy of this treatment, however, in preventing the paint from peeling. Paint will not ordinarily adhere to metals and some metals are worse in this respect than others. Try corroding the metal slightly with copper sulphate in solution slightly acidulated with nitric acid. Wash off in an hour or two and permit the surface to dry, after which apply the paint. A first coat of red lead paint is said to adhere well to galvanized metal thus treated.

How may rotary converters be operated in parallel to supply a direct-current load? P. V. T.

Where several rotary converters are to feed the same direct-current system they may be connected in parallel just like shunt or compound-wound direct-current generators. With compound-wound converters an equalizing connection is made between the different machines. The load will be divided among the converters according to their direct-current voltages as in the case of direct-current generators. The voltage may be regulated by changing the alternating-current voltage. Slight changes may be made in the voltage by regulating the field current or by shifting the direct-current brushes. If the rotory converter under load has a strong series field, it may be necessary to short-circuit the series coils when throwing another rotary in parallel with it. The machine thrown into circuit has its field strengthened by dividing up the load and the other rotary has its field weakened, thereby causing the flow of heavy currents between the machines. This extra current is liable to cause disturbance which may reverse the polarity of the rotary carrying the load as well as to cause a heavy rush of current in the alternating-current feeder circuits. The rotaries thus paralleled should not receive energy from the same transformer secondaries.

Kindly publish directions for making a dry battery. J. S. S.

An inexpensive and yet withal a very serviceable dry battery may be made as follows: Fit snugly inside a zinc cup a tube of blotting paper. Pour into the bottom of the cup about two tablespoonfuls of hot melted pitch or rosin to insulate the bottom. Dissolve 5 ozs. of sal ammoniac in one pint of water and add about 7 ozs. of granulated chloride of zinc. Stir the mixture until all is dissolved and continue stirring every few mintes for one-half hour or more. The solution is then ready for use. Soak the blotting paper inside the cup thoroughly with the solution by filling the cup about three-quarters full and allowing it to stand for a few minutes. Pour out the solution and place a carbon plate in the center of the cup; about it pack a depolarizing mixture of 8 ozs. of powdered black oxide of manganese and 16 ozs. of powdered carbon which has been previously moistened with about 5 ozs. of the solution. The packing will probably force a little of the solution up the paper by compression; but will not injure the cell any. When the powdered elements are wet enough, clean away all particles of the carbon element from the top of the paper and zinc cup so that there will be no internal short circuit. The cup may then be sealed with pitch or rosin and when connections have been made to the zinc and carbon, the cell is ready for use.

The Central Station Inquiry Department.

By John G. Learned.

During the past few years, so much has been said regarding the various methods of securing new business, that one is greatly surprised at the lack of expression relative to the proper handling and retaining of customers. Perhaps this is due to the fact that central station managers are too busy getting new customers. It is generally conceded that a satisfied customer is the best advertisement that the central station can secure. A great question seems to be "How to obtain and maintain friendly relations with that portion of the public secured as customers."

Assuming that the central station management is offering reasonable rates, and that the service is good; one naturally concludes that complaints and dissatisfaction would be entirely eliminated. Contrary to this, experience has taught that complaints are sure to come in, especially in the fall and winter season of the year. As one central station manager said: "As the days become shorter, our troubles become greater." Most companies maintain a complaint or claim department, even though it be a one-man department, and that man often a combination general manager, superintendent and contract agent. The customer with a grievance, has it intensified and magnified when he encounters a complaint department, because it so thoroughly fits in with his own ideas. Therefore, let us ease off the first meeting by establishing an "inquiry department." It is an innovation, which, practiced by the writer who is contract agent of the North Shore Electric Company of Chicago, works exceptionally well. This department takes the complaining customer off his guard and teaches him that the company does not solicit or recognize complaints. The writer will treat of methods of handling inquiries or so-called complaints from customers on high bills for electric lighting service rendered on a meter basis, only.

No..........

ADJUSTING BUREAU

District...... Date......................

Customer..

Address...................... Town....................

Refers to bill from............to............ Amt...... ....

Complaint made by {servant / customer} by {Phone / Verbal / Letter}

Nature of inquiry...

....

....

Signed...........................
Employee

Referred to meter dept. for investigation ....

Returned by meter dept. on..............with Report No.........

Remarks..

Answered on............................by letter as per copy

verbally by..

FIG. 1.—COMPLAINT MEMORANDUM.

All employees who come in contact with the public should be thoroughly schooled in the art of courtesy. This is especially necessary to those answering telephone calls. The innocent telephone causes considerable trouble for the central station management, especially when it is the avenue for receiving inquiries or complaints. If the telephone could be eliminated, the treatment of inquiries and complaints would be comparatively easy.

Every telephone inquiry or complaint regarding a high bill, should be directed to the party who will make a final disposition of it. Many customers will use the telephone in giving a prolonged explanation regarding a high bill. After receiving this verbal explanation, it is well to request that a written explanation be sent in, together with the bill in question. In a large majority of cases, the complaint received later is not so formidable as the one received over the telephone. To some, it may seem cumbersome to have all complaints, other than those received in person, reduced to record. However, it works well in practice, as one becomes more conversant with his customer by this means. The next step necessary after receiving a complaint is to make an acknowledgment of it. The following is a sample form satisfactory for this purpose:

DIST..........

METER TEST RECORD

No...........

NAME..

ADDRESS ....

Type...... No........ Amp........ Volts'....... Constant.......

Old Meter Out............190 Read...............

New Meter Set...........190 Read...............

Rev.	Sec.	Standard Watts	Meter Watts	Per Cent Fast	Per Cent Slow	Per Cent Load	Creeping
....	....	....	....	....	....	....	......
....	....	....	....	....	....	....	......
....	....	....	....	....	....	....	......

REMARKS ....

....

....

....

TESTED.............190 BY......................

FIG. 2.—RETURN REPORT FROM METER DEPARTMENT.

> Replying to your inquiry of the 2d inst., relative to your lighting bill for the period from Nov. 1 to Nov. 30, amounting to $3.80, we desire to advise you that we have referred the matter to our meter department for investigation. We will advise you of the result of this investigation later.

A memorandum of the complaint is handed to the meter department with the request that the meter, wiring, lamps, etc., be inspected. Even though the company is small, the blank shown could be used so as to preserve a record of the work accomplished. (See Fig. 1.) The accompanying is a fair sample of the return report from the meter department. (See Fig. 2.) Having this information at hand, the customer is advised as follows:

> Referring to your inquiry of the 2d inst. relative to your electric light bill for the month ending Nov. 30, amounting to $3.80, we beg to advise you that our inspector visited your premises Dec. 4, and made a very thorough inspection of your meter, wiring and lamps. He reports that the meter is in perfect condition and is registering accurately; also that the wiring is free from any defects whereby there could be a leakage of electricity. Our records show that your lamps have recently been renewed and are in good condition. We would suggest that the dust be removed from the latter periodically. By so doing, the efficiency of the lamp will be greatly increased. We have very carefully rechecked your meter cards and your bills, and beg to assure you that the bill as rendered is correct.
>
> We respectfully desire to call your attention to the fact that the bill rendered covers a period in which the days are shorter than those of the previous month, and consequently more energy would be consumed.
>
> Trusting this explanation is satisfactory to you, we beg to remain,

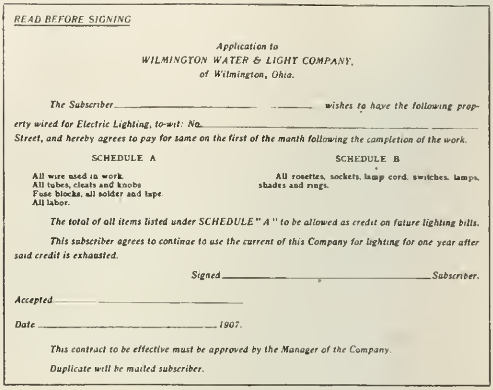
In correspondence of this nature the tendency is to be too abrupt, and it is surprising to note the results obtained by giving a customer a reasonable amount of time and attention. If a customer is questioning the accuracy of a meter after it has been thoroughly tested, it is well to extend to him the privilege of securing an expert at his expense and have the meter re-tested in his presence. Out of over one hundred such offers made by the writer, none were accepted.

Verbal complaints are the easiest to take care of and to settle satisfactorily. One of the most convincing arguments is to show a customer a meter in operation. It is well to install in the office a standard meter, connected to a bank of lamps of various candle-powers. The company should not take the arbitrary stand that it is always in the right. This should be proved by conclusive argument. Tact and diplomacy have saved many a customer, and have made satisfied customers out of those ready to send in a request to discontinue the service. The larger companies make a practice of testing and adjusting their meters periodically. Owing to the limited number of complaints which the average central station receives from customers having motors, these complaints will not be given consideration here. Complaints may be forestalled if the customer is taught to read his meter, so that he may be able to check up his bills. A number of companies send to the customer with his third or fourth bill, directions for reading meters, in the form of circulars, which serve a double purpose as they usually have an advertisement on the reverse side. "An ounce of prevention is worth a pound of cure" holds equally true in the electric lighting business as in other enterprises. It should be as much of the agent's or solicitor's duty to instruct the customer in the use of electric appliances as it is for him to secure his application; also to show him how to secure the best possible results for the least money. It devolves upon the solicitor to call upon the customer after he has been connected to the service to see if he is perfectly satisfied. This applies equally to the large and small customer. The time now seems ripe when the smaller companies are warranted in having a special agent to discover and fill the wants of the companies' present customers. The inauguration of a lamp renewal department often prevents a large number of complaints. Many companies now maintain such a department, the employees of which are constantly kept busy calling upon the companies' customers and renewing any burnt out or defective lamps. In conclusion, too much stress cannot be laid upon the importance of considering all complaints as inquiries.

Special Proposition for Residence Wiring at Wilmington, Ohio.

Mr. J. C. Martin, vice-president and manager of the Wilmington Water & Light Company, Wilmington, Ohio, has had in successful use for some time a plan to induce residence owners to wire their houses. Under this plan, the customer pays for the wiring in cash at the time the job is completed, but receives a rebate on his electric light bills until the bills aggregate an amount equal to a certain specified part of the cost of the wiring. In other words, the company gives him service for a certain length of time after his service is connected. The meter is read monthly, but no bill is presented until the customer has exhausted his credit. In the meantime, the family has contracted the habit of using electricity. They are always urged to take irons and as many devices as possible that consume energy. It would take two or three years to get them to use these under a different introduction plan. When his credit is used up, the customer may be surprised, but he has formed a habit that he will not care to change. The details of the method of determining how much of the cost of wiring shall be allowed on the customer's credit memorandum are interesting. The customer first fills out an application card on the accompanying form.

After this application is made and accepted by the company, an agreement is signed by the subscriber and by the company that the company will wire the premises complete at prices named in an itemized statement, which includes and specifies the items under Schedules A and B in the foregoing application. The company agrees that on the full payment of the total amount, the customer shall be entitled to a credit on his lighting bills for energy consumed to the amount of Schedule A. At the bottom of this agreement is a blank receipt which is signed by the collector when the job has been completed and the customer pays for the wiring. This receipt certifies that the subscriber is entitled to credit on future lighting bills due the company to the amount of Schedule A, specifying the exact amount. Mr. Martin stated before the last convention of the Ohio Electric Light Association that he had increased the number of customers from 159 to 700 since 1903, this being one of the plans used to secure the increase.



READ BEFORE SIGNING

Application to
WILMINGTON WATER & LIGHT COMPANY,
of Wilmington, Ohio.

The Subscriber ______________ ______ wishes to have the following property wired for Electric Lighting, to-wit: No. ______________ Street, and hereby agrees to pay for same on the first of the month following the completion of the work.

SCHEDULE A	SCHEDULE B
All wire used in work. All tubes, cleats and knobs Fuse blocks, all solder and tape. All labor.	All rosettes, sockets, lamp cord, switches, lamps, shades and rings.

The total of all items listed under SCHEDULE " A " to be allowed as credit on future lighting bills.

This subscriber agrees to continue to use the current of this Company for lighting for one year after said credit is exhausted.

Signed ______________________ Subscriber.

Accepted ______________

Date ______________ 1907.

This contract to be effective must be approved by the Manager of the Company.

Duplicate will be mailed subscriber.

APPLICATION CARD.

Business-Getting Campaign at Dubuque, Ia.

The Union Electric Company, of Dubuque, Iowa, under the management of Mr. L. D. Mathes, has for several years been considered one of the most progressive of the Iowa electric lighting companies in seeking for new business. Although the returns in Dubuque have not been as great in proportion to the labor expended in solicitation as in some other towns, the management is by no means inclined to relax its efforts to get new and more profitable business. In fact, Mr. Mathes considers that in view of the recent financial panic there is likely to be more of a falling off in central-station business during the early part of 1908 than is customary after the holidays. For this reason he has arranged to spend considerably more money than ever before in retaining old business and in seeking new business to counteract the general tendency of customers to retrench.

Dubuque is a prosperous, but very conservative trading and manufacturing city of about 40,000 inhabitants, in which many of the people are of thrifty German descent. This class usually does not spend money freely or take to innovations rapidly. This being the case, an electric lighting company coming into a city where gas has been strongly intrenched for many years, has much hard work ahead of it to get electricity as extensively used as in some newer cities, and must spend more to get a given amount of new business. The gross earnings of the company for 1907 are about $3 per capita.

WINDOW LIGHTING AT FLAT RATES.

Last October a movement was begun to get merchants to make a flat-rate contract for window lighting, the company switching these lamps in and out of circuit at stated times. Formerly, each merchant had his window lamps connected to the same meter as the lamps in the rest of the store and had to look after the switching of window lamps on and off himself.

The result of this was, as is usual under such circumstances, that the windows would be dark many nights per week because the merchant would turn off the window lamps at the time of closing the store, as he would have no means of turning them off later in the evening without hiring some one to do it or to return himself for that purpose.

It was calculated that the average number of hours, per day that a merchant's window lamps were burning under the meter system was about 1.5. The company went to the merchants with a proposition that the window lamps should be connected independently of the meter, and that the company should switch the window lamps into circuit each night at dusk and switch them out again at 10 p. m. every night except Saturday, when they are left in circuit until 11. They would thus average about four and one-half hours burning per night. For a merchant using electricity for lighting the interior of his store, the flat rate named in the contract was based on securing to the company a gross revenue of 6 cents per kw-hour. No rate, per kw-hour, however, is named in the contract. The contract simply mentions the amount to be paid per month, and the number and candle-power of the lamps. For customers who do not use electricity for the general lighting of the store, the contract for window lighting is figured at 8 cents per kw-hour. The company now has 31 flat-rate window and sign customers. Nearly all of these were changed from a meter rate within about a month. Many of these customers added to their window lighting at the time the change was made.

INEXPENSIVE STREET LAMP POSTS.

The aggregate result of this change was beneficial both to the customer and to the company. The customers are getting the benefit of evening advertising, which they did not get under the old arrangement, and the company has changed the load which formerly averaged only 1.5 hours per night into one averaging 4.5 hours per night.

The rate secured for electrical energy for the flat-rate business is, to be sure, lower than the meter rate, or there would be no inducement for persons to change to the flat rate other than that of having the lamps turned on and off. On the other hand, the net revenue of the company for window lighting is, of course, considerably increased. By getting some of the more progressive customers on flat-rate window lighting contracts so that their windows were lighted every night, other customers were obliged to keep windows lighted every evening and to increase the amount of window lighting in order to make as good a showing. This they were able to do because of the lower rate. Thus the movement acted as a general stimulus to the window lighting business in Dubuque, and caused it to assume a much more important position than heretofore. It takes one man about two hours per day to switch the lamps in and out of circuit.

In order to understand the relation of the flat rate to the existing meter rates, it may be said that the rate for commercial store lighting is 14 cents for the first two kw-hours' use per month per 16-cp lamp connected and 6 cents for all over that. In other words, the customer gets the 6-cent rate as soon as he has used the equivalent of 40 hours' use per month of his connected load.

In the down-town district of the city the full number of rates are the same, except that only one-half of the connected load in lamps is counted, heating devices being omitted. In the down-town district there is also an optional rate of 14 cents for the first 50 kw-hours used and 8 cents for all above that.

FREE LAMP POLICY.

The company has taken up promptly with all the new high-efficiency lamps and furnishes free Gem lamps, together with reflectors whenever they are located in stores or placed where they yield a steady revenue. Such lamps would not be furnished free for out-of-the-way places where they would be used only occasionally.

As a result of this policy very extensive use is made of Gem lamps, as they are seen everywhere in the down-town district. Much of the window lighting is done with Gem lamps in concentrating reflectors. The lamps are suspended from the ceiling of the window and are usually visible from the street. While this arrangement does not give as much illumination on the goods as some concealed systems do, it answers very well for conditions in the small city where the attractive appearance of the lamp itself is considered desirable, as well as illumination on the goods. Considerable light is thrown out on the sidewalk with this plan.

SOLICITATION AND ADVERTISING.

The company employed two solicitors up to Oct. 1, 1907, since which time three solicitors have been employed. The superintendent of the lighting department, Mr. H. G. Gorr, also makes estimates on large motor installations. The company has a very economical steam turbine-driven generating plant, and is gradually acquiring a load from some of the large factories in Dubuque.

From $75 to $80 per month is being spent in advertising in the two daily newspapers. Some is also spent for advertising in entertainment programmes and other places where the advertising value is doubtful, but where the company wishes to offer its support and good-will to the organization having the matter in charge. The regular space in the daily newspapers is 5 ins. double column. The same advertisement is inserted in both papers for a week and then changed. The company subscribes to the Curtis Advertising Company's monthly bulletin for distribution among present and prospective customers.

ELECTRIC TOASTERS.

Recently a special effort has been made to introduce the new electric toaster made by the Pacific Electric Company. This is believed by Mr. Mathes to be one of the best devices to push, next to the electric iron, because it is likely to yield a fairly steady revenue after once introduced, and it gives such excellent results. A circular letter was written offering to loan these toasters free to customers on thirty days' trial. They are sold at $4.90 each, and the company guarantees to maintain them, except for damages caused by misuse. About 40 toasters have been put out in this way.

LIGHTING OF OFFICES.

The company has offices on the main street which are fitted up in good taste, but without elaborate display. A few of the principal heating devices, and several sizes of motors, are kept on exhibition. Probably the most striking thing about the offices is the way in which they are lighted. The lighting is done by means of Gem lamps in type B bowl-shaped reflectors placed near the ceiling. They are suspended from the ceiling in a symmetrical design. The lamps have frostel tips and the bowl reflectors cover the lamp sufficiently so that no direct, undiffused glare from the lamp filaments can be seen. The result is a very pleasant and comfortable illumination, even though the lamps are large, being of the 187-watt and 250-watt size. The watts per square foot are 2.15, and the illumination on the desks is probably not less than 4 foot-candles, this illumination being very uniform over the entire room.

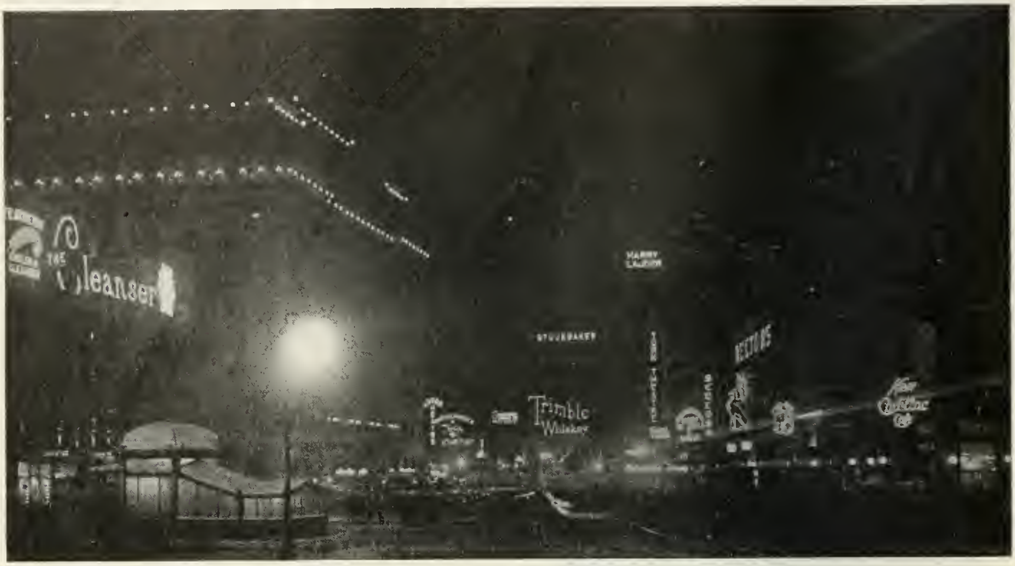


FIG. 1.—VIEW OF BROADWAY, NEW YORK, LOOKING NORTH FROM TIMES SQUARE.

ORNAMENTAL, INEXPENSIVE STREET LAMP POSTS.

In front of the offices and of the Julien Hotel, next door, a row of ornamental lamp posts has been installed, which is shown herewith. These posts are inexpensive, yet neat in appearance, and may give some good ideas in this line to others planning lighting of this kind. The lower parts of the post consists of lengths of different sizes of steam pipe fastened together with reducing nipples. The ornamental goose-neck was purchased from an electrical supply company.

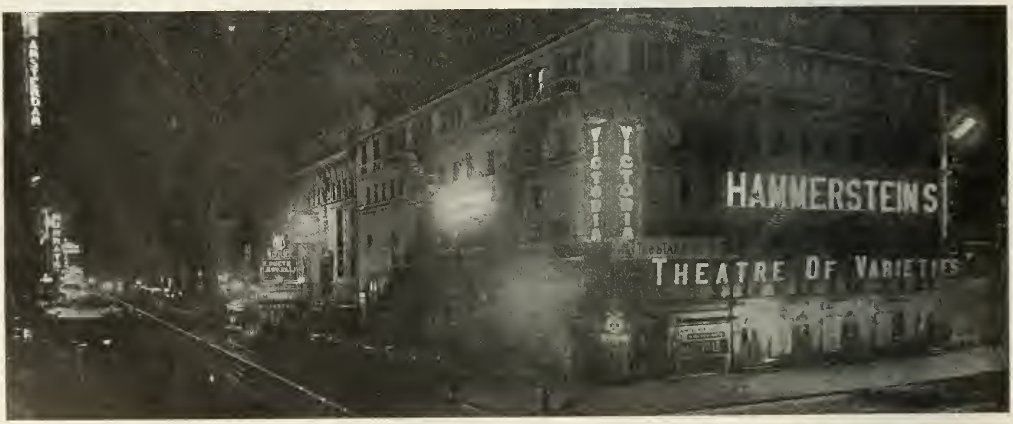


FIG. 2.—VIEW OF FORTY-SECOND STREET, WEST OF SEVENTH AVENUE.

Electricity in Modern Advertising.

One of the fundamental rules for successful advertising is that the advertisement shall appeal to the eye. It is universally recognized by advertisement writers that much depends on the display, so that consciously or unconsciously the appeal of the writer of advertising is not primarily to the reason, but to the sight.

The ultimate aim of any advertiser is to make the name of his product so well known that when one thinks of a particular article, or has a desire for it, he will recollect the advertiser's brand, and to this end the advertisement is so devised that a retinal image of the particular product, or of its name or trade mark, is readily transferred to the brain of the public. As one writer on publicity has said: "What devotee can readily forego the spell cast by the electric time recording sign with its direct command: 'Time to Take a Wilson Highball,' when seated in a club or cafe, after watching the marvelous working of its electric mechanism and play of light."

This leads up to the illuminated advertisement or the electric sign. The enormous increase in the use of electric signs throughout the United States simply means that its possibilities as a trade bringer are becoming recognized. When the electric sign was first introduced it consisted of a painted surface illuminated by electric lamps. Gradually individual letters studded with incandescent lamps came into use, then the talking sign, followed by the animated electric sign. No single feature has contributed so largely to the growing popularity of this means of advertising than the easy adaptability and flexibility of the electric sign in fulfilling the requirements of advertisers; while the low cost that attends even a lavish use of electricity for purposes of advertising is an additional incentive to use this form of publicity.

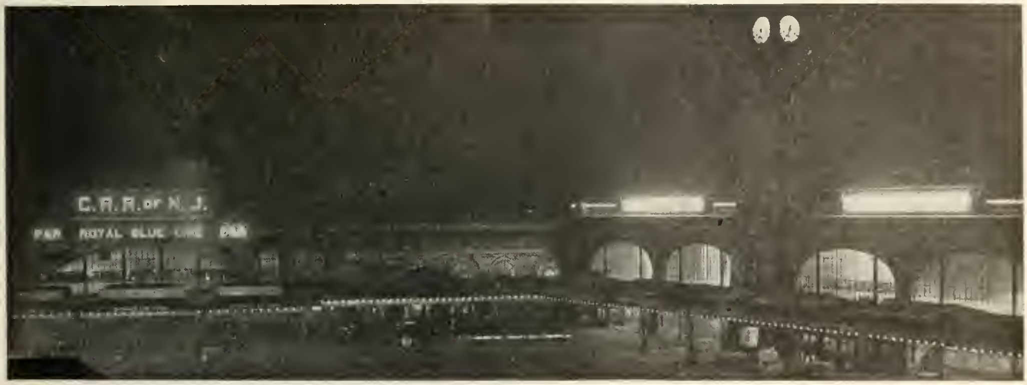


FIG. 3.—SIGNS ON FERRY HOUSE AT TWENTY-THIRD STREET AND HUDSON RIVER.

The sign of the time is unquestionably the electric sign. Probably nowhere is this more noticeable than in and around New York City, where it would seem every available roof, wall and vacant lot space is utilized to exploit the merits of some modern commodity. Visitors to the metropolis cannot be but strangely impressed with the wonderful showing. Some idea of the efficiency and popularity of advertising in New York City may be gained from the rental paid by one of the outdoor advertising companies for the roof privileges at Broadway and Thirty-fourth Street facing Herald Square. The yearly rental of this desirable location on a three-year contract is reputed to be $50,000.

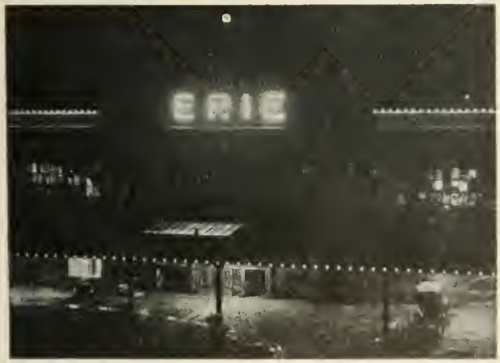


FIG. 4.—RAILROAD FERRY SIGN ON TWENTY-THIRD STREET.

The commodities advertised by means of the electric sign include everything salable. No matter if it be a name, a brand of goods, or a place that the advertiser desires to impress on the mind of the public, he finds that the electric sign answers the purpose best. The demand for more light is becoming greater and greater, and with the increase of light comes the safety of travel at night. Advertisers appreciate the fact that the greater the amount and the longer the hours of illumination the later does the hour for retiring become.

The advertiser who obtains the greatest benefit from an electric feature is the one whose ideas and sign are large enough to startle the public. There are approximately 2000 hours of darkness in a year between the hours of dusk and midnight. If the class of goods advertised is such that it might attract the attention of the general public, these hours are good for advertising in, since those who patronize the theaters, social affairs, and the functions which cause them to be around late at night, have great purchasing ability. Every theater of any consequence is equipped with an electric sign and on the principal streets of almost every live town are to be found illuminated signs, windows, etc., to attract the attention of people at night when the cares of business life are set aside.

The merits of electrical advertising are independent and self-sustaining if the business or commodities advertised are worth advertising. All of the large outdoor advertising companies use it in large cities both here and abroad. In Paris, for instance, there are over 3000 electric signs in use and one company pays over $40,000 per annum for electricity used for this purpose.

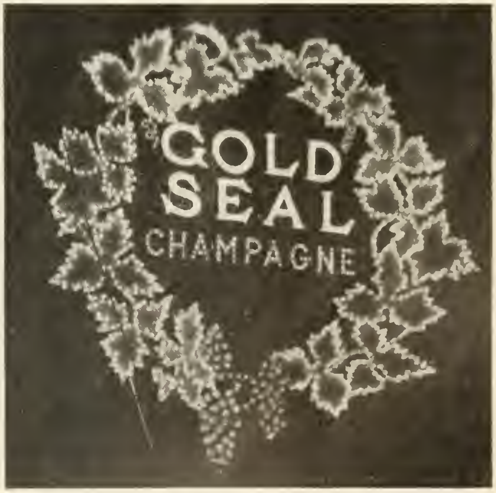


FIG. 5.—ARTISTIC SIGN ON BROADWAY.

It is significant that the national advertisers are great users of electric signs. In all of the large cities of the country and on their factories and salesrooms, these national advertisers have erected magnificent signs of huge proportions. Along the railroad tracks may be seen factories with large electric signs on their roofs. Boards of Trade in numerous cities have erected signs for the purpose of advertising their cities. In fact there is no business or attraction which appeals to the public that cannot be advanced by the use of electric signs.

Before the era of electric illumination of show windows and signs, the merchant pulled down his shades when the store was locked for the night. His business stopped, although his expense went on. Now the multitude at night is attracted to the windows by tempting displays well lighted until midnight and the desire to purchase is aroused. To electric signs and electrically lighted windows many cities owe their brilliantly lighted thoroughfares.

Electric light companies oftentimes supply the electric energy for the lamps at a flat rate, the company controlling the circuit. The service extends to midnight and the lamps are switched into and out of circuit by a time clock or by a man employed for that purpose. The majority of the lamps used in signs are of four candle-power, although 2-cp, 8-cp and 16-cp lamps are often used. Where bill boards are illuminated, arc lamps, flaming arc lamps and 16-cp incandescent lamps are used, the arc lamps being provided with shades and reflectors and hung some distance from the sign and about abreast the center. Incandescent lamps are placed in troughs suspended about 6 ft. from the sign and even with the top of it.

It is not the purpose to touch on spectacular advertising in this article, and by that is meant signs operated by flashers or other motor-driven devices, since these will be covered in a subsequent article. The accompanying illustrations show portions of "The White Way" of New York City. Fig. 1 showing the view looking up Broadway from Times Square, although scarcely doing the thoroughfare justice owing to the shortcomings of the photographic art, gives an idea of the extent to which electricity is employed for sign lighting in New York. Fig. 2 shows a view looking west on Forty-second Street from Seventh Avenue. This shows the heart of the theater district. Broadway at this point is a bewildering confusion of electric and painted signs that in itself is sufficient to interest and amuse the visitor to the city. Much has been written on the sign display along Broadway; but so many new and novel signs constantly appear that the subject never really grows stale.

Broadway, however, does not monopolize all of the electric signs in New York City, nor is New York the only city in which electric signs exist. It is surprising to note how the railroad companies have taken to the electric sign and also to what an extent electric signs are used along New York's river front. In the latter case the use of immense signs is in a measure restricted owing to their effect upon navigation. Figs. 3 and 4 show signs at the railroad ferries at Twenty-third Street and the Hudson River. Those shown in Fig. 3 are lighted with incandescent lamps, while the word "Erie," in Fig. 4, is lighted by mercury vapor lamps.

Many of the large signs in New York and other cities used by national advertisers are very artistic by day and by night. These are usually erected on steel frame-work with individual letters and borders, the trade-mark oftentimes being painted on glass behind which incandescent lamps are placed. The lamps used are either colored glass or are fitted with color caps, and at night, the steel frame-work being invisible, the color effect is beautiful. Fig. 5 shows one of these signs.

Electric signs are used by the leading theaters of the country and within the past few years the number of such signs has increased enormously. The greater part of the theater signs are made of angle iron with individual letters, the feed wires for which are carried in conduit back of the supporting rails. "T" outlets are provided every 12 ins., through which a spur of wire projects and on each spur is fastened a copper connector bushed with rubber tubing and compound.

The Electric Flat Iron.

By W. J. Barr.

One of the most difficult problems in the manufacture of electric heating appliances is the construction of the heating elements so that these will stand the occasional neglect of remaining in circuit when not in use; give even distribution of the heat generated, be quick acting and yet not overheat. The electric flat iron, now turned out by many manufacturers, no longer gives any serious trouble, and conservative central station men, who have heretofore regarded the sale of these devices as imprudent, may now introduce them with confidence of permanent results. More attention has been given to the manufacture of the flat iron lately because it has a great commercial value, and because it of all heating devices is best appreciated in the home supplied by electricity.

While the electric iron is gradually becoming a salable article in department and other stores, it is not yet so well known or understood as to make it much of a factor in the sale of electrical energy. For several years to come, it may be necessary and advisable for electric light companies to make vigorous "introducing campaigns." The 30-day trial proposition, so much in vogue at present with central station men already engaged in this work, has been a pronounced success. The reported "returns" have not averaged more than 5 per cent and with the improvements this should be very much lessened.

It has been intimated from many sources that a reduction in price of all heating appliances would be beneficial. To the purchaser not conversant with the convenience of the electric flat iron, the present price doubtless injures quick sales. It is questionable, however, whether price reductions will obtain. There was a period when incandescent lamps cost 30 cents; later they could be purchased for as low as 10 cents, and now many are willing to pay 60 cents each for lamps of recent invention; and engineers firmly believe that these high-priced lamps are the lamps of the future. It is not likely that heating appliances will increase in price in this ratio, but necessary improvements will add to the cost of construction and, as with the high-efficiency lamps, people will be willing to pay the added cost. The improvements referred to are such as will assure long life to the heating units, together with the introduction of devices to render the flat iron impossible of overheating.

The present price, however, should in no way limit the sale of the electric flat iron. In order to substantiate the claim of convenience, the central station management must permit free use of these appliances for a period. If after investigation it should be considered impossible to effect sales because of the poor clientage, it should be borne in mind that electric flat irons can be given away with profitable results.

Much of the general advancement in the manufacture of electric flat irons and cooking utensils has been due to the counsel given by central station men to the manufacturers of such apparatus at several conventions; and the manufacturers have not been lax in following advice that will result in enhancing the security, comfort and enjoyment of heating devices.

LETTER TO THE EDITORS.

Capitalizing New Business Investments.

To the Editors of Electrical World:

Sirs:—An interesting and important question relating to American central station finances is whether money spent in building up central station earnings in a commercial way be charged as investment, just as is money spent in building up the tangible, physical property. This question has not come up in this exact form to any extent as yet because of the small amount of commercial cultivation done by most central station companies prior to three years ago, and because of the general custom of charging money spent in getting new business to operating expenses. The practice of charging all expenses of the commercial department to operation is safe and conservative, but it would seem illogical to deny to a corporation the privilege of charging to capital account investment which is essential to the earning power of the business. If a central station company can by organized solicitation secure profitable business and thereby can put itself on a dividend-paying basis where otherwise it would pay nothing, there has certainly been something put into the business in the nature of an investment. This question is of immediate practical importance in two connections. One of these is where a company has just spent considerable money enlarging its plant and will have an idle investment upon which to pay interest if money is not spent in getting enough business to put this investment to work.

Another practical bearing of the question relates to appraisals and reports to state public service commissions which control the issuance of securities and other financial operations of electric lighting companies. The commissions have been generally inclined to the idea that only physical property should be included in capital or investment charges. This has been on the theory that whatever is earned over and above fair interest on physical value of the property represents value of the franchise, and that the franchise belongs to the people, who should receive whatever benefits are derived therefrom, either in the shape of taxation or increased rates. This theory is coming to be rather generally accepted as regards public utilities in which there is little risk. As regards central station enterprises, however, there is enough risk to call for some compensating advantages in the way of possible greater returns than common rates of interest, in order to induce capital to invest in such enterprises.

But, even taking all these things into consideration, thus far there has been no recognition of the principle that allowance should be made for money spent in purely commercial development and which in the general business world is capitalized under the head of "good name." It is undoubtedly true that the gates should not be opened to loose practices in charging money spent in commercial development to capital account. An immense amount of money can be wasted in misdirected commercial attempts at promotion. On the other hand, much money is frequently wasted on the physical property of a company through bad engineering judgment and the purchase of apparatus unsuited to the company's needs.

New York, N. Y. Charles L. Ford.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Covering Open Slots.—R. Goldschmidt.—The author has made experiments to improve the quality of direct-current machines with open slots by covering the slots with pieces of iron. Methods of doing this are described and the results of experiments show that the heating, the iron losses, and the exciting current are diminished.—*Elek. Zeit.*, Dec. 5.

Induction Motors.—R. Goldschmidt.—The first part of a theoretical paper in which the author develops methods for the calculation of the no-load current and the leakage reactance of three-phase, two-phase and single-phase induction motors, taking account of all influences as far as possible.—Lond. *Electrician*, Nov. 29.

Lamps and Lighting.

Carbon-Filament Lamps.—With reference to the article of Teichmueller, recently abstracted in the Digest, on standard carbon-filament lamp specifications in Great Britain and Continental Europe, the great difference between the official definition of a good carbon lamp in the United Kingdom and in Austria, Germany and Switzerland is pointed out. This is chiefly due to the fact that the German hefner candle is only 0.88 British candle. The following comparisons between a British standard 220-volt, 800-hour 16-cp lamp and a Continental 16-hefner-cp lamp rated at the same life and voltage, are instructive:

	British Standard Lamps.	Continental Standard Lamps.
Candle-power (British)	16.	14.
Total watts	65.6	63.
Watts per candle-power	4.1	4.5

A comparison of the British 8-cp with the foreign 10-hefner-cp of the same voltage and rated life is still more useful:

	British Standard Lamps.	Continental Standard Lamps.
Candle-power (British)	8.	8.77
Total watts	36.	45.
Watts per candle-power	4.5	5.13

The difference in specific consumption, it will be seen, is actually 24 per cent in favor of the British lamp. A further examination of the foreign official standards shows that an 800-hour 8-cp British lamp has a lower initial specific consumption than a 600-hour standard Continental lamp.—Lond. *Elec. Eng'ing*, Dec. 5.

Metallic Filament Lamps and the Central Station.—An anonymous article "by a lamp maker," who says that the low-efficiency carbon-filament lamp is doomed and that the metallic-filament lamp will surely take its place. He says that the 8-cp, 8-watt lamp of high voltage is surely coming. It has been argued that as a result a loss of revenue might be expected in central stations, but that the decreased revenue would be balanced by an increased use of electric light. The author thinks this argument is all wrong. He says the householder is not going to use any more light than he really needs. The commercial lamp unit is now quite as high as the present standard of domestic comfort desires, and although in time it may increase somewhat, it will not do so to any appreciable extent. If under the present method of distribution of electric light and rates of charging new outlying districts should be attracted, the author thinks that this will not provide sufficient revenue to balance the reduction in the income from present customers. On the contrary, under existing methods of charging it will be financially disastrous to couple up the additional customers. The author gives various figures and estimates to prove this, and his conclusion is that the metallic-filament lamp has come to stay and that radical alterations in systems of connections and charging will be necessary unless disastrous results are invited. What radical alterations he advocates, he does not say in detail. Lond. *Electrical Engineer*, Dec. 6.

Street Lighting.—H. Harrison.—A note on the lighting of three London streets with similar types of lamps. The tests were made with a universal flicker photometer measuring direct illumination. The results showed that illumination obtained depends not only on the lamps used, but also on the method of their installation. The low minimum illumination in one of the three streets is to a large extent due to the low candle-power of the two lamps at rays approaching a horizontal, which is accentuated by the lamps not being erected as high as they should be. The good results obtained in the best lighted of the three streets are due simply to the correct arrangement of the lamps in proper distances and at proper heights, and have not involved any appreciable increase of cost.—Lond. *Electrical Review*, Dec. 6.

Plain and Frosted Lamps.—E. P. Hyde and F. E. Cady.—A long illustrated paper giving a comparative study of plain and frosted lamps. This paper is an enlargement of the National Electric Light Association paper of the same authors.—*Bull. Bureau of Standards*, Vol. 4, No. 1, December.

Power.

Cost of Steam Power Plants.—F. Koester.—An article giving figures on the cost of constructing steam-driven electric power plants. The figures represent average recent practice and are quoted per kilowatt of rating. The superstructure for plants up to 5000 kilowatts costs from $15 to $25 per kilowatt, for larger size plants from $10 to $20. A radial brick chimney for large-sized power plants costs from $1.75 to $2.25 per kilowatt; reinforced concrete chimneys and plate-steel chimneys may cost from $1.50 to $2. The figures for equipment for handling coal and ashes range from $1.50 to $3; those for cost of water-tube boilers from $8 to $10, with from $2 to $3 extra for mechanical stokers. Steam-driven blowers for induced draft cost $1 per kilowatt. Where economizers are installed of sufficient rating to heat water from 200 to 220 deg. F., they cost about $2 per kilowatt. The cost of boiler-feed pumps alone is some 50 cents per kilowatt; when storage tanks are necessary, the combined outfit costs from 75 cents to $1. Piping may cost from $2 to $6. For plants varying from 10,000 to 20,000 kilowatts in rating, the piping system not being elaborate, but sufficient for continuous operation, from $2.50 to $2.75 has covered the cost, including a high grade of covering for steam piping. A 5000-kw turbo-generator should cost from $20 to $22 per kilowatt. Reciprocating engines of this rating are sold at roughly the same price, and about $10 per kilowatt is to be added for the generator. The total cost for smaller units, of from 600 to 3000 kilowatts, is from $20 to $25 per kilowatt, whether they consist of turbine or reciprocating-engine apparatus. The cost of jet-condenser equipment runs from $3 to $5 per kilowatt; that of surface-condenser apparatus from $5 to $8, though it may be less in special cases. A steam-driven exciter unit costs from 35 to 40 cents per kilowatt. If a condenser should be installed in connection with it, the cost may run as high as 70 cents per kilowatt, assuming that the exciter rating is equal to approximately 1 per cent of the total rating of the plant. For high-tension equipments, the cost of the switchboard runs from $2 to $3.50, while for low-tension (2300 volts or less) the switchboard costs from $1 to $2 per kilowatt. There are many other items, such as traveling cranes, which will amount to 25 to 50 cents per kilowatt. Smaller items, like house pumps, water meters, etc., may total from $1 to $2 per kilowatt. In tabulating the total costs of a power plant, separate figures are given by the author for steam-turbine plants and reciprocating-engine plants. The cost of a steam-turbine plant per kilowatt, when exceptionally low, is $65, and a fair average is $103. The corresponding figures for reciprocating-engine plants are $70.25 and $104.50. But plants have been installed which cost as much as $125 and $150 per kilowatt. All these figures refer to plants of large rating. Small plants of about 3000 kilowatt rating have been erected in the West at from $120 to $130 per kilowatt, which cost may be reduced if a simple combination of machines is provided.—*Eng'ing News*, Dec. 19.

Superheat.—Ulrich.—A review of the use of superheated steam in electricity plants. The limit to which it is economical to superheat the steam is determined by the saving of steam and fuel on one hand, and the extra expense of first cost and maintenance of the superheaters on the other hand. Only a few of the older reciprocating steam engines are suitable for effective superheating, although with old boilers with very wet steam and badly utilized heating gases even the drying of the steam may have economical advantages. Even with the more modern reciprocating engines it is economical only in exceptional cases to superheat to more than 250 deg. steam temperature. It is different with steam turbines, which are suitable for superheating to 500 deg. almost without exception.—*Elek. Zeit.*, Dec. 5.

Power from Peat.—T. Tomlinson.—The author discusses the possibilities of utilization of peat for energy production in Ireland, and seems to favor the use of peat in gas producers for the production of power in gas engines with simultaneous recovery of the ammonia.—Lond. *Electrical Review*, Dec. 6.

Electric Power in Iron and Steel Mills.—W. E. Reed.—In iron and steel mills special arrangements must be made to overcome the disadvantages of the large fluctuating loads. In a continuous mill this is simply accomplished by increasing the flywheel effect. On the other hand, in reversing mills when the rolls are to be reversed, the kinetic energy, or flywheel effect, of the reversing parts should be reduced to a minimum. One form of equalizer that is suitable for these requirements consists of a motor-generator flywheel set connected between the roll-driving motor and the source of energy. A recent continuous mill installation is that of the Edgar Thomson Steel Works, which is equipped with two 1500-hp, compound-wound, 220-volt, 100 to 125 r. p. m. direct-current motors, which are direct connected to the rolls. A 125,000-lb. cast-steel segmental flywheel, 18 ft in diameter, is mounted on the motor shaft to assist in equalizing the load on the motor and power house The speed of the motor drops from approximately 125 to 90 r. p. m. in actual operation, which allows the flywheel to take care of the peak loads. A reversing mill installation is at the Hildegrade Works, in Australia, which has already been noticed in the Digest. Another is at the Illinois Steel Works.—*Elec. Journal,* January.

Electric Motors in Textile Factories.—W. B. Woodhouse.—A paper read before the Bradford Engineering Society on the use of electric motors in textile factories. Since a very large proportion of textile machines are required to be run at a constant speed, the most suitable type of motor is the alternating-current induction motor. The individual drive has important advantages, due to the elimination of belts, gearing, shafting and resulting in the reduction of power, and the advantage of freedom from limitations as to the position of machines. In the matter of capital cost, the electric drive effects considerable saving in a new mill. The building may be much lighter in construction. Moreover, there is an important increase of output due to the steadiness of speed.—Lond. *Electrician*, Nov. 22.

Electric Motors in Cement Works.—A fully illustrated description of the electric motor equipment of a British cement works. Direct-current motors are employed on a three-wire system, so as to get a fairly wide range of speed.—Lond. *Electrical Eng'ing*, Nov. 28.

Electric Cranes.—H. H. Broughton.—A continuation of his illustrated serial. In the present instalment the author discusses the brakes necessary in connection with crane motors. These may be either electrical or mechanical, although the latter are not now much in use. Brake-releasing electromagnets are then dealt with, and a description is given of one made by the Helios Company. The author concludes with a description of the solenoid brake made by Siemens Brothers.—Lond. *Electrician,* Nov. 22.

Cranes.—A brief description, with illustrations, of the electric crane equipment of the new steamers *Lusitania* and *Mauretania.* The equipment consists of four deck cranes and four baggage and mail hoists.—Lond. *Elec. Engineering,* Dec. 5.

Energy Transmission by Alternating Currents.—C. Breitfeld. —An article in which the author shows how to determine a certain important constant in Roessler's theory of energy transmission by alternating current.—*Elek. und Masch.*, Nov. 24.

Traction.

Brake.—An illustrated description of a new electromagnetic brake devised by A. W. Maley. No braking effect whatever is exerted on the wheels, and reliance is placed entirely on the braking effect upon the track. The brake is a combination of slipper blocks in front of and behind a powerful electromagnetic brake, the whole acting on the track. A side elevation of the device is depicted in Fig. 1, which shows how the magnetic brake is linked up mechanically to the leading and trailing shoes. The descent of the magnet also causes the shoes linked up to it to make contact with the rail, and the three blocks exercise a powerful retarding effect on the car. The magnets are excited either by the current taken from the motors acting as

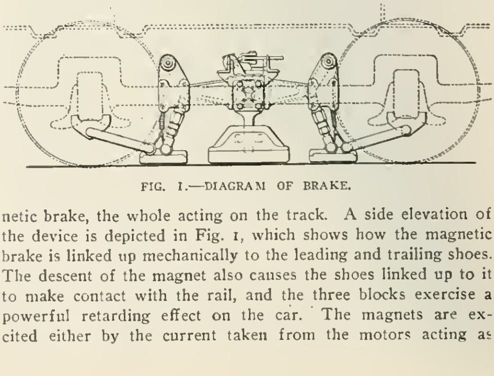


FIG. 1.—DIAGRAM OF BRAKE.

generators or by the operation of a special canopy switch; they may be energized directly from the trolley wire. It is claimed for the equipment that it affords three distinct brakes, two of which may be applied instantaneously, and no one of which reduces the braking effect if simultaneously applied with any of the others. The first brake is the electromagnetic track brake operated in conjunction with the motors, being suitable for all purposes, service, emergency and coasting. Second, there is the electromagnetic brake operated from the trolley line, which represents a powerful emergency brake. Thirdly, there is a manually-applied track brake suitable for service and coasting, and, in the event of failure of both the first and second brake, it represents a better reserve brake in case of runaway than existing wheel brake. Tests recently made at Leeds appear to have given very satisfactory results.—Lond. *Electrician,* Nov. 29.

Installations, Systems and Appliances.

Knife Switches.—W. O. Milton.—A second article in his illustrated serial on circuit-interrupting devices. The author discusses various points of the design of knife switches with reference to the rules of fire underwriters. Switches are generally made of the best hard-drawn copper with a current density of from 800 to 1000 amperes per sq. in. of cross-section area and from 50 to 75 amperes per sq. in. of contact surface. In the construction of the base, slate or marble is efficient in radiating heat. The radiation increases somewhat more rapidly than the rise in temperature, and since the heat generated varies as the square of the current, the temperature rise will be somewhat less than proportional to the square of the current. Thus a switch which will carry 1000 amperes with 20 deg. rise will carry 2000 amperes with about 60 deg. rise. The underwriters require that knife switches must operate successfully at 50 per cent overload in amperes and 25 per cent excess in voltage, under the most severe conditions with which they are liable to meet in practice. To make sure this is the case, the following minimum breaking distances and spacings between poles of knife switches for 250-volt service should be carefully maintained.

Amperes.	Minimum separation of metal parts of opposite polarity	Minimum break distance.
10 or less	1½ in.	1¼ in.
11 to 30	1¾ "	1½ "
31 to 100	2¼ "	2 "
101 to 300	2½ "	2¼ "
301 to 600	2¾ "	2½ "
601 to 1000	3 "	2¾ "

Generally the following two tests are made: A drop test and an insulation test. The drop test consists in taking the drop across the switch at full load. This should not exceed about 12 millivolts from jaw block to jaw block. The principal object of this test is to insure good contact between the jaws and blade. Moreover, a reasonably small temperature rise is assured if the drop is low. The insulation test consists in testing between break and hinge jaws with switch open, between opposite poles, and from jaws to ground. In the test an e. m. f. of from 3000 to 5000 volts is used, the principal object being to test the base. In order to prevent surface leakage the distance from nearest live metal part to ground should never be less than ½ in. For cross-bars, wood is most suitable; it should be thoroughly dried and treated so that it will not absorb moisture. In the design of lugs, all sections should be large enough to afford about 1 sq. in. for each 800 amperes where copper is used, and for brass lugs the sections should be larger in proportion to the reduction in conductivity.—*Electric Journal,* December.

Starting and Protecting Alternating-Current Motors.—A description of a device for starting and protecting alternating-current motors. The arrangement suitable for a three-phase induction motor is shown in Fig. 2; it is fitted with an overload coil, which is in series with a secondary, and the no-voltage release coil which is connected across one of the primary or stator phases. *R* is the rotor, *S* is the stator, *L* the line, *A* the overload coil, and *B* the no-voltage coil already referred to. The overload coil *A* is disposed in such a manner as to open the circuit of the no-voltage release coil *B* in case it should operate; that is, if an overload should occur. Fig. 2 shows the connections when the motor is running. In starting up the motor the brush-carrying lever *C* closes first the primary or stator circuit of the motor, and is then successively moved over the various contacts C^1, C^2, C^3, C^4, C^5, finally reaching the last contact C^6, or the running position, where all the resistance is cut out, and where it is held closed against the tension of a spring *D* by a suitably arranged hook *H*. The spring *D*, for commercial purposes, is really situated in the center of the brush-carrying lever *C*, but for the sake of clear illustration, it is here arranged as shown in the illustration. To make clear the working of the device, we will suppose that through some cause the supply is cut off from the motor. In such a case the no-voltage release coil *B* receives no current, and will consequently release its core, which is arranged so as to fall down on the hook *H*, and the brush-carrying lever *C* at that moment, through the influence of the spring *D*, flies back to the "off" position and thus disconnects the motor from the line. If the motor is overloaded, it is obvious that the current in the rotor circuit will increase in practically the same proportion as the stator or line current, and the overload coil, therefore, will operate. In doing so the coil opens the circuit of the no-voltage release coil *B*, and the brush-carrying lever *C* again flies back to its "off" position as before, thus disconnecting the motor from the line. If the supply should be cut off on one of the phases only, as sometimes happens when one of the main fuses blows or through the breakage of a wire, the machine will continue to run as a single-phase motor, but the rotor current will increase in a most dangerous manner even if the motor carries only a comparatively small load. The overload coil *A* in such a case will immediately operate and this causes the motor to be cut off from the line as before.—Lond. *Electrical Review,* Dec. 6.

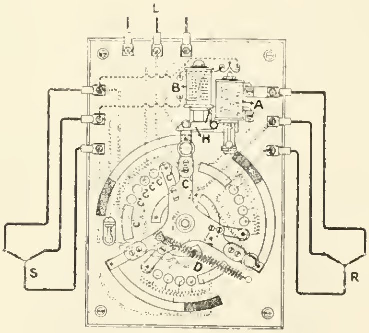


FIG. 2.—DIAGRAM OF CONNECTIONS.

Special Applications of Standard Transformers.—H. W. Young.—In a case in practice it was important to install without delay transformers for raising the e. m. f. from 360 volts primary to 2400 volts secondary. This became possible by means of ordinary standard transformers as follows: Both a standard transformer for 120-volt primary, with a 20 to 1 ratio, and a standard transformer for 240 volts primary, with a 10 to 1 ratio, give 2400 volts secondary. Since 120 + 240 equals 360, it will be seen that if two transformers were used with their high-tension windings in parallel at 2400 volts and their low-tension windings in series, one connected for 240 and the other for 120 volts, the group would operate at a ratio of 360 to 2400 as desired. This was successfully done in the case in practice, where 15 kilowatts were to be dealt with. It may be noted that full-load current for the 10-kw transformer at 240 volts corresponds to the current of the 5-kw transformer at 120 volts, thus permitting the operation of the transformers in series on the low-tension sides, as indicated. The author shows some other special applications of the regular types of transformers and deals with the following two problems in detail: The first is to get 7.5 kilowatts at 500 volts from a 60-cycle, 1000-volt circuit with the standard transformers available. The second problem is to get 250 volts for starting and 400 volts for running a three-phase, 20-hp, 60-cycle motor from a 1150-volt line.—*Electric Journal*, December.

Wires, Wiring and Conduits.

High-Tension Cables.—C. FELDMANN AND J. HERZOG.—An article on the construction and testing of high-tension cables with special reference to grading the insulation. Commercial cables for e. m. f.'s of from 25,000 to 30,000 volts are now available, and are quite satisfactory. Long tests with the use of double or three times the normal voltage may weaken the interior layers of the insulation without the cable breaking down during the test. It is, therefore, preferable to make short tests with a moderately increased voltage. Such tests are fully sufficient to find any weak points of manufacture.—*Elek. Zeit.*, Dec. 5.

Cable Drum.—H. SCHULTZ.—An illustrated description of a transportable cable drum used by the German telegraph department and operated by electricity, the generator being driven by a gasoline engine. These machines and the cable drum are placed on two trucks.—*Elek. Zeit.*, Nov. 28.

Fuses.—An account of the discussion which followed the recent Berlin Electrical Society paper of Meyer on theory and practice of fuses. Emde gave some notes on the operation of fuses on the basis of Fourier's theory of conduction of heat.—*Elek. Zeit.*, Nov. 28.

Wooden Poles.—R. NOWOTNY.—An article on the life of wooden poles in Austrian transmission lines. In view of the increasing cost of wood, it is important to counteract the gradual destruction of the wood, and for this purpose the Austrian Telegraph Department is making experiments with new methods of impregnating poles for their protection.—*Elek. und Masch.*, Dec. 1.

Electrophysics and Magnetism.

Weighing a Magnet in Varying Magnetic Fields.—L. A. BAUER.—An abstract of an American Physical Society paper on results of careful weighings of a magnet in various magnetic fields. The magnet was weighed in two horizontal positions, and also in two vertical positions at various places in Canada and the United States. One of the conclusions of his measurements is that the mean result of weighings of a magnet in two positions 180 deg. apart will not necessarily give the true weight or, say, the weight which the same substance would have if demagnetized. This was proved also by repeated magnetizations and demagnetizations of two different magnets. To get the true weight of a magnet within the accuracy attainable with the balance used, the weighings of the substance when magnetized would have to be made for at least eight equidistant positions.—*Physical Review*, December.

Radium Emanation.—A. S. EVE.—A paper on the amount of radium emanation in the atmosphere near the earth's surface. The emanation in the atmosphere is absorbed by cocoanut charcoal; its presence can be proved and its magnitude determined. The author has made four measurements at Montreal, and the results are given in terms of the amounts of radium required to maintain the supply per cubic meter constant. The amount of emanation is of the correct order to account for the active deposits of radium-C which may be collected on negatively charged wires from the atmosphere.—*Phil. Mag.*, December.

Magnetic Testing of Iron.—W. H. F. MURDOCH.—A paper describing a simple permeameter for workshop testing of iron which has the advantage that the material tested may be in very large pieces. The accuracy aimed at is about 5 per cent. The arrangement is indicated in Fig. 3, where *A* is the bar to be tested and *B* the yoke. A tractive effort is exerted on *A* in the direction of the arrow by means of a weight suspended over a roller. The friction pull is determined both with magnetized and unmagnetized magnetic circuit.—Lond. *Electrician*, Nov. 29.

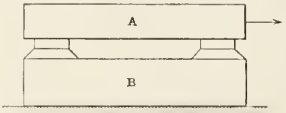


FIG. 3.—MAGNETIC TESTING OF IRON.

Miscellaneous.

Wireless Telegraphy.—F. A. FLEMING.—His full (British) Physical Society paper on the theory of magnetic oscillators as radiators in wireless telegraphy.—*Phil. Mag.*, December.

BOOK REVIEWS.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Vol. 14. Edited by D. C. Jackson, C. L. Crandall and W. T. Magruder. New York: Engineering News Publishing Company. 300 pages. Price, $2.50.

This volume contains the proceedings of the fourteenth annual meeting of the Society for the Promotion of Engineering Education, held in Ithaca, N. Y., last year. Several of the papers treat subjects of specific interest to the electrical engineer, and almost all the remainder have a general interest for him, as they treat of various phases of engineering education in general. Among the former class of papers are one by Prof. Henry H. Norris, of Cornell University, on "Blank Forms for Use in Electrical Engineering Instruction," a topical discussion as to the profitability of undergraduate instruction in the design of electrical machinery; "Work in the Mechanical and Electrical Engineering Laboratories of Sibley College," by Prof. R. C. Carpenter. Prof. Charles F. Burgess, as chairman, submitted the report of the committee on technical books for libraries, which includes a list of periodicals and books on science and technology for the reference library, and lists corresponding to the various branches of engineering. Those for electrical engineering are grouped under the heads of electricity and electrical measurements; dynamo-electric machinery; electrical power transmission; telephone and telegraph; electrochemistry and batteries; miscellaneous applications of electricity. Related subjects covered by lists are inventions and patents, materials, drawing and designing. Biography is also represented by a list of books.

THE STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS. New York: McGraw Publishing Company. 1300 pages; 1300 Company. 300 pages. Price, $2.50.

A complete review of a book of this character would occupy more space than could be possibly devoted to the purpose, therefore we must confine ourselves to a general description of the book as a whole. The entire field of electrical engineering has been more completely covered in this book than in any similar book the writer has seen, not excepting those published in England, Germany, France and Italy. It is a book of which American engineers can well be proud. One of the most striking and satisfactory features is the method of treatment. The field is divided into 20 sections, each section being treated as a unit. The list of sections and authors is as follows: 1. Units, by Otis Allen Kenyon; 2. Electric and Magnetic Circuits, by Otis Allen Kenyon; 3. Measurements and Measuring Apparatus, by Otis Allen Kenyon; 4. Properties of Materials, by Otis Allen Kenyon; 5. Magnets, by Otis Allen Kenyon; 6. Transformers, by A. S. McAllister, Ph.D.; 7. Electric Generators, by H. M. Hobart and Otis Allen Kenyon; 8. Electric Motors, by A. S. McAllister, Ph.D.; 9. Batteries, by Edward Lyndon; 10. Central Stations, by R. C. Beardsley and George Shaad; 11. Transmission and Distribution, by Arthur Vaughan Abbott and Otis Allen Kenyon; 12. Illumination, by Louis Bell, Ph.D.; 13. Electric Traction, by A. H. Armstrong; 14. Electrochemistry, by E. F. Roeber, Ph.D.; 15. Telephony, by Kempster B. Miller; 16. Telegraphy, by Otis Allen Kenyon; 17. Miscellaneous Applications of Electricity, by Otis Allen Kenyon; 18. Wiring, by William H. Onken; 19. Standardization Rules; 20. Tables and Statistics.

The order of arrangement seems to be: Principles, theory, apparatus, generation, transmission, distribution and utilization. This scheme is carried out in the arrangement of the sections with reference to one another. Each section in itself forms a complete, but condensed, treatise of the subjects covered by its title. This arrangement is logical and notably free from repetition, frequent use of cross-references being made.

There are many novel features embodied in this work, but the most notable departure from usual practice is the method of indexing. The paragraphs of each section are separately numbered, and the paragraph and section numbers are set at the head of the page. Index references are made to section and paragraph numbers. This method has the advantage of taking one closer to the item of which one is in search. If equipped with a thumb index to the sections, this system would be ideal. Although the publishers have made a great improvement by adopting this system, it is hoped that the next edition will be equipped with a thumb index.

It is a pleasure to note that a uniform system of symbols and abbreviations is used throughout the book, and also that one is not referred to a key, but finds the meaning given with each formula and equation.

The extensive use of curves for presenting data is to be commended. The graphical method has several distinct advantages: it reveals the law which governs the phenomena, it condenses the space into which a given amount of information can be put,, and it gives data for any set of conditions without interpolation.

It is impracticable to discuss the contents of each section separately. However, special mention should be made of the sections on Transformers, Generators, Motors, Traction and Electrochemistry. These sections are especially valuable, since they fill gaps in the existing literature on these respective subjects, and any one of them would be welcomed as a separate book.

The preparation of a work like this is a giant undertaking, and when one has finished a thorough examination of this book, it seems little short of marvelous that such an immense amount of material written by so many eminent and busy men could be obtained, carefully edited, indexed, illustrated and co-ordinated in a single volume. The up-to-dateness is quite puzzling, there being references and quotations from articles which appeared as late as a few weeks before the publication of the book.

The book work is first-class, especially the binding and paper. The illustrations are sometimes a trifle small, but the character of the book justifies this economy in use of space.

It is safe to say that the book will soon make a reputation for itself which can be compared only with that at present enjoyed by the "Ingenieurs Taschenbuch," published by the Hütte, in Germany. It should be valuable to students of electrical engineering, as well as to practicing engineers, and will probably be used in a great many colleges as a text-book.

Dimmers for Domestic Electric Lighting.

BY CHARLES WIRT.

Although contrary statements have been made, the writer believes the first theatre to be electrically lighted was the Academy, in Halsted Street, Chicago, in which were installed 150 Edison lamps in 1882. No stage lamps were used owing to the fact that dimmers or electric regulators had not at that time been designed. The first dimmers which the writer remembers as applied to stage work were rheostats constructed with galvanized wire resistors and having five steps. A sunset effect in five jumps is something which needs to be seen to be appreciated.

The improvement shown in the evolution of electric light regulation adapted to the exacting requirements of artistic stage work—the contrast between the crude results exhibited in 1883 and the years succeeding, and the fine work which may at present be seen nightly in any first-class theater—is equal to that shown in the same time by other branches of the art of illumination.

While the demands of artistic stage work have been met in the perfect control afforded by the modern theatre dimmer, little has been done in the way of perfecting the incandescent lamp for all household requirements.

One of the many accessories designed by Edison was an incandescent lamp stand permitting of graduation of the light. This comprised a wooden base, supporting a vertical brass cylinder with a 16-cp lamp at the top. This cylinder contained parallel rods of Carré carbon of small section, which were joined into circuit by turning the cylinder. The dimming effect was very good, but the device was expensive and cumbersome.

While installing incandescent lamps at the Milwaukee County Hospital, in 1884, a positive demand was made for turn-down lamps. This demand was met by a small, cheap rheostat construction having five or six steps, each adapted to control a single lamp, the rheostats being placed upon the wall near each lamp.

A "lamp regulating switch" for one lamp was listed by the electrical trade in 1892, and many were sold. However, the expense of this device was out of proportion to the effect, and the plan would probably not be acceptable to the fire underwriters to-day.

For night lamps a series and parallel attachment has been sold, adapted to connect two ordinary lamps into series or parallel; this plan has been applied in bedroom lighting quite successfully. The best arrangement comprises a special switch operated by a flexible cord in order to be worked from the bed.

The Patent Office shows a great many devices of the "two filament" class, the best known of these being the Hylo lamp, which is almost universally used, at least in the United States. Many lamps of this class have been placed on the market, some of which are very little known.

Although the two-filament turn-down lamp is simple and cheap, and sometimes quite satisfactory, it does not meet the condition so often quoted of "An electric light which will turn up and down like gas." There have been produced a great many designs of regulators intended to be directly applied to the lamp. Generally these have been made in the form of a socket containing reactance or resistance controlling devices. The Ries regulating socket, of Elias E. Ries, of Baltimore, which is intended for alternating currents, contains an iron core with winding subdivided into steps and operated by the socket key. This article is quite familiar, although not in large use, probably owing to the rather expensive construction involved.

Of the rheostat or resistance sockets, the Brunt is a good representative, comprising a very well made ventilated rheostat having a perforated brass shell, and a resistor in sections wound on porcelain. No fault can be found with this device. It is large for the work to be done, and apparently not cheap in construction. It has performed excellent service. Later specimens of this form of regulating socket are in the market, and are used for controlling small motors, as well as in connection with incandescent lamps.

It is a fact not immediately apparent that while the ventilated rheostat is perhaps the best form for heavy work, it does not give the simplest construction nor the smallest possible size. The heat generated is dissipated both by convection and by radiation, but at low temperatures under usual conditions convection is ineffective. Small rheostats or heaters working at moderate temperatures lose the greater amount of heat by radiation. Surrounding a rheostat or a heater of this description by a perforated shield accomplishes only one object; the perforated shield acts as a guard and does not get as hot as the interior, but its presence increases the interior temperature and decreases the effectiveness both of radiation and convection. Wherever the temperature is moderate, better results are obtained on small rheostats by bringing the heating element into good contact with the atmosphere.

Evolution shows this plainly in the case of small field-circuit rheostats, in which the ventilated type has largely disappeared.

and, as a result, sizes have been reduced somewhat and the cost reduced greatly.

Fig. 1 shows an exterior view, and Fig. 2 a section of a form of rheostat socket which is being manufactured by Charles Wirt & Company, and which is adapted to be used with an ordinary 8-cp or 16-cp incandescent lamp, or with lamps of the tantalum or tungsten class consuming from 20 to 60 watts.

The resistor drum of the "Dim-A-Lite," as it is called, is only 1½ ins. in diameter and 1 in. long. It contains a resistor coil of zero temperature-resistance coefficient wire, molded under pressure in a stone-like insulating composition called Di-el-ite.

The commutator bars, which serve to make contact when the cylinder is rotated, can be seen in Fig. 2. This resistor being molded into a steel shell, which is entirely filled with the insulating stone parts, will heat readily and the wire is well protected.

By properly porportioning the resistance steps it is possible to control a 50-watt lamp by a rheostat of this small size with a rise of temperature at the surface of not more than 120 deg. F. (66 deg. C.).

Control is had by rotating the resistor cylinder by means of a "pull string," for which purpose a linen fish line serves perfectly. The first dimalites were made with flexible chain, on account of the anticipated heat effect upon the cord, but the chain was found to be expensive and unnecessary.

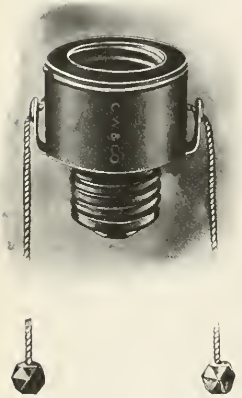


FIG. 1.—DIMALITE LAMP RESISTOR.

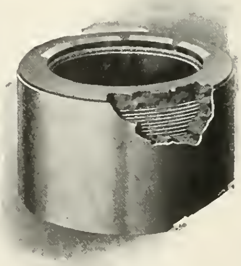


FIG. 2.—PART SECTION OF RESISTOR.

The useful grades of lighting for ordinary domestic use, including nurseries, is found to be, according to the experience of a large number of users, a two-candle step for softened illumination. This amount of light in a room of ordinary size, whether a bedroom or drawing-room, is ample for general illumination, and one or two additional steps, giving extremely low candle-power, in fact, too low to be measured. A good practical specification of the lowest step is "light enough to read a clock dial close to the lamp." The use of an insulating cord, keeping the hands away from the socket, is thought to give a certain measure of safety against the possibility of shock. Although it is rather rare to get a serious shock from lamp fittings in proximity to bathroom fixtures, the danger is worth considering.

The scepticism of people in general, and also some electricians, regarding economy in consumption of energy by the use of resistance regulation is rather remarkable. Only 100 per cent of the lamp resistance in series with the lamp is needed to reduce the amperes to one-half, and since the total voltage is the same, the power and energy are reduced by 50 per cent, and the meter reading is decreased by that amount. Although the problem is a very simple one it seems to puzzle some men who are otherwise familiar with electrical arithmetic.

To meet all requirements from 200 to 300 per cent of the lamp resistance is needed in the dimalite, requiring a current when "all in" of one-third or one-quarter the full value. At one-quarter normal current a 16-cp, 50-watt carbon-filament lamp will consume about four watts (at the lamp) while the resistor will consume about nine. The candle-power will be too low to measure by an ordinary standard photometer, but there will be light enough to read a clock or watch close to the lamp.

The writer feels certain that in future lighting of homes graduation will be insisted upon. The advent of lamps of less consumption than three watts per candle will favor the use of resistance graduation. The conditions can now be met fairly well even with a three-watt lamp. With better lamps it will be very easy to give perfect control of each lamp, and as there will be less power to deal with the economy will be more satisfactory. It is necessary merely to examine the rooms of a house lighted with gas and note the varying degrees of light at each separate jet to realize how much is lost with incandescent lighting when one is unable to do anything of the sort in the case of the better lighting agent.

Commercial Testing of Watt-Hour Meters.

By W. C. Andrews.

Accurate periodic testing of their customers' meters has been an established policy of lighting companies for many years. The almost universal system of metering the energy used by the individual consumer has brought a recognition of the value of inspection at regular intervals not only to prevent lost revenue from inaccurate meters, but to maintain a positive up-to-date record of the meters' performance. Most central station managers look upon their meter-cards as an important asset, on account of their usefulness in settling disputes over lighting bills. The major portion of the company's income is based on the meter readings, and arguments are at times unavoidable, but many a discontented customer has been completely satisfied by an inspection of his meter's history. The indisputable evidence that the management knows what it is talking about produces a moral effect on the customer that can be accomplished in no other way, and thus strengthens greatly the standing of the company.

The value of the tests depends largely on two characteristics, accuracy and rapidity, accuracy maintained under existing conditions of operation and observation is of paramount importance in all testing work, and rapidity enables the meter cards to be kept up to date without undue expense. The apparatus, furthermore, should be compact and suitably arranged for safe transportation, it should be low in first cost and maintenance, and should be simple in construction and operation. Development along these lines has produced many methods of meter up-keep.

The practice of replacing, periodically, customers' meters with new ones, fresh from the testing room of the illuminating company, was early discarded on account of its expense, both in labor and extra equipment, and of the loss of confidence produced on the customer. The testing and adjustment of meters on the customers' premises was then tried and originally made by what were practically laboratory methods. As the watt-hour meters could not be brought to the laboratory, the laboratory watt meters, stop watches, lamp banks, wires, switches, etc., were carried from house to house by the inspector and as many assistants as were necessary. Many objectionable features outside of the expense and inconvenience were found in this method; accurate determinations necessitated a correct averaging of all the readings of the indicating instruments during the period of test, which was hardly practicable under ordinary fluctuations of load or voltage; observations were often difficult on account of poor light, etc., the stop watches were seldom reliable, and the calculation of the results was complicated and liable to inaccuracies.

The laboratory instruments suffered from the necessarily rough usage and continuous handling, and their repair was expensive. Furthermore, the number of instruments required to test the meters accurately at different loads made the outfit costly and cumbersome.

A makeshift intended to cheapen the work was found in the so-called "constant-load" method. A bank of "standard" lamps was generally employed, and a voltmeter and stop-watch were necessary. To the other possibilities of error, therefore, was added the variation in resistance of the lamps, and this method was little used.

In a paper read before the Association of Edison Illuminating Companies, in 1902, Mr. W. J. Mowbray, of the Brooklyn Edison Company, described a great advance in the art of watt-hour meter testing and a system upon which the present most approved methods are based. Mr. Mowbray used a modification of a Thomson watt-hour meter, in which the usual dial was omitted, and the revolutions of the disc were compared with the revolutions of the disc of the meter under test. Special series coils were also provided for testing at different loads, making a very wide range with no light-load errors.

This method of testing has been in constant use by a large number of companies for several years. With recent improvements in the apparatus, of which a practical form is shown in the accompanying illustration, an excellent system for periodical meter inspection has been developed.

The portable standard test energy meter shown has a negligible error for variations in frequency, voltage, load or temperature. That is, no matter what the conditions are during test, within ordinary commercial fluctuations or changes, the results show the operation of the meter being tested under those conditions, and one standard may be used to test watt-hour meters of different makes and characteristics. It is absolutely necessary for satisfactory tests that definite results at the time of making the test be obtained—if the voltage, frequency, etc., are abnormal, these results may be reduced to the probable operation under other conditions by applying the proper correction factor for the meter under test, but in all cases the standard should be accurate and determine the exact performance of the meter under test.

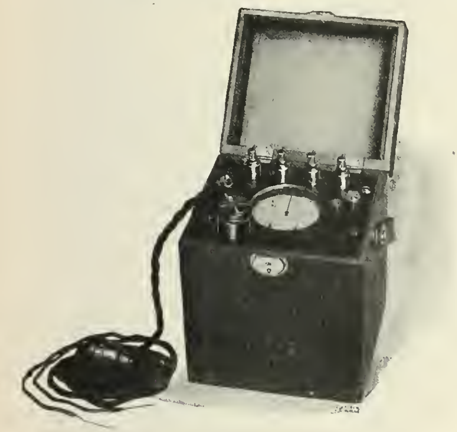


FIG. 1.—PORTABLE STANDARD FOR TESTING WATT-HOUR METERS.

The test meter consists of a high torque induction energy meter with the ordinary combination of braking magnets and motor elements, but with the usual vertical register replaced by a horizontal one at the top of the meter frame. The disc shaft passes through the center of this dial and carries a pointer which shows directly the revolutions of the disc. The auxiliary small dials, within the large one, have pointers indicating tens and hundreds of revolutions, and the large dial is divided into hundredths, so that 1 per cent of a complete revolution may be observed. Three series coils are used which in ordinary standard meters are for 1, 10 and 20 amperes, respectively, as being most suitable for testing the average types of meters on customers' premises, ranging in rating from 3 to 25 amperes.

The 1-ampere coil gives extremely accurate results on light loads. With, say, one lamp, the load on the standard will be approximately 50 per cent of the rating of the coil used, and the accuracy will be practically the same as at full load. If the 1-ampere coil were omitted, the light load accuracy would have to be very carefully maintained in order to give reliable readings within the limits of observation provided by the large, easily-read, registering hand. The coils are so wound and calibrated that the same percentage of full load on each produces the same torque on the disc, and hence the same accuracy. One terminal of each coil is connected to a common binding post at the top of the meter, and a separate binding post is used for the other end. This makes the most convenient and reliable method of changing the rating of the meter, as one flexible series lead alone has to be moved. The shunt coil of the motor element terminates in a plug receptacle, also on the top plate. In this particular make of test energy meter the friction is reduced to a very small value by careful workmanship, the register staffs being made of highly polished steel and the gearing accurately cut and polished, while a cup diamond jewel is used for the lower bearing of the meter shaft supporting the disc.

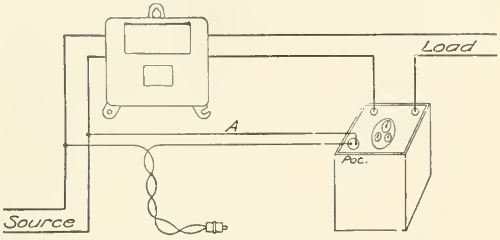


FIG. 2.—CONNECTIONS OF TEST METER IN USE.

The test energy meter is enclosed in a wooden carrying case with cover and strap, suitable for convenient transportation. A small thumb nut near the dial is connected to a locking device, which raises the moving element from its jewel bearing, and holds it safely during any shocks or jars to the case.

In use, the series coils are simply connected between the load and the meter under test, and the shunt coils are connected by means of a lamp cord to the service wires. This connection prevents either meter registering the energy taken by the shunt coil of the other, and so avoids an appreciable error on light loads. A pendant snap switch is inserted in one side of the potential circuit of the standard for conveniently starting and stopping it. The operator observes the dial reading of the standard before starting a test. The revolutions of the meter under test are

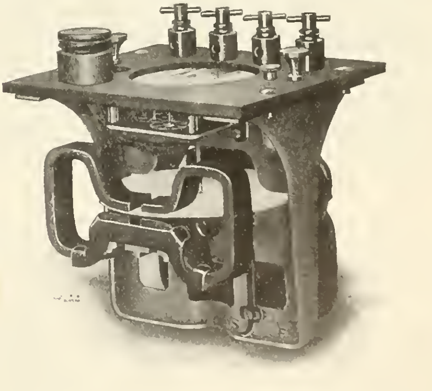


FIG. 3.—MECHANISM OF STANDARD TEST ENERGY METER.

observed by watching a spot on the disc as it passes the calibrating window. The pendant switch is closed just as the first counted revolution of the meter under test begins, thus starting the standard, and a given number of revolutions are then counted on the meter under test. As the last revolution is completed the pendant switch is opened, which stops the standard, and the dial reading is noted. The difference between the readings of the standard at the beginning and the end of the test gives the number of revolutions of the standard's disc, so that the only observation during the test is the counting of the revolutions of the disc of the meter under test, and one operator can conduct the entire operation. When the meters have the same constants, that is, when the same load should produce one revolution of the disc in a given time, a direct comparison of the numbers of revolutions made by the two discs will indicate the accuracy of the meter under test. If the constants of the meters are different, as is generally the case, it is merely necessary to reduce the numbers of revolutions to the corresponding watt-hours by multiplying the constant by the number of revolutions, and then to compare the number of watt-hours.

The elimination of the light-load errors by interchangeable series coils gives the method a decided advantage over the use of wattmeters. With the latter, even if the indications are correct on the lower end of the scale, the graduations are generally so small at that point that an error no greater than the width of the needle will often change the results obtained by several per cent. To avoid these errors, several watt-meters must be carried around, and the standards continually interchanged during the tests, a method not only inconvenient, but prone to inaccuracy.

Another familiar and prolific source of error that is removed is the stop-watch with the constant attention and repair necessary to give even moderate reliability.

It is important that the portable standard energy meter be correct; its accuracy should be maintained, therefore, by periodical checking and adjustment against laboratory wattmeters or watt-hour meters of known reliability. A feature of the portable standard illustrated is the ease with which it may be calibrated. The full-load adjustment is obtained by moving the brake magnets toward or away from the center of the disc as it is desired to increase or decrease the speed of rotation. Shifting a small rectangular conductor situated between the disc and the potential winding distorts the flux and changes the light-load adjustment of the meter without affecting the calibration at full-load.

The connections, as shown, are simple, the calculation of the results takes only a moment with little chance for clerical mistakes, and the duration of the test is never more than a few minutes. Rapidity, one of the essential features is, therefore, obtained at no sacrifice in the accuracy of results.

An Accumulator with Boxed Active Material.

The Standard cell is the first commercial storage battery to break away from the traditions of accumulator construction as it provides an electrode in which the active material is actually boxed up and so held in contact with its lead backing that buckling is impossible and no disintegration can occur. The result is a cell which has all the good qualities of the ordinary lead accumulator and is practically indestructible under service conditions. A single plate of the Standard cell is composed of a lead conducting plate sandwiched between two layers of active material, held permanently in place by very porous earthenware plates. These plates, of which the inner surfaces are reticulated to grip the active material, and the outer surfaces ribbed for strength and to furnish flues for the circulation of the electrolyte, as shown in Figs. 1 and 2, form a thin tight box about the conducting plate which absolutely prevents the escape of the active material. The plates are so porous as to offer no material obstruction to electrolytic action while preventing completely loosening, escape, or infiltration of the active material.

The result is a cell identical chemically with other lead-lead-oxide cells, but very light for its rating on account of the absence of heavy retaining grids, and free from all the usual causes of deterioration. Cells of this type in use for as much as five years are still in as good condition as when first put together and apparently are good for many years more of regular service. Cells of 100-ampere hours rating sealed in rubber jars complete with electrolyte can be brought down to a scant 20 lbs. in weight without difficulty or increased risk of deterioration.

Fig. 1.—PLATE OF STANDARD ACCUMULATOR.

The unit system is employed in the Standard construction, the individual plates being about 2½ ins. square. In building up elements, as many of these as are necessary to secure the desired output are assembled about a common conducting plate, thus forming a single large plate of whatever proportions are expedient and of these composite plates as many as are needed are built up and clamped together to form the element. This construction gives a considerable choice as to the relative proportions of the larger elements, which is sometimes very convenient.

Repeated tests of Standard cells have shown excellent efficiency and the same immunity from deterioration in practice that would be expected from theory. Even severe short-circuiting does no permanent damage and the cell thus treated can promptly be brought back to its full capacity.

One considerable advantage of the Standard construction is that the active material can be disposed in a thin layer without fear of disintegration, which promotes uniform chemical action and lessens the chance of forming local circuits. Thick plugs of active material as found in ordinary gridded plates are liable to inequalities of electrolytic action which both injure the efficience and promote disintegration. In fact, the Standard plates when examined after long use show the active material remarkably coherent and homogeneous with no signs

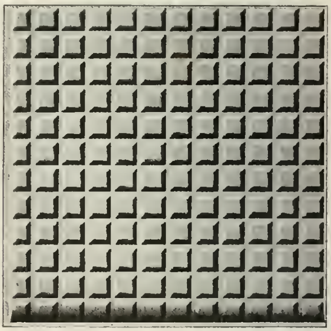


FIG. 2.—PLATE OF STANDARD ACCUMULATOR.

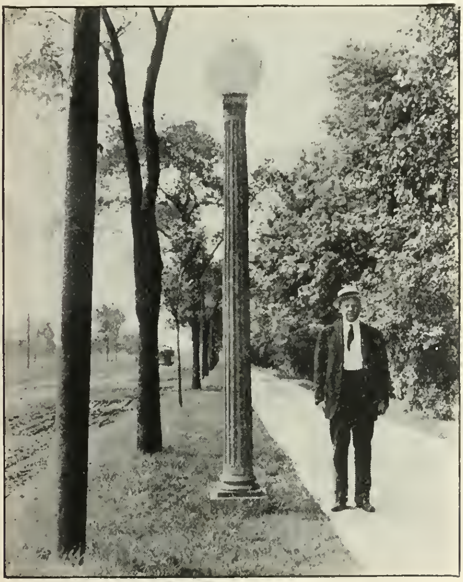
of local action. The Standard accumulator is manufactured in all the usual sizes and put up in sealed rubber jars, glass cells or lead-lined wooden tanks as occasion demands; and the unit system of construction makes it easy to develop cells of special weights or capacities. This battery is made by the Standard Electric Accumulator Company, 141 Broadway, New York City.

Artistic Outdoor Lighting Fixtures.

By C. L. ESHLEMAN.

When it is considered that during the year 1906 the sale of arc and incandescent lighting apparatus in the United States aggregated approximately $12,000,000, the great importance of this particular branch of the electrical industry can be fully appreciated. The above figures cover only the lamps and closely related apparatus, and do not include the many millions expended for boilers, engines, turbines and other devices required to furnish the necessary power to produce the light.

As we follow the development of arc and incandescent lamps we note that most manufacturers in their eagerness to produce an article possessing higher efficiency and greater mechanical strength, have overlooked artistic qualities. A radical change, however, has taken place within the last five years, and to-day illuminating engineers are spending their entire time and exerting every effort to plan installations in which the æsthetic as well as practical taste is satisfied.



CONCRETE ELECTRIC LIGHT POST.

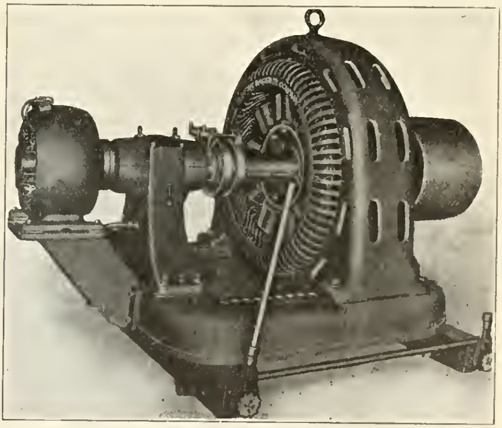
The need of artistic street lighting was early appreciated by Mr. W. E. Daniels, of the South Park Commissioners, Chicago, Ill., whose position gave him an excellent opportunity to study all phases of outdoor illumination, the result of which study was the invention and patenting of the Daniels system of boulevard lighting. The manufacture and exploitation of this system has been undertaken by the Jandus Electric Company, of Cleveland, Ohio.

As indicated by the accompanying illustration, the fixture consists of a rectangular base, reinforced concrete post of Colonial design, covered by an Ionic capital and the whole surmounted by a 20-in. opal ball globe, contained within which is a complete arc-lamp mechanism. The system has been designed to operate on either multiple direct current or series alternating current, and is, therefore, specially adapted for use, either in city business quarters, where direct current is usually furnished, or in residence and outlying districts, where alternating current service is in use. During the development of this system exhaustive experiments were made with both steel and concrete posts, but concrete construction seemed so admirably adapted to this particular service that it was finally decided to eliminate steel entirely. The concrete post can be molded and finished to correspond to sandstone, marble and granite; in fact, any natural stone or marble finish, ranging in color from dark gray to pure white. These posts are practically indestructible and are much more attractive than painted steel goose-neck designs. They will not oxidize; and it is stated that the cost is so reasonable that the system may be applied economically to ordinary street lighting. The lighting of boulevards and parks, public squares, public buildings, capitol grounds, business blocks and numerous other applications fall within the sphere of the "Boulevard lamp."

Belted Alternators.

In its line of belt-driven alternators, the Electric Machinery Company, Minneapolis, Minn., has paid particular attention to ventilation. Upon the ventilation depends the temperature rise of the machine, and, hence, the life of the insulation. Moreover, for a certain limiting temperature rise, the least constructive material is required when the ventilation is properly arranged. It is seen, therefore, that both the initial cost and the cost for replacement are closely related to ventilation.

In the machine illustrated herewith the revolving field-core has vents at intervals in the pole-pieces which admit cool air from near the shaft, up through the pole-piece inside of the field coil. The vents register with vents in the armature core, which are formed by corrugated spacers which obstruct the air only very slightly. The cooling air currents easily find their way out of the frame through the many openings, and carry off the heat that is generated in the windings and core. The tooth supports at the ends of the armature core are also open and afford a good opportunity for air to sweep by the ends of the cores and between the armature coils. The coils do not lie close to each other, but are open like a grate and permit air to pass through on all sides of each coil, so that no local heating results.



BELTED ALTERNATOR.

The field-coils are excited by a 125-volt exciter, directly driven by the alternator shaft, as shown. The exciter may be belt driven if desired.

The machine, it is stated, runs quietly under all loads, the design of the armature teeth, pole tips and air gap being carried out with that object in view. This alternator may be run in either direction.

It is stated that the temperature rise after a 10-hour run at full non-inductive load does not exceed 25 deg. C. in any part of the machine above surrounding air, and with 25 per cent overload following the above run the additional rise does not exceed 10 deg. C. With inductive load, the temperature rise is slightly higher in the field coils, but about the same in the other parts.

On account of the distribution selected for the constant and variable losses, the efficiency of this line of alternators is nearly uniform over a range of load from one-third load to 25 per cent overload. This efficiency is high, due to liberal proportions of both copper and iron sections. An alternator rarely works for long periods at full-load, and it is, therefore, very important that it give a good efficiency over quite a wide range of load. It is claimed that the rise of voltage when the load is thrown off is very small, not exceeding 8 per cent on non-inductive load, even with the smallest size of machine, and being not over 6 per cent in larger machines.

Turbo-Alternators.

The accompanying illustrations show the constructive features of Allis-Chalmers alternators designed for direct coupling to steam turbines. Fig. 1 illustrates a revolving field core before being wound, while Fig. 2 shows a complete rotor for a 1500-kw turbo-alternator. The field cores are according to size and conditions, built up either of steel laminations or of nickel steel forgings, of high magnetic permeability and great physical strength. The slots formed in the core to receive the field coils are radial, the field winding being flat strap copper. The method of winding flat strap in radial slots has been made possible by a specially designed forming machine which bends the copper edgewise and gives an increasing spread to each successive turn of the coil. The carefully insulated coils are firmly held in the slots by means of Parsons manganese-bronze wedges. The completed rotor is thus formed as a smooth surface cylinder, no matter what the number of the poles, thereby reducing the windage loss, besides tending to quiet operation.

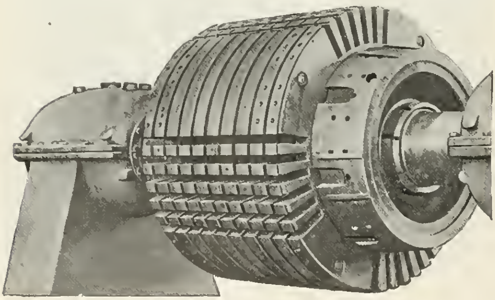


FIG. 1.—REVOLVING FIELD CORE READY FOR WINDING.

Ample spaces are allowed at regular intervals between the laminations, or discs of the core, to provide for ventilation of the core itself and of the coils, air being drawn in through openings formed parallel with the axis and discharged at the periphery. The ventilation of the ends of the coils is attained by allowing them to project beyond the ends of the core in such a way that they can be thoroughly cooled; the coils at this point being firmly secured against the effect of centrifugal force by means of nickel-steel rings, which form an extension of the core, and are provided with openings for the passage of the cooling air current.

Fig. 3 shows the stationary armature with the coils in place. Every precaution is taken to secure thorough ventilation, so as to prevent excessive temperature of the armature core and winding. The laminated core is provided with numerous air ducts, and the frame is so formed as to assist in the circulation of air.

The armature coils are all completely formed in the shop so that no connections have to be made after they are placed in the armature core at the purchaser's station, except the connections of the coil terminals, thus reducing to a minimum the risk of defective insulation at joints. The advantage of this will be appreciated by station operators, especially for high-voltage work.

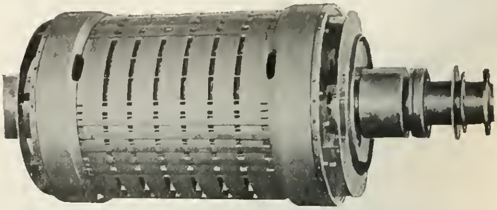


FIG. 2.—COMPLETE ROTOR FOR A 1500-KW TURBO-ALTERNATOR.

Care is taken in the insulation of the coils by successive dippings and bakings after the application of the various layers of insulation. The coils are firmly secured in the slots, and particular attention has been paid to the form of the coil-ends and the securing of them in such a way as to prevent deformation in case of a short-circuit.

For the purpose of obtaining adequate ventilation and for muffling the noise produced by the circulation of the air, these turbo-generators are enclosed in such a manner that the air is taken in at the sides of the machine, passing through fans which discharge it over the end connections of the armature coils into the bottom of the machine, whence it passes through the ventilating ducts of the core to an opening at the top.

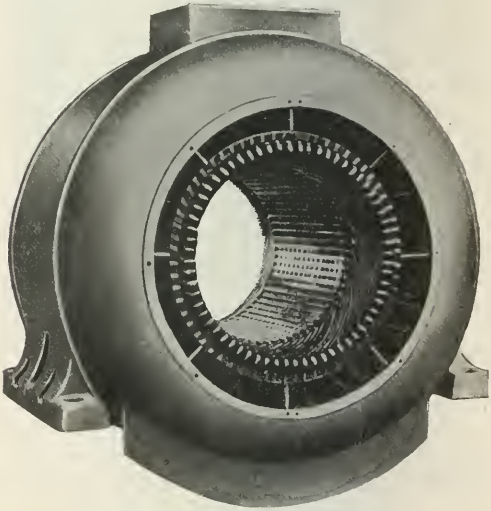
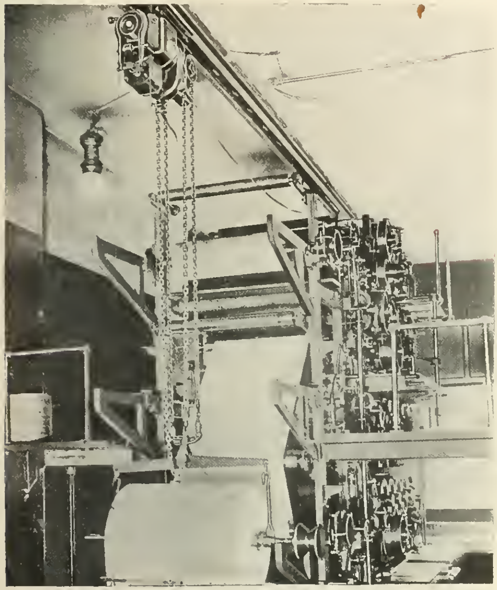


FIG. 3.—STATIONARY ARMATURE WITH COILS IN PLACE.

Electric Paper Hoists.

In large printing plants the transfer of the paper from the storage rack to the press is a task which yearly has become more and more arduous to the pressman. In years gone by the paper was easily transferred by hand, but as the size and weight of the paper increased, chain blocks were installed to do the work. At present, with the greatly increased demands made upon large printing plants, especially those devoted to newspaper work, the chain blocks are as inadequate as were the manual methods of former years, being slow and not easily operated. Electric hoists, on the other hand, are quickly and easily operated, and are particularly well adapted for the purpose. They are now used in many press rooms throughout the country.

The accompanying illustration shows an electric paper hoist, recently installed in the printing plant of the Pittsburg *Gazette-Times,* at Pittsburg, Pa. This is a two-chain hoist, operated by a 3-hp, 115-volt, direct-current enclosed series motor. It is capable of lifting 4000 lbs. on the hook at a speed of 10 ft. per minute; the maximum height of lift is 15 ft.



ELECTRIC PAPER HOIST.

This hoist is operated from the floor by pendant ropes which connect with a single-speed controller mounted on the trolley carriage. It is fitted with a mechanical brake.

The Sprague Electric Company, 527-531 West Thirty-Fourth Street, New York, manufactures these electric paper hoists for operation on 115, 230 or 500-volt direct-current circuits, and for lifting from 1000 lbs. to 6000 lbs.

Economy Electric Flatiron.

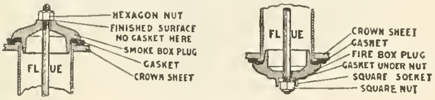
The electrical department of the Art Machine Company, of Brooklyn, N. Y., manufacturer of electric heating appliances, has brought out an electric flatiron said to possess many valuable points of merit. The heater is constructed according to a patented principle whereby the heat is produced at the bottom of the iron. The internal electric heater covers the bottom of the iron, thus heating its entire surface. The irons are fitted with a removable hardwood handle, and being always cold, no protecting pad is needed. Each iron is furnished with 8 ft. of flexible, fireproof, approved cord, with a separable plug at each end, one to screw into a standard socket and the other on the flatiron. The asbestos stand, which is part of the equipment, is a very strong, fireproof and heat resisting device having the appearance of marble and mounted on four supports. The irons are made in a variety of shapes and weights suitable for traveling, sewing room, family and laundry use.

ELECTRICALLY-HEATED FLATIRON.

Boiler Flue Plug.

The accompanying illustrations show the application of the Betterman standard boiler flue plug, made by A. L. Smith & Company, of Philadelphia, Pa. The plug consists of two caps with gaskets and nuts, which are held in place by an iron rod threaded for a nut at each end.

It is very plain to be seen that in placing or removing this plug the flue sheet is subject to no strain or other injury which very frequently happens in the use of temporary expedients and devices usually resorted to when flues leak. The simplicity of the plug, means of quick repair, ease of application, perfect adjustment, combined with high factor of efficacy and economy, commends it to all users of steam boilers, and to the best mechanical judgment. Any boiler may spring a leak at any moment, and however small the leak in connection with a tube there is necessity for instant repair. Risk is always incurred when leaks in tubes are not attended to, but repairs usually have necessitated shutting down, owing to the location of the plant, more or less annoyance, loss of time, trouble and expense in procuring the services of a boilermaker and material to replace the flue.



BOILER FLUE PLUGS.

The size of the plugs correspond to standard tube measures. Plugs ranging in size for tubes 1 in. in diameter to 6 ins. are made.

Recording Milli-Volt Meter and Shunt Ammeter.

The accompanying illustrations show an accurate and sensitive recording milli-volt meter, which is adapted to practical every-day service, as well as for laboratory tests, and a recording ammeter of the shunt type which can be connected by leads to the main bus-bars. The shunt system is especially convenient where large values of current are to be indicated or recorded, because the instruments may be located at a considerable distance from the main circuit, thus eliminating the expense for extending the main conductors to the location of the instrument.

Two of the important fundamental features of the recorders are a sensitive electrical movement of special design, and a recording system using a smoked chart so arranged that there is absolutely no friction between the recording arm and the chart.

It is stated that the instruments are so sensitive that the recording arm will move over the whole scale for five millivolts or less, making it possible to record accurately one ten-thousandth of one volt. The graduations on the chart are evenly proportioned over the entire range so that even though the current is small in value the readings may be as readily taken as if the current was the maximum that the instrument would record. This feature is of value for use where it is desired to install instruments for increasing future demands, and it is important that the records be perfectly clear, even though the loads are very light when the outfit is first used

The records are made on a semi-transparent smoked chart, which is periodically brought into momentary contact with the end of the recording arm by means of a special vibrating device. In this way a series of white dots are made on the smoked surface, and these form a continuous line. The rate of vibration of the chart is timed to suit the frequency and range of the variation in the current to be recorded. The usual period of vibration of the chart is once in ten seconds, but to obtain continuous lines where the fluctuations of the current are quite rapid, the vibrating attachment may be made to operate twice every second. When the record is completed, the chart is dipped in a simple fixative solution which makes the record permanent for filing.

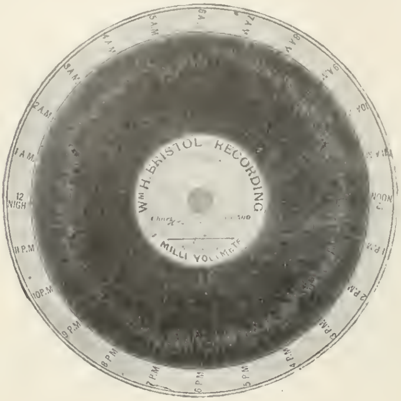


FIG. 1.—CHART OF RECORDING MILLI-VOLT METER.

The recording shunt ammeter is shown in Fig. 2, and Fig. 1 is a reduced photographic facsimile of a chart taken from one of these instruments in connection with electrolysis surveys of underground structures which are being conducted by the Electrical Testing Laboratories, of New York City. The graduations of this chart are arbitrary. It was revolved once in 24 hours, and was vibrated once every ten seconds. The zero position of the recording arm was the middle of the scale, so that the record might be independent of the direction of the current, as in many cases the direction of the current changes from negative to positive during the day. It is expected that by using a number of these instruments operating simultaneously at different points, stray currents in water and gas mains, or in any underground structure, may be recorded, making it possible to discover the causes of trouble and to devise a method for their elimination.

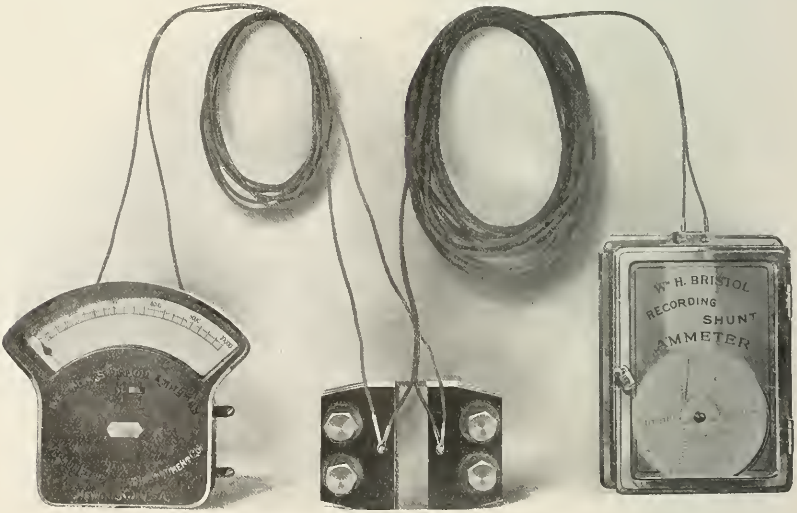


FIG. 2.—INDICATING AND RECORDING AMMETERS CONNECTED TO A COMMON SHUNT-BLOCK.

The recording ammeter, shown in Fig. 2, is connected to a standard 10,000-ampere shunt, to which is also connected an indicating station ammeter. The recorder may be readily applied to any standard shunt which is already in service without disturbing the indicating instrument at the swtchboard. As illustrated here, leads of almost any desired length may be used to connect the indicating and recording instruments to the shunt on the main bus-bar. It is even possible to have the recording ammeter located in the superintendent's office at a great distance from the shunt, and the indicating instrument located on the switchboard convenient for the observation of the operator.

For preliminary tests, the recorders are provided with special fast vibrators for the smoked chart and with a clock movement to revolve the chart once in one hour, but for continuous daily records, the standard 24-hour charts are recommended.

These instruments are manufactured by Wm. H. Bristol, 45 Vesey Street, New York City.

Window Reflectors.

The National X-Ray Reflector Company of Chicago is planning important new developments in the reflector line for 1908. Since February, 1906, when the "Poke Bonnet" reflector, as a substitute for the single trough reflector for show windows, was brought out, over 40,000 have been sold. From the dealers' and contractors' standpoint, this reflector is popular because each reflector, containing two lamps, is a complete unit in itself, which can be carried in stock so that the dealer or contractor does not have to wait for a trough to be made to order of the proper length, as in the case of the single window trough reflector. From the user's standpoint, it is popular because of the high character of its reflecting surface and its slower rate of depreciation than common mirrors. Besides having an advantage in this respect, it utilizes some light which is wasted in common forms of troughs by efficiently reflecting the light given off in the direction of the lamp tip, rather than allowing it to be lost by absorption against the sockets of adjoining lamps. The "Poke Bonnet" is adapted for deep windows where the reflectors are not placed at a great height above the window. The "Helmet" reflector, recently brought out, is intended for that large class of windows which are high and shallow, or where the show window proper is shallow and the lamps are placed at the ceiling considerably above the window. These are conditions calling for a concentrating reflector. The "Helmet" is a very powerful concentrator intended to use 125-watt Gem lamps or tungsten lamps of the same size. It is, in fact, the first window reflector adapted especially to the new high-efficiency tungsten lamps, since the lamp is used in a vertical position, and the proper distribution of light to give uniform illumination on the goods is obtained by the peculiar symmetrical shape of the reflector. Several very large stores with high windows have ordered these reflectors.

A New Separable Wireless Cluster.

The Benjamin Electric Manufacturing Company, 42 West Jackson Boulevard, Chicago, has just made some interesting improvements in its wireless clusters for multiple use. These improvements make it possible to remove completely the outer shell, together with shade holders and glassware, without disturbing the wiring. On clusters as heretofore constructed this has not been possible, and it has consequently been necessary to clean the reflector which surmounts the cluster without taking it down. With prismatic reflectors it was difficult to thoroughly clean the angles of the prisms without taking the reflector down, and consequently they were frequently allowed to collect much more dirt than was consistent with either appearance or efficiency.

Fig. 1 shows one of these new clusters disassembled. The porcelain base, which is the middle of the three parts shown in Fig. 1, is screwed onto the fixture or fastened against the ceiling. The wires are connected to binding posts on this base. The lower shell is then slipped over the base and given a turn which fastens it with a bayonet catch arrangement. One type of base is used for all clusters having a bottom lamp (such as shown in Fig. 1) up to a seven-lamp cluster, while another type is used for all clusters without a bottom lamp (such as shown in Fig. 2) up to a six-lamp cluster. The base carrying the bottom lamp is applicable to all clusters of from three to seven lamps, which saves complications in carrying a stock. After the base is once wired up in place the number of lamps can be increased or reduced. The type of base which carries a bottom stocket has three binding posts, so that the lamp in the bottom socket can be lighted alone if desired, or all lamps but the bottom one can be lighted. This porcelain base is only 2¼ ins. in diameter, being purposely made as small as this so that a reflector made for a 3¼-in. shade holder will pass the base through the neck. Such reflectors can, therefore, be taken down from above such a base.

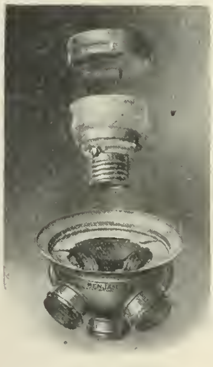
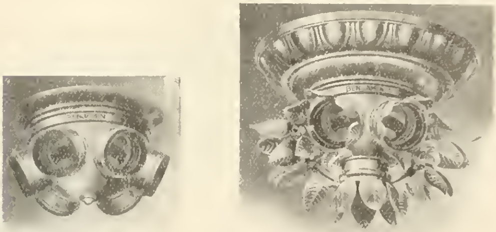


FIG. 1.—WIRELESS CLUSTER DISASSEMBLED.

The lamp receptacles on the cluster shell have a bead like a common standard socket, so that they will take any standard shade holder, and a special holder is not required for the cluster as heretofore. If it is not desired to use reflectors on the cluster, ornamentation can be added, as in Fig. 3, by putting on stamped metal husks, which are made by the same company, to slip over the bead on the socket shell. The cluster shell is made so that it can form the bottom half of a standard 4-in. chandelier ball. This was done so that a cluster of this kind can be used on a combination gas and electric fixture. The cluster could then carry all the electric lamps on the bottom of the chandelier, and there would be no need of wiring the chandelier arms, thus reducing cost and complication.



FIGS. 2 AND 3.—WIRELESS CLUSTERS.

Electric Heating Specialties.

The Vulcan Electric Heating Company, Chicago, announces for 1908 two important additions to its product. The first is an electrically self-heated, self-regulated curling iron, with a cord and plug attachment fitting any lamp socket. It has a continuous and uniform heat, and, therefore, accelerates the work of hairdressing and saves a great deal of time consumed with non-electric irons. The iron has a swivel cord attachment which allows perfect freedom in its manipulation. The utensil is adapted to both curling and "marcelling."

FIG. 1.—CURLING IRON IN USE.

The other device is the toaster shown in Fig. 2. It is one of the small electric energy consuming devices that allow electric service to obtain a firm foothold for domestic application. The toaster here shown is designed for hotel and restaurant use, and it meets with immediate favor wherever introduced, because the toast obtained is unscorched by flame and untainted by gas. It can be placed in operation as readily as can any electric lamp, and is intended for attachment to a lamp socket. By its use bread can be toasted on the breakfast table, each slice being obtained crisp and hot as desired.

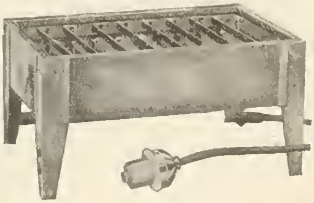


FIG. 2.—ELECTRIC BREAD TOASTER.

Polyphase Induction Motors.

In the type of induction motor illustrated in Fig. 1, special efforts have been made to obtain the maximum of ventilation, the minimum of iron loss and the least practicable wear in the bearings.

The scheme for ventilation follows somewhat after the usual arrangement found in direct-current apparatus. The iron on the outside of the primary laminations is open to the air so that the maximum amount of radiating surface is directly exposed. Large openings along the shaft give the rotor iron ample radiating surface. The coils are well distributed and are so placed that the maximum amount of surface is exposed for radiation. There is a space between the coils in each slot which allows a continuous draft of air to pass from the rotor through the slots to the outside. Thus a continuous circulation of air is effected through all the windings of the machine.

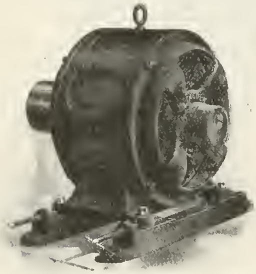


FIG. 1.—POLYPHASE INDUCTION MOTOR.

The primary core loss is kept low by using a specially good quality of iron worked at a low magnetic density. Thus the temperature is kept low and the efficiency high.

On account of the short air-gap required in induction motors, the bearings become the most important mechanical feature of the motor. In the induction motor here illustrated the bearings are made very large, and are well flooded with oil. The oil is carried up on the shaft by the usual ring oiling device. Distribution is effected by oil grooves which insure that all parts of the bearing will be equally well lubricated.

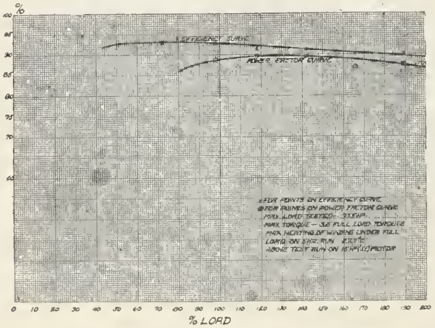


FIG. 2.—CHARACTERISTICS OF 15-HP MOTOR.

Fig. 2 shows efficiency and power factor curves of a 15-hp, 6-pole, polyphase, 1200-r. p. m., 60-cycle motor of this type. The efficiency of the machines is uniformly good, largely by reason of the low iron loss—a fact that is indicated by the accompanying efficiency curve which reaches maximum at about three-fourths of full load.

This line of induction motors has been placed on the market by the Lincoln Electric Company, 1232 East Third Street, Cleveland, Ohio.

Electrically-Driven Coffee Mills.

The coffee mills shown in the accompanying illustrations have been designed especially for use with electric motors. That is to say, the equipment as a whole has been arranged as a compact self-contained unit, each part being proportioned for its particular duty in connection with the other parts. The mills are provided with ball bearings to minimize the friction due to the thrust on the end of the grinder. The grinders themselves are arranged as pulverizers or granulators.

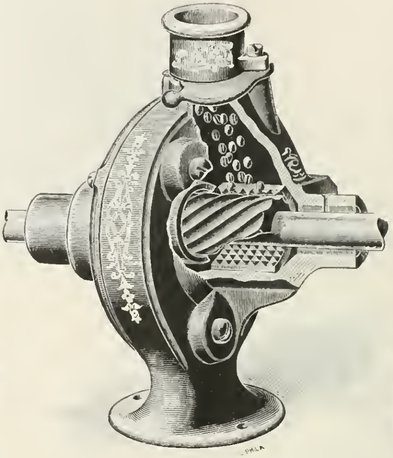


FIG. 1.—PART SECTIONAL VIEW OF MILL.

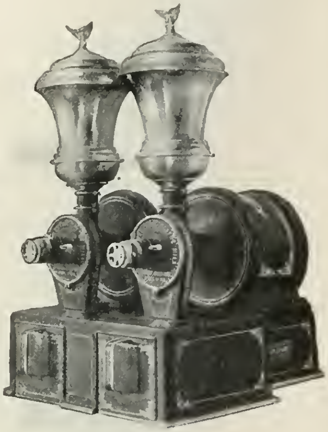


FIG. 2.—DOUBLE MOTOR-DRIVEN COFFEE MILL.

The motors are of either the direct-current or the alternating-current type, being designed for either 110 or 220 volts; a 500-volt direct-current motor can also be used. The switches and fuses are mounted on the base, the direct-current rheostat being placed inside the base. The alternating-current mill is driven by machine-cut gears working into a raw-hide pinion.

The mill is designed to break the coffee before it reaches the grinders. Fig. 1 shows grains of coffee dropping into the breaker, by which they are reduced to fragments and fed into the grinders. Fig. 2 shows a self-contained pulverizer and granulator mounted on a common base plate. These mills are built by the Coles Manufacturing Company, 1615 North Twenty-third Street, Philadelphia.

Reflectors for Picture Lighting.

For the proper illumination of pictures individually or collectively, the Frink system of reflectors made by I. P. Frink, of 551 Pearl Street, New York, has found extended use. For single picture lighting, an adjustable reflector the size of which is governed by the dimensions of the canvas is used. The reflectors are made on the proper angles so as to avoid glare and can be confined to small compass, making them unobstructive as they can be finished to match the surroundings. The Frink portable reflector can also be used to advantage in this connection. For concealed lighting of painted ceilings the Frink system is unsurpassed. The manufacturer has an extended experience in the illumination of paintings, etc., and the long list of public and private art galleries in which the Frink system of reflectors is installed attests to its excellence.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—On the whole, trade was quiet and industry slackened perceptibly, but the financial situation is easier. Mild weather is still complained of as affecting retail trade in seasonable goods. Job and wholesale trading were quiet. Quietness also prevails in industrial lines, a very general shut-down for the holidays being noted, and the textile trade, especially, has shown a tendency to further curtail output. Eighty per cent of the New England cotton spindles, it is stated, have agreed to reduce or curtail production in the next 60 or 90 days. The iron and steel trade is somewhat quieter, and the first cut in finished steel was made in steel bars to the extent of $2 per ton. There is some talk of export trade being sought in iron and steel and some large lots of sheet and tin plate bars are reported to have been disposed of for shipment to Wales. While business in pig iron continues quiet, the lower price levels have brought out some small orders. A buying movement is looked for after the holidays—in fact there is some talk now of purchases for investment. In finished iron and steel, trade hardly equals one-third of the output. Copper prices are firmer, the domestic demand for metal, however, being light; the advance is ascribed to speculation. The closing quotations are 13 7/16c. for Lake, 13 5/16c. for electrolytic, and 13 1/16c. for casting. *Bradstreet's* reports 248 business failures during the week ending Dec. 26, against 300 in the week previous and 161 in the corresponding week last year. Collections are still slow, but in many cities a currency basis has been established and the market for mercantile paper shows more activity. Railway earnings tend to diminish as the volume of business on the roads shrinks and the quantity of idle equipment increases. A very favorable feature in the situation is the increase in export trade in several lines, wheat being prominent in this respect. Another favorable feature is the announcement of resumption in many mills and factories, and the receipt by the Government Labor Bureau in Washington for 20,000 immigrants. Cotton exports are also of good volume.

AMERICAN EXPORT TRADE.—According to advices from Washington, the foreign commerce of the United States in 1907 makes a new record both as to imports and exports. While only 11 months' figures are yet available, the record for that period so far exceeds that of any corresponding period of earlier years as to justify the statement that the total of both imports and exports will be larger for the calendar year 1907 than in any preceding year in the history of our commerce. For the first time the monthly export record has crossed the 200,000,000 line, the total for November, 1907, being $204,444,860, while the import record of $133,110,170, made in March, is the largest total of importations in any single month in the history of our commerce. The figures at hand justify the estimate that the imports of the full year will exceed $1,400,000,000, and that the exports will probably exceed $1,900,000,000. If to this is added the trade with the non-contiguous territories of the United States, the value of the merchandise entering the ports of the continental United States would aggregate nearly $1,500,000,000, and the merchandise leaving the ports of the continental United States would aggregate nearly $2,000,000,000. The growth in the foreign commerce is chiefly in manufacturers' materials and manufactures. In imports, crude material for use in manufacturing shows for the 10 months for which figures are available an increase of about $40,000,000 over the corresponding period of last year, and manufactures for further use in manufacturing show an increase of about $29,000,000, while manufactures ready for consumption show an increase for the period named of $46,000,000. On the export side, raw materials for use in manufacturing show an increase of $48,000,000, manufactures for further use in manufacturing an increase of $13,000,000, and manufactures ready for consumption an increase of $29,000,000. In foodstuffs there is a slight increase in the importations, but a decrease in exportations, as measured by values. This increase in imports and exports occurs in the commerce with nearly all sections and countries of the world. To Europe the exports in the 10 months ending October were $1,003,000,000, against $970,500,000 during the coresponding months of last year; to North America, $308,000,000, against $269,333,330 during the 10 months of last year; to South America, $71,000,000, against $64,000,000 in the same months last year; to Asia and Oceanica, $116,500,000, against $105,000,000 in the corresponding months of 1906, and to Africa, $13,000,000, against $105,550,000 in the corresponding months of last year. The imports from Europe are $625,000,000 against $562,000,000 in the 10 months of 1906.

THE TELEGRAPH FIELD.—A recent dispatch from New Haven, Conn., stated that reductions in force would be made by the two big telegraph companies at the beginning of the new year. This is said to be untrue. This is the dull season with telegraph companies, and it was admitted that men were being laid off here and there temporarily, but no more extensively than in other years. From October to April business falls off and the companies adjust their working force to meet these conditions. In addition to denying the truth of published reports of retrenchment plans, Mr. Edward J. Nally, vice-president and general manager of the Postal, stated that the reports received at the main offices from the State superintendents and district managers were exceedingly optimistic for the future. As a further evidence of faith in the future Mr. Nally said that the company had not cut down the usual amount spent for betterments and improvements to the Postal system. He said that the company was looking for a good business after the holiday season, when it has always been at its lowest ebb. Even in the dull season, he said, the reports of managers in many places showed an increased business, and the expected recessions were not as marked as usual. No reductions in salaries of employees were being considered, he stated, and the only persons laid off were operators at points where business did not demand their services. This, however, was nothing unusual in the telegraph business, he said. At the office of Mr. Robert C. Clowry, president and general manager of the Western Union, it was stated that no general retrenchment plans were being or had been discussed. Business was slack, it was said, but nothing was thought of that at this season of the year. Employees were being released, it was said, to meet the requirements of business in some places, and being taken on in others. The Western Union force varied from day to day, but nothing being done, it was said, warranted any statement of retrenchment.

NEW YORK-PHILADELPHIA WIRELESS.—Preparations have been made for the establishing of a wireless telegraph system between Philadelphia and New York. Plans have been filed in the Philadelphia Bureau of Building Inspection, by a representative of the United States Wind Engine and Pump Company, of Batavia, Ill., for the erection of a 200-ft. wireless telegraph tower at Chestnut Hill, the companion of one that will be erected in the environs of New York. The tower will rest on concrete foundations and will be of steel and wood. It will be pyramidal in shape, the base measuring 30 ft. square and the altitude 200 ft. Besides the tower a building for the housing of the transmitting apparatus and for office purposes, will also be erected. Plans for this building have not yet been filed. Wireless messages will be received from New York at the Chestnut Hill station. Thence they will be conveyed by telephone to various parts of the city. To this end the operating company will establish stations in several sections.

COLORADO POWER SCHEMES.—It is announced from Denver that the Central Colorado Power Company, capital $22,500,000, and the Eastern Colorado Power Company, a subsidiary organization, capital $7,000,000, which practically ceased work on extensive canals and reservoirs connected with immense electric power schemes, when the Knickerbocker Trust Company failed, will resume operations with increased forces soon. The companies reduced their working forces by about 2000 men, although at no time was the underground work suspended. Interested in both companies are Thomas F. Walsh,

D. H. Moffat, and others of Denver, former Governor Myron Herrick, of Ohio, and Eastern, European and Colorado Springs millionaires. The companies will eventually supply all of eastern and central Colorado with electrical energy.

MEXICAN POWER PLANTS.—Advices from Mexico state that Rafael Bigot will establish a plant on the Las Balsas River, State of Michoacan, for his mines and reduction plant; Joseph E. Buell, at El Tajo, on the Ameca River, State of Jalisco; Manuel Pardo, on the San Diego River, State of Coahuila; Manual Marcias, on the Abra de Caballaros, State of San Luis Potosi; Victor Manuel Castillo, on the Chimalpa, State of Chiapas; Luis G. Saldivar, on the Lerma, State of Mexico; Jose M. Mena, on the Los Cadtillos, State of Guanajuato; Mrs. Leopoldo Gavito and sons, on the Atoyac, State of Puebla; Luis Pintado, on the Ameca, State of Jalisco; Thomas P. Honey and Jose L. Martinez, on the El Purgatorio, State of Puebla; Victor Manuel Castillo, on the Chimalpa, State of Chiapas; Charles B. Knocker, on the Moctezuma, State of Hidalgo; Eugenio H. Gayou, near Guaymas; Felipe Chavez, on the La Compania, State of Mexico; Luz Bringas, on the Blanco, State of Vera Cruz; Electric Power Transmission Company, of Hidalgo, on the La Santera, State of Hidalgo; Angel Diaz Rubin, on the Cantarranas, State of Puebla; S. P. Applewhite, on the Grande, State of Oaxaca; Rafael Garcia, on the Duero, State of Michoacan; Alberto Stein, on the Presidio, State of Sinaloa; Tri-States Development Company, on the Fuerte, State of Sinaloa; Macario Gonzalez Perez and Geronimo Martinez, on the Pupataro, State of Michoacan; Mrs. Elena V. Viuda de Ibarra, on the Tlapaneco, State of Puebla. Alberto Guarjardo, of Saltillo, is preparing to install an electric light and power plant at Villa Sabinas, State of Coahuila. Bernard McDonald, an American who has made a fortune in mines in Mexico, is at the head of a company to install a series of plants in northern Mexico, the Monterey Hydro-Electric Company, to expend about $3,000,000 on the Pilon River, near Montemorelos, State of Nuevo Leon. These plants will be three in number and more than 12,000 horse-power will be generated. The water will be brought from the river through a tunnel 8 miles long. The power will be transmitted to Monterey, Montemorelos and other towns of that region.

SALES OF STURTEVANT APPARATUS.—The popularity of the B. F. Sturtevant Company's generators is indicated through its electrical department. Mr. F. R. Chinnock, New York office, reports a few of the recent installations made by this company, are: Board of Water Supply, Babylon, L. I., one 9 in. x 8 in. vertical center crank engine, direct connected to one standard, slow-speed, 25-kw generator; Hanover National Bank, New York City, one 12 in. x 10 in. engine 50-kw generator; Eberhard Faber Pencil Company, Brooklyn, N. Y., one 16 x 14 horizontal automatic center crank engine, direct connected to a 100-kw generator; Bouker Contracting Company, New York City, one 4½ x 4½ engine, direct connected to a 5-kw generator; Central Union Gas Company, New York City, one 5 x 7 engine, direct connected to a 15-kw generator; Vulcan Detinning Company, Sewaren, N. J., one 7 x 7 vertical engine; Hotel Takanassee, Long Branch, N. J., one 16 x 14 engine, direct connected to a 75-kw generator, one 13 x 12 horizontal engine, direct connected to a 50-kw generator; H. J. McCoy, New York City, one 11 x 9 vertical engine; Washburn Brothers, Saugerties, N. Y., one 25-hp motor; New York State Reformatory for Women, Bedford, N. Y., one 13 x 12 horizontal engine direct connected to a 50-kw generator; Isidor Fajans, New York City, one 6 x 6 engine direct connected to a 10-kw generator; Votey Organ Company, Garwood, N. J., one 3½ x 3 engine, direct connected to a 3-kw generator; Johnson & Johnson, steamer *Robert Johnson*, one 10-kw generator, direct connected to a 6 x 6 vertical engine; Andrew McLean Company, Passaic, N. J., one 6 x 6 vertical engine; Royal Mfg. Company, Rahway, N. J., one 8 x 6 vertical engine, direct connected to a 6-kw generator; New York Engineering Company, New York City, three 4½ x 4½ vertical engines, directed connected to a 5-kw generator; Parker Engineering Company, New York City, one 14 x 14, direct connected to a 75-kw generator; Henry Steers, Inc., New York City, three 7½-kw generators; Samuel Smith & Sons, Paterson, N. J., one 14 x 14, direct connected to two 50-kw generators.

NAVY DEPARTMENT CONTRACTS.—Paymaster General E. B. Rogers, U. S. N., has recently issued the following circular letter, on behalf of the Navy Bureau of Supplies and Accounts: The bureau recently forwarded to certain manufacturers—160 in all—a circular letter explaining the recent improvements in the contract business of the Navy Department as regards (a) waiving of bonds and contracts on proposals less than $500 in value; (b) unloading, at Government expense, deliveries at navy yards; (c) obviating delays in payment for deliveries made, and (d) abolishing 10 per cent reservation from value of deliveries, etc., with a view of encouragaing competition, thus eliminating certain objectionable features of bidding. This letter has been given wide-spread attention through certain mediums—trade journals, jobbers' associations, etc.—and the impression has been created and disseminated broadcast throughout the country that the bureau intends to confine competition to manufacturers only, by refusing to consider bids from the wholesaler, jobber, retailer and middleman. The bureau has neither the desire nor the power to exclude any reputable dealer from bidding on naval supplies. All bids from such persons will be given the same consideration, and in each case award will be made to the lowest formal responsible bidder. By reason of the onerous requirements under the old form of contract many responsible firms were unwilling to deal directly with the bureau. By removing these onerous conditions it is hoped that such firms will bid directly for the Navy business, and, by thus widening competition, give to the Navy better prices and prompter deliveries.

UNION SWITCH AND SIGNAL.—Advices from Pittsburg state that on account of the large number of orders that are pouring into the company's office, the Union Switch & Signal Company, one of the large Westinghouse concerns, will not be allowed to remain idle for repairs as long as was expected. The plant closed down Dec. 20, expecting to remain idle until Jan. 8, in which time many needed repairs were to be made. Within the past week, however, the company has received an order for supplying the Pennsylvania Railroad tunnel in New York with switches and signals, the contract being for $2,000,000. The company has also received an extensive order from the Harriman lines. In consequence of these contracts, which will keep the big plant running day and night, the company sent notices to all of its employees to report for work Jan. 2.

HABIRSHAW WIRE COMPANY.—One of the interesting and important changes of the new year is that by which the India Rubber & Gutta Percha Insulating Company becomes the Habirshaw Wire Company. The product of this well-known concern has always been popular and familiar as "Habirshaw" wire and cable and Dr. W. M. Habirshaw has long been a dominating figure in this industry. Although not now giving such close attention to details as he once did, he keeps in touch with the growth of the art and is regarded as the leading authority on a subject that he has made so much his own as manufacturer, engineer and expert. The general feeling in the trade is that the change is a good one also in its advertising value, from such considerations.

CIRCUIT BREAKERS.—Mr. J. N. Kelman, of Los Angeles, Cal., has just completed, he states, "the installation of 75,000-volt circuit breakers in all the sub-stations on the Los Angeles Edison Company's 75-000-volt transmission line from Kern River to Los Angeles. These circuit breakers are operated by means of trip coils placed directly in the line, and to the best of my knowledge are the only circuit breakers for that voltage that are operated in this manner, if they are not the only 75,000-volt circuit breakers of any type in use on any system to-day. We have tested them thoroughly, and find that they are just as reliable as 500-volt direct-current breakers, such as are used on street railway work."

BUENOS AYRES SUBWAY.—U. S. Consul-General A. G. Snyder, of Buenos Ayres, Argentine Republic, reports that the city of Buenos Ayres has called for tenders for the construction of two lines of the underground electric railways which form part of the system proposed and approved by the Municipal Commission; and for the leasing of the operation of said lines upon their completion. The requirements of said bids can be obtained by interested parties from the office of the Secretary of Public Works of the Municipality, at Buenos Ayres. Bids will be received until May 1, 1908.

SPANISH TROLLEYS.—The Gaceta de Madrid states that the Spanish Director General of Public Works has granted a concession to La Compania General de Tranvias y Ferrocarriles Vincinales, of Alicante, Spain, to install electric traction on the tramways in Alicante, of which they are concessionaires.

BATTERY IN STEEL WORKS.—The Cambria Steel Company has just placed with the General Storage Battery Company an order for 45 G cells of Bijur battery, with automatic reversible booster and Bijur regulator, for use in their Franklin Works. This is a second order. The Cambria Steel Company uses two large ore bridges and one car dumper, all operated by electric motors and supplied with current by a set of feeders from the main power house, the center of the load being approximately 3000 ft. from the power house. The work of these motors is of necessity heavy and intermittent, so that the load on the power house fluctuates widely. The momentary current values vary from 400 to 4000 amperes, equivalent to rapid fluctuations in load from 100 to 1000 kilowatts at 250 volts. Prior to the installation of the storage battery, 12 cables of 500,000 circular mils were used as feeders (six outgoing and six returning), to supply the motors operating the ore bridges and car dumper. The voltage at the center of the motor load, at the same time, fluctuated through wide limits. It was found that the installation of a storage battery would maintain the voltage at the center of the load at a higher working value, would furnish a reserve in emergencies, and by dispensing with enough feeder copper to pay a good part of the cost of the battery. It was necessary, however, that the storage battery installed should go from charge to discharge, with small changes in voltage at its terminals; should be capable of being operated with little or no attention; should be able to withstand occasional overloads without detriment; and in emergency be able to stand fully discharged for short periods, without permanent injury. The battery installed is of the Bijur high-duty type, consisting of 106 cells having a capacity of 2400 amperes for 20 minutes. By the selection of the proper number of cells, the battery has been arranged so that while merely floating on the line, its total charge and total discharge over an extended period are equal, hence the state of charge of the battery remains substantially constant. In order to provide for an increase in the condition of charge, and to give occasional overcharges, required for best operation, a separately excited motor-driven booster is installed in the power station.

THE BRILLIANT ELECTRIC COMPANY FACTORY.—The new factory of the Brilliant Electric Company, situated at Conneaut, Ohio, has an annual output of 5,000,000 lamps. It is unusually advantageously located, being on both the Lake Shore & Michigan Southern Railroad and the New York, Chicago & St. Louis Railroad, and having easy access for lake shipments from the well-known Conneaut harbor. The building is three story, brick and iron construction, each floor having 13,330 sq. ft. The top floor, upon which most of the actual making of the lamp is done, is a light room without a partition or post to obstruct. It is the only factory which has been built especially and exclusively for the manufacture of incandescent lamps. The equipment is one of the most modern character and is entirely new throughout. Mr. H. F. Schadel, who has been in the lamp business for the past 25 years, is superintendent of the factory, under the management of Mr. E. J. Kulas, secretary and general manager of the company.

PLANING MILL PLANT.—A recent fire destroyed the building containing the planing mill and wood working shops of the Chicago, Milwaukee & St. Paul Railway, at West Milwaukee, making it necessary to rebuild and replace a portion of the equipment. The work of restoration is being rushed, and a contract has been let to Allis-Chalmers Company, of Milwaukee, for a 400-kw engine-type direct-current generator, 240 volts, 90 r. p. m. This machine is intended for lighting and motor service.

WIRELESS ON PACIFIC.—The steamship *Portland*, of the Alaska Coast Company, sailed from Valdez, Wash., for San Francisco, Cal., Dec. 26, equipped with wireless. The other boats of the Alaska Coast Company's fleet will be similarly equipped. The United Wireless Telegraph Company (De Forest system) is being used.

LARGE TESTING LABORATORIES.—There is now being installed in the plant of the Lima Insulator Company, at Lima, N. Y., a 450,000-volt testing apparatus, which will give to the company one of the largest testing outfits. The apparatus is being installed by the Central Laboratory Supply Company, of Lafayette, Ind.

THE AMERICAN THREAD COMPANY, Watuppa, Mass., recently purchased a duplicate of the 1500-kw Allis-Chalmers steam turbo-alternator ordered some months ago. The second unit was bought through the Thread Agency for the Kerr Mills, at Watuppa, and is a 60-cycle, three-phase, 550-volt machine.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the early part of the week there was a depression in stock quotations, from which, however, there was a tendency later to recover sharply as the year closed. This improvement was due to renewed high rates for money on call and resultant liquidation and bearish pressure. An expectation of better financial conditions after Jan. 1 is supported by the weakness of foreign exchange and the renewed buying of commercial paper by interior and local institutions. The erratic action of the New York Central exerted some unfavorable influence, and the stock dropped to 89 on persistent selling and the absence of support. No explanation as to its behavior was given. Pennsylvania shares were sympathetically affected by this movement, and most of the standard railroad lines inclined to sell off more or less, similar irregular weakness being shown in the leaders of the industrial list, although the steel shares were relatively better supported than the others. Copper stocks were somewhat neglected in the transactions. The electric and traction stocks were as a whole weak and little business was transacted in them. Prices in most all cases slightly declined. The Curb market in a general way followed the movement of the stock market, with early weakness succeeded by an all-round rally. Following are the closing quotations of Dec. 31:

NEW YORK.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
Allis-Chalmers Co.	5⅞	6	General Electric	110	112
Allis-Chalmers Co. pfd..	16½	17	Hudson River Tel.....	—	—
Am. Dist. Tel.........	39	39*	Interborough Met. com.	6½	7⅞
American Locomotive..	37	34¾	Interborough Met. pfd..	17¼	18¼
Amer. Locomotive pfd..	88	36⅜	Mackays Cos.	51	54
American Tel. & Cable..	50	55	Mackays Cos. pfd......	59⅛	60¾
American Tel. & Tel...	101	100	Marconi Tel.	—	—
Brooklyn Rapid Transit.	38¾	39	Metropolitan St. Ry....	—	22
Electric Boat	—	—	N. Y. & N. J. Tel......	94	92
Electric Boat pfd......	—	—	Western Union Tel....	55	57
Electric Vehicle	—	—	Westinghouse com.....	43⅛	43
Electric Vehicle pfd...	—	—	Westinghouse pfd......	60	—

BOSTON.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
American Tel. & Tel...	101½	100	Mass. Elec. Ry. pfd....	—	38½
Cumberland Telephone.	—	—	Mexican Telephone.....	1¼	—
Edison Elec. Illum....	—	208	New England Telep....	105	—
General Electric	—	112	Western Tel. & Tel....	—	—
Mass. Elec. Ry........	—	8½	West. Tel. & Tel pfd...	—	—

PHILADELPHIA.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
American Railways.....	43	43	Phila. Electric	6¼	6⅜
Elec. Co. of America...	9¼	9½	Phila. Rapid Transit....	17	17¼
Elec. Storage Battery...	27	30	Phila. Traction	82½	—
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Dec. 23	Dec. 31		Dec. 23	Dec. 31
Chicago City Ry.......	150*	150*	National Carbon	—	—
Commonwealth-Edison ..	78	78½	National Carbon pfd....	—	—
Chicago Subway	15½	16½	Union Traction	—	—
Chicago Tel. Co.......	105	105½	Union Traction pfd....	—	—
Metropolitan Elec. com.	16½	15*			

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*Asked.

WESTERN UNION STOCK.—The $1,217,000 stock of the Western Union Telegraph Company which is to be listed on the New York Stock Exchange will be distributed to the stockholders as a quarterly dividend in conformity with the resolution adopted by the directors on Dec. 11. This issuance will make the total amount outstanding $98,587,000. This new stock will carry dividends accruing after Jan. 15. The authorized capital stock of the company is $125,000,000, of which $10,000,000 is reserved to take care of the outstanding $10,000,000 convertible 4 per cent bonds due 1936 and $15,000,000 will be reserved to take care of $15,000,000 of said bonds not yet issued. The stock to be listed is a part of the $13,800,000 increase authorized in 1892. It is expected that the company will right itself rapidly now the strike is a thing of the past. The company has a surplus on its books of $14,273,114.

NASSAU LIGHT MORTGAGE.—Stockholders of the Nassau Light & Power Company have voted to mortgage the property and franchise to secure $1,000,000 5 per cent bonds, dated Oct. 1, 1907, and payable Oct. 1, 1927. The plant is located at Roslyn, N. Y., and is operated under the management of J. G. White & Co. The system has grown very rapidly.

WESTINGHOUSE BONDS.—The receivers of the Westinghouse Electric & Manufacturing Company have given notice that interest on the bonds will be paid as usual, on Jan. 1, by the Farmers' National Bank, of Pittsburg. The earnings provide for the interest, with a very large margin.

WORCESTER ELECTRIC LIGHT.—The annual report of the Worcester (Mass.) Electric Light Company shows that the gross earnings for the year were $307,532, against $306,019 in 1906, a gain of $1,513. The receipts in 1905 were $294,459, showing a gain in 1907 from two years ago, of $13,073. The company declared an 8 per cent dividend for 1907, amounting to $51,096, leaving a surplus at the present time of $101,582. The statement in detail follows: Real estate, $94,647.42; steam plant, $98,805.27; electric plant, $118,324.47; electric lines, $704,-400.70; transformers, $28,972.51; meters, $20,663.17; arc lamps, $28,437; due for light and power, $30,362.86; fuel on hand, $4,590.10; carbons on hand, $2,270.17; oil and waste on hand, $22.56; incandescent lamps on hand, $11,148.52; globes on hand, $553.49; other materials on hand, $2,544.30; fixtures on hand, $1,529.95; horses, wagons, etc., $3,291.31; sundry accounts due company, $3,115.72; office furniture, $1,114.91; cash on hand, $258,835.26; total assets, $1,413,629.99. Liabilities—Capital stock, $754,800; unpaid bills, $42,938.05; deposits, $1,125; premium on new stock, $262,880; total liabilities, $1,061,743.05. Profit and loss balance, $351,836.94. Total, $1,413,629.99. Manufacturing account—Operating expenses at station, $62,155,08; cement bought, $1,538.75; distribution, $46,158.60; management, $17,285.18; taxes and incidentals, $27,683.10; total, $154,820.71; sale of light and power, $303,459.48; other sources, $4,040.02; total, $307,499.50. Profit and loss account—Balance last year, $323,454.18; balance of manufacturing account, $152,678.79; interest received, $5,438.33; jobbing, $199.39; other items of income, $23.32; total, $481,794.01. Dr.—Interest paid, $186.36; dividends declared, $51,096; depreciation, $78,624.71; balance, $351,886.94; total, $481,794.01.

DIVIDENDS.—The Consolidated Traction Company has declared a dividend of 2 per cent on its capital stock, payable on and after Jan. 15. Directors of the Washington, Alexandria & Mt. Vernon Railway Company have declared a dividend of 1 per cent, payable Jan. 2, 1908. Directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable Jan. 8. A dividend of 1 per cent has been declared on the capital stock of the Springfield Railway & Light Company, payable Jan. 2. A quarterly dividend of 1½ per cent has been declared on the preferred stock of the Evansville Light Company, payable Jan. 2. A quarterly dividend of 1½ per cent has been declared on the preferred stock of the Peoria Light Company, payable Jan. 2. The Electric Storage Battery Company has declared the regular quarterly dividend of 1¼ per cent on both the common and preferred stocks, payable Jan. 2. The United Traction and Electric Company of New Jersey has declared a dividend of 1¼ per cent on the capital stock. Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1¾ per cent, payable Jan. 15. The North American Telegraph Company's directors have declared the regular semi-annual dividend of 3 per cent, payable Jan. 1. The Coal & Iron National Bank of the City of New York has declared a regular quarterly dividend of 1½ per cent.

GENERAL ELECTRIC BUSINESS.—The General Electric Company continues to book a heavy volume of new business. New orders received during November aggregated about $4,200,-000, or at the rate of $50,000,000 gross for the year, and December sales will, according to present appearances, reach about the same figures. The fiscal year of the General Electric Company ends Jan. 31. Unless there is a totally unlooked-for shrinkage in business in January, it now seems probable that the current fiscal year will show gross sales even in excess of last year. In the year ended Jan. 31, 1907, the company booked orders for $60,483,659. For the nine months ended Oct. 30 last the new orders received totaled $49,677,500, so that if monthly orders for the last quarter averaged no higher than the November total, gross sales for the year would run in excess of $61,600,000, or more than $1,000,000 greater than in the 1907 year. The officials of the company are shaping their plans to handle a gross business during the coming fiscal year of not less than $50,000,000.

DETROIT TROLLEY EARNINGS.—The Detroit United Railway will close the year 1907 with an increase of about $700,000 in its gross earnings over the year 1906. The gross earnings up to Dec. 1 were $6,166,479, which is an increase of $616,392 over the same period last year. The average increase a month for the 11 months was about $56,036, which amount for December added to the $616,392 would bring the total to $672,-428. Operating expenses and taxes were $3,836,748, an increase of $440,755 over the 11 months of 1906. This leaves net earnings of $2,329,731 for 11 months of 1907, an increase of $175,637 over 1906. Other income in 1907 amounted to $49,117, an increase of $8,222, making the total income $2,378,848, an increase of $183,859. The charges in 1907 were $1,263,830, an increase of $127,534, leaving a surplus of $1,115,018 for the 11 months, an increase of $56,325.

BOSTON WEST END.—The Massachusetts Railroad Commission has approved of an issue of 20,218 shares of additional common stock by the West End Street Railway Company, and fixed the issue price at $70 per share, plus the amount of dividends which shall have accrued on said stock under the provisions of the lease to the Boston Elevated at date of payment for the same. This is the amount of stock asked for as reasonably necessary for payment to the Boston Elevated for additions, improvements and alterations made from April 1, 1904, to Sept. 30, 1907, to the amount of $2,135,750. The stockholders have voted in favor of the issue. At the present time the West End owes the Boston Elevated $2,139,000. The new stock will provide $1,415,000, leaving a balance of $724,000 to be taken care of by the issuance when conditions warrant of $750,000 5 per cent 15-year bonds.

CHICAGO CONSOLIDATION.—The South Chicago City Railway Company and the Calumet Electric Street Railway Company are to consolidate. An agreement between the officials of the two corporations has been reached, but the papers have not been signed. The Calumet Electric is still in the hands of a receiver, but of recent years has been doing a fairly good business. Ira M. Cobe, the receiver, confirms the news of the consolidation. According to Mr. Cobe, the Calumet Electric has issued bonds in the amount of $3,000,000, which fall due Nov. 1, 1909. There are $500,000 in stock and $675,000 of receivers' certificates outstanding. The South Chicago City Railway Company operates 37 miles of track within the Chicago city limits and the Calumet Electric operates 75 miles.

NEW ENGLAND TELEPHONE.—The New England Telephone & Telegraph Company will close its current fiscal year with the best record of gross and net earnings in its history. Gross earnings will run in excess of $10,500,000, while the gain in net will be considerably in excess of the customary annual increase of $200,000. The New England Telephone Company during the past 12 months has been able to cut down its operating ratio by practical business economies without in any way curtailing maintenance or impairing efficiency of service. The construction work installed during 1907 has been confined largely to actual necessities, so that construction account will show a substantial cash credit at the end of the year.

MEXICAN LIGHT & POWER.—The Mexican Light & Power Company has sold an additional $2,400,000 of its 7 per cent preferred stock in London. The entire amount was underwritten by Sperling & Company, of that city. The new issue makes the total share capital outstanding $15,400,000, United States currency. The proceeds of the new issue will be used to complete the construction of the company's works at Necaxa.

AUTOMATIC ELECTRIC.—According to advices from Chicago, a director says that the mortgage for $1,000,000 in 6 per cent bonds to be placed ahead of the stock should not interfere with dividends. The obligation thus created, amounting to $60,000 a year, is about one-half the amount the Automatic has paid the Strowger Telephone Company in royalties.

WESTERN ELECTRIC STOCK.—Nearly half of the 700 minority stockholders of the Western Electric Company have assented to the American Telephone & Telegraph Company's offer to take over their holdings for bonds or cash, but not one-half of the $6,000,000 minority holdings. A large majority of the stock is expected before Jan. 20, the time limit.

MEXICAN TELEGRAPH.—The Mexican Telegraph Company for the three months ended Dec. 31, shows a gross of $185,000, expenses of $35,500, a surplus after dividend, etc., of $97,248, and a total surplus of $2,156,340. The Central & South American Telegraph Company had a gross of $425,000, expenses of $145,000, a surplus after dividends, etc., of $139,948, and a total surplus of $1,146,447.

HUDSON RIVER POWER.—The Hudson River Electric Power Company reports earnings for November as follows:

	1907.	1906.	
November gross............	$124,860	$85,763	Inc. 10,853
Expenses	60,804	49,763	Inc. $39,097
November net............	$64,056	$35,812	Inc. $28,244

GENERAL NEWS

Construction News.

BREWTON, ALA.—The citizens are contemplating installing two new boilers of 150-hp. each, in the municipal electric light plant and water works, and erecting a 100,000-gallon stand-pipe. G. E. McCants is manager.

EDMONTON, ALB.—R. R. Kelly, city engineer, writes that bids will probably be called for at once for the construction of a power station building and six miles of transmission lines. The cost of the proposed work is estimated at $40,000.

HEADLAND, ALA.—J. L. Kelly, mayor, writes that the citizens on Dec. 16 voted to issue $23,500 in bonds for the construction of water works and an electric light plant.

GLOBE, ARIZ.—The local electric light and gas plants owned by Messrs. Cotter and James, have been sold to A. F. Gressler, of Bisbee, and W. D. West of Chicago, Ill. The new owners contemplate making improvements and increasing the equipment of both the electric and gas plants.

PHOENIX, ARIZ.—Redmond Toobey and Harry J. Bennett have applied to the Board of Supervisors of Maricopa County for a franchise to construct and operate an electric railway between Phoenix and Mesa by the way of Tempe.

LITTLE ROCK, ARK.—The Walnut Hill Telephone Company has filed a certificate with the Secretary of State changing the location of its business to Bradley, and providing for the construction and operation of local lines in Walnut Hill, Lewisville and Waldo.

VAN BUREN, ARK.—The Fort Smith Light & Traction Company, of Fort Smith, has been granted a franchise for a term of 50 years to distribute electricity for light, heat and power purposes in Van Buren.

BISHOP, CAL.—W. H. Snyder, of Snyder's Camp, near old Chrysopolis, states that mines there are to be opened on a large scale, and that the owners contemplate an expenditure of from $500,000 to $1,500,000 in developing the mines. It is said one of the earliest steps will be the erection of an electric plant on Big Pine Creek to transmit electricity to the camp for use in milling.

COMPTON, CAL.—The Compton Electric Light & Power Company contemplates extending its lines to Watts and Willow Brook. G. R. Fulton is secretary and manager.

ESCONIDO, CAL.—A. Steiner and W. A. Sickler are interested in a project to erect an electric light and power plant to be owned and operated by the people in connection with a water system, which they have developed.

FILLMORE, CAL.—The Pacific Coast Telephone Construction Company has submitted a proposition to the directors of the Board of Trade, proposing to construct a local telephone system, provided 100 subscribers can be secured.

FRESNO, CAL.—The Kings River Power Company, of Los Angeles, has given notice of the appropriation of 25,000 miner's inches of the water from the Kings River to operate machinery for the generation of electrical energy to be transmitted to Fresno, San Francisco and Los Angeles.

HAYWARD, CAL.—The Pacific States Telephone & Telegraph Company is planning to erect a building here for its exchange, to cost about $10,000. The company will also install a two-party line system throughout the town. F. C. Michel is resident manager.

HERMOSA BEACH, CAL.—The City Council is considering the question of installing a municipal electric light plant.

JUNCTION CITY, CAL.—The Northern California Power Company has been granted a permit to occupy a right of way 27 miles long for a transmission line through the Trinity National Forest Reserve.

MARE ISLAND, CAL.—We are informed that plans are being made to place the electric wires underground in the center of the yard at the Mare Island Navy Yard. A 250-kw motor generator has just been installed to furnish direct current for motors. Electricity for the navy yard plant is furnished by the Bay Counties Power Company.

MONROVIA, CAL.—The City Council has awarded the contract for the installation of a new plant at the city wells to the Edison Electric Company, of Los Angeles, for $11,450.

MORENO, CAL.—Steps have been taken by the Los Angeles & San Diego Beach Railway Company for condemnation proceedings to secure a tract of land on which to erect its power station in this place. As soon as the property is secured work will commence on the construction of the plant. The plant will furnish electricity to operate the La Jolla line.

OAKLAND, CAL.—The Oakland Traction Company is planning extensive improvements and additions to its system during the coming year, including the building of ten miles of new track, the erection of a new power station having a rating of 10,000 kilowatts and sub-stations. Twenty interurban cars and ten standard railway coaches will be built at the shops of the company.

OCEAN PARK, CAL.—The Seaboard Construction Company has presented to the Board of Trustees of Ocean Park a plan for providing a gas and an electric lighting plant, which will receive the attention of the board at its regular meeting.

PASADENA, CAL.—The City Council has decided to call a special election to vote on the proposition to issue $50,000 in bonds, instead of $200,000, for the completion of the electric light plant. The election will probably be held the latter part of this month or the first of February.

SAN FRANCISCO, CAL.—The Board of Supervisors has granted the Merchants' Ice & Cold Storage Company permission to erect and maintain an overhead electric cable for the purpose of transmitting electricity for operating a pump on the wharf to convey salt water to the property of the company located at the corner of Sansome and Lombard streets.

SAN RAFAEL, CAL.—The Snow Mountain Power Company will soon begin to erect poles for its transmission line in Marin County. The company is now erecting a large sub-station at Vichy Springs.

SANTA ANA, CAL.—The Anaheim Chamber of Commerce is considering the advisability of installing electric lamps along the road from Santa Ana to Fullerton.

SANTA MONICA, CAL.—The Santa Monica Bay Home Telephone Company has increased its capital stock from $250,000 to $500,000. The company is contemplating making extensions to its system and entering new territory.

SANTA ROSA, CAL.—The Santa Rosa Lighting Company contemplates changing its system from two to three phase and rewiring the town. R. Leo Van de Naillen is manager.

COLORADO SPRINGS, COL.—It is reported that work will soon commence on the construction of the proposed electric railway of the Manitou & Crystal Park Railway Company, from Manitou to Crystal Park. The cost of the road is estimated at $500,000. J. K. Vannatta is president of the company.

HOTCHKISS, COL.—J. W. Lee, representing the Colorado Fruit Company and the Hotchkiss Packing & Power Company has been granted a franchise to operate an electric light plant for a term of 20 years. The company was organized for the purpose of furnishing the town with electricity for lighting and also for running a canning factory and evaporator.

JEWETT CITY, CONN.—Extensive improvements are being made to the borough municipal electric light plant. A new generator was recently installed and other changes are being made.

HARRINGTON, DEL.—The Coursey mill property has been purchased by the local heat, light and power company, which proposes to erect an electric light plant on the site.

WASHINGTON, D. C.—Bids will be received at the office of Bernard R. Green, superintendent of construction of the National Museum of Congress, until Jan. 21, for furnishing and installing complete the electric wiring required for the new building for the National Museum.

ST. PETERSBURG, FLA.—Charles Braaf is considering plans for irrigating his property in Northern Mobile, in connection with an artesian well recently sunk, which will furnish water to irrigate the land and power to operate an electric light plant.

ATLANTA, GA.—The Atlanta Telephone Company has petitioned the City Council for the right to place additional underground conduits on Edgewood Avenue.

TYBEE, P. O., SAVANNAH, GA.—Messrs. Stubbs & Keen are contemplating the installation of an electric light plant in connection with a summer resort, and are in the market for prices for electrical machinery.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company is planning to double the present output of its plant and extend its transmission lines to Cottonwood, twenty miles distant. D. C. Van Buren is manager.

MORAVIA, IDAHO.—Plans are being considered for organizing an electric light and power company in this place. Nels Peterson, H. Rolling and others are interested in the project.

RATHDRUM, IDAHO.—The A. O. Skinner Electric Light & Power Company is contemplating erecting five miles of high-tension transmission line. H. R. Saunders is secretary and manager.

REXBURG, IDAHO.—The Falls Power, Light & Water Company has decided to extend its high-tension transmission line from Blackfoot to Rexburg.

FLANAGAN, ILL.—It is reported that the Village Board is considering the proposition of installing an electric light plant.

JOLIET, ILL.—The Economy Light & Power Company is constructing an 8000-hp hydro-electric plant. Charles A. Munroe is manager.

EVANSVILLE, IND.—C. M. Katterjohn, superintendent of the Cumberland Telephone Company, has asked the Council for an extension of time from Jan. 1 to May 1 for installing new equipment and making other changes in the telephone system provided for in the franchise secured several months ago. It is the intention of the company to install a central energy system with the latest improved equipment. A new switchboard and other new fixtures will be necessary and changes are being made in the wires and cables.

HAGERSTOWN, IND.—The contract for the construction of the new municipal electric light plant has been awarded to Wesley Cornel, of Cambridge City.

INDIANAPOLIS, IND.—The Trustees of the Central Indiana Hospital for the Insane are asking for proposals for the installation of a direct-current generator, direct connected to a steam unit (engine or turbine) foundations, steam connections, switchboard panel and all necessary connections. Bids will be received until Feb. 4.

KNIGHTSTOWN, IND.—The question of issuing bonds to secure funds with which to reconstruct the municipal electric light plant was submitted to a vote of the taxpayers on Dec. 27, resulting in favor of the improvement.

DES MOINES, IA.—The controlling interest in the Hawkeye Telephone Company, the branches of the mutual telephone organization, in Dallas, Guthrie and Polk counties, has been sold by President G. N. Brady to the Brenton Brothers, of Dallas Center. Charles R. Brenton will become president of the company upon the retirement of Mr. Brady, and D. R. Griswold will be the secretary and general manager.

KEOKUK, IOWA.—Preliminary surveys have been completed for the Keokuk & Columbus Railway Company, which proposes to construct an electric railway to connect Keokuk, Charleston, Columbus Junction and intervening cities. The road will be about seventy-five miles in length and will be operated by electricity. J. E. Peterson, of New London, is president, and T. A. Craig, of Keokuk, secretary.

VENTURA, IA.—The Western Electric Telephone Company is planning to consolidate the different telephone lines running into Ventura and using the same central office.

WEBSTER CITY, IA.—The managers of the municipal electric light plant are changing the plant from 110 to 220 volt, three-wire system. R. J. Mullins is manager.

HERINGTON, KAN.—The water and light committee is contemplating the rebuilding of the electric lighting plant soon. C. E. Stromquist is general manager.

HUMBOLDT, KAN.—The managers of the municipal electric light plant are contemplating establishing a day service next spring. W. A. Moore is superintendent.

RICHMOND, KY.—We are informed that the Richmond Electric Power Company will install an additional boiler in its plant next summer. The General Engineering Company, of Cleveland, Ohio, has charge of the plant.

MIDWAY, KY.—The Versailles Electric Light Company is making arrangements to extend its transmission line to Midway, a distance of six miles. The company has a franchise in Midway. Harry Reid is president and manager.

CROWLEY, LA.—Armas Durio, superintendent of the municipal electric light and water works plant, writes that an additional boiler will be installed in the plant next summer.

BRUNSWICK, ME.—The Brunswick Electric Light & Power Company has filed a notice with the Secretary of State showing an increase in the capital stock of the company from $50,000 to $100,000.

LEWISTON, ME.—The Lewiston & Auburn Electric Light Company has announced a reduction in the price of electricity for lamps in Lewiston and Auburn from 9 cents per kw-hour to 8 cents per kw-hour, beginning with Jan. 1. A short time ago the company reduced its rate from 10 cents to 9 cents per kw-hour.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has awarded the contract for improvements to its Penn Street electric sub-station. A new roof, etc., will be built and a cable and wire tower will be constructed. P. O. Keilholtz is engineer.

AMESBURY, MASS.—The State Board of Gas and Electric Light Commissioners has authorized the Amesbury Electric Light Company to issue bonds to the amount of $50,000.

CLINTON, MASS.—The Clinton Wire Cloth Company proposes to install a new 500-hp dynamo to generate electrical energy for use in its plant. At present the Clinton Electric Lighting Company is furnishing electricity for the plant.

COTTAGE CITY, MASS.—Extensive improvements are being made to the plant of the Cottage City Gas & Electric Light Company. Some of the old equipment is being removed and replaced by new.

GLOUCESTER, MASS.—The Board of Aldermen has approved the contract submitted by the committee on fuel and street lights with the Gloucester Electric Company for street lighting for a term of five years. The company is to furnish not less than 90 arc lamps at $80 each per year and 650 tungsten incandescent lamps at $14.50 per lamp per year. Under the new contract the committee has secured a reduction in the price of arc lamps from $82 to $80 per year, and the incandescent lamps of 25 cents per lamp, making a saving of $128 per year on arc lamps and $131 on incandescent lamps per year.

HYDE PARK, MASS.—Plans are being drawn for an electric power plant for the Becker Brainard Milling Machine Company in Hyde Park, the cost of which is estimated at $60,000.

MALDEN, MASS.—The Malden Electric Company has petitioned the State Board of Gas and Electric Light Commissioners for an approval of an issue of $150,000 additional capital stock to retire the floating debt incurred in enlargements to its plant.

ROYALSTON, MASS.—A representative of the Connecticut Power & Light Company, of Boston, Mass., has been in town recently looking up the route and getting permission to set poles for a transmission line from Vernon, Vt., to Boston. The company is building a large power plant in Vernon for the purpose of transmitting electricity to Boston and proposes to furnish electricity for lamps and motors to towns on the route.

STOCKBRIDGE, MASS.—The State Board of Gas and Electric Light Commissioners has granted the petition of the Stockbridge Lighting Company to issue its initial capital to the amount of $25,000, par value.

WINTHROP, MASS.—The citizens on Dec. 10 voted to enter into a contract with the Suburban Gas & Electric Company, of Revere, to light the town for a term of five years. Under the new contract the streets are to be lighted all night. At present the lamps are extinguished at 1:30 o'clock in the morning and relighted at 4:30.

CADILLAC, MICH.—Work on the Tyler dam of the Electric Land & Development Company has been suspended, but officials of the company state that it will be resumed after the holidays. The money stringency is assigned as the cause of the delay.

GLADWIN, MICH.—Schulz & Prindle, owners of the local electric light plant, are contemplating establishing a day service. F. L. Prindle is manager.

MARQUETTE, MICH.—The total income of the municipal electric light plant for the sale of electricity during November was $7,819, and the expenditures only $3,641, leaving a balance of $4,178. The rates for lighting are five cents per kilowatt-hour for business places and seven cents for residences. It is stated that a new and larger plant will be erected within the next year or two, and it will be built largely from the earnings of the present plant, without the aid of a bond issue.

OWOSSO, MICH.—The Shiawassee Light & Power Company has applied to the city for a 20-year franchise and a lighting contract for a term of 10 years.

PETOSKEY, MICH.—W. L. McManus, who was refused permission to run wires from his sawmill to the Cushman House, which he recently purchased, now wants to purchase the municipal lighting plant, which has been operated by the city for fifteen years. He has asked the Council to set a price. The plant under municipal control has piled up a big deficit.

ALEXANDER, MINN.—The village is contemplating the construction of a new station to replace the present municipal lighting plant. C. A. Johnson is manager.

BRAINARD, MINN.—The City Council has authorized an issue of $25,000 in bonds to aid the Mississippi Water Power & Boom Company in constructing a dam in this city.

BRECKENRIDGE, MINN.—The Breckenridge Telephone Company has been formed and is making plans for the installation of a local exchange.

CROOKSTON, MINN.—The Crookston Water Power & Light Company is contemplating the construction of a large power plant on Red Lake, a distance of 12 miles from the city. Nothing will be done for the present, owing to the stringency in the money market.

NEW PRAGUE, MINN.—The citizens contemplate putting in a storage battery in the municipal electric light plant next spring. A. K. Adams is superintendent.

NORTHFIELD, MINN.—The Northfield Light, Heat & Power Company has obtained a lease on a mill property at Waterford, two miles distant, and will develop a water power of from 150 to 210 horse power. The company will install a 120-kw Westinghouse, alternating-current generator, and will also furnish a day service. The present plant of the company will be connected with the water-power plant about Feb. 1. A. K. Ware is president.

PRINCETON, MINN.—The village is contemplating installing an air lift pump, fire pump and induced draft system in the electric light and water works system. C. A. Dow is superintendent.

ST. PAUL, MINN.—The City Assembly on Dec. 23 accepted the bid of the St. Paul Gas Light Company to furnish both gas and electric lighting.

ST. PAUL, MINN.—The West Side Power, Heating & Lighting Company has filed amended articles of incorporation with the Secretary of State increasing its capital stock from $50,000 to $300,000.

NATCHEZ, MISS.—Plans and specifications for a municipal electric lighting plant are now being prepared by Krumbbaar & Aiken, of New Orleans, La. The plans call for a series, alternating-current, arc-lighting system of 150 lamps.

YAZOO CITY, MISS.—The city has awarded contracts for the construction of about three miles of new track, and also proposes to repair the car house and install a generator and engine in the power house. The city will purchase four additional cars in the near future. James S. Butler is superintendent of the street railway system.

BROOKFIELD, MO.—The Brookfield Electric Light Company is contemplating the installation of a three-phase power service and will establish a 24-hour service in the spring. Percy W. Markham is superintendent.

HARLOWTON, MONT.—A. C. Graves, of this place, contemplates the construction of an electric light plant and water works system here, to cost about $20,000. Bids for construction of the plant will probably be called for in March. The engineer has not yet been selected.

TOWNSEND, MONT.—The managers of the municipal electric light plant are contemplating installing a new alternator and arc circuit for street lighting; also meters. G. F. Ramspeck is manager.

CHADRON, NEB.—The Chadron Electric Light & Power Company is installing an Erie Ball engine direct connected to a 75-kw Crocker-Wheeler two-phase generator to replace a Buckeye high-speed engine. W. J. McCarthy is manager.

MALMO, NEB.—The Village Trustees have appointed a committee to investigate the cost, etc., of installing water works and an electric light plant.

PERU, NEB.—The Peru Electric Light & Power Company is contemplating extending its transmission line into the country and also establishing an alternating-current day service. L. K. Pettit is superintendent.

SUPERIOR, NEB.—The Superior Electric Light Company is contemplating establishing a day circuit. Walter M. Lee is manager.

TEKAMAH, NEB.—The managers of the municipal electric light plant are contemplating erecting about 30 blocks of pole line next spring. W. F. Poot is superintendent.

SPARKS, NEV.—Engineer E. Talbot, of Carson City, writes that the proposed power plant to be constructed on the Truckee River, 18 miles east of Reno, will cost about $250,000. The matter has been held up by litigation until July, 1908. Nothing definite will be done until after that time.

CLAREMONT, N. H.—L. N. Wheeler, manager of the Claremont Power Company, writes that the company is completing the installation of a 500-hp Diesel oil engine direct connected to a 300-kw, 2300-volt, 60-cycle, three-phase generator at its plant in Claremont, and has also nearly completed the construction of a hydro-electric plant at Cavendish, Vt., on Black River, where the company is installing three 750-hp Pelton water turbines under 120-ft. head direct connected to three 500-kw, 11,000-volt, 60-cycle, three-phase generators. The transmission line from Cavendish to Claremont, a distance of fifteen miles, is nearly completed.

CONTOOCOOK, N. H.—A new electric light plant has been installed in connection with the new mills at West Hopkinton.

WARREN, N. H.—The Warren Water & Light Company contemplates extending its transmission lines to Rumney for the purpose of furnishing electricity for lighting at Rumney, Wentworth and West Rumney. The company also contemplates utilizing the water power at Baker Pond, in Orford.

JERSEY CITY, N. J.—The Jersey City Electric Company has secured the contract for electric wiring of School No. 9, for $1,650.

DEMING, N. M.—The Deming Ice & Electric Company is rebuilding its plant and will extend its local service. C. M. McCamey is treasurer and manager.

BATH, N. Y.—The Village Trustees last summer refused the application of the Bath Electric Light Company for a new contract, alleging poor service. The franchise was then granted to Clinton Tower, of Buffalo, who agreed to have a new plant for street lighting in operation by Oct. 1. Mr. Tower failed to have the plant ready and asked for an extension of time, which the Trustees granted. At a meeting of the Trustees held recently Mr. Tower asked the Trustees to annul the franchise given him and to grant him an entire new franchise. The reason given for this request is that he has allowed the first franchise to become possessed by several New York City capitalists, who will not surrender the franchise unless they are paid $1,500. The Bath Electric Light Company, at the request of the Village Trustees, is still supplying the street lighting service at the schedule of prices as stipulated in the old franchise.

OSWEGO, N. Y.—The People's Gas & Electric Company is contemplating installing a 500-kw steam unit in its plant. J. M. Dickenson is manager.

SODUS, N. Y.—The Public Service Commission has granted the Sodus Gas & Electric Light Company permission to extend its transmission lines from Sodus to Webster and to Sodus Point, and to increase its capital stock from $15,000 to $90,000 for this work.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company will develop water power not far distant from its present plant, which will practically double the output of the present plant. Orders have been placed with the S. Morgan Smith Company, of York, Pa., for water wheels. W. H. Bangs is superintendent.

LITTLETON, N. C.—It is reported that A. E. Gonzales and W. H. Lyles, of Columbia, S. C., have acquired water power rights on the Broad River at Littleton, and contemplate building a dam for developing power.

COOPERSTOWN, N. D.—The Platt Electric Company is making extensive additions and improvements to its plant. The location of the plant has been changed and a new 125 horse-power Weber gas engine, and also another generator having a rating of 70 kilowatts, are being installed in the plant. Frank J. Simpson is treasurer and manager.

ENDERLIN, N. D.—The Enderlin Electric Light & Power Company contemplates installing a gas producer and extending its lines to Sheldon. M. A. Abbott is manager.

LEWISBURG, OHIO.—The citizens on Dec. 24 voted to issue $26,000 in bonds for the construction of a combined electric light plant and water-works system.

MILLERSBURG, OHIO.—Announcement has been made that the Millersburg & Eastern Railroad Company will soon commence work on the construction of its road, which will connect Millersburg, Wilmot, Berlin Trail and Beach City. The road will be about twenty-six miles long and will be operated by electricity. D. S. Olmstead, of Millersburg, is president.

RAVENNA, OHIO.—The Ravenna Gas & Electric Light Company is now changing over its plant from the single to the three-phase system. E. C. Lindsey is superintendent.

BARTLESVILLE, OKLA.—The Bartlesville Electric Light & Power Company is contemplating installing a 300-hp, water-tube boiler and erecting several miles of transmission line. S. J. Smallwood is president and general manager.

PANAMA.—Bids will be received until Jan. 20 by Lieut.-Col. H. F. Hodges, U. S. A., Washington, D. C., for an engine and generator, engine-driven exciter, storage battery, incandescent globes, hydrometers, sand pump, pump governors, steel tubing, etc., as per circular No. 412.

BRADFORD, PA.—The Bradford Electric Light & Power Company is contemplating the installation of new arc lamps. J. H. Rose is manager.

DANVILLE, PA.—Plans are being made by the Standard Electric Light Company to change its system from 133 to 60 cycles. George M. West is superintendent.

LANCASTER, PA.—The Lancaster County Railway & Light Company has recently installed a 1500-hp engine in its power house at Engleside.

OLYPHANT, PA.—The borough electric light committee contemplates establishing a day service and will install a new engine, generator and boilers in the municipal electric plant. W. J. Lynott is chief engineer.

PITTSBURG, PA.—The Ardmore Street Railway Company has filed with the State Department a notice of an increase in its indebtedness of $1,250,000 for improvements.

QUAKERTOWN, PA.—Plans are being made to change the system of the municipal electric light plant to two phase, 60 cycles. The present system is single phase, 125 cycles. G. Frey is superintendent.

ANDERSON, S. C.—The Anderson Traction Company is contemplating extending its lines from Belton to Greenville, which means the construction of twenty-five miles of new track.

FLORENCE, S. C.—The City Council is considering the question of more and better street lamps for lighting the streets of the city, and also the question of municipal ownership of the lighting plant. The contract between the city and the Florence Light & Power Company will expire early in 1908. The service given by the company is not all satisfactory and some other arrangement for lighting the city will have to be made.

NEWBERRY, S. C.—Plans are being considered for enlarging and improving the electric light plant and water-works system, which will include the installation of a new 200-kw generator and a well pump. H. W. Schumpert is superintendent.

SUMMERVILLE, S. C.—The Crystal Ice Company is planning to install a 125-kw generator and a 175-hp engine and boiler in its plant next fall. Milton P. Skinner is president and treasurer.

FULTON, S. D.—Lincoln Eves, of Meckling, has purchased the Fulton telephone exchange, and will install a new switchboard and make other improvements.

HARTFORD, S. D.—The Hartford Electric Light & Telephone Company contemplates the installation of a storage battery in its plant. Fred B. Harris is manager.

VEBLEN, S. D.—We have been informed that the Veblen Traction Company, which was recently incorporated, with a capital stock of $500,000, to build an electric railway between Lidgerwood and Veblen, will begin construction work next spring. The railway will be thirty miles long and the overhead trolley system will be used. The officers are: B. P. Hammersbach, of Veblen, president; E. A. Movius, of Lidgerwood, vice-president; J. B. Holsey, of Veblen, secretary, and George F. Anderson, of Veblen, treasurer.

JEFFERSON CITY, TENN.—The Jefferson City Electric Company contemplates installing a compound engine and a three-phase, direct-current generator to furnish power for a large woolen mill, and also installing arc lamps for street lighting. J. M. Coile is secretary and manager.

BEAUMONT, TEX.—The Beaumont Ice, Light & Refrigerating Company is planning to change its primary voltage from 1100 to 2200 volts. Joseph E. Carroll is president and manager.

COLUMBUS, TEX.—The Columbus Light Company contemplates the installation of a new boiler in its plant. J. Shaw is secretary and manager.

GONZALES, TEX.—The Citizens Electric Light & Power Company is planning to install two new generators in its plant in the spring to furnish electrical energy to operate an oil mill and cotton mill. T. H. Spooner is secretary and manager.

LODI, TEX.—George Gordon, village president, writes that the village recently purchased the local electric light plant and is now reconstructing the same at a cost estimated at about $10,000.

MERKLE, TEX.—The Merkle Light & Power Company will install a fifteen-ton ice plant in connection with its electric light plant. J. C. Hamm is president and manager.

QUANAH, TEX.—The Quanah Light & Ice Works has remodeled its plant and increased the output and changed the system from 133 to 60 cycles. E. A. Clausnitzer is owner and manager.

BRATTLEBORO, VT.—The Connecticut River Power Company is constructing a hydro-electric plant for long-distance transmission. J. G. White & Company, of New York, are designing the plant and equipment, plans for which have not yet been decided upon. H. S. Harriman is general manager.

FORT COVINGTON, VT.—The Fort Covington Light, Heat & Power Company is considering the question of building a new dam and establishing a day service next summer. W. S. H. Keefe is manager.

ROANOKE, VA.—The Roanoke Water Power Company contemplates the installation of a 1000-kw Allis Chalmers generator as an auxiliary to its present plant. R. C. Camp is general manager.

NORTH BEND, WASH.—Henry Hewitt, of Tacoma, has obtained franchises from the cities of Marshfield and North Bend, to construct and operate an electric light plant and street railway system in both cities.

POMEROY, WASH.—The Tucannon Power Company is making arrangements to install a steam plant to provide against freshets or accidents which may put its water power plant out of commission. The company is now installing a 158-hp Lane & Bodley Corliss engine in its plant, and has placed an order for a 100-kw generator. The work is being done under the supervision of J. J. Henley and W. W. Richardson.

CHARLESTOWN, W. VA.—The Kanawha Water & Light Company is contemplating installing 50 additional 6.6 amp. arc lamps on its street lighting system. G. F. Maddock is manager.

GRAFTON, W. VA.—John T. McGraw and associates have purchased the property of the Grafton Gas & Electric Company and will make extensive additions and improvements to the electric plant, which will double the present equipment of the station. The improvements include the installation of a 150-hp engine to operate a generator to furnish electricity to operate the street railway system; the erection of an addition to the boiler room, providing space for two new boilers. The cost of the work is estimated at about $20,000. The company contemplates building a coal tipple and bins later, to be used for storing coal.

WHEELING, W. VA.—It is reported that the Wheeling Electrical Company is contemplating making an application to the City Council for a 50-year franchise in this city. The company is connected with the Consumers' Electrical Company, the former owning the generating plant, and the latter being the distributing company. If a franchise is granted it is planned to consolidate the two companies as the Wheeling Electrical Company and increase the equipment of the electric plant.

BARRON, WIS.—Owing to the low water in the Yellow River the municipal electric light plant is unable to generate sufficient electricity to light the town. An engine was installed last winter, but is not capable of furnishing power enough to operate the whole system, and unless another engine of greater power is installed in the plant the city will not have electric light until next spring.

BAYFIELD, WIS.—Extensive additions and improvements are contemplated for the municipal light, power and water plant, including the installation of a new 500-hp Webster open feed water heater, one water tube boiler of 200-hp, a new smokestack 125 ft. x 6 ft. and a 500-gal, triple pump. J. T. Dohm is manager.

ELKHORN, WIS.—Plans are being contemplated for extending the municipal electric lighting system to the County Poor and Insane Asylum, a distance of three miles. William Pitz is manager.

MELLEN, WIS.—The Mellen Water & Light Company is contemplating changing its system from 133 to 60 cycles and establishing a day service after April 1. J. F. Pribnow is president and manager.

MINERAL POINT, WIS.—The Mineral Point Electric Light Company is planning to install a 100-kw steam turbine in its plant and establishing additional power circuits next spring. F. C. Ludden is manager.

MONROE, WIS.—The Monroe Electric Light & Power Company contemplates changing its system to 60 cycles and establishing a day service. W. P. Bragg is secretary and manager.

PESHTIGO, WIS.—The Peshtigo Lumber Company is contemplating changing the city lighting service from direct-current to alternating-current. S. D. Woodward is manager.

WATERLOO, WIS.—F. E. Peschel, village clerk, writes that about $5,000 will be expended on improvements to the electric light system, the work to be done by day labor. D. C. and William B. Jackson, Commercial National Bank Building, Chicago, Ill., are the engineers.

NANAIMO, B. C.—The Nanaimo Electric Light & Heat Company is planning to erect a large dam three miles from here to increase the output of its plant.

CAMPBELLFORD, ONT.—John S. Fielding, 15 Toronto Street, Toronto, Ont., writes in regard to the proposed municipal power plant for Campbellford, that bids are wanted for turbine wheels with a rating of 1350 horse-power, at 25-ft. head. He also states that Bogue & Buchanan, of Peterboro, have secured the contract for constructing head race, power house and tail race, and the Allis-Chalmers-Bullock Company the contract for the electric equipment. The total cost of the proposed plant is estimated at $60,000.

DUNVILLE, ONT.—The Dunville Electric Light Company is changing its street lighting system from Thomson-Houston arc lamps to alternating-current enclosed arc lamps. James Rolston is treasurer and manager.

GRANBY, ONT.—The village is increasing the equipment of the municipal electric light plant by the installation of a 150-kw, alternating-current dynamo to furnish electricity for incandescent lamps. F. B. Farnsworth is superintendent.

OTTAWA, ONT.—The city engineer has been instructed to confer with C. H. Keefer, civil engineer, of this city, to prepare plans for developing 30,000 horse power by the construction of a hydro-electric plant on the Ottawa River. As soon as his report is completed a by-law will be submitted to the ratepayers.

PORT ARTHUR, ONT.—We have been informed that the City of Port Arthur has authorized Smith, Kerry & Chace, Confederation Life Building, Toronto, to make a survey for power development at Silver Falls on the Kaministiquia River, about 25 miles distant from Port Arthur.

TORONTO JUNCTION, ONT.—E. R. Clarkson has been appointed receiver for the Stark Telephone, Light & Power Company.

WESTON, ONT.—Action has been started by Lorenzo Wynn to have the town restrained from entering into an agreement with the Stark Telephone, Light & Power Company for supplying the town with electricity for lamps and motors. According to the agreement the Stark company is to pay the town $500 for the use of the municipal plant and guarantees to supply electricity to consumers to operate motors for 2½ cents per kilowatt-hour, and for lamps at 10 cents per lamp per month, with a discount of 20 per cent if payment is made before the 15th of the month. It also agrees to furnish arc lamps of 1000 candle power at $50 per lamp per year.

WINGHAM, ONT.—The Town Council is considering an expenditure of about $25,000 for repairs to the hydro-electric plant in this place. W. J. Wyles is manager.

New Industrial Companies.

THE AUTOMATIC HOME TELEPHONE COMPANY, of Wilmington, Del., has been incorporated, with a capital stock of $200,000, by I. A. Morrison, S. L. Morrison, Ray Blaisdell, A. J. Vernier, Fred G. White, C. R. Tombaugh, H. S. Allen, A. F. Mett and E. B. Kipp, all of Pontiac, Ill., and Charles F. Branson, of Cadiz, Ohio. The company proposes to manufacture and deal in electric contrivances for transmitting sounds and signals.

THE ELECTRIC LIABILITY & CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000. The directors are Mitchell Bisher, Joseph Bisher and Leo Rochlitz, of New York.

THE MURPHY ELECTRICITY RECTIFIER COMPANY, of Rochester, N. Y., has filed articles of incorporation, with a capital stock of $1,000,000. The directors are Walter B. Duffy, George W. Aldridge and Thomas J. Murphy, of Rochester.

THE NATIONAL ELECTRICAL MANUFACTURING COMPANY, of Oakland, Me., has been incorporated, with a capital stock of $100,000, by G. S. Jewett, of Norridgewock; J. Harry Myers, O. M. Sibley, V. C. Totman, S. J. Foster, Harry L. Hunton and D. M. Marshall, of Oakland.

THE NEW ENGLAND MACHINE & ELECTRIC COMPANY, of Providence, R. I., has been incorporated, with a capital stock of $3500, by Frederick W. Smith, Elizabeth H. Smith and Roscoe M. Dexter. The purpose of the company is to engage in the business of general machinist and electrical contractor, and of dealing in electrical machinery, supplies, etc.

THE S. S. BRADY COMPANY, of Boston, Mass., has filed a certificate of incorporation, with a capital stock of $3,000, for the purpose of conducting a general electrical machinery and supply business. The officers of the company are Stephen S. Grady, president; Herbert I. Perry, of Rockland, treasurer.

THE TWICE TWO CYCLE ENGINE COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $10,000, by H. S. White, E. R. Casebeer and H. R. Kingsley. The company proposes to manufacture and sell engines.

New Incorporations.

MONTICELLO, IND.—The Tippecanoe Electric Light & Power Company has been incorporated with a capital stock of $75,000, by Abraham S. Straus and others.

PELLSTON, MICH.—The Pellston Light & Power Company has been incorporated with a capital stock of $25,000.

SALLISAW, OKLA.—The Southern Light & Power Company has been incorporated, with a capital stock of $20,000, by William A. Langdon and Webster Ray, of Sallisaw, and Richard Jackson, of Chicago, Ill.

WASHINGTON, PA.—The Monongahela & Carroll Street Railway Company has been chartered, with a capital stock of $12,000, to construct a street railway from Monongahela into Carroll, a distance of two miles. E. B. Hartman, Jr., of Pittsburg, is president of the company.

GORMAN, TEX.—Articles of incorporation have been filed for the Gorman Light & Power Company, with a capital stock of $15,000, by E. B. Winters, S. B. Bowles and W. A. Wallace.

SALT LAKE CITY, UTAH.—The Beaver River Power Company has filed articles of incorporation, with a capital stock of $500,000. The company proposes to build power plants for the generation and distribution of electricity. The directors are L. L. Nunn, E. P. Bacon, C. S. Ruffner, A. D. Smith, L. B. Fuller, W. L. Blearsach and F. F. Steigmeyer.

SHEPERDSTOWN, W. VA.—The Shepherdstown Electric Light & Power Company has filed articles of incorporation, with a capital stock of $20,000. The incorporators are Samuel J. Hodges, Harrison Schley, E. H. Rinehart and others.

Legal.

SOUTH TEXAS TELEPHONE COMPANY.—H. T. Huntington, of New York, N. Y., and F. C. Smith, of San Antonio, Tex., have filed a suit in the district court for the appointment of a receiver for the South Texas Telephone Company. The case is set for Jan. 15, and a temporary injunction restraining the company from disposing of any of its property was granted. Messrs. Huntington and Smith obtained judgment against the company for $47,000 for alleged breach of contract.

INJUNCTION AGAINST ELECTRIC LIGHT PLANT REFUSED.—In an action against the United Electric Light Company, an injunction closing down the plant of the company, was denied in the following closing the plant of the company, was denied in the following language: "The service which the defendant is rendering is of quasi public character; and in the particular neighborhood, embracing a large territory, for whose benefit this plant is operated, the defendant company is the only institution of its kind from which electric light, heat and power can be obtained. It supplies over 5,000 customers, and the range of its service takes in the lighting of the streets and schools belonging to the public, and our bridges that span the rivers in this section of the city obtain both light and power therefrom. Factories are dependent on this station for power to operate their machinery, and a great number of apartment houses operate their elevators by power received from the defendant. It is thus made patent that the injury that would be wrought, not only to the defendant, but to the public as well, by the issuance of an order that would cause a cessation in the operation of this plant, would be of an exceedingly grave and serious character. Some vibration, I presume, must necessarily ensue when machinery of any kind is employed, and, if institutions of the defendant's character are entitled to exist at all, all that can in fairness be exacted of them is that they will employ every agency in their power to reduce this to a minimum." Floyd-Jones vs. United Electric Light Co., New York Supreme Court, 106 N. Y. Supp. 648.

TELEGRAPH ANTI-TRUST SUITS.—New York Supreme Court Justice Hendrick, in a decision last week, defeated Attorney-General Jackson's effort to begin an action against the Western Union Telegraph Company and the Postal Telegraph Cable Company, restraining them from entering into a combination in restraint of trade. At the time the suit was entered, both companies denied that any merger was contemplated. Mr. Jackson, on July 8, obtained from Justice Platzek an order directing Clarence H. Mackay and other directors of both companies to appear before a referee and to testify regarding certain contracts and arrangements between the two companies. This order is now vacated by Justice Hendrick. In his decision in favor of the two companies, Justice Hendrick says: "The vital question to be determined is whether or not a telegraph company manufactures, produces or sells a commodity or article in common use, such as is within the prohibition of the Donnelly Anti-Trust act. If it does, then this motion should be denied; if not, it should be vacated." The court goes on to add that telegraph companies are not included under this act, and holds that the transmitting of messages from one point to another does not make the messages so transmitted a commodity, within the meaning of the act. "The reasons urged by the Attorney General," the court states, "might be laid before the Legislature, to the end that laws may be enacted to correct any evils found to exist under the present statutes of this State. It is my duty simply to declare the law as I find it, and, after a very careful examination of the question involved, I am of the opinion that the motions must be granted to vacate. The Attorney-General, at the time he obtained the order from Justice Platzek, said he intended to begin suits to restrain the two companies "from doing in this State any act in, toward, or for the making or consummation of the contracts, agreements, arrangements or combination set forth in the petition." The petition stated that the telegraph companies had entered into a combination which created a monopoly in the receipts.

WIRELESS TELEPHONY.—The *New York Herald* has the following: "Because of contentions over a patent an injunction may be issued prohibiting the use of wireless telephones which have been installed aboard the ships of the navy by the De Forest Wireless Telegraph Company. The Poulsen Wireless Telephone Company, controlled by the Amalgamated Radio Telegraph Company, Limited, of London, of which Lord Armstrong is president and holds control, alleges infringement of its patent rights and is reported to be preparing suit against the De Forest company. In view of the importance this suit will have for the navy, Captain Francis M. Barber, retired, on special duty for the United States Government in Paris, has informed officials at Washington of the Poulsen company's claims and its plans for seeking redress. The bone of contention is the patent governing the use of the hydrogen arc enveloper employed in connection with the wireless telephones, in which the spark system obtaining in wireless telegraphy cannot be utilized because of the frequency of the vibrations caused by the click of the telegraph instrument. For this reason resort is had to the wave system, but although vibrations as great as eighty thousand a second can be recorded, there is some difficulty in accurately recording vibrations of high frequency which occur when one talks through the telephones. Poulsen, it is alleged, discovered that by enveloping in hydrogen the arc where these vibrations are first recorded the vibrations could be more easily recorded. He patented this idea. De Forest uses in his wireless telephones an alcohol flame which produces hydrogen to envelope the arc. Poulsen, it is alleged, contends this is an infringement of his patent. De Forest asserts that the idea was used before Poulsen obtained his patents, and that the Poulsen patents do not cover the idea of producing the hydrogen enveloper which he has worked out. As a result Poulsen, it is said, will call for an injunction against the use of the De Forest instruments on the battleship fleet and on other ships of the navy, including the six torpedo boat destroyers, which started out for the Pacific Coast on Dec. 2."

Obituary.

MR. JOHN W. McNAMARA, formerly president and general manager of the United Traction Company, at Albany, N. Y., died recently. Mr. McNamara was also interested in the Union Railway Company, of New York City, N. Y.

MR. J. C. LAFFARGUE.—Notices have been received in this country of the death in Paris, at the early age of forty-three, of Mr. Joseph Clement Laffargue, well known to many of our readers as editor of *La Nature*. He was a practicing electrical engineer and formerly manager of the municipal lighting plant of the Halles Centrales. He was also connected with the municipal control of the lighting systems of Paris. He was general secretary of the Federation des Mecaniciens-Chauffeurs-Electriciens. He had the decorations of chevalier of the Legion d'Honneur and oficier de l'Instruction Publique. All who knew Mr. Laffargue appreciated him for many sterling qualities of heart and head, and his loss will be deeply felt. He leaves a wife, a son and a daughter.

DR. COLEMAN SELLERS.—We regret to note that Dr. Coleman Sellers, the distinguished engineer and scientist, died at his home in Philadelphia, Dec. 28, aged 81 years. Dr. Sellers suffered from a general physical breakdown and but little hope of his recovery was held from the beginning of his illness. He was born in Philadelphia Jan. 28, 1827. His education was obtained at private schools and at Bolmar's Academy, West Chester, Pa. He first went to work in 1846 as a draughtsman in the Globe Rolling Mill, Cincinnati, Ohio, and was soon advanced to superintendent. Three years later he entered the service of Niles & Company, locomotive builders, and remained with them for five years as foreman. In 1856, at the request of his kinsman, the senior partner of the firm of Sellers & Company, he returned to Philadelphia and entered that establishment as chief engineer. Later he was admitted to the firm as a partner. He retired from active interest in the business in 1888 and had since devoted himself to private practice as a consulting engineer. One of the first and most important of Dr. Sellers's inventions was a coupling device for shafting. His feeds for lathes and other machinery tools were also an important advance in the art. His other inventions have done much to advance the efficiency of mechanical appliances. In 1861 he recommended the use of absorbent cotton for surgical purposes, which has since become indispensable. In connection with his experiments in photography he proposed the employment of glycerine to keep the plates damp. In 1889 Dr. Sellers was called upon by several capitalists to consider the possibility of developing the water power of Niagara Falls. Dr. Sellers represented America in the International Niagara Commission of five members, with Lord Kelvin as chairman, which was established in London in 1890. Since that time he had been the acting engineer of the Cataract Constructing Company and the chief engineer of the Niagara Falls Power Company. To this work Dr. Sellers brought the advantage of his wide engineering experience in meeting many problems presented by the novel character and magnitude of the undertaking. The King of Sweden in 1887 conferred on Dr. Sellers the Royal Norwegian Order of St. Olaf. In 1888 he received from the Stevens Institute the degree of D. E., and one year later the University of Pensylvania conferred upon him the degree of D. Sc. Dr. Sellers was a member of the board of managers of the Franklin Institute, and was its president for five years. He was also president of the American Society of Mechanical Engineers and of the Pennsylvania Museum and School of Industrial Art. He was a member of several engineering societies. His son, Mr. Coleman Sellers, Jr., is well known, and succeeds to much of his father's work in the engineering field.

Personal.

MR. F. ALTREDE, of Hungary, a royal engineer, commissioned to examine electrical power installations in America, was recently in California, where he visited many of the notable plants in that State.

MR. ARTHUR WAINWRIGHT, of South Norwalk, Conn., State superintendent of lighting for the Connecticut Company, has resigned his position to become manager of the Mohawk Gas Company, of Schenectady, N. Y.

MR. HENRY F. SCHMIDT, of Buffalo, N. Y., electrical and steam heating engineer, after Jan. 1, will become an assistant to Mr. J. R. Bibbins in the publication department of the Westinghouse Machine Company.

MR. B. S. READ, manager of the Louisville, Ky., district of the Cumberland Telephone & Telegraph Company, has been promoted to the superintendency of the New Orleans, La., district. Mr. Read assumed the position Jan. 1.

MR. CLARKE CARSON, of Davenport, Iowa, has succeeded Mr. Francis Stewart as manager of the Washington, Iowa, Gas & Electric Company, Mr. Stewart leaving the field to associate himself with the American Pearl Button Company.

MR. CHARLES F. TURNER has been appointed superintendent of the Columbus, Delaware & Marion Railway Company, of Columbus, Ohio. Mr. Turner will have supervision over the power houses, sub-stations and all rolling stock of the company.

MR. WILLARD B. STOUGHTON, of Messena, Can., has been appointed superintendent of the electric light plant of the Danbury & Bethel Gas & Electric Light Company, of Danbury, Conn. He succeeds Charles R. Hodgson, who will go to Mexico City, Mex.

MR. JULIUS AUERBACH, president of the Electrical Accessaries Company, has returned from his European trip, where he spent six weeks in Budapest and Augsburg, in behalf of the "Just" tungsten lamp, which his company is importing into the United States.

MR. C. M. HOBBS, general manager and of the owners of the Nevada-California Power Company, operating at Tonopah and Goldfield, Nev., has retired as general manager. Mr. Delos A. Chappell, of Denver, who was recently elected president of the company, now assumes the general management of the affairs.

MR. LLOYD LYONS has been appointed secretary of the Mobile Light & Railway Company, of Mobile, Ala. Mr. Lyons was formerly assistant manager and assistant treasurer of the San Juan Light & Power Company, of San Juan, P. R. Mr. J. E. Z. Watson, who has held the position of secretary of the local company for more than a year past, has returned to St. Louis, Mo., where he will engage in business.

MR. C. M. SPONSEL.—Mr. C. M. Sponsel, of Hartford, a consulting engineer, has been appointed manufacturing superintendent of the Stanley Company by vice-president C. C. Chesney. For the past four months Mr. Sponsel has been in the plant familiarizing himself with the workings of the various departments. Mr. William J. Baughman will continue to superintend the heavy machine departments and the supply departments.

MESSRS. D. C. AND WILLIAM B. JACKSON, engineers and experts, announce some changes in office arrangements. The office, which has formerly been at Madison, Wis., due to the fact that Prof. D. C. Jackson was formerly professor of electrical engineering at the University of Wisconsin, has now been moved to the Commercial National Bank Building, Chicago. Mr. William J. Crumpton will be in immediate charge of the Chicago office. A Boston office will also be maintained as before.

MR. A. W. ZAHM has resigned as manager of the Fort Dodge Light & Power Company, Fort Dodge, Iowa, and expects to take a vacation for his health in New Mexico. He intends while there to investigate and report on a new water power project, returning later to engage in the central-station business in Iowa or Minnesota, where he has been so successfully at work in this line for a number of years. He will be succeeded at Fort Dodge by Mr. Wm. B. Foshay, formerly of Hutchinson, Kan.

MR C. H. NORWOOD, of Chicago, announces that he has given up all sales agency arrangements and will devote his entire time to contract engineering work, making a specialty of industrial and railroad power plants, electrical equipment for railroad bridges, motor applications for industrial and railroad work, and electrical pumping apparatus. Mr. Norwood advises us that he is at present installing a power plant and complete electrical equipment for one of the largest draw bridges in the world located at Portland, Ore., equipped throughout for alternating current.

MR. HARRY B. KIRKLAND.—A complimentary dinner was tendered Mr. Harry B. Kirkland, of the National Metal Molding Company, at Delmonico's, Dec. 27, by Major George L. Gillon, vice-president and treasurer of the Watson-Stillman Company. Among the guests present were Henry L. Doherty, Richard Jordan, Charles N. Boynton, W. S. McGowan, Charles A. Schieren, Jr., Charles Smith and Geo. W. Elliott. During the evening the guest was presented with a handsome umbrella by Major Gillon. Mr. Kirkland has just returned from a successful three months' trip to the Pacific Coast.

PROF. D. C. JACKSON.—Prof. Dugald C. Jackson, head of the department of electrical engineering at the Massachusetts Institute of Technology, has gone to Chicago, at the invitation of the city officials, to assist the municipal government in devising a system of bookkeeping in connection with the business of the Chicago Telephone Company. Professor Jackson was chairman of the Chicago telephone commission, and is therefore familiar with the business transactions and methods of the company. Recently he has been engaged in expert work in the West, appraising the property of the Minneapolis General Electric Company. He was chairman of the board of arbitration in the matter between the city of Boston and the Edison Electric Illuminating Company.

MR. J. W. AGER, electrical aide in the Bureau of Yards and Docks, U. S. Navy Department, has resigned his government position to enter the employ of Muralt & Company, engineers, 114 Liberty Street, New York, as manager of their Southern office in the Title Guarantee Building, Birmingham, Ala. Mr. Ager is a graduate of Columbia, where he took the degree of M. E. in 1903 and of the Massachusetts Institute of Technology, where he obtained the E. E. degree in 1904. He then was engineer with the Western Electric Company in New York, during 1905 and 1906, and was in the service of the United States Navy Department from 1906 until now. He was last identified with the engineering and construction work being carried out in connection with the movement to consolidate the power plants in the various U. S. navy yards. Muralt & Company have obtained several municipal and government contracts in the Southern territory, and Mr. Ager will undoubtedly prove a very valuable acquisition for them in connection with this work.

MR. O. BAERWINKEL, who has for some time past been prominently identified with the Excello Arc Lamp Company, has resigned for the purpose of taking up a new proposition in Europe. Mr. Baerwinkel sails on the *Kaiserin Auguste Victoria* on Jan. 4. A pleasant incident of his departure from the Excello Arc Lamp Company was the presentation to him by the office force of a handsome diamond locket suitably engraved. Mr. Baerwinkel has had a life of considerable commercial activity in Germany in different lines. He spent four years in a responsible position in England and, as is generally known, travelled for six British concerns in the British Colonies and far eastern countries. During his co-operation with Mr. Hirschberg in the Excello Arc Lamp Company, he has been largely instrumental in building up the business which has taken remarkable dimensions in a comparatively short time. Although the proposition he is going to take up in Europe will be a considerable step in advance, his departure from this country will be greatly regretted by his numerous American friends, both business and otherwise.

MR. W. R. ROBERTS.—On Jan. 1, Mr. William R. Roberts, now manager of the Atlanta exchange of the Southern Bell Telephone Company, will become the special agent of the company, succeeding Judge H. E. W. Palmer. Mr. Roberts has been connected with the Bell Telephone Company for the past six years. Prior to that time he was one of the best-known and most popular newspaper men in Atlanta. For a long time he was with *The Atlanta Journal*. When the old *Atlanta News* was organized he was one of the prime spirits of that lively newspaper. After the demise of *The News*, Mr. Roberts was for a time connected with *The Constitution*. He left *The Constitution* to go with the Bell Telephone Company, with which company he has been since that time. Judge H. E. W. Palmer, the present special agent of the company, has been appointed general attorney, succeeding Hunt Chipley, who is to be general counsel of the American Bell Telephone Company. Mr. C. F. Roddy, cashier of the Atlanta exchange, will succeed Mr. Roberts as manager of the Atlanta exchange. Mr. Roddy has been connected with the company for a number of years, and is one of its most valuable employees.

Business Notes.

THE ROBERT GAIR COMPANY, Brooklyn, has recently installed a large number of "Radiante" lamps in its factory. These lamps are the well known product of Felix Hamburger, New York.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., announces that its business for 1907 shows a very marked increase over that of any previous year in the history of the company, a fact which reflects great credit upon the able management of Mr. A. C. Garrison.

THE BRISTOL COMPANY, of Waterbury, Conn., was awarded a silver medal for its recording instruments at the Jamestown Exposition. Its recorders have received high awards at every exhibition where they have been entered and shown, as competitors, including those of recent years at Paris, Chicago and St. Louis.

THE ELECTRICAL ACCESSARIES COMPANY is now importing a full line of commercial "Just" tungsten lamps, not alone 25, 40 and 100-cp for 100 to 120 volts, but also 50-cp lamps for 200 to 250 volts. The president of the company, Mr. Julius Auerbach, who has just returned from a visit to the Just factories at Budapest and Augsburg, has been successful in making arrangements for large quantities of lamps to be shipped to the United States, so as to be able to ship promptly any quantity from New York stock. He states that the 25-cp lamps are a step in advance which will make the "Just" tungsten lamps still more popular. The most important development, of course, is the high-voltage lamp, which is now being imported. The repeated official tests of the last few months have, he states, shown that the life of the "Just" tungsten lamp is in every respect satisfactory; in fact, the Electrical Accessaries Company is ready now to guarantee the life of the "Just" lamp.

WEBER GAS ENGINES.—A careful service and economy test of the 250-hp Weber gas engine and suction gas producer installed in the large manufacturing plant of McClary Manufacturing Company, London, Ontario, has, it is said, demonstrated conclusively that it surpassed the guarantee called for in the contract. In regular operation less than .95 of a pound of coal per horse-power-hour is used. Their total cost for generating power, including fuel, labor, supplies, depreciation and interest on the investment, shows, it is alleged, a handsome profit over the price of electrical energy from the distant Niagara Falls power companies. The Weber Gas Engine Company, of Kansas City, Mo., is at work installing several 350 horse-power gas power plants in cotton mills, electric light plants and flour mills, as well as a number of smaller units.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutical Association. Secretary, Dr. C. E. Skinner, New Haven, Conn.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower. London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice. United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby. 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual Meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New England, Philadelphia, Pittsburg and Chicago. Meetings in New York, second Thursday of each month.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, Charles West. Next meeting, Chicago, January 21, 22 and 23, 1908.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting. Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August

Michigan Electrical Association Secretary, A. C. Marshall. Port Huron. Mich.

Missouri Independent Telephone Association. Secretary. Houck McHenry, Jefferson City, Mo.

Missouri State Electric Light Association. Secretary. C. Z. Pierson, St. Charles, Mo.

National Arm, Pin & Bracket Association. Secretary, J B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W Freeman, Brooklyn Edison Company, Brooklyn, N. Y.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

National Interstate Telephone Association. Secretary, A. L. Tetu, Nashville, Tenn. Next meeting, Chicago, January 21, 22 and 23, 1908.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee. January 15 and 16, 1908.

Ohio Electric Light Association Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Charles W. Ford, Oklahoma City, Okla.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

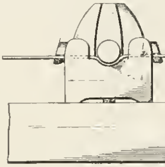
Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 24, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

874,411. SYSTEM OF ELECTRICAL TRANSMISSION AND PROPULSION; Maurice LeBlanc, Paris, France. App. filed March 31, 1904. An electrical transmission line, carrying alternating currents of a wave length which is short with reference to the length of the line, which has the ratio of its capacity to its self-induction artificially increased at points along the line in a manner to prevent the superelevation of voltage, the consecutive distances between which points are short with reference to a half wave length of the current, substantially as described.

874,445. INSULATOR; Albert L. Shears, Seattle, Wash. App. filed March 5, 1907. A form of porcelain cleat insulator having grooves on its upper surface in a special rectangular formation, and which co-operate with certain lugs at the side to bind the circuit wires in place.



874,445.—Insulator.

874,477. RAILWAY SIGNAL; Harry M. Abernethy, Cleveland, Ohio. App. filed April 3, 1906. A railroad signal of the type operated by a gear train driven by an electric motor, the motor being clutched into a relation to raise either the danger or the caution signal according to the completion of certain circuits. The signals are dropped to danger by a magnet-operated trip.

874,483. ELECTRIC FIRE AND BURGLAR ALARM; Melancthon J. Briggs, Philadelphia, Pa. App. filed April 25, 1906. A combined electric fire and burglar alarm, including mechanical features and electrical circuits. Has an annunciator and thermostats and mechanically-operated circuit closing devices.

874,496. PROCESS OF RENDERING SOLUBLE IN WATER THE NICKEL AND COPPER CONTAINED IN SULFID ORES AND MATTES; Walter S. Gates and Herbert H. Dow, Midland, Mich. App. filed March 22, 1906. A process for making nickel and copper sulfid ores soluble in water electrolytically.

874,511. INTERRUPTER; William Kaisling, Chicago, Ill. App. filed Jan. 3, 1907. An automatic interrupter of a type employed in the selectors of automatic telephone exchanges. Covers mechanical features of construction.

874,527. ORE REDUCING FURNACE; James McLoughlin, Rye, N. Y. App. filed March 21, 1906. A vertical furnace having the general appearance of a cupola or blast furnace and which has a chamber at its lower part through which the electric current is passed.

874,531. AUTOMATIC MOTOR STARTER; William C. O'Brien, Baltimore, Md. App. filed Oct. 23, 1905. An automatic starter for electric motors operating to cut out the starting resistance as the motor acquires speed without the use of dashpots or other mechanical retarding devices.

874,552. WIRE FASTENER; Sylvester Wilburn and Thomas E. Smith, Tunis, Tex. App. filed Sept. 9, 1907. A form of insulator having clamping jaws of the type which bind upon the wire by the pivotal movement of a cam wedge.

874,558. ALTERNATING DIRECT-CURRENT SYSTEM OF CONTROL; Howard L. Beach, Wilkinsburg, Pa. App. filed March 3, 1906. Relates to the control of the trolleys for electric locomotives adapted to take electric current from an overhead or a third-rail system as desired. Includes electrically operated pneumatic apparatus.

874,559. SYSTEM OF CONTROL; Howard L. Beach, Wilkinsburg, Pa. App. filed March 3, 1906. A system for the control of motors adapted to be operated by either direct or alternating current. Provides means whereby the circuits of the system may be arranged automatically in accordance with the character of the energy supplied.

874,564. ELECTROLYTIC APPARATUS FOR THE MANUFACTURE OF NITROCELLULOSE; Gaston C. DeBrailles, Paris, France. App. filed March 10, 1906. A receptacle is provided with a perforated diaphragm dividing it into upper and lower chambers and has electrodes of gilded platinum wire located in the lower chamber.

874,567. ELECTRIC CONTROLLER; Roy W. Brown, Amsterdam, N. Y. App. filed Feb. 19, 1907. A construction of rheostat having a contact which is spring actuated to move in one direction and an electromagnet for controlling said contact.

874,601. SWITCH FOR HIGH POTENTIAL CIRCUITS; Joseph N. Kelman, Los Angeles, Cal. App. filed April 8, 1907. An oil bath switch of the type for controlling three-phase, high-potential circuits of 60,000 volts or over. Has ribbed insulators supporting plungers which dip into the oil bath.

874,602. TELEGRAPH KEY; John P. Kinney, Pocatello, Idaho. App. filed April 23, 1907. Telegraph key of the "Mecograph" type adapted for either right hand or left hand manipulation.

874,608. DANGER SIGNAL; Clevia J. Luther, Desloge, Mo. App. filed Aug. 13, 1907. An apparatus for exhibiting a danger signal in case of fire or floods on a railway system.

874,628. PROCESS OF PRODUCING STEEL; George O. Seward, East Orange, N. J. App. filed July 6, 1907. The process of producing steel which consists in fusing iron as an electrode in the presence of refining slag.

874,630. THIRD-RAIL ATTACHMENT FOR ELECTRIC CARS; George H. Sohn, Lincoln, Cal. App. filed June 10, 1907. A form of current collector for underground trolley systems having a special truck which runs upon the conduit groove and from which depends the shoe engaging the underground trolley.

874,635. REGISTERING DEVICE; Ralph Storm, Joseph F. Underwood and Robert Jackson, Waterloo, Iowa. App. filed May 10, 1907. A registering device for use with railway systems by which a record can be kept of passing trains and their stoppage for orders.

874,638. CONTROLLER; Emmett W. Stull, Norwood, Ohio. App. filed May 3, 1906. Provides means whereby an injured or disabled motor may be cut out of circuit without interfering with the regulation of the remaining motor or motors.

874,665. BRUSH HOLDER FOR ELECTRIC MACHINES; Giorgio Finzi and Emilio Tallero, Milan, Italy. App. filed April 2, 1906. A brush holder of the type having a plunger gripping a carbon block at its extremity and spring impelled to engage the commutator. Has two independent systems of springs acting at different points on the plunger.

874,690. LINE TESTER; Edwin S. Lincoln, Brookline, Mass. App. filed Feb. 11, 1907. A testing outfit for telephone and telegraph and similar electrical circuits by which the condition of the circuit under test is determined by the aid of a telephonic receiver.

874,707. ELECTROLYTIC REFINING OF TIN; Elmer A. Sperry, Brooklyn, N. Y. App. filed Sept. 15, 1906. The method of refining tin which consists in melting the alloy or tin-bearing material to improve its slime coagulating qualities and electrodepositing the resulting mass in a suitable electrolyte.

874,745. TELEGRAPHY; Patrick B. Delany, South Orange, N. J. App. filed June 13, 1903. A form of detector for wireless telegraph systems including the relay circuits and tape recorder.

874,780. THERMO-ELECTRIC ELEMENT; Albert L. Marsh, Lake Bluff, Ill. App. filed Jan. 17, 1907. A thermo-electric couple, one element of which consists of an alloy of vanadium and a nickel.

874,781. TEMPERATURE CONTROLLING DEVICE FOR FURNACES; Allan G. Mather and Ernest C. Shaw, Milwaukee, Wis. App. filed April 7, 1905. Electromagnetic mechanism having a thermostatic circuit closer for controlling the operation of a motor connected to the air draft of a furnace.

874,792. ELECTRIC HORN; Leon Chalas, Edouard Requillart and Camille Contal, Levallois-Perret, France. App. filed Sept. 20, 1905. Horn for automobiles of the type having a diaphragm vibrated by an electromagnet.

874,795. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed March 19, 1906. Construction of cap for a safety fuse by which a good electrical connection is made to the fuse element.

874,796. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed April 5, 1906. Construction of safety fuse having a wire electrically connected to one of the end caps through which the current passes after the main fuse is blown and which has an indicator on the exterior of the fuse casing.

874,797. SAFETY FUSE; Joseph Sachs and Frank D. Reynolds, Hartford, Conn. App. filed April 18, 1906. Relates to modifications of the above.

874,798. SAFETY FUSE; Joseph Sachs, Hartford, Conn. App. filed April 18, 1906. A safety fuse comprising terminals, a holder of insulating material, a pocket integral with said holder, and wires connected at one end with the respective terminals, and at the other electrically connected with each other by a fusible joint within the said pocket.

874,826. NULLIFYING DISTURBANCES IN TELEGRAPHIC OR OTHER SIGNALLING CIRCUITS; Edward Blakeney, Ossining, N. Y., and Robert E. Chetwood, Jr., Elizabeth, N. J. App. filed May 29, 1906. A form of bridge system adapted to balance exteriorly received impulses.

874,834. INSULATOR AND PROTECTOR FOR ELECTRIC CONDUCTORS; Thomas C. Copping, Houston, Tex. App. filed Jan. 24, 1906. A casing for electric wires or conductors adapted to insulate them from trees, posts, etc., and protect them from injury by abrasion.

874,841. STORAGE BATTERY PLATE; William Gardiner, Chicago, Ill. App. filed April 26, 1906. A storage battery plate having a rectangular frame in which are received a plurality of drawers containing the active material.

874,860. INCUBATOR; Oliver P. Phillips, Amo, Ind. App. filed Oct. 24, 1906. Incubator of the type embodying a thermostat for automatically governing the temperature within the incubating chamber. Has a system controlled by a thermostat.

874,864. ELECTROLYTIC PROCESS FOR REFINING NICKEL; John N. Pring, New York, N. Y. App. filed Nov. 8, 1906. Relates to the purification of nickel and consists in dissolving crude nickel and treating it electrolytically in successive stages analogous to copper refining.

874,868. TELAUTOPHOTE; Sidney Rothschild, New York, N. Y. App. filed Sept. 6, 1906. Covers the transmission of images by electricity by means of synchronously rotating cylinders. Has a vacuum tube for the illuminating agent for the photographic reproduction.

874,869. CONTROL SYSTEM FOR ELECTRIC VEHICLES; Olof A. Sandborgh, Swissvale, Pa. App. filed March 3, 1906. Provides means for automatically completing circuit connections from one collecting device to a car when said device engages its supply conductor and for completing circuit connections from a second collecting device when the first is disengaged from the supply conductor.

874,895. MOTOR CONTROLLING TREADLE; Albert B. Mann, Cincinnati, Ohio. App. filed Dec. 4, 1906. A motor controlling treadle for operating laundry machines.

874,898. AUTOMATIC STARTING BOX; Thomas M. Morris, New Haven, Conn. App. filed May 3, 1907. Specially designed for use with telephone ringing machines. Automatically starts the power motor in case the same is stopped by a temporary interruption of the current thereto.

874,908. APPARATUS OR MEANS FOR THE PRODUCTION, TRANSMISSION AND DISTRIBUTION OF ELECTRIC CURRENTS; Charles E. Fritts, New York, N. Y. App. filed Nov. 23, 1886. The combination of an electric generator producing normally straight or unipolar currents, electromotive force, or potential; apparatus uniformly varying the same and therewith charging one or more condensers connected to the poles of the generator; and one or more lines having their ends connected to said poles through said condensers.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, JANUARY 11, 1908. No. 2.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, Pres.; CURTIS E. WHITTLESEY, Sec. and Treas.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................................590 Old Colony Building
CLEVELAND OFFICE..................................1015 Schofield Building
PHILADELPHIA OFFICE..........................Real Estate Trust Building
SAN FRANCISCO OFFICE..................................601 Atlas Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico..........................per year, $3.00
Dominion of Canada..4.50
Other Foreign Countries within the Postal Union.....................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1906, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 16,750 copies are printed.*

NEW YORK, SATURDAY, JANUARY 11, 1908.

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THE PATENT OFFICE GAZETTE.

Several weeks ago we printed a letter protesting in vigorous terms against the recent action of the U. S. Patent Office in curtailing the usefulness of the *Patent Office Gazette* to inventors, and elsewhere we print a number of comments on this letter, the writers with two exceptions being patent attorneys. As will be seen, the ruling criticized does not adversely affect patent attorneys; indeed, by making the *Gazette* even more useless to inventors than in the past, it actually serves their interests; and since all the larger manufacturing companies maintain a patent department with anywhere from one to a half-dozen or more patent attorneys, or their equivalent, on its staff, this factor in the patent situation would appear also not to be affected adversely by the ruling. But the Constitution does not establish a patent monopoly for the benefit of patent attorneys nor even for the profit of manufacturers, except in so far as this profit shall tend to the encouragement of invention intended ultimately for the benefit solely of the public at large. To the extent that the order of a Patent Commissioner limiting the number of claims printed in the *Gazette* reduces the value of the publication to the inventor, it is adverse to the interests of typical American inventors, who vastly outnumber those who are able to call at any moment on patent attorneys for expert advice, or to whom such advice is supplied through employees. While the claims of a patent may not be adequate to give a thorough understanding of an invention—which qualification carries a criticism of the practice permitted in this country with respect to the character of claims—they are of some assistance to those who depend upon the *Patent Office Gazette* alone, and this assistance should not be minimized by suppressing the record therein of all claims but six. Moreover, the ruling to this effect presents a strong temptation towards confining in the future the least possible disclosure of an invention in the first six claims, which practice would bring our patent system still further under suspicion of a large class of inventors who now believe that the system as at present organized can, through manipulation of technicalities, be used for ends never contemplated by the founders. The contention that the *Patent Office Gazette* is of no great value to inventors even if all the claims of a patent are printed therein is in itself a reflection on the Patent Office, not only with respect to the allowed phraseology of claims, as noted previously, but also because—contrary to practice abroad—of the omission of the classification data which would enable an inventor to select and order, without the intervention of a patent attorney, the patent specifications as issued belonging to the sub-class in which his work lies.

The ruling to which this refers is still another instance of the working of bureaucratic economy at the expense of inventors, which, during the past generation, has so strongly characterized the Patent Office. At one time the entries in the

Patent Office Gazette included a brief of the specifications preceding the claims—which is still the practice in most foreign countries—but this was discontinued about 25 years ago. Formerly a bulletin issued from time to time by the Patent Office contained the patent classification, from which an inventor could learn the number of patents issued in the class in which he was interested, and thus be enabled to determine whether he could afford to purchase the entire class; for several years past this classification has been absent from the bulletin. No general index of patents has been printed for a quarter of a century, and although the material for such an index has been compiled, it has not been printed for the stated reason of the great expense that would be entailed. Finally, the classification in the Patent Office has been placed in a more or less chaotic condition by the great advance in inventive activity since the date of last revision, and while a new classification has been authorized and Congress at one time enlarged the Patent Office force in order to enable this classification to be completed, the date when this will be done is entirely indefinite, and, in fact, at the rate of progress in the past, may be a generation distant—the cause of delay being that the force which should have been engaged on the work has been diverted to other duties in the office. In short, notwithstanding that the Patent Office is not only entirely supported from the fees of inventors but yearly turns into the Treasury a large profit from its operations its policy has consistently been one of economy at the expense of the interests of the inventor. Invention in this country is already sufficiently discouraged by the inevitable litigation with its enormous expense necessary to secure to the inventor the fruits of his thought and labor, without a further handicap being added in order that the monetary profit which a government department derives from him shall not be reduced.

Temperature Rise of Active Conductors.

The most familiar fact connected with the existence of an electric current in a wire is that the wire becomes heated. Our incandescent lamps and our fuses utilize this universal principle, so that the fact is not totally regrettable. We would much prefer that our switches, rheostats, house-wiring and cables did not become heated by the currents, but if the property did not exist, our incandescent lighting business would vanish at the same time. Although the heating of conductors by currents is so manifestly and manifoldly presented to our senses, yet the laws controlling the temperature rise under different conditions are complex. The conductor gets hotter and hotter until in the final state the flow of heat from its surface into surrounding space balances the internal generation of heat by the current. As the escape of heat from the conductor's surface takes place, in general, by thermal conduction, by fluid convection and by radiation, the amount of temperature elevation which is necessary to determine the required rate of escape depends intimately upon the environment of the conductor; that is, as to whether it is covered thickly with cotton or merely supported in free air, is motionless or rapidly moving, immersed in running water or encased in piping.

If a conductor did not change in resistance with temperature the rate of generation of heat by the current would be directly proportional to the square of the current. Again, if the thermal conducting power of the conductor's environment remained constant for all temperature elevations met with in practice, the final rise of temperature would be strictly proportional to the rate of heat generation, and, under the conditions assumed, to the square of the current. In other words, if the resistance of the conductor kept constant, and the thermal resistance in the path of the escaping heat remained constant, doubling the current would mean quadrupling the temperature elevation of the conductor in the steady state. The assumptions are not absolutely correct because the conductor offers more electric resistance as it gets hotter, and produces more heat than in proportion to the simple current squared. A thin conductor in air, moreover, does not behave in regard to radiation as though its external thermal resistance were constant. The thermal resistance of radiation comes down as the temperature elevation increases. However, to a first approximation, we may neglect these deviating circumstances and consider that doubling the steady direct-current strength through a conductor quadruples, for practical purposes, its ultimate steady temperature elevation. This means that if we plot temperatures against currents on logarithm paper, or paper ruled not evenly, but to the uneven gradations of the engineer's slide rule, the graph will be a straight line, inclined to the horizontal at an angle of 63° 26′, whose tangent is 2.

The article by Mr. C. C. Badeau, appearing on page 95 of this number, embodies this plan in a convenient graphical form. By reference to the diagram in the paper the final temperature elevation of a conductor can be approximately predicted along a straight line for different currents, when its final temperature elevation with any one given steady current is known. It was shown in a paper by Dr. Kennelly and Mr. E. R. Shepard, read before the American Institute of Electrical Engineers last June, that for copper wires cooled by conduction the straight lines on logarithm paper are a little steeper than those given in Mr. Badeau's paper; *i. e.*, that they lie more nearly at an inclination of 65° 33′, if the temperature elevation does not exceed 50° C., and steeper yet, or more nearly at 66° 30′, if the temperature elevations approach, but do not exceed 100° C. This extra inclination of the straight lines is attributable to the heating up of the copper and its consequent increase in resistance. For many practical purposes this refinement is unnecessary, and the diagram of Mr. Badeau, which is very easily reproduced, may be employed conveniently.

Another Single-Phase Road.

We are interested to note the completion of still another electric road using single-phase motors, this time just over the Canadian border. In spite of various adverse influences the compensated series motor is making steady progress and must be reckoned with in every new interurban road. It has, in fact, succeeded to an extent that is notable considering the adverse conditions under which it began its career. There was little genuine enthusiasm for the system in its early stages, and it was pretty consistently damned with faint praise.

While most single-phase roads are of rather recent construction, there is strong evidence of satisfactory results, in that there has been offered no general criticism of any particular source of trouble, indicating that the serious difficulties have been pretty well eliminated. The road before us is a type of the cases in which single-phase traction has done well—a fairly high-speed interurban line with a moderately powerful equipment, unhampered by complicated direct-current connections and free to develop its own territory in its own way. The total length is, including an extension now under way, 37 miles, and the service includes passengers, express and freight. The motor cars, each equipped with a pair of 100-hp motors, are big enough to haul trailers when necessary, and the service is typical of the modern interurban line. We are glad to note that the working pressure is 6600 volts throughout, the city of Windsor, the chief terminal, having very sensibly agreed to the use of this voltage within its limits. With the first-class catenary construction used in this case, and when the entrance route is reasonably clear of obstruction, there seems no valid reason for objecting to 6600 volts as against the 1100 which had been discussed. Either is equally safe if well installed, or dangerous if badly installed, and the higher voltage is practically about as easy to insulate securely as the lower. With the catenary construction the number of points of support is reduced to a minimum and adequate insulators are obtainable without the slightest difficulty. It is found, too, that there is no trouble in executing repairs on a trolley wire at this voltage by the aid of a platform mounted on the same kind of insulators that carry the line. A somewhat unusual feature of construction is the use within the city of Windsor of concrete trolley poles.

The line is operated from a single power station located on the shore of Lake Erie where water for condensation is pumped. The plant at present consists of two 500-kw units, single-phase, stationary armature machines, directly coupled to cross-compound, Corliss type engines running at the somewhat unusual speed of 125 r. p. m. The periodicity is 25 cycles and the armatures are so connected that they give both 6600 and 13,200 volts at the switchboard, the former for use indirectly on the trolley wire, the latter for transmission to distant parts of the system as required—at present to but a single reducing station. One of the two banks of water-tube boilers is now being equipped for firing with natural gas, which is fortunately available, and the second bank may be similarly fitted later. For an interurban road of this character the single-phase system certainly has much to recommend it, especially in cost of construction and in simplicity of operation as regards motive power. It would be exceedingly interesting in this instance to know just how the cost of equipment compares with what would have been required had the line been laid out with the more usual combination of transmission to sub-stations with synchronous converters, and working a conductor at 600 volts. Of course, in the case of the Windsor, Essex & Lake Shore road the length of line favors strongly the alternating-current system, and the small number of motor cars reduced the extra expense of alternating-current motors; but, on the other hand, it is this very condition that is the reason for being of the alternating-current system. One cannot always deal with short lines and heavy traffic. The relative maintenance of direct-current and alternating-current equipments is as yet uncertain from lack of data. One would naturally expect in using alternating current more repairs on the cars and less on the rest of the system than with direct current. Yet strong claims are made for the endurance of the alternating-current motors—claims which necessarily take time to substantiate since it is not the first year or two of operation that measures the depreciation of car equipments.

THE TELEPHONE.

It is but a few years ago that the whole art of telephony was developing by such leaps that it was not uncommon for methods and apparatus to be superseded almost upon installation—"grown old over night" as it were. To-day we find quite a different state of affairs. Indeed it is doubtful if one can point to a single change introduced during the past year which may be termed radical, and yet there is probably to-day as much thought and energy expended upon the perfection of the art as at any time in its history. So long as a discovery inspires investigation from purely scientific motives, development is apt to reflect originality of thought. When, however, a discovery attains a strong commercial status, commercial considerations largely influence the trend of technical development. To illustrate with respect to telephony, at first the discoveries were made almost entirely by scientific men. Then coincident with a great wave of popular interest came the inventive period, during which inventions followed each other in an almost continuous stream. Nothing was too trivial nor too radical to receive inventive consideration, and patents were obtained for the slightest details. The interests in commercial control fostered and encouraged invention from any source. Competition instituted a great wave of duplication, and almost everything already invented had consequently to be reproduced in one form or another. We now come to the present day when the whole technical development is controlled from the purely commercial side, and when the inventor must prove his invention to be immediately commercial in order to obtain consideration. It is also a period of development for inventions cast aside in the great desire for something new. In short, the present period is one of technical economy, when technical developments must show a saving with respect to operating expense or annual charges.

At present we find in the wire plant a more extended use of cable, both underground and aerial. For distributions to subscribers' premises great attention is given to devices for economically running wires, both for individual stations and for large groups. In the same department we note the beginning of concrete pole construction as represented by a few experimental installations. In toll-line work there is an increasing interest in duplexing, if it may be so called. The possibility of this was shown years ago by Mr. Frank Jacobs, but it is only within a recent period that duplexing has been finding its way into practical and extensive use. At the subscriber's station there is a better designed instrument. Accessibility of parts and wiring are now matters of prime importance. The sets are smaller and more compact, and often not a single wire is exposed to view to tempt the user. At the central office there is a general tendency toward standardization of parts and circuits, the switchboards, however, growing rather more complicated. This last, however, is due to economy through reducing the operator's work. Labor for operating is a very considerable item in the cost of giving service, and fractional savings in the work per connection soon aggregate a handsome total. Because of this every traffic man is recommending means for relieving the operators of responsibility. Automatic ringing is practically standard for trunk working, and it seems but a question of a short time when all ringing will be automatic in large installations. The extensive use of a separate jack for each station of a party line is a step in this direction. With this arrangement all stations are numbered alike, and in so far as the operator is concerned, all are rung alike, the operator thus being relieved of all distinctions of code. The use of the service meter, where charging is on the message basis, is still another economy, rendering it possible to attain with a momentary pressure of the finger the equivalent of the written memorandum of a few years ago. These are typical of the kind of technical development we may expect for the next few years. Of course there may be some startling and unforeseen developments. The now much talked of wireless telephone may even make its impression. Again, there may be a great stride in the automatic or semi-automatic field at any time. However, the greater part of effort will probably continue to be expended on improvements along the line of greater economy with respect to existing installations.

ELECTROTECHNICAL PROGRESS DURING THE YEAR 1907.

The year which has just passed has revealed no epoch-making electromagnetic discoveries, perhaps, but has witnessed substantial advances in electromagnetic applied science. In the science of electromagnetics, there has been a steady development of the electronic theory. Not only have physical researches further developed this theory, but the outlines of the electronic theory have been spread among practical men. As an indication of the latter condition, the presidential address before the American Institute of Electrical Engineers last year was entitled "The Properties of Electrons." Side by side with the advance of the electronic theory has gone the study of radioactivity. The doctrine of the transmutation of substances under the influence of radium emanation has received further experimental support, and the idea of the permanence of elements has steadily lost ground. The recourse to the conservation of energy is, however, all the more earnest. To the extreme school of electronists, matter is but a localized evidence of intense activity, the forms of which may be transitional. The sum total of energy in the known material universe is believed to be constant, although the sums total of the various elementary substances are not necessarily constant.

In regard to experimental electromagnetics, a prominent achievement concluded last year has been a redetermination of the velocity ratio between the electrostatic and electromagnetic units, by the Bureau of Standards at Washington. As already reported in our columns, this ratio for free space is given as 299,710 kilometers per second, obtained by balancing a periodically intermittent charging current in a condenser against a steady current from the same electromotive force, through a known resistance. This velocity is, therefore, very nearly one-tenth of one per cent less than 300,000 kilometers per second in free space, as against 299,860 kilometers per second, the best accepted free-space velocity of retina-stimulating light, from the measurements of Michelson, Newcomb, Perrotin and Weinberg. These two outstanding velocities are thus separated by one part in 2000, a discrepancy for future experimenters either to eliminate or to explain. The knowledge of electromagnetic waves and their properties has been perceptibly developed during the past year, both experimentally and mathematically, by reason of researches in wireless telegraphy. This most useful daughter of electromagnetic-wave science has now grown sufficiently strong to contribute to the welfare and progress of the mother subject.

The technical progress of wireless telegraphy has caused additional labor to be directed to the precise computation of inductances and capacities. Several new formulas for the precise computation of inductances of coils, or the capacities of condensers, have been published last year. Instead of confining our knowledge to the case of a relatively long coil, the inductance of any coil whose winding is cylindrical may now be computed. The range of practicable wireless telegraphy has been extended until it reaches across the Atlantic Ocean. Moreover, methods of inducing and maintaining forced vibration of wireless-telegraph antennas have come into application. These bid fair ultimately to replace the free-vibration methods of spark telegraphy, with their rapid damping and short wave-trains. Wireless telephony has also markedly increased its range during the year, from only a mile or two, up to a hundred miles or more; although such long ranges are not as yet in ordinary use. Wire telegraphy has made distinct progress during the year in the direction of high-speed automatic long-distance type-printers. Wireless telegraphy has publicly entered into competition with submarine-cable telegraphy across the Atlantic Ocean; but with as yet no recognized effect on the submarine traffic.

In the technology of electrical engineering, a noteworthy event of 1907 was the publication of a revised and enlarged edition of the standardization rules of the American Institute of Electrical Engineers. The rapid growth of electrical engineering caused the preceding edition of these rules to be out of date, and behind the best practice, in various directions. Perhaps the most rapid development of technology has been in the direction of controlling and measuring high voltages. The technology of electric lamps, lighting and illumination has advanced steadily. The advance has been made both from the experimental and from the engineering sides. At least one new and seemingly practical suggestion has been put forward, looking towards a new and improved primary standard of light. This is the more urgently needed, because of all commercially distributed commodities, lighting is still far the most inefficient and technically the least definitely measurable. No better primary standard of light than a flame, either of pentane, colza-oil, or amyl-acetate, has yet been satisfactorily produced.

A noteworthy event in last year's electrotechnical chronology has been the death of Lord Kelvin, the British pioneer of applied electricity. Prior to his work, electrical measurement was in a primitively chaotic state, and electrical units hardly existed. Contemporaneously with his work, and greatly aided thereby, electrical measurement and electrical units have come into universal use all over the world, the electrical units of all countries being the same. Lord Kelvin has been buried, within the last few days, in Westminster Abbey, at the request of the Royal Society. The previously most recent interment of a scientist in Westminster was that of Darwin 25 years ago.

ELECTROCHEMISTRY IN 1907.

While scarcely any of the commercial electrochemical developments of 1907 can be called revolutionary, the steady evolution of the industry has proceeded along correct and logical lines and in a way which opens the brightest prospects for the future. The application of the electric furnace to the metallurgy of iron and steel has occupied the foreground, and the chief commercial development, at least in this country, has been the extension of its use in the manufacture of ferro-alloys.

This is a logical development, for the reason that the manufacture of ferro-alloys involves the reduction of highly refractory oxides, like silica, titanic oxide, etc., in which the high temperature required can be obtained conveniently and economically only in the electric furnace. The earliest commercial developments began in Europe, following the collapse of the calcium-carbide boom. The erection of calcium-carbide furnace plants had been over encouraged by the large European manufacturers of electrical machinery, and when the price of carbide as a consequence dropped to an unprofitable point, it became necessary to use the furnaces for some other purpose, and many were converted into ferro-alloys plants. To indicate the industrial importance of this industry, it may be noted that a single French company—that using a Girod process—which started with a small experimental plant of 28 horse-power in 1898, employs now a total of 18,000 horse-power in three plants, while water-power developments now in course will bring up the total to some 45,000 horse-power. Almost all of the plants for the manufacture of ferro-alloys are hydro-electric, the low cost of energy from which is of special importance in the manufacture of ferro-silicon, since, owing to the cheapness of the raw materials, power is the chief item in the cost sheet. Most of the ferro-silicon in the past has been imported from Europe, while American manufacturers, owing to the higher prices for power, directed their attention first to the manufacture of ferro-alloys other than fero-silicon. The past year has, however, witnessed the establishment of the ferro-silicon industry in this country. The pioneer ferro-chrome plant in the South has undertaken the manufacture of ferro-silicon intermittently with ferro-chrome, in order to keep the plant uniformly loaded without overproduction of ferro-chrome. In California ferro-silicon is now being made in a plant which ultimately is to be employed for making pig iron. Finally, a new Canadian works has been established near Niagara Falls, where it is claimed that power can be secured more cheaply than at Niagara Falls itself, and where ferro-silicon is made successfully on a considerable scale. Otherwise American ferro-alloy manufacturers have paid special attention to the production of ferro-alloys free from carbon, which command a high price and in whose production the power cost is of less importance.

While quite a number of electric steel plants have been erected during the past year in Europe, progress along this line in this country has not been rapid. Two processes are chiefly used, employing respectively the induction furnace and the Heroult furnace. In both cases the object is simply to refine ordinary steel, and in order to save power, the steel is fed from the open-hearth furnace or from the converter into the electric furnace in molten state. The metallurgical procedure of the Heroult process has become well defined and almost standardized. In this, the open-hearth process is carried further than is usual, the object being to reduce the content of prosphorous in the open hearth to the desired amount. Naturally the carbon is simultaneously reduced and the metal highly oxidized. This molten peroxidized metal is then introduced into the electric furnace, in which, by the successive formation of proper slags, the sulphur is removed, the metal de-oxidized and also re-carburized to the desired hardness. There can be no doubt that with the electric furnace it is possible to control the chemical composition of a steel more thoroughly and more economically than in any other metallurgical apparatus. Finally, an unique plant now in course of erection at California for the production of pig iron in the Heroult electric furnace, should be mentioned. The conditions which make this plant unique are availability of extensive iron deposits, comparatively cheap electric power and cheap charcoal. This first commercial electric pig-iron plant will thus not compete in reality with the blast furnace since in the absence there of cheap coke, blast-furnace operation would be impossible.

Another electrochemical development around which much interest has centered during the past year is the fixation of atmospheric nitrogen, which for some time past has been successfully carried out in Norway. It will be remembered that in the Birkeland-Eyde process which is used there, the nitrogen and oxygen of the air are forced into combination by means of the electric arc; but in order to handle a large quantity of air and treat each particle of air no longer than necessary, the arc is deviated by means of a magnetic field in a manner to form a flaming disc, the air being passed through the disc in a direction perpendicular to it. It is interesting to note that Moscicki, in Switzerland, previously known for his experiments with high-frequency, high-tension discharges, is now working along the same lines with a somewhat different apparatus. The commercial success of this process in Norway is largely dependent on the low cost of power at the plant, which is stated to be somewhere about $4 or $5 per hp-year. Since the raw material costs nothing, the power is here also a decisive factor for economical success and this explains clearly why no attempts have been made to employ this process, for instance, at Niagara Falls with a price for power four or five times higher. The other method of fixation of atmospheric nitrogen, in which nitrogen is caused to react with calcium-carbide to produce calcium-cyanamide, appears to be making good progress in Europe, and it is proposed to erect in this country a cyanamide plant in the South for the supply of this material as a fertilizer. Cyanamide may either be used direct as a fertilizer, or worked up into other chemical products like cyanide, etc.

With respect to other established electrochemical industries, a steady progress may be recorded. The large electrolytic copper refineries near New York City have greatly extended their plants. Some patents issued during the past year have directed attention to a new phosphorus works in Pennsylvania producing phosphorus in the electric furnace from wavellite (aluminum phosphate). The electric production of chlorine and caustic has further assisted the paper industry, diaphragm processes being chiefly used. The Niagara works using the Townsend cell have now been in operation almost two years, with apparently satisfactory results. The two most interesting developments during the last year in other branches of electrochemistry were probably Mr. E. G. Acheson's method of making deflocculated graphite and Dr. Henry Noel Potter's work on silicon-monoxide. Deflocculated graphite introduces the artificial-graphite industry into the lubricating field and "monox" (the trade name for silicon monoxide) is useful for making paints and inks, while a screen coated with monox powder is claimed to be impervious to fine solid particles and to all sorts of germs and organisms. These two examples show in an interesting way how electrochemical development reacts on other industries and in unexpected ways.

Wireless Telegraphy on the Great Lakes.

The extent to which wireless telegraphy is being used on the Great Lakes will be appreciated when it is known that nearly 70,000 messages were handled during the season of 1907 for marine interests by the Clark Wireless Telegraph System.

When the season opened, early in March, there were only two stations in operation, one at Detroit, Mich., and the other at Cleveland, Ohio. Early in the month of May a station was placed in operation at Port Huron, Mich. In August a fourth station was placed in operation, at Buffalo, N. Y., and in September a fifth station was placed in operation, at Toledo, Ohio. The five stations brought Buffalo, N. Y., Cleveland, Ohio, Toledo, Ohio, Detroit, Mich., and Port Huron, Mich., into wireless communication.

With the opening of navigation, the Clark Wireless Telegraph Company began the work of soliciting the telegraph business of the bulk-freight handlers from many of the large marine interests on the Great Lakes. These interests combined represent some 320 fleets and over 1000 vessels. The telegraph work consisted in reporting boat passages, orders, etc., from Port Huron and Detroit to the owners' and managers' offices in Cleveland, Toledo and Buffalo, and in receiving in reply messages and orders for the captains of the boats, as to the destination for the vessel to go with her cargo, also furnishing the Cleveland office with all the up and down passages at Port Huron station—these were transmitted twice daily. The passages up to 8 o'clock in the morning were sent in at 8:30 a. m., and the passages up to 1:30 in the afternoon were sent in at 2:30 p. m. The vessel owners were thus able to formulate the destination orders before the vessels reached Detroit.

In many instances the vessel orders and destination orders were given for the vessel on passing at Detroit, and the destination changed again before the vessel passed the Lime Kiln Crossing. In many instances this could not have been accomplished by wire telegraph or even long-distance telephone. The Cleveland station operator and Detroit station operator transmitted and delivered some of these rush message orders in less than three minutes. It is stated that the stations were operated for the entire season without serious delays.

State Regulation of Water Powers.

In connection with the extension of the privileges of the Hudson River Electric Power Company, already noted in these pages, a concurring opinion has been filed by Commissioner Osborne, dealing more particularly with the question of general development of the water power resources of the state, and the precautions to be observed by the Public Service Commission in granting water-power privileges to private corporations. As a general proposition, Mr. Osborne sets forth that it is the duty of this commission, if it be possible, so to act that if the state should decide to follow along the lines indicated by the Governor's message, and the newly established water supply commission, no action on the part of the Public Service Commission should put the state in a less advantageous position than it would have been if this commission had not acted.

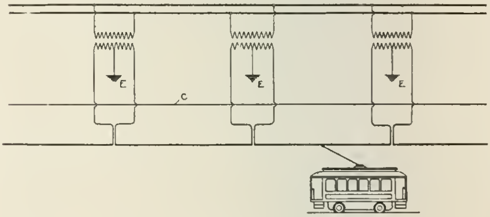
Commissioner Osborne, after calling attention to the clause in the annual message of Governor Hughes, relative to the placing of undeveloped water powers under state control and the establishment of the state water supply commission as a result of these suggestions, says: "From the above facts, the recommendation of Governor Hughes, the action of the Legislature in the Fuller bill, and the efforts of the state water supply commission, it is evident that the possibility of a 'just regulation for the public benefit' by the state of such water powers as those proposed to be used by the Hudson River Electric Power Company has been more than seriously considered—the first legislative step has been actually taken." The opinion of Commissioner Osborne is, that while the commission is not called upon to decide as to whether such policy is or is not a wise one, or whether, being wise or unwise, it is likely or not to be carried out by the state either now or in the future, yet in view of this fact, it devolves upon the Public Service Commission to see that nothing be done which may prejudice the state in any present or future policy which will not leave the state the utmost freedom of action in dealing with the development of these water powers.

Mr. Osborne quotes section 55 of the Public Service Commissions law, forbidding the capitalization of franchises, and says: "These provisions as well as the whole trend of the law show clearly that the Legislature did not intend to allow certain powers granted by state or municipality to inure to the benefit of private individuals in the case of public utilities; and while the Legislature has not by any means so clearly or fully declared itself in the policy concerning the water courses of the state, it has indicated a possible policy to be pursued by the state in which the same principles which underlie its present attitude toward its public utilities may possibly be assumed in the future toward its water powers, which, as the Governor has pointed out, may be developed and utilized by the state to great public advantage."

Mr. Osborne closes as follows: "When the choice comes squarely between rejecting or granting the application of the Hudson River Electric Power Company, there is this further consideration: The conditions seem to be such that if the state should ever determine to develop the water power of the Sacandaga Valley it could do so with such manifest advantage to the Hudson River Electric Power Company that there is every reason to believe that the company would have every incentive to further rather than hinder such development. The self-interest of the private owners may thus yield to the state what the state might better have the legal right to exact. While, therefore, I should greatly prefer to have such conditions embraced in the order as would give the state the legal right to assume control of the water power any time within a given number of years, I concur in the opinion of Commissioner Decker and the granting of this application to construct and operate under the franchise of the applicant."

Eliminating Disturbances on Telegraph Lines.

The accompanying illustration shows a scheme for neutralizing electromagnetic and electrostatic disturbances to telegraph circuits by single-phase railway lines, as disclosed in a patent issued Dec. 10, to Mr. J. B. Taylor. Energy is supplied from the high-tension conductors to the trolley circuit through step-down transformers, of which three are shown. The trolley wire is arranged in sections, each section extending from one transformer station to another. The central point of the secondary of each sub-station transformer is connected to earth, and the outer terminals of the secondary winding are connected to the ends of the two sections ending at that sub-station. With this arrangement it will be seen that at the instant when one section is at a positive potential with respect to earth the adjacent section will be at an equal negative potential. Consequently if a low-voltage conductor *C* extends parallel with and adjacent to the working conductor, the static inductions of the two sections on the conductor *C* will neutralize each other. Since the currents in the two portions of each section of the working conductor supplying energy to a car neutralize each other, as far as magnetic induction upon the adjacent conductor *C* is concerned, practically all inductive effects upon the conductor *C* are avoided.



TAYLOR SYSTEM OF DISTRIBUTION.

Arrangements at the Chicago Electrical Show.

The general plans for the Chicago Electrical Show have already been noted. Subjoined is a list of the special days at the show and the features associated with them:

Monday, Jan. 13.—Opening night. Souvenir post cards showing interior view of electrical show will be given away.

Tuesday, Jan. 14.—Ladies' souvenir day. A gold hat pin will be given to each lady visiting the show on this day.

Wednesday, Jan. 15.—Students' Day. Special demonstrations of scientific apparatus will be given and new developments shown in electrical devices.

Thursday, Jan. 16.—Societies' Day.

Friday, Jan. 17.—Joint meeting of the Illuminating Engineers' Society and the Northwestern Electrical Association.

Saturday, Jan. 18.—Annual meeting of the Electrical Salesmen's Association.

Monday, Jan. 20.—Rejuvenation of the Sons of Jove. Souvenir for everybody.

Tuesday, Wednesday and Thursday, Jan. 21, 22 and 23.—Annual convention of the International Independent Telephone Association will be held in the Coliseum Annex Hall. Miniature telephones will be distributed as souvenirs on Tuesday, Jan. 21.

The Decorative Lighting of the 1908 Chicago Electrical Show.

The scheme of decorative lighting while is being carried out for the Chicago Electrical Show, to be held at the Coliseum in Chicago, Jan. 13 to 25, is one of the most notable examples of interior lighting of an exposition building ever offered. It has probably never been surpassed in the history of shows and expositions of this kind. The decorative lighting is a part of a general architectural scheme of decoration which has been worked out by D. H. Burnham & Company, architects. The exhibitors' booths are to be of uniform design. The lamps for decorative lighting will be hung in festoons from the roof girders and from between the posts at the corners of exhibitors' booths and on massive chandeliers.

Fig. 1, reproduced from the architect's painting, shows the general appearance of the building as decorated. Fig. 2 is a cross-section drawing of the Coliseum Building, showing the position of the bunting and the festoons of lamps. The bunting will form a false ceiling for the building when it is decorated. This bunting is hung from the roof girders. It is notable that this will be the first time in the history of this well-known structure that the illumination is to be from festoons of this kind instead of from lines following the roof trusses. The effect of this decoration is to change entirely the apparent contour of the roof. In Fig. 3 is illustrated a longitudinal section of the building, which shows the festoons along the side of the building and also the locations of the row of great central chandeliers, designed especially for this occasion. Besides these chandeliers, there is a central canopy which serves the double purpose of a chandelier and support for festoons of bunting. In Figs. 2 and 3 the number of sockets on each festoon is indicated by the number within the circle.

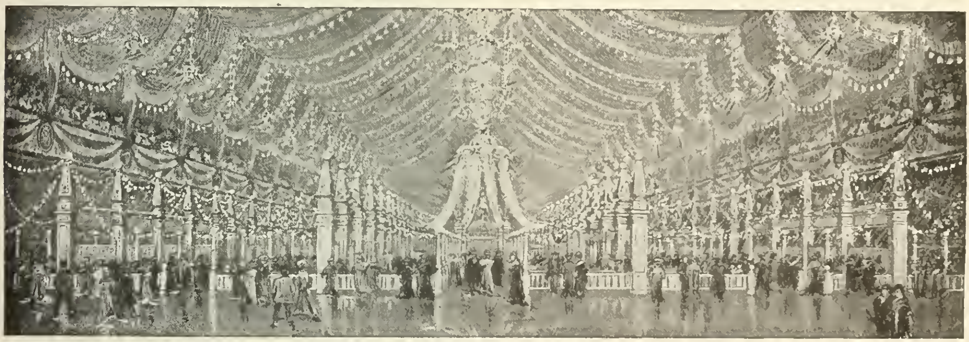


FIG. 1.—PERSPECTIVE VIEW OF CHICAGO ELECTRICAL SHOW DECORATIONS.

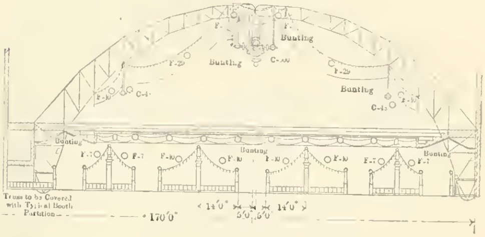
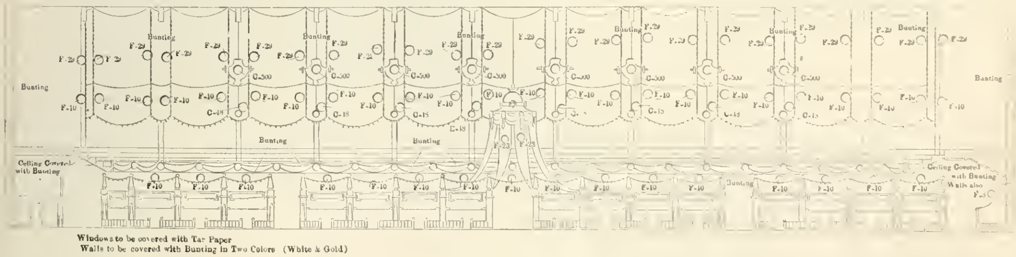


FIG. 2.—CROSS-SECTION OF COLISEUM.


Bunting
F-29
C-500
F-10
C-18
Bunting
F-23
Ceiling Covered with Bunting
F-10
Ceiling Covered with Bunting Walls also
F-3

Windows to be covered with Tar Paper
Walls to be covered with Bunting in Two Colors (White & Gold)

FIG. 3.—LONGITUDINAL SECTION OF COLISEUM.

One of the special features of this lighting is a number of specially designed papier-mâché chandeliers. There are eight 275-lamp chandeliers hung from the center of the building, flanked on each side by smaller 41-lamp chandeliers. The positions of these chandeliers can be seen from Figs. 2 and 3. The general lines of these chandeliers are spherical and hemispherical, as seen in Fig. 4. Fig. 5 shows the detail of the canopy which forms the central feature in the building.

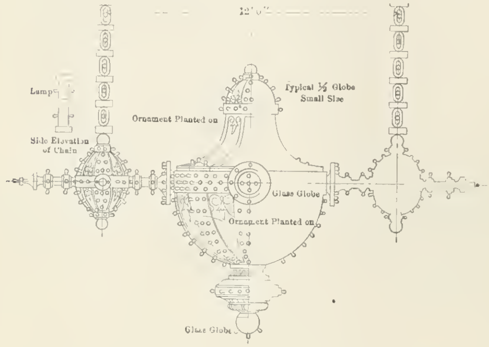


FIG. 4.—ELEVATION OF CHANDELIER.

The following is a schedule of the lamps to be used in the decorative lighting, not including any lamps installed by exhibitors for their own special purposes.

The general dimensions of the building are about 300 ft. x 170 ft., and from the floor to the highest point in the ceiling is about 70 ft. The mean spherical candle-power of the lamps used for decoration totals over 45,000, making about 570,000 lumens for a floor area of 51,000 sq. ft. If 30 per cent of the total light generated reaches the plane of the exhibits, the illumination on the exhibits will be over 3 foot-candles from this decorative lighting alone. The bunting which fills in the spaces between the festoons of lamps, as shown in Fig. 3, is to be gold and white; that is, it is to be white between the festoons of a pair, while the greater space between pairs is to be gold.

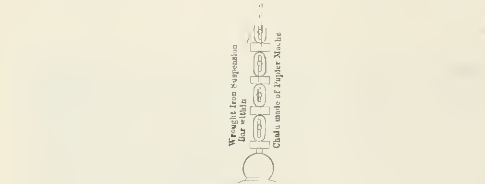

Wrought Iron Suspension Bar within
Chain made of Papier Mache
Ribs and Ornament Planted on
Globe
Globe
Globe
Typical Rosette
Globe
Globe
Festoon
Festoon
Festoon
Festoon

FIG. 5.—ELEVATION OF CENTRAL CANOPY.

Designation.	Candle-Power.	No. of Sockets.
207 10-lamp festoons	4	2070
100 7-lamp festoons	4	700
20 11-lamp festoons	4	220
18 17-lamp festoons	4	306
14 9-lamp festoons	4	126
4 6-lamp festoons	4	24
5 8-lamp festoons	4	40
4 14-lamp festoons	4	56
48 10-lamp festoon ceiling	2	480
48 29-lamp festoon ceiling	2	1392
319 1 lamp on posts (Gem)	40	319
8 275-lamp chandeliers, large	2	2200
16 41-lamp small chandeliers	2	656
388 1-lamp central feature	2	388
13 1-lamp globes, central feature	40	13
1 Sign—buffet	2	84
2 Signs—at annex independent telephone exhibit	2	496
22 19-lamp festoons between trusses	2	418
Total sockets		9988
8 8-lamp clusters of arc lamps		64
2 flaming arc lamps, 10 amperes each		2

The windows will be covered to prevent daylight from interfering with the decorative lighting.

Kelvin Memorial Exercises.

Kelvin memorial exercises will be held at New York by the American Institute of Electrical Engineers in the Engineering Societies Building on Sunday, Jan. 12, at 3.30 p. m., lasting about an hour and a half. President Stott, of the Institute, will preside and kindred societies have been asked to be officially represented. Prof. Elihu Thomson will deal with Lord Kelvin's career as an electrical engineer. Prof. E. L. Nichols will speak of his work as a physicist and Mr. George G. Ward on his achievements in submarine cabling. One or two other aspects of his long and brilliant life will also be discussed. Music will be given during the exercises by the Hans Kronold orchestra. The exercises will be open to the general public.

New Harlem River Bridge.

On Monday, Jan. 6, the new bridge across the Harlem River, at 207th Street, New York, was officially declared open for traffic. The bridge is a swinging structure, opening horizontally upon a central pier and table. At present the opening of the bridge is accomplished by steam, but within the very near future alternating-current motors will replace the engines for its operation, the motors having already been purchased and mains run for the establishment of electrical service.

In 1903 the foundation of the bridge was laid, and the work pushed forward from that time. From Sedgewick Avenue and 184th Street, Bronx, an approach of granite masonry carries the roadway out over the tracks of the New York Central Railroad to the bulkhead of the river.

That part of the approach which is over the river is in three sections of steel construction. These three sections were formerly parts of the bridge over the Harlem Ship Canal, at West 221st Street, the old span being moved to its present location in the 207th Street structure, the transportation of the draw span, 170 ft. in length, being accomplished by means of floats within the period of three days.

The electric motors which will operate the bridge in the very near future will consist of two 20-hp two-phase induction motors. The approach to the bridge will be lighted by alternating-current arc lamps, all the energy being supplied from the mains of the United Electric Light & Power Company.

The city has also provided for the lighting of Tenth Avenue, Broadway and Emerson Street near the Manhattan entrance of the bridge. Very shortly Nagle Avenue will also be lighted by electricity, thus forming a complete electrically lighted thoroughfare from the City Hall, through Broadway, St. Nicholas Avenue and Nagle Avenue, to the Bronx, no lighting by gas in the vicinity of the bridge having been provided for. All of the lighting service, together with the motive power of the bridge, will be supplied from the mains of the United Electric Light & Power Company.

Combined Steam and Gas Engine.

In a paper dealing with the evolution of the internal combustion engine presented at the New York meeting of the American Society of Mechanical Engineers, Mr. S. A. Reeve called attention to the possibilities of development along the line of continuous combustion under constant pressure. In order to eliminate the high operating temperatures in gas engines, the author proposes the use of the products of gas combustion to make steam before attempting to drive a piston with them; the heat of the gas should be transferred directly to the water by actual contact. To obtain the desired result, the gas flame may be generated upside down over water, and the products of combustion passed into the water. The furnace thus produces a mixture of superheated steam, nitrogen and carbon-dioxide, which is used directly in a reciprocating engine which differs immaterially from the ordinary steam engine. It is claimed that this method of utilizing the energy of the gas is more advantageous than employing the gas in an explosive type of engine. In comparison with the operation of a steam engine in the usual way, the method proposed avoids the presence of a steam boiler under pressure and the transmission of heat through metals. Moreover, high thermodynamic efficiency is obtained by expanding the steam from the highest practicable temperature of superheated steam down to the lowest temperature of exhaust which is useful with steam, yet without the use of a condenser, or an air pump.

CURRENT NEWS AND NOTES.

EARTH WIRELESS TELEPHONE.—A Wilkes-Barre, Pa., dispatch states that John Grehowski, 20 years of age, has talked by wireless telephone through an earth circuit a distance of 1000 feet. It is stated that the waves are communicated to the earth by means of a 6-ft. rod.

REGULATION IN NEW YORK. —In his annual message Governor Hughes has recommended to the legislature that telephone and telegraph companies be included in the jurisdiction of the Public Service Commissions, and be regulated as the street railways, lighting systems and other utilities are now.

CORPORATION TAXES IN NEW JERSEY.—The New Jersey State Board of Assessors has filed its schedules showing the taxes levied for the year 1907 against six classes of public utilities, which are taxed on the basis of gross receipts, 2 per cent being the rate. Street railway companies are taxed $265,517.52; gas and electric companies, $244,775.72, and telegraph and messenger companies, $910.47. The total tax on the six classes of concerns is $626,212.86.

MARCONI DEVELOPMENTS.—Before sailing from Halifax for England in the steamer "Tunisian," Mr. Marconi last week stated that the Clifden-Glace Bay system is now handling about 1500 words of press matter across the Atlantic, but that in three weeks it would take any amount of business offering. When he returns next month Mr. Marconi will have something to say as to transcontinental and Pacific Ocean work, now under discussion. During February he is to lecture on his work before a joint meeting of the American Institute of Electrical Engineers and the New York Electrical Society.

FRENCH POSTAL TELEGRAPHY.—It is announced from Paris that M. Simyan, French Minister of Posts and Telegraphs, has just made an important reform which will go far to remove the criticism to which the French postal service has long been subjected. The reform takes the shape of a "letter telegram." When a French citizen misses the last mail for some point in France, however distant it may be, he may turn his letter in at a special wicket and by the payment of a very small sum have his letter or letters transmitted by telegraph during the night. At the place of destination the letter thus telegraphed will be placed in an envelope and delivered by the postman on his first rounds the next morning. This is practically the "telepost" system now struggling for a place in the American telegraphic economy.

TREATY ON WIRELESS.—A meeting of the Senate Committee on Foreign Relations has been called at Washington this week to consider the treaty on wireless telegraphy recently transmitted to the Senate by the President. John W. Griggs, ex-attorney general, and now the attorney for the Marconi interests, will be heard in opposition to the treaty. The article of the treaty which provides that wireless messages shall be exchanged between ships and coastal stations and between ships themselves, regardless of the particular system adopted by ships and wireless stations, is not regarded favorably by Marconi, as his attorney will set forth. It is understood that the statement of Admiral H. N. Manney, a member of the United States delegation attending a Berlin wireless conference, regarding the disputed article has been obtained by the committee.

PRODUCTION OF HOMOGENEOUS BODIES FROM TANTALUM.—In the production of homogeneous bodies from tantalum it is usual to employ powdered tantalum as the starting material, solid bodies being made by compression. These bodies are heated to their melting point in an indifferent atmosphere between two electrodes by the electric current. The melting operation necessitates a relatively small expenditure of energy when the body which is to be melted is itself employed as a positive electrode in the formation of the arc formed by the current. With a very high vacuum, however, the arc passes with difficulty between the electrodes. According to a patent issued Dec. 17 to M. von Pirani, electricity may be made to pass of its own accord to the electrodes. A metallic oxide which emits ions when heated is arranged in a combustion furnace in connection with the cathode, for the purpose of facilitating the passage of electricity between the electrodes, even with very high vacuum. The oxide is connected with the cathode, and the heating is effected by means of a wire embedded in the oxide, which is heated by an electric current. It is stated that barium oxid is particularly suitable for the ionization; but that strontium oxid, calcium oxid, or magnesium oxid, or other oxids may also be employed.

ONE FEATURE OF RELIEF.—A leading financial writer discussing the general situation in the *New York Times* says: "There is every reason to believe that the American public has become pretty well convinced of the fallacy of municipal ownership. If this proves to be true, it is bound to have an important effect upon the demand for securities of all classes. It will have a good effect upon demand for municipal securities. Several years ago Sir Felix Schuster, governor of the Union Bank of London, said to me that he felt that municipal ownership had been carried so far in Great Britain that nearly every municipality was on the verge of bankruptcy. The result of investigations by thoroughly competent and impartial commissions has shown that municipally owned railways, telegraphs, public utilities and industrial concerns do not give nearly as good service, and that, although they may give lower rates to consumers, they invariably bring about great increase in taxation, and if they give anything like the service demanded by the public they are bound to dangerously increase the public debt. Furthermore, when the public is convinced that the policy of all branches of Government will be strongly against confiscatory methods, and that their efforts will be in good faith directed only toward reasonable regulation, and that corporations are simply combined enterprise for mutual advantage, and that the corporate form has aided the development of mankind, and if given a fair show and properly regulated will continue to aid mankind as no other force is able to do, individuals who now have a fear of the stability of corporations will gladly invest their savings in the securities of those combinations of capital whose management has made a satisfactory record."

SUBMARINE TELEPHONES.—Advices from Paris state that as the result of elaborate experiments to prevent the recurrence of accidents to submarine vessels, the minister of the navy has issued orders that all submarines be fitted out with detachable telephone buoys, which, in case of accident, will permit of communication with the surface.

OVERSHOES FOR GLOVES.—In Williamsburg, Brooklyn, last week, seeing two boys receiving shocks from a telephone wire that had fallen on them and was crossed with a trolley feed wire, a young woman took off her rubber overshoes, used them as gloves and pulled the wire away, tying it around a pole. The crowd tried to dissuade her from the attempt. She refused to give her name. The boys, whose lives had been saved, were taken to a hospital.

AN ADMIRABLE STRIKE.—The employees of the Pana, Ill., Gas & Electric Company were recently called out on strike by the Federation of Labor because the night engineer had been discharged. He had broken two important and proper rules. One offence was that he did not blow the warning whistle to employees out on the line, and the other was that he allowed visitors to enter the dynamo room. It is difficult to understand how man can strike in support of such conduct.

CANADIAN TELEPHONE.—It is announced from Winnipeg that the arrangements have been completed for the transfer to the Manitoba Government of the entire system of the Bell Telephone Company in the province for a consideration of $3,500,000, payable in 4 per cent Government bonds. At a cabinet meeting, Tuesday, the fact was noted that the transfer would be completed by Jan. 15. This is a preliminary step to the acquirement of the Bell systems by Alberta and Saskatchewan.

READING IN BED.—The Commonwealth Edison Company of Chicago, in a recent advertisement under the heading "The Habit of Reading in Bed," calls attention to the luxury of reading in bed, a practice which can only comfortably and safely be indulged in without eye strain when electric light is used. It points out the fact that reading in bed has been considered injurious largely because of poor light coming from an improper angle. With electric light, it is possible to hang a portable fixture directly over the head of the bed which will throw the light down on the reading page and will not shine in the eyes. The charms of this habit, as depicted in Barrie's delightful little essay on the subject, are heightened and enhanced by electricity as thus applied.

OWNERSHIP IN CLEVELAND.—Special dispatches from Cleveland state that Mayor Tom L. Johnson, in order to gain money for his municipal ownership program, including electric lighting, the taking over of all gas companies except the East Ohio, and eventual city ownership of street railway lines, will seek means to raise $60,000,000 in the Legislature this winter. Two plans are suggested. By the first the Longworth act would be amended to permit issuing bonds without vote of the people on more than 1 per cent of the tax duplicates, the present limit, while a joint amendment would give to the mayor power to name the real estate valuation board, which could raise taxes. The other contemplates authorizing the issue of industrial bonds, the mortgage being on the property of the city rather than on the taxable property of the citizens.

TUNGSTEN LAMP.—A United States patent granted on Dec. 17 to Mr. Charles van Brunt and assigned to the General Electric Company is interesting in indicating probable developments of the tungsten lamp. It relates to a process of purifying metallic compounds, especially tungsten trioxide. The process is one of fractional precipitation and from the chemical standpoint the use of organic bases for the precipitation is the principal feature. While with the old method of repeated evaporations and crystallizations such purification as is necessary for this purpose requires a week or two, the new method enables one to purify a complete batch of oxide in a single day. The purified tungsten trioxide is an almost fluffy, impalpable powder and is reduced to pure tungsten by means of hydrogen. Tungsten filaments made in this way are "strong, free from cracks and imperfections, and for a short time, at least, will operate at a temperature corresponding to a specific consumption of only a few tenths of a watt per candle."

"ELECTROMOBILE."—Lord Halsbury, in the British Court of Appeals, has just decided that "electromobile" is not a special designation, but a plain, ordinary, "common or garden" word. A suit had been brought to restrain from the use of the precious word, and a refusal to enjoin was followed by the appeal, now denied. Lord Halsbury gave judgment. He said the question was simply one of fact, and, viewed as a matter of fact, there seemed to him to be no reasonable probability of confusion between the two names. The degree of probability of confusion arising by people being deceived depended very often upon the nature of the name. In this case an injunction was asked to restrain a new company taking two words. "Mobile" was a good classical French word, and "electro" was applicable all over the world to electricity. Those names signified the qualities of the carriage. He did not believe that the word "Electromobile," which was admitted to be a generic word describing a car driven by electricity and having the power of motion, had from 1902 been so specifically appropriated by any particular company that it would lead people to be deceived if two companies having that word in their registered names were permitted to co-exist. The question was always one of fact. If the name sought to be restrained was one which merely conveyed, whether accurately or not, the qualities of a thing, it required clear evidence to establish the fact that it would lead to deception. Proper names were distinctive enough, although, as a matter of fact, he did not deny that even a person might be restrained from using his own name if, in point of fact, a particular thing had become identified with that proper name. Lord Justice Vaughan Williams and Mr. Justice Bingham concurred. The appeal was dismissed with costs.

THE FUNERAL OF KELVIN.—In a letter to a friend in this country, Mr. Joseph Wetzler, of New York, who represented the American Institute of Electrical Engineers, at the Kelvin funeral in Westminster Abbey, with Mr. H. F. Parshall, says: "I have never attended an occasion of greater solemnity. In keeping, as it were, with the spirit of the occasion, the heavens were covered with a black pall, so intense and dark that not only indoor, but outdoor illumination was required everywhere in order to pick one's way into the Abbey. Every seat in the great and glorious old pile was filled to overflowing and one could see at a glance that it was not idle curiosity but a genuine affection that had drawn so large a gathering to pay the last respects to the noble departed. I was seated in the Poets' Corner, and while waiting for the service to begin glanced around me and read the names on some of the monuments, names of third-rate poets one never hears of; I could not help thinking how little England had appreciated some of the men who have made her really great. To think that since Newton's time only half a dozen leaders in Science have been buried in the Abbey is enough to make one weep. Very appropriately Kelvin's remains have been placed next to those of Newton—a worthy juxtaposition. As I came away I recalled the great privilege and pleasure it was to me to have dined with Lord Kelvin. I shall never forget the impression made upon me at such close range. With all his greatness, he had the rare simplicity of the child, and I remember particularly the youthful glee with which he showed me the new Spinthariscope of Crookes, which revealed the apparent movement of the particles of radium under a strong magnifying power. The élite of British science was at the funeral, and one heard on all sides the stories of his knowledge, insight and lovable qualities."

General Office Building of the Philadelphia Electric Company.

The new office building of the Philadelphia Electric Company, at Tenth and Chestnut Streets, is a fireproof structure built on a steel skeleton, with floor construction of steel girders and floor beams arched between with reinforced concrete. The building is seven stories high, above the basement, and has a frontage of 32 ft. on Chestnut Street, 229 ft. on Tenth Street and 32 ft. on Sansom Street. It is obvious that a building of this shape, fronting on three streets, permits of ideal lighting and ventilation.

The exterior of the building was designed with a view of giving the structure an appearance of dignity and strength befitting the home office of one of the largest and most important corporations in the city of Philadelphia. The architecture is simple in motif, and the materials used are a combination of Indiana limestone and hard, red brick, laid in Flemish bond with a white mortar which brings out the full richness of tone and color of the brickwork.

The main entrance of the building is on Chestnut Street, opening into a dignified and imposing display room. There is perhaps no business house in Philadelphia which contains anything that is better, architecturally or artistically, than this apartment. This display room acts as an ante-room to the various offices throughout the building, and in it are exhibited all the lighter and more attractive pieces of electrical apparatus—particularly the smaller electric lighting, cooking and heating utensils. A specialty is made of a portable electric lamp exhibit; this dispay being in keeping with the handsome appearance of the room, and also helping at night to make the view, from both Chestnut and Tenth Streets, through the large plate glass windows, most attractive. The rest of the first floor is devoted to the cashier's and stock transfer offices, waiting room and other general offices of the company largely used by customers; while in the rear are located the record and lamp departments for the local district. A special entrance on Tenth Street has been provided for persons renewing lamps, etc., and the rear entrance, on Sansom Street, is used for freight.

In the basement immediately beneath the first floor display room is a similar room, used for exhibition purposes. In this room all the heavier electrical apparatus is exhibited. It is fitted up as completely as space will permit, and contains all the apparatus which is in daily use in places of business, as well as dwellings. To the rear of this display room is the mailing department, office of the superintendent of the building, mechanical plant and main switchboard, lamp and stationery rooms, locker rooms, etc. Light and ventilation are furnished to the basement by means of an area-way lined with white enamel brick and covered with an iron grating extending along the Tenth Street front of the building.

On the second, third, fourth and fifth floors are the offices of the various officials of the company, with their clerical forces, and the necessary adjuncts of fireproof vaults, storage, etc. On the sixth floor is located the auditorium or assembly room. This auditorium is used for the monthly solicitors' meetings, and also for the meetings of all the other employees' associations. No attempt has been made to secure an elaborate or luxurious effect in this room. It is comfortable and well ventilated. From the switchboard in one corner of the room both direct and alternating current may be obtained; gas outlets are also provided at this point, so that illustrated lectures or demonstrations of any nature pertaining to electricity or gas may be given. Adjoining the auditorium, on the same floor, are located committee rooms, cloak room, and a library for the employees. The latter room will be completely equipped with books of a technical character, and with all the electrical magazines and periodicals.

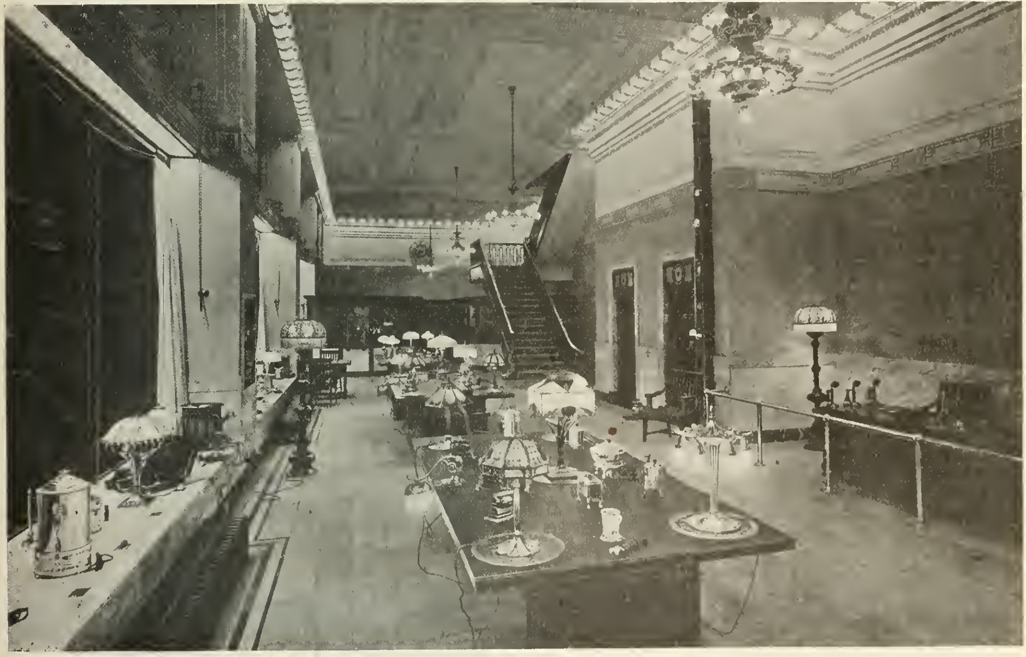


FIG. 1.—GENERAL VIEW OF DISPLAY ROOM ON MAIN FLOOR OF THE PHILADELPHIA ELECTRIC COMPANY'S OFFICE BUILDING.

The Philadelphia Electric Company has extended to the American Institute of Electrical Engineers and to the Illuminating Engineering Society the privilege of using the auditorium for their monthly meetings, subject, of course, to the rules regulating the building, and the Philadelphia sections of both these bodies have accepted this offer.

The lighting scheme for the building was devised by the officials and engineers of the company, in consultation with the architect, and, when finally completed, they are of the opinion that the results will be satisfactory in every particular.

The entire equipment of the building, in fact, every important detail of the structure, has been given the thought of President Joseph B. McCall and his executive staff, with a view of obtaining a result which would convey an impression of solidity and practicability rather than one of extravagant and unnecessary ornamentation.

The building is heated from the commercial steam mains of the company, the system used being the Werren-Webster direct steam radiation, operated by two 5½ in. x 8 in. vacuum pumps, one being a reserve.

Owing to the favorable location of the building it was not considered necessary to install a mechanical system of ventilation.

Two passenger elevators, one combination passenger and freight elevator, and an automatic electric dumb waiter, all of the Otis make, have been installed; the two passenger elevators being in the front of the building and the combination elevator and dumb waiter being in the rear.

One of the passenger elevators is of the traction type with a lifting capacity of 2500 lbs. at a speed of 600 ft. per minute, the motor being rated at 150 amperes, 220 volts, 625 r. p. m., and the other passenger elevator is a standard worm-gear and drum type, having a lifting capacity of 2000 lbs. at 400 ft. per minute, the motor being rated at 145 amperes, 220 volts, 800 r. p. m. These elevators are equipped with the Otis magnet control and flashlight signal system.

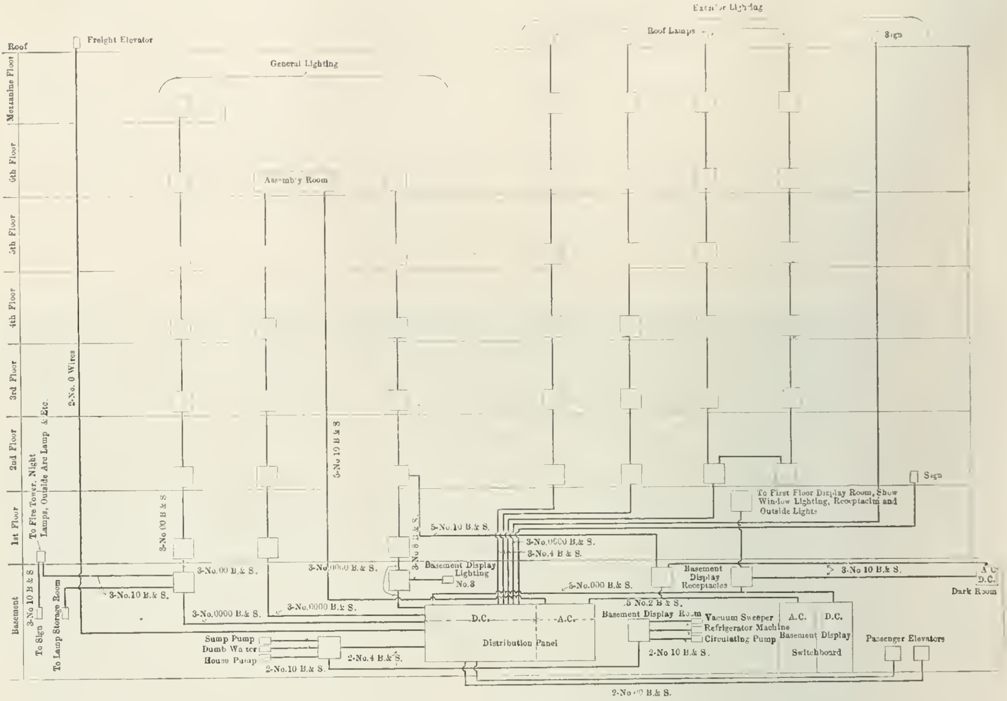


FIG. 2.—ARRANGEMENT OF FEEDER CIRCUITS IN OFFICE BUILDING OF PHILADELPHIA ELECTRIC COMPANY.

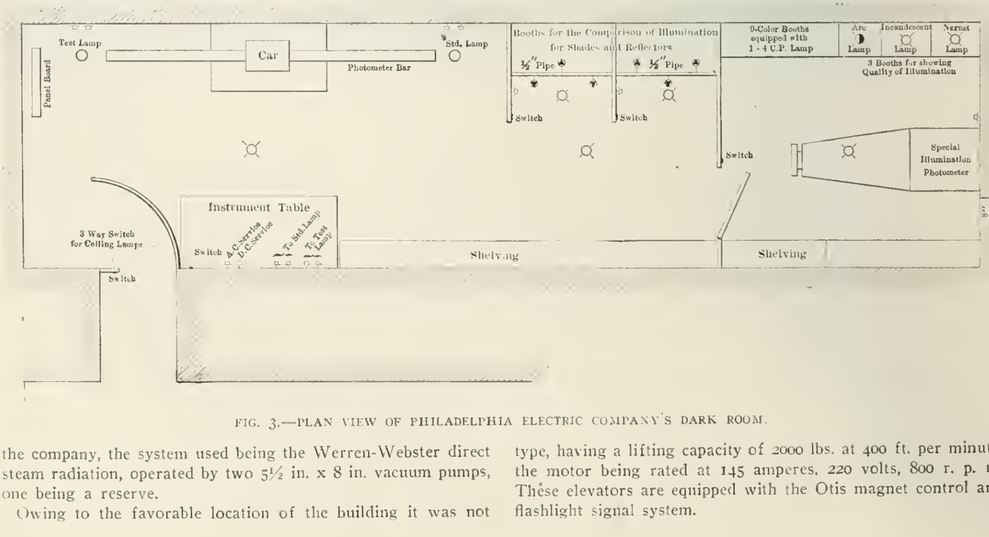


FIG. 3.—PLAN VIEW OF PHILADELPHIA ELECTRIC COMPANY'S DARK ROOM.

The combination passenger and freight elevator is also of the worm-gear and drum type, with a lifting capacity of 2000 lbs. at 300 ft. per minute, or 5000 lbs. at a lower speed. The dumb waiter has a capacity of 200 lbs. at 300 ft. per minute, and can be called to or dispatched from any floor by a series of push buttons located on each floor, but the car cannot be interfered with if already in use, cannot be started until the doors are locked, and none of the doors can be opened unless the car is opposite that particular door.

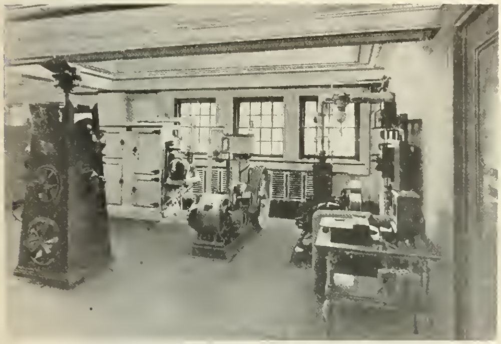


FIG. 4.—ONE CORNER OF BASEMENT DISPLAY ROOM.

The motors and driving mechanism of the two passenger elevators are located in two clear, wire glass and iron enclosures in the basement display room. The dumb waiter mechanism is similarly enclosed in the rear end of the basement, while the motor, etc., for the combination elevator is located in the top of the fire tower.

The sump pit is equipped with a centrifugal pump driven by an automatically operated 2½-hp Diehl motor.

The house pumps consist of one duplex steam and one triplex pump, direct connected to a 3-hp, 220-volt, General Electric motor, automatically controlled by a pressure regulator and Cutler-Hammer starter.

A rotary fire pump is used. This is direct-connected to a 55-hp General Electric motor.

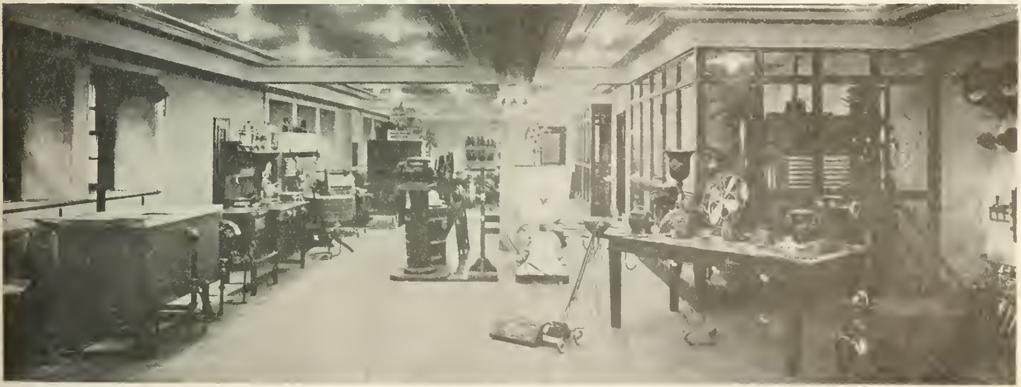


FIG. 5.—GENERAL VIEW OF WORKING EXHIBITS IN THE BASEMENT DISPLAY ROOM OF THE PHILADELPHIA ELECTRIC COMPANY.

The refrigerating plant for drinking water consists of a Larsen-Baker ammonia compressor of 2-ton capacity, the water tank, freezing coils and condenser being located in the vault under the Tenth Street pavement. This machine is driven by a 5-hp, 220-volt, Northern variable-speed motor. The water is delivered to drinking fountains on each floor, the circulation being maintained by a 1-in., two-stage Worthington turbine pump, driven by a 1-hp, 220-volt, 2400 r. p. m. Rossmassler-Bonine motor.

A vacuum cleaning and sweeping plant, manufactured under the Lotz patents and furnished by the Sanitary Dust Removing Company, has been installed. The machine is operated by a 7½-hp, 220-volt Westinghouse motor, and has a rating sufficient to operate four nozzles. The dust tanks are located in the vaults under the pavement.

FIG. 6.—NIGHT VIEW FROM THE STREET OF MAIN FLOOR DISPLAY ROOM.

The main switchboard is of a type which would ordinarily be installed in any building of this size, and is so arranged that the energy used for various purposes is metered separately, the sub-divisions being as follows: General lighting; signs; exterior lighting; basement and first floor, direct-current exhibits; basement and first floor, alternating-current exhibits; passenger elevators; freight elevator, and miscellaneous motors.

Three sub-meters are connected in series with the meter for miscllaneous motors, these being for the refrigerating machine, vacuum sweeper and circulating pump.

An auxiliary switchboard is erected in the basement display room for controlling the various exhibit circuits. This board is equipped with direct-current and alternating-current panels and is arranged so that temporary connections may be made for exhibition or testing purposes.

The building has been wired for three-wire, 110-220-volt direct-current service, and an alternating-current service has also been introduced for furnishing single-phase and two-phase 110-220-volt current for use in the display room, dark room, and for experimental and lecture purposes in the assembly room on the sixth floor. A diagram showing the general arrangement of and wiring is shown in Fig. 2.

The panel boards generally used throughout the building are of the plug-fuse type, with polished copper finish on black enameled slate. The panel controlling the basement display room lighting circuits is one of the exceptions, this having push-button switches in the metal trim of the panel, as shown in Fig. 9. The panel boards in the first floor display room are also worthy of mention, being of the ordinary knife-switch and enclosed-fuse type, but illustrating, with their marble and gold finished metal trims, that a panel board can be made ornamental as well as useful.

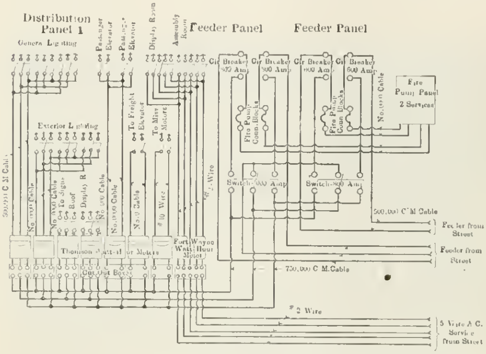


FIG. 7.—SWITCHBOARD WIRING DIAGRAM.

In the illumination of the building, the general idea of introducing as many different methods of lighting consistent with certain standards of efficiency was followed, making the entire illumination of the building more or less an exhibition of such methods, which, while not all being equally as efficient, are fair examples of various methods in which customers are likely to be interested.

The basement display room having a low ceiling, the lighting is accomplished by studding the panelled ceiling with 16-cp, round-bulb frosted lamps, so arranged that each panel may be lighted separately. The two columns are surmounted with bands of similar lamps. The column lighting, however, is not used in conjunction with the ceiling lighting, but is installed merely to demonstrate this form of lighting to those interested.

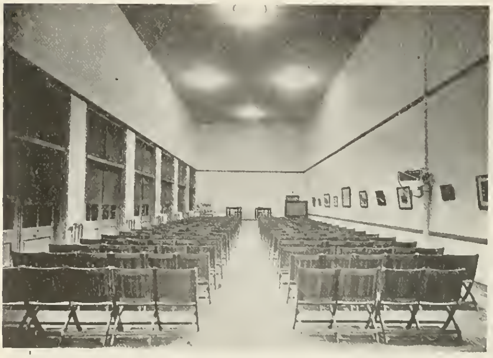


FIG. 8.—AUDITORIUM ON TOP FLOOR.

The hallways throughout the building are all lighted by means of high-efficiency lamps of various sizes equipped with bowl reflectors installed close to the ceiling, while the night lamps for illuminating the hallways are on separate circuits and are mounted on brackets of the torch pattern installed at the stairways.

A large room on the second floor is illuminated by 10 three-glower Nernst lamps equipped with Holophane hemispheres. The assembly room on the sixth floor is illuminated with General Electric arc lamps equipped with concentric diffusers, the body of the lamp passing through the ceiling and allowing the diffuser to bear directly against the ceiling. Each of the six lamps used is controlled by a separate switch, and, in addition is operated by a solenoid switch controlled by several push buttons located in different parts of the room.

The first floor display room is beautifully illuminated by four specially designed Italian Renaissance electroliers, each having 25 16-cp, round-bulb frosted lamps. This room is also illuminated by 178 round-bulb, 16-cp frosted lamps located in the soffit panels of the planacea between the modillion brackets of the Corinthian cornice, thus showing different methods of lighting the room. The windows, which open into this room, are illuminated by "Frink" reflectors installed in the hollow transom bars between the upper and lower sections of glass, making a practically concealed form of lighting, very effective for windows of this description.

The offices in the rear of the display room on this floor are all lighted by means of Holophane clusters equipped with tantalum lamps. The other rooms and offices throughout the building are illuminated by a standard design of fixture, high-efficiency lamps installed in single units, and by clusters of various types equipped with the lamps best suited to the particular type of cluster or the space to be illuminated.

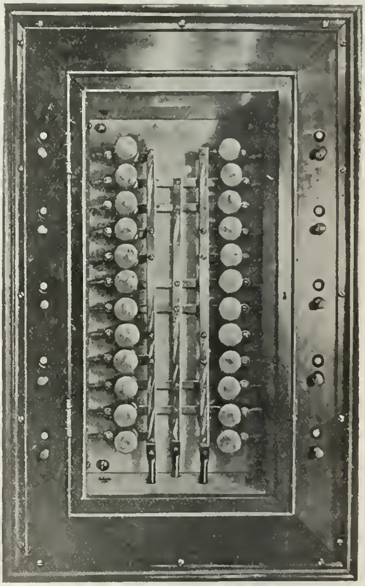


FIG. 9.—PANEL BOARD IN BASEMENT.

No other permanent illumination on the exterior of the building has been provided, except six massive torch-form of brackets located on the main piers of the building on the Chestnut Street and Tenth Street fronts. Four mains for exterior lighting, however, extend from the basement to the roof as shown on the wiring diagram, and brass-capped outlets have been left outside the building on each floor from each of these mains. Decorative lighting circuits on the exterior of the building can, therefore, be easily supplied with energy.

The dark room in the basement has been equipped with a standard photometer and the necessary instruments, and direct and alternating current, and also gas, are available at this point. This room also contains two booths fitted with ceiling and other outlets for comparative displays of lamps and shades. Also a number of color boxes for illustrating the effect of different colored walls on illumination.

There are, in addition to the equipment already mentioned, three small booths containing, respectively, an arc lamp, a Nernst lamp, and an incandescent lamp, for making comparisons of the quality of the illumination on the same colors. The shelving for the display of Holophane glassware and other shades completes the equipment of this room, although it is proposed to install a special luminometer to show the comparative illumination from any angle of two different types of lamps, with or without shades. This luminometer will also be equipped with a standard lamp and scale, by which the candle-feet at any angle can be measured. The arrangement of the apparatus and also the disposition of the outlets for connecting the various lamps, etc., in circuit, are shown in the plan view of the room given in Fig. 3.

The basement display room, in addition to the machinery for the two passenger elevators, the refrigerating machine, ice-water circulating pump, vacuum sweeper and dynamotor for supplying energy to operate the bells and annunciators, which are a part of the mechanical plant of the building, contains a large and varied assortment of electrical apparatus supplied with electrical energy from both alternating and direct current circuits, all in practical operation.

The exhibition at the present time includes the following: Two telautograph stations, one at each end of the room; two methods of rectifying direct current, namely, a General Electric mercury arc rectifier and a Westinghouse two-phase motor-generator set and panel; two refrigerating boxes for domestic or small store use, etc., one being an ethyl chloride machine, practically automatic and working at a maximum pressure of 15 lbs., and also a Brunswick Refrigerating Company's box; a large number of 110 and 220-volt, direct-current machines, from the small 1/40-hp motor only 3½ ins. in diameter, to the larger sizes, and also 110 and 220-volt single and two-phase, alternating-current motors of various makes. These motors are connected in circuit showing different methods of starting, speed control, etc.

An exhibit which has attracted considerable attention is the "Reason" electrically operated shoe polishing machine. There are also a large number of articles for domestic use, such as a sewing machine, General Electric cooking table, ovens and utensils; also a Simplex ironing board and iron; Simplex cooking outfit, instantaneous water heater, electrically driven washing machine and wringer, Hutchinson carpet sweeper, buffing and polishing machines, coffee mills, meat choppers, portable vacuum cleaner, and a model automatic push-button elevator for residences, etc. Near the latter apparatus, the flasher, commutator and other mechanism for a talking electric sign are arranged for practical demonstrating purposes.

In the larger apparatus there are ventilating fans of several kinds, ice cream freezer and ice crusher operated by a 1¾-hp Westinghouse motor, dough mixer and egg beater operated by a 2-hp General Electric motor, Insinger dish washer operated by a ¾-hp motor, and a grinder driven by an enclosed motor built by the Northern Electrical Manufacturing Co., of Madison, Wis.

Another interesting exhibit is the ozone generator, manufactured by the Ozone Purification Company. There are, in addition, monogram flashers, sign flashers, fans and lamps of all descriptions, whirlers for window advertising, arc lamps and Nernst lamps, and a large number of other pieces of electrical apparatus.

In addition to the flush wall and floor receptacles located in this room, a double trench has been run around three sides of the room, with a section extending to the center, in order that additional electrical conductors, water, steam, and drain pipes could be run to any of the apparatus on exhibition requiring these connections.

The switchboard for this display room is erected immediately over the trench and the steam, water and drain connections terminate in the trench in order that connections to the present or future exhibits may be readily made.

Temperature Rise of Conductors.

By C. C. Badeau.

The existence of an electrical current in a conductor is always accompanied by the phenomenon of heat. With direct current, the resultant heat is always a function of the resistance and the amount of current. With alternating current, other factors enter into the problem, which complicate it somewhat, and the skin effects, iron losses, etc., all have a bearing on the resultant temperature. For moderate-sized apparatus, however, not containing iron, the temperature rise, either by direct or alternating current, is almost directly proportional to the square of the current. Experiments have shown that this ratio is practically constant between 0 and 100 deg. C., and is independent of the position of the apparatus; that is, whether the radiation be good or bad, the relative relations of the temperature rise at different currents is constant.

The accompanying chart, which is based on the above facts, is particularly useful in obtaining the temperature rise on overload of such apparatus as cables, switches, circuit breakers, bus-bars, etc., in which the entire loss is copper loss, though it may also be used to determine the overload temperature rise of machines, if the iron loss is known.

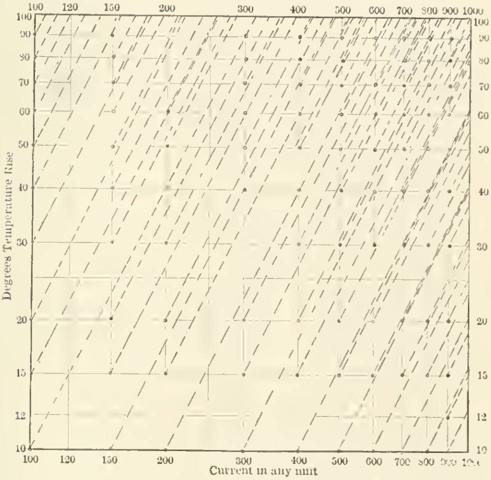


Chart Showing Relation Between Temperature Rise and Current.

The chart consists of a number of straight lines on logarithmic cross-section paper. The horizontal cross-section lines represent degrees, Centigrade or Fahrenheit, and the vertical lines current in amperes, milliamperes, hectoamperes, or any other unit. The chart is used as follows:

Given the problem of a 200-ampere switch with a normal rise of 20 deg., what will be the rise on 300 amperes? Referring to the curve, the vertical line marked 200 is followed upward until it intersects a diagonal, which starts at 20 deg., being the normal rise of the apparatus. This diagonal is then followed upward until it intersects a vertical line at 300 amperes, being the amount of current which the apparatus is to convey. The horizontal line intersecting the vertical line at this point gives the rise in degrees, which is 45. In other words, a switch which will carry 200 amperes with a temperature rise of 20 will experience a temperature rise of 45 deg. when the current is 300 amperes.

The figures for the current or the temperature rise may be multiplied or divided by ten, without affecting the accuracy of the results. In fact, as will be noted, the chart is arranged for any temperature scale and for any scale of current, whether milli-amperes, amperes, or kilo-amperes.

A Deflection Potentiometer for Voltmeter Testing.[1]

By H. B. Brooks.

In a former paper[2] the writer derived an expression for the current through the galvanometer of an unbalanced potentiometer used in connection with a volt box, and showed how this formula could be applied to the design of a class of instruments, for current and voltage measurements, having properties intermediate between those of the balance type and of the deflection type. A description was given of an instrument constructed on this principle, which was used for measuring voltage in photometric work, and which has now been in service for the past two years, giving satisfactory speed and accuracy.

The object of the present paper is to show what features should be incorporated in an instrument of this kind for such work as the testing of voltmeters, and to describe an instrument of this type recently constructed. This has been designed for voltmeter testing and other precision measurements of voltage in the laboratory and testing room.

An instrument to be used as a standard for voltmeter testing should first of all be accurate, permanent and unaffected by magnetic fields and similar disturbing influences. This requires that the bulk of the unknown voltage be measured by the potentiometer method, as no known type of voltmeter, not even so-called "laboratory standard" instruments, will meet the above requirements. In order to save time and avoid the necessity for extreme steadiness of the test voltage, a small portion of the quantity should be measured by the deflection of a galvanometer. This galvanometer should be a pivoted instrument, of good working qualities, and should have a sensibility such that one division of its scale corresponds to say one-tenth to one-fifth of a scale division of a voltmeter of the same maximum range as the potentiometer. This gives great ease of reading, as it is usually sufficient to read the galvanometer to the nearest division, neglecting tenths. These requirements indicate a deflection potentiometer, and as a number of variations are possible, in the arrangement of circuits for such an instrument, these various plans have been examined with a view of determining the one which is the most suitable. The plan adopted has many practical points of advantage in construction and operation. The volt-box resistance is high and constant; the resistance of the galvanometer circuit is constant, and the galvanometer may thus be critically damped at all settings. The steps on the main dial are equal resistances, and by suitable design may also be made even values, which facilitates checking and adjusting. Multiple ranges are readily provided, and if it is desired to measure pressures in excess of the highest for which the instrument is built, this may be done by the use of an external multiplier, giving a very small but constant percentage correction to the deflection reading.

It is desirable that the standard instrument be semi-portable, for while such an instrument is commonly used in one place, it is often necessary to make precision measurements in other places on relatively short notice. In the case of the deflection potentiometer, by building the pivoted galvanometer in as a part of the apparatus, the only accessories are the storage battery and the standard cell; the former must be carried separately, and preferably the latter also.

An instrument has been designed in accordance with the above-mentioned plan, for use in voltmeter testing in the Bureau of Standards. A diagrammatic plan of connections is given in Fig. 1.

The main dial has 25 steps of 100 ohms each. This is in series with a coil of 9.4 ohms and a dial of 10 steps of .05 ohm each. The Weston standard cell is balanced around 509.4 ohms plus the amount on the dial, and as the standard current is .002 ampere, cells of 1.0188 to 1.0198 volts may be used, and if need be, this range may be varied by changing the 9.4 ohm coil. In the storage cell circuit is a series rheostat whose minimum resistance is 297.5 ohms, increasing from this value in 15 steps of 1.5 ohms each. At the same time that the series resistance is increased, a resistance in shunt to the potentiometer wire decreases from a maximum of 6814 ohms to a minimum of 2667.5 ohms. A fine rheostat of 11 ohms in the battery circuit covers any step of the coarse rheostat, and has a compensating resistance of 7.5 ohms maximum in the galvanometer circuit.

The drop is taken from the ends of a 500-ohm coil, which is in series with 12,000 ohms when the range switch is set on × 1. When this switch is at × 2 and × 5 the total resistance between the e. m. f. posts is 25,000 and 62,500 ohms, respectively. All of these coils, except the first 500 ohms, are mounted within and well insulated from a brass box which entirely encloses them. The negative e. m. f. terminal post is inside of, and well insulated from, a brass sleeve which projects into the box and is soldered to it. This box is connected by a wire to the positive e. m. f. post, and acts as a "guard wire" to prevent leakage currents from flowing through the circuits of the potentiometer proper. This is a very important precaution, which will be appreciated when we consider the high pressure (625 volts) available for producing leakage, and the fact that the full deflection of the galvanometer is produced by .00006 ampere, a current which 625 volts would send through a resistance of over 10 megohms; while a current sufficient to give a readable deflection would flow, under this pressure, through 3000 megohms. With the arrangement shown, the maximum pressure which may produce leakage through the galvanometer is 6 volts.

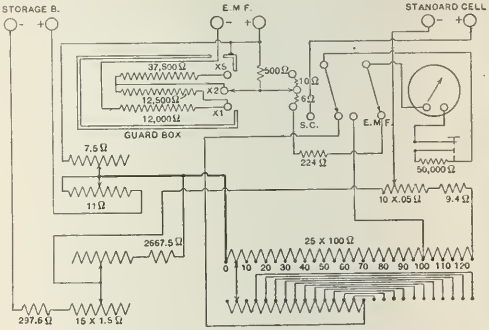


FIG. 1.—DIAGRAM OF POTENTIOMETER CONNECTIONS.

The main dial has a set of compensating coils for keeping constant the resistance between the sliding contact and the 0 end of this dial. By arranging the resistances of the series and the shunt rheostat and the standard cell coils so that the resultant resistance beyond the 125 end of the dial is 300 ohms, the total resistance in the storage battery circuit being 2800 ohms, the point of maximum resultant resistance to the galvanometer current will come at the setting 70; the resistance at 75 will be the same as at 65, and so on. Hence compensating coils are used up to the point 70, and by the use of cross-connections no additional coils are needed beyond this point.

A double-pole double-throw switch is used to change from standard cell to e. m. f., and a push button is provided in the galvanometer circuit. This button operates a double successive contact key having a protective resistance of 50,000 ohms in the first contact. The fine adjustment rheostat consists of two semi-circular coils of insulated wire, the insulation being removed on the face to allow the sliding brush to make contact

While the lowest range provided is nominally 0 to 125 volts, the range 0 to 5 volts may be had by using as the — e. m. f. terminal the lever of the range switch, and adding sufficient resistance to the galvanometer circuit to make the proper total. In other words, the normal range of the potentiometer is from

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[1] Abstract of a more detailed paper to appear in a forthcoming number of the *Bulletin* of the Bureau of Standards.

[2] *Bulletin* of the Bureau of Standards, Vol. 2, p. 225, 1906; abstracted in Electrical World, Vol. 47, p. 564, 1906.

0 to 5 volts, readable to .0004 volt (one-tenth of a scale division of the galvanometer). This range may be increased as desired by adding resistance in the e. m. f. circuit at the rate of 100 ohms per volt. The reason for not making the lower ranges immediately available by setting the range switch is the danger of accident to these low ranges, due to the inadvertent application of the usual working pressures of 100 volts and over. The lower ranges are not frequently required, and may be arranged for specially as above described. It is proposed to construct an external rheostat which may be quickly connected up to give the ranges 0 to 12.5, 0 to 25, and 0 to 62.5 volts, the proper compensating resistances being thrown into the galvanometer circuit for each range. The presence of this special accessory apparatus would constitute an indication of the need for caution as to the value of the voltage to be applied.

A view of the instrument is shown in Fig. 2, from which it will be seen that the galvanometer is built into the rubber top, making the apparatus self-contained with the exception of the cells. The scale of the galvanometer is shown in Fig. 3.

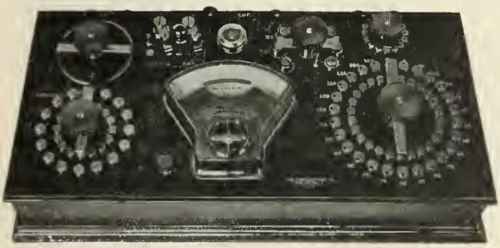


FIG. 2.—GENERAL VIEW OF POTENTIOMETER.

It has two sets of figures; an upper with 0 in the center, and a lower with 5 in the center. Ten divisions of this scale correspond to one volt, the upper set of figures being used when the dial reading ends in 0, the lower set when it ends in 5. Thus, if the dial reads 110 and the galvanometer needle stands at 22 divisions to the right, the e. m. f. to be measured is 110 + 2.2 = 112.2 volts. In practice, the dial reading is set at the center of the galvanometer scale, using upper or lower figures as required, when the value of the voltage can be read off from the scale, reading directly to tenths of a volt and estimating hundredths. The above applies to the first or principal range; when the range switch is at × 2 or × 5 the operation of the instrument is exactly the same, but the values are to be multiplied by 2 or 5, giving a maximum range of 625 volts. Should it be necessary to extend this by using a multiplier, this may be done with an error less than 0.2 per cent of the deflection portion of the reading. At full scale deflection this is about .05 division, or about the limit of setting the needle on a line. Hence, in this design, multipliers introduce a negligible error.

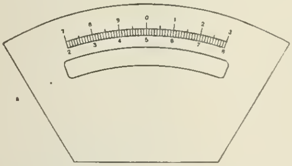


FIG. 3.—SCALE.

This instrument was built by the Leeds & Northrup Company, of Philadelphia, Pa., the galvanometer being supplied by the Weston Electrical Instrument Company, of Newark, N. J. It is so rapid and dead-beat in operation that the only limit to the rapidity of testing voltmeters with it is the ability of the operator to control the voltage and read the voltmeter under test. The appliances now in use at the bureau for voltage control will be replaced soon by others, which will give the maximum speed of working.

While intended primarily for direct-current testing, the new instrument will be of assistance in testing alternating-current voltmeters. This is done by the use of a transfer instrument which is equally correct on direct and alternating current; the transfer instrument, the potentiometer and the voltmeter to be tested being connected in parallel with each other, first on alternating, then on direct e. m. f. The change from alternating to direct voltage is accomplished by a quick-acting snap switch, the circuit being broken for so short a time that the deflection of the transfer instrument is maintained. This results in a saving of time, and the avoidance of zero errors, and is a very accurate and convenient method.

A test of this potentiometer in comparison with a five-dial standard potentiometer showed very small errors, which are entirely negligible in voltmeter testing, and which may be allowed for when the instrument is used for work of greater precision.

In this and in the preceding article stress has been laid upon the desirability of using a pivoted portable form of galvanometer. This has been done because the aim has been to produce instruments that can be quickly and conveniently operated and moved from one place to another without requiring the special setting up which is necessary with reflecting galvanometers having delicate suspensions and small clearance between coil and pole pieces. Any galvanometer can be used which has a good zero and a constant that is reasonably permanent. It is desirable, if a reflecting galvanometer is to be used, to employ a taut suspension above and below, heavy enough to give quick working and good zero. For a given set of conditions the sensibility required can be determined, and the suspensions can then be chosen to give this sensibility. The matter of critical damping should be taken into account, as before mentioned.

In the case of a deflection potentiometer for current measurements in connection with suitable shunts, which might have, say, 150 millivolts as the upper limit of its range, the small amount of power available imposes much greater requirements upon the galvanometer than in the case of an instrument for the measurement of voltage, such as the one above described. The design of such a potentiometer for current measurements has been begun.

While the potentiometer for voltage measurements, as described in this article, is best adapted to laboratory use, where voltmeters of various ranges must be tested, a simpler and less expensive instrument would answer all requirements in central station work. For example, a range of 105 to 125 volts, with provision to double and quintuple the range, would cover the most important requirements of the light and power station. The sensibility in this case would not need to be as great as for the laboratory instrument, so that a less sensitive galvanometer would be satisfactory. Preliminary work on the design of such an instrument has been begun.

Single-Phase Equipment of the Windsor, Essex & Lake Shore Rapid Railway.

The first company to adopt single-phase railway equipment in Canada was the Windsor, Essex & Lake Shore Rapid Railway Company, which is at present using single-phase cars between Windsor and Kingsville, Ontario, a distance of 28 miles. The single-phase system is now being extended from Kingsville to Ludmington, a distance of 9 miles.

The company is now carrying express as well as passengers, and is planning to carry freight. The cars were built for interurban traffic by the Ottawa Car Company. At present the equipment includes five motor-cars, four passenger trailers and two trailers for express. The trailers are not regularly used and not more than one is drawn by a single motor car. There are on each motor-car two 100-hp Westinghouse single-phase series motors. These motors are provided with compensating field coils for neutralizing the armature reactance. The regular Westinghouse pantagraph is used on the cars. It is raised by means of springs under tension and is pulled down by a trolley rope. The motor-cars are provided with air-brakes, and two cars are now being equipped with air-operated pantagraphs. The air compressor is driven by a 3.3-hp, single-phase, 100-volt motor.

A complete diagram of the wiring of the cars is shown herewith. It will be noticed that provisions have been made to take energy from the wire both at 1100 volts and at 6600 volts. Only one of these voltages, however, is used, although when the equipment was bought it was intended to use 1100 volts in the city of Windsor, and to supply energy at 6600 volts for the rest of the line. As permission was granted to use the higher voltage at Windsor, a change-over switch is no longer necessary and only one lead to the auto transformer is used. If the necessity should ever arise, 1100 volts can be used at any point without altering the car equipment.

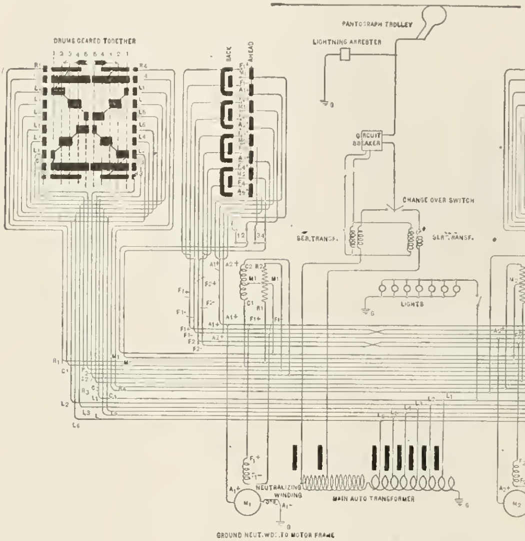


FIG. 1.—DIAGRAM OF CAR WIRING.

The connection from the pantagraph to the circuit-breaker is made with lead-sheathed, rubber-insulated cable. The resistance coils, *R* and *C*, are connected between the controller segments and the armature to minimize sparking at the controller. The auto-transformer is of the oil-insulated, self-cooled type, rated at 100 kilowatts; there is one to each car.

The contact line is of catenary construction, with poles set 120 ft. apart on the tangents and as close as 80 ft. on the curves. Bracket construction on the poles is used exclusively, except where the line passes through towns. The trolley wire used is 000 grooved. The hangers from the messenger wire to the trolley wire are spaced 10 ft. apart. Where the bracket construction is used, the messenger wire rests in the groove of the insulator, which is fastened to the T-bracket arm. The hangers cause the trolley wire to remain below the arm, and no further insulating devices are necessary on these poles, except where there is a lateral strain on the wire. Where this is the case, and on all curves where brackets exist, a steady strain device of the wooden-arm type is used. The porcelain insulator holding the steady-strain rod is carried in a malleable iron yoke which is adjustable on the bracket arm. The steady-strain rod is made of a thoroughly impregnated wooden rod having malleable iron end-lugs. This is used instead of a sleeve type in order to bring the trolley wire closer to the bracket arm. In addition to using these on curves, they are located at 12-pole intervals on the tangents.

Since the messenger and the trolley wire are both electrically connected, at each section break, it is necessary to open the circuit on both of these conductors. The messenger wire is cut at the point of the change of circuit, and the ends are fastened to separate wire insulators, the insulators being suspended from the insulator arm of the bracket. To open the circuit upon the trolley wire, a piece of second-growth hickory, treated to make it moisture-proof, is introduced into the line. The ends of this block are provided with terminals into which the ends of the trolley wire are fastened, the construction of the terminals and the shape of the wooden bar being such that the trolley passes smoothly from one circuit to the other across the intervening space without leaving the line. The arc is broken on the terminal casting. Line section-insulators are used at the sub-station, one at Kingsville, near the car shed. The latter insulator allows all the wires in the yard to be connected or disconnected without interfering with the rest of the line. A separate switch for controlling the yard circuits is installed in the power house. It is found that the men can work with perfect safety from a repair tower even when the voltage is on the line, by using a platform mounted on four double-skirt insulators, such as are employed on the poles for span-wire construction. The cross-span construction is of the steady-strain skirt type. In this type of construction the only insulators ordinarily used are those on the poles, the span wires being connected to the trolley at all times. In the present installation there was inserted in the span wires, at a distance of 3 ft. from the catenary structure, a wood strain-insulator, which makes the span-wire "dead" except for 3 ft. on each side of the trolley wire.

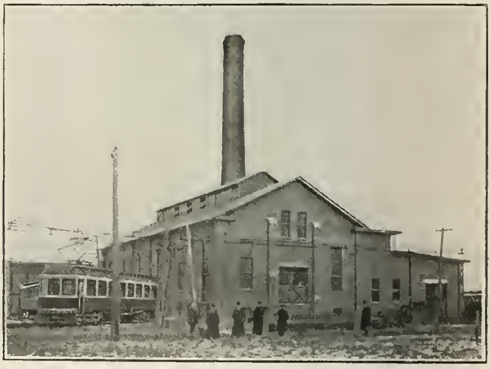


FIG. 2.—TROLLEY WIRE AT POWER HOUSE AND CAR SHED.

The poles in the city of Windsor have been made of concrete. Each is required to withstand a horizontal strain at the top of 1000 lbs.

The catenary structure conveys all of the energy used as far as the sub-station at Mirdstone, a distance of 18 miles, at 6600 volts. At this point there is installed an auto-transformer, which receives energy from the power house over a special transmission wire at 13,200 volts and reduces the e. m. f. to 6600 volts. The transmission line is supported on the same poles with the trolley wires, except in a few instances where it is placed on a special line of poles on account of trees. A diagram of the wiring of the sub-station is shown in the right-hand lower corner of the switchboard diagram. The transformer is rated at 300 kilowatts; it is oil-insulated and self-cooled.

The power house is located at Kingsville by Lake Erie, from which water for the condensers is pumped. The main part of the building, which is the engine room, is of brick. The walls of the boiler room and the division wall between the boiler room and engine room are made of concrete blocks. The chimney, which was built by the Alfonse Custodic Chimney Company, is of radial brick.

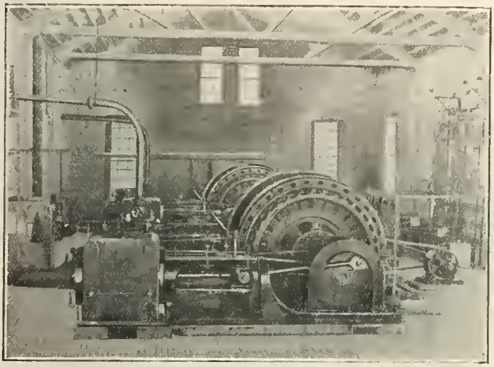


FIG. 3.—ENGINE ROOM.

There are two Goldie-Corliss cross-compound engines, 20 ins. x 40 ins. x 36 ins., manufactured by the Goldie & McCulloch Company, of Galt, Ont. These engines are provided with steam-actuated dash pots, and have separate eccentrics for the steam and exhaust valves. The speed is 125 r. p. m. The governor is belted to a pulley on the main shaft and is similar in action to a flywheel-type governor. The generators are 500-kw, 25-cycle, single-phase, Westinghouse machines, direct-connected to the engines. The exciters are 30-kw machines belted to the main engines. Space is left for one more complete unit similar to the above in the engine room.

The condensers, boilers and piping were manufactured and installed by the Canada Foundry Company. There is one jet condenser for each engine, size 16 ins. x 24 ins. x 24 ins. The injection water, as previously mentioned, is piped from Lake Erie, through two 10-in. pipes.

One condenser has a lift of 22 ft. and the other 19 ft. The distance from the power house to the end of the intake pipe is 500 ft. The end of the pipe was placed 100 ft. from the foot valve in order to obtain good, clear water. The pipes are attached to the side of a pier with bolts. In order to keep stocks and such matter from getting into the pipes an extra piece 3 ft. long with a cap was screwed on the end, and the pipe as well as the cap was perforated with ½-in. holes.

The horizontal pipe from the foot valves to the end was set 2 ft. below the average level of the lake to insure getting water when the lake at this point became low, as is frequently the case during north-west winds. In order to get the pipe down to this depth it was necessary to dig a trench for about 75 ft. under water, which is very shallow near the shore. This work was done in the winter, a scoop scraper, pulled by horses being used, and the men holding the scraper walking on the ice. The foot valve was kept down at the same depth as this pipe, thus insuring its always being under water. A manhole was built around the foot valve from which the water can be pumped, should any repairs here be required.

The two condensers feed into a common hot-well, the overflow from which discharges into a 14-in. pipe back to the lake.

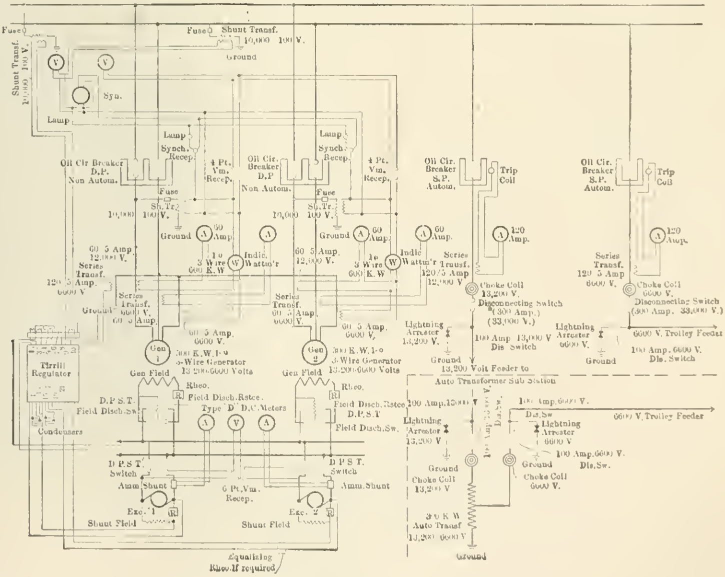
In the boiler room there are four 360-hp Canada Foundry Company water-tube boilers, and there is room for two more. There are two Cochrane feed-water heaters supplied with water from the hot well by a 10 in. x 6 in. x 10 in. Blake duplex pump, and these heaters are supplied with the automatic attachment for regulating the feed from the hot well by placing this pump in and out of service as the water is needed.

The boiler feed pump is a Canada Foundry Duplex, size 7½ ins. x 4½ ins. x 10 ins.

It is now being arranged to use natural gas, and under one battery of boilers is being installed 26 5-in. Gwynne burners manufactured by Reinecke Wilson & Co., Pittsburg. These are to receive oil through a 6-in. supply pipe at a pressure of 10 oz. per square inch. The other battery of two boilers will not be equipped until these prove satisfactory. The grates used are the cyclone grates made by the Canadian Steam Boiler Equipment Company, Toronto.

There is a gravity oiling system, with oil separator, filter and steam operated pump, purchased from the Pittsburg Oil Gauge & Supply Company. The plant was run for a little over a month and a half non-condensing, as this part of the work was not finished.

It may be interesting to state the comparative costs per hp-hour running with and without the condenser. Up to the time the condenser was put in service (Nov. 19, 1907) the average cost of operating the plant was 1.155 cents per hp-hour. From Nov. 19 to Nov. 30, the cost was .708 cent. These figures are given only to show a comparison between running condensing and non-condesing, and do not represent what will be done


Fuse
Shunt Transf. 10,000 100 V.
Fuse
Shunt Transf. 10,000 100 V.
Ground
Syn.
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4 Pt. Vm. Recep.
Oil Cir. Breaker D.P Non Autom.
Lamp
Synch. Recep.
4 Pt. Vm. Recep.
Oil Cir. Breaker S.P. Autom.
Trip Coil
Oil Cir. Breaker S.P. Autom.
Trip Coil
Fuse
Sh. Tr.
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Ground
60 Amp.
Fuse
Sh. Tr.
10,000 100 V.
Ground
60 Amp.
60 Amp.
120 Amp.
120 Amp.
60 5 Amp. 12,000 V.
Series Transf. 120 5 Amp. 6000 V
1φ 3 Wire 600 K.W
Indic. Wattm'r
60 5 Amp. 12,000 V.
1φ 3 Wire 600 K.W
Indic Wattm'r
Series Transf. 120/5 Amp 12,000 V
Series Transf. 120 5 Amp 6600 V.
Choke Coil 13,200 V.
Disconnecting Switch (300 Amp.) (33,000 V.)
Choke Coil 6600 V.
Disconnecting Switch (300 Amp. 33,000 V.)
Series Transf. 6600 V. 60 5 Amp.
Ground
Series Transf. 60 5 Amp. 6600 V.
60 5 Amp. 6600 V.
60 5 Amp. 6600 V.
Lightning Arrester 13,200 V.
100 Amp 13,000 V Dis Switch
Lightning Arrester 6600 V.
6600 V. Trolley Feeder
100 Amp. 6600 V. Dis. Switch
Ground
Ground
Gen 1
300 K.W. 1-φ 3-Wire Generator 13 200-6600 Volts
Gen 2
300 K.W. 1-φ 3-Wire Generator 13,200-6600 Volts
13,200 Volt Feeder to
Auto Transformer Sub Station
Tirrill Regulator
Gen Field
Rheo.
Field Disch. Rstce.
Gen Field
Rheo.
Field Disch. Rstce
D.P.S.T Field Disch. Sw.
D.P.S.T. Field Disch. Sw.
Type "D" D.C. Meters
200 Amp. 13000 V
100 Amp. 6600 V.
Dis. Sw.
Dis. Sw
6600 V. Trolley Feeder
Lightning Arrester 13,200 V
Lightning Arrester 6600 V
100 Amp. 6600 V. Dis. Sw.
Condensers
D P.S T. Switch
Amm Shunt
D P S T. Switch
Amm. Shunt
6 Pt. Vm. Recep.
Exc. 1
Exc. 2
Shunt Field
Shunt Field
Ground
Choke Coil 13,200 V
Ground
Choke Coil 6600 V.
300 K W Auto Transf 13,200 6600 V
Ground
Equalizing Rheo. If required

FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

under better conditions. The steam pipes have not yet been covered and the average load is a little under 50 per cent of the full rating of the machines.

In the switchboard arrangement there are three wires from the stationary armature of each generator—one ground wire, one carrying energy at 6600 volts and the other at 13,200. Both of the latter wires are lead-sheathed, rubber-insulated cables, and are run to the switchboard in fibre conduit. This conduit is designed to withstand over 34,000 volts on a puncture test. A Tirrell voltage regulator is used. The resistance coils and potential transformers are located in the basement of the building directly below the switchboard apparatus.

Each feeder wire enters the building through two glass plates set in 10-in. glazed tile. Both outside and inside the building the wires are fastened to insulators supported on a bracket structure made of 3-in. angle irons bolted together. The lightning arresters, disconnecting switches and auxiliary apparatus are mounted on an oak framework well shellacked. The same method is used for incoming wires, lightning arresters, etc., at the sub-station.

The road is now in successful operation and the construction work is being pushed towards Leamington as rapidly as possible. The line operates through a very prosperous district and promises to prove a good investment. We are indebted to Mr. S. C. DeWitt, electrical engineer of the Windsor, Essex & Lake Shore Rapid Railway Company, for the information contained in the above description.

Street Lighting and New Illuminants.

By Dr. Louis Bell.

The commonest fault in street lighting is lack of light. The average street in town or city is illuminated only in spots owing to unduly wide spacing of the lamps whether arc or incandescent, and at the point midway between lamps blackness reigns supreme. The strong light near the lamps is not at all without value since the protection afforded against night prowlers depends quite as much on the illumination of dooryards and alleys as upon that on the sidewalk, but save in rare instances the minimum illumination is far too low. It frequently falls to less than .01 foot-candle, whereas, to afford the equivalent of even dim moonlight, it should be at least twice this figure.

The cause of this insufficiency is not far to seek. It proceeds primarily from frugality, not to say parsimony, on the part of the authorities—a quality sometimes stimulated by the fact that no one has any acute pecuniary interest in good lighting save the lighting company, whose enthusiasm is not regarded as altogether altruistic. In matters of paving or grading or sewerage, which furnish opportunities for thrifty wardsmen, there is far greater alacrity in promoting civic improvements.

Secondarily, in the early days of electric lighting the prices charged were undoubtedly high, so high as to put illumination into the category of luxuries. As time has gone on prices have been materially reduced, but even now if one considers merely the care of the lamps and the energy required, street lighting looks like a pretty profitable proposition. The thing which the public forgets is that as lamps are usually spaced the distribution costs of street lighting are exceptionally high. One gets up to 30 or 40 miles of circuit in surprisingly small places, and this circuit is more difficult to maintain than any other class of distribution. If street lamps were spaced closely enough to give proper illumination upon the streets the cost of distribution per lamp would be enough reduced to justify a decrease of price.

In spite of this difficulty, the tendency of lighting prices is downwards and some lighting companies now deliberately pursue the policy of doing public lighting on a rather modest margin of profit. Nevertheless, it is rare to find street lamps spaced near enough to give really good illumination, and the tendency in improvement is to use more powerful lamps at the old spacing. Right here is where some of the new illuminants are going to prove extremely useful in virtue of giving considerably more light for the same money.

There is in fact a good deal of humbug about "subdivision" and "distribution" of street lamps. That they should be so distributed that the minimum illumination should be at the very least double the usual figure admits of little doubt, but how far it pays to make this gain at the expense of the average illumination is another question.

A street lighted on the basis of the minimum value alone would generally be very badly lighted. A minimum of .01 foot-candle, for instance, could be met by common candles spaced 20 ft. or so apart along the curb, but the result would be easier to imagine than adequately to describe. The protective value of lighting depends on brilliancy over as much of the street as possible and a specification of minimum intensity neglects this very important matter. An occasional old street illuminated dimly by single gas flames is a case in point. There is good reason, therefore, in bringing up the minimum by increasing the power of the radiants, although it would often be wise to decrease the spacing as well. To secure a proper minimum of say not less than .03 foot-candle on a street, requires more than double the amount of light generally used at present, coupled with closer spacing.

Fortunately the greatly increased efficiency of some of the recent illuminants enables the necessary increase to be gained by a rather moderate increase of cost. They beat the old arcs and incandescents almost as the Welsbach beats the open gas flame. It must not be supposed, however, that the gain is without its penalties. Could the Welsbach be kept up to its laboratory standard on the street, it would be a very formidable competitor, but experience shows that, necessarily open to access of air, it soon accumulates dirt and deteriorates so that its average condition is bad.

In similar fashion, some of the new arcs have idiosyncracies that so far have tended to delay their introduction. The flaming yellow arc, for example, requires frequent trimming, with rather expensive electrodes. Its distribution of light is rather downward than outward, so that it fails to throw its strongest rays out along the street. Nevertheless, it is tremendously effective in lighting large open spaces when hung rather high, and with increasing use the cost of supplies will come within reasonable bounds, so that it, or some near derivative of it, is bound to be a valuable adjunct where great brilliancy is desired. Anyone who has seen it pour its flood of light deep down into the excavation for a new building turns away with a profound respect for its prowess. There is no adequate reason for the present high cost of the special carbons, and when this is properly reduced the cost of trimming will cease to be the bug-a-boo that it is at present. After all the labor cost of trimming even the old open arcs was a comparatively small item, and when one is dealing with an arc that gives nearly five candle-power per watt, one can afford to trim frequently.

The so-called luminous arc, whether of the magnetite or titanium variety, presents a different set of conditions. Its distribution being outward instead of downward, it is especially well fitted for street work. There will be, however, in its use a rather strong temptation to rely too much upon its capacity for raising the minimum illumination between lamps, at the expense and to the detriment of the average illumination. The best results would be obtainable by spacing these new and efficient lamps with reference to preserving a high average and letting the minimum take care of itself. The result would be a minimum high enough to really be of some use for the first time in the history of American street lighting. These luminous arcs are not without some inherent troubles of their own, not yet fully taken care of. They produce a smudge of oxides difficult to keep out of mischief, and to bring this within practicable limits it has so far been necessary to work with very small currents in the arc. An arc system with, say, three amperes as its standard current is naturally hypersensitive to grounds, and the arc lacks the stability of one carrying the usual current of the systems now in use. The control of these difficulties is the crucial point in the commercial use of these otherwise very promising arcs, and the reports thus far are rather encouraging. The gain in energy consumption is very considerable and should be in part applied to increase in the number or power of lamps in order to secure the better lighting, which is sadly needed.

A still more promising innovation is the application of the tungsten filament to series incandescent lamps for street service. With a specific consumption of little over a watt per candle-power, the series tungsten lamps give more than double the effective candle-power of carbon-filament lamps taking the same energy. Something of this gain must be set over against the increased cost of lamps, but the net result should be a very considerable increase in both minimum and average illumination on the streets, the distribution of the new lamp being practically the same as that of the old. It certainly would not be desirable to use fewer lamps on account of their increased candle-power.

The relative value of arc and incandescent lamps for street lighting is a moot question. The smaller units obviously give the more even lighting, but generally a much lower average illumination than the arcs, and as already intimated the value of brilliancy, especially in the more densely populated parts of a city, has been of late too much overlooked. In comparatively open country, where the lamps are really markers along the road, and in densely shaded streets where arcs if hung low enough to be of much use shine directly into the eyes, there is much to be said for the incandescent lamp.

With respect to the tungsten lamp, it should be noted that its useful life is much longer than that of the carbon lamp. It occasionally blackens early in its career, but, on the whole, its candle-power stays well up to its initial value till near the end of its life, which seems to be at least double that of a carbon lamp, unless the latter is burned until long past usefulness. A street lighted with tungsten lamps will certainly show not only much higher illumination for the same energy, but considerably greater freedom from dim lamps than if carbon lamps were used.

At present tungsten lamps must be burned with the tip down and the axis very nearly vertical, which is, however, no material objection. Series incandescent lamps do not give a large end-on candle-power, and light the street quite as well with axis vertical as when inclined. In the latter position the zone of maximum light is in great measure wasted by being turned up into the tree tops instead of being in a plane nearly parallel to the surface of the street. The amount of light wasted on the sky in ordinary street lighting is very striking when one gets the distant view of a city at night.

Evidently the next few years are going to make a considerable change for the better in street lighting. The thing which the writer desires particularly to impress is the need of applying the gains in efficiency to increase of both the average and the minimum illumination, and not in the interest of petty economy to throw away the chance for better lighting. However desirable it might be to return to the simple life and going to bed at nightfall, the fact is that cities are steadily growing more nearly nocturnal in habits and must, therefore, require increasing brilliancy of illumination. It is fortunate that recent improvements enable it readily to be supplied.

New Telephone Patents.

ANTISEPTIC DEVICE.

It is probably safe to say that there have been developed hundreds of ideas for antiseptic devices for telephone instruments. Most of these, of course, are for application to the transmitter. However, there are also a considerable number for use with the receiver. Probably the most prolific type is that in which a sheet of paper adapted for ready renewal is stretched across the instrument opening. Others provide a holder for an absorbent which may be saturated with antiseptic solution, and still a third class embraces a reservoir for the antiseptic itself. In this last class is the device just patented by C. J. Printz, of Milwaukee. A double-walled annulus is formed up of sheet metal, exposed edges being at the aperture. In doubling over the metal to form the periphery of the annulus, the metal walls are so shaped that at the outer edge they are some distance apart, while at the hole they are close together leaving merely a slit between them. This receptacle is clamped between the shoulder of the mouthpiece and the transmitter face. Small holes are drilled in the mouthpiece to register with the slit, and also in the transmitter case, to provide for circulation. A mouth and stopper provide a means of introducing the antiseptic solution.

TRANSMITTERS.

In Fig. 1 is shown a sectional view of a double-acting transmitter. The casing affords a channel for the sound waves to the main diaphragm, which is located within the instrument. The second diaphragm is heavier and closes the mouth of the cup. The inventor is H. W. Haff, of New York City, and he has assigned his patent to the General Accoustic Company.

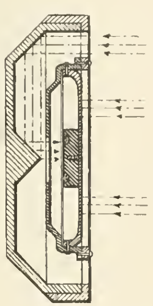

FIG. 1.—HAFF TRANSMITTER.

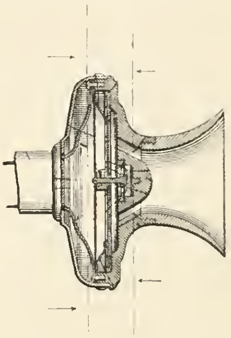

FIG. 2.—HANSEN TRANSMITTER.

Rather a novelty in the transmitter line is the instrument shown in section in Fig. 2, this the invention of R. Hansen, of Chicago. It will be seen that the front plate is thickened, so that its middle part forms a receptacle for the microphone button. This latter is similar in design to that of the "solid back" transmitter. The figure indicates most clearly the arrangement.

Transmitters have been so long universally of the microphone type, *i. e.*, of that type where a difference of pressure at the contact point of two solids effects a resistance change, that one scarcely looks for the adaptation of any other principle. However, E. E. Ries, of New York City, has just received a patent for a liquid transmitter. His is not like the old Gray arrangement, wherein the vibrating diaphragm varied the depth to which one electrode dipped into the liquid, but the inventor varies the area of contact of the liquid with the electrodes.

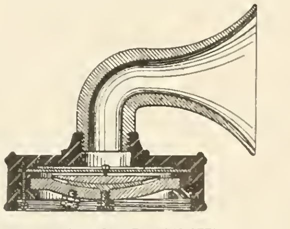

FIG. 3.—RIES TRANSMITTER.

Fig. 3 will serve to show the arrangement. As the electrodes approach, capillary attraction will cause a great increase in the area of contact of the liquid, if there be a reservoir connected to supply liquid. Of course, there is a diminution of the thickness of the film, but by properly shaping the electrodes this can be made small compared to the increase of area of contact.

LETTERS TO THE EDITORS.

Turbine Tests.

To the Editors of Electrical World:

Sirs:—I have seen a letter of Mr. J. R. Bibbins in your issue of Dec. 14 and other correspondence in your columns concerning tests of a 7500-kw Parsons turbine at the Waterside Station of the New York Edison Company compared with reported performances of one of the 8000-kw Curtis turbines in Chicago. In reducing the reported results to the same conditions, Mr. Bibbins applies certain corrections in the case of the Curtis machine which he says are advocated by its builders. The correction thus arrived at is not correct, and I desire to put this comparison in correct form on the basis of existing published data.

In the case of the Curtis machine tested in Chicago, it is necessary to make no assumption concerning correction factors. This machine was tested daily for nearly a month by Prof. L. P. Breckenridge, of the University of Illinois, and Prof. Storm Bull, of the University of Wisconsin. During this time all conditions of load, initial pressure, vacuum, and superheat were thoroughly investigated and curves were drawn from which results for almost any condition can be taken without appreciable correction.

The accompanying curve sheets give load water rate curves of this 8000-kw machine taken from the curves in the report and in comparison show, first, the results of the New York Edison test reduced to similar conditions; and, second, the results of the test of a similar Parsons machine, made in the Manhattan Station of the Interborough Rapid Transit Company, and published in the *Electric Journal* for July, 1907.

The report of the New York Edison test in question was published in the Electrical World of Oct. 12, 1907, and in this report, rates of correction were given for variations of vacuum, initial pressure, and superheat. These rates I have used in making the comparisons shown by the accompanying curves.

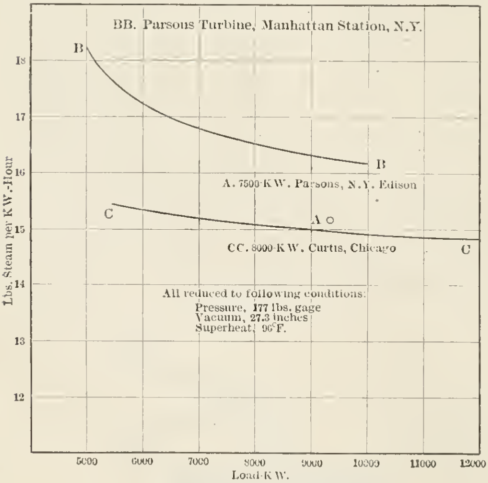

FIG. 1.—COMPARISON OF TURBINE TESTS.

Point A.—Test of N. Y. Edison Parsons turbine, as taken from *Electrical World*, Oct. 12, 1907.
Curve BB.—Derived from tests published in *Electric Journal* of July, 1907; results reduced to conditions of N. Y. Edison tests by constants published in connection with that test in *Electrical World*, Oct. 12, 1907.
Curve CC.—Taken from test curves made by Prof. Storm Bull and Prof. L. P. Breckenridge in February, 1907.

Fig. 1 shows the actual result reported in the New York test of the 7500-kw Parsons turbine, and above it the result of the test of the Parsons turbine in the Manhattan Station reduced to the same conditions by the constants mentioned above: and in comparison is shown the performance of the Curtis turbine in Chicago, under the same conditions, taken from the test reports without appreciable correction.

Fig. 2 shows the same performances of the Parsons turbines reduced by the constants above mentioned to conditions which fairly represent the average of daily service under which the Chicago machine operates. In this case also the performance of the Curtis machine is taken from actual test reports without the necessity of appreciable correction.

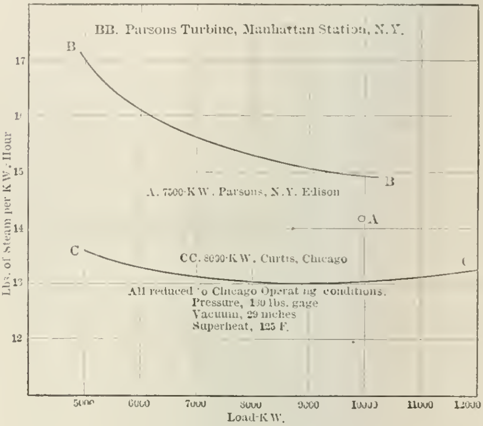

FIG. 2.—COMPARISON OF TURBINE TESTS.

Point A.—Result of N. Y. Edison test corrected to regular operating conditions of Chicago turbines by constants given in the test report, *Electrical World*, Oct. 12, 1907.
Curve BB.—Test of Parsons turbine in Manhattan station of the Interborough Rapid Transit Company, New York, published in the *Electric Journal* of July, 1907; results corrected to Chicago operating conditions by the same constants as point A.
Curve CC.—Taken from test curves made by Prof. Storm Bull and Prof. L. P. Breckenridge in February, 1907.

This latter comparison illustrates very clearly the superiority of the Curtis turbine under conditions of high vacuum, and shows also the large gains which good vacuum affords in a machine designed to use it.

There is good reason to believe that these comparisons do more than justice to the Parsons machines, first, because the corrections made give credit for considerable improvements on account of increase of initial pressure, though such improvement cannot be appreciable in a machine which governs by virtual throttling; and, second, because the rate of improvement for vacuum, while probably correct for a range between 27 ins. and 28 ins., is presumably too large for correction to 29 ins.

The reason for the large difference in the performances of these two Parsons machines has not been explained, and it has been generally understood that the turbine parts of the two machines are practically identical. It would seem probable that one of the tests is incorrect, or else the New York Edison test was run with a closer adjustment of leakage clearance around balancing rings.

In the end of his letter, Mr. Bibbins deprecates the cultivation of extreme operating conditions in turbine plants, and in this presumably refers to the use of high vacuum. Increased vacuum affords very great increase of available energy, and with a turbine which does not leak air, involves in most cases little additional expense. Since a properly designed Curtis turbine affords high efficiency to extreme vacuum ranges, it is folly to use low vacuum where high vacuum can be produced. In many large plants where Curtis turbines are used, a vacuum of 29 ins. or over is carried almost throughout the year. In the Chicago plant, where the above-mentioned tests were made, the vacuum generally exceeds 29 ins., and sometimes reaches

29½ ins. The auxiliaries in this station involve a loss of 0.7 per cent.

The greatest advantage of the turbine over the reciprocating engine lies in the fact that it is efficient in the lower ranges. In reciprocating engines we gain only about 20 per cent by condensing, as compared with non-condensing conditions, while in a properly designed turbine we gain 100 per cent. It is certainly not good engineering to throw away these advantages by binding ourselves to vacuum conditions which have prevailed in reciprocating engine practice, where increase of vacuum affords no important improvement.

SCHENECTADY, N. Y. W. L. R. EMMET.

The Rolling of Thunder.

To the Editors of Electrical World:

SIRS:—I have read with interest Mr. Carpenter's article on "The Rolling of Thunder" in your issue of Dec. 21. I note also your editorial comments upon the same.

In your editorial you refer to reverberations reflected from earth and sky, while Mr. Carpenter may fairly be presumed to have included the same idea in his closing sentence. It seems to the writer that these phenomena are as prolific in producing the rolling of thunder as any others, but this fact should not distract the attention from the possibilities exposed in the valuable article referred to. With these remarks in mind the following account of a sun shower on the shores of Lake Minnetonka, about three years ago, is ventured:

There was a small rain-cloud overhead, from which a shower was being precipitated intermittently. There was considerable blue sky, with several other rain-clouds in various directions, one of which was near by, over the lake. From the cloud overhead there came several sharp flashes at intervals of 20 or 30 seconds. In each case, clearly distinguished, there was a report as of an explosion originating in the cloud overhead, closely followed by an apparent echo, but very much larger in volume, from the large cloud over the lake.

It was undoubtedly a case of reflection, made more apparent by the explosive phenomena unusually localized in the cloud overhead. It is difficult to account for the larger volume of the echo, though it may have been due to a focusing effect resulting from the shape of the reflecting cloud.

UNIVERSITY OF MINNESOTA. B. F. GROAT.

The Patent Office Gazette.

To the Editors of Electrical World:

SIRS:—The letter of Mr. H. C. Ford in your issue of Dec. 28, while containing much valuable discussion of the action of the Commissioner of Patents in cutting down the number of claims printed in the official *Gazette* to five, contains also some error.

The *Patent Office Gazette* is not the only official, general publication of the patents issued, nor is it a publication at all, but is really only an index. Only one figure of the drawings is reproduced, and while all the claims have heretofore been published, and only five are hereafter to be published, the claims cannot be understood without the complete specification. Nobody would rely upon the claims standing alone either for validity or scope. The real official publication is the patent itself; 150 copies of the complete specification and drawings are issued gratuitously and distributed to every state capitol and to the clerk's office of every federal district court, and extra copies are printed for sale.

The multitudinous claims often foolishly demanded by applicants, a practice unfavorably commented on by the courts, but for which the Patent Office has its share of responsibility in rejecting functional claims, have made the *Gazette* very bulky and the expense of publication unduly large, $160,000 a year; whereas the change inaugurated by the Commissioner of Patents saves $60,000, reduces the size, and leaves the *Gazette* reasonably reliable, as a mere finger-post and index. Probably the method adopted is better than a mere abridgement or digest, and sufficiently indicates the character of the invention to those interested, who must after all order the full copies of the patents in which they are specially concerned.

However, there are further changes that would be wise and especially beneficial to inventors. The cost of all copies might be reduced to one cent, the present cost for patents when the whole series is ordered. Furthermore, under section 4903, when any claim is rejected, the commissioner is required to notify the applicant, giving him briefly the reasons for such rejection, together with such information and references as may be useful in judging of the propriety of renewing his application or of altering his specification; under this provision there is also ample authority for sending copies of all the references gratuitously to the applicant, enclosed with the official rejection. This would result in an enormous saving of time to applicants, would entail no further clerical work in the Patent Office, and would tend to get the enormous piles of published matter accumulating in the Patent Office out into the world, where it would do the most good. Indeed, inventors and investigators ought in some way to be provided with a complete classified set of all printed patents located in half a dozen of the great cities of the United States, say, Boston, New York, Pittsburg, Chicago, San Francisco, Atlanta and New Orleans, and this might be accomplised by co-operation between the Patent Office and the public libraries in those cities.

NEW YORK, N. Y. JOHN S. SEYMOUR.

To the Editors of Electrical World:

SIRS:—Mr. Ford's letter in your issue of Dec. 28 raises an interesting and important question. I agree with Mr. Ford that the curtailment of the weekly disclosure in the *Patent Office Gazette* as to the subject matter of the weekly issue of patents is ill-advised. Indeed, I think it is a step in the wrong direction.

A patent for invention is a contract between the inventor and the public, whereby in consideration of a full and clear disclosure of the invention the inventor secures a monopoly of use for a limited term of years. The advantage to the public lies solely in the disclosure of the invention and the publicity that is given to it. Any step tending to diminish the publicity given to patented inventions is a step in the wrong direction, for it diminishes the consideration passing to the public.

Again, the public is entitled to know not only the ingenious and useful things that it may employ after the patents for them have expired, but also the things that it must not use until the patents for them do expire. The law conclusively presumes that every individual in the country knows what patents issue every Tuesday in Washington, and what those patents are for, and what the claims of those patents are—not merely the first five claims, but the entire 55, if there be so many. The law does not accept ignorance as an excuse for infringement. The burden would, therefore, in all fairness seem to be upon the administrators of the law to give the utmost publicity possible to the patents that are issued and to the claims of those patents, one and all. To publish only a part of those claims, if they happen to exceed five in number, seems to me to be a step in the wrong direction.

The *Official Gazette* of the United States Patent Office has from its commencement, so far as I am at present informed, published each week all of the claims in full of all of the patents of the weekly issue. To discontinue this practice and instead publish an arbitrary limited number only of the claims, selected without reference to their subject matter or importance, but simply by the accident of their numerical arrangement in the patent, seems like a step backward.

The *Official Gazette* formerly published in connection with the claims a brief explanatory abstract of the invention. This was long ago discontinued. To resume it would be a step in the right direction. The *Official Gazette* to-day publishes inadequate drawings of the inventions, too few in number to disclose the invention and too much reduced in size frequently to be legible. The publication of legible drawings would be a step in the right direction.

The immense increase during recent years in the number and complexity of the patents that are issued weekly, as compared with earlier years, does not diminish the advantage of publicity, nor does it diminish the duty of publication, but rather the reverse.

And in this same connection it is proper, perhaps, for me to add that the admirable digests of British patents that are regularly prepared by the officials of the British Patent Office and regularly published by that office are such a permanent aid in the direction of publicity and accessibility that it seems to me the officials of our Patent Office would do better to turn their attention and their efforts in the direction of adding such publications instead of curtailing the meagre publications now made.

And one more suggestion. It is, of course, possible for anyone to get a copy of a patent from the Patent Office who knows that he wants it and will take the trouble to order it and pay the price. But the difficulties and delays of late years, in getting such copies after the order has been given and the price tendered or paid, have been so great as to discourage investigation and defeat the ends of publicity and exhaust the patience of all save those who must and will have the copies. These delays have apparently been caused by the discontinuance of the early and time-honored practice of the Patent Office of immediately reprinting old patents as soon as the supply on hand was exhausted, and by waiting instead until orders were received, and later until in many cases urgent reasons were given for the copies. This amounts to cheating the public out of the disclosures of things ingenious and useful which the public have bought and paid for by the 17-year monopolies granted by the government, and which disclosures should be given by the government the broadest and the widest possible publication. Those who seek copies of patents, the printed copies of which have been exhausted, should be treated not as enemies of the public purse, but as owners coming in to their own. I am glad to say that the present commissioner has taken steps in the right direction in this matter and improvement is already noted and greater and gradual improvement is promised. Surely it should never be the case, as has been my experience within a few months, that a defendant sued for infringement of a patent is unable for upwards of six weeks to obtain a single printed copy of the patent in suit in order to see what the thing is that he is charged with infringing and in order to make his answer to the bill of complaint.

Those charged at Washington with the duty of administering the finances of the Patent Office and making annual report as to same, naturally desire to reduce expenses and to make as good a showing as possible; but ambitious economy may lose sight of the purpose of the whole patent system and the reason for being of the whole department, which is, not that the department shall be a money-maker for the government, nor yet that the department shall be self-supporting, but that inventors shall be encouraged to invent and to disclose their inventions, and that the public shall have the utmost possible benefit of those disclosures; and publicity, periodical and systematic, and complete and cheap, and the utmost accessibility and the promptest availability of the stored treasures and records of the department are the channels and the means of advantage to the public and the only channels and the only means of advantage.

I, therefore, agree with Mr. Ford that no possible motives of economy in regard to the printer's bill requires or justifies the curtailment in the weekly publication of the claims of issued patents, and I would advocate steps in the direction of fuller publicity and greater accessibility of records in the directions pointed out and in other directions.

I take the opportunity afforded to write thus emphatically because I think a sound public opinion should be created on the subject. There should be no curtailment of the printing and publication divisions of the Patent Office, nor in the high standards sought in the technical examining staff of the office.

New York, N. Y. Wm. Houston Kenyon.

To the Editors of Electrical World:

Sirs:—It is morally indefensible to reduce the *Patent Office Gazette* to the mere index referred to by Mr. Ford in his recent letter printed in your columns. Subscribers who have paid in advance for all the claims of all patents should receive them, of course; it smacks of bad faith to cut off part of the consideration without their consent. The fault, however, lies with the Congress, and the commissioner should not be blamed for what he cannot help; it would perhaps be better to suspend the issue until he has sufficient funds to publish correctly, but that he must decide.

No arbitrary number of claims can be useful, any more than any arbitrary number of claims can sufficiently protect an invention. The opportunity to deceive by putting trivial claims first would not be availed of by any good lawyer, and the others do not get cases big enough to make it matter. No sane patent lawyer or expert attaches any importance to the showing in the *Gazette;* for obvious reasons he must see the whole disclosures in the letters patent themselves. What is done, therefore, interests them less than the manufacturer and inventor.

It must not be forgotten that not a dollar of the public funds goes to the support of the Patent Office, which for many years has more than paid its way. Several millions of dollars (about seven, I think) are in the patent fund, and several more would be there if the various departments quartered in the Patent Office (the building was paid for with inventors' fees) paid a fair rent. Morally, if not legally, what the inventors want the *Gazette* to be, it should be, since they, and not the public, pay the bills.

New York, N. Y. T. J. Johnston.

To the Editors of Electrical World:

Sirs:—Regarding the letter of Mr. Ford relating to the *Official Gazette* of the United States Patent Office, this publication has been increasing in bulk with successive years. It was first published in 1872, two volumes per year; in 1883 it had so increased that four volumes per year became necessary; in 1902 four volumes became too bulky to bind properly or handle conveniently and six volumes were found necessary. This latter increase was due to trade-mark registration, a record of which was made part of the *Gazette* about this time.

The issue of Tuesday, Nov. 19, 1907, appeared with the usual reproduction of one figure of an issued patent, and five claims only, not six, as Mr. Ford states. This has resulted in a welcome decrease in bulk and gives a satisfactory amount of information as to the subject matter of the patent. No complete and accurate knowledge of a patent can be had without a complete copy for examination. The expense of maintaining a complete set of bound volumes of the *Gazette* is not a burden; it is $5 per year subscription, and $2 per volume for binding, say $17 per year; but the shelf space required is more burdensome; this is to-day approximately 100 sq. ft. of wall space, and the rental value of office space is a considerable item. It is like the horse or the motor car—the first cost is not prohibitive.

So far as I am concerned I am very well satisfied with the new arrangement.

New York City. W. B. Vansize.

To the Editors of Electrical World:

Sirs:—The criticisms of Mr. Ford, printed in your issue of Dec. 28, in regard to the recent action of the Patent Office in curtailing the number of claims printed in the *Official Gazette*, are not without considerable force. There is no doubt that the *Gazette* will be less useful to subscribers than before. We think, however, that the Patent Office is perhaps warranted in making this change, for the one reason that the *Gazette* has been growing so rapidly in size that the volumes have become unwieldy and occupy too much valuable space in our libraries.

In the issue of the *Official Gazette of* Nov. 19, 1907, attention was called to this change by the following notice:

"Beginning with this date and number of the *Official Gazette*, all patents having five claims or less are printed in full. Where patents have more than five claims each, only five claims are printed and the number of claims omitted is indicated in each case. This plan will be followed in each succeeding number of the *Gazette*. All the specifications and claims will be printed in the patents and library edition in large type."

At the beginning of the publication of the *Official Gazette*, in 1872, it was customary to print not only the claims and one or more figures of the drawing of each patent, but also a "Brief" of the specification, the object being to give as much information as possible. This practice continued less than 10 years, however, presumably because the number of issued patents had considerably increased and the size of the bound volumes was becoming unduly large. In 1872 the average number of patents issued per week was about 230; in 1906 the average number issued per week was about 800. In 1872 the *Official Gazette* was published yearly in two small volumes; in 1906 it was, and is at the present time, published yearly in six large volumes. It will be seen, therefore, that unless some measure is taken to condense or decrease the matter published in connection with each patent, the number of volumes per year, or their size, will reach impracticable proportions. The *Official Gazette* was never intended to be a complete disclosure of the contents of the patents noted in it, but was designed rather to give a general idea of the subject matter, so that any one might, from the data given, order from the Patent Office a complete copy or copies of such patents as he was particularly interested in. The recent change is within the discretion of the Commissioner of Patents.

NEW YORK. ROSENBAUM & STOCKBRIDGE.

To the Editors of Electrical World:

SIRS:—In reference to the practice recently adopted by the Patent Office of printing in the *Gazette* only the first five claims of current patents instead of all the claims, as heretofore, I consider the change most unfortunate. The only possible justification I can conceive for the departure is to economize in the make-up and printing of the *Official Gazette*, but if so, it is most deplorable that the inventors of this country should be subjected to the evil effects which must inevitably result, when it is remembered that the Patent Office is one of the few money-making bureaus of our government. During its existence the Patent Office has turned over to the Treasury a good many millions of dollars in excess of its expenses, and this money has come from the pockets of our inventors. The policy of the government toward inventors should be to encourage them in every possible way by which their interests may be advanced, and not to interpose difficulties and pitfalls in their paths. Of course, inventors and attorneys living in Washington, or those who have access to the bound volumes of complete patents, will not be seriously prejudiced; but most of the inventors and attorneys are not so fortunately situated and must depend to a large extent on the disclosures of inventions found in the *Official Gazette*.

With the complete claims in the *Gazette*, it is possible in most instances to obtain a fairly accurate idea of what a patent may cover, but with only a portion of the claims printed one must necessarily be entirely in the dark. In fact, it would be just as well not to print the claims at all, because to print only the first five claims will give no indication whatever of what the others may be, and undoubtedly the temptation will be very hard to resist in the future to introduce the broad claims after the specific claims of the patent, so as thereby to withhold as much of a disclosure from the public as possible. The change means that in the case of every patent containing more than five claims which an inventor or attorney may have to consider, a complete copy must be ordered from the Patent Office, involving delays of from a few days to two weeks for the transmission of the mails alone. Furthermore, it very frequently happens when orders for copies of patents are given that the entire edition is found to be exhausted and to reproduce the copies means a further delay of three weeks or more. A person interested in concealing from the public the true scope of his patent could by promptly exhausting each edition as printed, and at an expense of only a few dollars, keep from the public practically all knowledge of the scope of the patent. It is not difficult to see that such a state of affairs might result in intolerable annoyance and oppression. Unless, therefore, some very good reason exists why the change should be continued, I think that every effort should be made by inventors of this country to have the old practice restored.

ORANGE, N. J. FRANK L. DYER.

To the Editors of Electrical World:

SIRS:—I have read with interest the letter on this subject in your paper, signed by W. C. Ford. I do not find this name in the last "Roster of Registered Attorneys," therefore, am led to the conclusion that this gentleman is not a patent attorney and therefore not qualified to speak as such.

The fact that all the claims of patents are not now published in the *Official Gazette* is not concealing them from the general public, because printed copies of all patents are obtainable, and these copies are also bound in volumes and some libraries contain these bound volumes complete, the same being accessible to the general public. In what sense Mr. Ford considers the claims of a patent "a part of the Federal Law" I am at a loss to comprehend; their grant or issue is not an act of Congress, or in any respect part of its proceedings, and even while they are a "prima facie" evidence of novelty, they are not a guarantee thereof, for the Patent Office (like everything of human origin) is not infallible.

The *Official Gazette* is printed under the eye of the Patent Office, independent of other government printing, and is paid for by the fees inventors pay into the office with their applications and is no part of the Congressional expenses. The Patent Office officials are alone responsible for printing the *Official Gazette* with only five of the claims of patents published, and the responsibility rests very lightly, for this action is one of the best in the line of progress the office has made; it is no disadvantage and can work no hardship for the following reasons:

1. These first five claims are usually the broadest or most generic of all the claims granted, and disclose the basic structure.

2. The remaining claims—when there are any—are specific and for details or sub-combinations, and are of secondary importance alongside the generic claims.

3. The complete drawings of patents never have been published in the *Official Gazette* or the previous Patent Office reports; consequently a copy of the patent was always needed for a full disclosure of the drawings.

4. Claims cannot well be read without a full disclosure of the drawings.

5. The disclosures by drawings and claims are now on the same level, with the advantage of less weight to handle and less space on the shelves of cases, and reduced cost for publication, thus leaving the Patent Office funds to be spent for more important uses, and as a stroke of business policy increasing the sale of copies of patents and consequent revenue, as well as disseminating an accurate knowledge of the patents granted.

The British Patent Office, like our own, has always printed for sale copies of British patents and these can be found in bound volumes in the Astor Library and possibly other large libraries; but the *Journal* of the British Patent Office only gives a figure of the drawings and a mere digest or summary of the invention, so that this publication is of less value than our *Gazette* with the six claims.

My own experience, extending over a period of more than 30 years, goes to show that any inventor or client who is interested in any particular patent for any reason, is sufficiently interested *to obtain a copy thereof* for a full disclosure and knowledge of the contents, for in no other manner—except through the bound volumes of copies—can a full, accurate knowledge be obtained, and in a matter of importance any knowledge short of a full knowledge is inadequate and misleading. This would obtain even if the claims of patents were published complete in the *Official Gazette*.

It is the concensus of opinion among all with whom I have talked on this subject, and also of those whose opinions have been quoted in my hearing, that this action of the Patent Office is not "ill advised economy," but advantageous to an extent outweighing any possible disadvantages.

The statement of Mr. Ford in his article that attorneys will no doubt arrange the first five claims of their cases so that when published they will practically disclose nothing of the invention, suggests a departure from the usual practice, which I believe disadvantageous, and further, suggests an excuse for a form of deception. This form of claim would also be impossible of realization because the Patent Office would not pass such claims to issue and a claim not a disclosure of an invention would in a suit for infringement be declared invalid by any competent court.

New York. Harold Serrell.

To the Editors of Electrical World:

Sirs:—In the matter brought up by Mr. Ford, concerning the abridgment of the claims in the *Gazette* to a maximum of six, for each patent, I repeat below the substance of my remarks to another association which called for my views.

The Commissioner of Patents is so accustomed to reading and understanding claims himself, that no doubt he considers they are easily understood by inventors, too. I have found, however, that prominent engineers, professors and manufacturers have not been able even to grasp the meaning of claims which I have prepared for the applications for patents *on their own inventions!* Claims are technical briefs, to be sure, but they are couched in such legal form that only a patent attorney can appreciate their true meaning. For certain reasons, also, from a literary point of view, claims are not intelligible for the purpose of understanding an invention. In order to know what an invention is, we must not only know its constitution, but its operation, advantages and uses. Now, a claim sets forth only the structure, and therefore one cannot understand the nature of the conception underlying the invention until he is versed in the operation, advantages and uses of the invention.

I believe, therefore, that the *Gazette* is at fault in containing any claims at all. Instead thereof, each invention should be set forth by a brief description of the leading ideas, which would take less space in the *Gazette*, and would be useful in letting inventors know the nature of the various inventions.

For five dollars per year (the subscription price), inventors could then have before them, 52 huge pamphlets, forming a valuable library of intelligible matter; whereas now, they have a mass of legal definitions of inventions that are from their very nature, impossible of understanding.

In some other countries, digests instead of claims are inserted in the official organ.

New York. Edward P. Thompson.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Constant-Current Machine.—E. Rosenberg.—Fig. 1 shows his constant direct-current machine (See Electrical World, Nov. 10, 1906, page 918). It has two sets of brushes *BB* and *bb*, the latter being short-circuited. The fundamental idea is that "if the resistance of the external circuit is not too large the current in it assumes approximately such a value that the armature flux produced by it ('tertiary' flux) becomes opposite and equal to the original flux ('primary' flux). For this reason the current produced by the machine is almost constant and independent of the external resistance and of the speed." It gives constant e. m. f. when the external resistance remains constant. This machine may be changed so as to suit those cases in which part of the external resistance varies while another part remains constant and where constant voltage is desired with variable speed. This is, for instance, the case in connection with the Ilgner (Ward-Leonard) system of electric winding in mines. If in connection with the three-phase motor, flywheel, direct-current generator set, an ordinary direct-current machine coupled with the flywheel would be used for excitation of the direct-current generator and winding motor, the variations in speed would offer distinct disadvantages. The author uses as exciter the machine which is shown in Fig. 2. In this case only the excitation of the winding motor is constant, while the excitation of the direct-current generator varies continually between zero and the maximum value. The machine is provided with a shunt and with a main winding. "The shunt winding *f* is separately excited and is so designed that the armature can give off useful current equal to the constant portion of the load (in the case chosen the excitation of the winding motor). The main winding *F* is in series with the regulating resistance *R* and the excitation *II* of the direct-current generator. Only that portion of the armature current which is variable passes through this circuit, and the winding *F* is so designed that its m. m. f. just compensates the tertiary flux produced by this part of the current." Practical experiments have shown that this compensation can be obtained with great exactness. The current in the circuit *II* could be varied between zero and three times the constant current in the circuit *I* without any considerable change of the voltage at the brushes *BB* or of the current in the circuit *I*. It is unnecessary to excite the shunt winding *f* separately since the arrangement of Fig. 3 has given satisfactory results. An iron resistor *w* is inserted to keep the exciting current in the winding *f* constant. Applications of these methods to train lighting are described.—*Elek. Zeit.*, Dec. 19.

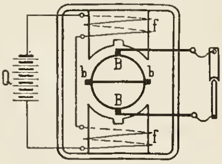

FIG. 1.—DIAGRAM OF MACHINE CIRCUITS.

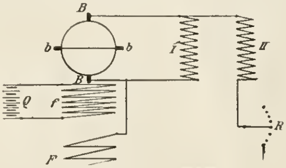

FIG. 2.—DIAGRAM OF EXCITER CONNECTIONS.

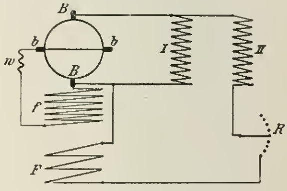

FIG. 3.—DIAGRAM OF CONNECTIONS.

Induction Motors.—R. Goldschmidt.—A continuation of his long illustrated and mathematical paper on the leakage of induction motors. The different classes of leakage are dealt with separately. Curves are given for the leakage with different slot dimensions and also tables showing the effect of the coil ends with different classes of windings. The calculation of the leakage factor with polyphase and single-phase motors and the influence on it of different forms of windings is shown, and an example is given showing how to use the curves, formulas and tables.—Lond. *Electrician,* Dec. 20.

Single-Phase Motors.—A long serial describing the action and properties of the different types of single-phase motors which have been proposed or built in the past, with diagrams of the different machines.—*Dingler's Polytech. Jour.*, Oct. 12, 19, 26, Nov. 2, 9, 16, 23, 30, Dec. 7, 14, 21.

Lamps and Lighting.

Metallic-Filament Lamps and Incandescent Gas Lamps.—Voss and Zinck.—Two papers read before the German Society of Gas Engineers. Voss gives a review of the various metallic-filament lamps, describing the osmium, tantalum, zirconium and tungsten lamps. The zirconium lamp is made both for 110 and 220 volts. It consumes from 1 to 1.2 watts per hefner candle and has an average life of 200 hours. The price is 4 marks (about $1.00) for the 110-volt lamp and 6 marks for the 220-volt lamp. The lamp is made for 110 volts with an output of 35, 56 and 80 hefner candles and for 220 volts for 70 hefner candles. The lamp must be used in a vertical position. For the tungsten lamp the specific consumption is given as one watt per hefner candle and the useful life as 1000 hours. While only 110-volt lamps are sold at present, the manufacture of the 220-volt osram lamp is practical. The price of the tungsten lamp is from 3 to 3.50 marks for lamps of from 25 to 50 hefner candles, and 5 marks for lamps of 100 hefner candles. It is expected that the specific consumption may be reduced to one-half watt per hefner candle. Zinck, while agreeing that these lamps represent a great progress, claims that their operation is more expensive than that of gas lamps, namely, from 2½ to 4½ times as much. He thinks that the inverted gas incandescent lamp will be the gas lamp of the near future.—*Jour. f. Gasbel.*, Nov. 9.

Flame Arc Lamps.—A. Blondel.—A translation in abstract of his French paper, which has already been noticed in the Digest, on recent progress in flame arc lamps. The difference between the incandescence and luminosity phenomena are pointed out and diagrams are given showing the distribution of illumination from different flame arc lamps without and with globes. The paper concludes with a table giving the comparative costs of various kinds of lighting, for which purpose the price of gas is taken as being four cents per cubic meter (or $1.14 per 1000 cubic feet) and of electricity 14 cents per kw-hour.

	Candle-power		Hourly consumption	Price per hour, cents	Heat expended calories per hour	Cost in cents per 100 mean sph'l c.p. hours
	Horizontal	Mean sph'l				
Incandescent gas.....	575	400	620 litres	2.48	3,200	0.62
Ordinary c.c. arc....	...	1,200	600 kw-hr.	8.40	380	0.70
Ordinary a.c. arc....	...	600	600 kw-hr.	8.40	380	1.4
C.c. flame arc.......	...	1,200	200 kw-hr.	2.80	130	0.234
A.c. flame arc.......	...	1,200	300 kw-hr.	4.20	200	0.35

—Lond. *Electrician,* Dec. 20.

Illuminating Engineer.—L. Gastner.—A paper read before the (British) Association of Engineers in Charge, on the province of the illuminating engineer. "Until the last few years the question of proper illumination had not received adequate recognition at the hands of either the gas or the electrical engineers. Their business has been to supply energy but not illumination, and the consumer has been left to make the best use he could of the illuminant provided." Some practical illumination questions are discussed; among them the advisability of instruments measuring quickly and directly illumination with an accuracy sufficient for ordinary practice.—Lond. *Electrician,* Dec. 13.—In an editorial on the subject, the belief is expressed that there is no need for a special illuminating engineer and that "existing engineers—the consulting engineer, the station engineer and whoever is concerned with such matters as part of his usual work—should take the trouble to inform themselves on these questions without producing a new class of engineers." Concerning the proposed formation of an illuminating engineering society in England it is thought that matters of illuminating engineering should be taken up rather by existing societies like the Institution of Electrical Engineers, instead of forming a new society. It is also thought to be inadvisable to launch a new publication devoted to illuminating engineering.—Lond. *Electrician,* Dec. 20.

Power.

Energy Transmission in France.—The Prefet de la Seine has appointed a commission to study from a scientific, business and financial standpoint the problem of transmitting electrical energy generated from the falls of the Rhone River to Paris. The commission consists of 15 members, Mr. Maurice Levy being the chairman. M. LeBlanc is also a member of the commission.—*L'Ind. Elec.*, Dec. 10.

Energy Transmission in France.—H. Armagnat.—Continuation of the illustrated description of the net work of electric stations along the coast of the Mediterranean Sea. The methods of maintaining constant voltage by means of Thury or Tyrill regulators and by means of transformers with an adjustable number of secondary turns are described, as is also the equipment of the chief transformer station.—*L'Industrie Elec.*, Dec. 10.

Pulverized Coal.—W. D. Ennis.—An article in which the author discusses the characteristics and preparation of pulverized coal, illustrating and describing the leading types of grinding and conveying devices applicable to its economic use as a boiler fuel. He also discusses methods of firing and construction of the furnace with details of cost of installation and operation. He thinks that the commercial value of pulverized coal is not limited to its use in the boiler furnace, but that it is destined to have a wide-spread application in metallurgical industries where its cheapness will enable it to replace oil and gas for the firing of certain classes of industrial furnaces with no loss of convenience or rapidity of operation.—*Eng'ing Mag.*, Dec. and Jan.

Electric Energy for Rolling Mills.—An article giving details of the first 12 installations of electric reversing mills in Europe. These installations have been made during the last one and a half years. Of these, seven are already in operation, while the other five are in course of erection.—*Stahl und Eisen,* Dec. 18.

Boiler Regulations.—A new set of boiler regulations has been issued in France by the Minister of Public Works. A review of the new points is given.—*L'Industrie Elec.*, Dec. 10.

Traction.

Fifteen Hundred-Volt Direct-Current Railway.—S. Herzog.—An illustrated description of the Misoxer Valley Railroad opened in 1907 and running from Bellinzona to Messocco, the total length being about 19 miles. The line has many grades, some being 2.9, 3.5, 4.1, 4.8 per cent, while the maximum grade at one place is 6 per cent. There are many viaducts, bridges and tunnels. The generating station is near Messocco, producing both 1500-volt direct current, which is supplied directly to the trolley wire, and partly 10,000-volt, three-phase currents which are used for energy transmission to a sub-station at the other end of the line for conversion into direct current. Each car is equipped with four 66-hp motors at 750 volts. Two motors are connected in series. The electric control system is the same as on the German road from Cologne to Bonn.—*Elek. u. Masch.*, Dec. 8.

Third Rail.—A. D. Williams, Jr.—An article in which the author discusses the physical difficulties arising in installation and maintenance of the third rail on main line railroads. A table of details of the location of third rail on various roads is given. The author concludes that the third rail, either over or under contact, leaves much to be desired in regard to its assistance in the introduction of electric traction, except on those lines handling special dwarf equipment.—*Eng'ing Mag.*, January.

Railway Signaling.—An illustrated description of the Bounevialle system of electric signaling in use on an experimental section of a British railway. The signal equipment consists of three parts, that on the line on the base of each signal, that in the signal box and that on the engine. A battery, one pole of which is earthed, is connected through a two-way switch and a lamp in the signal box to one of two conductors placed between the running rails. Shoes, fitted on the locomotive, make contact with these conductors, and the position of the signal is by these means indicated in the cab. The equipment is described in detail with illustrations.—Lond. *Electrician*, Dec. 20.

Electric Automobiles.—W. A. Th. Mueller.—The first parts of a long review of recent progress in the construction of electric automobiles. The author deals with the arrangement of the motors, the arrangement of the battery and discusses the question whether the front or the back axle should be used as driving axle. He then deals with the single and two-motor systems, connections and regulation, and the general construction of the automobile, and gives some illustrated examples of recent designs.—*Elek. Zeit.*, Dec. 12, 19.

Installations, Systems and Appliances.

Monocyclic System.—F. Niethammer.—The monocyclic system has been used on some stations, but has been abandoned on account of its disadvantages. Various of these monocyclic stations have disconnected the teaser altogether so as to operate their network by single-phase current. As long as the load consists essentially of motors the monocyclic system behaves similarly to the three-phase system. But when the chief phase is strongly loaded with lamps the system becomes unbalanced. Tables are given showing the poor behavior of a three-phase motor on a monocyclic system.—*Elek. und Masch.*, Dec. 8.

Wires, Wiring and Conduits.

Drawing-In Cable.—W. Plesance.—Some practical notes on drawing cables into pipes or ducts. Some think a serving of jute for lead-covered cables is a good protection, but the author thinks it is rather liable to cause damage since the jute has a tendency to make the cable bind. It is advisable to order the cable in lengths so that all lengths of one size and class of cable to be pulled in at one box shall be rolled together on one or more drums, each drum being stenciled with the lengths it contains and the number of the box for which they are intended. As to the question from which end the cable should be drawn in, the author remarks that, other things being equal, it is always better to pull down a slope than in the opposite direction, and in pulling through a length of pipe which has a sharp bend at one end, such as occurs in a deep dip in a crossing or an awkward bend around a box, the pull should be arranged so that the cable does not enter the bend until towards the end of the pulling. The passage of the ropes through the pipes preliminary to the actual pulling will show whether water is present or not. Manila rope has the advantage over steel rope that it often sucks up any small quantity of water standing in any depression within the run and can be much more safely and easily handled than a wire rope. Whenever possible the cables should be pulled through with their ends hermetically sealed with a lead cap, but as this necessitates the cable being gripped by its lead sheath, the method has its drawbacks, since if rope is used this projects and is liable to catch in the pipe, whereas if wire is used there is considerable risk of cutting into the lead and damaging the insulation. This risk also exists with a rope grip, but in a less degree. A patent device, consisting of a wire mesh, the open end of which is slipped over the cable while the other end is provided with an eye to which the rope is attached, has been successful. This device has been especially satisfactory for telephone cables where the lead is not supported by a solid core. Where cables of any size are dealt with it is safer to pull in not by the sheath, but by the core. The strands of the cable are opened and passed through the eye of the swivel attached to the pulling rope, one-half of the strands used being passed through the aperture in one direction and the other half of the strands in the opposite direction; these are bound back upon themselves. To make the eye in the cable and its attached copper strands waterproof, a hot composition of a cheap variety is poured over the whole of the portion of the cable which is being bared, or else the cable is wrapped from the lead up to the swivel with white tape and then covered with a layer of composition. A refinement is to pour composition inside the junction of the cable with the rope before the taping-up is entirely finished. The cable should be pulled off the drum by one man whose duty it is to prevent any slack forming. If the box is large enough a man should be placed in it to grease the cable and see that it enters fairly into the duct without catching on the top of the pipe. With heavy or stiff cables special cable guides are advisable. When light cables or short lengths are being pulled, operation by hand is considerably quicker than the use of a winch. But the winch has the advantage over hard pulling for busy thoroughfares where a long line of men would take up space and hinder the foot-traffic. When the cable is drawn through, the end must be carefully examined to see whether it shows any sign of damage and, further, whether there is any danger of water having penetrated to the insulation. When the cable has been tested and found in good condition, the ends should be sealed and this should be done with as little bend as possible.—Lond. *Electrical Review*, Nov. 29.

Alternating Current Transmission in Cables.—C. V. Drysdale.—The first parts of a long article, fully illustrated by diagrams, in which the author points out the importance of the study of the transmission of alternating currents in cables instead of single impulses. A graphical method of finding the distribution of current and potential difference in a cable is described, with applications to special cases.—Lond. *Electrician*, Dec. 6, 13 and 20.—A communication by A. J. Albridge criticizing the article in the issue of Dec. 6, and a reply by the author in Lond. *Electrician*, Dec. 13.

Electrophysics and Magnetism.

Radioactivity of Lead.—J. C. McLennan.—The conductivity of air enclosed in lead cylinders has been shown to vary widely with the samples of lead selected. The lowest conductivity observed in air enclosed by this metal corresponded to the production in the air of 23 ions per c.c. per second, and the highest to the production of 160 ions per c.c. per second. These wide variations show that the high activity of lead which has been observed generally is due to the presence of active impurities in varying amounts in the lead, and not to a high intrinsic radiation from the metal. Calculations made on the observations show that the differences in the conductivities of air confined in vessels of different metals, including lead, when free from active impurities, arise from and are due to differeneces in the secondary radiations from these metals. Experiments made with the gamma rays from radium showed that, of the ionizations produced by these rays in air enclosed in lead receivers, two-thirds was due to the excited secondary rays and one-third to the gamma radiation itself. With aluminum cylinders, on the other hand, the measurements show that approximately two-thirds of the ionization was due to the gamma rays, and one-third to the secondary rays excited by this radiation in the metal. Calculations based on observations on the conductivity of air confined in different receivers lead to the conclusion that approximately 9 ions per c.c. per second are generated in free air by the penetrating radiation from the earth.—*Phil. Mag.*, Dec.

Measuring Ionization.—S. J. Allen.—A description of a method of measuring ionization, particularly that caused by radioactive substances. In this method the sensitive quadrant electrometer is used as an indicating and not as a measuring instrument. The ionization which it is desired to measure is balanced against that due to a standard, previously accurately calibrated, and the electrometer serves simply as a means of telling when this balance has been obtained.—*Phil. Mag.*, Dec.

Dielectric Losses.—W. Hahnemann and L. Adelmann.—An illustrated translation in abstract of their German paper on dielectric losses in condensers with solid dielectrics and on an experimental method for determining the damping decrement due to these losses in high-frequency circuits.—Lond. *Electrician*, Dec. 13.

Force Oscillations.—A. Stephenson.—A mathematical note on the stability of the steady state of forced oscillation.—*Phil. Mag.*, December.

Electrochemistry and Batteries.

Resistance Heating.—An illustrated article on the use of kryptol (a powdered mass of a resistance material mixed with silicates, carborundum, etc.) as a resistor in electric furnaces. Various forms of apparatus are described.—*L'Industrie Elec.*, Dec. 10.

Units, Measurements and Instruments.

Measuring Dielectric Strength.—S. M. Hills and T. Gorman.—In order to carry out some tests on insulation for use on armature coils under conditions resembling those of actual practice the authors have devised a new method which they think is preferable to the usual method of testing a dielectric between two parallel plates. In their method a sample of the dielectric is tested in a laminated iron slot, the arrangement of the apparatus being shown in Fig. 4. A slot 8½ ins. long was built up from ordinary soft-iron armature laminations; the dielectric to be tested was wrapped round a brass conductor and placed in the slot. The disruptive stress was applied by connecting one terminal of the source of supply to the brass conductor and the other terminal to the laminated iron walls of the slot. Conductors of various sizes were used in order to test various thicknesses of dielectric, the size of the conductor being larger or smaller than the first conductor used, in direct proportion to the thickness of the dielectric, thus securing the same pressure on the dielectric. Before being tested all the samples were dried at a temperature of 70 deg. C. for a period of four hours, then stored in a box containing calcium chloride, and used as required. The figure of 60 deg. C. for the running temperature of a dynamo was taken, and all samples were tested in an atmosphere maintained at that temperature. In order to overcome the disadvantage of using several conductors of various sizes, the authors employ a conductor as shown at the top of Fig. 4, which essentially consists of two brass strips kept apart by two cylindrical springs. Since electricity readily discharges from points, and since in the laminated slot there are several points or ridges, it was expected that this method would give a lower break-down voltage than the parallel plate method. This was, indeed, the case, and for Japanese rice paper the breakdown voltage per mill was found to be almost one-third the value obtained by the parallel plate method. The difference is not so great in the tests of parchment paper treated with linseed oil, for which the results are given in Fig. 5. It is important to use a method of gradually raising the voltage without jerks, but fairly rapidly. This is done by the method shown in Fig. 6, a long-range transformer being so placed that the secondary is in the supply circuit and the primary forms a circuit of its own through a rheostat of carbon or water. This provides the regulation, another transformer being employed in the usual manner for increasing the voltage. In this method of regulation the transformer resolves itself into a choking coil, and as the actual regulation is done in a separate circuit, the increase of voltage must be gradual. The transformer used should be a "leaky" one, and should also be capable of withstanding a short-circuit on the secondary. In order to avoid a rush of current on switching on, a rheostat is introduced into the main circuit.—Lond. *Electrical Eng'ing*, Nov. 28.

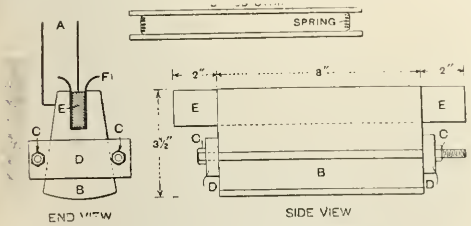

FIG. 4.—MEASURING DIELECTRIC STRENGTHS.

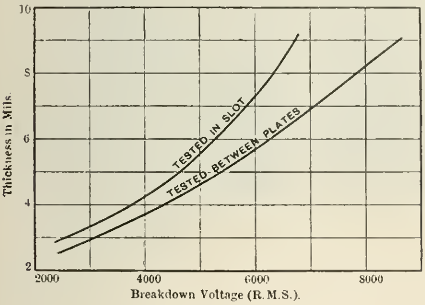

FIG. 5.—BREAKDOWN TESTS.

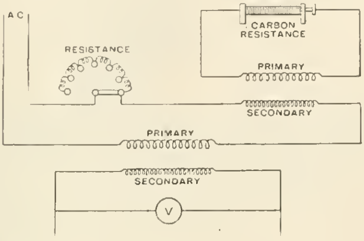

FIG. 6.—DIAGRAM OF METHOD OF VOLTAGE CONTROL.

Measurement of Iron Losses.—J. Sahulka.—An illustrated translation in abstract of his German article recently noticed in the Digest on a rapid method of determining the relation connecting the core-loss per cycle with the frequency.—Lond. *Electrician*, Dec. 13.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—An illustrated description of the wireless telegraph station of the Amalgamated Radio Telegraph Company at Cullercoats, which is the only British station in which the De Forest spark method and the Poulsen arc method are operated side by side. The Poulsen apparatus requires very much less space, which is partly due to the fact that the public supply is by continuous current. The two systems use the same antenna. The transmitting circuit for the arc method is shown in Fig. 7, the oscillating circuit being in shunt with the arc. It comprises an inductance coil of many turns of stout copper and a battery of oil condensers. The spaces between the plates which are sheets of zinc are only about 3 mm. The capacity is arranged in two sections so that though a point of the induction coil is connected to earth the two outers of the public supply remain insulated. A condenser of variable capacity (not shown in the illustration) is kept in parallel with a fixed condenser to enable changes to be made in the emitted wave length, which is usually between 1200 and 1500 meters.

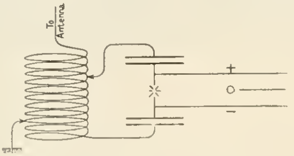

FIG. 7.—TRANSMITTING CIRCUIT.

The coupling of the antenna is "direct and loose." The hot-wire ammeter inserted permanently in the leads to the antenna gives a visible record of the oscillatory current delivered to the antenna. The receiving apparatus is connected to the antenna in place of the sending apparatus by simply turning over a switch. The receiving circuit is shown in Fig. 8. The coupling to the antenna is "electromagnetic and very loose."

This looseness of coupling is possible because with long trains of waves the effects of resonance can be made very marked, and is moreover very advantageous because the resonance curve of a circuit is the sharper and purer the slighter its ties to other circuits. Tuning is effected by the use of a condenser of variable capacity in the resonance circuit. For perceiving the oscillations use is made of the "ticker," which is an electromagnetic trembler in which a very light rapidly moving hammer closes and opens a branch circuit containing a condenser of larger capacity than that in the resonant circuit. The result of the closing of the contact is that a great deal of the energy accumulated in the oscillation circuit passes into the condenser in the branch circuit, and on the opening of the contact the condenser discharges through the telephone. The contact points are made of crossed gold wires. Both the spark and the arc apparatus have approximately the same power, namely, 5 kilowatts. Since there are no insulation difficulties in the arc apparatus it is more compact. The dispatch of a spark message is acclaimed by a string of deafening reports, while the dispatch of an arc message is absolutely silent. As regards the receiving apparatus there are no great visible contrasts between the two methods. The principal feature of the Poulsen apparatus is the sharpness of tuning between the stations and ships of the Scandinavian American Line. Comparative tests of the arc and spark methods have been carried out over ranges of about 900 miles. One of the most interesting points arising out of these tests is the fact that the undamped waves are less obstructed by mountainous country than are the damped waves from a spark transmitter of the same wave-length.—Lond. *Electrician*, Dec. 20.

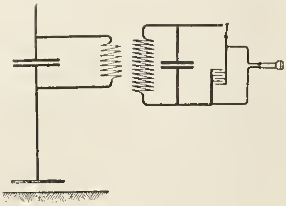

FIG. 8.—RECEIVING CIRCUIT.

Wireless Telegraphy.—W. Duddell.—An address comparing the principal differences between the spark method of producing damped oscillations and the arc method of producing continuous oscillations and their applications in radio-telegraphy. The arc method seems eminently suitable for very high speeds of working.—*Science*, Dec. 13.

BOOK REVIEWS.

Die Montage Elektrischer Licht-und Kraftanlagen. By H. Pohl. Hanover: Dr. Max Janecke. 167 pages; 230 illustrations. Price, 2.40 marks.

The subject of the installation of electric light and power plants becomes every day of greater practical importance. The author has sought to give the elements of this subject in this little volume, an exposition adapted to the needs of constructing engineers. The book is well and copiously illustrated. It contains brief directions for the setting up of dynamos, storage batteries, switchboards, mains, cables, lamps, motors and other apparatus. The book will be useful to students of electric installations as indicative of recent German practice.

Correction: In the caption of a review in our issue for Jan. 4, which read as follows:

The Standard Handbook for Electrical Engineers. New York: McGraw Publishing Company. 1300 pages; 1300 Company. 300 pages. Price, $2.50.

the last line was evidently incorrect. This line should have read,

illustrations. Price, $4.00 net.

As will be noted from our issue just referred to the incorrect line is a duplicate of the last line of a caption for the review of another book on the same page, the line of type having become misplaced in arranging the forms for the press.

Single-Phase Motors in Textile Industry.

The polyphase induction motor has long held an enviable position in the operation of all classes of machinery on account of its excellent starting characteristics and its ability to give constant and reliable service with a minimum of attention and repairs. The single-phase motor, on the other hand, has not been so fortunate in gaining the attention of either the manufacturers or the central station men on account of its poor starting characteristics, and for years the manufacturers of single-phase motors have centered their efforts on the production of a motor having all the desirable features of the polyphase machine.

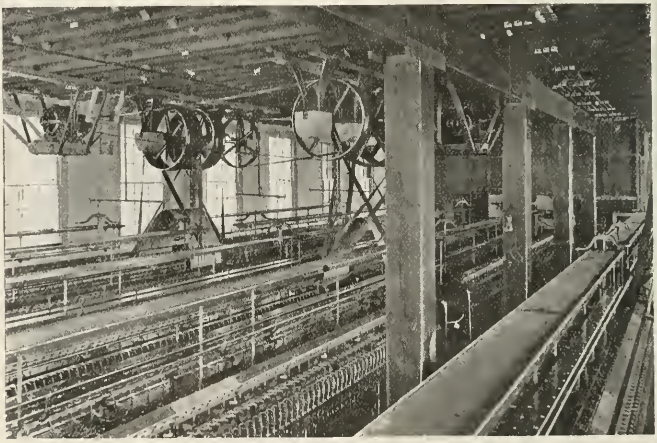

FIG. 1.—SPINNING FRAMES DRIVEN BY SINGLE-PHASE MOTORS.

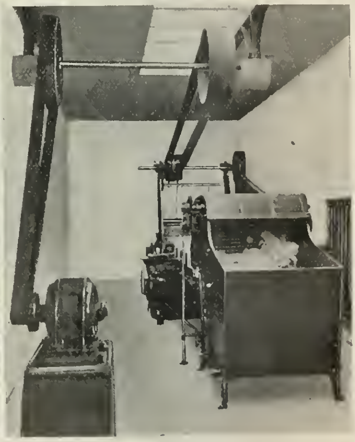

FIG. 2.—MOTOR-DRIVEN PICKER.

An interesting example of the application of the single-phase motor to the operation of textile machinery, and one that is worthy of notice, is found in the factory of the Ayvad Manufacturing Company, of Hoboken, N. J. The product of this company is the "water-wings," a device used by bathers and beginners in swimming to assist in floating the body. The style of drive used throughout is what is commonly known as the "group," in which a number of machines are driven by a motor from countershafts. The electrical installation consists of nine single-phase induction motors, of a total rating of 75½ horsepower. The type of motor used is the three-phase induction machine developed by the General Electric Company for operation on single-phase circuits.

The conditions influencing the final decision in favor of the single-phase motors were that the factory was located in a part of the city supplied with single-phase energy for lighting and that the motors used must operate without affecting the lamps on the same circuit; also that all sparking of motors must be entirely eliminated. This last condition is one peculiar to textile mills, for in the early stages of cloth manufacture the cotton is in a highly inflammable condition and the least spark might start a disastrous fire. A thorough investigation of the single-phase motor finally selected satisfied the manufacturers that all conditions were met in the design of the motor, all commutators and brushes being eliminated.

Until this year, the practice of the Ayvad Manufacturing Company was to buy the cloth used in the manufacture of its produce from textile mills, its factory converting the fabric into the finished product. Since it was impossible to inspect properly every yard of the cloth for flaws, there often resulted a product of inferior quality. Delays in shipment and in transportation further added to the difficulties of manufacture. To avoid all delays and to insure a good, uniform quality of cloth a complete textile equipment, from picker to loom, was installed. The textile equipment now enables the company to operate the factory during the entire year, where heretofore only six months' operation was sufficient to supply the demand. Any excess of cloth produced forms a profitable side line. The factory will furnish employment for about 60 persons.

The entire plant is well equipped, roomy, and modern in every respect. It affords an excellent example of the methods by which single-phase motors may be advantageously applied to the operation of textile mills, and it also brings forward to central-station managers the possibilities existing in territories reached by single-phase distribution lines.

Storage Battery Auto-Truck for Industrial Railways.

The Westinghouse Machine Company is putting on the market storage-battery auto-trucks with a carrying capacity of 10 to 40 tons, after having practically tested this type of truck in its own shops for several years. A 40-ton truck complete is illustrated in Fig. 1, and a 10-ton truck, with the deck removed, is shown in Fig. 2.

The steel frame of these trucks is substantially braced, and the journals run in roller bearings. As in street railway practice, the driving axles carry the motors, which are spring-suspended from the frame at one end, and connected to the driving axle by suitable reduction gearing. A spring-suspended cradle of angle iron carries the battery trays. At the operating end of the truck are mounted the controller, brake, charging receptacle, cut-out switch and volt-ammeter. A convenient step and draw-bar head are provided at each end.

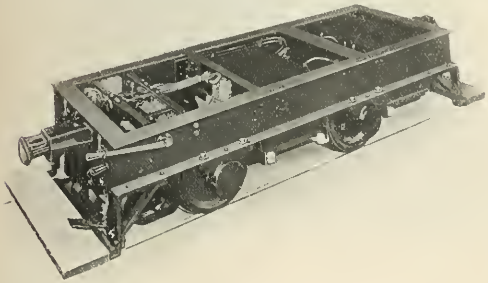

FIG. 1.—TEN-TON TRUCK, DECK REMOVED.

All the machinery is below the top of the frame and is covered by a heavy wooden deck, on which the load is carried. This deck is made in sections, so that any part of the mechanism is readily accessible. The motors are of the Westinghouse vehicle type, capable of withstanding heavy overloads. The controller is also of the Westinghouse vehicle type, giving four speeds in either direction. It is provided with operating and reverse levers, which are interlocking to prevent premature reversal, thus protecting the motors and the batteries.

The battery is contained in two or more trays of cells, and is especially designed to operate at high rates of charge and discharge. The batteries can easily be charged during periods when the truck is not in use.

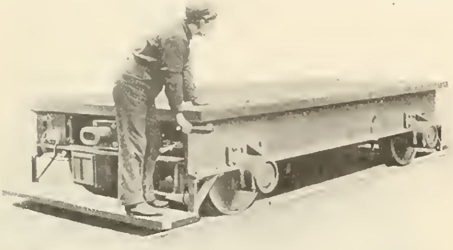

FIG. 2.—40-TON TRUCK.

During a six months' test of the standard 10-ton truck, the energy required to charge the battery in regular and heavy shop service was accurately metered, and averaged 63 kw-hours per month. At 5 cents per kw-hour, the cost of energy would thus be only $3.15. The work done was recorded and averaged practically 700 ton-miles per month, the loads running from a few hundred pounds to 15 tons.

It is stated that these trucks used as locomotives on a level track and without any weight to secure adhesion can haul, on suitable cars, from one-half to their full rated carrying capacity as a truck, depending upon the condition of the track and kind of bearings on the cars hauled. By placing sufficient weight over the drivers to secure adhesion, they are capable of handling from one to two times their own capacity as a truck for a continuous period of not more than five minutes.

On account of the facility with which these trucks can be handled, delays in the transit of material are avoided, and since the trucks furnish their own energy, the number of laborers required for the moving of material is greatly reduced.

The Brush Lighting System of Galveston, Tex.

The Brush Electric Light & Power Company, of Galveston, Tex., which has been completely remodeling its plant and practically doubling the output, in response to urgent demands from customers for increased service, has recently installed two Allis-Chalmers steam turbines and generators of 1500-kw normal rating, with liberal overload capacity, and converted four of the smaller existing dynamos into motor generator sets of 400-kw output, mounting them two by two on common bedplates with Allis-Chalmers induction motors of 300 horsepower each. To the steam producing plant, consisting of 1200 horse-power in Heine boilers, has been added sufficient capacity in Erie and Stirling water tube boilers, operating under a pressure of 150 lbs., to provide for the increase in the electric generating system.

The first of the new units to be installed was a 500-kw machine to deliver two-phase, 60-cycle current with a pressure of 2300 volts, running at 3600 r. p. m., and, soon after this had been placed in operation, it was followed by a unit of 1000-kw rating, at 1800 r. p. m., with the same service characteristics.

Both turbines operate condensing, water for this purpose being taken from Galveston Bay and lifted by an induction-motor-driven centrifugal pump to two Tomlinson condensers. with discharge directly to the city sewer system—the condensed steam, which is entirely free from oil or other impurities, going, of course, directly to the feed-water heaters. All of this auxiliary apparatus, as well as exciters, switchboards, etc., was also supplied by the builders of the new turbo-generator units.

The ordering of the turbines was hastened by an accident to the power house which occurred during a heavy electrical storm some months ago, at which time lightning entered the station, despite the usual protective apparatus, and resulted in the breaking of a large driving belt connecting the flywheel of one of the principal engines to its generator. As a consequence, the engine ran away and completely wrecked itself.

Inverted Arc Lamps for Press Rooms.

In press rooms, especially where presses are employed on color work, it is essential for the proper matching of colors that lamps giving a light enabling the printer to do this with certainty be installed. During the day it is an easy matter to match colors by the light of the sun; but not all presses cease working at sundown, and many run all night. Two colors extensively used which cause the printer most trouble are yellow and blue. Neither of these can be seen by any of the ordinary sources of artificial light, such as the gas lamp with mantle, the incandescent electric lamp, etc., and the usual practice is to match the color in day time and fill the ink fountains with sufficient ink of the desired tint to complete the run. This, however, is very unsatisfactory, since the printer cannot tell whether the rollers are feeding and also cannot look "into the color" printed on the paper in order to determine the proper quantity of ink to use. It is also difficult to retain good printers for night work without proper light, as they claim color work tends to make them blind. For these reasons color work is usually done during the day. In the color printing plant of the Curtis Publishing Company, of Philadelphia, inverted arc lamps with upper reflectors are used; the upper reflector serving to concentrate the light on the printed sheets on the jogger or board. Fig. 1 is a view of the press room, and shows the arrangement of the lamps very well. The lamp serves three very useful purposes. The source of light is entirely screened so that there is no light of high candle-power in the line of vision to distress the eye and make it less sensitive to the light reflected from the objects which it is desired to work on. There is also no shadow caused by the reflected light, and the latter is of such a quality that it lends itself to the accurate matching of colors. The mechanism of the lamp is shown in Fig. 2. The positive carbon is fed from below, while the negative carbon is stationary above it. The central tube carrying the lower or positive carbon is screwed into upper and lower castings, which form the base plates of the upper and the lower end of the lamp. The upper casting also has a bearing carrying a chain wheel, one end of the chain being attached to the positive carbon; the other end being fastened to a counterweight sliding in a tube. The frame also carries the bearings for the rocker, one end of which is attached to the armature and the other end carries the clutch. The latter is made to engage the chain. The series resistor is connected in the usual way. The negative carbon holder is bolted to the top of the upper casting and completes the circuit for the upper carbons. A long upper frame is provided so that the lamp may be hung a proper distance from the ceiling. The binding posts are on the upper end of this long frame, where they are convenient to the outlets from the ceiling. The lamp is designed for 110-volt direct-current circuits and may be operated two in series on 220-volt circuits. A reflector is provided which just covers the inner globe and which throws the light received from the negative carbon to the ceiling or ceiling reflector, it being understood that where the ceiling is unobstructed and otherwise offers a suitable reflecting surface, the lamp may be used without the upper reflector. The lamp, which is made by the C. J. Toerring Company, of Philadelphia, Pa., is particularly adapted for the illumination of drafting rooms, textile mills, press rooms, and all places where the elimination of sharp light contrasts is an important factor or where true color values are to be maintained.

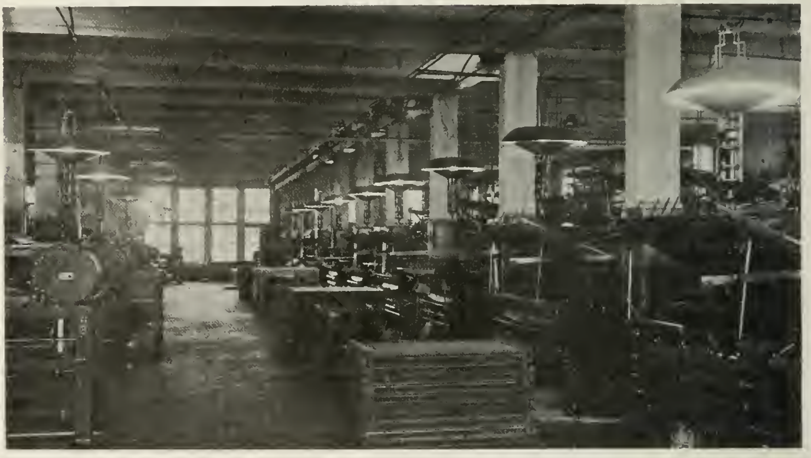

FIG. 1.—COLOR WORK PRESS ROOM OF THE CURTIS PUBLISHING COMPANY.

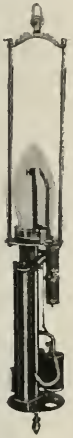

FIG. 2.—LAMP.

Mammoth Motor-Driven Planer.

The acompanying illustrations show a motor-driven planer recently installed in the plant of the McIntosh-Hemphill Company, Pittsburg, which is probably the largest and heaviest metal-working planer ever built. The total weight of the machine is 845,000 lbs. Four direct-current motors, having a total rating of 207.5 horse-power, are required to operate the tool.

The machine is, in general effect, an extremly large planer, but, in addition to the mechanisms found on a standard machine, there are many new ones. Each head is fitted with a slotter bar independently driven by a rack, giving a cutting speed that is practically constant from one end of the stroke to the other, and providing a quick return stroke. Through motor and change gears, the cutting and return speeds can be altered as desired. Each head is arranged for transverse planing. The mechanisms for slotting and transverse planing make it necessary to throw out the regular driving mechanism to the table and connect it to a separate feed device, which, in this case, is entirely distinct from the regular feed gears. The throwing out of the driving mechanism, however, means simply that the pneumatic driving clutches are thrown into and left in their idle position. The machine is fitted with its own air compressor and motor, thus making it independent of the air supply pipes in the shop, to which, however, it can be connected if it seems desirable.

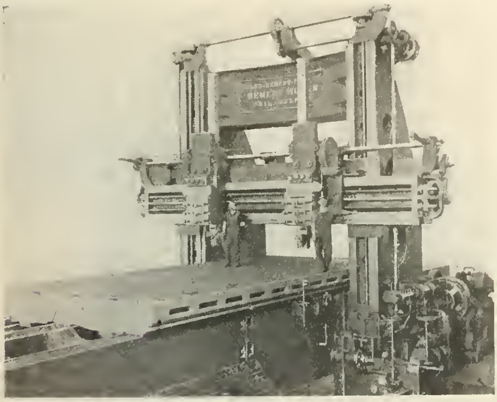
FIG. 1.—GENERAL VIEW OF PLANER.

A complete switchboard is installed for the control of the motors. The main driving motor is rated at 100 horse-power; the motor for lifting the cross-slide is a 20-hp machine; the motor for driving the traversing mechanism on the cross-slide is rated at 7.5 horse-power, while a 30-hp motor drives the air compressor.

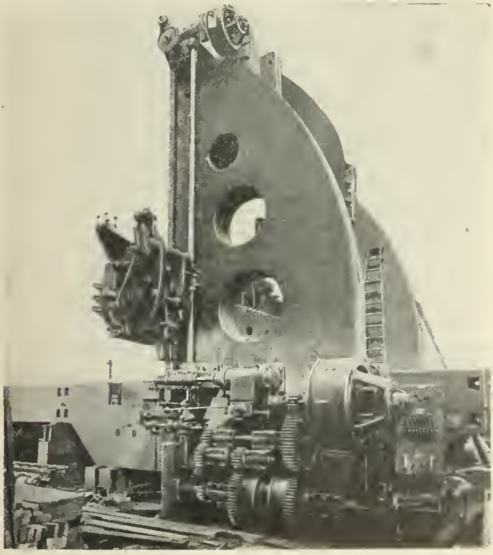
FIG. 2.—DRIVING GEAR OF PLANER.

The main driving mechanism is shown in Figs. 1 and 2, the gearing being connected to the pneumatic reversing clutches at the base of the upright. The speed of the clutches can be varied to some extent by changing the speed of the motor, and a great variation can be obtained by the simple reversal of two change gears. The pneumatic clutches, which are shown thoroughly encased, are provided with a large number of friction discs, whereby great friction area is obtained in a comparatively small compass. These clutches, as their name implies, are operated by compressed air. A small valve, easily moved by hand, controls the stopping, starting and reversal of the table. The handling of this large motor-driven planer, it is almost unnecessary to state, would be quite impracticable if a belt-drive was employed. The remaining devices, in practically every respect, are similar to those found on any planer, except, of course, in this instance they are exceptionally heavy and powerful. It is noteworthy, however, that the feeding devices are operated by compressed air, so that the machinist is not called upon for extra physical exertion.

The above-described planer was built at the Bemont-Niles (Philadelphia) Works of the Niles-Bemont-Pond Company.

Marine Annunciators.

The prime requisite for annunciators in marine service is ability to withstand dampness and moisture. In the annunciator illustrated herewith the coils are treated with a moisture-proof compound and baked so as to prevent any short-circuiting from disintegration of the insulation. Non-corrosive metals are used, so as to prevent all possiblity of rust forming at the pivot points and interfering with the instantaneous operation of the drop. The drop resetting rod passes through a rawhide gasket secured to the inside of the frame. The cover, which is hinged to the backboard, is fitted with a rubber gasket so that when closed the ingress of moisture is prevented. As an additional precaution against dampness, paraffin is run around the edge of the glass where it meets the frame.

MARINE ANNUNCIATOR.

The above equipments are built by the Holtzer-Cabot Electric Company, Brookline, Mass.

A Large Coal Dock with Remote-Controlled Induction Motors.

The Berwind Fuel Company, at Superior, Wis., has a large coal-handling plant for unloading coal from vessels and loading it onto railroad cars or storing it, which is of electrical interest from being entirely equipped with alternating-current motors operated with master controllers and alternating-current contactors. This plant has a movable bridge with three bridge tramways, each equipped with a three-ton clamshell bucket having an extreme horizontal travel along the bridge of 474 ft. These clamshells are used for taking coal out of the vessels and depositing it either on the storage pile on the dock or in car-loading pockets, and for picking up coal off the dock and depositing it in loading pockets. For the hoisting of the clamshell, one 225-hp variable-speed General Electric induction motor is used. This is supplied with energy from a three-phase, 25-cycle, 440-volt circuit. This motor is of the reversible type, but in ordinary operation it is not reversed, as the weight of the clam is sufficient for lowering. For the horizontal movement of the bucket along the tramway, a 75-hp variable-speed induction motor is used. This is also of the reversible type. The motors are controlled by a master controller on the general plan of the master controller used in electric railway practice. The control circuits, however, are alternating current, and so operate alternating-current contactors. The tramway was designed to make an average of 60 trips per hour, or one trip per minute, thus handling 180 tons of coal. It actually has a record of 100 trips an hour, handling 300 tons of coal. In addition to the bridge tramways, the dock is equipped with two box-car loaders, each having a 75-hp variable-speed reversible induction motor for operating the loader. There are also two locomotive cranes and two movable pockets and screening towers. The entire bridge can be moved along the dock at a speed of 50 ft. per minute by means of 75-hp induction motors on the axles of the track wheels on the front and rear towers. Energy is supplied by the Great Northern Power Company, of Duluth. The sub-station, or transformer house, is located at the dock, which receives three-phase, 25-cycle current at 13,200 volts, and by means of three 500-kw transformers this voltage is reduced to 440 for use by the dock motors.

Commutator Grinder.

Fig. 1 herewith shows a Phillips commutator grinder which has found extensive use abroad and which is now being introduced in this country by Messrs. Figg & Watson, 320 Broadway, New York. The device is intended for truing commutators in position, permitting this operation to be performed without the use of a separate driving apparatus, the grinder being driven from the commutator itself. A clearer understanding of the device and of its operation may be had by reference to Figs. 2 and 3. The supporting frame *A* is clamped around the rocker bearings of the dynamo or motor, or it may be secured to any other fixed part of the machine, provided the part is convenient for the purpose for which the grinder is used. To the main frame is bolted and fixed a standard *B* which carries the slide *C*. The set screw *D* passing through the lug *B* permits of vertical adjustment. The sliding carriage *C* carries the spindle *F*, upon which the grinding wheel is fixed. The grinding wheel is caused to rotate rapidly and at the same time to traverse the surface of the commutator. This transverse movement is brought about by means of the rack *G*, which has a portion of its screw thread cut away so as to form a smooth channel. The rack is carried in bearings at each end of the carriage. The rack can be turned through an angle of 90 deg. so as to bring either the threaded portion or the smooth channel into the top position for the purpose of throwing the automatic gear in or out of action by means of the handle *H*. The slide *C* carries in bearings at its upper side the worm wheel *I*, driven by gearing from a cog wheel itself driven by the chain leading from the friction wheel gearing. When the rack is turned into the engaging position, that is, when the screw portion is uppermost, the worm wheel engages with it and when the apparatus is in action the rack is revolved and the carriage is slowly driven forward thereby moving the grinding wheel across the surface of the commutator. The reversing action is governed by the stops *K*, which are adjusted to the width of the commutator. When the stops come into contact with the thread *L*, the action *M* is thrown over, thereby reversing the transverse movement; the grinding wheel, however, revolves in the same direction as before. The driving apparatus is also carried by the main frame, which is pivoted to the center column, marked *O*. This is screwed down until the friction wheel *P* touches the commutator, which causes it to revolve in a direction opposite to that of the commutator. At the end of the bearing is a pulley wheel *Q*, not shown in Fig. 2, but readily seen in Fig. 1, over which a leather belt passes. The belt is continued over two jockey pulleys *R* to a long cylindrical drum to which the grinding wheel is attached. The grinding wheel may be adjusted by means of the set screw *D* to grind only very lightly or may be caused to grind deep. The friction wheel pressure may be adjusted by means of the set screw *O*. The device once set will continue to grind without attention until a further setting is made; the grinding action being automatic. The device can also be adapted to any dynamo or motor up to 10 ft. in diameter. The grinding wheel is of carborundum and revolves at very high speed and the finished surface is said to be polished without breaking the mica or dragging the copper. Where no rockers are used, the machine is fixed around the nose of the outer bearing. Distance rings of different sizes are obtainable to fit various sizes of rockers.

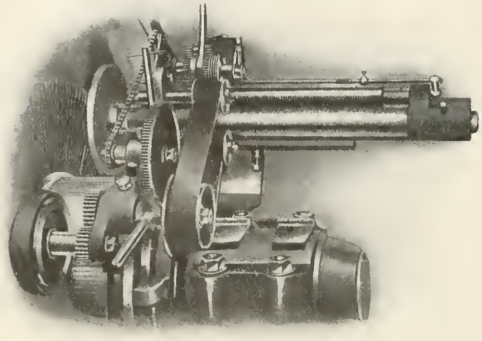

FIG. 1.—COMMUTATOR GRINDER.

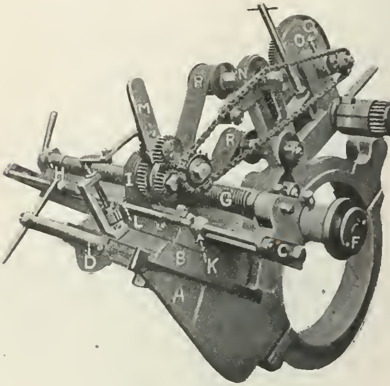

FIG. 2.—DETAILS OF COMMUTATOR GRINDER.

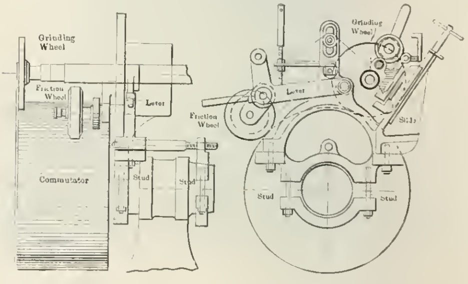

FIG. 3.—GRINDER ATTACHED TO BEARINGS.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Quiet was general in trade and industry, but the financial situation was somewhat improved. Retail trade was slightly stimulated at some cities, but the mild weather limited seasonable distribution at the Northwest, while the holding of cotton affected retail trade and collections in the South. Stock-taking absorbed interest in the wholesale lines and preparations for spring trade are under way. The prohibition laws which went into effect in wide areas in the South has had an important immediate effect on retail trade in that section In the cotton goods trade 1907 closed less auspiciously than it opened, and prices of Dec. 31, were practically the same as those prevailing in January, 1907. The curtailment movement has made great headway in the North, and even in the South it is gaining popularity. The dry goods business was generally quiet at the end of the year, with practically nothing in sight for export. The wool trade opened the year 1908 with only moderate stocks on hand, and prices are somewhat lower than a year ago. In the shoe and leather trade there has been a renewal of confidence with the new year. Lumber, during the week, was generally quiet and traffic on leading railroads is still shrinking. Restriction of output is still noted in iron and steel, though some mills have resumed after the holiday shut-downs. While inquiries for pig iron were more numerous, the actual volume of business was very light. Furnaces are still being blown out of blast, and others are expected to do likewise. The demand for structural material was fair, and new business in plates was quite good. Copper was firmer and steadily held, and the gradual gain in price of the last two weeks was maintained. Sales were not made in great quantity, but inquiry was good. Sales for export were somewhat larger than for domestic consumption. Prices were advanced a little during the week, the closing quotations being 13 7/16c. for Lake, 13 5/16c. for electrolytic, and 13 1/16c. for casting stock. *Bradstreet's* reports 345 business failures in the week ending Jan. 2, against 248 in the week previous, and 185 in the corresponding week of 1907.

THE TUNGSTEN ELECTRIC LAMP COMPANY.—On Oct. 29, 1907, the Tungsten Electric Lamp Company was incorporated under the laws of the state of Ohio, with a capital of $100,000. The incorporators are as follows: Messrs. G. G. Lockwood, A. C. Garrison, H. B. Vanzwoll, A. S. Terry, L. P. Sawyer, H. H. Geary, J. C. Fish, H. C. Rice, E. H. Haughton, E. W. Gillmer, J. B. Estabrook, W. D. Packard, William Coale, E. J. Kulas, J. E. Randall and T. W. Frech, Jr. Mr. T. W. Frech, Jr., was elected president and appointed manager. Mr. J. E. Randall was voted vice-president and made chief engineer. Both of these gentlemen possess experience born of years in the lamp business. A fireproof building, with four stories and basement, having a floor area of 30,000 sq. ft., has been constructed as a factory in Cleveland, Ohio. Its output at the present time is not over 2,000,000 lamps per year. This, however, can easily be increased. The officers of the company have given up all other interests and are devoting their entire time and attention to producing tungsten lamps. The lamp is being put out in 40 and 60-watt sizes for multiple work, and 4, 5.5, 6.6, 7.5-ampere selections with total wattages of 40, 50 and 75 watts for street series service. The specific consumption per mean horizontal candle-power is 1.25 watts.

A CHEERFUL OUTLOOK.—"It is daily becoming more apparent," said President W. H. Whiteside, of Allis-Chalmers Company, in a recent interview, "that the general business of the country has not been so seriously injured by the recent sudden financial depression as the public has been inclined to believe. And I am firmly of the opinion that the thing now most necessary is to loosen the chains of conservatism and give courage an opportunity to assert itself and make advances consistent with the general prosperous conditions and well distributed resources of the country. As the production and use of basic machinery, such as prime movers for the generation of power, is a very potent and a leading factor in our commercial activities, very naturally it is one of the first lines of business to be affected when the pendulum swings from optimism to pessimism, and likewise the first to feel the effect when the change in sentiment again manifests itself. The number and character of inquiries which our offices located in the principal commercial centers of the country have recently been receiving convincingly demonstrate a return of confidence, and bear evidence that not only a diversified, but a large volume of business will be offering ere the middle of the first quarter of 1908 has been passed."

REPAIR ASSOCIATION.—A number of gentlemen, representing electrical repair concerns, met last month in the rooms of the Modern Science Club, 125 South Elliott Place, Brooklyn, N. Y., for the purpose of organizing a trade association, the necessity of which has been felt for a long time. Mr. James F. Hughes, of Chas. A. Borne Company, New York, was elected temporary chairman, while Mr. Leopold F. Luedecke, of the Thompson-Bonney Company, Brooklyn, was elected temporary secretary. Mr. Hughes stated the purpose of the new association, emphasizing the essential reasons why such an association should be called into existence. He touched upon the abuses and impositions the repair man has become more and more exposed to by irresponsible parties, and said that the time is ripe and that they should rise in self-defense. A general debate ensued in which the most salient points of the repair business were discussed. It was decided to name the new organization the Metropolitan Electric Repair Protective Association. The chairman appointed a committee to prepare a constitution and by-laws, consisting of Mr. John P. Bonney as chairman; Mr. Eugene E. Higgins, of the Graham Brothers Company, New York, and Mr. Leopold F. Luedecke. Mr. Hughes then read letters from electrical repair concerns, not represented at the meeting, who promised their hearty co-operation. It was after midnight before the meeting adjourned after every one present had pledged his personal and his firm's support, to meet again Jan. 16, 1908, at the same place, by which time the membership is expected to have doubled.

CUBAN TELEPHONY.—Mr. Howard, the British secretary of embassy, at Washington, has called on Secretary Taft at the War Department in the interest of certain bondholders of the Marianao Telephone Company of Cuba. These bondholders assert that they have been deprived of the right conferred by a Spanish decree to operate telephones in Havana proper. Secretary Taft thought the subject proper for adjudication by the courts, or that at least it should be allowed to remain in status quo until the Cuban Legislature is again convened and ready to deal with the subject.

WHITNEY POWER ENTERPRISE.—Advices from Salisbury, N. C., state that on Jan. 1, the Whitney Power Company on the Yadkin River, at Whitney, N. C., will double its working force and complete the undertaking in time to begin the distribution of electrical energy on July 1. The financial stringency caused some change in the management, but will not interfere with carrying out the original purpose as to completion.

THE COMMERCIAL STREET BOILER WORKS, of Seattle, Wash., are building a new shop for the construction of marine boilers and engines. The shop will be equipped throughout with electric-driven modern machinery, and will have installed two 30-ton Shaw electric cranes, one of which will be operated from the floor. Howatt, MacLean & Company, of Seattle, have charge of the entire electrical installation.

ISTHMIAN CANAL COMMISSION, Washington, D. C., will receive bids until Jan. 20 on various supplies and apparatus, including engine and generator, engine-driven exciter, storage battery, hydrometers, incandescent lamps, and a quantity of mechanical items.

CANADIAN MICA MINES have been shutting down lately and closing out their stocks of mica owing to absence of American demand, and it is stated that the present outlook indicates a scarcity of mica this year in consequence.

LICENSEE SUPPLIES IN CLEVELAND.—The Cleveland Electric Illuminating Company has written a letter to Mayor Tom Johnson, stating that the General Electric Company will be released from its agreement not to sell supplies to a competitor in that city, for the period of one year. The city desired to purchase some of the General Electric products, but found that a licensee contract preventing such purchase existed between the company and the Cleveland Electric Illuminating Company. Thereupon Mayor Johnson wrote the company asking that the agreement be set aside in favor of the city.

THE HOLYOKE MACHINE COMPANY, of Worcester, Mass., has just been awarded a contract by Mr. E. A. Merritt, receiver of the Hannawa Falls Power Company, Potsdam, N. Y., to furnish one of its latest models of type "A" improved governors in connection with the remaining unit of Sampson wheels, which is just being installed in its power plant.

THE PENNSYLVANIA LINES, West of Pittsburg, will install new electric motor and lighting equipment at Mahoningtown, Pa., including three 110-kw Allis-Chalmers 60-cycle, three-phase, 240-volt alternators, and a large number of induction motors ranging from 5 to 15 horse-power.

Financial Intelligence.

THE WEEK IN WALL STREET.—The securities market in the first days of the new year showed a rather cheerful tone with moderate advances, in spite of the Seaboard Railroad system's receivership and other adverse factors. There was a disposition to improve on the lowering of the currency premium and a general feeling, both here and abroad, that normal conditions in the money situation were being steadily restored. The defaults in January interest, such as those on the bonds of the Third Avenue Railroad and the Consolidated Steamship Company had apparently been fully discounted and were not regarded as material reasons for bearishness after the Stock Exchange reopened on Thursday. At the close of the week the market was strong, money was easier, and call and time loans were more freely offered. Interior banks were reported as buying more freely of commercial paper. There was an increased strength and activity in electric and traction shares, and in most cases net advances were recorded, General Electric leading with 3½ points. The curb market during the week rallied sharply. following the lead of the general market. Gains of 25 to 35 points were made in some of the high-priced issues, such as American Tobacco and Standard Oil. There were more inquiries for bonds, including Allis-Chalmers 5s. Following are the closing quotations on Jan. 7:

NEW YORK.

	Dec. 31	Jan. 7		Dec. 31	Jan. 7
Allis-Chalmers Co......	6	6	General Electric	112	115
Allis-Chalmers Co. pfd.	17	17½	Hudson River Tel.....	—	—
Am. Dist. Tel.........	39*	—	Interborough Met. com.	7⅛	6½
American Locomotive...	34¾	36⅞	Interborough Met. pfd..	18¼	18¼
Amer. Locomotive pfd..	—	86	Mackay Cos.	54	58
American Tel. & Cable..	55	—	Mackay Cos. pfd......	60¾	61
American Tel. & Tel...	100	101¼	Marconi Tel.	—	—
Brooklyn Rapid Transit.	39	40	Metropolitan St. Ry....	22	—
Electric Boat	—	—	N. Y. & N. J. Tel......	92	—
Electric Boat pfd......	—	—	Western Union Tel....	57	57
Electric Vehicle	—	—	Westinghouse com.....	43	41½
Electric Vehicle pfd...	—	—	Westinghouse pfd......	—	—

BOSTON.

	Dec. 31	Jan. 7		Dec. 31	Jan. 7
American Tel. & Tel...	100	102	Mass. Elec. Ry pfd.....	38½	49
Cumberland Telephone..	—	—	Mexican Telephone.....	—	1¼
Edison Elec. Illum....	208	208	New England Telep....	—	106
General Electric	112	—	Western Tel. & Tel....	—	4
Mass. Elec. Ry........	8½	10½	West. Tel. & Tel. pfd..	—	50

PHILADELPHIA.

	Dec. 31	Jan. 7		Dec. 31	Jan. 7
American Railways.....	43	43	Phila. Electric	6⅜	5¾
Elec. Co. of America...	9½	9½	Phila. Rapid Transit....	17¼	17⅞
Elec. Storage Battery...	30	31½	Phila. Traction	—	84
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Dec. 31	Jan. 7		Dec. 31	Jan. 7
Chicago City Ry.......	150*	150	National Carbon	—	53
Commonwealth-Edison ..	78½	78	National Carbon pfd...	—	102
Chicago Subway	16½	—	Union Traction	—	—
Chicago Tel. Co.......	105½	108	Union Traction pfd....	—	—
Metropolitan Elec. com.	15*	15			

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*Asked.

PENNSYLVANIA BELL TELEPHONE.—The Bell Telephone Company, of Philadelphia, has notified the Philadelphia Stock Exchange that under resolutions adopted at special meeting of the stockholders of the company, held Dec. 3, 1907, the name of the company was changed from "The Bell Telephone Company, of Philadelphia" to "The Bell Telephone Company, of Pennsylvania," and the par value of its shares of stock changed from $50 to $100 each to take effect Jan. 16, and that upon the opening of its transfer books on that date only the shares of the company of the par value of $100 will be transferred, being the shares of the Bell Telephone Company of Pennsylvania, one share of which will be issued in exchange for every two shares of stock of the Bell Telephone Company of Philadelphia of the par value of $50 outstanding. The company has arranged with H. R. Roney, Seventeenth and Filbert Streets, to purchase or sell such shares of stock of the Bell Telephone Company, of Philadelphia, at $50 per share as will enable stockholders to make the necessary exchange.

WESTINGHOUSE PLANS.—Advices from Pittsburg state that a plan has been made public whereby the receivership for the Westinghouse Machine Company may be dissolved and the business of the company restored to the stockholders. There seems no doubt that the plan will be successful. The arrangement contemplates, in brief, that the company shall issue three-year 6 per cent notes for its existing indebtedness. These notes are to be secured by the company's bonds at 85 per cent of their face value, as collateral, and are to be in denominations of $500 or multiples thereof. Claims of less than $1,000 are to be paid in cash. On claims exceeding $1,000 the creditor will receive three-year 6 per cent notes to the amount of the nearest multiple of $500 that is not in excess of the claim, the balance being paid in cash. It is further agreed that the company will not pay any dividends to its stockholders until provision has been made for the payment of all the notes outstanding. There are about 500 creditors with claims less than $1,000, and 75 creditors with claims exceeding $1,000.

DIVIDENDS.—Jacksonville Electric Company dividends have been declared semi-annual of $3 per share on preferred and $3 per share on common, payable Feb. 1, 1908. The Electric Company of America has declared the regular semi-annual dividend of 3½ per cent, payable Feb. 3. Directors of the Standard Underground Cable Company have declared the regular quarterly dividend of 3 per cent and an extra dividend of 3 per cent, payable Jan. 10. Directors of the National Light, Heat & Power Company have declared the regular quarterly dividend of 1¼ per cent. Directors of the Union Traction Company, of Indianapolis, have declared a semi-annual dividend of ⅔ per cent on the common stock payable Jan. 10. The Fall River Electric Light Company has declared a quarterly dividend of 2 per cent. Directors of the Harbison-Walker Refractories Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Jan. 20. Directors of the Boston Edison Company have declared a regular quarterly dividend of 2½ per cent, payable Feb. 1. The regular semi-annual 3 per cent dividend for the last half of the year 1907 on the preferred stock of the Guanajuato Development Company, has been paid to stockholders of record Dec. 31. Directors of the Multiphone Operating Company have declared the sixteenth monthly dividend of 1 per cent, payable Jan. 2. Directors of the Western Multiphone Company have declared an initial dividend of 1 per cent, payable Jan. 2.

MEXICAN TELEGRAPH.—The Mexican Telegraph Company has issued a statement for the three months ended Dec. 31 (partly estimated), as follows: Gross, $185,000; total net earnings, $176,500; proportion to Mexican Government, $7,500; balance, $169,000; January dividend, $71,752; surplus, $97,248; previous surplus, $2,059,092; total surplus, $2,156,340. The Central & South America Telegraph Company reports the following statement for the three months ended Dec. 31 (partly estimated): Gross, $425,000; total income, $285,000; January dividend, $145,052; surplus, $139,948; previous surplus, $1,006,499; total surplus, $1,146,447.

THE SOUTH BEND-RAYMOND ELECTRIC COMPANY, of Raymond, Wash., is about to place on the market its first bond issue of $40,000. The income of the system is rapidly increasing, and is now approximately $16,000 per annum. The bonds will run 20 years, and bear 7 per cent interest. Mr. J. H. Marshall, who is vice-president of the company, states that $150,000 bonds will soon be placed for the construction of a trolley line from Raymond to South Bend.

SALT LAKE FRANCHISES.—The Utah Light & Railway Company has accepted the franchise passed by the Council, giving the company a monopoly of the street railways' business in Salt Lake City for the next 90 years. The company is controlled by E. H. Harriman, and has appropriated $5,000,000 for reconstruction and new equipment.

GENERAL NEWS

Construction News.

ELBA, ALA.—The Pea River Water Power Company is said to be considering the development of water power at Elba.

HOT SPRINGS, ARK.—Otis Capelin, city clerk, writes that it is proposed to erect an electric light plant in this city at a cost of about $30,000, bids for which will soon be called. G. M. French is engineer.

LITTLE ROCK, ARK.—The Municipal Electric Company has applied to the City Council for a 50-year franchise. The proposed company is represented by Atwood Benton, of Kansas City, Mo.

PINE BLUFF, ARK.—The Little Rock & Pine Bluff Traction Company, which is now building an interurban railway from Pine Bluff to Little Rock, is contemplating the construction of an electric railway from the Little Rock-Pine Bluff line to Stuttgart. The company has submitted a proposition to the town of Stuttgart, which is now being considered. The company has awarded the contract for electrical supplies to the Westinghouse Electric & Manufacturing Company for $115,000.

CORONA, CAL.—The Corona Gas & Electric Company has entered into a contract with the Pacific Light & Power Company, of Los Angeles, for electricity, and will extend its transmission line to Pedley, a distance of seven miles, to connect with the Pacific Light & Power Company's station at that place. The transmission line will have a potential of 17,000 volts.

EUREKA, CAL.—It is reported that the North Mountain Power Company has secured an option on the property and holdings of the Eureka Lighting Company. C. G. O. Miller is president and manager of the Eureka Lighting Company.

INWOOD, CAL.—We are informed that the Shasta Power Company commenced supplying the Redding Shasta Company with electrical energy Dec. 1, 1907. The power house of the Shasta Power Company is located on Snow Creek, 28 miles from Redding. The length of the water conduit is 35 miles, of which 17½ miles consists of ditching and flume. The present equipment of the plant is rated at 1200 kilowatts. The transmission lines have a potential of 40,000 volts. The officers of the company are H. Shannon, president; A. Rossi, vice-president; G. Scalmanini, secretary, and Fred C. Turnbull, superintendent.

LOS ANGELES, CAL.—Two large engines in the power plant of the Los Angeles Gas & Electric Company were destroyed by an explosion Dec. 27, causing a loss of about $125,000. Arrangements have been made to secure electricity from other companies until the engines can be replaced.

LOS ANGELES, CAL.—Creditors of the Electric Heating & Manufacturing Company, of Dolgeville, have filed a petition of involuntary bankruptcy in the United States district court. It is explained that the action is taken by friendly creditors who desire to forestall radical action. The assets of the company are given as $41,000 and the liabilities as $26,000. W. A. Vetter is president of the concern, which was organized three years ago.

LOS ANGELES, CAL.—The Southwestern Home Telephone Company has recorded in San Bernardino County a trust deed, conveying all of its franchies and personal and real property to the Southern Trust Company, of Los Angeles, for the purpose of securing a bonded indebtedness for the sum of $1,000,000. An examination of the trust deed would indicate that the Southewestern Home Telephone Company plans to make extensive improvements to its system as under the terms of the deed $500,000 of the bonds are to be delivered immediately, the proceeds to be used for that purpose.

MENDOCINO, CAL.—Owing to the high cost of fuel the Mendocino Electric Light & Power Company has extended its transmission lines to connect with the system of the Fort Bragg Electric Light Company, and now takes energy from that company on a percentage basis of gross receipts. The Mendocino company has installed new transformers and is not now operating its plant, the equipment of which is for sale. A. Brown is secretary and manager.

REDWOOD CITY, CAL.—The Board of Supervisors has granted W. J. Martin a franchise for an electric light plant in the First Township.

SANTA BARBARA, CAL.—The Merchants' Mutual Light & Power Company will build a transmission line into the Goleta Valley, a distance of 12 miles, in the spring, to supply electricity for pumping purposes, and also for lamps. It will operate the three-wire system at 11,000 volts, 60 cycles. The company has just completed a transmission line along the ocean front, called the Mesa, a distance of six miles, to furnish electricity for lamps and motors. F. W. Hunter is manager.

CREEDE, COL.—The power plant of the Happy Thought mine was recently destroyed by fire, entailing a loss of $100,000.

DELTA, COL.—The Delta Electric Light Company is planning to install an additional engine and alternating-current generator of from 75 to 100 kw. J. E. Shue is treasurer and manager.

TORRINGTON, CONN.—It is understood that the Connecticut Company, which owns and controls the Torrington & Winchester Street Railway Company, contemplates changing the power house from Burrville to Torrington. It is reported that the new power house will be erected on the site recently purchased by the railway company on North Elm Street.

COEUR D'ALENE, IDAHO.—The Consumers' Company, Ltd., informs us that it is going to install in its plant an electrically driven pump of about 150 or 200 hp. George Harding is manager.

DAVIS, ILL.—The capital stock of the People's Mutual Telephone Company has been increased from $10,000 to $15,000.

EAST MOLINE, ILL.—Harry Schriver, of this city, and J. A. Logsdon, of Moline, have applied to the towns of East Moline and Watertown for a 20-year franchise to construct a gas and electric plant.

JOLIET, ILL.—An injunction suit against the Economy Light & Power Company, of Joliet, to prevent the construction of a dam at Dresden Heights was filed Dec. 30 in the circuit court at Morris by Governor Deneen and Attorney-General Stead. It is contended that the Desplaines River is navigable and that the company's dam will interfere with deep waterway plans.

MANSFIELD, ILL.—William Schuler, of Saybrook, Ill., is reported to have purchased the local electric light plant.

MARSHALL, ILL.—The Blackhawk Light, Heat & Power Company, of Vincennes, Ind., has filed articles of incorporation in Illinois with a capital stock of $25,000. The company will locate in Marshall. The Indiana Company is capitalized at $1,000,000.

MONTICELLO, ILL.—The Monticello Electric Light Company is contemplating the installation of new enclosed arc lamps for street lighting. James P. Lodge is manager.

FARMLAND, IND.—The citizens are considering the question of installing an electric light plant in this place.

GOSHEN, IND.—The directors of the Goshen Home Telephone Company have decided to expend $25,000 in improvement and new equipment for its system.

SARATOGA, IND.—Cyrus Bousman is planning to receive bids for the installation of an electric light plant in connection with his hotel and also proposes to furnish electricity to light the town, including business houses and dwellings. It is proposed to operate the dynamos by a gasoline engine.

SULLIVAN, IND.—The Sullivan Electric Light & Power Company and the Sullivan Heat, Light & Power Company have been consolidated under the name of the Sullivan Lighting Company. The company is capitalized at $50,000 and the directors are A. S. Courtwright and others.

WINCHESTER, IND.—The Winchester Water & Light Company has notified its patrons that after May 1 it will discard its flat rates and all service will be furnished by meter, which will enable the company to furnish a day service.

WINONA LAKE, IND.—The capital stock of the Winona Interurban Railway Company has been increased to $1,200,000.

WORTHINGTON, IND.—At an election held recently the citizens voted to sell the municipal electric light plant at public auction. The plant was established several years ago by the city at a cost of $75,000 and has been operated at a loss.

CARROLL, IA.—The Carroll Light & Power Company has been reorganized and H. G. Long elected president.

ELMA, IA.—The municipal electric light plant was completely destroyed by fire Dec. 29, causing a loss of about $6,000. The plant was insured for $2,000.

RED OAK, IA.—The business men of Red Oak and other prominent citizens of southwestern Iowa are investigating the feasibility of an electric railway from Red Oak via Greenfield to Des Moines. Judge Horace E. Deemer, of the Iowa Supreme Court, is one of the leaders of the movement. A company will be formed in a few weeks to do the preliminary work.

SHEFFIELD, IA.—The Sheffield Brick & Tile Company is contemplating installing an electric light plant for its own use and will furnish electricity for lighting the city.

BELOIT, KAN.—The citizens have voted to issue $15,000 in bonds to purchase the electric light plant.

FORT FAIRFIELD, ME.—The plant of the Fort Fairfield Electric Company, at Stevensville, was destroyed by fire, Dec. 29.

LEWISTON, ME. The Lewiston & Auburn Electric Light Company has announced that meter rates for electricity for lamps in Lewiston and Auburn will be reduced from nine cents to eight cents per kw-hour. The new rate took effect Jan. 1.

MONSON, ME.—At a town meeting held recently the citizens voted to raise $350 and to appropriate $250 to light the town by electricity.

PORTLAND, ME.—The Portland, Gray & Lewiston Electric Railway Company has completed surveys for its proposed railway from Portland to Lewiston. Work will commence on the construction of the road early in the spring. John A. Jones, of Lewiston, is engineer.

CENTREVILLE, MD.—The Centreville Electric Power Company has completed arrangements for the lighting of Queenstown during January.

EASTON, MD.—The City Council will consider propositions for granting a franchise for a light, heat and power plant, and a contract for lighting the streets of the city. Martin M. Higgins is mayor.

DANVERS, MASS.—The electric plant investigating committee has engaged the services of Harold Davidson, of New York, N. Y., to investigate the municipal electric light plant and report to the committee his opinion of the ways and means to improve the condition of the plant and also make an appraisal of the value of the same.

ESSEX, MASS.—The citizens are considering the question of having the streets of the town lighted by electricity.

HOLYOKE, MASS.—The contract for a 2500-kw turbo-generator for the municipal electric light plant has been awarded to the General Electric Company, of Schenectady, N. Y., for $45,000. The city clerk writes that about $60,000 will be expended for improvements in the electric lighting department. For further information address William H. Snow, manager of lighting department.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company is contemplating extending its lines to Lunenburg for commercial and private lighting.

SALEM, MASS.—A 60-hp electric motor has been installed in the car shops of the Boston & Maine Railroad Company. Electricity for operating the shops will be furnished by the Salem Electric Lighting Company.

TURNERS FALLS, MASS.—The Connecticut River Power Company is contemplating the construction of a dam on the Connecticut River near Little Rock dam. The company has recently completed its transmission line from Turners Falls to Amherst, Hatfield, Pelham, Sunderland and South Deerfield, a distance of 19 miles.

ALBION, MICH.—The managers of the municipal electric light plant are contemplating changing the 37½-kw dynamo for a 70-kw machine, or changing the entire system to alternating current at 60 cycles. A. E. Ward is manager.

EAST JORDAN, MICH.—The dam of the East Jordan Electric Light & Power Company gave way recently, causing a loss of $75,000. The dam was a concrete structure and held a 25-ft. head of water. The machinery of the plant was not damaged and the village is now lighted by the auxiliary steam plant.

TRENTON, MICH.—The Washtenaw Light & Power Company has purchased the local electric light plant, and has also secured a 30-year franchise from the Morguagon Township Board to erect electric transmission lines into the township over any route desired, which will eventually give the residents of Grosse Isle an electric light service. It is said that the company intends to extend its transmission line from Ypsilanti to Trenton and supply the villages along its line with electricity for lamps and motors.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has leased the new dam of the Minneapolis Mill Company and the Pillsbury-Washburn Mill Company for a term of 25 years. This water power will increase the aggregate output of the Minneapolis General Electric Company's system by 25,000 horse-power.

OLIVIA, MINN.—The question of increasing the equipment of the municipal electric plant and installing a storage battery is under consideration. J. F. Morgan is superintendent.

OWATONNA, MINN.—The Rice Lake Rural Telephone Company has been formed to install a telephone line through the eastern part of the county. William Hartle is secretary.

OXFORD, MINN.—The City Council has passed an ordinance authorizing an issue of $15,000 in bonds for an electric light plant.

WALKER, MINN.—The citizens are contemplating duplicating the present equipment of the municipal electric light plant. John E. Gray is chief engineer and electrician.

LEXINGTON, MISS.—The electric light and water works plants were damaged by fire, Dec. 29, and were put out of commission.

MEADVILLE, MISS.—A stock company has been organized recently in Meadville by Lee Rush, of Henderson, Tenn., for the purpose of installing an electric light plant. The equipment of the plant will be shipped from Henderson, where it is at present in operation. The contract for lighting in Henderson expired Jan. 1. It is expected to have the plant in operation in about three months.

RICHTON, MISS.—The electric lighting system recently completed by the Richton Electric Light Company was put into operation Dec. 21. S. E. Shannon, of Hattiesburg, is manager.

KANSAS CITY, MO.—The West Side Council has passed an ordinance requiring the telephone companies to bury their wires in the principal streets in that section of the city.

SEDALIA, MO.—The Sedalia Light & Traction Company on Jan. 2 filed a first mortgage on all of its property, including the Sedalia street railway, power and light plants and realty, to the City Trust Company of Boston, Mass., to secure an issue of $1,500,000 in bonds.

STANBERRY, MO.—The Stanberry Electric Light & Power Company is contemplating increasing the equipment of its plant and will install two boilers, engine and dynamo. J. R. Creightan is manager.

STEVENSVILLE, MONT.—The Missoula & Bitter Root Traction Company has practically completed the surveys for its proposed electric railway. The company is capitalized at $55,000. F. O. Lewis, of Stevensville, is secretary and treasurer of the company.

FREMONT, NEB.—It is said that the City Council has adopted the revised plans of C. A. Chapman, of Chicago, Ill., for the power house for the water and light plant, to cost about $23,045. Frank Hammond is secretary of Board of Public Works.

OMAHA, NEB.—We are informed that the Omaha & Nebraska Central Railway Company expects to award contracts for grading and track material in the spring of 1908, after which active construction work will begin. The proposed railway will extend from Hastings to Omaha, and is to be 159 miles long. The officers of the company are: H. C. Long, of Boston, Mass., president; A. Texter, of David City, vice-president; J. H. Rogers, of Hastings, secretary; E. R. Long, of David City, treasurer, and J. C. Baker, of Hastings, general manager.

SIDNEY, NEB.—The Sidney Electric Service Company is contemplating the installation of another unit of 75 kilowatts, 220 volts, direct connected to a high-speed engine. The company would like to receive prices and information on different types of engines. A day service will be established during the coming summer. W. N. Alexander is superintendent.

LOVELOCK, NEV.—The Lovelock Light & Power Company is constructing a new power plant, the equipment of which will consist of an alternating-current, 2300-volt, 60-cycle, two-phase generator operated by a 200-hp gasoline engine, and by water power, using vertical turbines. No contracts for machinery have yet been closed. W. B. Joslyn is vice-president and general manager.

COLEBROOK, N. H.—The W. E. & W. Drew Electric Light Company is now changing from flat to meter rates. The price for electrical energy will be 12½ cents per kw-hour.

DUBLIN, N. H.—C. F. Appleton, treasurer and manager of the Dublin Electric Company, writes us that the company placed its new plant in operation Dec. 15 and is giving perfect satisfaction. The old plant will be abandoned.

DEAL, N. J.—The New Jersey Consolidated Water & Light Company is planning to install an additional boiler, engine and generator in its plant. F. M. Inman is superintendent.

LAS CRUCES, N. M.—The Las Cruces Electric Light & Ice Company contemplates installing a new unit in its plant in the near future, consisting of a 125-kw, alternating-current generator and a Corliss engine. B. L. Berkey is president and manager.

TUCUMCARI, N. M.—The Tucumcari Telephone Company has increased its capital stock from $5,000 to $25,000.

FORT COVINGTON, N. Y.—The Fort Covington Light, Heat & Power Company writes that it may possibly construct a new dam and establish a day service during the coming summer. W. S. H. Keefe is secretary and manager.

TROY, N. Y.—The Troy Gas Company has nearly completed the work of changing its electric system from 60 to 40 cycles and changing the street lamps from open direct-current series to inclosed alternating-current series. J. F. Cahill is manager of the electrical department.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company has been granted a franchise to construct a loop over certain streets in the city. The franchise is free for 25 years, with the option of renewal for 25 years upon the payment of $200 for each mile of track.

LONG ISLAND, N. C.—Plans are being considered by the Long Island Cotton Mills for the construction of a hydro-electric plant at Buffalo Shoals, to develop 500 horse-power to operate a proposed cotton mill. The cost of the power plant is estimated at $30,000. Osborne Brown, of Long Island, is president of the company, and George H. Brown, of Statesville, is treasurer.

BELLEFONTAINE, OHIO.—The Ohio Electric Railway Company has commenced excavations at Lewistown Reservoir for its new power house, which will furnish electricity to operate the Lima-Bellefontaine division.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has filed a bill of $54.96 a lamp per year for furnishing energy for street lamps. This is $12.96 less than the figure for the past year and will result in a saving of about $20,000 to the city. In all about 1425 lamps are in use, but an additional number will be put into service the present year.

CINCINNATI, OHIO.—We are informed that arrangements have practically been completed by the Northern Ohio Traction Company for furnishing energy for operating the electric railway between Hamilton and Dayton. The new power station at Lindenwald, near Hamilton, has been equipped with the following machinery: three 1500-kw turbo-generators; one 750-kw turbo-generator; three 300-kw rotary converters, and a battery of eight 400-hp Babcock & Wilcox boilers. The electrical energy generated in this station will be distributed from the sub-station at College Hill, Trenton, Franklin and Dwyer; each sub-station will be equipped with two 300-kw rotary converters complete with six 100-kw, 33,000-volt transformers. The company contemplates placing orders for a number of interurban cars within a few months, to be operated between Cincinnati and Dayton.

HAMILTON, OHIO.—Sealed proposals will be received at the office of the city auditor until Jan. 22, for $20,000 electric light bonds, the proceeds of which will be used for enlarging and improving the municipal electric light plant. T. Straub is city auditor.

MORROW, OHIO.—The People's Electric Company is contemplating installing a producer gas plant. E. G. Wilson is secretary and manager.

SILVERTON, OHIO.—The Village Council has granted a franchise to the Fitzsimmons Telephone Company for a term of 25 years.

BAKER CITY, ORE.—The Eagle River Electric Power Company is contemplating the installation of an 800-kw unit. J. K. Romig is secretary and general manager.

ALLIANCE, PA.—The Town Council has decided against a municipal electric light plant, and has entered into a contract with the Lehigh-Northampton Gas & Electric Company for lighting the town for a term of five years.

BETHEL, PA.—The Blue Mountain Electric Company is planning to install an engine and larger dynamo during this year. H. C. Stambaugh is president and manager.

HARWOOD, PA.—The Harwood Electric Power Company is contemplating installing two 1500-kw General Electric steam turbines, and raising the line voltage to 11,500 volts, three-phase; also erecting 25 miles of transmission lines. John S. Wise, Jr., is secretary and treasurer.

PITTSBURG, PA.—It is reported that bids will soon be asked for repairs and extensions to the municipal electric light plant of the former city of Allegheny, which will supply electricity for lighting the north side; also to the downtown district of Allegheny.

FAIRMONT, S. C.—The owners of the Tyger Cotton Mills are contemplating the construction of another plant to cost about $300,000. The company has purchased water power property for $10,000, which will be developed to furnish power to operate the proposed mill.

BERESFORD, S. D.—Extensive improvements and additions are being made to the local electric light plant owned by Louis Wagner, including the installation of a 12 x 30 Murray Corliss engine, and another generator, which will be installed some time next summer.

MILLER, S. D.—The Miller Electric Company is contemplating making additions and improvements to its plant, which include the installation of a new engine and dynamos. Ira C. Robinson is manager.

SIOUX FALLS, S. D.—The Sioux Falls Light & Power Company is developing a water power and installing three 500-kw generators, direct connected to water wheels. The work will be completed about Aug. 1. Arthur Huntington is superintendent.

BRISTOL, TENN.—The Bristol Gas & Electric Company will install a large coke manufacturing plant here at a cost of $125,000. The company proposes to utilize the gas produced in the manufacture of coke for fuel for the generation of steam.

KNOXVILLE, TENN.—It is reported that Wilkerson & Boyce, of Asheville, N. C., are making arrangements for the proposed development of water power on the French Broad River and the transmission of electricity to Knoxville. The company plans to construct a 15-ft. dam. About 4500 acres of land have been secured and options have been obtained on other property. Roland A. Thayer, of Lockwood, Greene & Company, of Boston, Mass., is said to be financially interested in the enterprise.

NASHVILLE, TENN.—Arrangements have been made whereby the Nashville Railway & Light Company will furnish electrical energy to operate the cars of the Nashville Interurban Railway Company between Nashville and Frankville. As soon as the Nashville-Franklin division is put into operation, work will begin on the Mt. Pleasant extension.

CROCKETT, TEX.—The Citizens' Light & Ice Company contemplates making extensive changes in its plant and will probably change over to three or five-wire direct-current system. They will use either steam turbines or gas producer plant and will furnish a day service for fans, etc. W. H. Brown is manager.

GORMAN, TEX.—The Gorman Light & Power Company, recently incorporated, is contemplating the erection of a plant, to cost about $15,000. J. R. Barclay has charge of the work.

McCOOK, TEX.—A. R. Scott, manager of the McCook Electric Light Company, writes that the company has recently added to its plant two 35-kw, direct-current generators belted to a 100-hp Weber producer gas engine.

MASON, TEX.—The Mason Ice & Light Company expects to erect new poles and establish a fan service. William Ellebracht is manager.

MINEOLA, TEX.—The Mineola Light & Ice Company will install a 100-hp suction gas producer and engine at once in its plant. The company will use lignite for fuel. J. P. Kittrell is manager.

BLACKSBURG, VA.—D. O. Matthews, superintendent of the electric light plant connected with the Virginia Polytechnic Institute, writes that the trustees are contemplating purchasing a steam turbine and a 240-kw dynamo for the plant.

BRISTOL, VA.—S. M. Vance, superintendent of the Bristol Gas & Electric Company, writes that about $100,000 will be expended for improvements.

DANVILLE, VA.—The City Council has decided to engage an electrical engineer to make investigations with a view of either enlarging the present electric light plant or erecting an entirely new plant.

NORFOLK, VA.—The Seventh Ward Local Board has authorized the lighting committee to make investigations as to the cost of installing and operating a lighting plant.

POMEROY, WASH.—The Tucannon Power Company is installing a steam plant to be used as an auxiliary to its water power plant. W. W. Richards is manager.

PORT TOWNSEND, WASH.—The Citizens' Electric Company will install a 30-kw direct-current dynamo for motor service in the business section of the city. J. M. Kincaid is secretary and manager.

PROSSER, WASH.—The Prosser Falls Land & Power Company is preparing to extend its electric light system across the river to take in the small ranches.

RAYMOND, WASH.—The South Bend-Raymond Electric Company is extending its transmission line to South Bend, a distance of 3 9/10 miles, which it expects to have completed within 60 days, and later will construct an electric railway to connect the two towns, at a cost of $150,000, including equipment. J. H. Marshall is manager.

TERRA ALTA, W. VA.—W. S. Ingram, owner and manager of the Terra Alta electric light plant, writes us that he is installing a new power plant, the equipment of which consists of two 150-hp boilers, two Ball engines and two 150-kw General Electric, three-phase, 2300-volt generators; and is in the market for a switchboard and a closed feed water heater. He also states that he expects to establish a 24-hour service, and will furnish electricity for manufacturing purposes and for pumping the town water supply.

AMHERST, WIS.—B. E. Dwinell & Company, owners of the local electric light plant are contemplating installing a pair of horizontal water wheels to develop 100 horse-power under 10-foot head. B. E. Dwinell is manager.

BARABOO, WIS.—The Baraboo Telephone Company will install 16,000 feet of cable throughout the business section of the city.

DARLINGTON, WIS.—The Darlington Electric Light & Water Power Company is contemplating establishing a power service. C. H. Williams is manager.

LOYAL, WIS.—An election will soon be held to vote on the proposition to issue $17,000 in bonds for an electric light plant and water works system. W. G. Kirchoffer, of Madison, is engineer.

MADISON, WIS.—All bids opened Nov. 22 by the Wisconsin Capitol Commission at Madison, for the equipment for the heating and power plant for the capitol, now under construction at Madison, have been rejected, all being considered too high. The proposed equipment will include boilers, engines, electrical generators and motors, mechanical stokers, pump (feed), pumps (building supply), storage tanks, conveying machinery, hoisting crane and open heaters. The bids ranged from $75,000 to $100,000.

MILWAUKEE, WIS.—The Board of Public Works has sent notices to the various public service corporations requiring them to place their wires in underground conduits to get ready for the elevation of the railroad tracks on the south side.

MILWAUKEE, WIS.—Plans are being prepared for the new power house which will be erected by the Continental Realty Company, near the Commerce Street station of the Milwaukee Electric Railway & Light Company. The cost of the plant is estimated at $50,000. Kirchhoff & Rose are the architects.

MILWAUKEE, WIS.—Bids will be received until Feb. 13 by the Board of Public Works for furnishing and erecting, ready for use in a building and on foundations furnished by the city, all machinery and appurtenances thereto to make a complete gas producer plant at Walker and Davidson Streets. Said gas producer to be a part of the municipal electric light plant. Plans and specifications can be secured on a deposit of $25. Charles J. Poetsch is chairman.

MONTICELLO, WIS.—The question of installing a storage battery in the municipal electric light plant is under consideration. E. L. Babler is superintendent.

PARDEEVILLE, WIS.—The Fox River Milling & Power Company is contemplating the installation of a storage battery in its plant. Myron L. Aldrich is superintendent.

PLATTEVILLE, WIS.—G. H. Kordenat, manager of the Platteville Electric Light & Power Company, writes that the company intends to install an additional engine and alternating-current generator in its plant, and will furnish both alternating-current and direct-current day service.

PRESTON, WIS.—The Preston Farmers' Telephone Company has increased its capital stock from $5,200 to $12,250. H. C. Shephard is president and A. B. Shephard secretary.

CASPER, WYO.—The Casper Electric Light Company contemplates rebuilding its plant entirely and increasing the output. Nathan C. Johnson is treasurer and manager.

CODY, WYO.—The Shoshone Electric Light & Power Company informs us that it expects to install arc lamps for street lighting during the year. George T. Beck is president and manager.

GREEN RIVER, WYO.—The Green River Electric Light & Power Company is contemplating duplicating the present equipment of its plant. George H. Maxam is manager.

CALGARY, ALB.—The City Council has awarded the contract to supply electrical energy for the city to the Calgary Power & Transmission Company for a term of five years. By the terms of the contract the company is to furnish a 24-hour service for $30 per horse-power per year, and to have its plant in operation by March, 1909, and supply 5000 horse-power.

EDMONTON, ALB.—R. R. Kelly, city engineer, writes that the city is about to install a new power station and will require material for six miles of transmission line at 10,000 volts, three-phase, 60 cycles; also line material including lightning arresters and switchboard at the sub-station; will have eight or nine incandescent circuits, two arc lamp circuits and a motor circuit. He also states that the city is about to install a 200-hp producer gas engine plant and will require new buildings. The building will cost from $8,000 to $10,000 and must be ready for occupancy by May 10. Mr. Kelly will be glad to hear from contractors and makers of reinforced concrete.

AYLMER, CAN.—The Hull Electric Company is contemplating the installation of a 500-kw motor generator in its sub-station. W. R. Baker is vice-president and general manager.

CAMPBELLTON, N. B.—The citizens are contemplating installing a new water tube boiler in the municipal electric light plant and erecting a new chimney. Hiram G. V. Farrer is manager.

TORBROOK, N. S.—The Londonderry Iron Mining Company is contemplating the installation of an electric plant at its mines here.

BRANTFORD, ONT.—The Hamilton Radial Electric Railway Company is seeking permission from Parliament to construct and operate an electric railway from Brantford to a point on the Detroit River at or near Windsor.

BROCKVILLE, ONT.—Extensive improvements and extensions are contemplated for the municipal electric light and power plant, including the installation of a new 250-kw direct-connected unit, the construction of a new chimney, etc. C. W. Wilkinson is manager.

CORNWALL, ONT.—The plant and holdings of the St. Lawrence Power Company have been purchased by a syndicate, of which George C. Foster, of Montreal, Que., is president and managing director. Plans for additions and extensions to this plant, at a cost of more than $3,000,000 have been submitted to the International Waterways Commission.

LINDSAY, ONT.—The capital stock of the Light, Heat & Power Company, of Lindsay has been increased from $125,000 to $300,000.

OTTAWA, ONT.—The contract for supplying lamps and electrical accessories for the Ottawa street lighting system has been awarded to the Canadian General Electric Company, of East Toronto, for $24,672. N. J. Ker is city engineer.

PETROLIA, ONT.—The Petrolia Electric Light, Heat, Power & Gas Company, Ltd., contemplates installing gas engines and gas producers in its plant. W. G. Fraser is manager.

PORT ARTHUR, ONT.—The city will install a 185-kw generator to provide additional energy for the street railway system, at a cost of $8,000. J. McTeigue is city clerk.

PORT HOPE, ONT.—The Port Hope Electric Light & Power Company, Ltd., contemplates installing a 30-in. Samson turbine in its plant. Thomas Tuer is superintendent.

ST. CATHERINES, ONT.—The City Council has granted the Falls Power Company a 25-year franchise in consideration for which the company offers to take over the city lighting contract at the rate of $39.50 per arc lamp per year, and to furnish electricity free of cost for 250 incandescent lamps to be used in public and charitable institutions, maintained by the city. The Hamilton Cataract Power Company is now furnishing energy for the street lamps at the rate of $72.50, but offered to make a contract at the rate of $45 per lamp per year. The new contract is to take effect July 1.

TORONTO, ONT.—The citizens on Jan. 1 voted in favor of issuing bonds to the amount of $2,750, to erect a plant to distribute electricity to be supplied by the Hydro-Electric Power Commission, of Ontario, from Niagara Falls.

WELLAND, ONT.—Frank W. Houston, superintendent of operation of the Falls Power Company, writes that the company will erect a new sub-station in the spring.

WEST LORNE, ONT.—The West Lorne Electric Light Company, Ltd., is contemplating installing a new power plant in the near future. D. F. Webster is secretary.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company has now under construction a 20,000-hp hydro-electric plant at Soulanges, and is erecting a 35-mile, 44,000-volt, three-phase transmission line. The company is also constructing a sub-station at Cote St. Paul, and 10,000-volt tie lines to the city station; and is rebuilding the Chenneville Street sub-station, installing two additional generators in the power house at Lachine Rapids and constructing underground conduits and placing tie lines, etc., underground. R. M. Wilson is superintendent.

THREE RIVERS, QUE.—The North Shore Power Company is contemplating extending its transmission lines to Ste. Anne de la Perade, Batiscan Champlain, Ste. Maurice and St. Malo. Ralph B. McDunnough is manager.

New Industrial Companies.

THE ELECTRIC MEAT CURING COMPANY, of Augusta, Me., has been organized for preparing, preserving, storing and packing meats and fish, etc., by electrical process or otherwise. The company is capitalized at $1,000,000 and the officers are: L. A. Ingals, of Augusta, Me., president, and E. J. Pike, of Augusta, treasurer.

THE PARAGON ELECTRIC COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000 by W. E. Groves, H. Warren Caster, and W. B. McDonald. The company proposes to manufacture electrical appliances.

New Incorporations.

SANTA BARBARA, CAL.—The Neilson-Smith Electrical Company, of Santa Barbara, Cal., has been incorporated with a capital stock of $25,000 by F. M. Neilson, B. C. Smith, R. W. Ealand, W. C. and H. T. Neilson.

WILLOWS, CAL.—The Glenn County Telephone Company has been incorporated with a capital stock of $100,000 by J. C. Campbell, A. F. Lindstrom and others.

PUEBLO, COL.—The Pueblo & Arkansas Electric Railroad Company has been incorporated, with a capital stock of $300,000, to build an electric railway from Pueblo to Fowler down the Arkansas Valley. The incorporators are M. J. Verner, Lester Wolf and others.

CHICAGO, ILL.—The Jackson Light, Heat & Power Company has been incorporated with a capital stock of $5,000 by J. E. Baker and others.

INDIANAPOLIS, IND.—The Indianapolis-Cairo Traction Company has been incorporated with a capital stock of $10,000,000 for the purpose of constructing an electric railway from Indianapolis to Cairo, Ill., through the Indiana and Illinois coal fields. The incorporators are A. L. Haas, of York, Pa., president; W. C. Buell, John T. Figg and Charles McDermott, of Indianapolis. The company has taken over the Eel River Railroad Company, which was incorporated two years ago to build a steam road along the same route. The officers of the company state that arrangements are being made with a New York firm to underwrite the company.

MONSON, MASS.—The Monson Light & Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The company proposes to generate and distribute electricity for heating, lamps and motors in the towns of Monson, Abbot and Blanchard. The officers of the company are: Harry W. Waite, president, and George F. Barnard, treasurer. The citizens of this place, on Dec. 26, voted to contract with the company to light the streets of the town for a period of not less than five years.

ADRIAN, MICH.—The Sand Creek Telephone Company has been incorporated, with a capital stock of $2,000, by Henry Middleton and others.

PORT HURON, MICH.—The Port Huron Citizens' Telephone Company has filed articles of incorporation with a capital stock of $20,000.

BRECKENRIDGE, MINN.—The Breckenridge Telephone Company has been incorporated, with a capital stock of $50,000, by H. L. Shirley and others.

MEADVILLE, MISS.—The Meadville Light & Power Company has been incorporated with a capital stock of $10,000. The company proposes to erect a plant having an output of 50 kilowatts. The contract for the installation of the machinery has been awarded to the Henderson Improvement Company, of Henderson, Tenn. D. L. Rush, of Henderson, Tenn., is general manager and has charge of the construction of the plant.

BERGER, MO.—Articles of incorporation have been filed for the Berger Commercial Telephone Company. The company is capitalized at $8,000, and the incorporators are E. Blumer, Joseph Rarhgeb, H. Wedephol, H. H. Meyer and others.

DONIPHAN, MO.—The Doniphan Telephone Company has been incorporated with a capital stock of $25,000 by T. L. Wright and others.

SHICKLEY, NEB.—The Shickley Telephone Company has been organized with a capital stock of $2,000. The officers of the company are: M. L. Schelkopf, president; Aruthur Nelson, secretary, and A. V. Vennell, Jr., treasurer.

RENO, NEV.—The Kings Hills Irrigation Power Company has been incorporated with a capital of $1,000,000 by Charles and Benjamin Hammett, C. B. Hurt, E. L. Rice and O. O. Haga. The company plans to build a large power plant on the Truchee River and also to construct a large irrigation canal, which will irrigate land in Spanish Spring Valley, close to Reno.

PAVILLION, N. Y.—The Pavillion Telephone Company has been organized, with a capital stock of $10,000, by Earl Starr, H. A. Bradley, D. L. Morrow, J. E. Sprague and others.

STEPHENS MILLS, N. Y.—Articles of incorporation have been filed for the Stephen Mills Telephone Company, with a capital stock of $10,000, by E. R. Kilbury and others.

MONTPELIER, N. D.—The Montpelier Telephone Company has been incorporated with a capital stock of $5,000, by Frank S. Eddy and others.

HESLOP, OHIO.—The Heslop Telephone Company has been incorporated with a capital stock of $10,000 by W. L. Hadley and others.

ALDEN, OKLA.—The Alden Telephone Company has been incorporated, with a capital stock of $1,000, by H. S. Sturgis and others.

FLORENCE, OKLA.—The Kent Rural Telephone Company has been incorporated with a capital stock of $840 by J. King, A. V. Ray, of Florence; Ira Wisel, George W. Sneeds and J. Sanfyker, of Byron; J. H. Wilson and J. H. Jessys, of Florence.

BEAVER FALLS, PA.—A charter has been granted to the Beaver Falls & Koppel Street Railway Company with a capital stock of $6,000 to build a street railway in the new town of Koppel, one mile in length; also to the Beaver & Lawrence Electric Railway Company with a capital stock of $6,000 to build a line from the dividing line of Beaver and Lawrence counties to the Hart Farm, a distance of one mile. T. P.

Simpson, of Beaver Falls, is president of both companies, and the directors are: S. L. Tone, C. W. Gibbs, W. J. Horgan, and B. S. Johns, all of Pittsburg.

EAU CLAIRE, PA.—The Butler County Telephone Company has been organized and has applied for a charter under the laws of Pennsylvania.

McDONALD, PA.—The McDonald Electric, Heat & Power Company has been organized with a capital stock of $100,000, by A. W. Valentour, W. H. Young and others.

LANSDOWNE, ONT.—The Lansdowne Rural Telephone Company has been incorporated with a capital stock of $20,000 by W. J. Webster, R. J. Mitchell, O. S. Landon, W. W. Shipman, H. Horton, C. Fredenburg, and G. F. Deane, of Lansdowne.

Legal.

RIGHTS OF TELEPHONE COMPANY IN PUBLIC STREET AS AGAINST ABUTTING OWNER.—That a telephone company, though holding a village franchise, is not authorized to occupy a street, the title to which is held by the abutting owner, against his wishes, without having acquired the right by condemnation proceedings, is a recent holding of the New York Supreme Court. The action was brought by the telephone company and it was alleged that the defendant was the owner of certain real estate in the village of Fishkill Landing; that it had permission from the village to construct, and operate its lines and erect poles on the public streets of the said village; that it did erect such poles, and the defendant cut down two of them and the ropes and wires attached thereto. The question arose whether the defendant was actually the owner to the middle of the street upon which her property abutted. The description of the property in the deed, under which the defendant held title, did not include any portion of the highway but referred to the plot as being bounded by the highway. It was held, nevertheless, that the defendant owned to the middle of the street and that the telephone company could not erect its poles in front of the defendant's property without the defendant's consent except by securing that right by condemnation. Hudson River Telephone Co. vs. Forrestal, 106 N. Y. Supp., 404.

ELECTRICIAN HELD TO BE A FELLOW SERVANT OF MILL OPERATIVE.—The right of a mill operative to recover damages from his employer, in an action recently brought, for injuries received as a result of the lamp circuit in the mill being opened by the electrician of the mill, depended upon whether the electrician and the mill operative were fellow servants within the rule which absolves an employer from liability to a servant who is injured through the negligence of a fellow servant. The plaintiff's work consisted of hauling pulp from the lower section of the mill to a room in the upper part of the mill, called the "Heater" room. The plaintiff was obliged to pull a truck loaded with the pulp over a platform leading from the mill entrance to the platform of an elevator. On a certain occasion the elevator platform was without sufficient light for plaintiff to see to perform his duties. In this condition of the light the plaintiff stepped around the truck to push it from the elevator platform, fell from the platform to the bottom of the elevator shaft, and sustained the injuries complained of. The light was turned off by the electrician in the mill, who had been instructed to use light only when required for the operation of the mill. It was contended that the defendant was liable because the electrician and plaintiff under the circumstances shown were not fellow servants. The argument was that the electrician was employed to perform a separate and distinct part of the work of running the mill, and was given full control thereof by the defendant, and that his duties were so completely separated from those of the plaintiff and the other mill operatives that he could not be said to have been engaged in a common employment with them. It was held that the plaintiff's and the electrician's duties were not so remotely connected as to remove them from a common employment, and a number of instances were cited in support of the holding. Miller vs. Centralia Pulp Co., Supreme Court of Wisconsin, 113 N. W. Rep., 954.

RIGHT OF ELECTRIC COMPANY TO RECOVER AGAINST MUNICIPAL BOARD FOR EQUIPMENT FURNISHED.—In an action against the city of Waseca and the water and light board of that city, by the American Electric Company, to recover for materials which had been furnished by the company for equipping an electric lighting plant, the defenses interposed by the defendant were held to be unavailing and the company was permitted to recover. The plaintiff company had entered into a contract with the board, by the terms of which the plaintiff agreed to furnish and deliver to the board at the city of Waseca equipment, apparatus, and machinery for the extension of the city's light plant, the purchase price of which was $3,700. The plaintiff complied with the contract and shipped the material to the board at Weseca, a portion of which was received and accepted by the board and was never returned. A dynamo, part of the machinery so contracted to be sold, was not shipped at the time of that which was received and accepted, but at a later date. About the time of the shipment of the dynamo a controversy seems to have arisen between the water and light board and the mayor or city council with reference to the propriety of the proceedings by the board, and an injunction suit was brought restraining the further performance of the contract. The dynamo referred to remained at the railroad station during this time, the board being unable to accept it because of the injunction. It was subsequently returned to the plaintiff and sold to other parties with the consent of the board, the company agreeing to furnish a new one when the controversy at Waseca would cease and the board should order it. The plaintiff made due demand for payment for the material furnished and accepted by the board, which the city refused to make, whereupon this action was brought. One of the defenses depended upon by the board was that the action could not be maintained against the board, for the reason that it was a mere agency of the city, incapable of being sued for goods sold to it for the use of the city. It was held that the board was, under the provisions of the charter of the city, clothed with the exclusive superintendence, control and management of the city light plant, and authorized to enter into contracts for and on behalf of the city, within the limitations contained in the charter, and judgment was given in favor of the company. American Electric Co. vs. City of Waseca, et al, Supreme Court of Minnesota, 113 N. W. Rep., 898.

TELEPHONE LINE IN HIGHWAY AS AN ADDITIONAL BURDEN ON THE EASEMENT.—A recent decision of the New York Supreme Court, that of Gannett vs. Independent Telephone Company, of Syracuse, 106 N. Y. Supp. 3, holds that the erection of a telephone line along a city street in front of the premises of an abutting owner is a proper street use and that the abutting owner may not, in such a case, restrain the company from erecting its line nor demand compensation. The decision intimates that where the abutting owner owns to the middle of the street, which as a rule he does, and the street is located in a rural district, or may properly be classed as a country road, the maintenance of a telephone line between the center line and the exterior line of the highway constitutes an additional burden, not contemplated by the original dedication of the highway, and not within the scope of the public use and that as such it may be restrained by the abutting owners, unless the company has received the right by grant or condemnation. But a distinction was made between city streets and rural roads. The action here was by the owner of property at Townsend Street in the city of Syracuse, located within half a mile of the center of the city.

But in a more recent Court of Appeals decision it has been held that the owner of the fee in a city street may restrain a telegraph and telephone company from erecting its poles therein, that a dedication of lands for general street and highway purposes does not include such a use, and that the city has no power to permit it without compensation to the owner. This action was brought to enjoin and restrain the defendant telephone company from entering upon the lands of the plaintiff on Fitch Avenue, in the city of Auburn, N. Y., for the purpose of digging holes and erecting telephone poles for the stringing of wires. With reference to the lower court decisions the court said: "The learned Appellate Division appears to have entertained the view that there was a distinction between rural and urban property. It is undoubtedly true that the use of highways is many times greater in cities than it is in country towns. We had occasion to consider this question to some extent in the case of Palmer vs. Larchmont Electric Company, and in addition to what we then said we only wish to remark that the fee to lands in the city is as sacred to the owner as it is in the country, and that in either place he is protected by the constitutional provision to the effect that property shall not be taken for public purposes without compensation." The court further said: "The primary object of highways is for the public travel by persons and animals and by carriages or vehicles used for the transportation of persons and goods other than by railroads. Sewers drain the surface water from the highways and thus relieve them from impairment and destruction. In this respect sewers are for a street purpose. In addition they may drain also the abutting property and houses, and thus tend to promote the public health. In this respect they are for a municipal purpose. Water supplied by mains through the highways may be used for cleansing and sprinkling the streets. In this respect it is for a street purpose. It may be used by the abutting owners for cleaning and for domestic purposes, and is also used for the extinguishment of fires. In this respect it is for a municipal purpose. Not so with telegraph and telephone wires. They in no way preserve or improve the streets or aid the public in traveling over them. * * * In recent years highways and streets have been appropriated for municipal and individual uses in many instances. This is especially true in the City of New York, where they have been constructing subways or conduits for wires through which there is transmitted electricity not only for lighting, but for telegraphing, telephoning and power purposes. They have also constructed pipe lines through which steam and other products are conveyed. None of these can be held to be for street purposes, but in that city the municipality owns the fee of the streets, and it may therefore contract, sell or grant the use of the streets for other purposes which are not inconsistent with and do not impair the public easement or use for street purposes. Many of our other cities have followed New York in acquiring the fee of the streets. In such cases the fee having been transferred to the municipality, it can grant rights in the streets other than for street purposes, which do not impair the public easement. We therefore cannot recognize the uses to which highways have been subjected in recent years as changing the law or the property rights of individuals." Eliza W. Osborne, appellant, vs. The Auburn Telephone Company, respondent, *Law Journal*, Nos. 13, 1907, p. 629.

Obituary.

MR. W. B. SENTER, general manager of the Amite Electric Light Company, of Amite City, La., died Dec. 27. Mr. Senter was 39 years of age, and is survived by his wife.

MR. JOHN W. KATES, formerly superintendent of the Western Union Company, of Richmond, Va., and later general superintendent of the Postal Telegraph & Cable Company, with headquarters at Richmond, died Jan. 2 at Manchester, Va. Mr. Kates was in charge of the office at

Manassas, Va., during the battles of Blackburn's Ford and Manassas. He transmitted the famous message from Jefferson Davis to General Joseph E. Johnson at Winchester, ordering that officer to make a junction with General Beauregard at Manassas.

Personal.

MR. F. ALTREDE, of Hungary, royal engineer, has been visiting California to inspect the power plants and long-distance transmission lines.

MR. ALBERT B. HERRICK, having finished a line of experimental work conducted at Ridgewood, N. J., has removed his main office to 120 Liberty Street, New York, where he will continue his practice as consulting electrical engineer and electric railway expert.

MR. F. E. FITZPATRICK has resigned his position as superintendent for the local manager of the California Gas & Electric Corporation in Sacramento, Cal. His time is entirely taken up with his work as general manager of the John Martin traction and lighting properties.

MR. B. S. READ, manager of the Cumberland Telephone & Telegraph Company, at Louisville, Ky., has been transferred to New Orleans, and is succeeded by Mr. J. D. Templeman, manager of the Bell exchange at Nashville. A large reception was given them at Louisville on the occasion of the change.

MR. FRED L. FULLAM, general superintendent of the gas and electric light plants at Leominster, Clinton and Ayer, owned and controlled by the Massachusetts Lighting Company, has resigned his position, the resignation taking effect Jan. 1. Mr. John F. Madden, manager of the Clinton plant also resigned.

MR. VICTOR M. TYLER, of New Haven, Conn., was elected director of the Southern New England Telephone Company at a meeting of the directors held Dec. 30, to fill the vacancy caused by the death of his father, Morris Tyler, who was president of the company. A new president will be elected Jan. 28.

MR. HAROLD ALMERT.—Mr. and Mrs. Jacob Henry Tiedman announce the marriage of their daughter, Anita, to Mr. Harold Almert, Dec. 28, 1907, at Chicago. Mr. Almert is a well-known central-station engineer, formerly manager of the Cicero plant at Oak Park, Ill., and now chief engineer of the Edison Light & Power Company of Wichita, Kan. During 1906 he was president of the Northwestern Electrical Association. Mr. and Mrs. Almert will be at home in Wichita after Feb. 15.

MR. F. H. PLAICE, formerly manager of the New Bremen (Ohio,) Electric Light & Power Company, is now manager of the Thornapple Gas & Electric Company at Hastings, Mich. The New Bremen plant was purchased by the city and taken over Jan. 1, 1908. It will be remembered that Mr. Plaice's paper at the last National Electric Light convention created much comment on account of the thoroughness with which possible sources of revenue had been worked at New Bremen and the large earnings per capita shown by the plant.

MR. W. T. MANNING, Mr. George T. Hanchett and Mr. W. D. Young have become associated as consulting mechanical, civil and electrical engineers, with an office and laboratory in New York, and an office in Baltimore. Mr. Hanchett will have immediate charge of the New York office, and Messrs. Manning and Young will reside in Baltimore. As a contributor to these columns and as the author of several electrical engineering treatises, Mr. Hanchett is well known in electrical circles. Mr. Manning is a member of the American Society of Civil Engineers, and has been prominent in railroad circles for the past thirty years, among other duties having been chief engineer of the Baltimore Belt Railroad and of the Baltimore & Ohio Railroad. Mr. Young began his career with the Thomson-Houston Company, going later with the Edison General Electric Company and the General Electric Company. From 1895 to 1901 he was superintendent of the Baltimore Belt Line electrical equipment and electrical engineer of the B. & O. R. R., and in the latter year visited the Philippine Islands to report on transportation conditions there.

Trade Publications.

DIRECT-CURRENT MOTORS for all industrial plant services are illustrated and described in bulletin No. 50A of the Northern Electrical Manufacturing Company, Madison, Wis.

MINIATURE MOTORS.—Catalogue No. 18, of the Knapp Electric & Novelty Company, 511 West Fifty-first Street, New York, is devoted to a line of well-built miniature electric motors, cars and locomotives.

TRACK DRILLS.—Cook's Standard Tool Company, Kalamazoo, Mich., has issued a well executed booklet of information concerning modern methods of maintenance of railways. Much space is devoted to the Climax track drill and the Standard track tool grinder.

METAL SPOOLS.—The Frank Mossberg Company, Attleboro, Mass., has issued a folder devoted to steel reels and metal spools. Catalogue No. 10, of the same company, describes wrenches, bells, reels, punches and dies, and special machinery.

ASBESTOS.—Asbestos in the form of sheet board, roll board, papers, building felts, etc., is described in a circular, No. 7235, recently issued by the H. W. Johns-Manville Company, 100 William Street, New York. Lead-joint runners made of asbestos are described in Circular No. 6875 of the same company.

DIRECT-CURRENT MOTORS.—Bulletin No. 60, of the Mechanical Appliance Company, Milwaukee, Wis., gives an excellent description of the constructive details of Watson motors and generators. Bulletin No. 61 contains 24 pages of illustrations showing various applications of Watson motors.

ALTERNATING-CURRENT GENERATORS for direct connection to steam engines are described in bulletin No. 74 of the Crocker-Wheeler Company, Ampere, N. J. Generators for use with gas engines are dealt with in bulletin No. 84, while belted alternators are treated in bulletin No. 77.

SUCTION GAS PLANTS.—R. D. Wood & Co., Philadelphia, Pa., have issued an illustrated catalogue giving much valuable data concerning the cost of converting the energy of coal into mechanical energy by means of suction gas producers. It is stated that a horse-power-hour can be obtained from one pound of coal.

TANTALUM LAMPS.—The Engineering Department of the National Electric Lamp Association has recently issued a new bulletin, having as its subject the tantalum lamp, as developed up to the present date. Sections are devoted to the performance of tantalum lamps on alternating current circuits and their use with Holophane reflectors.

WESTINGHOUSE STORAGE BATTERIES.—The Westinghouse Machine Company has issued a pamphlet on "Storage Batteries for Portable Service," in which a long line of such batteries is described, adapted for electric locomotives, car lighting, automobiles, railway signal work, etc. This line of storage batteries supplements the Westinghouse storage battery for stationary work which was placed on the market about two years ago.

STORAGE BATTERIES.—Two new booklets have recently been issued by the Electric Storage Battery Company, Philadelphia, "The Exide Instruction Book," of interest to users of electric vehicles, and "The Exide Sparking Battery Instruction Book," giving instructions and information applying to the 1908 model of the exide sparking battery for gasoline vehicles. These books will be forwarded upon application to any of the sales offices of the Electric Storage Battery Company.

PORCELAIN INSULATORS.—The Ohio Brass Company, Mansfield, Ohio, has issued a handsome, 64-page catalogue devoted entirely to porcelain insulators. This company has developed long lines of insulators for both low-tension and high-tension work, ranging from a pony insulator to line insulators for a voltage of 60,000. In addition, the catalogue describes types of wall insulators, high-tension porcelain tubes, porcelain circuit-breakers and various forms of steel insulator pins. An interesting section of the pamphlet is devoted to the subject of insulator tests, concerning which much information of practical value is given.

STANDARD SYMBOLS FOR WIRING PLANS.—The National Electric Contractors' Association of the United States and the American Institute of Architects have issued a chart of standard symbols showing various outlets, fixtures and other wiring devices. The General Electric Company, Schenectady, N. Y., has just issued a booklet containing sample plans of an office or accounting room, and of a kitchen and dining-room, in which the symbols are illustrated. The other pages of the brochure are used to illustrate and describe many of the G. E. specialties indicated by the symbols in the plans. Among these are key sockets, "Security Snap" pendant sockets, ceiling rosettes, cabinet panels, wireless clusters, snap switches, flush pocket wall receptacles, floor outlets, receptacles for heating devices, lamp receptacles, combined switch and cutouts, etc. The booklet is being given a very wide circulation with the hope that it will aid in the general adoption of the standard symbols.

FORE RIVER SHIP BUILDING YARD.—The ship yard of the Fore River Ship Building Company, of Quincy, near Boston, Mass., although opened only a few years ago, has already become one of the most important plants on the Atlantic coast for the construction of large ships. It would be difficult to find one equipped more completely and embodying more of everything that is latest and best in engineering practice, as will be seen from a reading of Allis-Chalmers Company's bulletin No. 2034, which, besides containing illustrations of motor applications, gives a description of the various features of electrical equipment furnished by that company, one of the most interesting of which is the system for speed variations. The generator is operated on the two-wire plan, supplying the highest voltage, 240 volts, and on this voltage are operated all the constant speed motors, the crane motors and the lighting system of the yard. For variations of speed, this voltage is divided into three, by means of a balancing transformer, and by proper combinations a number of pressures may be obtained. The system is one in which the impressed electro-motive force upon the armature of a motor is changed to meet the requirements of speed regulation; or, in other words, change of speed is secured by increasing or diminishing the pressure and not by varying the resistance, as is more commonly practiced.

Business Notes.

GRAY & GROSH.—At Salt Lake City, Messrs. Owen M. Gray and Milton D. Grosh have organized a firm with the above title, for general engineering practice, making a specialty of mechanical, electrical and hydraulic work.

ROBBINS & MYERS.—The Robbins & Myers Company, of Springfield, Ohio, has just opened a store and salesroom in Chicago at 48 West Jackson Boulevard, the Atlantic Building, and will carry there a large stock of its well known fans and power motors.

THE ELECTRIC SERVICE SUPPLIES COMPANY has made a change in its St. Louis office, Mr. N. P. Hall temporarily succeeding Mr. Ernest Boehme, former manager of the St. Louis branch. A rearrangement of the personnel of the branch will be made early in the year.

B. S. BARNARD & COMPANY, 39-41 Cortlandt Street, New York City, manufacturers of electrical clay conduits for underground work, with factories throughout the West, have established an office in Chicago in the Monadnock Building. Mr. B. S. Barnard, who is still president of the Standard Vitrified Conduit Company, is also president of B. S. Barnard & Company, and will retain headquarters at their New York office, managing the sales of both. Mr. Barnard has been identified with the electrical field for the past 15 years, and is thoroughly conversant with the requirements of the trade in this line, having successfully executed some of the largest conduit contracts given out of late years. He is a member of the National Electric Light and National Telephone Associations, the Railway Club and several of the leading clubs in New York. Having factories throughout the West, in view of the large business to be done in this line next season, he has established a Western office, which will be in charge of Mr. E. F. Kirkpatrick, who occupies a position in the West similar to that held by Mr. Barnard in the East. Mr. Kirkpatrick was with the General Electric Company, Westinghouse and Fort Wayne Electric companies for some years and of late has been very active in the manufacture of clay conduits. Mr. Kirkpatrick is taken into the corporation as vice-president, managing the Chicago office. B. S. Barnard & Company's Western factories place their new office in a position to quote favorable prices, on account of the advantage in freight rates. The Electrical Show in Chicago, and the National Telephone Convention, will find on exhibition the product of B. S. Barnard & Company, which will be in charge of Messrs. Barnard and Kirkpatrick, jointly.

CHICAGO ELECTRICAL SHOW.—Twenty per cent more space for the Chicago Electrical Show than last year has already been sold and the number of exhibitors is greater. For music, John C. Weber's prize band of Cincinnati has been engaged, assisted by Miss Blanche Mehaffey, soprano soloist. The exhibit includes a nine-room house completely equipped by the Commonwealth Edison Company; the wireless telephone of the Radio Telephone Company; an electrical sign writer by Mr. L. I. Kahn; purifying water by the Ozone Company of America; special sanitation devices by the Thordarson Electric Manufacturing Company; a model of the Brennan gyroscopic car in operation; high voltage, high frequency experiments, and the typograph for transmitting typewriter letters and receiving them. The exhibitors are as follows: Alexander, F., Manufacturing Company; American Automatic Telephone Company; American Clock Company; American Electric Fuse Company; American Electric Novelty Company; American Electric Telephone Company; American Steel & Wire Company; American Telephone Journal; Anderson, A. & J., Manufacturing Company; Atlas Anchor Company; Automatic Electric Company; Automatic Igniter Company; Austin, H. B., & Company; Barnard, B. S., & Company; Benjamin Electric Manufacturing Company; Big "4" Manufacturing Company; Bristol Company; Buyers' Reference Company; Central Telephone & Electric Company; Central Electric Company; Century Telephone Construction Company; Chicago Lamp & Reflector Company; Chicago Telephone Supply Company; Chicago Fuse Wire & Manufacturing Company; Chicago Telephone Company; Chicago Pneumatic Tool Company; Commonwealth Edison Company; Cook, Frank B.; Couch, S. H., Company; Crane Company; Cullerton, John F., Company; Crescent Manufacturing Company; Dean Electric Company; Dixon, Jos., Crucible Company; Dossert & Company; Electric Appliance Company; Electrician Publishing Company; Electrical Review; Electric Storage Battery Company; Electrical World; Electrocraft Publishing Company; Einstein, A. O., Company; Federal Electric Company; Fort Wayne Electric Works; General Compressed Air & Vacuum Company; General Electric Company; International Correspondence Schools; International Telephone Manufacturing Company; Jewell Electric Instrument Company; Johns-Manville Company; Kellogg Switchboard Company; Lang, J., Electric Company; Lindstrom-Smith Company; Manhattan Electric Supply Company; Manufacturers' Record; Matthews, W. N., & Bro.; Moline Incandescent Lamp Company; Monarch Electric & Wire Company; Monarch Telephone Manufacturing Company; McDowell-Stocker Company; McRoy Clay Works; National Lamp Association; North Electric Company; North Shore Electric Company; Nungesser Electric Battery Company; Pardee, F. W.; Phoenix Glass Company; Public Service Publishing Company; Roebling, John A., Sons Company; Roth Bros. & Company; Shelton Electric Company; Solar Electric Company; Sterling Electric Company; Stoltz Electrophone; Stromberg-Carlson Telephone Manufacturing Company; Swedish-American Telephone Company; Swedish Electric Vibrator Company; Telephony Publishing Company; United Clock Company; Universal Manufacturing Company; Vivax Storage Battery Company; Vote-Berger Company; Wagner Electric Manufacturing Company; Western Electric Company.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 31, 1907.

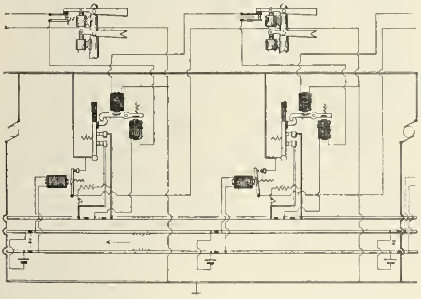
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

874,941. ELECTRIC CLOCK; Ulysses L. Collins, St. Louis, Mo. App. filed March 13, 1907. Relates to an electric-operated winding mechanism for clocks. Includes a form of motor having an oscillating armature.

874,944. ART OF ELECTRIC SMELTING; Frank Creelman, New York, N. Y. App. filed Jan. 5, 1904. The production of calcium carbide by fusing the entire mixture in a zone of fusion produced by an electric arc maintained by a source of energy of substantially uniform amperage.

874,977. INCANDESCENT ELECTRIC LAMP; Charles L. R. E. Menges, The Hague, Netherlands. App. filed May 22, 1899. A process for producing incandescent conductors or filaments for electric lamps.

874,979. TROLLEY HARP; William J. Murphy, Bridgeport, Conn. App. filed July 20, 1904. The trolley wheel is pivoted between jaw members of the harp which are resiliently pressed together, whereby the bearing will automatically take up wear.



875.028. Train Stop for Electric Railways.

874,990. MULTIPLE VOLTAGE SYSTEM OF MOTOR CONTROL; William H. Powell, Norwood, Ohio. App. filed Oct. 19, 1905. Relates to controllers for electric motors, and particularly controllers adapted to vary the speed of a motor by changing the voltage applied thereto and operated from a multiple voltage system.

875,028. TRAIN-STOP FOR ELECTRIC RAILWAYS; Ernst Woltmann, New York, N. Y. App. filed Feb. 23, 1907. Relates to railway installations in which the power is supplied through a third rail constructed in insulated sections for train-stop and other purposes. Patentee provides connecting bonds for the separate sections whereby the third rail acts as a current-carrying conductor for the transmission of the power of the system. In this way separate copper cables are made unnecessary or greatly economized.

875,029. ELECTRIC SWITCH; James J. Wood, Fort Wayne, Ind. App. filed April 28, 1905. An electric switch adapted for use in a prepayment meter for cutting off the electric light when the meter makes its final counting down movement upon the measuring out of the amount of electric energy for which the customer has prepaid.

875,030. SWITCH FOR ELECTRIC METERS; James J. Wood, Fort Wayne, Ind. App. filed Sept. 19, 1905. Relates to modifications of the above.

875,035. ELECTRICAL IGNITING DEVICE FOR GAS STOVES; Vincent C. De Ybarrondo, Los Angeles, Cal. App. filed May 20, 1907. A form of spark plug particularly adapted to gas stoves for igniting the same.

875,040. AUTOMATIC LEAK INDICATOR FOR SHIPS; Charles Bergstrom, Tammerfors, Russia. App. filed July 5, 1907. Covers a float chamber having an electric contact device by means of which a leak in a ship is indicated.

875,057. RAILWAY TIE; Eli T. Forrester, Washington, D. C. App. filed June 29, 1907. Conduit construction for underground trolley roads; has a combined tie and yoke of composite or cushion form.

875,059. HYDRO-ELECTRIC MACHINE; Henry E. Fry, Dorchester, England. App. filed April 15, 1907. An apparatus for generating electricity directly by a steam jet on the principle of the frictional generation of electricity.

875,061. VENTILATION OF ELECTRIC RAILWAY MOTORS; George Gibbs, New York, N. Y. App. filed July 24, 1907. A complete pneumatic piping system extending co-axially through the pivots of the bogie trucks.

875,062. METHOD OF PRODUCING CAMPHOR FROM CAMPHENE, ISOBORNEOL OR OTHER CAMPHOR-PRODUCING SUBSTANCES; App. filed Jan. 26, 1906. The process of obtaining camphor which consists in suspending isoborneol in a solution of an alkali metal chlorid, passing an electric current through the mixture and separating the camphor.

875,063. SAFETY CAR SIGNALING DEVICE; George W. Goddard, Philadelphia, Pa. App. filed Jan. 15, 1907. Provides means for preventing the conductor from ringing the bell whenever there is anybody standing on the step or boarding or alighting from the car.

875,081. TELEPHONE-DICTATING SYSTEM OR APPARATUS; John W. Kelly, Jr., Camden, N. J. App. filed April 15, 1907. A dictating apparatus for business offices in which a single manager may dictate letters telephonically to any one of a corps of stenographers. Has a very sensitive transmitter and a loud ear-piece at the manager's station and the circuits arranged so as to be entirely separate in the respective directions. Only three wires are employed, however, between the manager's station and any stenographer's station.

875,091. ELECTRICAL ALARM DEVICE; Burnett Menkin, New Haven, Conn. App. filed July 18, 1905. An alarm device having means whereby the closing of one circuit will automatically effect the closing of a second circuit and cause the alarm device to be continuously actuated until the second circuit is manually broken.

875,105. ELECTROLYTIC RECEIVER; Fred C. Pickett, Kansas City, Mo. App. filed March 12, 1907. A receiver for electromagnetic waves having the receiving point with a split flattened end portion in an envelope of viscid material.

875,120. AUTOMATIC ELECTRIC BLOCK SIGNAL; William A. D. Short, Lexington, Ky. App. filed Nov. 25, 1905. Automatic block signals for systems of that type known as a spindle-operated electric-motor signal in which the controlling mechanism is located directly in line with the spindle shaft on top of the signal post.

875,138. TELEPHONE TRANSMITTER; Christian Umbrach, New York, N. Y. App. filed Feb. 8, 1907. In a telephone transmitter, a button provided with a movable electrode having a stud projecting therefrom, a diaphragm, means for supporting said button and diaphragm, and means for securing said diaphragm to said stud, said means being self-adjusting to adapt itself to the angle at which the stud and diaphragm are assembled.

875,156. TELEPHONE TRANSMITTER; Henry P. Clausen, Chicago, Ill. App. filed Aug. 20, 1902. Renewed April 6, 1905. Has two diaphragms communicating by curved passages with a single mouthpiece.

875,178. ELECTRIC MOTOR; Dugald C. Jackson, Madison, Wis. App. filed Feb. 20, 1901. In an induction motive device, the combination with means for creating a single-phase alternating field, of an armature provided with electric circuits having different time constants subjected to said single-phase, alternating-current field, the said field inducing out of phase currents in said armature circuits, substantially as described.

875,179. ALTERNATING-CURRENT MOTOR; Dugald C. Jackson, Madison, Wis. App. filed April 1, 1901. Renewed March 17, 1904. The herein-described method of operating induction motors, which consists in creating a single-phase, alternating field, subjecting a revolubly mounted electric conducting circuits of relatively different reactance or resistance to the action of said field in its normal unmodified condition, substantially as described.

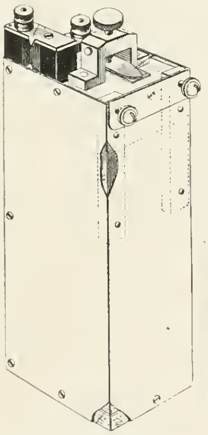
875,198. ELECTRIC BOND FOR RAILS; Frank M. Marcy, Worcester, Mass. App. filed May 3, 1906. Two conical blocks are connected by a bond compressed transversly thereinto by the force which hammers the blocks in place.

875,205. ELECTRIC REGULATION; Morris Moskowitz, New York, N. Y. App. filed Jan. 5, 1906. Relates to means for regulating electric circuits, particularly lamp circuits using a constant-current machine and a storage battery in multiple.

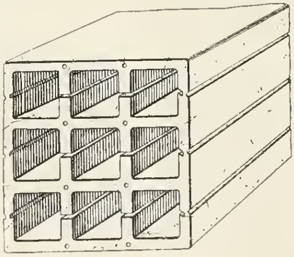
875,207. FIELD MAGNET; William D. Pomeroy, Norwood, Ohio. App. filed Oct. 30, 1903. Relates to dynamo electric machines of the revolving field type in which all the parts are held firmly in place and prevented from working loose in use.

875,208. PROCESS OF PRODUCING FERROVANADIUM; Edgar F. Price, Niagara Falls, N. Y. App. filed Dec. 29, 1906. Relates to the production of ferrovanadium low in silicon and containing a moderate percentage of carbon.

875,213. SECONDARY OR STORAGE BATTERY; Hugh Rodman and George M. Howard, Philadelphia, Pa. App. filed Dec. 22, 1905. The active material for the negative plates consists of lead or an oxide of lead containing sulphate of barium precipitated from a cold solution.



875,472. Induction Coil and Box for Explosion Engines.



875,489. Conduit Tile.

875,215. TROLLEY POLE; Frederick M. Ross, Newport, Ky. App. filed March 4, 1907. A form of trolley retrieving device having latches which are tripped by a sudden abrupt movement of the pole.

875,238. COMPUTING METER; Warren E. Boyce, Pierce City, Mo. App. filed Oct. 3, 1906. Provides a meter which will compute and indicate the value of the energy consumed in dollars and cents, instead of in kw-hours.

875,259. METHOD OF EXTRACTING METALLIC ORES AND MATTE; Emil Gunther and Rudolf Franks, Eisleben, Germany. App. filed June 18, 1907. Relates particularly to the treatment of copper and nickel ores and to matte produced from such ores.

875,279. JUNCTION OR CONNECTING BOX; John A. McCoy, Somerville, Mass. App. filed March 19, 1906. Connection box at which a plurality of cables terminate and in which means are provided for interconnecting the conductors of the cables.

875,284. GRANULAR FURNACE; Henry N. Potter, New Rochelle, N. Y. App. filed May 14, 1904. An electric furnace consisting of a refractory heating resistance composed of free granules clamped between refractory electrodes, together with a refractory hollow body embedded within the said granular resistance.

875,285. METHOD OF MAKING SILICON; Henry N. Potter, New Rochelle, N. Y. App. filed June 10, 1905. The method of producing silicon by reducing silicon monoxide.

875,286. ART OF PRODUCING SILICON MONOXID; Henry N. Potter, New Rochelle, N. Y. App. filed June 14, 1905. The process of producing silicon monoxid which consists in causing an incomplete combustion of metallic silicon.

875,313. BLOCK SIGNAL APPARATUS; Alexander Bevan, Providence, R. I. App. filed April 18, 1907. Block signal system in which the signals are automatically operated by the passing cars to indicate the presence or absence of a car in the block, as well as the direction in which it may be moving.

875,331. FURNACE FOR DESULFURIZING AND AGGLOMERATING ORES; Andrew J. Dull, Harrisburg, and Joseph Weatherby, Jr., New Cumberland, Pa. App. filed Feb. 4, 1907. Construction of ore roasting furnace having a plurality of electrodes, one of which moves the agglomerated ore beyond the radius of action of the arc.

875,332. PROCESS OF DESULFURIZING AND AGGLOMERATING COMMINUTED ORES; Andrew J. Dull, Harrisburg, and Joseph Weatherby, Jr., New Cumberland, Pa. App. filed Feb. 4, 1907. Covers modifications of the above.

875,357. LAMP SOCKET; Walter R. Lambert, London, England. App. filed Feb. 1, 1907. Form of receptacle having a small spiral spring to constitute the central stud contact terminal.

875,376. HANDLE FOR ROTARY SNAP SWITCHES; Johann G. Peterson, Bridgeport, Conn. App. filed Nov. 21, 1905. Construction of handle or turn button for rotary snap switch.

875,394. ELECTRIC HEATER; August Voelker, Berlin, Germany. App. filed June 6, 1906. Form of resistance element having a cylindrical cartridge with a circuitous passage including refractory comminuted resistance material.

875,406. SWITCH; Christian N. Bergmann, Allegheny, Pa. App. filed May 4, 1905. Features of construction of a knife-blade switch by which the handle is securely attached to the blades.

875,410. PRINTING TELEGRAPH RECEIVER; John Burry, Ridgefield Park, N. J. App. filed Nov. 19, 1904. Relates to receiving or printing apparatus for type telegraph systems.

875,413. ELECTRIC SIGNALING; Dorabji M. Daboo, Bombay, India. App. filed July 17, 1905. Provides means whereby the controlling devices may all be electrically worked from one desired station to another, irrespective of distance.

875,454. AIR BRAKE; Edmund B. Powers, New York, N. Y. App. filed Feb. 26, 1907. Provides means whereby an engineer may test the entire length of a train pipe for obstructions, the result being indicated by a signal in the cab.

875,472. INDUCTION COIL AND BOX FOR EXPLOSION ENGINES; Richard Varley, Englewood, N. J. App. filed July 24, 1907. An induction coil unit for automobiles and other uses where induction coils are used in a series arranged side by side. In place of a wooden receiver, patentee makes use of a sheet-iron box open at one side to prevent choking the coil, and which effectively shields its action from the adjacent coils, thereby preventing cross induction.

875,489. CONDUIT-TILE; John Balch, Newark, N. J. App. filed Feb. 5, 1907. A conduit having grooved opposing walls and slotted interior division walls.

875,491. ALARM CIRCUIT; Joseph F. Bastel, St. Louis, Mo. App. filed June 28, 1906. A form of indicator to produce a signal in case the rails of a track are disturbed.

875,536. ELECTRIC CONTROLLER; Joseph Ledwinka, Philadelphia, Pa. App. filed Aug. 3, 1907. A means to permit the contemporaneous charging of the storage battery and operation of the vehicle motors by connection with the railway supply system when the current of such system is of such voltage as not to be directly applicable to charge said storage battery.

875,581. SYSTEM OF ELECTRIC MOTOR CONTROL; Henry D. James, Pittsburg, Pa. App. filed May 6, 1907. System of motor control in which the energy is supplied through sources of different voltages. Has means whereby a large range of speeds can be secured.

875,582. MULTIVOLTAGE SYSTEM OF ELECTRIC MOTOR CONTROL; Henry D. James, Pittsburg, Pa. App. filed May 6, 1907. Relates to modifications of the above.

875,583. METHOD OF CONTROL OF ELECTRIC MOTORS; Henry D. James, Pittsburg, Pa. App. filed May 6, 1907. Covers additional modifications.

875,584. MULTIPLE VOLTAGE SYSTEM OF CONTROL; Henry D. James, Pittsburg, Pa. App. filed May 6, 1907. Modifications of No. 875,581.

875,596. TROLLEY POLE RETRIEVER; Luther M. Perkins, Tacoma, Wash. App. filed May 6, 1907. A pneumatically operated retriever having a valve which opens to admit air to the retrieving cylinder in case the trolley wheel leaves the wire.

875,632. METHOD FOR DETINNING AND PRODUCING TIN COMPOUNDS AND OTHER PRODUCTS; Elmer A. Sperry, Brooklyn, N. Y. App. filed Aug. 24, 1907. The process of anhydrous detinning which consists in subjecting compacted scrap to the action of chlorinated anhydrous liquid and feeding dilute heated chlorin to the mass.

875,641. APPARATUS FOR REFINING COPPER; Frank L. Antisell, New York, N. Y. App. filed July 5, 1906. Relates to apparatus for electrolytic refining of copper where an impure copper anode is suspended in an electrolyte and deposited in an approximately pure state by an electric current.

875,643. PRINTING TELEGRAPH; John C. Barclay, New York, N. Y. App. filed April 22, 1905. Details of circuits and mechanical construction.

875,660. PRINTING TELEGRAPH; Frederick J. Haig, Hyattsville, Md. App. filed Aug. 30, 1906. Construction of printing telegraph in which the transmitter closely resembles in structure and in operation the usual commercial typewriting machine.

875,663. SYSTEM OF CONTROL; Henry D. James, Pittsburg, Pa. App. filed May 6, 1907. Provides an arrangement of the circuits of the motor control system by which the proper voltages may be applied to the operating or controlling magnet windings of the separately actuated switches of the control system.

875,668. PROCESS OF PRODUCING AN ALLOY FOR USE IN STEEL-CASTING; Maurice Meslans, Paris, France. App. filed July 7, 1902. An alloy of aluminum and calcium containing more than 8.6 per cent calcium.

875,672. METHOD OF MAKING SILICON; Henry N. Potter, New Rochelle, N. Y. App. filed June 10, 1905. The method of producing silicon which consists in reducing silicon monoxid by heating it with silicon carbide.

875,673. METHOD OF MAKING SILICON CARBID; Henry N. Potter, New Rochelle, N. Y. App. filed June 10, 1905. The method of producing silicon carbid by heating together one equivalent of silicon monoxid and two equivalents of carbon.

875,674. METHOD OF MAKING SILICON DIOXID; Henry N. Potter, New Rochelle, N. Y. App. filed June 10, 1905. The method of producing comminuted silicon dioxid which consists in oxidizing silicon monoxid.

875,675. METHOD OF PRODUCING SILICON MONOXID; Henry N. Potter, New Rochelle, N. Y. App. filed June 10, 1905. The method of producing silicon monoxid which consists in reducing silica by means of silicon.

875,676. METHOD OF PREPARING SILICON-MONOXID POWDER; Henry N. Potter, New Rochelle, N. Y. App. filed June 10, 1905. The method of producing silicon-monoxid powder which consists in distilling vitreous silicon monoxid.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, JANUARY 18, 1908. No. 3.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, Pres.; Curtis E. Whittlesey, Sec. and Treas.
239 West Thirty-ninth Street, New York.
Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office....................................590 Old Colony Building
Cleveland Office..................................1015 Schofield Building
Philadelphia Office......................Real Estate Trust Building
San Francisco Office.............................601 Atlas Building
European Office....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.........................per year, $3.00
Dominion of Canada...4.50
Other Foreign Countries within the Postal Union...................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should he made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1906, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 16,250 copies are printed.*

NEW YORK, SATURDAY, JANUARY 18, 1908.

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THE KELVIN EXERCISES.

It was altogether felicitous and appropriate that the American Institute of Electrical Engineers should hold memorial services in honor of the late Lord Kelvin. This distinguished physicist was not only one who had done much to bring this country in closer social and commercial intercourse with his own by means of the submarine cable, but his relationships with our leading electrical engineers were always and throughout of the most friendly and intimate character. The remarks and reminiscences at the exercises were in themselves a clear evidence of this, if any were needed. But Lord Kelvin had also from the first taken a deep interest in the welfare of the Institute, had extended hearty courtesies to it and had accepted grateful courtesies in return. The officers of the Institute are to be congratulated upon this function, and upon the dignity and success that attended this effort to pay a final tribute to one who was never more happy than when on these shores studying American advance and, in his own words, deriving fresh inspiration from contact with American electrical engineers.

From 1884, when the Institute was founded, and when the first annual meeting was held at Philadelphia, down to 1902, when Lord Kelvin last visited this continent, was a period of tremendous electrical development, and the 20 years embraced advances and inventions on this side of the water that appealed strongly to the intensely practical side of his nature. Aged as he was at the time of his departure, he expressed quite cheerfully the hope of coming over again in a few years to find new objects of interest and admiration. His life and work remain a stimulus, which will be all the greater if we realize that as in his case, it is possible to prosecute and promote the furthermost researches of pure science without loss of scientific dignity, while urging on to their best endeavor the men who are striving to turn discovery to the benefit of mankind. This he never disdained, but, on the contrary, he was ever ready to construct and design, the compeer in his time of any other great inventor.

THE SLIDE RULE IN THE CALCULATION OF REACTANCE

As Thomas Carlyle remarked, man is a tool-using animal In fact, we might refine upon this remark, and say that the engineering man is a slide-rule using animal, a creature that is apt to have a slide rule in his inside jacket pocket. It is really wonderful that a rule carrying a divided scale ten inches long should be able to effect a single multiplication or division to a precision of at least 1 part in 500. During the last few years, the slide rule has become the engineer's *vade mecum* in all parts of the civilized world. The designing and computing offices of engineering works have been described by casual visitors as places where the men spend their time in pushing slide rules. A number of methods of computation adapted to the slide rule have appeared in our columns since 1900. Thus, we have methods for computing the diameter or area of any given size of wire, the change in resistance of copper conductors with temperature, and of the size of wire required for a given distance, current and drop. The object of these methods is not merely to facilitate computation, but also to dispense with tables, making the slide rule take the place of a table.

On page 142 we publish this week another slide-rule method of computation, by Mr. M. S. Howard, for calculating the reactance of alternating-current transmission lines. A formula is first derived which expresses the reactance per thousand feet of wire at the frequency of 60 cycles per second in terms of the logarithm of a square root, and this is readily applied to the slide rule. There can be no doubt that where many such reactances have to be worked out successively, or where such reactances have frequently to be computed, this formula will save time to learn and to use. When, however, such computations only occur at rare intervals in the particular work of an engineer, it is questionable whether it is worth while spending much time in learning this slide-rule method, because it becomes doubtful whether he will remember the method so as to apply it with confidence when the time comes. He had better be able to reconstruct in his mind the fundamental formula for reactance in case he has no tables available, even though the practical computation should thus be rendered longer and more cumbersome. Or, he might record the formula on the back of his slide rule. This does not, of course, depreciate the value of the slide-rule method for those who are in a position to employ it frequently.

It might be worth the pains of some manufacturer of slide rules to print indelibly on the backs of the rules some of these slide-rule formulas. An electrical engineer's slide rule would then differ from a civil engineer's slide rule, in respect to the data furnished on the back of the rule. It is remarkable how much data can be recorded in compact form in the 25 sq. cms. available surface on the back of a slide rule. It has been aptly said that Napier's invention of the logarithm tables has virtually doubled the lives of astronomers since his day. Engineers do not, of course, ordinarily occupy themselves with computing or logarithms as much as the average astronomer, but the slide rule has undoubtedly enhanced the benefit of logarithms to the engineer by engraving them on tablets of wood and celluloid for his ready transportation. The adaptation of frequently recurring formulas to slide rule use is distinctively a twentieth century accomplishment.

SERIES-REPULSION RAILWAY MOTOR.

As noted on page 144 of this issue, Mr. E. F. Alexanderson at the January meeting of the A. I. E. E. described a type of single-phase commutator developed for railway service within the past few months. As actually built, the motor is provided with a fractional-pitch armature winding such as is commonly used on a direct-current motor, its main field coils are arranged in a manner identical with that used with a compensated single-phase series motor, while its "compensating" coils differ from those of the latter machine in being given twice as many turns as the armature, and in being subjected to an e. m. f. in time-phase with the supply e. m. f. rather than being required to carry a current in direct phase-opposition with the armature current. Under running conditions, the machine possesses the advantage over the compensated-series motor of exhibiting no tendency to spark at the brushes, and the relative disadvantage of operating at a lower power factor. At starting the machine has an advantage over the corresponding compensated-series motor in possessing a decreased short-circuit voltage at the coil under the brush for the same starting torque, but is at a disadvantage in comparison with a motor having resistance-leads in that even the lower voltage produces a greatly increased short-circuit current.

It would seem that the disadvantageous lower power factor under running conditions can be rendered of secondary importance, because the problem of increasing the power factor of a single-phase commutator motor is one that permits of a simple and easy solution. It can safely be stated, therefore, that the Alexanderson motor at running speed possesses advantages that greatly overbalance its disadvantages. The disadvantageous starting conditions inherent in all simple forms of single-phase commutator motors have not been eliminated in the new machine, although an attempt has been made to minimize the cause for the heating and sparking at very low speeds, or with stationary armature. To what extent the excellent running characteristics of the Alexanderson motor overbalance its poorer starting features, only actual operation under service conditions can determine. Doubtless, however, when the design proportions are such, and the equipment can be so arranged, that the armature cannot be stalled and is never required to run at low speed for any appreciable length of time, the new motor will give good service. Thus the machine seems well adapted for single-car interurban service and for multiple-unit train propulsion. The starting conditions in locomotive service are much more severe, and experience will be necessary before final judgment can be passed as to the adaptability of the new motor for use with locomotive work.

SOLENOIDS IN SERIES WITH RESISTANCE.

The solenoid is the favorite form of electromagnet intended for a long pull and a strong pull. It is not, of course, the only type of electromagnet capable of assuming such duties, but it is a form which has done good service in this respect, and with which much experience has been already gathered. The behavior of a solenoid of arbitrarily assigned dimensions and winding, is a very complex matter to analyze and determine. Nevertheless, in certain standard forms of jacketed solenoid, the laws of the pull at different points of the stroke have been fairly well cleared up, so that an experienced designer can frequently predict the pull of a standard solenoid with a satisfactory degree of precision. The ordinary data are the voltage applied to the solenoid, the initial pull required and the limiting current strength or the watts developed in the coil. In recent years, solenoids are frequently installed with a resistance in series inserted either automatically at the end of the stroke, or permanently, thereby reducing the current and power in the solenoid. Special modifications of the ordinary formulas have to be adopted in the design and computation of such solenoids. The matter is discussed by Mr. Charles R. Underhill in the article on page 140.

The article shows clearly that if we have to work a solenoid through a given extra resistance, say 200 ohms, on a constant-potential circuit of, say, 500 volts, we shall develop maximum watts in the solenoid when we make its resistance equal to the fixed external resistance, or 200 ohms in the case considered. Because, if we make the solenoid's resistance very small we may get a current of nearly 2½ amperes, but with only a very small voltage across the solenoid terminals. On the other, hand, if we make the resistance of the solenoid very large, we may get nearly 500 volts across its terminals, but the current will be very feeble. With a 200-ohm solenoid the current would be 1¼ amperes, and the voltage 250, or half of that between mains, making the power a maximum at 312.5 watts in the solenoid, which will be half the power delivered by the mains. Nevertheless, the maximum is not very sharp, and a distinct deviation from equality between internal and external resistance can be made without departing markedly from the maximum watts. Thus, the solenoid might have 250 ohms, and the watts would only diminish to 308.5, a fall of roughly one per cent, or the solenoid might have 150 ohms, and the watts would only diminish to 306, a fall of roughly two per cent.

Having a given size and volume of winding space on the solenoid, the designer usually seeks for a winding which will give the maximum ampere-turns for a given external resistance in series. If this should give unnecessarily great magnetic power, then the design can be improved in economy either by reducing the size of the solenoid, or by increasing the external resistance in series, or both. It is shown that if the thickness of insulating covering on the wire were negligibly small, the winding most powerful in ampere-turns would also be the winding most powerful in watts; that is, with equal internal and external resistance. But owing to the complication produced by the insulating covering, the resistance usually has to be made less than that for maximum watts, and in a general way it is recommended that the next larger size of wire be adopted than works out, with the insulation, for maximum watts. This is a useful rule. The formulas employed would be much simpler if the inch were not employed for workshop purposes, as the unit of length. In practice this will not make much extra difficulty, but in simplifying the steps of the reasoning the metric system offers great advantages.

Dangers of Artificial Lighting.

Dr. Seabrook's paper, read before the Illuminating Engineering Society, and abstracted elsewhere in this issue, is of importance as pointing out some of the dangers incurred in using powerful illuminants. In particular, he lays great stress on the danger of too powerful ultra-violet rays, which have certainly been shown to produce serious lesions of the cornea, iris, and lens. It appears to us, however, that in his paper there is some confusion between this particular action and the general effect of too strong light upon the retina itself. If the action of light upon the retina is due to photochemical action, as is generally believed to be the case by physiologists, then danger from overstimulation of the retinal layer should depend on its photochemical sensitiveness. This, as is well known, has its maximum, not in the red or violet of the spectrum, but at the point where a given amount of luminous energy has the maximum effect, *i. e.*, in the yellow or yellowish green. The rays which may be called actinic with respect to photographic action are relatively very ineffective in vision, and consequently can hardly be supposed to produce considerable photochemical changes in the retina itself. The serious results of too bright light on the retina cannot, therefore, be properly charged against the rays which are known to be ineffective in stimulating it.

On the other hand, there can be little doubt that ultra-violet light if sufficiently concentrated, may get through to the retina in damaging amounts. But this action, if present, must be exercised in the main on other things than the photochemical elements there present, which are incapable of reacting strongly to ultra-violet rays. Hence any possible damage of this sort is incidental rather than direct. In fact, ultra-violet light, unless strongly concentrated, seems to be entirely harmless. Diffused sky light, which is far richer in violet and ultra-violet rays than any common artificial illuminant, is certainly most inoffensive, although its so-called actinic power, as shown for instance, on the ordinary photographic plate, is very high. So far as so-called actinic rays go there is very little difference between incandescent lamps and flames, including the kerosene flame. Arc lamps, especially the enclosed arc of small amperage, give more violet and ultra-violet rays, but even these give a far smaller proportion of such rays than does sky light. The only artificial lights which are conspicuously rich in ultra-violet radiation are the quartz mercury arc and the iron arc used by Finsen. That these at short range are dangerous there is no manner of doubt, and it is worth enquiring whether the titanium arc now in experimental use may not be equally so. Yet even in these cases it is very doubtful whether anything short of extreme concentration of the radiation would produce serious results, and it is reasonably certain that any system of shading which would bring the luminous intensity within reasonable bounds would also effectively cut off the ultra-violet.

Aside from these extreme cases the deleterious effects of too intense light must be charged up to excessive intrinsic brilliancy rather than to special peculiarities of radiation. As Dr. Seabrook very happily pointed out, too intense stimulation may overburden even to permanently crippling the recuperative powers of the retina. Such overstimulation depends on the concentration of energy in the image, which, at short range, depends in turn on the intrinsic brilliancy, *i. e.*, the luminous radiation per unit of surface, of the source. Hence one has an entirely sufficient reason for the infrequency of overstimulation from oil lamps and the like, which have an intrinsic brilliancy of only a few candle power per square inch, as against some hundred in the case of arcs and high-efficient incandescents. The obvious moral is to shade all such sources so as to keep the intrinsic brilliancy low. In the case of natural lighting by diffused daylight the intrinsic brilliancy is considerably lower than in artificial lighting with unshaded sources, and is correspondingly less likely to cause trouble. From the same instructive standpoint of recuperation, the explanation of the good effects of amber glass in protecting the eye become obvious, for amber glass, with its selective transmission in the yellow, lets through precisely those rays which enable one to see most with the minimum access of total energy to the retina. It therefore will have a minimum total work of recuperation to do to compensate for the necessary stimulation. The retina works most efficiently by yellow light, but it must not be overworked even with this, and we are inclined to think that the flaming arc at short range would produce very serious results despite its relative weakness in the violet. Suitable shading is the remedy for all such difficulties.

The Chicago Electrical Show.

As we go to press word comes of the successful opening on Monday evening of the third annual electrical show in Chicago. These Chicago shows have come to have an established place as a kind of midwinter meeting place for the electrical men of the Middle West. They serve not only as an exposition of new appliances for the benefit of electrical men from a large surrounding territory, but give the local central-station and supply interests a chance to read the general public of a great city. Incidentally, in showing to the public of Chicago the various applications of electricity, it also brings before the visiting central-station man some of the latest popular uses for central-station service, which he may go home and introduce in his own town. The decorative lighting scheme of the Chicago show this year is exceptionally elaborate, as described in our issue of last week. It is undoubtedly the best thing of the kind yet done at a temporary show of this nature.

The Chicago show of last year went into history as the first public exhibition of American-made tungsten incandescent lamps in this country. This year's show marks an equally important advance, namely, the exhibition for the first time of quantities of American-made tungsten lamps, not as curiosities, as heretofore, but as regularly manufactured articles available in considerable quantities for common commercial use. Some amusing stories (now amusing, but at that time harrowing), are told of the difficulties of transplanting some of those early tungsten lamps to last year's Chicago show. Difficulties of breakage in transportation seem to be rapidly diminishing, with improvements in manufacture and packing. Next week we shall present in convenient shape for easy reference and reading an account of the new things, both large and small, at the show. The list of new appliances exhibited for the first time at this show is a long one.

Kelvin Memorial Exercises.

Memorial exercises in honor of Lord Kelvin were held in the Engineering Societies' Building, New York, in the main auditorium, on Sunday, Jan. 12, at 3:30 p. m., when in spite of severe weather the attendance was large. The affair was under the direct auspices of the American Institute of Electrical Engineers, of which Lord Kelvin had long been an honorary member, but a number of other societies assisted, their names and official representatives being as follows: American Association for the Advancement of Science, Prof. Edward L. Nichols, retiring president; American Electrochemical Society, Dr. E. F. Roeber, chairman executive committee; Prof. Joseph W. Richards, secretary; American Institute of Mining Engineers, Dr. A. R. Ledoux, past president; American Philosophical Society, Mr. Andrew Carnegie, Prof. Michael I. Pupin; American Mathematical Society, Prof. J. Howard Van Amringe, LL.D.; American Society of Civil Engineers, Mr. Charles Macdonald; American Society of Mechanical Engineers, Rear Admiral George W. Melville, U. S. N., past president and honorary member; American Street and Interurban Railway Association, Prof. B. V. Swenson, secretary; Association of Edison Illuminating Companies, Mr. John W. Lieb, Jr., past president; Franklin Institute, Mr. T. Commerford Martin, corresponding member; Institution of Electrical Engineers (Great Britain), Mr. George G. Ward, honorary secretary and treasurer for U. S. A.; Illuminating Engineering Society, Dr. C. H. Sharp, Dr. A. H. Elliott; National Electric Light Association, Mr. Dudley Farrand, president; Mr. W. W. Freeman, secretary; New York Electrical Society, Prof. A. F. Ganz, president; Mr. G. H. Guy, secretary.

The exercises were accompanied by music furnished by the Kronold Sextette, Mr. Hans Kronold giving "Oh, Rest in the Lord" as a 'cello solo. The prayer and benediction were pronounced by the Rev. W. T. Manning, D.D., who also delivered an excellent brief address on Lord Kelvin's strong Christianity and his reverent nature.

President H. G. Stott, of the Institute, spoke in his introductory remarks from acquaintance with Lord Kelvin, and as to his modesty in spite of all his achievement quoted his utterance: "I have lived long and I have learned enough to realize I know nothing."

Prof. Elihu Thomson spoke of Lord Kelvin as an electrical engineer. He declared that his life was a standing rebuke to those who affect to find a superior merit in working for pure science over working for practical results. Nothing could be less sordid, he declared, than Kelvin's desire to achieve practical results. "It is characteristic of Lord Kelvin," he went on, "to note that his conceptions were complete from the beginning. A pioneer is hampered by lack of men, material, and experience, but on Kelvin's inventions later work only helped out the details, and these were often provided for from the start."

In reviewing the great scientist's visits to America, Professor Thomson spoke of his views with regard to Niagara. "To him there was just as much romance and sublimity in founding great communities, in making real additions to the wealth of the world, in extinguishing the smoke of railroads and lighting towns hundreds of miles away as in a mass of water falling over a precipice. In this I concur. In the daytime there may be many elements of sublimity in the fall, but remember they go on unseen at night or when they are obscured by fog and mist." Professor Thomson in his address referred specifically to many inventions made by Lord Kelvin in electro dynamics and mentioned his dynamo and his instruments of precision.

To Prof. E. L. Nichols, of Cornell, was assigned the topic of "Kelvin as a Scientist." He compared him in his pre-eminence to Helmholtz, and pointed out how hard it is to realize the state of science in 1841, when Kelvin went up to Cambridge, and there were few railroads or steamships, and the telegraph and telephone were entirely unknown. "To Kelvin," he said, "science meant first an effort to give the precise mathematical relation between things and to guess at hidden relations; second, to grasp the mechanism of things when it could be seen or to imagine it when it could not. He had a passion for computation, and in an address at Philadelphia he protested against what he termed the barbarous system of English measurements. He declared it held science in bondage, and hoped that America would free itself from it." This summary by Professor Nichols of Kelvin's physical work was full and admirable.

Mr. George G. Ward, vice-president of the Commercial Cable Company, paid an eloquent and comprehensive tribute to Kelvin's work as a submarine cable engineer and inventor, and spoke as one who had worked from the earliest period of their introduction with his mirror galvanometer and his siphon recorder. Mr. Ward presented a striking list or summary of the work done in this difficult field by one who was so distinctively a pioneer in it.

Rear Admiral G. W. Melville, U. S. N., followed with an equally graphic sketch of the work done by Kelvin in the field of marine engineering, with reference particularly to his compass and his deep sea sounding apparatus. He spoke also from intimate personal knowledge and acquaintance.

Mr. T. C. Martin, past president of the Institute, said that Lord Kelvin, attending the Electrical Congress and Exhibition at Philadelphia, did much to help the struggling Institute, then just brought into existence, by advice and sympathy. Thrice president of the kindred institution in England, his suggestions and ideas had been most helpful and valuable at a time when all the encouragement was needed that could be got. It was natural that Lord Kelvin should early become an honorary member and that the relationship thus early established should be maintained down to the time of his death. The Institute was officially represented at the jubilee of his professorship at Glasgow University in 1896, and when he returned to this country for the last time in 1902 a reception was given him by the Institute, with other societies, at Columbia University, attended by over 2000 persons.

For the exercises a special 6-page programme of simple and dignified design was printed, giving Lord Kelvin's European and American memberships and decorations, and accompanied by the sonnet of Prof. W. M. Stine, printed in these pages Jan. 4.

Automobile Engineers.

The Society of Automobile Engineers held its third annual meeting in New York, Jan. 3, with President A. L. Riker in the chair. Several papers were read and discussed.

The annual dinner was held in the evening, followed by a second business session. It was decided to hold quarterly meetings hereafter, the next one being scheduled for Boston during the progress of the local automobile show there, March 7 to March 14. The following-named gentlemen were elected officers for the ensuing year: Thomas J. Fay, of New York, president; E. T. Birdsall, of Rochester, N. Y., second vice-president, and Henry Hess, of Philadelphia, treasurer; Russell Huff, of Detroit, and F. J. Newman, of Chicago, managers for three years. President Fay appointed Charles B. Hayward as secretary.

January Meeting of the New York Section of the I. E. S.

At the meeting of the New York section of the Illuminating Engineering Society, held on Jan. 9, the following section officers were elected for the year 1908: Chairman, Mr. W. W. Freeman; managers, Messrs. W. C. Morris and Albert Mahle; secretary, Mr. P. S. Millar.

The paper of the evening was read by Dr. H. H. Seabrook, on the "Effects of Light Upon the Eye." After explaining the optic nerves, pigment layer, retina, lenses and cornea of the eye, Dr. Seabrook stated that of the various rays of the luminous spectrum those towards the violet end are the most harmful to the eye. Disintegration and disassociation of the cells in the pigment layer, occurring from exposure to light, are at a minimum in the yellow.

The most satisfactory light is, no doubt, daylight (not sunlight) a few feet within a closed window on a bright day. In this light, finer lights and shadows and delicate colors may best be distinguished by healthy eyes. A greater distance from the source of light diminishes vision, and even taking away the protection of the window glass, causes more dazzling and decreased retinal endurance. The adaptability of the eye is small for increased illumination, and the limits of increase of vision with stronger light is within the medium limits of illumination. The movable kerosene lamp may be, and is usually, placed in a good position to illuminate the object, while the incandescent electric lamp is usually not well placed, often in offices being rigidly fixed so that either the eyes must be subject to direct light, or the head must be bent forward for work, congesting the eyes. No amount of green on a tin shade will correct this improper permanent position of the lamps.

Present lighting effects may be improved by attention to position, including the distance of the source of light from the eyes, as measured by the course of the rays, and protection of eyes by glass properly colored. Light weak in chemical rays is better suited to the eyes than any other.

Many substances absorb chemical rays and allow luminous rays to pass. For practical purposes there seems no need to consider any of them except glass as a protection for the eyes from the intrinsic brightness of too intense light. Neither does there seem any question that yellow is the color to choose to conserve or improve vision and protect the eyes from the chemical action of light. Globes may be used of pink, orange, red, or green, as desired, when the light may be diminished in luminous qualities. It is best to choose for protective purposes that shade of yellow which appears in the best ray filters or is shown in the glass used for modifying the light of developing rooms for photographic plates. This amber yellow may be darkened by a brown admixture for weak or diseased eyes, or to protect from unusual light exposure.

Growth of Western Society of Engineers.

The Western Society of Engineers held its thirty-eighth meeting and banquet at the Chicago Atheletic Association, Jan. 7, 1908. Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company of Chicago, the retiring president, acted as toastmaster. He announced that the society had just reached a membership of 1000. Civil engineers outnumbered the mechanical and electrical in the society, but the majority of papers had been on mechanical and electrical engineering topics. The very important announcement for Chicago engineering circles was made that the society directors had just entered into a 10-year lease for space in the Monadnock Block, which will enlarge the present quarters 100 per cent and afford a larger meeting room with high ceilings in place of the inadequate quarters in which the society has been suffering recently. In the present quarters good ventilation has been impossible, and this has affected both the attendance and the value of the discussions. As both the Western Society of Engineers and the Chicago section of the American Institute of Electrical Engineers hold meetings in these quarters, this matter is of interest to a large number of electrical men in Chicago. At the annual election of the society, electrical interests were represented by the election to the second vice-presidency of Mr. Peter Junkersfeld, electrical engineer of the Commonwealth Edison Company.

Investigation of Centrifugal Pumps.

The recent construction of a complete hydraulic laboratory at the University of Wisconsin has given opportunity for investigation along various lines of hydraulic engineering. The first bulletin, entitled "Investigation of Centrifugal Pumps. Part I. A Discussion of the Theory of the Centrifugal Pump and Tests of a Six-Inch Vertical Centrifugal Pump," has just been issued by the university.

Referring to the theory of the centrifugal pump, the bulletin discusses the general theory as ordinarily given for deriving the theoretical head developed by the impeller of a centrifugal pump, and shows how the various conflicting formulae ordinarily given are essentially the same in result.

The experiments with the six-inch vertical centrifugal pump were arranged specially to investigate the effect, on the discharge and efficiency, of the number and shape of the vanes of the impeller of the pump. For this purpose the impellers to be compared were made of the same general size so as to be easily placed in the same pump casing, while the number and shape of the vanes of the impeller were varied. The general shape of the vanes used was radial, and radial with curved entrance, while the number of vanes for each shape was varied, being six, twelve and twenty-four in number. The form of water way between the vanes was also varied by increasing the thickness of the outer ends of the vanes. The comparison of the results of the experiments thus show the effect on discharge and efficiency of the pump of practically all possible modifications of the simple radial vane. Additional experiments are now being made which will show the effect on discharge and efficiency of curving the vanes of the impeller both forward and backward, and also of varying the form of the pump casing.

The importance of the subject is such that the investigation has been laid out on broad lines and will last several years. It is hoped that the results of the investigation, when completed, will be of material aid to a thorough understanding of the subject.

The general scope of the investigation has been laid out by Daniel W. Mead, professor of hydraulic and sanitary engineering, while the details of the investigation and writing of the bulletins have been performed by Mr. C. B. Stewart, C. E. Copies of the first bulletin, University Bullentin No. 173, may be obtained by addressing the Secretary of the Board of Regents of the University of Wisconsin, Madison, Wis.

Educational Course of the N. Y. Edison Co.

The lecture course on electrical engineering provided by the New York Edison Company for its employees has proven an effective means for raising the technical status of the employees. The lectures are given by Prof. Sydney W. Ashe under the auspices of the Association of Employees of the New York Edison Company, a special lecture committee having been appointed consisting of Messrs. W. I. Donshea, W. T. Fernandez, W. H. Lawrence, A. H. Lawton, Alexander Maxwell, chairman, and Samuel Ring, secretary. Twelve of the lectures from a series of 25 have thus far been completed, and the total attendance has been about 4000 men.

In carrying out the general scheme of these lectures, it has been found advantageous to distribute to all employees a syllabus giving dates, topics, etc., for each lecture, as well as a general outline of each lecture with experiments. The course is general, extending over the electrical field from the elements of magentism to the subject of alternating-current measurements. Wherever possible the applications of the theory to the practice of the company has been made plain. With each lecture numerous experiments are performed, and where possible specific values are obtained by means of ammeters, voltmeters, galvanometers, thermopiles, etc., whose readings are projected on the screen by means of an electric lantern.

Extensive arrangements have been made in the auditorium of the Edison Company for these lectures. The problem of demonstrating to an audience of over 400 men, which the auditorium accommodates, is difficult, and all experiments have, therefore, been performed either on the screen or on a large scale on the lecture table. The lecture table is provided with direct and alternating-current outlets, as well as an outlet for illuminating gas. It is massive in construction so that motors up to 5 horse-power in ratings may be operated upon it. A large blackboard was constructed which could be raised to a considerable height so that all could be able to see whatever was written upon it.

The accompanying illustrations show the general arrangement of lantern, screen, table, blackboard, etc., for a lecture on the arc lamp. Direct and alternating open and enclosed arcs, with a flaming arc and a magnetite arc, were operated so that comparisons of distribution, color, efficiencies, etc., could be made with incandescent and mercury-vapor lamps.

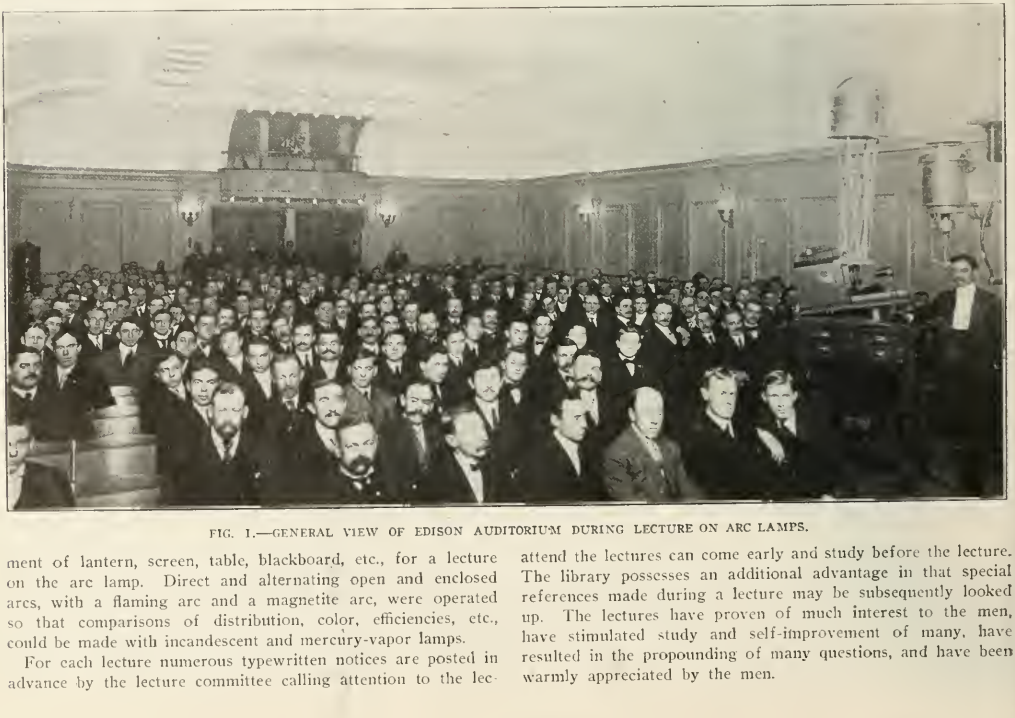

FIG. 1.—GENERAL VIEW OF EDISON AUDITORIUM DURING LECTURE ON ARC LAMPS.

For each lecture numerous typewritten notices are posted in advance by the lecture committee calling attention to the lectures, giving directions for study and dwelling upon the advantages of attendance.

Each lecture is delivered twice, at 1:30 p. m. and 8 p. m., on the same day, so as to give all men on all watches an equal opportunity to attend. While the number who attend the afternoon lectures is not large (about 40), still the officers believe that this policy is necessary in order to be fair to all.

The expense associated with these lectures is borne by the Edison Company, the course being free to all employees. The various text-books recommended to be used in conjunction with the course have been purchased by a great many, and in addition several sets of these books have been purchased by the management of the company and placed at the disposal of the men in the library. This library contains practically all of the modern standard electrical books, as well as the various technical publications. It is one of the most complete libraries of its kind in New York City. This library is conveniently located in the same building as the auditorium, so that those who attend the lectures can come early and study before the lecture. The library possesses an additional advantage in that special references made during a lecture may be subsequently looked up. The lectures have proven of much interest to the men, have stimulated study and self-improvement of many, have resulted in the propounding of many questions, and have been warmly appreciated by the men.

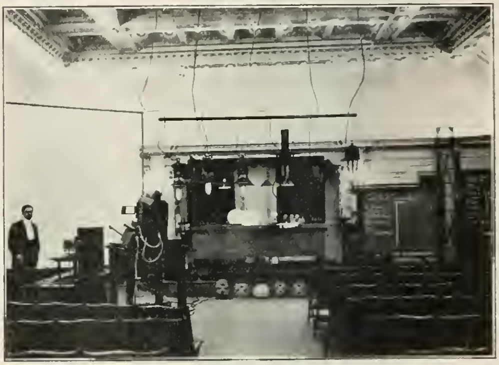

FIG. 2.—ARRANGEMENT OF APPARATUS FOR LECTURE ON ARC LAMPS.

Use of Means of Communication.

The use of means of communication should be taken as one measure of civilization. In this respect the United States appears to compare favorably with Europe. An interesting summary in the New York *Evening Post* gives a few figures on the subject. In the last year for which the complicated figures are available, that is, the year ending Jan. 1, 1905, it appears that the messages sent by post, telegram, and telephone per each one thousand inhabitants were about three times more numerous in the United States than in Europe.

Of letters and postal cards each one thousand persons sent 66,719, as compared to 29,554 for Europe. In the matter of telegrams each one thousand Americans sent 1,099 messages for every 731 transmitted by Europeans. But it is in the matter of telephonic messages that the inhabitants of the United States far surpassed those of the Old World. While each thousand of population in the old country sent 7,364 messages by the telephone, each one thousand Americans sent 44,344, or more than six times as many.

The tabulated figures for the two divisions per one thousand inhabitants are:

	Europe.	U. S.
Letters and postal cards	29,554	66,719
Telegrams	731	1,099
Telephone communications	7,364	44,344

In the United States, as appears from the above, telephone messages were nearly as common as postal communications, and forty times as common as telegraphic messages. In other words, the telephone was the greatest factor in commercial inter-communication. In every class except the comparatively insignificant one of telegrams, the United States has shown a greater increase over the preceding year than has Europe.

Postal communications in this country gained 5.5 per cent, as compared to 4.4 per cent abroad, and while Europe's increase in telegraphic messages was 4 per cent, as compared to 1 per cent here, the increase in American telephone messages was 12.9 per cent, as compared to 11.9 per cent. And that does not take into consideration the fact that the population of Europe is about five times that of the United States.

Altogether, the number of messages for each 1,000 inhabitants was almost three times as great in this country as abroad. For each 1000 inhabitants Europe sent 37,649 messages, as compared to 112,162 in this country. Where the average European in the course of a year sends 30 letters, less than 1 telegram, and 7 telephone calls, the average American writes 66 letters, sends 1 telegram and 44 telephone calls.

The figures showing the state of "telephonic development" in this country and abroad are interesting. To obtain the percentage of telephonic development an arbitrary standard is adopted. All the population under twenty years is eliminated as not coming within the class of possible subscribers. Of those left, one-half are arbitrarily eliminated, and the remainder regarded as possible subscribers. The telephonic development, then, of any country is indicated by the percentage of these possible subscribers who already have telephones.

In this telephonic development, according to the latest figures, America far outstrips the world, with an average of 9.3 per cent. Sweden is the nearest competitor, having a telephonic development of 8.1 per cent, but the average for all Europe is only 1.4 per cent, or less than one-sixth that of the United States. Hungary, for example, has a development of only one-half of 1 per cent; that is, only one possible subscriber among every 200 has a telephone. The figure for France is 1 per cent, for the German Empire 3.3 per cent, for Great Britain 3.5 per cent, with other countries occupying intermediate positions between Hungary, the minimum, and Sweden, the maximum.

Perhaps American superiority in regard to the use of the telephone is better shown in regard to the total number of conversations as compared to those in Europe than in any other way. The total population on which these figures are based is 409,557,325 in Europe as compared to 85,568,000 in the United States, and the number of possible subscribers as established by the already explained arbitrary measurement is 118,771,624 abroad as compared to 23,956,000 in this country. Yet with the population in Europe five times as great as here, the total messages sent during the year were practically equal in the two countries, giving America a superiority of more than five to one.

According to the figures for the last year available, Americans used the telephone 3,680,000,000 times as against 3,114,541,691 time abroad. In Europe, with its five times greater population, there were 1,726,880 subscribers as compared to 2,241,367 in the United States.

Statistics of American Railroads.

The twenty-first report of the Interstate Commerce Commission gives some very interesting data in regard to the railroads of the United States. "On June 30, 1906," says the report, "the total single-track railway mileage in the United States was 224,363.17 miles, or 6,262.13 miles more than at the end of the previous year."

There were in the service of the carriers 51,672 locomotives, the increase being 3,315. The total number of cars of all classes was 1,958,912, or 116,041 more than for the year 1905.

The number of locomotives and cars in the service of the railways aggregated 2,010,584, of which 1,827,789 were fitted with train brakes, or an increase for the year of 186,394, and 1,989,796 were fitted with automatic couplers, or an increase of 118,206. Of 1,837,914 cars in the freight service on June 30, 1906, the number fitted with train brakes was 1,689,141, and with automatic couplers 1,820,854.

The reported number of persons on the pay rolls of the railways in the United States on June 30, 1906, was 1,521,355, which is equivalent to an average of 684 employees per 100 miles of line.

The total amount of wages and salaries reported as paid to employees during the year ending June 30, 1906, was $900,801,653; but this amount is deficient by more than $27,000,000, because of the loss of railway records in the San Francisco calamity.

On June 30, 1906, the par value of the amount of railway capital outstanding was $14,570,421,478, which is equivalent to a capitalization of $67,936 per mile for the railways in the United States.

Of the total capital stock outstanding $2,276,801,333, or 33.46 per cent, paid no dividends. The amount of dividends declared during the year was $272,795,974, being equivalent to 6.03 per cent on dividend-paying stock.

The number of passengers carried by the railways in the year ending June 30, 1906, was 799,507,838, this item being 60,673,171 more than for the year ending June 30, 1905.

The number of tons of freight carried was 1,631,374,219, which exceeds the tonnage of the year 1905 by 203,642,314 tons.

The gross earnings of the railways in the United States from the operation of 222,340.30 miles of line were, for the year ending June 30, 1906, $2,325,765,167, being $243,282,761 greater than for the year 1905. Their operating expenses were $1,536,877,271, or $146,275,119 more than in 1905.

Five thousand passengers and employees were killed, and 76,286 injured on the railroads during the year of report, or about ten thousand more than in the previous year.

Economy of Electric Elevators.

The gearless, one-to-one, traction, electric elevator was described in a paper by Mr. J. D. Ihlder, of the Otis Elevator Company, New York, read before the Western Society of Engineers, electrical section, at Chicago, Jan. 10. Mr. Ihlder was not present on account of illness, and his paper was read by Mr. H. Russell Smith, of the Otis Elevator Company, Chicago. The paper was illustrated by stereopticon views. This is the type of elevator employed in the new 42-story Singer Building, in New York City. In the discussion which followed the reading of the paper Mr. Smith cited tests made on an elevator, in actual service in a large office building, in which the elevator averaged 20 miles per day for a week and took 2.67 kw-hours per car-mile.

Mr. S. M. Bushnell, engineer of the contract department of the Commonwealth Edison Company, Chicago, said that an electric elevator load was at first looked upon with suspicion by central-station men because of its extreme fluctuations. With a large number of elevators connected to the system, however, these fluctuations were smoothed out and became negligible. The elevator load was now one of the best classes of motor load for a central-station company. The electric elevator formed the last link in a chain of complete electric service for office buildings. With successful electric elevators for high speed and high lifts, the entire power service of a building could be supplied electrically either from a central station or from an isolated electric generating plant. He gave it as his experience, based on extended investigation by his company, that the kw-hours required per car-mile for purely electric elevators was about half that required by hydraulic elevators with the pumps operated by electric motors.

Mr. John Mabbs referred to the elevators of his invention used in the Board of Trade Building, Chicago. In these elevators the motor and mechanism form the counterweight, this counterweight being driven up and down by a rack and pinion. These elevators have made 35,000 miles in five years, consuming 3.44 kw-hours per car-mile. The cars had 36 sq. ft. floor space. The service was of the severest nature. The old elevators in the same building, which the Mabbs elevators displaced, took 5.35 kw-hours per car-mile. Repairs on the Mabbs elevators have averaged $83.24 per year per elevator.

Circuit-Breaker Litigation.

Judge Ray, of the United States Circuit Court for the Southern District of New York, handed down on Jan. 8 a decision in a suit of the Westinghouse Electric & Mfg. Company against the Conduit Electrical Mfg. Company of New York, sustaining the validity of a patent on an automatic circuit-breaker, granted Sept. 26, 1899, to C. Wright and C. Aalborg. This patent was the subject of prior litigation in the United States Court of the Third District. In the lower court of the Third District the claim of infringement of the patent was denied on the ground that while the defendants' device secured the early closing and delayed break "by a shifting movement of both the shunt terminal and piece," the complainant accomplished the same result "through a stationary shunt terminal and a moving shunt piece actuated by a long arm pivoted to the main contact member near the toggle joint," and consequently there was no infringement. This decision was reversed in the Circuit Court of Appeals, which held that the pivotal connection is essential to practical operation of the patented device and was infringed by the defendant.

In the present case the defense was that the device in suit was anticipated by prior patents granted to Larsen, to Potter and to Packard, and that the mechanism in the alleged infringing device was not the equivalent of the mechanism in the patented device. In discussing the question of patentability, the opinion states that "we are dealing with a device which has to do with electricity, the power of which is so tremendous as to be appalling, and one purpose of which is to prevent accident and destruction;" and that "the control of electric current and devices, therefore, is an art as yet in its infancy, probably." The opinion also states that "when an invention has been extensively introduced and has met with success and large sales, we have, sometimes, from this fact alone persuasive evidence of patentable invention. It is sufficient to turn the scales, as the courts have frequently held." The final conclusion of the court was that patentable invention is disclosed in the claims.

As to difference in construction, the court held that the defendants' circuit-breaker answers literally the terms of the claim in the suit except that the movable shunt-carbon is mounted on a spring arm which extends upward from the laminated contact member instead of being actually pivoted to a rigid arm extending up from this member. The function of the movable carbon in the complainants' circuit-breaker is to adjust the current contact between the stationary and movable carbons, and to allow the main contact to close and open before the carbon contacts are open, and this, it is declared, is the sole function of the defendants' spring-mounted carbon. In the defendants' device, the axis of motion of the movable carbon is not confined to the line of a pin or pivot, as in the complainants' device, but is distributed along the spring arm. This, however, is held to be immaterial as the function is the same, and the mode of operation of this part of the device is substantially the same. The final conclusion is that the defendants by substituting an equivalent did the same thing Wright and Aalborg had done and protected by their patents, and the defendants' device is not differentiated from the complaintants' by the mere substitution of a well-known equivalent. The claims 2 and 5 of the patent were held valid and declared infringed by the defendants and a decree in accordance was ordered.

Annual Meeting of the Illuminating Engineering Society.

The annual meeting of the Illuminating Engineering Society was held on Jan. 10 in the rooms of the Electrical Club, 14 Park Place, New York City. The meeting was preceded by an informal dinner. The report of the finance committee showed that the society has a surplus of a few hundred dollars, the income from advertisements in the *Transactions* having prevented a deficit. The committee made a strong plea for an increase in membership, which would place the society on a better financial basis so that it would not have to depend on the receipts from advertisements. The latter fund could be devoted to research and other work. The report of the advertising committee showed that the income from advertisements was about $800.

After the reading of the reports Dr. C. H. Sharp delivered his presidential address.

The address of President Sharp was confined largely to an account of the experience during the past year in the working of the society under its federal organization. This was found to be far from satisfactory, owing to the fact of non-attendance at council meetings of the vice-presidents representing the several societies, and to neglect on the part of these in communicating with the council in regard to such matters as should be brought before it, or to keeping in such close touch with the affairs of the society at large as to be able to present to the sections they represent the broader views of the affairs of the society that the council must always take. While the *Transactions* are dependent upon the activities of the local sections for the supply of papers and the sections are to a considerable extent dependent upon each other in this regard, it was stated that during the past year nearly all sections have fully met their responsibility in this matter, as is shown in the papers and discussions printed in the *Transactions* during the year. President Sharp stated that the membership at the present time numbers 944.

After the address the report of the tellers appointed to canvass the results of the annual election was received. This report showed that the officers elected for the ensuing year are as follows: President, Dr. Louis Bell, of Boston, Mass.; vice-presidents, Messrs. Arthur Williams, of New York, and C. E. Stephens, of Pittsburg, Pa.; secretary, Mr. V. R. Lansingh; treasurer, Dr. A. H. Elliott; directors, Messrs. W. H. Gartley, W. H. Eyre and Bassett Jones, Jr.

Dr. Bell, after being presented by Dr. Sharp, made an optimistic address, outlining his reasons for the belief that the society has a great future before it and stating that it was essential among other things to increase rapidly the membership. There followed a broad discussion on the future of the society and the policy it should adopt with regard to the character of papers to be presented. Mr. Arthur Williams, of the New York Edison Company; Mr. John Gilchrist, of the Commonwealth Edison Company; Mr. F. J. McGuire, Mr. W. H. Gardiner, Dr. A. H. Elliott and others participated in the discussion. The meeting was a most interesting one and did not adjourn until a very late hour.

Helion Incandescent Lamp Filament Patents.

Three patents were issued Jan. 14 to Mr. Walter G. Clark on processes for making incandescent lamp filaments of the type consisting of a combination of silicon and carbon. The deposits of silicon have been obtained by the decomposition of chlorides, and the object of the patent is to obviate the difficulty that has been experienced in getting a uniform product and to prevent the chlorine once free from combining with the silicon. The first of the several patents describes a process wherein a carbon filament is placed into a receiver containing a small quantity of mercury, after which a silicon chloride, such as a tetra-chloride and also a gas which contains carbon, are introduced. When the current is passed through the filament the chloride is decomposed and the silicon deposited upon the carbon, and the free chloride combines with the mercury. The second patent covers the use of the carbon gas referred to above, the claims being for the mixture of marsh gas and an olefiant gas, or marsh gas, olefiant gas and carbon dioxide. The third patent states that the hydrocarbon gas may be some form of illuminating gas, but is preferably the marsh gas. When the deposition on the filament takes place the silicon and combination of silicon and carbon, which is a dense, non-porous combination, enter the pores of the carbon base, combine with and build up on the base, so that the latter becomes a combination of silicon and carbon, which gradually merges near the surface into a substance having characteristics similar to those of silicon.

Grounding of Alternating Systems.

As chairman of the National Electric Light Association Committee on the grounding of alternating current systems, Mr. W. H. Blood, Jr., called a conference of the committee to consider this subject on Jan. 7, the meeting being held at the offices of Stone & Webster, in Boston. There were present at this conference representatives of the National Electric Light Association, the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies, and the National Electrical Inspectors' Association.

The N. E. L. A. committee had formulated its ideas on the subject in advance, and the conference approved largely the suggestions offered, although making some slight modifications. The final draft will be presented to the Underwriters for action at their meeting in March.

The N. E. L. A. committee has suggested that the grounding of transformer secondaries up to 150 volts be made compulsory, and that above 150 volts the ground shall not be permitted. It has also added a provision for making ground connections through driven pipes, which is an entirely new feature in the Code; and it has specified how these pipes shall be tested to see whether the ground is satisfactory and adequate.

CURRENT NEWS AND NOTES.

ELECTRICITY FOR TSINANFU.—Advices received in Washington state that owing to the inability of the present plant at Tsinanfu, Shantung, to supply the electricity needed by the city the local authorities have evolved a scheme of building a plant to cost $160,000. Permission to organize a company for this purpose has been asked of the Central Government at Peking.

TIENTSIN STREET RAILWAY.—In a recent report by the Belgian concessionaires for the electric street railway in Tientsin, it is shown that while the lines do not as yet pay much, the Chinese are riding in ever-increasing numbers, and in a few years the company expects to obtain handsome returns. At present much is being done to extend the lines in the Chinese city, and in the French, Italian, and Austro-Hungarian concessions.

BROOKLYN EDISON INCREASE.—On January 1, 1907, the Edison Company had connected to its system the equivalent (in lamps, motors and all other electrical appliances) of 1,167,595 16-candle-power incandescent lamps. During the year this has been increased by approximately 200,000 such equivalents, or about 17 per cent. The company has been directing its attention particularly toward residential lighting, and has featured house wiring in its campaign for more business.

WESTERN SOCIETY OF ENGINEERS.—The electrical section of the Western Society of Engineers elected the following officers at its meeting Jan. 10, 1908: Chairman, D. W. Roper, assistant chief operating engineer, Commonwealth Edison Company; vice-chairman, H. R. King, engineer, Western Electric Company; member of committee to serve three years, E. N. Lake, of the Board of Supervising Engineers, Chicago Traction. These officers are for the electrical section only. Mr. P. Junkersfeld, of the electrical section, was elected second vice-president of the society at the recent election.

BRITISH PATENT LAW.—U. S. Consul Albert Halstead, of Birmingham, notes that the new British patents and designs act became operative Jan. 1, 1908. This act, which has already been summarized in these pages, makes compulsory the working "to an adequate extent" in the United Kingdom of patents having the benefit of the protection of the British patent laws, and will force the manufacture in the United Kingdom of many articles now made in the United States for export to the United Kingdom. It will bring work to British labor, and that is what it is intended to do. Its effect will be most striking in connection with the manufacture of automatic shoe machinery.

WIRELESS RULES RATIFIED.—Ambassador Tower has cabled the State Department from Berlin in answer to an inquiry as to the number of countries that had undertaken to execute the provisions of the Wireless Telegraphic Convention of 1906, as follows: Belgium, Denmark, Mexico, Holland, Norway and Roumania have deposited with the German Government ratifications of the Wireless Telegraphic Convention. Argentina and Brazil have officially approved the convention, and are ready to deposit the ratifications. France awaits the ratification of Great Britain, while the German Government has introduced in the Reichstag a bill to authorize ratification

WIRELESS IN CARIBBEAN.—U. S. Consul Drew Linard, of Ceiba, reports that the rumor that a series of wireless stations is to be erected at several ports on the Caribbean coast has been confirmed, and adds: "The United Fruit Company has negotiated with the De Forest Wireless Telegraph Company for the establishment of stations at Belize, Puerto Barrios, Puerto Cortez, and Ceiba, probably extending the system as far south as Port Limon, Costa Rica. It is assured that wireless communication between these points and the United States will be in operation by the first week in February. The United Fruit Company will serve the public, but subject to censure of all messages, retaining the privilege of refusing for transmission such messages as may appear prejudicial to their business interests. This exception to public service is due to the constant competition among the several steamship lines operating in the fruit trade between the United States and Central American ports. The business men of Ceiba are much elated, and welcome the advent of the wireless as a factor of inestimable value to them in their commercial relations with the United States."

ELECTRICITY IN GERMANY.—U. S. Consul Norton, at Chemnitz, Germany, in a review of industrial conditions, states that all the electrical industries "continue to manifest an exceptional degree of activity, and there are no indications of a setback in 1908."

ELECTRIC HEATING DEVICES.—The North Shore Electric Company, operating in the suburban territory around Chicago, has succeeded in making the demand for electric heating appliances so common that in Evanston, the largest suburb which it serves, two stores handle electric irons, chafing dishes and toasters. One of these stores is a hardware store, the other a general department store.

MUNICIPAL PLANT AT PENNSBURG, PA.—In the description of the municipal electric lighting plant at Pennsburg, Pa., published in the Jan. 4 number, credit should have been given and is here extended to Mr. S. S. Edmands, Professor of Electrical Engineering in the Pratt Institute, Brooklyn, and to Mr. F. G. Ortt, of Brooklyn, the designer and contractor, respectively, of this very interesting plant.

AN ELECTRICALLY HEATED HOTEL.—The Eagle Hotel at Grand Rapids, Mich., has taken advantage of the low rates offered by the Grand Rapids-Muskegon Power Company, and has twenty-seven rooms equipped with electric radiators as the only source of heat. The halls are heated by steam. A 10-cent theater in Grand Rapids is also being heated electrically by means of air heaters located in registers under the floor.

UNDERWRITERS' LABORATORIES.—A pamphlet just issued by the Underwriters' Laboratories, 382 Ohio Street, Chicago, Ill., gives information relating to the nature of the work done in the laboratories and the terms and conditions under which it conducts tests of fire appliances and materials. Illustrations are given of the different departments of the laboratory and the various inspection labels are reproduced in colors. A list is given of the staff of the laboratory and of the engineers in charge of branch offices in 18 cities throughout the country.

SAFETY IN MINES.—Mr. L. C. Huber, an engineer, of Louisville, Ky., has written to Governor Willson of Kentucky and to President Roosevelt, strongly advocating the exclusive use of incandescent lamps in mines, as the only real safety lamps, and as a preventive of such terrible "accidents" as have occurred lately. The mine disasters of this season in the United States show a death roll of 3000, and Mr. Huber asserts that the government should force electric lighting on the mine owners to stop such fearful loss of life, just as it did the use of safety couplers on the railroads.

MUNICIPAL PLANT TROUBLES.—Word comes from St. Joseph, Mo., that Walter C. Stewart, superintendent of the Municipal Lighting Plant, with which he has been connected 21 years, has been indicted on the charge of obtaining money by false pretenses. Charles W. Waller, foreman, is under arrest, and other indictments are out. In its report the grand jury states that men long dead are still on the pay roll. In one instance a schoolboy, who worked a few hours at the plant on Saturdays, was drawing $50 a month. The jury says that St. Joseph has been defrauded out of thousands of dollars by padded pay rolls.

VARIABLE-VOLTAGE GENERATOR.—A patent granted Dec. 17, to Mr. K. A. Pauly discloses means for automatically preventing too rapid a change in the field strength of a variable-voltage generator supplying energy to direct-current motors It is well known that when the voltage impressed upon the armature of a separately excited direct-current machine is increased rapidly excessive current is taken from the generator, while if the generator voltage is rapidly decreased the motor will return energy to the generator. The inventor places a short-circuited winding on the generator field-pole, so that the rate of change of the generator field magnetism is properly damped.

NIAGARA TRANSMISSION LINE.—Construction has been begun on the first section, 28 miles long, of the 60,000-volt transmission line, which will carry Niagara Falls current to the Buffalo, Lockport & Rochester Railway. This road is a high-speed interurban between Lockport and Rochester, through connection with Buffalo over the International Railway being contemplated. Construction is well advanced and cars will be run over a finished portion of the road within the next few weeks. The transmission line connects with the 60,000-volt lines of the Ontario Power Company near South Greece, and runs thence across country to Albion on the Buffalo, Lockport & Rochester Railway; it then parallels the railway.

DISCOVERY OF ELECTROMAGNETIC INDUCTION.—A recent accession to the A. I. E. E. library, entitled "Recherches et Expériences sur l'Electricité," which consists of a collection of eight papers published between 1825 and 1827 by Daniel Colladon, the Geneva physicist, includes a short paper on an experiment on electromagnetic induction made in 1825, five years prior to the great discovery of Faraday. The experiment was similar to the later and successful one of Faraday, but gave negative results for the reason that the galvanometer employed was not of a type to respond to instantaneous currents, and Colladon states that he did not suspect that the induction had only an instantaneous effect.

A NIAGARA IN BRAZIL.—U. S. Consul George A. Chamberlain, of Pernambuco, sends a comprehensive description of the Paulo Affonso Falls and the San Francisco River, situated in that part of Brazil. The falls are 230 miles from either Pernambuco, which has a population of 200,000, or Bahia, with 230,000 people. The average flow of the river is 1000 cubic meters per second, and between Jatoba and Piranhas, a distance of about 65 miles, the fall is 756 feet, 400 of which takes place in the rapids, extending about 15 miles. This vast undeveloped water power will become in time the nucleus of a great industrial region. Mr. Chamberlain's report may be consulted at the Bureau of Manufactures in Washington.

LIGHTING FIXTURES IN THE HARRISBURG CAPITOL.—In order to increase the efficiency of the smaller chandeliers in the Capitol at Harrisburg, it has been decided to turn them upside down. The chandeliers are in the smaller series of brass and bronze affairs which cost between $600 and $1,000 each. They are hung profusely in various offices and are fitted with semi-transparent shades, as in ordinary open-flame gas practice. As pointed out in our article a year ago describing the lighting of the Capitol, the fixtures are so massively bronze that most of the light is absorbed by themselves, in most cases necessitating the use of desk lamps. The plan of reversing them is said to have resulted in much better illumination.

SCIENTIFIC TELEPHONE RATES.—Mr. George Albree, appointed by the Massachusetts Highway Commission to examine the affairs of the New England Telephone & Telegraph Company, has reported exhaustively to the board, arriving at these conclusions: 1. If the present policy of treating the entire territory of the company as a unit is to continue no separation of accounts on territorial lines or areas is necessary. 2. If, however, any attempt is to be made to correct any irregularities or inequalities in existing rates by substitution of scientific methods of determining rates on cost, for one of expediency, in any exchange, or for any class of service, it at once disturbs the established policy and the separation of accounts is inevitable. Whichever of the courses is determined later best to meeting existing conditions, the commission will be confronted with the fact that whether treating the company as a unit, or as an aggregate of units, the three elements, cost of plant, cost of maintenance, and cost of operation, are yet to be determined.

Japanese Hydro-Electric System.

A HYDRO-ELECTRIC generating and transmitting system utilizing energy from the Hitaka River, in Japan, which was recently placed in service, possesses many points of interest to electrical engineers. Not the least interesting feature is found in the location of the generating station, which was so nearly inaccessible that the cost of conveying the generators and turbines over the last 20 miles of the route was equal to the initial cost of the equipment. For ten miles use was made of special floats for the machinery, which was drawn by hand for the other ten miles.

The turbine station makes use of a total fall of 76 ft. in a distance of 3 miles of the above river. The hydraulic development was rendered comparatively simple, but none the less interesting, by reason of the fact that the particular 3 miles selected covers an almost closed horseshoe bend, so that a tunnel 600 ft. in length and a 220-ft. canal were sufficient to connect the higher elevation with the lower. The tunnel and canal serve a double purpose. Not only do they guide the water to the turbines, but this water acts as a means of conveyance for rafts of timber which are floated down the Hitakagawa and shunted from the entrance to the flumes along a special timber incline. The timber rafts, which in some cases are 240 ft. in length, are 6 ft. in width. The tunnel is almost circular in cross-section, being 16 ft. in height and 16 ft. in width, and is provided with two steel lock gates; the water is kept at a depth of 8 ft. In the canal the water depth is also 8 ft.; the width at the bottom is 16 ft., and at the top it is 20 ft.

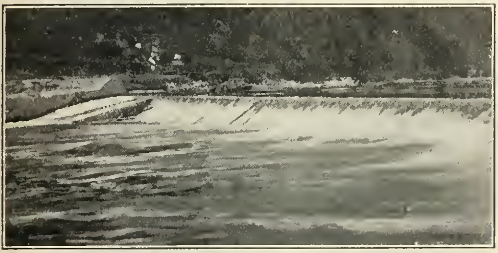

FIG. 1.—VIEW OF DAM.

The dam, which serves for deflecting the water of the river into the tunnel, although it is only 4 ft. above the original water level of the river on the up-stream side, differs greatly in design from dams of similar height in this country. The problem of constructing a dam across the Hitakagawa was rendered difficult by reason of the violence of the stream during the flood season, when heavy timbers and large boulders are swept along with great rapidity. The dam is a stone and concrete structure 280 ft. long and 6 ft. wide at the top. The up-stream slope is .25 to 1, and down-stream slope 2. to 1, and is connected with circular curve to the bottom rock; the dam is 22 ft. in height on the down-stream side.

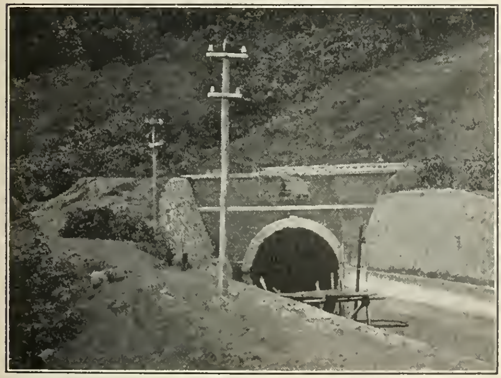

FIG. 2.—TUNNEL EMPTYING INTO CANAL.

The water in the canal has three outlets, namely, through a sluice gate to feed the fields of Kawakami village, through the penstock to the turbines, and along an overflow spillway. This spillway is terraced to minimize damage from the energy of the water. The steel penstock is 9 ft. in diameter and 220 ft. long.

The power house is a brick building having main dimensions of 40 ft. x 120 ft., with an extension 15 ft. x 30 ft. The hydraulic equipment consists of four Francis reaction turbines made by the Ateliers de Constructions Mecaniques, Vevey, Switzerland. Each turbine is directly coupled to a 625-kw, three-phase, 12,000-volt, 50-cycle generator with revolving field The generators are 16-pole machines, and run at 375 r. p. m.; they were built by Brown, Boveri & Co., Baden, Switzerland.

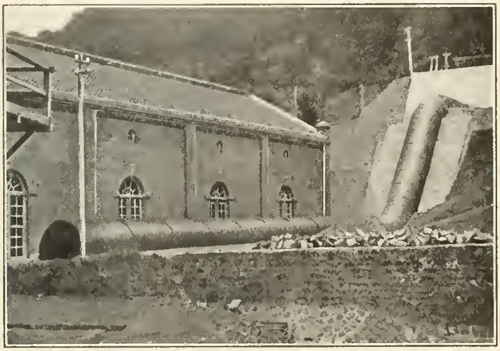

FIG. 3.—VIEW OF 9-FT. PENSTOCK.

The e. m. f. of the generators is sufficient for transmission over the 26 miles separating the power house from the substation in Wakayama. The latter is a city 40 miles from Osaka, containing a population of about 70,000 people. The substation contains oil-insulated, water-cooled transformers for reducing the e. m. f. to 3000 volts, at which value the energy is distributed to the various customers. Some few motors are operated at 3000 volts, but most of the motors are wound for 220 volts, while the lamps receive energy at 100 volts. Thus additional transformers are installed on the customers' premises for delivering the required e. m. f. A portion of the energy is used for operating the railways between Wakayama and Wakaura, a place famous for its beautiful scenery, a distance of 5 miles, and between the latter place and Kuroye, a distance of 3 miles. About half of the output is used for lighting.

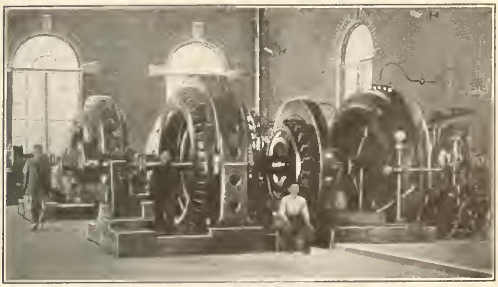

FIG. 4.—VIEW OF INTERIOR OF GENERATING STATION.

The above-described hydro-electric equipment was designed and installed by Saiga & Company, of Osaka, Japan. We are indebted to Mr. S. Mitsui, chief engineer of the company, for the information contained in this article.

The Design of Prepayment Watt-Hour Meters.

By Arthur Pestel.

The difficulties in the design of a reliable prepayment watt-hour meter which can be trusted in every respect are so many that it may be of interest to consider systematically the more important points involved in this type of instrument, with a view to indicating in what way the difficulties may be overcome.

An electrical prepayment meter consists in general of a watt-hour meter to which a time switch with a prepayment device is connected.

In the design of such an instrument the following appear to be the most important points to be considered: (1) The main circuit should be broken when the energy paid for has been consumed. (2) The device should show the consumer how much of the money he has placed in the meter is still to his credit. (3) There should be an adjustment for different rates of payment. (4) The instrument should be absolutely fool-proof. (5) It should be cheap.

In considering the first four points, the common watt-hour meter will be accepted as a standard instrument which cannot be altered in its main features.

The greatest difficulty will be encountered in the design of the circuit breaker because there is required a contact switch which must be automatically released when the energy paid for has been used.

It will be necessary to find a switch which will require very little power to release. In mechanical construction the switch should be very light, but strong, and it may be advisable for the designer to consider first the main principles of construction on existing knife, brush, spring, carbon, mercury switches, etc., and to ascertain which will cause the least friction and require but little power to release.

A simple and almost frictionless device is found in the mercury switch, but utmost care must be taken to adapt it for shipment if it should not be found more convenient to place the mercury into the meter after the latter has reached its destination. A switch from which the mercury has almost no possibility of escape might be made as shown in Fig. 1. Here an iron fork slides through bushings in a case made of insulating material. The mercury in the basins has no means of escape, even if the case should be placed upside down, as the bushings are made much longer than the depth of the mercury. There is, however, a possibility that a few drops might be able to go through the bushings in which the fork slides if the switch should be shaken violently. If this should happen, it will be necessary to place this switch in a separate chamber, at the back of the meter for instance, and have it arranged in such a way that the mercury cannot find its way to the other mechanism.

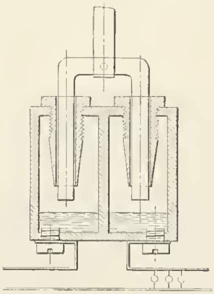

FIG. 1.—MERCURY CONTACT SWITCH.

As, up to the present time, it has not been possible to do without a switch in a prepayment meter, it will be assumed that this device is used and it will now be necessary to seek the simplest, surest and cheapest way to release the main cut-out.

As the release can be obtained by either mechanical or electrical means, and as this again can be done either directly or indirectly there are the following four cases of which the last three seem to be the most practical:

(1) In releasing the cut-out directly, by mechanical means, the prepayment mechanism is connected to the registering device of the watt-hour meter in a mechanical way and is supposed to overcome all friction and release the cut-out directly. However, as it is nearly impossible to overcome all friction, and as thus far no satisfactory results have been, and perhaps never will be, attained, it may be sufficient here merely to mention this case without going into further details.

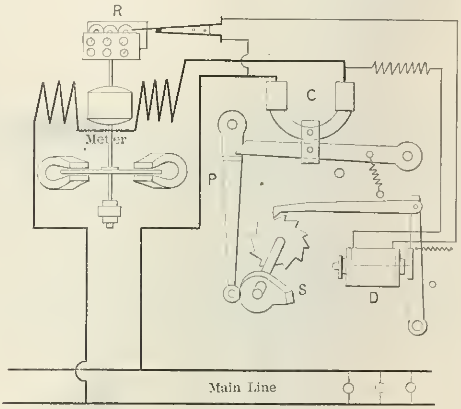

FIG. 2.—COIN-CONTROLLED MECHANISM.

(2) The release of the cut-out directly, that is, without depending upon any additional source of power, as spring for instance, but by electrical means, can be arranged in such a way that the prepayment mechanism with cut-out is either combined with the watt-hour meter or is a separate instrument. In either case the release of the cut-out could be accomplished by the operation of an electric relay. This relay must be actuated with as little power as possible in order to have the breaking spark of the relay switch reduced to a minimum. This switch would have to be used in connection with the registering device of the watt-hour meter, and be opened and closed in accordance with a certain number of passing watt-hours. As the relay will, therefore, make a constant number of strokes during one kw-hour, it will be necessary merely to move a simple mechanical device away from the releasing point of the main cut-out, when placing a coin in the meter. For each coin this device would have to be moved a certain distance, which then would require a certain number of strokes of the relay to return the former to the releasing point, in order to open the main circuit.

Fig. 2 shows the principle of this arrangement. In this diagram *C* is the main cut-out, held in position by lever *P*, which is operated by some mechanical device *S* moving back and forth by either the coin or the relay *D* through the contact at *R*, as described above.

(3) The release of the cut-out indirectly by mechanical means can be made in such a way that the prepayment mechanism with switch is either separate or combined with the watt-hour meter.

In releasing the cut-out indirectly, an additional source of power will be required, which could be in the form of a spring or weight. These could be arranged as mechanical relays, assisting the watt-hour meter in releasing the main switch. By using a clock spring in connection with a train of wheels, which, by means of an escapement and escapement-wheel, for instance, are connected to the registering device of the watt-hour meter, the registering device will not require very much power to operate the escapement, while the release for the main switch could be in direct connection with the clock spring and thus have sufficient energy to break the circuit. If a weight should be used instead of a spring, it could be raised and held in position until the meter releases it.

Fig. 3 shows such an arrangement. Here lever *L* stands in a raised, nearly vertical position and is held by a stop *S* which moves forward when a coin is inserted. As soon as this stop is returned again by the action of some kind of mechanism *M* through the registering device *R* of the watt-hour meter, lever *L* will drop, strike the switch lever stop *P* and thus release the cut-out *C*.

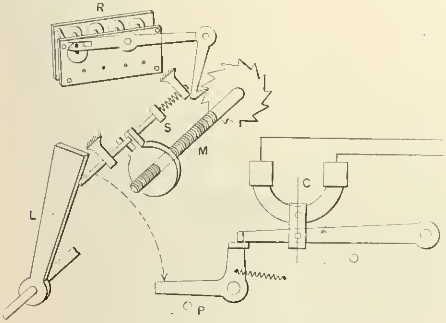

FIG. 3.—COIN-CONTROLLED MECHANISM.

When lever *L* is in its upward position, it will be seen that very little energy will be required to release it.

(4) In considering the fourth and last case, releasing the main switch indirectly and with electrical means, the accumulated energy of a spring or weight could be made useful in combination with an electrical relay, which latter could be operated by a small switch on the registering device of the meter, as shown in Fig. 2.

In the application of any of these four cases, the coin, which is placed in the meter, can be forced to be useful in many ways. The coin could close a small circuit either directly by its own metallic substance or indirectly by its own weight, falling on two spring contacts, for instance. It could also move a small mechanical device from the releasing point of the main cut-out (Fig. 2). The coin could be used to cause the consumer to wind up a spring or raise a weight by means of a lever or knob and at the same time close the main switch.

It would be decidedly convenient for the consumer if he should not be forced to do any operation whatever by placing a coin in the meter, but as there are so many disadvantages in regard to the absolute positive actions of the mechanism and also in regard to the tamper-proof condition of the meter, it seems almost certain that the future prepayment meter must have a device to be operated by the consumer when inserting a coin.

Any of the above-mentioned arrangements could be used for a switch for interrupting from 15 to 25 amperes at 120 volts. If a switch for a much heavier current should be desired, it would be advisable to shunt only a small current through the cut-out in the meter, which then again could be used to operate a main cut-out for any amount of current required. Several styles of automatic switches which would answer the purpose for this main switch are found on the market, and could easily be connected separately with the cut out of the prepayment meter.

Fig. 4 shows an automatic switch with plunger magnets in connection with a prepayment meter. *A* is the meter cut-out, for from .5 ampere to 1.0 ampere, which makes connection with contact plate *E*. As the current will pass through the solenoid S_1 of the main switch *B*, the plunger with knife-blade will fly up and make connection between M_1 and M_2, open the solenoid switch K_1 and remain in its position. As soon as the credited amount in the prepayment meter has reached zero, the knife-blade *i* of the meter-switch *A* will be released and will make contact at *F*, where solenoid S_2 is connected, which pulls down the plunger, opens the main circuit and cuts out the solenoid S_2 at K_2.

It will now be necessary to consider point (2) as mentioned at the beginning of this article. A device should show the consumer how much of the money he has placed in the meter is still to his credit. This device could be constructed in the form of a graduated scale, which might be either round or straight, and could be used in connection with that mechanical device which is moved back and forth at the releasing point of the main switch as shown at *S* in Figs. 2 and 3.

As the coin device, and therefore the scale or pointer, can be used only for a certain number of coins, the designer must consider that after this number of coins is placed in the meter, the operator might be able to damage it by inserting an extra coin and thus bringing the scale or pointer out of position, or breaking a part of the inside mechanism. To prevent damage, the coin-slot could be closed by a lever, moving relatively to the scale or pointer, or the superfluous coin could be lead into another channel and thrown out again.

The scale should be as large as possible, in order to be visible and readable from a distance. It should show the consumer how many coins he can still place into the meter and also indicate, within a short time, when the main circuit will be broken. A lamp or bell might be used in connection with the scale or pointer for informing the consumer that the switch will soon open the circuit.

As the price of energy differs at many central stations, it will be necessary to have an adjustable mechanism secured to the meter which can be set in such a way as to give more or less energy according to the value of the coin thrown in the meter. This mechanism should be so constructed that it is possible to get at it while the prepayment meter is at the consumer's premises, in order to save time and money, which otherwise would be required for sending a newly-set meter from the plant or factory, if the price should be changed. A graduated scale should be made for this mechanism, showing different prices per kw-hour, to enable the electrician or the money collector easily to set the meter for the required amount.

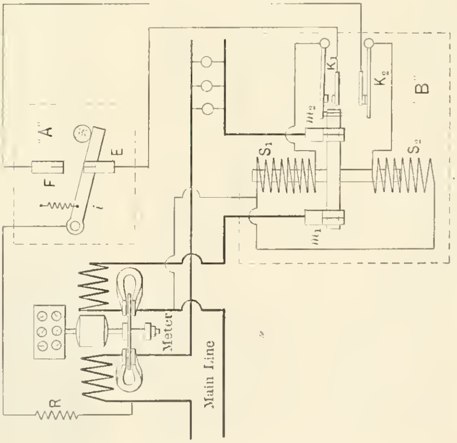

FIG. 4.—AUTOMATIC SWITCH ARRANGEMENT.

In order to have the meter absolutely fool-proof and tamper-proof, the designer must consider every little point carefully. As the meter is generally located in a hall or cellar and seldom in a public place a certain class of people may therefore try to fasten the coin on a string and after the coin has done its work, will take it out again, or they may force a piece of wire through the slot in the meter, stop the working mechanism and thus cause the main switch to remain closed.

If the prepayment meter should be operated with a clock spring, a consumer may keep the handle or knob in such a position that the spring energy which is designed to release the main cut-out may be taken off and thus prevent it from doing so.

One may take a strong magnet and stop the operation of the mechanism, or obtain access to the money box and so forth.

In regard to the construction itself, not much can be said, for it depends mostly on the ability and also originality of the designer himself, as there are many possibilities of tampering with the apparatus. It might be said, however, that as far as the coin is concerned, it has been found that when operated with a knob or lever, the coin ought to be out of sight and the slot closed during its operation.

If the consumer must operate as indicated above in order to work the meter, he may handle it rather roughly and, therefore, the question whether the watt-hour meter and the prepayment device should be combined in one or built separately as two different instruments should be carefully considered.

An important feature of separating the prepayment device and the meter lies in the advantages of being able to connect the prepayment device to any kind of meter, whether for direct or alternating current, or for high or low voltage.

A practical prepayment meter could consist of a device which is entirely separated from the meter and only connected with wires, leading from an electric relay in the prepayment mechanism to a contact on the registering device of the meter. It seems to the writer that the switch release of the prepayment device should be actuated by an additional source of energy to assure the positive actions of the mechanism.

Single-Phase Railway System.

At the December meeting of the A. I. E. E. two papers were presented dealing with the single-phase railway system. A paper by Mr. E. F. Alexanderson dealt with a new type of combined "repulsion" and series motor. An outline of the characteristics of this motor is given on page 143 of this issue. This motor was mentioned on page 1084 of our issue for Dec. 7, 1907. As intimated on page 8 of our Jan. 4 issue, this motor has been selected by the New York, New Haven & Hartford Railway Company for its New Canaan Division.

Mr. W. S. Murray presented a paper discussing the difficulties encountered and the successes obtained with the 11,000-volt overhead catenary single-phase system of the New Haven Company. A complete description of this system was given in our issue for Aug. 17, 1907. The single-phase equipment has been in use about six months, and much valuable experience has been obtained.

The author offered a number of observations and recommendations which will prove of value to engineers interested in the substitution of electric for steam locomotives.

1. In one, two, three, and four-track railroads, the distributing circuits should include by-passes or feeders, in addition to the trolley wires.

2. The electrical sections should average not less than 1.5 miles in length.

3. Twenty-two feet is a safe general working distance of the trolley from the rail.

4. The de-insulating effect of steam locomotives stack discharges is a most important consideration to be kept in mind in insulating the high-tension wires from ground.

5. High insulation factors should be used where high-tension construction due to low bridges is brought nearer the rails than the normal height of 22 ft. Strong mechanical shields should be used to deflect the locomotive blasts from the messenger insulators at low bridges. Care should be exercised in the installation of these shields so that a safe distance exists between the high-tension conductors and the ground. Wherever possible insulators should be installed away from the direct line of the locomotive blast.

6. If the auxiliary wires cannot be carried over highway bridges as aerial conductors, they should not be carried under, unless they are enclosed in lead-covered cables with end-bells properly enclosed in suitable housings at points where the conductors change from aerial to lead-covered cables.

7. All circuit-breakers connecting feed wires (or by-passes) to the trolley bus-bars should be equipped with time-relays, so that any short-circuit will immediately open the trolley-breakers, thus locating the grounded trolley section. Equipping the feeder breakers with time-relays insures continuity of voltage on wires not affected by the short-circuit. Each trolley-breaker pilot-switch should be provided with a lamp to indicate when it opens, and an announcer bell should ring in the signal tower at the same time so that the operator is promptly notified.

8. On account of deleterious influences of the weather and of locomotive stack discharges, together with the general inconvenience of getting at bus-bars and switches when installed on anchor bridges, all section oil-switches should be installed in switch houses erected at the side of the tracks, with lead-covered cable connections between the trolley and the switches.

FIGS. 1 AND 2.—FLEXIBLE SINGLE CATENARY SUSPENSION IN THE PORT CHESTER YARD.

9. The signaling apparatus should be arranged so that the operator can prevent the engineer from spanning two sections by his locomotive shoes in the event of one section being grounded.

10. All signal towers should be interconnected with a reliable telephone service. Immunity from electromagnetic and electrostatic disturbance in the telephone system can be secured by using twised-wire pairs enclosed in lead-covered sheath, the sheath being grounded frequently.

The last suggestion is more particularly applicable to the interrupted or tower-to-tower telephone system. In this case the distance of exposures of the telephone wires is not great, and thus the summated effect of electromagnetic induction is negligible. In the case of the through telephone line where the circuit is uninterrupted throughout the zone of electrification, again the lead sheath and twisted pair are respectively effective in removing all static charges, and electromagnetically balancing the circuit; but on account of the cumulative action of the electromagnetic induction, either compensating transformers or a system of impedance coils installed across the telephone circuits at intervals of 2 miles (this distance may be less, depending on the electromagnetic destiny) with their central points grounded should be used. Either method will satisfactorily remove the impressed voltage due to electromagnetic induction. The importance of reliable telephone service between operating towers cannot be too greatly emphasized.

In regard to sectionalization it is noteworthy that it is impossible to elect some standard distance and then apply it to an old steam road. Even in the extreme case of an entirely new electric line it would be a strange coincidence to find, for example, 50 towns just two miles apart along the right of way. It is necessary to consider the individual lengths in accordance with the local condition, but the total number used over a certain length of road can largely be specified with considerable freedom.

The anchor insulators, which have given the best results from a combined mechanical and electrical stress point of view, have been of corrugated cylindrical form. In this form their insulating value is unquestionably less than the mushroom or petticoat type of insulator, and experience indicates that they are very much less reliable than the mushroom or petticoat type (this form of insulator is used to support the messenger cables on intermediate catenary bridges). It is believed, however, that by suspending some form of protective shield or petticoat from the anchor insulator, its insulating value will be greatly enhanced. The blast from steam locomotives seems to produce a very rough enamel of coal dust and cinders, which, on account of deeply imbedding itself in the insulator, is almost impossible to remove, in consequence of which insulating values are greatly reduced.

None of the difficulties encountered with the system has been of a character which could be interpreted as a menace to the general principles involved. The difficulties have either been corrected, or their correction is easily in sight.

At the conclusion of the reading of his paper, Mr. Murray stated that the discussion of the relative advantages of double and single cantenary constructions had been omitted intentionally. A choice of the one or the other must be a compromise of a great many considerations, the principal one being the number of tracks and the local conditions, but there is one fact that has been conclusively demonstrated, namely, either the trolley wire or the trolley shoe must be flexible whether the construction be for main or branch lines. In the single catenary construction a flexible contact conductor is provided. In the triangular construction the contact conductor is rigid. This requires a flexible shoe, which in a degree is secured by the spring pantagraph arrangement. Experience, however, has shown that the pantagraph should be still further supplemented by a light, but strong mechanism, which will insure flexible contact between the shoe and the trolley wire, thus not offering a great deal of inertia in movement when the shoe meets the hard spots of the line, which exists at the catenary hanger points.

A form of construction adopted in the East Port Chester yard, in which the latitudinal catenaries are supported by cross catenaries (in some cases spanning as many as ten tracks) contains a great many attractive features, and experience may indicate the desirability of using the cross catenary for main line work. Such an arrangement, if more frequently reinforced with cross-bridge anchorages, such as are now used in the New Haven system, will afford a lighter and cheaper construction, and possibly give a greater opportunity in insulating the overhead system from ground. There seems to be no reason why single catenary spans should be made any less in length than those used in the double catenary construction, as the cross-rigidity that may be desired, can be obtained by tying together adjacent latitudinal catenaries all of which are subject to the pull off construction at present employed.

(The flexible suspension in the Port Chester yards, described by Mr. Murray in the above paragraph, is illustrated herewith.—EDITORS.)

DISCUSSION.

Mr. L. B. Stillwell expressed his sincere appreciation of the attitude of the New Haven road and its engineers in frankly disclosing not only the successes but the difficulties. He stated that the strong point of the Alexanderson motor is its ability to commutate under speed without sparking. However, at the moment of starting the sparking may be serious. The facts given concerning the new motor seem to show that it will gain as much in the ratio of output to weight by a reduction of the frequency from 25 to 15 cycles as will the compensated series motor.

A communication from Mr. B. G. Lamme was read by F. H. Shepard. Mr. Lamme showed that in order to limit the sparking at starting in the Alexanderson repulsion motor it is necessary to reduce the field strength considerably below the value allowable when resistance leads are used with a compensated-series motor. Even if the field strength were reduced to 70 per cent of normal the short-circuit current would have five times the normal value and the working current for double-torque would have to be 2.86 times the normal. With preventive resistance leads the short-circuit current would be 1.25 times normal and the working current for double-torque only 1.6 times normal. Thus the brushes of the former motor would have to carry three times as much current at starting as those of the latter. With the same limiting short-circuit voltage, the flux could be increased by 66 per cent by using 15 instead of 25 cycles, and the output could be increased by about 30 per cent.

Mr. W. B. Potter expressed the opinion that overhead wires subject to lightning should not be run through lead cables. Since auxiliary wires can be so located as to be less exposed to the locomotive exhaust than can the contact-trolley wire, there is little need of supporting them on insulators underneath a bridge, and it is better to omit the lead covering suggested by Mr. Murray. The only safeguard against spanning two trolley sections in the event of one of them being grounded is to place a fuse between the two collectors. The essence of the improvement embodied in the Alexanderson motor is the better inherent commutation. By reason of this improvement it is possible to modify other features affecting the performance of the motors which have heretofore been subordinated to commutation, with an accompanying greater reliability, lessened maintenance cost and increased output for a certain amount of active material.

Mr. O. S. Lyford, Jr., remarked that in sectionalizing a trolley system other things must be taken into account besides the trouble on the line. On a railroad provided with a positive block system, the process of getting the rules abandoned so that a special train can proceed against the block is about as difficult as making the repair after reaching the trouble. It is essential to insulate the high-voltage trolley system thoroughly, which at the present state of the art dictates the exclusive use of porcelain.

Mr. W. I. Slichter explained that in the Alexanderson motor certain features are introduced to assist in starting, and others are employed only when running. The compensating and inducing winding is provided with twice the number of turns as are on the armature. Hence when the armature is short circuited at starting there is twice as much current in the armature as in the field coils, while under running conditions the current in the field coils is equal to that in the armature. Thus the field flux is relatively smaller at starting than while running. The tendency to sparking, which is minimized at starting, is neutralized under running conditions. A certain amount of wattless volt-amperes is required for maintaining the commutating field, but the improvement in commutation increases the efficiency and lessens the maintenance cost.

Dr. C. P. Steinmetz stated that the two great objections to alternating-current commutotor motors for railway work have been the impracticable low power factor and the hopelessly bad commutation. About 18 years ago Mr. Eickemeyer produced the compensating winding which allows a motor to be constructed with a reasonably good power factor. The second serious problem of the motor relating to commutation has been eliminated in the Alexanderson motor, and the alternating-current commutator motor may now be considered in practically as good a shape as the direct-current motor. It may be stated, therefore, that the period of youth of the alternating-current railway motor is concluded.

Solenoid in Series with Resistance.

By Charles R. Underhill.

There are many cases in practice where a solenoid is operated in a circuit containing a resistance in series with, and external to, the resistance of the winding itself. Theoretically there will always be some external resistance, as, for instance, the resistance of the leads to the solenoid and other wiring; but since the resistance of windings for local use, and particularly if designed to remain in circuit indefinitely without overheating, is great as compared with the resistance of the wiring and source of energy, this external resistance is not usually considered.

However, in this article the resistance in the circuit external to the resistance of the winding will be taken into consideration. The old rule "Make the internal and external resistances equal," holds for the maximum electrical power in watts which may be obtained in a winding, and also for the maximum magnetizing force for the winding under certain conditions; but this rule is not strictly correct as applied to the conditions in actual practice.

If we let E = voltage of source of energy,
E_1 = voltage across winding,
R = resistance of winding,
and R_1 = all other resistance in the circuit,
then $E_1 = \frac{RE}{R + R_1}$ (1).

Fig. 1 shows the percentage of maximum values for volts and watts for the winding according to this rule, the watts being maximum when $R = R_1$, and $E_1 = \frac{E}{2}$.

It is well known that the ampere-turns in a winding are constant when the size of wire, diameter of average turn (M), and voltage across the terminals of the winding, are constant, and regardless of the number of turns and consequently the space occupied by the insulating material on the wire. This relation may be expressed: $In = \frac{E_1}{\pi \rho M}$ (2), in which ρ is the resistance per unit length of wire. In English measure, with the inch as the unit, $\rho = \frac{8.6284}{10^7 d^2}$ (3) at 68 deg. F., where d represents the diameter of the wire. (2) may therefore be written: $In = \frac{10^7 E_1 d^2}{27.107\, M}$ (4).

In the American wire gage (B. & S.) the cross-sectional area of the wires varies nearly in the ratio of 10 for every ten sizes, the real ratio being 10.164:1. On this basis Fig. 2 has been plotted, the values for wires from No. 20 to No. 30 being correct; but for wires from No. 10 to No. 20 and between No. 30 and No. 40 the values are correct within 1.64 per cent, which is near enough in practice, owing to the gaps between consecutive sizes of wires.

The ampere-turns may be quickly found by this method in the following manner: First find the ratio θf by dividing the voltage across the winding by the diameter of the average turn (M), or $\theta f = \frac{E_1}{M}$ (5). Then by comparing the value $\theta = \frac{E_1}{fM}$ (6) with the desired ampere-turns, the proper size of wire (B. & S.) will be found under the value of f, which value will be either 10, 10^2 or 10^3 for the sizes indicated in Fig. 2. It is well to note here that when $f = 10$, the values are for wires from No. 10 to No. 20, and when $f = 10^2$ the values are for wires from No. 20 to No. 30, etc. When the value of $\theta = \frac{E_1}{fM}$ exceeds the values of the points of intersection on the chart, divide this value by 10, and multiply the corresponding value of ampere-turns by 10, or multiply the value of f by 10, according to whether the size of wire or the ampere-turns, is fixed.

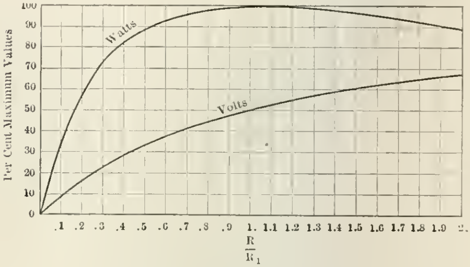

FIG. 1.—CHARACTERISTICS OF TWO RESISTANCES IN SERIES.

While the ampere-turns in a winding are absolutely independent of the number of turns in the winding, under the conditions mentioned above (voltage constant), the economy of operation varies directly with the resistance of the winding. Therefore the greater the resistance of a winding of fixed dimensions, voltage and size of wire, the greater will be the amount of copper contained in the winding, and the greater will be the economy.

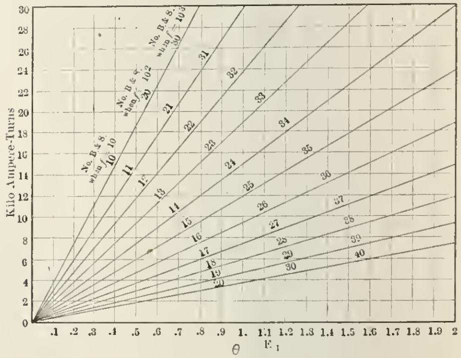

FIG. 2.—AMPERE-TURN CHART.

For a winding in the form of a hollow cylinder,
where M = diameter of average turn,
L = length of winding,
and T = thickness of wall of winding,
the resistance may be expressed:

$$R = \frac{27.107\, MLT}{10^7 d^2 d_1^2} \quad (7)$$

in which d_1 is the diameter over the insulation on the wire.

The watts in the winding will then be $W = \frac{10^7 E_1^2 d^2 d_1^2}{27.107\, MLT}$ (8), and since by (4), $In = \frac{10^7 E_1 d^2}{27.107\, M}$, $W = \frac{In E_1 d_1^2}{TL}$ (9), and $In = \frac{WTL}{E_1 d_1^2}$ (10). The relations in (9) and (10) will be clear since $n = \frac{TL}{d_1^2}$ (11). Therefore the watts may be calculated from the ampere-turns when the other constants are known, and vice versa.

The coefficient of space utilization, when round wire is considered, is $c = \frac{d^2}{d_1^2}$ (12), and hence to determine the economy factor (h) of a winding, the watts should be multiplied by c. Therefore $h = Wc$ (13) or $h = \frac{Wd^2}{d_1^2}$ (14).

Now consider a magnet winding of fixed dimensions in series with an external resistance, equal to that of the magnet winding, and a source of energy of constant voltage. When $\frac{d^2}{d_1^2} = 1$, which would be the ideal case for round wire, the ampere-turns will attain their maximum value for that size of wire, but if, as in the case of a No. 30 wire insulated with 4 mil increase double silk, $\left(\frac{d^2}{d_1^2} = .51\right)$, it would be necessary to use a wire of approximately twice the resistance per unit length in order to keep the resistance of the magnet winding the same in the latter case as in the former, and hence when the watts in the magnet winding were maximum, the ampere-turns would be approximately 50 per cent of their maximum value for ampere-turns in the ideal case.

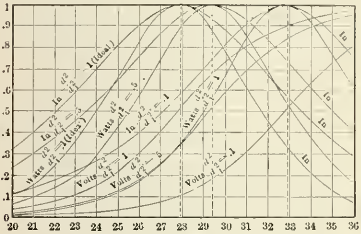

FIG. 3.—EFFECT WITH VARIABLE THICKNESS OF INSULATION, $\frac{d^2}{g^2}$ CONSTANT.

However, there are two distinct effects to be considered: (a) in which case the space occupied by the insulation on the wire bears a constant relation to the space occupied by the wire throughout the various sizes of wire, as for instance, when $\frac{d^2}{d_1^2} = .5$ for all sizes of wire, and (b), in which the thickness of insulating material on the wire is constant for all the various sizes of wire. In the former case (a) it would be necessary to use a different thickness of insulating material for each size of wire, in order to keep $\frac{d^2}{d_1^2}$ constant, and hence case (b) is the method adopted in practice. In this latter case the value of $\frac{d^2}{d_1^2}$ changes with every change in the size of the wire.

By assuming $E = 100$ and $R_1 = 100$, the relations in Figs. 3 to 5 have been calculated. Under these conditions the maximum value for the watts in the winding will be 25, when $E_1 = 50$ and $R = 100$. Fig. 3 shows the relations for several values of $\frac{d^2}{d_1^2}$ under case (a) in which these values are constant. It will be noted that the ampere-turns and watts are maximum simultaneously for each respective value of $\frac{d^2}{d_1^2}$, and that this point is determined by the intersection of the volts curve with the ordinate .5. While the maximum value for watts is 25 for any size of wire, under these conditions, the ampere-turns vary in the ratio shown in Fig. 4.

In Figs. 3 and 4 the relations expressed by the rule first referred to hold true, but in Fig. 5, where the values of $\frac{d^2}{d_1^2}$ are variable (case b) the watts and ampere-turns are not maximum simultaneously, although the point of maximum watts is determined by the intersection of the volts curve with the ordinate .5 as in case (a), Fig. 3.

The point for maximum ampere-turns with $\frac{d^2}{d_1^2}$ variable (Fig. 5) is determined by the intersection of the insulation curve with the ampere turns curve for that insulation. This gives the value of $\frac{d^2}{d_1^2}$ which will show the percentage of ideal ampere-turns, as in Fig. 4. This curve is reproduced in Fig. 5 (marked c) and its origin is at the intersection of the ideal volts curve and the ordinate .5, which ordinate represents the maximum value for the percentage of ideal IN (curve e).

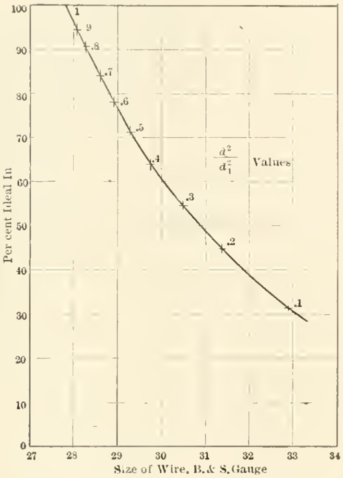

FIG. 4.—EFFECT OF INSTALLATION.

The size of wire which will give the maximum ampere-turns under these conditions, and with a given thickness of insulation, is determined by the intersection of the volts curve for the given insulation with curve c. Having once plotted curve e it is an easy matter to find the size of wire to give the maximum ampere-turns for any case, by first calculating the size of wire (assuming the insulation to be nil) which will produce the maximum ampere-turns for the ideal case $\left(\frac{d^2}{d_1^2} = 1\right)$. Two points for volts may then be calculated, taking into consideration the insulation on the wire. One of these points should be taken on the ordinate .5, i. e., when $R = R_1$ (and hence $E_1 = \frac{E}{2}$) calculating the size of wire. The other point should

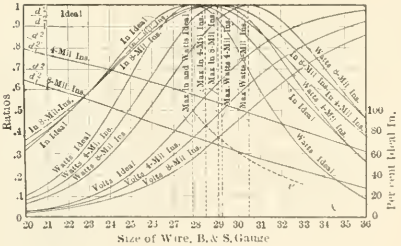

FIG. 5.—EFFECT WITH CONSTANT THICKNESS OF INSTALLATION, $\frac{d^2}{g^2}$ VARIABLE.

be taken for voltage on the abscissa representing the size of wire to produce ideal ampere-turns, referred to before. Connecting these points will locate the size of wire on curve *e* which will produce the maximum ampere-turns with the given insulation as previously explained.

Fig. 6 shows this principle, in which curve *e* is plotted to the same scale as in Fig. 5. In this case, however, the curve is a straight line at an angle of 50 deg. with the ordinate .5.

As an example, assume a solenoid with an available winding volume of 20 cubic inches, and with an average diameter of 2 ins., to be operated on a 220-volt circuit in series with a resistance of 200 ohms. Assuming $d^2 = d_1^2$, and by rearranging (7), the diameter of the wire (d) is found to be .017 in., or between No. 25 and No. 26 (approximately No. 25.4) B. & S. By (2), or referring to Fig. 2, the ampere-turns are found to be approximately 5850. Now when $E = E_1$, $R = R_1$, and hence the resistance of the solenoid, when watts are maximum, will be 200 ohms. Assuming 8 mil insulation, and calculating d from (7), the diameter of the wire is found to be .0136 in. or between Nos. 27 and 28, or by the formula $S = \frac{\bar{1}.662758 - \log d}{.0503535} - 3$ (15) in which S is the size of wire, B. & S. gauge, the fractional size is very nearly No. 27.5.

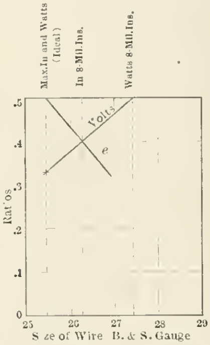

FIG. 6.—CURVE "E" AS STRAIGHT LINE.

The point where the voltage curve intersects the ideal abscissa is calculated from the same size of wire as in the ideal case, i. e., No. 25.4 or .017 in. diameter, but with the 8 mil insulation. By (7) the resistance is found to be 95.5 ohms, and by (1) the voltage (E_1) is 71, or 32.2 per cent of 220 volts. Therefore the size of wire with 8 mil insulation, which will produce the maximum ampere-turns under these conditions is approximately No. 26¼.

As a practical proposition the size of wire may be calculated for a 50-per cent drop in volts across the winding, using the next larger size of wire, unless the value of $\frac{d^2}{d_1^2}$ is near unity.

The Slide Rule in the Calculation of Magnetic Reactance.

By M. S. HOWARD.

Although several articles have appeared in the electrical journals in recent years setting forth the relations between the logarithmic scale of the slide rule and the wire table, and giving methods for obtaining the weight, resistance, diameter, etc., of wires, and for calculating the sizes of wire required for a certain distance, load and loss with the slide rule alone without the use of tables, the writer has never seen in print the following simple and expeditious method for calculating the reactance of alternating current circuits by means of the slide rule.* It is therefore offered in the hope that it may prove of some value, as it makes possible the determination of the characteristics of a circuit or transmission line with great rapidity and sufficient accuracy in ordinary cases, without reference to tables of any kind or the tedious solution of formulæ.

The general formula for the inductance of a single wire of raduis r situated at distance D from the return wire is, in henrys

$$L = l\left(2\log_e \frac{D}{r} + \tfrac{1}{2}\right) 10^{-9}$$

in which l is the length in centimetres. For $l = 1000$ feet and in terms of common logarithms the expression becomes, in henrys

$$L = \frac{1404.}{10^7}\left(\log \frac{D}{r} + .1086\right)$$

Reactance $x = 2\pi f L$, hence for a frequency $f = 60$ cycles per second

$$x = \frac{2 \times 3.1416 \times 60 \times 1404}{10^7}\left(\log \frac{D}{r} + .1086\right) \text{ in ohms}$$

$$= .053\left(\log \frac{D}{r} + .1086\right) \text{ in ohms.}$$

If d is the diameter of the wire, equal to $2r$, the formula may be put into the form

$$x = .053\left(\log \frac{D}{10d} + 1.4096\right) \text{ in ohms}$$

which reduces to

$$x = .106 \times \tfrac{1}{2}\log \frac{D}{10d} + .0747 \text{ ohms}$$

$$= .106 \log \sqrt{\frac{D}{10d}} + .0747 \text{ ohms} \qquad \text{(a)}$$

or approximately

$$x = \frac{1}{10} \log \sqrt{\frac{D}{10d}} + .0765 \text{ ohms.} \qquad \text{(b)}$$

The constant term is made .0765 in equation (b) instead of .0747 to distribute the error introduced by using the coefficient $\frac{1}{10}$ instead of .106 for the first term. In this form the formula admits of a very simple solution on the slide rule, and the maximum error for extreme values of the ratio $\frac{D}{10d}$ will seldom exceed two per cent and for ordinary working values of this ratio the accuracy is within one per cent. If greater accuracy is desired, however, use may be made of equation (a), which will give the same degree of accuracy as can be obtained with the slide rule in the solution of any other problem.

To avoid the necessity of remembering the constant term it should be marked on the zero end of the logarithm (L) scale.

To get the reactance for any other frequency multiply the result as obtained for 60 cycles by $\frac{f}{60}$, f being the given frequency.

For example let it be required to find the reactance per 1000 ft. of wire at a frequency of 25 cycles per second of a circuit of No. 2 B. & S. gauge wire spaced 30 ins. between centers.

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*Since the present article was prepared, the writer's attention was directed to an article by Mr. T. W. Varley appearing in the ELECTRICAL WORLD of Feb. 9, 1907, wherein there is described a graphical method for determining reactances by employing a logarithmic diagram. While the process of calculating reactances is rendered quite simple by the use of this diagram, it is probably no more convenient than the usual reactance tables and no more likely to be at hand when needed. Moreover, the use of tables is not entirely eliminated as the scheme includes a table of values of the ratio $\frac{D}{10d}$ to be used with the diagram. The slide rule, however, is a standard device usually found in the office and drafting room, can be conveniently carried in the pocket when in the field, is not limited to the one operation, and, with the exception of the one addition, the entire solution of the problem is possible with it.

Then $D = 30$ and, as the diameter of No. 2 B. & S. gauge wire is .257 in., $10d = 2.57$. Set 2.57 on the B scale beneath 30 on the A scale, turn the rule over and read .534 on the logarithm (L) scale on the back of the slide opposite the right hand index. Then for a frequency of 60 cycles per second, if equation (b) is used, the reactance per 1000 ft. of wire would be

$$x = \frac{.534}{10} + .0765 = .1299 \text{ ohms,}$$

or using equation (a)

$$x = .106 \times .534 + .0747 = .1313 \text{ ohms}$$

and for 25 cycles per second

$$x = .1313 \times \frac{25}{60} = .0547 \text{ ohms.}$$

The explanation of the first operation is obvious, since $10d$ on the B scale having been set beneath D on the A scale, the quotient $\frac{D}{10d}$ would be read on the A scale opposite the left hand end of the B scale, and the square root of this quotient $\left(\sqrt{\frac{D}{10d}}\right)$ would be obtained on the D scale directly beneath and opposite the left hand index of the C scale; therefore, the reading on the logarithm (L) scale, which is the logarithm of the number on the D scale opposite the index of the C scale,

$$\text{is } \log \sqrt{\frac{D}{10d}}.$$

If 10 times the diameter of the wire ($10d$) is greater than the distance between the centers of wires (D), the slide will project to the left when $10d$ on the B scale is set beneath D on the A scale, which indicates that the characteristic of log $\sqrt{\frac{D}{10d}}$ is —1, because $\sqrt{\frac{D}{10d}}$ is less than 1. By advancing the slide by the full length of the scale to the right, the mantissa of the logarithm may be read on the L scale as before. As an illustration, if, in the example given above, the distance between wires had been 2 ins. then, on setting 2.57 on the B scale beneath 2 on the A scale, the slide projects to the left. When the slide is advanced the full length of the scale to the right the mantissa is found to be .945 and, since the characteristic is — 1,

$$\log\sqrt{\frac{D}{10d}} = -\bar{1}.945$$
$$= -.0055$$

and

$$x = .106 \times -.0055 + .0747 \text{ ohms}$$
$$= .0689 \text{ ohms.}$$

For sizes smaller than No. 10, $10d$ is fractional, and it is necessary to multiply by 100 to bring it within the range of the rule; in order not to effect the final result, the same factor must be introduced into the numerator. The expression then becomes

$$x = .106 \log\sqrt{\frac{100\,D}{100 \times 10d}} + .0747 \text{ ohms}$$
$$= .106\left(\log 10 + \log\sqrt{\frac{D}{1000d}}\right) + .0747 \text{ ohms}$$
$$= .106\left(1 + \log\sqrt{\frac{D}{1000d}}\right) + .0747 \text{ ohms.}$$

That is, when $10d$ is less than unity, multiply it by 100 and add 1 to the logarithm as then found.

For example, find the reactance per 1000 ft. of wire at a frequency of 60 cycles per second of No. 14 B. & S. gauge wire spaced 10 ins. between centers. As the diameter of No. 14 wire is .0648, $10d = .648$ and $100 \times 10d = 64.8$. When 64.8 on the B scale is set beneath 10 on the A scale the slide projects to the left, which shows that the characteristic of the logarithm is —1. Advancing the slide by the length of the scale to the right, the mantissa read on the L scale is .594 and

$$x = (1 + -1.594) + .0747 \text{ ohms}$$
$$= .106 \times .594 + .0747 \text{ ohms}$$
$$= .1377 \text{ ohms.}$$

Likewise if the distance D between centers of wires exceeds 100 ins. divide it by 100 and then add 1. to the logarithm as found.

As the diameter of the wire may also be obtained directly from the slide rule when the B. & S. gauge number is given, the entire operation for determining reactance may be performed without reference to tables. Methods for obtaining the diameter have been given by Mr. Carl P. Nachod (ELECTRICAL WORLD March 3, 1907, and Sept. 7, 1907), and by Mr. Otto E. Falch, Jr. (ELECTRICAL WORLD, Aug. 3, 1907). Another convenient way is as follows: Set the number representing the size of the wire on the L scale opposite the index on the back of the rule, and place the runner at 10400 (approximately the circular mils in a No. 10 wire) on the D scale, then the number of circular mils in the chosen wire may be read under the runner on the C scale and the square root of this is the diameter sought. If a slide rule is at hand, therefore, neither resistance nor reactance tables of wires are essential to the calculation of circuits or transmission lines, since it is possible to determine by means of the slide rule alone the size of wire required for certain conditions of distance, load and loss by using the formula given by the author (ELECTRICAL WORLD, Dec. 30, 1905), and with the same device, the size having been determined, to calculate the reactance by the method given in this article and the resistance by methods described in Mr. Carl P. Nachod's articles. Moreover all these processes are devoid of complication and give quite accurate results.

Dynamometer for Testing Automobiles.

An important advance has been made in the manufacture and sport of the automobile in the construction, by the Automobile Club of America, New York, of a dynamometer which will determine instantly the speed in miles per hour and feet per second, draw-bar pull or tractive effort, horse-power, grade climbing ability, and power of the brakes of any automobile which is placed upon it.

The dynamometer, besides being the most complete apparatus ever built for testing automobiles, makes it unnecessary to get special permission to speed machines in making a running test, will eliminate all danger of road accidents during tests, and give the results more quickly and accurately than in any other way.

The dynamometer is a moving track upon which cars can be fully tried out while remaining stationary and under observation. In 1904, Dr. Schuyler Skaats Wheeler was requested by the club to invent, design and build a machine for determining accurately the performance of cars of all kinds. The present machine is, therefore, the result of several years' attention to this problem on the part of Dr. Wheeler.

It is an assemblage of power absorbing and measuring instruments, and a large power chart with automatically operated pointers. It carries the problem of power measurements, integration and automatic recording of the final results, much farther than has hitherto been attempted. It absorbs and measures the power so that, at a glance, the speed, tractive effort and horse-power can be clearly seen and read at each instant. The measurements show the power delivered at the ground by the wheels of the automobile. This includes every element in the operation of the automobile, and, therefore, shows the net power that is available for driving the car.

Instead of traveling along, as on a road, the car is held stationary by cables upon the floor with its driving wheels resting upon two large drums which reach up through the floor, and which the engine of the automobile causes to revolve. The revolution of the drums is resisted by a huge pendulum hanging below the floor, and attached to the drum shaft, not rigidly, but through a device furnishing a degree of friction which can be varied.

The pendulum, in consequence, swings out from the vertical a distance exactly proportional to the pull exerted by the car upon the drums. The amount of this pull, or tractive effort, is indicated by a pointer attached to the pendulum and reaching above the floor. This weighing apparatus or pendulum has been tested and certified correct by the Fairbanks Company. The indications given by the pendulum are transferred to a ruler traveling across the face of a large chart by a wire cable moved by a small motor, in such manner that with each varying position of the pendulum pointer, the cable is moved to correspond to its new position.

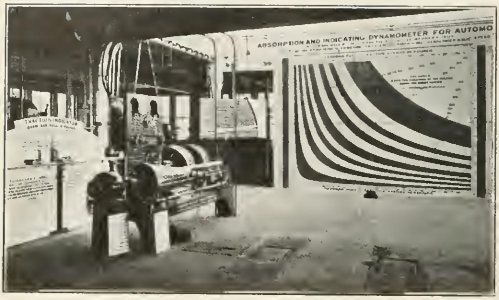


FIG. 1.—DYNAMOMETER FOR AUTOMOBILES.

The more difficult operation of measuring accurately the speed of the car, by moving another ruler vertically across the large chart, is accomplished by special apparatus of some novelty.

A cone is revolved by an electric motor at absolutely constant speed. To verify this speed, a bell, attached to the cone shaft, rings at each 100 revolutions, or at intervals of 30 seconds. A wheel or roller, driven by the automobile and, therefore, revolving slowly or fast to correspond, rolls upon the surface of the cone and is pulled, by an independent motor, back and forth between the small and large ends of the cone until it finds the point where it does not slip because that portion of the cone presents the same speed as the roller. This longitudinal adjustment of the roller is transmitted by a wire cable to the speed ruler on the chart, and the power required for moving the ruler is thus made independent of the automobile. In other words, none of the power of the automobile is used in operating the indicators on the chart. The method of speed measurement employed, based upon one element running at a constant speed like a clock, that can be verified, insures great accuracy. The roller, driven by the car if running at 60 miles per hour, must be drawn to a position near the large end of the cone in order to run with the cone. Whereas, if the car drives the roller at only five miles per hour, it must be drawn to a position near the small end of the cone. A system of electric contacts is arranged with a motor to shift the roller automatically until it finds the point where it will roll on the cone without slipping.

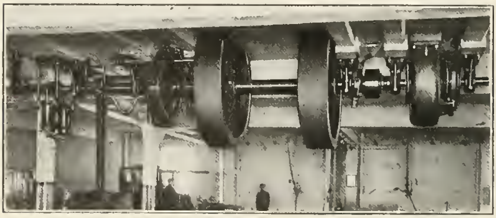


FIG. 2.—PORTIONS OF DYNAMOMETER BELOW TESTING FLOOR.

The speed and power rulers are thus moved across the chart automatically to correspond with the speed and the tractive effort or pull that the dynamometer shows the car is making.

On the board are painted the horse-power corresponding to each different speed and pull so that the result at each moment can be read at a glance and without calculations.

The chart is in heroic scale and can be read easily by the driver of the car. The speed of the car may be read from the chart in either of the popular ways of stating it; miles per hour, minutes per mile, kilometers, etc., by means of the several different scales provided.

All of the measuring apparatus is made reversible so that when running backward the performance of the car may be measured.

As a secondary apparatus, a grade meter is provided, operated by the pendulum indicator of the dynamometer. To use the grade meter the clamp is set upon the sliding scale at the point representing the weight of the car. The moving lever then assumes at each moment the angle of inclination of the grade the car would climb (if there were no wind resistance, slipping, etc.), with the effort that the car is then making.

To observe an automobile coasting down hill, either forward or backward, it is necessary merely to start the electric motor on the shaft carrying the two large drums upon which the driving wheels of the automobile rest. The brakes may then be tested, and the wheels or gears or engine may be run free (not run by the power of the automobile) and the relative friction loss of the automobile may be ascertained. The exhaust from the automobile engine is directed into a pipe connected to an electrically driven exhaust fan so that the test room is free from smoke and obnoxious fumes. The apparatus was built by the Crocker-Wheeler Company.

Single-Phase Railway Motor.

At the meeting of the A. I. E. E., held on Jan. 10, Mr. E. F. Alexanderson presented a paper devoted to a technical description of a single-phase commutator motor that possesses advantageous characteristics for railway work. The machine is called a "series-repulsion" motor, because it embodies many of the best features of the so-called plain repulsion motor and of the compensated series motor.

In mechanical construction the machine differs immaterially from either a (Thomson-Atkinson) repulsion motor or a conductively compensated motor. However, the "compensating" winding, termed the "inducing" winding, has twice as many turns as would usually be employed for a series motor. The mechanical arrangements of the circuits are indicated in Fig. 1.

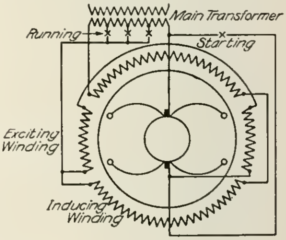
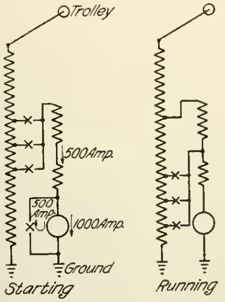


FIG. 1.—ARRANGEMENT OF MAGNETIZING CIRCUITS.

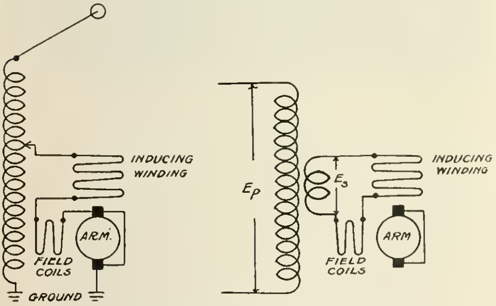
The electrical connections of the rotor and stator circuits during the starting and the running periods are shown in Figs. 2 and 3, respectively. The magnetizing actions of the stator windings are not indicated in the last two illustrations, but they can be ascertained by studying these two diagrams in connection with Fig. 1. It is believed that the characteristics of the motor under starting and running conditions can most readily be shown by the use of Figs. 4, 5, 6 and 7.

The connections of Fig. 4 are electrically equivalent in all respects to those of Fig. 2, while the magnetic relations are also properly shown. Fig. 5 shows circuits whose electrical characteristics and magnetic behavior are the same in every respect to those in the circuits of Fig. 4 or Fig. 2. It will be noted that the motor indicated in Fig. 5 is a so-called plain (Thomson-Atkinson) repulsion motor, and possesses all of the characteristics of this machine. The "inducing" winding has twice as many effective turns as the armature, hence the armature current at starting is equal to twice the current in the inducing coil, or to twice the current in the field coil, as shown in Fig. 2. It is claimed that by the connections shown in Fig. 2 (and reproduced in Figs. 4 and 5), the starting torque is doubled for the same current and same commutation as would be obtained with a compensated series motor.



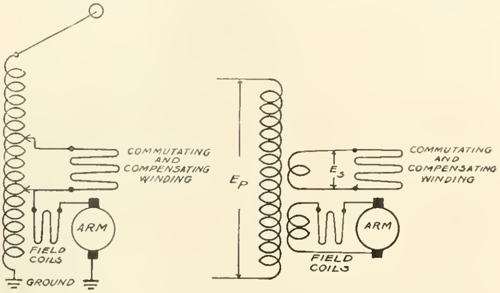
FIGS. 2 AND 3.—ELECTRICAL CONNECTIONS IN STARTING AND RUNNING POSITIONS.

The electrical connections shown in Fig. 3 are reproduced in Fig. 6, which indicates also the magnetic relations. The circuits of Fig. 7 are electrically and magnetically equivalent to those of Fig. 3. The performance characteristics of the motor of Fig. 7 are similar to those of a compensated single-phase motor, but the action throughout the commutation zone is quite different. In the motor of Fig. 7 the flux along the brush axis depends solely upon the e.m.f. E_s, and is unaffected in any way by the current in the armature; the current in the compensating and commutating winding is a dependent variable, having a value such as not only to oppose the magnetomotive force of the armature current, but also to supply the m.m.f. to produce the flux demanded by the e.m.f. E_s. The cutting of this flux by the armature conductors under running conditions generates in the armature coil under the brush a speed e.m.f. that neutralizes the transformer e.m.f. produced in this coil by the alternating field flux.



FIGS. 4 AND 5.—EQUIVALENTS OF CIRCUITS SHOWN IN FIGS. 1 AND 2.

It is interesting to examine the required value and time-phase position of the commutating flux. The transformer e.m.f. of the field flux varies in value solely with the field strength, and is always in time quadrature therewith; it is unaffected by the speed, except to the extent that the speed may alter the field strength. The speed e.m.f of the commutating flux is in time-phase with this flux and it varies in value with both the flux and the speed. It is seen, therefore, that the commutating flux should be in time-quadrature with the field flux and it should decrease in value as the speed increases. When the connections shown in Fig. 7 are used the commutating flux is always in time-quadrature with the e.m.f. E_s (or E_p). Now, under speed conditions, the current through the armature and field circuits is approximately in time-phase with the e.m.f. E_p. Hence, the field flux, which is in time-phase with the field current, is almost in time-quadrature with the commutating flux. Fig. 2 shows the arrangement of connections which allows the e.m.f. E_s, and therefore the commutating flux, to be decreased as the e.m.f. impressed across the motor field and armature circuits is increased, or as the speed increases.


COMMUTATING AND COMPENSATING WINDING
E_p
E_s
COMMUTATING AND COMPENSATING WINDING
ARM
ARM
FIELD COILS
FIELD COILS
GROUND

FIGS. 6 AND 7.—EQUIVALENTS OF CIRCUITS SHOWN IN FIGS. 1 AND 3.

It is stated that the commutation of the machine at a frequency of 25 cycles is much better than that of a conductively compensated series motor at the same frequency, and even better than that of the latter motor at 15 cycles. This result is due largely to the use of the connections described above, although some improvement is attributed to the use of a fractional-pitch winding on the armature. The latter improvement is said to be of the same character as that accompanying the change from an ordinary direct-current machine to a commutating-pole machine. The introduction of the commutating flux tends to lower the power factor slightly, but the greater liberty in design that is gained in the new type allows the motor, as constructed for railway service, to possess practically the same power factor as does a conductively compensated series motor for the same duty.

Electricity in Buffalo Grain Elevator Service.

Electricity from Niagara applied to grain-elevator service in Buffalo has surpassed steam in economy. Exact figures of what it costs to elevate grain by steam are difficult to secure, for the kind of grain handled, the time required and other conditions complicate the problem. It is conservative, however, to estimate the cost of handling grain by steam power at from 50 to 75 per cent above the expense per bushel by electricity. There are no stand-by charges with the electrical installation, and the depreciation of motors and controlling apparatus is much less than the depreciation of an idle steam plant. Intermittent service is readily handled by electric power, and the question of licensed attendance becomes of small moment.

In Buffalo some of the largest grain elevators are operated by electricity supplied by the Cataract Power & Conduit Company. The standard rate for elevator power is 2.5 cents per kw-hour. One of the largest elevators equipped is the Mutual, which has 27 motors of the induction type, making about 1240 horse-power connected load in this single installation. The maximum load of the Mutual elevator seldom exceeds 500 kilowatts. The maximum number of bushels of grain handled by this elevator in a 1907 month up to December was 2,372,000. The total capacity of this elevator is about 3,000,000 bushels per month. The motors here vary from 100 horse-power down. There are four 100-hp units driving the main outside elevator or "marine legs," four 75-hp motors on the inside legs, and nine 50-hp motors, driving belt conveyors and other apparatus

These motors are all wound for two-phase, 440-volt current, and are supplied from the local distribution circuits of the company through two 500-kw, 2300-volt, three-phase to two-phase step-down Westinghouse transformers. This installation has been in satisfactory service for about 11 years. Auto starters are used in the motor circuits.

The Dakota elevator at Buffalo is equipped with 15 motors aggregating 930 horse-power connected load. This elevator runs at a capacity of about 1,000,000 bushels per month, and its maximum load is about 350 kilowatts. This is a three-phase installation with General Electric equipment. Three 250-kw transformers step the voltage down to 460 from 2300, the former being the working potential. The installation includes two 100-hp motors on the main legs, eight 75-hp, one 10-hp and four 30-hp motors. The motors are started on low voltage taps. The Great Eastern elevator has 20 Westinghouse induction 440-volt motors aggregating 912 horse-power, two of these being 150-hp outfits. Three 200-kw transformers wound for 2300 to 440 volts are installed in this establishment. In these elevators the service during six months of the year is generally intermittent. Owing to the different weights per bushel of corn, oats and wheat, and the storage of all kinds in a single elevator as well as the transfer and shifting of grain from boat to car and from bin to bin, it is difficult to give an accurate estimate of the power cost per 1000 bushels. In some cases, however, this has been figured considerably below 75 cents, and it is probable that it can in some instances be done for upwards of 50 cents. There is no question about the superiority of electricity for this work.

The Tantalum Lamp in Central Station Service at Muncie, Ind.

By Geo. C. Osborne.

Situated in the central part of the state of Indiana is the city of Muncie, possessing about the same opportunities and limitations to the central station as the ordinary city of 30,000 inhabitants. With an abundant supply of natural gas, distributed by five or six separate companies, and a widespread use of gasoline for individual lighting plants, the task of materially increasing the use of electricity for lighting cannot be called an easy one.

Under such conditions the Muncie Electric Light Company has during the past year obtained an income per capita increase of 40 per cent; connected lighting demand increase. arc lamps, 4 per cent; incandescents 23 per cent, and an enviable broadening of the peak of the lighting-load curve.

Much of this improvement is a direct result of the use of tantalum lamps, their application being widespread, included among its users being nearly all of the prominent stores, hotels, churches, theaters, and numerous residences.

Mr. Fred Leslie, the present aggressive manager of the Muncie Electric Light Company, talks enthusiastically of the merits of the tantalum lamp and its aid in obtaining and retaining business which otherwise would have been lost to gas or gasoline. He relates many instances of customers voluntarily increasing the amount of money they were willing to spend on lighting, due to their adoption of the tantalum lamp and obtaining a whiter, a more brilliant and a steadier light. An ample tribute to their appreciation of the worth of the tantalum lamp is the 10,000 tantalum lamps now in use out of a total of 32,000 16-cp lamp equivalents connected. This appreciation is further attested by the fact that each lamp was sold at 60 cents, and that few converts again returned to the old carbon-filament lamp, which they could obtain at about 15 cents.

There are two methods of charging employed by the Muncie Electric Light Company, one, a straight meter rate, sliding from 10 cents to 5 cents per kw-hour, according to the total energy used, the low rate being given on all bills showing over 1000 kw-hours' use per month; the other, a flat rate of 60 cents a month for each 16-cp lamp connected (or lamp of equivalent wattage). On the meter rate, a customer increases his cost for lamp renewals and with a total increased cost, including renewals and energy charge, of from 10 per cent to 20 per cent (depending upon rate), he obtains continuously 60 per cent more light. On the flat-rate basis he gets this additional 60 per cent more light at a lower proportionate cost, varying with his average daily hours use of light. His total cost for lighting on an average daily use of two hours is increased by 2½ per cent; four hours, 5 per cent; eight hours, 10 per cent, etc.

It will be noticed that with the longer daily hours' use, although the cost for energy to a consumer on a flat rate is constant, his increased cost for lamp renewals on a lamp like the tantalum is sufficient to prevent a wilful waste of energy.

About one-half of the tantalum lamps installed are used on the flat-rate charge, under a two years' contract, the company in this case agreeing to furnish the customer with fixtures, sockets and porcelain shades.

It will be seen that the rate of 60 cents per month for each 50 watts connected produces $144 per annum per kilowatt connected, a lucrative return to the central station. This rate is attractive to the consumer only in connection with the tantalum lamp, giving 25 candle-power for 50 watts, instead of 16 candle-power, at simply the increased cost for lamps, which averages less than five cents a month for each outlet. Most of the stores have adapted their distribution of fixtures and sockets to the use of the tantalum lamp, thereby reducing the number of outlets and in that way deriving all the benefit of the superior efficiency of the new lamp.

TANTALUM LAMPS IN MUNCIE STORE; OLD GASOLINE LAMPS SHOWN.

Mr. George W. Tidd, formerly manager of the Muncie Electric Light Company, and now continuing his work with the American Gas & Electric properties, is a practical, hustling central-station man. He early saw the possibilities of the newer metallic-filament lamps, and while other companies were debating whether specific consumption of 2.8 w. p. c. or 2.5 w. p. c. should be adopted, Mr. Tidd reached out and secured the most efficient lamp available, and the result is to-day that Muncie is the best electrically lighted city in the Middle West. It is best from the consumer's point of view, because he is obtaining an abundance of light of a beautiful, brilliant white quality, and best from the central-station man's standpoint, as he is obtaining more and more business on the basis of $144 per year per kilowatt.

Tungsten Lamps for Leicester, Mass.

In connection with the purchase of the local electric lighting interests at Leicester, Mass., by the Worcester Electric Light Company, a plan has been developed to use tungsten series lamps in the street lighting of the town, which is a small village, located about 6 miles south of the Worcester Company's generating plant. The tungsten lamps to be used are to be operated in two circuits of about 100 lamps each. The company has purchased 400 of these lamps, but only 199 are as yet required by the town service. About 12 miles of wire will be required in the town, and the new lamps will take the place of 25-cp, 3.5-watt, carbon-filament incandescents located on the same poles. The height of the lamps above the street will probably be from 15 ft. to 18 ft., and the existing spacing is in in the neighborhood of 100 yards between lamps, all being located on the same side of the street. The size of wire required on the circuit in the town will be No. 8 B. & S., and the total lighting load of the town will be supplied by two No. 0000 wires running from the Worcester mains at 2200 volts, single-phase, 60 cycles. The contract price for the service is at present $18 per lamp per year, the circuit being shut down at midnight.

The 40-cp series tungsten lamp is the smallest of this type manufactured. When operated at four amperes these lamps are figured at a consumption of 1.25 watts per candle-power. At Leicester the conditions are somewhat peculiar, however, in regard to the tub transformers located at a central point in the town, and the lighting contract calls for but 25 candle-power. The tubs are made for 3.5 amperes, and for these reasons the new lamp will probably be run at from 30 to 35 candle-power. This should give a long life without serious sacrifice of efficiency, though when the contract expires next summer it is likely that a new adjustment of rates may be suggested. The tubs cannot be run at much below three amperes. The plans for Leicester are somewhat tentative, but they illustrate the flexibility of a high-efficiency system in comparison with the older equipment.

LETTERS TO THE EDITORS.

The Neutral Commutation Zone.

To the Editors of Electrical World:

Sirs:—On page 1058 of your issue for Nov. 30, 1907, there appeared a brief reference to an article by me in the *Elektrotechnische Zeitschrift* which was so worded as to leave the impression that I believe that the brushes should not be displaced in order to obtain sparkless commutation in direct-current machines. According to my theory the brushes must be displaced because they must follow the displacement of the neutral zone, while, according to the usual theory, the brushes must be displaced beyond the neutral zone. Thus, although I hold that a perfect commutation takes place in the neutral zone, this zone is not stationary. I use the word "neutral" in its real sense, that is, devoid of magnetic polarity.

It may be well to mention the importance of definiteness in expression. It is not uncommon to find such a contradiction as "the magnetic field in the neutral zone." The expression "geometrical neutral line" is sometimes used when "symmetry line" is intended. In view of the indefinite and incoherent expressions used by certain authors it is not unnatural that they become confused in their own intricate explanations.

C. L. R. E. Menges.

Villa Mar, Scheveningen, Holland.

The Patent Office Gazette.

To the Editors of Electrical World:

Sirs:—The many letters in your Jan. 11 issue relating to a recent change in the *Patent Office Gazette* show a remarkable diversity of views which ought not to exist if the real, practical utility of the *Gazette* is appreciated.

The publication of portions of patents in the *Gazette* has its greatest usefulness as a means of eliminating unnecessary work and unnecessary delays. This utility arises both when a representative of a manufacturer that might be affected by newly issued patents examines the *Gazette* week by week to obtain knowledge of patents that might be of interest, and also when the *Gazette* is used more in the manner of an encyclopedia. In either case the examination of the *Gazette* with reference to any particular patent will enable the searcher in a great number of cases to ascertain that the particular patent is of no interest, thereby obviating expense and the delay of waiting for a full copy of a patent. This, I think, answers the suggestion made by some of your correspondents that one must go to the full copy of the patent in any event before deciding upon the validity or scope of the patent.

No matter what plan is pursued as to the *Patent Office Gazette* it must necessarily be true that no one would attempt to decide that a patent is valuable by reading the *Gazette,* but in a great majority of cases it can thereby be decided that the patent is of no value. Where a manufacturer is interested in a line of work as to which numerous patents issue every week, it is of the greatest benefit to him that he can eliminate, by reading the *Gazette,* the great bulk of those that issue of no interest to him. The *Gazette,* therefore, should be published from the standpoint of giving to the reader as clear an idea of the general scope and character of the invention as it is possible to do without too great bulk. The old way was none too good, because, as pointed out by your correspondents, the drawings were most incomplete and the claims were often meaningless without reference to the specification. Frequently the drawings showed only old and familiar devices, while the claims related to automatic features in no way indicated in the drawings published. Yet, in most cases by reading over the claims, it could, at least, be determined whether the patent might have some relation to the purpose in view, or whether it clearly had none.

But the new way seems to me to be without excuse, because it is a purely arbitrary matter to select the five claims numbered one to five in the patent. It is emphatically not true even now that the most important claims are always among these first five. Without any attempt to draft claims in any unusual order, it frequently occurs that the broader claims have high numbers. Frequently this is the case because the full scope of the invention does not become at once apparent—it seldom does. Under the new arrangement it would be undoubtedly the case that a still smaller proportion of the patents would be drafted with the strongest claims among the first five. One might almost as well eliminate all the claims as arbitrarily to select the first five. Indeed, if an abstract prepared intelligently by the Patent Office were inserted, this would be superior to the present rule.

It is true that the *Patent Office Gazette* is getting exceedingly bulky and occupies valuable shelf space, but the removal of this annoyance should not be effected by any such artificial elimination as is now practiced. Either the old method should be revived, or what would be better, there should be an intelligent preparation of the matter that is to appear in the *Gazette.* Sufficient of the drawings should be selected by the examiner to enable the general character of the invention to be understood, and the examiner should prepare a brief digest of the object, nature and construction of the invention, and should select claims sufficient in number to enable the reader to know generally what features are claimed and how broadly they are claimed. In some cases a single claim and two lines of descriptions would be ample. In other cases perhaps a half column of description and 15 or 20 claims might be necessary.

My point is that a change from the old order would be wise, but that it should be one that is based upon an intelligent and careful study of each individual patent. Thus the utility of the *Gazette* would be largely increased and its bulk would be much reduced.

New York, N. Y. Richard Eyre.

A Rectifier for Small Alternating Currents.

To the Editors of Electrical World:

Sirs:—While investigating the silicon wireless detector I discovered that it has remarkable unilateral conductivity which causes it to act when properly adjusted as an effective rectifier for small alternating currents. Perhaps the following very brief preliminary account may be of interest to your readers.

The rectifier, as used in the experiments, consisted of a bit of silicon embedded in solder in contact with a piece of either brass or steel wire attached to a flat spring. The contact pressure could be varied by means of an adjusting screw. Some points on the silicon seem to have the rectifying property in a superlative degree, hence the point of contact was also made adjustable. In the following table a few values showing the marked unilateral conductivity are given:

Direct e. m. f.	Current in milli-amperes.	
Volts	Brass to silicon.	Silicon to brass
0.028	.008	.0075
0.042	.012	.0100
0.070	.021	.0160
0.14	.050	0250
0.28	.300	.0800
1.00	8.400	.4000
2.80	47.000	2 8000

Alternating voltages at 60 cycles applied to the rectifier gave asymmetrical currents corresponding fairly closely to the differences in the two columns of the table.

For small voltages the rectification is roughly proportional to the square of the voltage, but for the higher values it increases more rapidly, reaching 91 per cent at 1.0 volt. Above this the whole phenomenon appears to be more irregular and the rectification becomes gradually less complete, at least with the present arrangement of contacts. Observations at 900 cycles and with high frequency currents indicate that the rectification is at least approximately independent of the frequency.

The cause of the peculiar unilateral conductivity is not yet by any means clear, but it seems from the present evidence that it is a surface phenomenon, depending vitally as it does on the position and pressure of the contact. The most effective contact resistance appears to lie between 1000 and 4000 ohms. With the silicon in contact with solder electrodes at both ends, well pressed together so that the resistance falls to a few ohms, the phenomenon practically disappears.

In the experiments mentioned above the action cannot be thermoelectric, for apart from the magnitude of the effect, the current produced by heating the brass-silicon junction has the reverse direction. It is possible, however, to make an adjustment of the contact pressure so that the rectified current, at least in the case of low voltages, coincides with the thermoelectric current. This is a condition in general difficult to secure or to maintain.

G. W. Pickard, in his patent specification No. 836,531, states that this last method of working is the one operative in the silicon detector, and he considers the action thermoelectric.

Bureau of Standards, Washington. Louis W. Austin.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

The Torque of Alternating-Current Motors.—V. A. Fynn.—A very long paper read before the Birmingham Section of the (British) Institution of Electrical Engineers on the torque conditions in a number of different types of alternating-current motors. The author first deals at considerable length with what he terms the "self-exciting, partly-compensated single-phase induction motor," commonly called the single-phase induction motor, and traces the three different components into which the torque may be considered as divided, and also indicates some methods by which some motors may be fully compensated. He then deals more briefly with the "separately-excited series-induction motor," known as the Atkinson repulsion motor; the "neutralized series-conduction motor," which is the compensated series motor; the "partly-compensated, separately-excited series-induction motor," otherwise called the Latour motor; the "partly-compensated, self-excited series-induction motor," and the "separately-excited, partly-compensated two-phase shunt-induction motor," which is the two-phase induction motor. Some methods of starting "single-phase, self-excited compensated-induction motors" are discussed, and a comparison of the specific weight of direct and alternating-current motors is made. He states as a basis for comparisons that the weight of a commercial continuous-current motor, as compared to that of a commercial 50-cycle, single-phase "self-excited partly-compensated shunt induction motor" with slip rings, is as 1 to 1.5, and that the weight of the continuous-current machine, as compared to a commercial 50-cycle, two-phase, partly-compensated, shunt-induction motor with slip-rings, is as 1 to 0.7. In cases where a commutator is used the weight is, of course, increased, but where such a commutator can be fully utilized in a rational manner, as is, for instance, the case with constant-speed machines, the increase in weight is fully compensated for by a correspondingly increased output. In other cases the use of a commutator leads to an increase in weight without a corresponding increase in output, as in the case of motors with a series characteristic. This increase in weight is from 20 to 25 per cent, varying with the type of machine. Of course, these figures are merely approximations; that is, if the design of the different types of machines is analogous. "The difference in the design-constants between commercial continuous and commercial alternating-current motors is most marked in the case of the continuous-current series traction motor as compared to the 'neutralized single-phase, series-conduction' machine. The armature ampere-turns of the latter very greatly exceed those of the former in a motor of equal output and same speed, with the result that the weight discrepancy between the two can often be reduced below the limit given, although this particular type of alternating-current motor requires a heavy cummutator. Thus, with a sinusoidad current wave and a periodicity of 25 cycles, the alternating-current machine for the same heating need be only about 40 per cent heavier than a continuous-current series motor of the same output, speed and voltage." An account of the discussion which followed is also given.—Lond. *Elec. Eng'ing*, Dec. 12, 19, 26.

Design of Direct-Current Generators.—H. M. Hobart and A. G. Ellis.—The first part of a second serial on the influence of the rated speed and output on the design of direct-current generators. In their former serial they described a method of determining the leading dimensions of direct-current generators of any rated output and speed, chiefly with reference to the reactance voltage as the commutation criterion. They also obtained the leading data for a 500-kw, 250-volt, direct-current generators for speeds between 125 and 2000 r. p. m. In the present serial they extend these considerations to designs for 250 and 1000 kilowatts for the same speeds. They also give some results of working out in detail a number of designs for the same rated outputs at high and low speeds.—Lond. *Electrical Review*, Dec. 20.

Voltage Coefficient.—A. Seugel.—In the equation of the effective value of the e. m. f. of an alternating-current machine $E = K N z f 10^{-8}$ (where N the useful number of lines of flux per pole, z the number of conductors per phase, f the frequency), the "voltage coefficient K depends considerably on the arrangement of the coils and poles. The author gives formulas for calculating this coefficient for the usual winding arrangements of single-phase and polyphase machines. A comparison of the values of K for the voltage between one phase and the neutral point and the voltage between two phases in polyphase machines shows that the ratio of the two voltages is not always the same, but depends partly on the arrangement of the poles and coils.—*Elek. Zeit.*, Dec. 12.

Three-Phase Induction Motors.—W. Oelschlaeger.—The plotting of the circular diagram of an induction motor depends on the knowledge of the magnetizing current and of the ideal short-circuit current. The former may be easily calculated, but the latter is generally found from the former with the aid of the leakage coefficient. This method has distinct disadvantages and the author describes a simple method for determining the ideal short-circuit current directly from the main dimensions of the machine. The method is based on the introduction of the term "number of ampere-conductors per unit of periphery for the ideal short-circuit current."—*Elek. Zeit.*, Dec. 26.

Mercury-Vapor Rectifiers.—J. Polak.—A translation in abstract, with illustrations, of his German paper, abstracted some time ago in the Digest, on the practical operation of mercury vapor rectifiers.—Lond. *Electrical Review*, Dec. 13.

Lamps and Lighting.

Effect of Light on the Eye.—Schanz and K. Stockhausen.—The authors, one of which is an eye specialist, have determined the effect of light on the human eye, and especially the effect of the ultra-violet rays. The eye is the more strongly affected by artificial sources of light the greater the brightness in candles per sq. cm. and the greater the area of the source of light. The maximum brightness which the eye can withstand without bad effect is 0.75 hefner candles per sq. cm. Only paraffine candles, oil lamps and certain special kinds of kerosene and gas lamps are below this limit. Any other source of light should be surrounded by a diffractive globe. Carbon-filament incandescent lamps have a brightness 100 times the allowable limit, metalic-filament lamps 270 times, the Nernst lamp 550 times, and the electric arc lamp 4000 times (evidently meaning incandescent lamps with plain globes and the Nernst filament and the arc without any globe). Lamp cylinders or globes must be made of glass so that the ultra-violet rays are absorbed. Incandescent lamps with plain globes should not be used for lighting working rooms and school rooms. Indirect illumination is in any case preferable.—*Jour. f. Gasbel.*, Vol. 50, 1907, p. 988, 1029 and 1070; *Elek. Zeit.*, Dec. 26.

Arc Lighting in London.—An article giving comparative curves of the illumination obtained in London streets partly with enclosed arc lamps on short lamp posts (13¾ ft. high), partly with white flame lamps placed on posts along the curb (20½ ft. high), and partly with yellow flame lamps suspended over the middle of the road (28 ft. high). The latter method of center suspension is possible only where the width of the street is suitable, and it introduces difficulties in trimming and attending to the lamps. It seems that in the third case the lamps had to be hung too high. If suspended at a lower height they would have given more illumination. On the other hand, although the maximum illumination is less than in the case of lighting from lamps along the curb, the drop variation from maximum to minimum is not so marked. The ordinary enclosed arc lamps are provided with unusually large opaque globes. "Complaints have been made of the glare of the flame arc and the unpleasant effect of the white arc when not obscured, and every means appears to have been taken to obvjate any trouble of this kind. These lamps (the enclosed arcs) give a measured candle-power of 300 at all angles below the lamp level, with a large light flux in all directions, thus giving clear illumination without harsh shadows, and the comparatively low intrinsic brilliancy of these lamps in the line of vision has the merit of enabling the even distribution of illumination to be more appreciated by the eye."—Lond. *Elec. Eng'ing*, Dec. 12.

Electric Lighting of Railway Cars.—K. Wallitschek.—An illustrated description of different systems of electric car lighting in use on Austrian railways. Besides a notice of the system of Stone and Boehm, those of Digg and Rosenberg are described to some extent.—*Elek. und Masch.*, Dec. 15 and 22.

Power.

British Power Company.—An article giving details of extended developments which have taken place in the motor load in some districts of the West Ham Corporation system. Two-phase induction motors are almost exclusively used, and a separate 6000-volt, two-phase cable system has been laid for motor service. Further developments are expected in connection with electrolytic work and factory heating purposes. The corporation hires out motors, arc and incandescent lamps, and act as contractors for wiring. Much of the extension of business is due to the activity of the canvassing department.—Lond. *Elec. Eng'ing*, Dec. 12.

French Water-Power Plant.—H. Armagnat.—In a continuation of his long serial on the electric stations along the Mediterranean coast of France, the Brillanne power plant is described. There are five generating units of 3000 kv-amperes. Each generator is driven by a double Francis horizontal turbine, and generates three-phase currents at 7500 volts at a frequency of 25. There are also some smaller machines for excitation and for furnishing the lighting current in the vicinity of the station. By means of a transformer sub-station it is possible to connect this system with other distribution systems in the neighborhood. —*L'Industrie Elec.*, Dec. 25.

Gas-Electric Power.—An illustrated description of the electric equipment of mines and metallurgical plants which is now going on in the celebrated Mansfeld copper district of Germany. The different generating stations are connected together to a ring so that in case of an accident in one station the other stations may act as reserves. The interesting feature of the installations is the utilization of the gases from the copper blast furnaces for producing electric energy in gas engines. Electricity is used for lighting and all kinds of industrial purposes, of which the most interesting are the winding equipment in the different mines. The great economy of electric motors over steam engines is shown.—*Electrochem. and Met. Ind.*, January.

Electric Motors in Railway Shops in Argentine.—An illustrated description of the electric equipment of the new workshops of the Buenos Ayres, Western Railway. The machinery throughout the works is electrically driven on the three-phase system at 440 volts. The generators are driven by gas engines, producer gas being supplied by two Mond producers, the fuel being bituminous slack.—Lond. *Elec. Review*, Dec. 20.

Electric Winding in Mines.—E. Kulka.—A mathematical article illustrated by diagrams for solving the different problems arising in the operation of electrically operated winding machines, especially at starting and stopping with constant current. —*Elek. Zeit.*, Dec. 12.

Electric Motors in Coal Mines.—An illustrated article of a general nature on the uses of electric motors in coal mines, especially for pumping, winding and the operation of compressers, drills and coal cutters.—*Cassier's Magazine*, January.

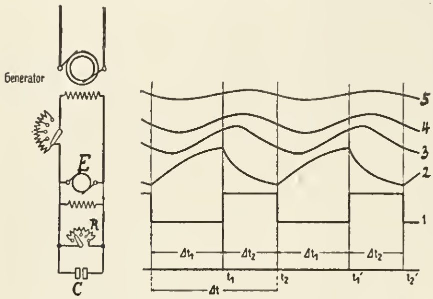
Assessment of Tramway Companies.—J. F. C. Snell.—An article in which the author reviews the methods of assessing electricity supply of tramway undertakings for the payment of taxes, and summarizes the decisions that have been given in Great Britain from time to time on various disputable points. Tables are given of the estimated life of the various kinds of plant machinery, and a comparison is made of the taxes paid by some typical electricity supply and tramway undertakings, expressed as percentages of the capital expenditure.—Lond. *Elec. Eng'ing*, Dec. 12.

Traction.

Signals for Locomotives.—J. Pigg.—*A* paper read before the (British) Institution of Electrical Engineers on a system of electrical cab-signalling on locomotives which has been put into experimental use by V. Raven on the North-Eastern Railway. In addition to repeating visually the indications of the semaphore, the instrument on the engine carries two pointers, which serve as route indicators, and a failure indicator for showing when the circuit of the local battery actuating the apparatus is out of order. An electric bell is used to give audible signals. A series of several contact-ramps between the rails required between the distant signalling point and the home signal, as well as a pair of spring bars outside the rails, actuate a rotary switch on the engine at the point where the driver's attention is first called. Several railway men took part in the discussion. Practically all admired the ingenuity of the system, but there was a tendency to regard it as too complicated and too expensive. Other causes of criticism were that in the event of failure of the local battery, the normal audible danger signal is not given, but only an entirely different visual indication, which the driver might neglect. The use of the same bell for both the danger and line-clear signal was also condemned, as well as the normal danger position of the miniature semaphore arm in the cab instrument. While the consensus of opinion favored indications in the cab, one speaker preferred loud audible signals alongside the track. The possibility of extending the action of the cab apparatus to actually stopping the train, as well as warning the driver, was discussed, as was also the extent to which such a system should be supplementary, or should replace, ordinary semaphore signals.—Lond. *Elec. Eng,ing,* Dec. 12.

Installations, Systems and Appliances.

Tirrill Automatic Voltage Regulator.—G. Grossmann.—A very long and profusely illustrated Berlin Electric Society paper on the modern Tirrill regulator. As indicated in Fig. 1, the action depends on a mechanism in continuous movement which periodically closes and opens a pair of contacts *C*, whereby the resistor *R* in the shunt-excitation of *E* is periodically short-circuited. *E* is the machine furnishing the exciting current for the generator shown at the top. In Fig. 2 the periodical variations in the resistance of the shunt-excitation circuit of *E* are shown in curve 1; they vary periodically between a maximum and a minimum. Curve 2 represents the exciting current of *E,* curve 3 the excitation voltage, curve 4 the exciting current of the generator, and curve 5 the effective generator voltage which is periodically fluctuating. These curves relate to the conditions when load and speed of the generator do not vary. The object of the regulator is to maintain the average effective generator voltage constant whatever the speed and load. This is accomplished by automatic adjustment of the exciting current of the generator. This exciting current must vary between a minimum value, corresponding to no-load at maximum speed, and a maximum value, corresponding to full-load at minimum speed and with minimum power-factor. In a special case it may, for instance, be necessary that the excitation voltage varies between 50 and 100 volts. The connections of the regulator are shown in Fig. 3. The periodic short-circuiting of the resistor (*R* in Fig. 1) is obtained by the pair of contacts c_1c_2 (Fig. 3). The upper contact (c_1) is stationary, while the lower, c_2, is fixed to the armature of the differential relay *e*. The latter is provided with two equal and opposite windings, *m n*, both of which are connected to the source of excitation voltage, but while the current exists continually in one, it exists in the other only when the main pair of contacts C_1C_2 (at the top of Fig. 3) is closed. Therefore, if C_1C_2 is closed the magnetic flux in *e* is zero; if C_1C_2 is open there is a flux in *e* and the armature is attracted. The opening and closing of the two pairs of contacts C_1C_2 and c_1c_2 is practically synchronous. The regulating mechanism consists essentially of two main parts. At the left-hand there is the direct-current magnet acting on the lever H_1 with the upper contact C_1. At the right-hand there is an alternating-current magnet acting on the lever H_2 with the lower contact C_2. The winding of the direct-current magnet at the left is in series with a non-inductive resistor and is connected to the terminals of the exciter so that the current in it is proportional at any time to the excitation voltage. This solenoid attracts the iron core K_1 downwards, which is counteracted by four spiral springs drawing the lever H_1 upwards. These are so arranged that the combined torque of the different springs varies approximately according to the same law as the electromagnetic tractive force, which increases the more the further the core is drawn into the solenoid. It can be so arranged that the distance to which the upper contact C_1 is raised is proportional to the change of the excitation voltage. In reality the excitation voltage constantly fluctuates, so that the lever H_1 and the contact C_1 oscillate continually with great speed around an average position which varies with the load of the generator and the excitation voltage. At the right-hand is the alternating-current magnet; *VT* and *CT* are a shunt transformer and series transformer, respectively, connected to the generator, as shown. The current in the alternating-current magnet has at any time an effective value proportional to the generator voltage. This solenoid acts on the iron core K_2, suspended on the lever H_2, while *G* is a counterweight. The two forces that act on H_2 are gravity and the magnetic tractive force. The latter depends on the position of the core relative to the solenoid and on the effective generator voltage. By proper design it is possible to obtain the following result for a certain predetermined normal voltage of the generator. As long as this generator voltage is maintained constant, the alternating-current lever H_2 is perfectly balanced in any position. If, however, the generating voltage decreases, a torque is exerted on the lever in a clockwise direction, and the torque and the voltage vary together. If, however, the generator voltage increases above the normal value, a torque is exerted in a counter-clockwise direction. The author shows in detail how the continuously moving mechanism operates as long as the load and speed of the generator are constant. The movement of the mechanism remains perfectly regular during this time. But if, for instance, the load is increased, and, therefore, the voltage decreases below the predetermined normal value the lever H_2 is acted upon by a torque in a clockwise direction so that the main contacts C_1C_2 are closed and the shunt regulator is short-circuited. The exciting current immediately increases until the voltage has again reached its normal value. If the voltage then rises above the normal, the main contacts C_1C_2 which were continually closed up to this moment are opened again and the oscillating movement begins again. While, as explained above, the generator voltage is continually fluctuating, the fluctuations are so small and so rapid that they are of practically no importance whatever. In general, the contacts make from 400 to 900 oscillations per minute. Some diagrams are reproduced to show a very great superiority of this automatic regulator over the most careful hand regulation, even with very strong fluctuations of load. Whenever there is a very great change in the load there is a small variation of the generator voltage, not more than 0.3 to 0.5 per cent, which, more-



FIGS. 1 AND 2.—AUTOMATIC VOLTAGE REGULATOR.

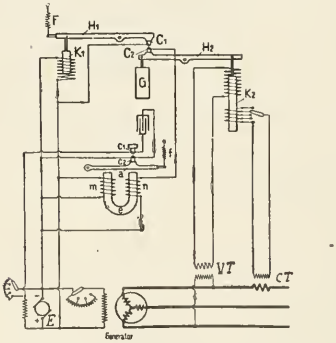


FIG. 3.—DIAGRAM OF VOLTAGE REGULATOR.

over, does not last more than a few seconds. The author thinks that the excellent properties of this regulator are due mainly to the ingenious construction of the lever H_2, which is not acted upon by forces of springs, but represents a system in unstable equilibrium which is able to react on the smallest impulse. As shown in Fig. 3, the alternating-current magnet has not only a winding influenced by the generator voltage and fed from the voltage transformer, but also a second one which is supplied with current from a series transformer. This second winding is adjustable, and in this way it is possible to vary the value of the generator voltage to be maintained constant. In practical constructions the voltage to be maintained constant may thus be adjusted within limits of 15 per cent. With the aid of this second winding it is also possible to obtain an automatic increase of the generator voltage proportional to the generator load, which method is useful if one wants to keep the voltage constant at a distant point, for instance, at a feeding point. The very long paper describes all the details of the apparatus at length.—*Elek. Zeit.*, Dec. 12, 19 and 26.

Mainz.—Furker.—An article on the equipment and development of the municipal central station of Mainz, in Germany. The object is to show that a three-phase system can be developed properly and economically in a city which has comparatively few industrial plants compared with the number of inhabitants. In such a case, however, the management of the plant should make use of all the most modern improvements in boiler house economy, machine construction, etc., so as to use the fuel always in the most rational way. It is also emphasized that municipal stations need not be less economical than private plants. It is important to meet the requirements of the consumers in every way and to adjust the rate for electric energy so that even the smallest merchants can use electricity.—*Elek. Zeit.*, Dec. 5, 12, 19.

Electric Equipment of an Hospital.—An illustrated description of the electric installation of the Royal Victoria Infirmary at Newcastle-on-Tyne, where electricity is used for lamps, for all kinds of industrial purposes, in the kitchen, in the dispensary (rotary mixers), in the laundry, etc., as well as for the operation of radiographic apparatus, electric baths, Finsen lamps and for Roentgen rays in skin diseases.—Lond. *Elec. Review*, Dec. 13.

Wires, Wiring and Conduits.

Lamp Socket.—An illustrated description of a device of Magunna, shown in Fig. 4, to connect, for instance, a lamp to two conductors. The two conductors are placed into the two grooves at the top of the base shown at the bottom of the illustration. Then the insulating piece shown in the center of the illustration is dropped into place and finally the metallic knob shown at the top is screwed on. As a result of the pressure thus exercised, the sharp points in the grooves penetrate through the insulation of the wires and make contact with the copper. A lamp may then be connected.—*L'Industrie Electrique*, Dec. 25.

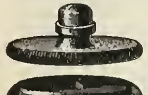


Fig. 4.—Lamp Socket.

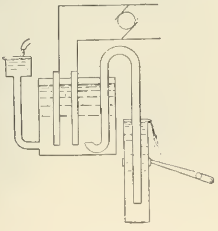


Fig. 5.—Adjustable Water Resistor.

Electrophysics and Magnetism.

The Parent of Radium.—Hahn.—It has formerly been suggested that radium is produced from uranium, though it was later shown that there must be one or more intermediate products between the two. Boltwood offered the hypothesis that actinium is the direct mother substance of radium, but Rutherford showed that it is not actinium, but some unknown substance present with the actinium. Boltwood has since found that this hypothetical element, which he calls ionium, follows the reactions of thorium. The present author has also found in another way that the direct parent of radium follows the chemical reaction of thorium and can thus be obtained from uranium minerals.—*Berichte*, XI, p. 4415; *American Jour. of Science*, January.

Electrochemistry and Batteries.

Steel Furnace.—Thallner.—A paper on the refining of steel in the electric furnace. The author points out that the electric furnace is not a simple melting furnace, but that its chief advantages rest in the possibility of using special slags which can be used only at the high temperature available, and which enable a very complete refining of the metal. This is especially possible with the Heroult furnace, in which not only may the sulphur and phosphorus be reduced to any desired amount, but the metal may be obtained free from oxides. A diagram gives the consumption of electric energy in the Heroult furnace with hot and cold starting materials for different sizes of furnaces.—*Electrochem. and Met. Ind.*, January.

Modification of Induction Furnace.—Wedding.—An illustrated description of a modification, due to Roechling and Rodenhauser, of the electric induction furnace for steel making in use in a German steel works. It is in reality a combination of an induction furnace with an electrode furnace, the electrodes being connected to a second secondary winding (the first secondary being the metal bath as in the ordinary induction furnace). The electrodes are made of refractory electrolytic conductors of the same nature as the filament of the Nernst lamp, which are non-conductors at low temperatures and become conductors only at elevated temperatures. They are preheated by the bath, while the furnace acts simply as a pure induction furnace. Some details of the metallurgical problems of refining are given.—*Electrochem. and Met. Ind.*, January.

Electrothermic Production of Iron and Steel.—J. W. Richards.—The first part of an illustrated Franklin Institute paper. After general introductory notes on the subject, the author discusses the induction furnace, the Héroult furnace, and the ferro-alloy industry.—*Jour. Franklin Institute*, December.

Units, Measurements and Instruments.

Adjustable Water Resistor.—F. Ross.—For testing large alternating-current generators water resistors are quite convenient, but it is preferable not to adjust the resistance by raising or lowering the electrodes or changing the distance between them, but by varying the level of the water. Fig. 5 shows the arrangement. It is best to use running water so as to prevent any considerable raise of the temperature. In general, a supply of one-third litre of water per minute per kilowatt is amply sufficient. The adjustment of the level is accomplished, with the aid of the tube, by raising or lowering the vessel at the right-hand of the illustration. The method is exceedingly simple, and is free from danger even with high-tension currents.—*Elek. und Masch.*, Dec. 8.

Silver Voltameter.—R. T. Glazebrook.—A Royal Society paper giving the results of an investigation made in the British National Physical Laboratory. F. E. Smith and T. Mather have compared many forms of silver voltameters and have determined the electrochemical equivalent of silver. They conclude that "the Rayleigh form of voltameter as employed by them is reproduced to one or two parts in 100,000, and that the electrochemical equivalent of silver is 1.11827 milligrams per coulomb." In a second part of the paper the chemistry of the silver voltameter is discussed by F. E. Smith and T. M. Lowry.—Lond. *Electrical Review*, Dec. 13.

Induction Coils.—B. Zirotka.—In order to avoid the use of an interrupter for the operation of Roentgen-ray tubes, wireless telegraphy, etc., the author endeavored to employ directly alternating currents from an ordinary supply network with the aid of an induction coil. He found that the voltage could he very essentially raised by employing two spark-gaps, as shown in Fig. 6, which indicates the arrangement for the operation of a Roentgen-ray tube. It will be seen that the two spark-gaps are connected opposite. The second spark-gap, which is earthed, is intended to carry off the current pulses of the polarity, which is not desired. In this way it is possible to get current impulses of uniform direction and to increase the voltage of the induction coil by about 100 per cent. Data are given on the design of an induction coil for such purposes.—*Elek Zeit.*, Dec. 12.

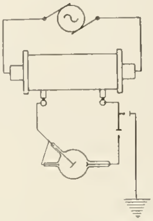


FIG. 6.—DIAGRAM OF INDUCTION COIL.

Measuring Damping Effects.—H. Rausch von Traubenberg and B. Monasch.—If the electromagnetic oscillations produced in a condenser circuit with air gap are caused to act on a resonance circuit, the form of the resonance curve in the second circuit depends on the sum of the damping factors or logarithmic decrements of the two oscillators. If the damping of the secondary system is to be determined a resistance whose value is known is added, etc. The authors show that much more exact results can be obtained by using continuous oscillations of constant amplitude produced by the Poulsen arc method.—*Phys. Zeit.*, Dec. 15.

Electrolytic Meter.—H. S. Hadfield.—An article describing some recent improvements in the Wright mercury electrolytic meter. After describing the original Wright meter and its practical defects due to the changes in the mercurous nitrate electrolyte the author describes his experiments made with other electrolytes which lead him to adopt a solution of a double iodide of mercury and potassium. As cathode either tantalum or sand-blasted pure iridium are most satisfactory. The meter is to be put on the market.—Lond. *Electrician*, Dec. 6 and 13.

A Repulsion Meter for Alternating Currents and Potentials.

By John M. Lea.

The field of electrical measurement comprises two different kinds of currents, direct and alternating. The practical measurement of the unidirectional currents and potentials is very satisfactorily accomplished by the Deprez and D'Arsonval type of instrument making use of a powerful permanent magnet and a very light pivoted coil. In practical measurement of alternating currents and potentials, however, much more difficulty is experienced, and the types of measuring instruments now in use are inferior in several respects to direct-current meters.

The most prominent and common of alternating-current measuring instruments are the dynamometer, hot wire, induction and "magnetic vane" or electromagnetic types.

The repulsion type of induction meter is as valuable as any of the forementioned, and, in addition, is very efficient and has a scale which is more even than that of any other type of alternating-current ammeter or voltmeter. A meter of this type patented by the writer and manufactured by the International Electric Meter Company, of Chicago, is shown herewith. Fig. 1 illustrates the moving element or coil, with index and pivots. The coil stamping, which is composed of aluminum, is only 8 mm in thickness, and is made so nearly balanced that very little counterweight need be added to the moving parts for poising or balancing and, therefore, the whole system is extremely light. This is a well known advantage for electrical measuring instruments. When complete with pointer, counterweights and pivots the weight is only 35 grains.

A clear idea of the instrument, its principles and its action may be obtained by reference to Fig. 3. In its elements this instrument embodies the principle of a short-circuited transformer, consisting of a primary or exciting coil *A* adapted to carry the current or a part of the current to be measured, and a secondary element or closed coil *B* linked in inductive relation to the primary by a suitable laminated iron core *C*, constructed to give a completely closed magnetic circuit. The primary and secondary, just mentioned, are so mounted as to have a relative movement under the influence of their mutual repulsion when the primary is traversed by an alternating current. Such movement of the secondary *B* is opposed by two tempered phosphor bronze spiral springs (acting in opposite directions to eliminate "zero" trouble), so that the extent of movement will be dependent upon the strength of the primary current and will indicate such strength of current. To increase the sensitiveness of the instrument, the adjustable secondary circuit *D*, which has an attractive effect, is provided upon the core near the extremity of the swing of coil *B*. The magnitude of this effect is proportional to the distance of this secondary from the end of the swing of the coil *B*, the further away the less the effect. This feature is made use of in adjusting the contour of the scale in calibration, as without it the divisions would tend to shorten, and the result is a very even scale throughout 70 per cent of the deflection.

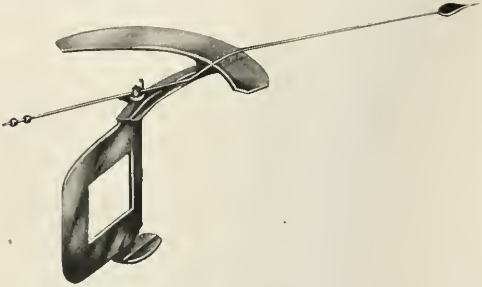


FIG. 1.—MOVING ELEMENT OF METER.

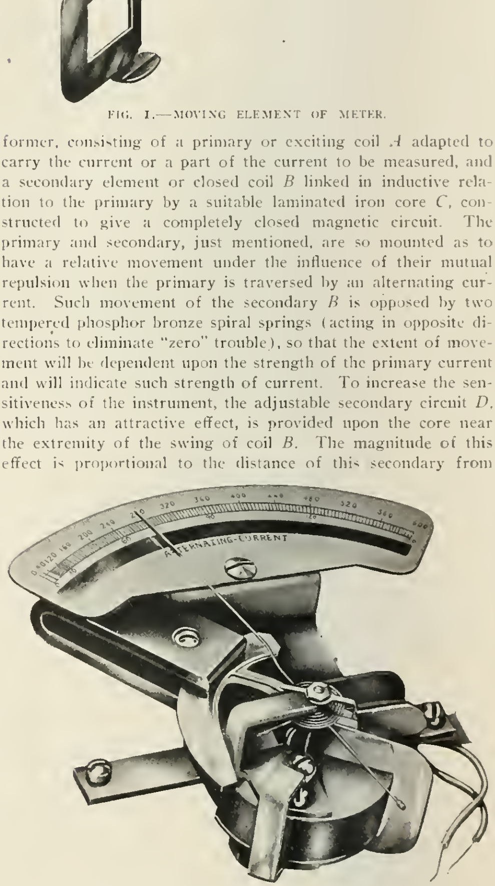


FIG. 2.—INSTRUMENT COMPLETE, WITHOUT CASE.

Thus, the movable secondary coil *B* is arranged to oscillate along the curve of the core *C* between the fixed primary *A* and the adjustable or fixed secondary *D*, being simultaneously repelled by the primary and attracted by the secondary. The action of the coil *D* allows a considerable reduction in the section of the coil *B* as it may be said to carry part of the active induced current. It can be made of considerable cross-section and of heavy metal with impunity. This allows the use of a metal of zero temperature coefficient, and thereby greatly reduces the temperature coefficient of the meter.

The vane *E*, which is a part of the coil stamping, is adjusted to swing freely and with a large amount of clearance between the poles of a strong permanent magnet *F*, which acts as a dampener on the oscillations of the moving element, but does not cause any friction or in the least affect the accuracy of the calibration. This magnet is not affected by the action of the alternating flux, as it is mounted in a position where there is very little leakage, the magnetic density in the core being exceedingly low.

Changes in the wave-form of the primary current have no appreciable effect on the indication of this meter as the greatest possible change, caused by change in wave form, is only 4 or 5 per cent of the core loss, while the probable change is much less and besides this the core loss is only a very small part of the total power required to overcome the I^2R loss in the coils and other losses.

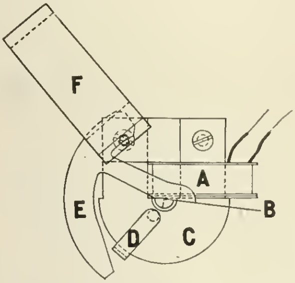


FIG. 3.—DIAGRAM ILLUSTRATING PRINCIPLES OF REPULSION METER.

The meter has a power-factor of from 60 to 70 per cent, and as the reactance is not affected by temperature changes, the meter is inherently less affected, by this cause, than is ordinarily the case. There are three additional provisions made to eliminate this effect in both ammeters and voltmeters.

New Model of Mercury Vapor Lamp.

The Cooper Hewitt Electric Company, of New York, has brought out a new model of mercury vapor lamp which embodies several mechanical and electrical improvements that add greatly to the commercial value of the lamp. The general form of the vapor tubes of the several types of lamps remain the same, the improvements, for the most part, being in the "auxiliary" and the method of installation. The new design makes it possible to handle each lamp outfit as a unit, and has simplified the hanging of the lamp.

No change has been made in the parts and functions of the auxiliary to the lamp tube, the improvements being embraced in the manufacture and assembling of this device. The new casing of the auxiliary resembles that of the ordinary arc lamp. As shown in Fig. 1, the cover is hinged, and when thrown open gives easy access to the parts of the auxiliary. The lamp rod which supports the vapor tube is attached by a pivot screw to the auxiliary.

Fig. 2 shows the details of the auxiliary. A ceiling plate, a short, threaded, pipe nipple and an insulating joint are furnished with each lamp outfit. These are fastened to the ceiling, and the auxiliary is screwed to the insulating joint. Where lamps are hung from outlet boxes, the ceiling plate can be dispensed with. When desired, the lamp may be hung from a wire rope by screwing a hook to the insulated joint and guying the lamp so that it cannot swing. The ballast or adjuster is fitted with a standard plug base and screwed into an Edison socket. The inductance coils are thoroughly insulated, and the resistor is made of wire entirely embedded in an enamel-coated spool which protects it from gases and dampness. Two binding posts are provided on the resistor for adjustment of the potential. Close regulation is not necessary, as the ballast and induction coil compensate for ordinary fluctuations. All standard lamps are made for either 110 or 220-volt circuits and standard series lamps may be operated from 500 to 600-volt circuits. The lamp shown has a small solenoid between the holder and auxiliary, and when the circuit is closed the current flows through the solenoid, which tilts the vapor tube for starting. This type of lamp is particularly suited for installation in such places where it would be difficult to reach the lamp to tilt the vapor tube by hand.

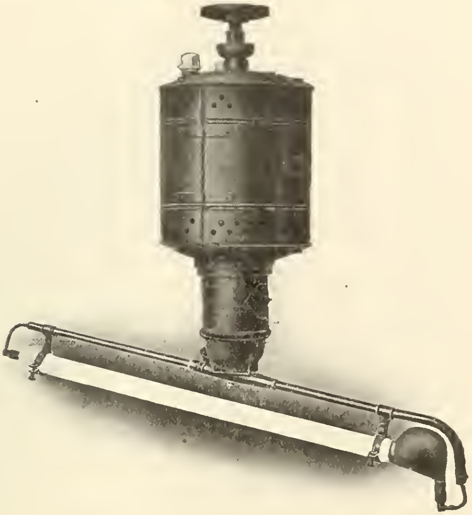
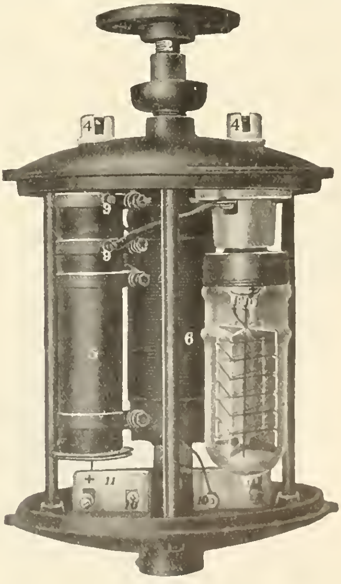


FIG. 1.—1908 MODEL LAMP.



FIR. 2.—NEW AUXILIARY, CASING REMOVED.

Automatic Pressure Regulator for Direct-Current Motors.

Fig. 1 herewith shows the latest motor-driven pressure regulator brought out by the Automatic Switch Company, of 131 Liberty Street, New York. The regulator is a combination of a motor-driven starter and a magnet switch operated in conjunction with a pressure-controlled pilot switch as shown in Fig. 2. The magnet switch is of the single-pole type; but can be obtained double-pole if desired, and requires energy only during the actual movement to close or open the circuit. The magnet is not subjected therefore to danger from overheating by reason of being continuously supplied with energy. The controlling circuits from the pilot control switch are broken on this main switch, thus obviating arcing at other points of contact, and means are provided on the magnet switch for taking care of any arcing. The contacts of the pressure control pilot switch are of silver and not being called upon to break a circuit carrying much current are not liable to injury due to arcing. The operation of the controller is as follows: The pressure at starting being nil, the pressure regulating gauge arm is in position to close a contact so that energy is supplied to the magnet switch. When this switch is closed, the circuit is made through the starting box to the motor, causing the armature to move and drive the worm shaft shown at the top which revolves the magnet clutch. An armature swung from the stud on which the cup revolves is magnetically clutched to the cup and, turning with it, pulls up the arm of the starting box. The magnet clutch winding is connected in series with a small retaining magnet shown at the top of the resistor segments. When the arm of the starting box comes in contact with the retaining magnet it short-circuits the clutch magnet coil and relieves the worm gear from any work other than the turning of the cup. As soon as the arm has reached its top-most point, a copper contact shown at the left of the retaining magnet bridges the carbon contact on the resistance arm causing the energy to flow through a metallic circuit without additional resistance. The motor will then have reached full speed in a time proportional to the load, the starting box arm having been driven at a speed directly proportional to the speed of the motor, but having a constantly progressing movement across the resistor contacts, thus decreasing the resistance as the motor increases in speed. When the pressure in the tank reaches the desired value the pressure regulating gauge arm will have left the contact by which the original circuit was made and will come in contact with the opposite circuit closing contact, thus opening the circuit to the main switch and causing the motor to stop. This operation is repeated every time the pressure drops from the predetermined value. As the arm of the starting box is driven by the motor it is starting, an overload on the motor produced by excessive friction or from other causes would prevent its movement across the resistor segments, or at any rate increase the length of time required, thus protecting the motor against the excessive current caused by too quickly short circuiting the starting rheostat. As the starting box arm is driven by a mechanical movement imparted through the magnet clutch, this clutching effect may be far in excess of the amount required without increasing the speed of the starting box arm. Thus it will be seen that this clutching magnet may be wound to work satisfactorily under almost any variation in line voltage, and it is especially necessary that such a device should be thus constructed when used in connection with street railway circuits where the voltage varies from 350 to 700 volts, although normally 500 volts.

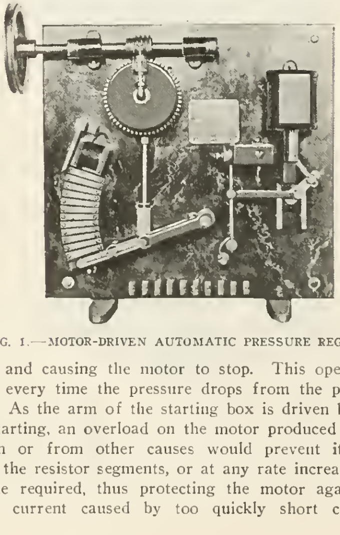


FIG. 1.—MOTOR-DRIVEN AUTOMATIC PRESSURE REGULATOR.

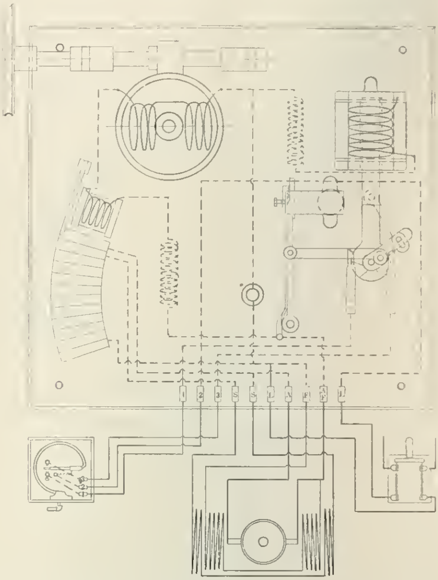


FIG. 2.—CONNECTIONS OF MOTOR-DRIVEN AUTOMATIC PRESSURE REGULATOR.

* * *

The Electric Drive in a Hardware Factory.

An interesting example of the application of the induction motor drive is found in the factory of the O. M. Edwards Company, of Syracuse, N. Y. This company is an extensive manufacturer of hardware specialties used in both the steam and electric railroad trade, such as window and extension platform trap door fixtures, steel window sash, moulding, etc. Formerly the company purchased energy from the Syracuse Lighting Company, using 500-volt direct-current motors for driving the wood and metal working machinery, and was so well satisfied with electric motor drive that when the factory was enlarged an isolated alternating current plant was installed together with a complete induction motor equipment.

The generating equipment consists of a Sweet "Straight-Line" engine direct-connected to a 220-volt, 70-kw, 60-cycle, three-phase generator. The generator is of the revolving-field type built by the General Electric Company. A tap is brought out from the neutral point of the generator winding for incandescent lighting purposes.

The motors are of the standard General Electric squirrel-cage type, the total rating installed being a little over 100-hp. The method of drive is what is commonly known as the group drive, and the motors are suspended on platforms from the ceiling. In each machine-room the machines are assembled in four groups, a motor in each corner of room driving separate line shafting from which machines are belt-driven. Starting compensators are placed conveniently near to the motors. The entire electrical equipment has been in operation continuously eleven hours per day for over a year without any operating trouble whatever.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—There was a decided improvement in sentiment throughout the country during the week—the outlook is considered brighter, and commercial loans were made with more freedom than in the recent past. Trade in general was somewhat backward and in some sections the mild weather is a check to the widest activities. Jobbers report trade quiet and merchants disposed to reduce stocks rather than to anticipate requirements. In some lines collections are better than those of last month. Many mills have resumed operation, although in some cases only on part time or part force, but the percentage of idle machinery has perceptibly decreased. Building was quiet; in 1907 expenditure at 60 cities was about 10 per cent lower than that of 1906. Iron and steel production has a more favorable outlook. During the past two months the annual rate of production has declined over 57 per cent, but on the whole production in 1907—over 25,700,000 tons—was the heaviest on record, being 1.5 per cent over the previous best year—1906. At some centers prices are a trifle firmer and the markets are generally easier. Finished lines are dull, and lower prices for light steel rails are looked for. The exports of wheat, including flour, from the United States and Canada for the week ending Jan. 9 aggregated 6,804,273 bushels, against 51,119,394 bushels in the week previous and 4,073,110 bushels in the corresponding week last year. Corn exports of the week were 1,111,874 bushels, against 741,691 in the previous week, and 1,296,187 bushels in the corresponding week of last year. Copper was firmer on European purchases, and a better financial situation, but domestic demand is still light, trade in finished goods being dull. The closing quotations were 13¾c. for Lake, 13⅝c. for electrolytic, and 13⅜c. for casting copper. Business failures during the week showed a large increase, 435 being reported by *Bradstreet's*, against 345 in the previous week, and 223 in the corresponding week of last year.

PLANT FOR PULP MILL.—After installing an electric generating unit and operating a portion of its plant with motor-drive, the Everett Pulp & Paper Company, proprietors of a large mill at Everett, Wash., noted for the quality of its output, recently decided that the economies effected by this system, as well as numerous other advantages, warranted it in putting its entire plant on the same basis. Accordingly the president and general manager of the company, Mr. W. H. Howarth, on his return from an extensive trip abroad, visited the leading industrial centers of the East, accompanied by Mr. T. H. McDonald, his chief engineer, with a view of deciding upon the best type of prime mover to use; and, after observing the operation of various standard machines, particularly in the light of his European experience, Mr. Howarth concluded to purchase a steam turbine, having 500 kilowatts capacity, of the improved type built by Allis-Chalmers Company. The question most thoroughly gone into by Mr. Howarth was that of "reliability," Mr. Howarth having some doubt as to whether the steam turbine could be sufficiently depended upon as a prime mover for the service required in his company's mill. The builder was, however, able to point to a large number of its turbines installed not only in electric railway and lighting plants, but also in industrial works of various kinds, ranging from factories where the load is comparatively uniform and steady to steel mills where it fluctuates widely and with great rapidity during continuous 24-hour operation, and the results demonstrated were such as to leave no doubt in Mr. Howarth's mind as to the dependence to be placed on these units even under the most severe conditions of service.

THE GREAT WESTERN POWER COMPANY, which is installing a large hydro-electric power plant on the Feather River, in California, is one of the few large companies in the country engaged on construction work that has not reduced its force on account of the financial flurry. Under favorable conditions it is expected now that the first development will be completed in July of this year. The transmission line will be run as directly as possible from Island Bar to Oroville. From that city to Sacramento the line will follow the right of way of the Western Pacific Railway. Future development work at Big Bend will depend on circumstances as to the quantity of electric power that can be developed after the machinery now ordered has been put in working condition and the demand for electricity has exceeded 50,000 horse-power. If the demand is good and a sufficient increase of power can be developed at Big Bend, another force of 1000 men or more will be put at work. The Great Western Power Company has another large power development at Butt Valley, on the Feather River, near Prattville. The company is said to own nearly all of Big Meadows about Prattville. A few miles from the latter place it has changed the channel of the Feather River and plans a great storage reservoir for water. The plan is to run a large tunnel through the hill between Big Meadows and Butt Valley. At the lower end of Butt Valley a high dam will be constructed. The company has also purchased the rights and property of the Golden State Power Company along the Feather River between Butt Valley and Big Bend. It is estimated that the Great Western Power Company can develop 200,000 horse-power along the Feather River.

INCORPORATIONS IN 1907.—Records that are apparently complete show a total of 898 industrial and miscellaneous companies formed during the year 1907, with a capital of $500,000 or more, the aggregate capital of which is $1,642,830,000, and 47 railroad companies, whose total reaches $333,100,000, or 945 companies representing a capital of $1,975,930,000. In a similar compilation for 1906 the amount of capital involved was $3,127,745,000 and the number of companies 996. Of the latter 891 were industrial and miscellaneous companies, with a total capital of $2,410,745,000, and 105 railroad companies with $717,000,000 capital. In 1905 the total number of companies formed was 774, with a capital of $1,893,870,100. In 1904 the number of companies was only 407, with a combined capital of $1,055,635,000, while in 1903, the 810 companies formed had $2,422,017,000 capital. The largest incorporation year was 1901, when 1090 companies were chartered with an aggregate capital of $4,333,099,250, while 1899 was second, the combined capital of the companies formed in that year being $4,207,000,000. In 1902 the number of companies formed was 1023, and the amount of capital $3,755,981,400. In 1900 the companies formed had a total capitalization of $2,589,649,000. The period of huge consolidations seems to lie in the past.

THE NORTH MOUNTAIN POWER COMPANY, of Eureka, Cal., has an option on the plants of the Eureka Lighting Company, and, it is reported, will buy them at a price in the neighborhood of $500,000. The North Mountain Power Company was organized several years ago. At the present time it has valuable water rights on the Trinity River and is planning the erection of a large power house there, one greatly exceeding the capacity of the power house at Junction City. A power line stretches from the Trinity River to Eureka, passing through an auxiliary station in the east end of the city. The Eureka Lighting Company is one of the branches of another corporation, headed by President C. O. G. Miller, and owning a large electric plant in Los Angeles. It is the pioneer lighting company in Eureka. There are two stations owned by it in Eureka. For the last two or three years, or since the North Mountain Power Company came into existence, there has been the keenest competition between the Eureka Lighting Company and the North Mountain Company, and it has gone to such a length that neither company has been able to gain much as a result, although the city of Eureka has profited very much in the matter of street light, which the North Mountain Power Company is now furnishing at $2.45 per arc lamp per month.

PLANT FOR RICHMOND, VA.—Following the purchase of a 3250-kw Allis-Chalmers steam turbo-alternator a few months ago, the Virginia Passenger & Power Company, of Richmond, Va., has recently made a further addition to its power plant equipment in the shape of a 750-kw Allis-Chalmers water-wheel type alternator wound for 2300 volts, 60 cycles, three-phase, and designed to operate at 128 r. p. m. This unit will be ready for operation by April 1, 1908.

EXPORTS OF MANUFACTURES.—It is noted that the exports of manufactures from the United States aggregated more than three-quarters of a billion dollars in value in the calendar year 1907. Eleven months' figures supplied by the Bureau of Statistics of the Department of Commerce and Labor show exports of manufactures aggregating over $700,000,000, a monthly average during those 11 months of $64,000,000, thus justifying the statement that the December figures, not yet available, will bring the total for the year above the $750,000,000 line. The manufactures exported in 1907 averaged more than $2,000,000 a day, against less than $1,000,000 a day in 1897. The value of these exports in the single month of June was more than in the entire year in 1870. The share which manufactures form of the total exports in the eleven months of 1907 is 41.7 per cent. Manufactures imported in 1907 aggregated in value about $650,000,000, against approximately $770,000,000 value of manufactures exported, thus indicating that the exportation of manufactures now exceeds the importation of manufactures by about $120,000,000 per annum. Before that time imports of manufactures always exceeded exports.

SUBMARINE SIGNAL.—The Submarine Signal Company, of Boston, has received a check from the United States Government in settlement for the equipment of 23 warships. As the Government never pays royalties, the apparatus is sold outright for a lump sum.

Financial Intelligence.

THE WEEK IN WALL STREET.—There were many sensational advances in the stock list, and dealings in stocks and bonds were the heaviest since the panic. Money rates were easier and the banks are doing business practically on a cash basis, and credit facilities have about entirely recovered. The receivership of the Chicago Great Western Railway had only a temporary individual effect on prices, but Southern Railway receivership rumors weakened the market on Friday. In the initial display of strength, the Hill stocks took the lead with Northern Pacific as a feature, there being strong hopes expressed of an extra dividend. On Wednesday, however, when the directors declared the regular dividend, a reaction occurred in that group. The anthracite coal stocks then came to the front and received strong support. The industrials were active, though the Steel issues showed only a moderate response to the bullish influences, this being accounted for by a variety of unfavorable reports about the volume of current orders. The electric and traction stocks shared the improvement with the general list, and substantial gains were reported all along the line. Some business was transacted in stocks which have been inactive for some time. The curb market was broader, with a revival of trading in the mining group on a scale much larger than in the previous week. In bonds there was a heavy trading, and Allis-Chalmers 5s rose sharply. Following are the closing quotations of Jan. 15:

NEW YORK.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
Allis-Chalmers Co......	6	6½	General Electric	115	123¼
Allis-Chalmers Co. pfd.	17½	21¾	Hudson River Tel.....	—	—
Am. Dist. Tel.........	—	—	Interborough Met. com.	6½	7¼
American Locomotive...	36⅞	41½	Interborough Met. pfd..	18¼	20¾
Amer. Locomotive pfd..	86	90	Mackay Cos.	58	58
American Tel. & Cable..	—	—	Mackay Cos. pfd......	61	62¾
American Tel. & Tel...	101¼	106	Marconi Tel.	—	—
Brooklyn Rapid Transit.	40	43½	Metropolitan St. Ry....	—	—
Electric Boat	—	—	N. Y. & N. J. Tel.....	—	—
Electric Boat pfd......	—	—	Western Union Tel....	57	58
Electric Vehicle	—	—	Westinghouse com.....	41½	50¾
Electric Vehicle pfd...	—	—	Westinghouse pfd......	—	—

BOSTON.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
American Tel. & Tel...	102	107	Mass. Elec. Ry pfd....	49	50*
Cumberland Telephone..	—	98	Mexican Telephone.....	1¼	1¼
Edison Elec. Illum.....	208	212	New England Telep....	106	113½
General Electric	—	—	Western Tel. & Tel....	4	5
Mass. Elec. Ry........	10½	12	West. Tel. & Tel. pfd..	50	62

PHILADELPHIA.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
American Railways.....	43	43	Phila. Electric	5¾	6⅜
Elec. Co. of America...	9½	8⅝	Phila. Rapid Transit....	17⅞	17½
Elec. Storage Battery...	31½	32	Phila. Traction	84	86⅝
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Jan. 7	Jan. 14		Jan. 7	Jan. 14
Chicago City Ry.......	150	150	National Carbon	53	50
Commonwealth-Edison ..	78	84	National Carbon pfd...	102	103
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.......	108	118¼	Union Traction pfd....	—	—
Metropolitan Elec. com.	15	17			

*Asked

WESTINGHOUSE PLAN.—The committee in charge of the affairs of the Westinghouse Manufacturing Company will meet the present week to decide upon the plan for reorganizing the company. Although a plan of reorganization has been outlined in general, nothing official will be divulged until after the meeting. According to current reports, a plan has been under discussion which provides for the creation of a first mortgage bond issue of $45,000,000 bearing interest at 5 per cent. In exchange for the $18,500,000 outstanding, convertible 5 per cent gold bonds, $18,500,000 of the new issue will be offered and the remainder of the issue will be used to pay off the floating indebtedness, outstanding short term notes and debenture certificates. The floating indebtedness, according to the reports of certified accountants, is $14,000,000 and it is proposed to fund most of this debt by offering to creditors the new bonds, dollar for dollar, for their claims. Similarly the new bonds will be offered, dollar for dollar, to creditors holding $1,969,000 debenture certificates of the $6,000,000 6 per cent collateral notes due Aug. 1, 1910, and the 5 per cent French loan due Oct. 1, 1917. It is said that George Westinghouse and his associates have agreed to take all or the greater part of $7,000,000 of stock, which is to be sold at par in order to provide working capital for the company. In all there is now outstanding $4,000,000 preferred stock and $24,000,000 assenting stock. The new stock will be of the latter class. The committee that has been in charge of the plan consists of Richard Delafield, president of the National Park Bank; James N. Jarvie, chairman; Albert H. Wiggin, vice-president of the Chase National Bank; Paul M. Warburg, of Kuhn, Loeb & Co.; F. H. Skelding, president of the First National Bank of Pittsburg; Charles A. Moore, of Manning, Maxwell & Moore; Neal Pantoul, of F. S. Moseley & Co., of Boston; and A. G. Becker, of Chicago. The committee is fairly representative of all interests in the company, and the members believe that the plan supplies equitable treatment to creditors, noteholders, bondholders and stockholders.

ELECTRICAL SECURITIES CORPORATION.—The annual report of the Electrical Securities Corporation was issued this week. It shows the following profit and loss account: Bond interest received and accrued, $287,712; other interest, notes, bank deposits, etc., $15,747; dividends on stock, $57,726; total, $361,185; collateral trust bond interest, $146,380; expenses, $47,034; net profit, $167,771; profit from sale of securities, etc., $87,062; total net profit, $254,833; previous surplus, $783,397; total surplus, $1,038,230; preferred dividend, $50,000; balance, $988,230; decrease in book value of assets, $119,341; surplus Nov. 1, 1907, $868,886. The statement of assets and liabilities as of November 1 last follows: Assets.—Underlying securities, $3,000,238; cash to redeem collateral trust 5 per cent bonds, $1,840; surplus brought forward, $251,578; investment securities, $3,017,343; notes and accounts receivable, $368,603; underwritings, $681,250; accrued interest receivable, $109,676; cash, $13,798; total, $7,443,826. Liabilities.—Collateral trust 5 per cent bonds, $2,750,000; surplus of collateral held as security, $251,578; common stock, $2,000,000; preferred stock, $1,000,000; notes payable, $544,526; accrued interest payable, $27,312; reserves, $1,524; net profit since Nov. 1, 1904, $368,886; surplus as of Nov. 1, 1904, $500,000; total, $7,443,826.

DIVIDENDS.—Directors of the Philadelphia Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable Feb. 1. Milwaukee Electric Railway & Light Company has declared the regular quarterly dividend of 1½ per cent, payable Jan. 31. The Edison Company, of Boston, has declared the regular quarterly dividend of 2½ per cent, payable Feb. 1. Directors of the Omaha Electric Light & Power Company have declared the regular semi-annual dividend of 2½ per cent, payable Feb. 1. Directors of the Manhattan Electrical Supply Company have declared the regular semi-annual dividend of 3 per cent on the preferred stock and a dividend of 4 per cent on the common stock out of the earnings of the past six months, both payable Feb. 3. Rochester, N. Y., Railway & Lighting Co. has declared a dividend of 5 per cent on the common stock, payable Jan. 15. Directors of the Michigan State Telephone Company have declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 1. Directors of the Electric Bond & Share Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable Feb. 1.

BELL TELEPHONE BONDS.—Underwriters of the American Telephone 4 per cent convertible bonds are in receipt of a call for the final payment of 10 per cent on account of subscriptions to the bonds, payable Jan. 15, 1908. By the middle of January the full amount of the bonds will be outstanding.

GENERAL NEWS

Construction News.

CORNING, ARK.—George Booster is making preparations to install a lighting plant in Corning. He proposes to purchase the existing plant owned by E. D. Sheeks, and remove it to his stave factory.

EUREKA SPRINGS, ARK.—Henry C. Brent, vice-president of the Kansas City Trust & Fidelity Company, of Kansas City, Mo., has been appointed receiver of the Citizens' Electric Company, which controls the electric lighting plant, the street railway and other important interests in the town. The application for the appointment of a receiver came from the Kansas City Trust & Fidelity Company, which holds $107,000 of the Citizens' Electric Company's bonds, which are the property of the defunct Citizens' Bank.

LAKEPORT, CAL.—George P. Low, general manager of the Lake County Electric Power Company, writes that the company will expend about $100,000 and will install gas engines, extend its electric transmission lines and make extensions to the gas plant. Natural gas will be used for fuel.

LITTLE ROCK, ARK.—George Belding, of Hot Springs, one of the promoters of the proposed Municipal Light Company, states that Atwood Benton, in whose name the company applied for a franchise, is the personal representative of R. G. Weber, secretary and treasurer of the Weber Gas Engine Company, of Kansas City, Mo., who, with George Belding, Mr. Beauchamp and others, is interested in the enterprise.

SPRINGDALE, ARK.—The Springdale Electric Light & Power Company, which was recently granted a franchise, will erect a power plant at a cost of about $8,500. The equipment of the plant will consist of a 65-kw, direct-current generator; 90-hp engine and a boiler of 100 hp.

BERKELEY, CAL.—The San Francisco, Oakland & San José Railway Company, operating the Key route system, has applied for a 50-year franchise to build and operate an electric railway along Sacramento Street from the Oakland line to the north end of Berkeley, and branching through the hill country to the north to the section donated for the proposed site of the state capitol.

COLUSA, CAL.—The Snow Mountain Electric Power Company contemplates calling for bids in the spring for the construction of a hydro-electric power plant at Colusa, the cost of which is estimated at $250,000. The plant will develop about 300 horse-power.

IMPERIAL, CAL.—The City Trustees have passed a resolution to have the streets lighted by electricity. It is understood that the contract for lighting the city will be given to the Holton Power Company.

OAKLAND, CAL.—An entire block of land in East Oakland, at White and Prospect Streets, has been purchased by the Western Power Company, according to deeds recently filed for record. The site will be used for the erection of a sub-station at the end of the high-tension line to be run from the Big Bend plant on the Feather River. A main steam plant auxiliary of 30,000 horse-power is to be erected at Sessions Basin, at the foot of Sixth Avenue.

OROVILLE, CAL.—The Oro Water, Light & Power Company has completed its new power plant at Coal Canyon and installed the machinery. A successful test has been made of the generating equipment. This company now has three power plants within 15 miles of Oroville. The largest one, with an output of 5000 horse-power, is located above Pentz, about 14 miles distant. The second, with about 2000 horse-power is located at Coal Canyon, and the third and the oldest is at Thompson's Flat, about 10 miles from Oroville. The rating of the last is less than 1000 horse-power. The same water runs the water wheels of all three plants.

SAN FRANCISCO, CAL.—The Southern Pacific Company will commence the work of converting the operation of its lines from steam to electricity as soon as the franchise is granted. The first change will be on the line running from Oakland to Berkeley, and will ultimately be extended as far as Niles. The plans for the power house to be located at the estuary shore have been completed and work will commence immediately after granting the franchise in the city.

WILLOWS, CAL.—The Northern California Power Company, which supplies Willows with electricity, through its branch corporation, the Willows Water & Light Company, has reduced the voltage on its main lines, as well as on the Willows line, from 40,000 to 20,000. This reduction has been made to lessen the accidents which have occurred since the wet weather set in. The high voltage will again be placed on the lines next summer.

PUEBLO, COL.—We are informed that the Pueblo & Arkansas Valley Electric Railway Company, which proposes to construct a railway to connect Pueblo, Avondale, Fowler and Rocky Ford, a distance of 53 miles, will commence work on the construction of its road next April. The road will be operated by steam and electricity. Energy for operating the road will be purchased from the Pueblo Traction Company. The capital stock of the company is placed at $300,000 and the officers are: N. Douthitt, Kansas City, Mo., president; M. G. Saunders, of Pueblo, vice-president; F. R. Stoller, Kansas City, Mo., secretary; F. B. Chappege, Kansas City, Mo., treasurer, and N. C. Van Natta, Pueblo, chief engineer. The main office of the company is located at Kansas City, Mo.

WILMINGTON, DEL.—The directors of the Street and Sewer Department have made arrangements with the companies now furnishing both gas and electric lighting for the city to extend the contracts until July 1. The contracts for street lighting expired Jan. 1.

WILMINGTON, DEL. The directors of the Street and Sewer Department have granted the Delaware Electric Transmission Company permission to bid for the next electric lighting contract on the same basis as the two companies now in business here, which made it necessary for the board to eliminate some of the obligations in the franchise granted to the company some time ago. The conditions that the company desired removed for the present were that the company should furnish energy to the city for 500 or more arc lamps of the same candle-power as those now in use, at the rate of $40 each per year, based on a five-year contract, and to furnish electricity to the city for lamps at two cents per kw-hour, and for other purposes at five cents per kw-hour, the minimum charge for commercial purposes to be 10 cents, with a 10 per cent reduction for cash. When the above proposition was submitted to the city the company expected to secure electricity from the Susquehanna Power Company's plant to be erected on the Susquehanna River, but owing to litigations, etc., it has not yet been able to begin the construction of its plant, and the Delaware electric company claims it will be impossible to generate electricity with coal or gas at the rates quoted.

TAMPA, FLA.—The Tampa Electric Company is contemplating making extensive improvements to its power plant, and will purchase a dynamo and other electric equipment. G. W. Wells is manager.

ALBANY, GA.—It is understood that plans and specifications have been prepared by J. E. Sirrine, of Greenville, S. C., for the Albany Power & Manufacturing Company for its proposed water power develnpment and hydro-electric plant, the cost of which is estimated at $1,000,000. It is proposed to construct a plant of about 10,000 horse-power.

AUGUSTA, GA.—The Atlanta & Carolina Construction Company has applied to the City Council for permission to construct an electric railway and erect terminal stations in the city of Augusta. The company proposes to construct an electric railway between Augusta and Atlanta.

EDGEWOOD, GA.—The new municipal electric light plant has been completed and was started Dec. 28. Over 40 arc lamps and 60 incandescent lamps have been placed on the streets.

LAFAYETTE, GA.—The city will soon vote on the proposition of issuing $10,000 in bonds for the construction of an electric light plant.

MACON, GA.—The Macon Railway & Light Company is contemplating extensive improvements at its power house, including the installation of a 1000-kw generator to furnish electricity for lamps.

NAMPA, IDAHO.—The Oregon Short Line Railway is said to be considering the proposition of establishing an electric light plant.

SALMON, IDAHO.—Plans have been perfected for incorporating the Andrews Light & Power Company with a capital stock of $50,000. The power house will be located on Charles Street.

SALMON, IDAHO.—We are informed that Messrs. Quarles & Quarles, owners of the local electric light plant, contemplate installing a new 120-kw, three-phase, 60-cycle alternator in their plant.

BARRY, ILL.—The power house of the Barry Electric Light & Power Company is reported to have been destroyed by fire.

CARBONDALE, ILL.—The capital stock of the Farmers' League & Community Telephone Company has been increased from $5,000 to $10,000.

DECATUR, ILL.—It is reported that the municipal electric light plant is to be enlarged. E. S. McDonald is mayor.

MURPHYSBORO, ILL.—The Murphysboro Water Works, Electric & Gas Light Company is contemplating installing a 500-kw, alternating-current, 2200-volt, two-phase direct-connected unit. W. O. Settle is manager.

CRAWFORDSVILLE, IND.—At a recent meeting of the City Council an appraisement of the municipal electric plant was ordered and a committee has placed the valuation at $57,632. The appraisement was ordered with a view of selling the plant to a New York corporation which has made an offer of $46,000 for it. No action has been taken as yet by the City Council.

KNIGHTSTOWN, IND.—Charles F. Baxter, town clerk, writes with regard to the proposed improvements to the municipal electric light plant, for which the citizens recently voted to issue $12,000 in bonds, that the generator, turbine and boilers have been purchased, but a condenser is yet to be purchased.

NEW ALBANY, IND.—The City Council has appointed a committee to prepare a new franchise ordinance for lighting the streets with a provision to sell the franchise to the highest bidder. The street lighting franchise of the United Gas & Electric Company will expire Sept. 1.

ROCKPORT, IND.—The City Council has granted a ten-year franchise to the Rockport Water Works & Electric Light Company to light the streets and to supply the inhabitants with electricity for lamps and motors and with water.

LINDSBORG, KAN.—The installation of an additional generator in the municipal electric light plant is under consideration. M. H. Blaine is manager.

TOPEKA, KAN.—The City Council has decided to submit the proposition to issue $50,000 in bonds for the enlargement of the municipal electric light plant to the voters at the coming spring election.

MAYFIELD, KY.—The Southern Electric Railway Company has filed a deed of trust to the Windsor Trust Company for a loan of $2,000,000, with which it is proposed to construct the new electric railway between Maysfield and Paducah.

SOMERSET, KY.—O. H. Waddle and W. C. Roberts, stockholders in the Somerset Water, Light & Traction Company, have filed suit in the Pulaski circuit court, asking that a receiver be appointed for the company, and that Dr. W. Godfrey Hunter be removed as manager. They allege that the franchise has been endangered by the present management, as the City Council is not satisfied with the manner in which the affairs of the company have been conducted.

NEW IBERIA, LA.—The City Council on January 6 awarded the contract for the new boilers for the municipal electric light and water works plant to Lawrence W. Ewing, for $2,394.

SLIDELL, LA.—The Slidell Light & Electric Company is planning to commence work on the construction of its new plant in the near future.

BANGOR, ME.—A bill was filed Jan. 4 foreclosing the mortgage on the Bodwell Power Company, and the appointment of a receiver was asked for by the Central Trust Company, of New York, N. Y., the trustee under the mortgage. The company has been obliged to default the January interest on its $1,000,000 first mortgage bonds. It is said that the present troubles are due to the refusal of one of its chief customers, a paper pulp concern, to pay an overdue bill for power.

GREENVILLE, ME.—The Greenville Light & Power Company is contemplating extending its transmission lines to Monson and Guilford. Harry L. Sawyer is manager.

HOULTON, ME.—The Bangor & Aroostook Railroad Company has recently installed an electric light plant at its station in this town to furnish electrical energy for lighting its shops and offices.

KENNEBUNKPORT, ME.—The Atlantic Shore Line Railway will soon install an electric lighting system for lighting the streets and residences in Kittery, Eliot and Sanford. Electrical energy for operating the systems will be supplied from the company's power houses at Kittery Point, Dover and Sanford.

LUBEC, ME.—The electric light plant was closed down Dec. 21 for an indefinite period. It is said that the Drew Machinery Company, which owned and operated the plant, will not continue the service and that a local company will be formed, and as soon as possible will equip the plant with new machinery and make other necessary improvements. R. J. Peacock is interested in the project.

MONSON, ME.—Ernest D. Blaisdell, of Dexter, has been awarded the contract for the installation of the electric light plant for the Monson Light & Power Company.

NORTH ANSON, ME.—The Carrabassett Stock Farms Company is installing a 100-kw dynamo to furnish electricity to light the town.

NORTHPORT, ME.—Some of the summer residences of this town are making arrangements to have the Belfast Gas & Electric Company, of Belfast, extend its electric lighting system to Northport next spring. As soon as the company submits prices a canvass will be made among the cottage holders.

EASTON, MD.—Martin M. Higgins, Mayor, writes that the question of constructing a municipal electric light plant will shortly be submitted to a vote unless in the meantime the city is able to procure parties to take a franchise for an electric light, heat and power plant. This franchise, if given, would include a contract for lighting the town for a number of years. The lighting commission, of which L. W. Trail is chairman, has recommended that the town be bonded for the construction of a municipal electric light plant.

ASHBURNHAM, MASS.—The new electric lighting system has been completed and was started Jan. 2. Electrical energy for operating the system is furnished by the Gardner Electric Light Company at the rate of four cents per kw-hour at the switchboard. By the terms of the contract the company is to supply electricity to the town for a term of ten years, the contract providing for a readjustment of prices at the end of five years, at the request of either party.

CHICOPEE, MASS.—The Electric Light Commissioners have awarded the contract for the new arc lighting system to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for $9,985.

CHICOPEE, MASS.—The J. Stevens Arms & Tool Company is making arrangements to install a 50-hp direct connected generating unit to furnish electricity for lighting its plant. The electrical machinery will be furnished by the Westinghouse Electric & Manufacturing Company. The municipal electric light plant now furnishes lighting service for the company at a cost of $50 per month.

GREENFIELD, MASS.—The Connecticut River Power Company, which is constructing a large dam between Vernon, Vt., and Hinsdale, N. H., proposes to erect within the next two or three years, or after the completion of the Vernon dam, a low dam at the head of the French King Rapids, a short distance above Turners Falls. The purpose of this dam is to develop power to generate electrical energy during the periods of low water. The dam will be a movable structure, and will be so arranged that in times of low water it can be raised to its full height of 10 or 12 feet and in times of high water lowered to the bed of the stream.

HOLYOKE, MASS.—An announcement has been made by the municipal gas and electric lighting department that the price of electricity will be reduced from 10 cents to 6 cents per kw-hour. The new rate will go into effect Feb. 1. During the past year the price of energy for street lamps has been reduced from $80 to $60 per lamp per year.

LEICESTER, MASS.—An order of notice, returnable on the first Monday in March, has been issued by the superior court on the petition of the Rawson Light & Power Company, of Leicester, for dissolution of its corporation. The petition states that the company has ceased to do business, has no debts and has disposed of all of its property. The company was incorporated in 1896 with a capital of $25,000.

LYNN, MASS.—The Lynn Gas & Electric Company has petitioned the State Gas and Electric Light Commissioners for authority to issue $195,000 additional capital stock.

MIDDLEBORO, MASS.—The managers of the municipal electric light plant contemplate establishing a day service for lamps and motors in the near future. George A. Philbrook is manager.

NEEDHAM, MASS.—It is reported that the town committee is contemplating selling the municipal electric light plant to the Edison Electric Illuminating Company, of Boston, providing a satisfactory contract can be made with the company to supply electricity for lighting the town.

NORTHAMPTON, MASS.—The Northampton Street Railway Company has petitioned the Railroad Commissioners for authority to issue $200,000 additional capital stock, the proceeds to be used in taking up floating indebtedness.

ROACHDALE, MASS.—The Worcester Electric Light Company is making improvements to its system in this place. The old transformers in the sub-station are being replaced with larger ones and the voltage increased from 1000 to 2000. When the improvements are completed 24-hour service will be established. It is said that the company contemplates a thorough overhauling of its lines next summer.

DETROIT, MICH.—The City Council on Jan. 7 passed an ordinance requiring all electric wires, except trolley wires, within a half-mile circle from the city hall to be placed in underground conduits before Jan. 1, 1909.

CALUMET, MICH.—It is reported that the Calumet & Lac La Belle Traction & Power Company will commence work about the middle of this month on the construction of its proposed line between Calumet and Mohawk. Sidney M. Weil is the financial agent. The company also proposes to furnish electricity to mines in Keweenaw and Houghton counties.

GRASS LAKE, MICH.—The directors of the Farmers' Telephone Company have voted to amend its articles of association changing the name of the corporation to that of Home Telephone Company and increasing the capital stock from $10,000 to $50,000.

ISHPEMING, MICH.—The Marquette County Gas & Electric Company has completed its new boiler house and installed the following equipment in the power house: one 500-kw vertical Curtis turbine; one 200-kw Buffalo Forge engine direct-connected to a 110-kw, direct-current, 550-volt street railway generator, also a new storage battery. The company has in view the construction of about two and one-half miles of new track, and is in the market for a double truck closed car.

OWOSSO, MICH.—At a meeting of the Owosso Light & Power Company the following named officers were elected: E. M. Hopkins, of Detroit, president; Charles W. Gale, vice-president; Frank Westcott, of Owosso, secretary and treasurer. The company announces that it will construct a dam 24 feet high and 800 feet long at a natural reservoir on the Shiawassee River, two and one-half miles north of the city. The plant will furnish electrical energy to operate the proposed Grand Rapids-Pontiac electric railway, and for lamps and motors in Owosso.

EVANSVILLE, MINN.—C. W. Webb is endeavoring to secure a franchise for an electric light plant in the town.

MANTORVILLE, MINN.—C. S. Wedge & Son, owners of the local electric light plant, are contemplating installing a new dynamo in their plant.

NEVADA, MO.—We are informed that the Missouri Water, Light & Traction Company will place contracts within a few weeks for the installation of the following equipment: Two 225-hp water tube boilers; 600-hp exhaust steam heater; 600-hp live steam water purifier and the necessary piping. Hiram Phillips is receiver for the company.

ST. LOUIS, MO.—It is reported that A. C. Einstein, president of the Union Electric Light & Power Company, will make application to the county court for an extension of the franchise of the company to cover the entire county.

SLATER, MO.—The municipal electric light plant will probably be rebuilt to increase the output, and a compressed air outfit for pumping installed. L. E. Shepherd is manager.

CHINOOK, MONT.—All bids received for the construction of an electric light plant were rejected and new bids will be called for. John C. Duff is town clerk.

CENTRAL CITY, NEB.—H. Forest, of Central City, has been granted a franchise to establish an electric light system.

COLUMBUS, NEB.—John W. Early, of Lincoln, Neb., consulting engineer, has been engaged by this city to attend to the technicalities of granting a 20-year electric franchise, and for making plans for remodeling the city pumping station, so as to operate the pumps by electricity. John T. Burke, of Omaha, represents the company, which has applied for a franchise.

WAYNE, NEB.—The managers of the municipal electric light department are contemplating establishing a day service in the spring. H. A. Moler is manager.

DOVER, N. H.—The City Council has voted to enter into a five-year contract with the Twin State Gas & Electric Company for the lighting of the city, said contract to cover all-night service.

ASBURY PARK, N. J.—Mayor T. Frank Appleby, in his annual message, recommends street improvements, the placing of telephone and telegraph wires underground and other improvements.

NEWARK, N. J.—In his annual report submitted to the Board of Freeholders, County Supervisor John F. Otterbein, suggested that an electric light plant be installed at the court house to be owned and operated by the county. At present the building is lighted by the Public Service Corporation of New Jersey, under a contract which will expire Sept. 1, 1908. The price for this service ranges from $509 to $1,040 per month.

PLAINFIELD, N. J.—The Public Service Corporation has submitted a proposition to the Council for lighting the streets of the city. The company agrees to furnish the city with incandescent lamps of 25 cp for $15 per lamp per year, and arc lamps up to 50 for $85 per year per lamp, and over 50 at $80. The company agrees to make a five year contract for arc lamps and a three year contract for incandescent lamps.

LAS VEGAS, NEV.—The Consolidated Light & Telephone Company has been granted permission to erect and operate an electric light plant in the town.

AUBURN, N. Y.—The Board of Supervisors of Cayuga County has accepted the proposal of the Auburn Light, Heat & Power Company for lighting the county building. The company has agreed to reduce its previous bid of $1,700 to $1,300, provided the county makes a contract for two years. By the terms of the contract the cost of lighting the building is not to exceed $1,300, and if the meter records show the amount of electricity used costs less than $1,300 the price will be fixed accordingly.

FLUSHING, N. Y.—The New York & New Jersey Telephone Company has planned extensive improvements to its service in the town of Flushing, and work has commenced on the construction of a trunk line from the Flushing central office to Douglaston for the purpose of connecting that section with the Flushing office.

HUDSON, N. Y.—The Common Council on Jan. 6 appointed a committee to make arrangements with the Albany & Hudson Railway Company for the temporary lighting of the streets and public buildings of the city until a permanent contract may be secured. The committee will also look into the question of installing a municipal lighting plant.

LIMA, N. Y.—The Lima-Honeoye Electric Light & Railroad Company is planning to place contracts during the next three months for the construction of about 36 miles of track. It will also purchase gas engines and other equipment for a new power station. Natural gas will be used for fuel.

PATCHOGUE, N. Y.—The control of the Patchogue Electric Light Company has been purchased by a syndicate composed of local citizens. The new owners propose to install new machinery, duplicating the plant and establishing a day service. Eugene Hawkins, president of the Ogdensburg Gas & Electric Company, is to be president of the new company.

VALLEY STREAM, N. Y.—At a meeting of the citizens, held Jan. 10, a committee was appointed to investigate the question of establishing a water and light district and report at the next meeting to be held Jan. 22. The members of the committee are: Christopher Schreiber, Joseph T. Hall and Henry Hendrickson.

WATERVILLE, N. Y.—Walter Bishop, of this village, has purchased a controlling interest in the Waterville Telephone Company. The officers of the company are: I. D. Brainard, president; S. S. Bissell, vice-president; H. M. King, secretary; Walter Bishop, treasurer, and Parks Terry, general manager.

FAYETTEVILLE, N. C.—The hydro-electric plant of the Cape Fear Electric Company, at Buckhorn Falls, has been started, and connections are being made from the sub-station with the electric service in this city. The plant will soon furnish electrical energy for operating the electric light plant, manufacturing plants, etc., in this city. The transmission line from Buckhorn Falls to Fayetteville is 32 miles long. The plant now generates 4000 horse-power and cost about $500,000.

SALISBURY, N. C.—The Salisbury & Spencer Railway Company is planning to construct a sub-station for which contracts will be placed during the next two months. Three 1000-kw transformers will be installed.

SALISBURY, N. C.—It is said that everything is in readiness to resume operations on the large power plant under construction at this place by the Whitney Reduction Company, of Pittsburg, Pa. It is announced that the electric plant with an output of 45,000 horse-power will be ready for service by March 1. A. J. Gillespie, of Pittsburg, Pa., has the contract for the work.

DRAKE, N. D.—The Northwestern Telephone Company has been granted a franchise over the county roads.

ALLIANCE, OHIO.—The Alliance Gas & Power Company is installing a 700-hp Babcock & Wilcox boiler in its plant. D. W. Low is manager.

COLUMBIANA, OHIO.—The Columbiana Water & Electric Light Company will install a 150-hp boiler in its plant this coming summer and may also install a new engine and generator. F. H. Grove is secretary and manager.

CONNEAUT, OHIO.—It is reported that the Meadville & Conneaut Lake Traction Company contemplates extending its lines from Linesville to Greenville, and from Linesville to Conneaut.

ELYRIA, OHIO.—The Elyria Southern Railway Company will commence the construction of its road this spring, which will connect the following cities: Elyria, La Grange, Spencer, West Salem, Ashland, Mansfield and Columbus. The company plans to install the overhead trolley system, electrical energy to be supplied from a power station which is to be erected at Elyria. The officers of the company are: Sumner B. Day president; W. E. Elliott, vice-president and general manager; W. E. Moser, secretary, all of Elyria; J. M. Starr, of La Grange, treasurer, and G. A. Lagron, of Elyria, engineer.

HAMILTON, OHIO.—It is reported that the Cincinnati Northern Traction Company will install a local electric railway system in Middletown.

MANSFIELD, OHIO.—We are informed that the Roberts-Abbott Engineering Company, of Cleveland, has been engaged as engineer to have charge of the proposed improvements contemplated by the Mansfield Railway, Light & Power Company.

NEW BREMEN, OHIO.—The electric light plant of the New Bremen Electric Light Company has been purchased by the village for $14,000. The village recently issued $20,000 in bonds to purchase and rebuild the plant.

ROCKY RIVER, OHIO.—The village has been in darkness for several nights, owing to the Village Government and the Cleveland Electric Illuminating Company having failed to agree upon rates for a new contract. The mayor and other officials were unwilling to treat with the company on any proposition that the company thought fair, so when the contract expired the service was stopped.

PERKINS, OKLA.—The citizens are considering the question of calling an election to vote on the proposition of issuing bonds for the purpose of purchasing an electric light plant.

SALLISAW, OKLA.—W. W. Ray, secretary and treasurer of the Southwestern Light & Power Company, writes that the company has awarded all contracts for the equipment of its plant.

EUGENE, ORE.—Announcement has been made that the Eugene & Eastern Railway Company will resume work on the construction of the electric line between Eugene and Springfield this month.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until Feb. 6, for power plant, consisting of boiler-room equipment, including boilers, boiler feed pumps, fuel economizer, smokestack, etc; engine-room equipment, including generators, condensers, vacuum pumps, circulating pumps, piping, electric crane, exciters, rotary converters, transformers, lightning arresters, switchboards, regulators, station voltmeter, portable instruments, etc. Blanks and general information relating to this circular No. 415 may be obtained at the office of the Isthmian Canal Commission, Washington, D. C., or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, La.; also from U. S. engineer officers in the following cities: Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Chicago, Ill.; Cincinnati, Ohio; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala.

CHAMBERSBURG, PA.—It is reported that the Chambersburg, Greencastle & Waynesboro Electric Railway Company contemplates making a proposition to the Town Council to install a 300-kw generator in the municipal electric light plant at its own expense, and pay a certain sum to the borough for a supply of energy to operate the railway extension from Greencastle to Chambersburg.

EASTON, PA.—The merger of the Easton Transit Company, the Easton & Bethlehem Transit, the Easton, Palmer & Bethlehem and the Northampton Central Traction Companies has been approved by Governor Stuart. The four companies have been consolidated under the name of the Easton Transit Company with a capital stock of $2,000,000.

LANCASTER, PA.—The Lancaster & York Furnace Street Railway Company has increased its bonded indebtedness from nothing to $150,000, and has also reduced its capital stock from $280,000 to $170,000.

ROYER, PA.—It is reported that the Morrison Coal, Electric Light & Power Company will soon let contracts for the installation of an electric power plant. The cost of the work is estimated at $45,000. For further information address Frank W. Moore, Indiana, Pa.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has decided to increase the equipment in the Waynesboro plant to provide electrical energy for the extension of the electric railway from Greencastle to Chambersburg. Joseph F. Geiser is superintendent.

WEST CHESTER, PA.—The Chester County Power Company has purchased another water power on Elk Creek for the purpose of having additional reserve power when needed.

WEST WHITELAND, PA.—P. M. Sharpless has acquired a water power in West Whiteland township, for the purpose of generating electricity for lamps and motors at his villa in West Goshen.

PAWTUCKET, R. I.—The Pawtucket Gas Company and Pawtucket Electric Company, of this city, and the Woonsocket Electric Machine & Power Company and the Woonsocket Gas Company, of Woonsocket, have been merged, and are in the control of a new syndicate composed of Col. Lyman A. Goff, Darius L. Goff and Frank A. Sayles, of this city; Estabrook & Company and the Stone & Webster Company, of Boston, Mass.

EDGELEY, S. D.—H. C. Tibbetts, village clerk, writes that the citizens on Jan. 6 voted to issue $3,000 in bonds to purchase dynamos and wire for the municipal electric light plant.

LEAD, S. D.—F. P. Hooper contemplates establishing a light plant in the town.

COVINGTON, TENN.—The Memphis, Covington & Northern Railroad Company has been granted a 50-year franchise to operate an electric railway between a point on the southern boundary of the town of Covington and the southern boundary of the county of Tipton.

ATLANTA, TEX.—J. T. Chamblee & Company, owners of the local electric plant, are contemplating establishing a fan service. H. P. Phipps is manager.

DALLAS, TEX.—L. Fulton has filed an application for a franchise to build and operate a street railway in Oak Cliff. The proposed line will be about three miles long.

ENNIS, TEX.—The Ennis Ice, Light & Power Company is contemplating installing a producer gas plant. A. D. Brown is manager.

FORT WORTH, TEX.—The Corron Electric Company, of St. Louis, Mo., has secured the contract for wiring and conduits for the U. S. post office building at Fort Worth for $1,664.

SHERMAN, TEX.—The capital stock of the North Texas Telephone Company has been increased from $40,000 to $52,000.

CASTLETON, VT.—The citizens have voted to make a contract with the Rutland Street Railway, Light & Power Company to light the streets of Castleton by electricity after Feb. 1.

CHRISTIANSBURG, VA.—The municipal electric light plant has been purchased by John L. Vaughan, of Shawsville, and associates. It is understood that a company will be organized to operate the plant.

DANVILLE, VA.—Frank Talbot, superintendent of the municipal electric light plant, writes that it is proposed to enlarge the plant.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company is installing three submarine cables from its new power house in Norfolk to the sub-station in Portsmouth to supply electrical energy in Portsmouth.

PETERSBURG, VA.—The City Council, on Jan. 7, accepted the contract with the Virginia Passenger & Power Company for lighting the streets of the city for a term of five years, at a cost of $57 per lamp per year.

SHEPHERDSTOWN, W. VA.—The Shepherdstown Electric Light & Power Company is reported to have purchased the municipal electric light and power plant. It is stated that no improvements will be made at present, but the company contemplates using power from a hydro-electric plant now under construction near Shepherdstown. John L. Livers is president and treasurer.

BERLIN, WIS.—The Berlin Lighting, Heating & Power Company is planning to install new boilers, stokers, heaters, pumps, etc., in its plant. O. C. Irwin is receiver.

CASHTON, WIS.—An election will be held Jan. 21 to vote on the proposition of issuing $15,000 in bonds for the purpose of establishing a municipal electric light plant.

CORLISS, WIS.—The construction of a combined water works system and electric light plant for this place is under consideration.

DOLDGEVILLE, WIS.—The City Council is considering the proposition of purchasing the present electric lighting plant or constructing an entirely new plant.

LOYAL, WIS.—An election will probably soon be held to vote on the proposition of issuing $17,000 in bonds for an electric light plant and water works system. W. G. Kirchoffer, of Madison, is engineer.

MEDFORD, WIS.—The city has recently voted in favor of issuing bonds for establishing a municipal water works system, and many of the citizens are in favor of purchasing the electric light plant owned by the Medford Light & Heat Company and consolidating the water and light plants to be operated by the municipality.

MILWAUKEE, WIS.—Contracts have been awarded by the Continental Realty Company for the building and machinery for its power plant, to be erected on Commerce Street. Kirchoff & Rose are the architects.

PLYMOUTH, WIS.—The citizens are contemplating increasing the equipment of the municipal electric light plant by the installation of a larger generator. A 200-hp engine has recently been installed and a day service established. P. J. Douglass is superintendent.

PRESCOTT, WIS.—Owing to the increase in the demand for electricity the Prescott electric plant is unable to meet the demands made upon it, and a dam is being erected on the Kinnickinic River at Clifton to develop power to increase the output of the plant.

CALGARY, ALB.—The City Council has entered into an agreement with the Calgary Power & Transmission Company, whereby the company is to furnish all the electricity required by the municipality for a term of five years.

EDMONTON, ALB.—R. R. Kelly, city engineer, writes that the city is about to install a new power station and will erect six miles of transmission lines to be operated at 10,000 volts, three-phase, 60-cycle, and will require all line material, including switchboard at sub-station. The city engineer will be glad to hear from all manufacturers of that class of equipment.

VANCOUVER, B. C.—The Canadian Pacific Railroad has discarded the steam plant for its shops in Vancouver and is now operating the machinery by electricity, which is supplied by the British Columbia Electric Railway Company.

NEW WESTMINSTER, B. C.—S. A. Crawley, of this city, has made application for water rights in behalf of the International Power Company.

MINNEDOSA, MAN.—The Minnedosa Power Company has been granted permission to construct a dam across the Little Saskatchewan River at the outlet at Clear Lake for the purpose of maintaining the high-water mark and supplying Minnedosa with electricity for lamps and motors.

BERLIN, ONT.—At the election held Jan. 6 the citizens voted in favor of issuing $30,000 in bonds to extend the electric light plant and street railway system.

GALT, ONT.—The citizens on Jan. 6 voted in favor of constructing a distributing plant at a probable cost of $27,000; electrical energy to be supplied by the Hydro-Electric Power Commission.

HAMILTON, ONT.—The citizens on Jan. 6 voted to issue $225,000 in bonds for the construction of an electric distributing system in connection to the project of the Hydro-Electric Power Commission.

INGERSOLL, ONT.—The citizens on Jan. 6 voted against the proposition to issue $50,000 in bonds for the purpose of the Ingersoll Electric Light & Power Company, to be used to distribute electrical energy from Niagara Falls in connection with the project of the Hydro-Electric Power Commission.

KENORA, ONT.—It is reported that the town and the Maple Leaf Flour Mills Company have petitioned the Provincial Government for permission to borrow $75,000 to complete the power development scheme. For this projcet $300,000 in bonds have already been issued. Confirmation of an agreement between the town and the company in regard to power is desired.

LISTOWELL, ONT.—This city has applied to the Provincial Legislature to pass a bill which will empower the city to issue $25,000 in bonds to construct and operate an electric light and power plant. It is proposed to supply electricity for street lighting and for domestic and commercial purposes.

ST. THOMAS, ONT.—The citizens on Jan. 6 voted to construct an electric distributing plant to cost about $42,493, to distribute electrical energy from Niagara Falls in connection with the project of the Hydro-Electric Power Commission.

TORONTO, ONT.—The citizens on Jan 1 voted to issue bonds to the amount of $2,750,000 for a plant to distribute electrical energy to be supplied by the Hydro-Electric Power Commission from Niagara Falls.

TORONTO, ONT.—The following cities voted on Jan. 6 in favor of constructing plants to distribute electrical energy to be supplied by the Hydro-Electric Power Commission from Niagara Falls: London, Brantford, Stratford, Guelph, Hespeler, St. Marys and New Hamburg.

MONTREAL, QUE.—The civic fire and light committee have recommended to the Council the acceptance of the tender of the Roberts syndicate to supply electricity for lamps and motors for municipal and domestic purposes for a period of 10 years. Under the tender arc lamps on wooden poles will cost $55 per year, on ornamental poles $57.50 per year, incandescent lamps 10 cents per kw-hour with a discount of 5 per cent on one year contracts and over, and a discount of 10 per cent on 10 year contracts.

MONTREAL, QUE.—A syndicate of European capitalists have subscribed $10,000,000 to be expended on developing water powers and building rural electric street railways around this city. For further information address Rudolph Forget.

QUEBEC, QUE.—The Quebec Railway, Light & Power Company, the Jacques Cartier Electric Light & Power Company, the Frontenac Gas Company, the Canadian Electric Light Company, and the Quebec-Charlevoix Electric Railway Company, with a combined capital of $10,000,000, have amalgamated. It is said that the consolidated company will be capitalized at $20,000,000.

ST. PAUL (BOULEVARD), QUE.—L. J. Marchand, owner of the local electric light plant contemplates adding a 150-kw generator direct connected to a vertical condensing engine to his plant.

REGINA, SASK.—An issue of $425,000 in debentures has been authorized for electric lighting, sewerage and water works. The managers of the municipal electric light plant are contemplating installing an additional generator during the year. E. W. Bull is manager.

SASKATOON, SASK.—The citizens are considering the question of installing an additional engine and 100-kw generator in the municipal electric light plant. E. L. White is manager.

Company Elections.

RED BLUFF, CAL.—At the annual meeting of the stockholders of the Pacific Power Company, held Dec. 10, the following named officers were elected: Dr. A. P. Tartar, president; A. A. Martin, vice-president and manager; Geo. C. Garrett, J. J. Wells and T. D. Goodwin, directors, and D. D. Dodson, secretary.

BALTIMORE, MD.—At a meeting of the directors of the Washington, Baltimore & Annapolis Electric Railway Company, held recently, the following named officers were elected: George T. Bishop, president; John Sherwin, first vice-president; J. N. Shannahan, second vice-president and general manager; W. A. Kappler, secretary and assistant treasurer; J. N. Shannahan, treasurer and assistant secretary.

SPRINGFIELD, MASS.—At the annual meeting of the Springfield Street Railway Company, held Jan. 8, the following named officers were elected: L. S. Storrs, president; Henry C. Page, vice-president and manager; L. Candee, of Boston, treasurer; J. T. Harmer, clerk and controller.

GRAND RAPIDS, MICH.—At the annual meeting of the Cadillac Water & Light Company, held in this city recently, the following officers were elected: William H. Anderson, president; Edward Fitzgerald, vice-president; L. H. Withey, treasurer; M. V. Gerrish, secretary; George Westover, manager. Improvements are contemplated during the new year.

NASHVILLE, MO.—At the annual meeting of the Nashville Telephone Company held recently the following-named officers were elected: Lafayette Scott, president; Riley Halley, secretary, and Julius Ehlers, treasurer.

STAFFORD, VA.—At the annual meeting of the Toluca & Fredericksburg Telephone Company, held recently, the following named officers were elected: Hugh Adie, president; C. A. Bryan, secretary, and E. S. Moore, business manager.

DAGGETT, WIS.—At a recent meeting of the Daggett-Nathan Telephone Company, the following officers were elected: Paul Perrizo, president; Eugene Houte, vice-president; C. W. Wilkins, secretary, and Dr. Landsborough, treasurer.

New Industrial Companies.

THE AMERICAN NATIONAL ASSOCIATION, of Indianapolis, Ind., capitalized at $50,000, has filed articles of incorporation with the Secretary of State. The object of the company is to promote, finance, construct, equip, rent and operate street and interurban railroads, and plants for generating and distribution of electricity for light, heat and power purposes in connection with such roads, and also to engage in electrical, mechanical and structural engineering. C. H. Wilson, C. W. Van Cleve and F. S. Hines are the directors.

THE COMMONWEALTH ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $1,000 by H. J. Dunbaugh, J. E. Wing and G. C. Madison. The company proposes to manufacture electrical apparatus, etc.

THE MULTI-STAGE ROTARY ENGINE COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $50,000. The directors are: Bertram F. Hoffman, Edward A Piall and Le Grand Hoffman, all of Buffalo, N. Y.

THE STANDARD TELEPHONE MANUFACTURING COMPANY, of Portsmouth, Ohio, has been incorporated with a capital stock of $50,000 by Eugene Knox and others.

THE TRIPLEX TELEPHONE MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by Abraham B. Cox, Harry W. Hillhouse, of New York, N. Y.; Robert E. Bond, of Montclair, N. J.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Toulumne Water Power Company, which is capitalized at $1,000,000. The directors are: Warren Gregory, George H. Whipple, Winfield Dorn, J. S. Lamson and H. R. Rolfe. The purposes of the company are to conduct a general water power and lighting business.

TRINIDAD, COL.—The Southern Colorado Power & Railway Company has been incorporated with a capital stock of $1,500,000 by W. F. Schuyler, K. C. Schuyler, C. Spiess, L. C. Duncan and Frank McLaughlin. The company proposes to supply electricity to the cities and mines in Las Animas and Huerfano counties. The gas and electric light plants and street railway system at Trinidad have been purchased by the new company. The main plants of the company will be established at Trinidad and at Walsenburg. At first the company will operate only in those two counties, but later it expects to extend its system, eventually going into New Mexico. The principal office of the company will be in Denver.

FAIRMOUNT, IA.—The Watson Company has been incorporated with a capital stock of $180,000 by S. L. Watson and others. The company proposes to build and operate electric light and gas plants.

PINCONNING, MICH.—The Pinconning Light & Power Company has been incorporated with a capital stock of $10,000.

SEDALIA, MO.—The Queen City Electric Company has been incorporated with a capital stock of $2,000 by J. A. Copen and others.

BATH, N. Y.—The Citizens' Electric Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $50,000, and the directors are E. J. G. Tower, W. H. Hallock and Thomas Shannon, all of Bath, N. Y.

MASSILLON, OHIO.—The Massillon Electric & Gas Company has been incorporated with a capital stock of $500,000 by J. W. McOlymonds, C. H. Russell and others.

MILFORD CENTER, OHIO.—The Union Light & Water Company has been incorporated with a capital stock of $12,000 by Edward A. Schambs, L. H. Osborne, M. H. Dea, Fred Richter and Frank Brugler.

CALUMET, OKLA.—The Bethany & Calumet Telephone Company has been incorporated with a capital stock of $1,000 by Martin Day, F. R. Siton and Hugh Bright, all of Calumet.

CHECOTAH, OKLA.—The Checotah & Shawnee Interurban Railway Company has been chartered to construct and operate an electric railway from Fort Smith, Ark., to Shawnee, Okla. The road when completed will be 160 miles in length and will cost $1,280,000. The incorporators are: R B. Hutchinson, R. G. Smith, L. F. Cain, R. D. Martin and W. M. Duffy, all of Checotah. The capital stock of the company is placed at $500,000.

CYRIL, OKLA.—The Cyril Southwestern Telephone Company has filed articles of incorporation with a capital stock of $500. The incorporators are: A. A. Hiatt, J. W. Thompson, F. A. Childs, R. W. Browning and G. E. Thorp, all of Cyril.

JESSUP, PA.—The Jessup Electric Light Company has been incorporated by John J. Sweeney. H. V. Lawlor and John Smoulter, of Jessup. The company proposes to furnish electricity for lighting the borough.

WEST CHESTER, PA.—Governor Stuart has approved the charter of the West Chester & Wilmington Electric Railway Company, which proposes to build an electric railway nine miles long from West Chester along the West Chester and Wilmington Turnpike to the Delaware State line. A separate charter will be obtained for the portion of the line in Delaware. The company is capitalized at $54,000, and the directors are Thomas E. O'Connell, of West Chester, president; C. P. Faucett, of Westtown; James A. Kirkpatrick, of Birmingham; Charles Gleason, of Brandywine; F. Harvey Day, of Talleyville, and M. A. O'Connell, of West Chester.

TREZEVANT, TENN.—The Trezevant Telephone Company has been organized and the following officers elected: Oliver C. Sloan, president; William G. Quinn, vice-president; R. E. Ware, secretary; and M. F. Hurdle, treasurer.

KERRVILLE, TEX.—The Kerrville Telephone Company has been incorporated, with a capital stock of $30,000, by J. W. Taylor and others.

COON VALLEY, WIS.—The Coon Valley Farmers' Telephone Company has been incorporated with a capital stock of $4,600, by Louis O. Bryce, Thomas Johnson and C. F. Bunkman.

BOWMANSVILLE, ONT.—The Dereham Telephone Company has been incorporated with a capital stock of $30,000 by R. W. Hawkins, I. Harris, J. W. Hopkins, S. A. Freeman, H. Minshall and K. E. Freeman, of Dereham.

DEREHAM, ONT.—The Dereham Telephone Company has been incorporated. The company is capitalized at $20,000.

DRUMBO, ONT.—The Princeton & Drumbo Telephone Company has been incorporated, with a capital of $30,000.

BURNT RIVER, ONT.—The Burnt River Telephone Company, Ltd., has been incorporated with a capital stock of $5,000 by W. Fell, J. Hodgson, A. B. Townsend, R. Maconachie and W. Britnell, of Somerville.

LANSDOWN, ONT.—The Lansdown Rural Telephone Company has been incorporated with a capital stock of $20,000 by W. J. Webster, R. J. Mitchell, O. W. Landon, all of Lansdown, Ont.

MELBOURNE, ONT.—The Caradoc-Ekfrid Telephone Company, Ltd., has been incorporated with a capital stock of $10,000 by A. B. McDonald, N. A. Galbraith, J. A. McEwen, of Ekfrid, and F. L. Williams, of Caradoc.

PRINCETON, ONT.—The Princeton & Drumbo Telephone Company has been incorporated with a capital stock of $20,000 by F. J. Daniel, W. H. Wells, T. Conway and W. Courtney, of Princeton

Legal.

PRICE OF GAS AND ELECTRICITY IN SARATOGA.—The Court of Appeals on Jan. 8 denied a motion made in behalf of the Attorney General to dismiss the appeal of the Saratoga Gas, Electric Light & Power Company from the judgment of the appellate division, which sustained the order of the old State Commission of Gas and Electricity, fixing the price of gas and electricity in the village of Saratoga. By its denial of the motion to dismiss, the Court of Appeals apparently takes the attitude that it will hear appeals arising from orders of commissions, such as that of gas and electricity. The court fixed for the argument the date of Jan. 20.

A FRANCHISE DECISION.—The Supreme Court of the United States has handed down a decision in the case of the city of Hutchinson, Kan., and the Hutchinson Water, Light & Gas Company, dismissing the company's demurrer to the pleadings. The company brought suit to secure an injunction to prevent the city of Hutchinson from granting a franchise to furnish electric light to the People's Electric Light & Power Company, and against the latter company to prevent its operating under the franchise. In Judge Pollock's court, at Topeka, the city entered a demurrer to the grounds upon which the Water Company based its complaint, which was that the franchise granted it by the city was exclusive and had been paid for by a valuable consideration. Judge Pollock sustained the demurrer. The Water, Light & Gas Company appealed to the United States Supreme Court. About a month ago the case was heard. The decision denies the power of the city of Hutchinson to grant an exclusive franchise to any public service corporation, and while in the case the franchise specified was for furnishing light, it was stated by attorneys that it will cover gas, water or other divisions of a public service corporation.

Obituary.

HON. EDWARD P. PAGE, of Skowhegan, Me., a well-known bank official and a former member of both branches of the Maine Legislature, died suddenly Jan. 3, of heart failure. Mr. Page was president of the Skowhegan Electric Light Company, treasurer of the Skowhegan Pulp Company, and financially interested in many other local enterprises.

MR. W. H. FAIRBANK.—Mr. Wilson H. Fairbank, Massachusetts commissioner to the Portland Exposition and recently commissioner from that State to the Jamestown Exposition, died at Warren, Mass., on Jan. 7. Mr. Fairbank returned from Jamestown early in December, suffering from malarial fever. Heart disease following this malady caused his death. He was seventy-one years old. Between 1864 and 1891 Mr. Fairbank served as superintendent of construction for various telegraph companies, including the United States Telegraph Company, the Atlantic & Pacific, the Postal and the American Telephone & Telegraph Company, and he built thousands of miles of telegraph and telephone lines throughout the country.

MR. A. B. SCOTT.—After an illness of about a year, Alfred B. Scott, of the firm of Scott & Bowne, pioneer in the emulsion business, died recently at Geneva, Switzerland, from paralysis. He was 60 years old. A daughter married Mr. J. S. Anthony, well known in the executive branch of the General Electric Company. He was born in Poughkeepsie, N. Y., and many years ago entered the emulsion industry. About twelve years ago he went to Geneva, from which city he established branches in Europe, Asia and Africa. These branches are separate from the American business, and he was in full charge of them. Up to a year ago he had large financial interests in the electric railways of Buenos Ayres, and his wealth was considerable. Mr. Scott, in connection with Theodore N. Vail, of Boston, reorganized the La Capital tramway system of Buenos Ayres, which was recently sold to a Belgian syndicate when Mr. Vail became president of the American Bell Telephone Company and failing health compelled Mr. Scott to retire.

Personal.

MR. JAMES FORSYTHE, of Springfield, Mass., has been appointed manager of the municipal electric light plant at Chicopee, Mass., to succeed Mr. George E. Stebbins, the present manager.

MR. H. W. KENT, general superintendent of the British Columbia Telephone Company, has resigned. Mr. G. H. Halse, formerly secretary of the company, has been appointed to succeed Mr. Kent.

MR. F. A. SCHROEDER, for several years connected with the Boston Heat, Power & Lighting Company, which controls the Leominster, Clinton and Ayer lighting companies, has been appointed to succeed Mr. Fred Fullam as superintendent of the Leominster, Clinton and Ayer plants.

MR. W. R. GARTON, formerly president and treasurer of the W. R. Garton Company, of Chicago, has associated himself with the Lord Electric Company, and has been appointed general manager of its manufacturing department. His headquarters will be located at its general offices, 213 West Fortieth Street, New York City.

MR. W. S. HULSE, of New York City, has succeeded to the work here of the late Mr. Louis J. Magee, as the representative in America of the interests of the Allgemeine Elektricitaets Company, of which Mr. Magee was a director. Mr. Hulse has been long and favorably known in the field of mechanical and electrical engineering.

MR. R. F. SCHUCHARDT, engineer of construction of the Commonwealth-Edison Company, of Chicago, has been awarded the Chanute medal of the Western Society of Engineers for the best paper on an electrical subject presented before that society during the year 1906. The paper which won this medal was on the subject, "The Rotary Converter Substation," presented in December, 1906.

MR. NORMAN R. COLE.—The *Canada Gazette* contains, in its issue for Jan. 11, 1908, the announcement of the appointment of Mr. Norman Richards Cole as special electrical measuring instrument expert to the Electrical Standards Laboratory, Inland Revenue Department, Ottawa. Mr. Norman Cole has, we understand, made a very special study of electrical measuring instruments, and his connection with the Canadian Standards Bureau promises some interesting results in the near future. Mr. Cole has been connected with some of the best instrument firms in Great Britain.

MR. FRED N. FOWLER, who has been superintendent for a number of years of the United Electric Light Company, of Springfield, Mass., has retired from his position to devote his entire time to the construction of the new plant. Mr. Fowler will have the title of consulting engineer. Mr. Walter H. Damon, chief engineer, has been promoted to the position of superintendent of the generating department, and will have entire charge of intendent of the generating department, and will have entire charge of the work in the three stations of the company. Mr. W. H. Cross has been appointed chief engineer and will have charge of the steam machinery under the supervision of the superintendent of generating. Mr. Paul Selden, superintendent of the meter department, has been promoted to chief electrician, and Mr. J. F. Murray has been promoted to the position of superintendent of the meter department.

VIELE, BLACKWELL & BUCK is the name of the consulting engineering firm of 49 Wall Street, New York City, which will carry on the business of the firm of somewhat similar name to which it succeeds. Mr. H. L. Cooper has retired from the company and his place has been taken by Mr. H. W. Buck, an officer whose engineering rank and ability have already given him high place in this country.

Trade Publications.

POLYPHASE INDUCTION MOTORS, ranging in rating from 15 horse-power to 200 horse-power, are discussed briefly in bulletin No. 88 of the Crocker-Wheeler Company, Ampere, N. J.

"THE ENGINEERING DIGEST" is the new name of "Technical Literature," issued at 220 Broadway, New York, as a monthly compendium or abstract of articles, etc., in the technical press.

ENGINEERING WORK.—Westinghouse, Church, Kerr & Co. have issued No. 3 of the publication "Work Done." Complete descriptions are given of the power station in Long Island City, the energy transmission line and third-rail system, the sub-stations, and the car equipment of the Long Island Railroad.

MACHINE TOOLS.—Catalogue No. 45, recently issued by the Newton Machine Tool Works, Philadelphia, Pa., is a handsome 303-page publication giving excellent illustrations of machine tools of all types, and brief descriptions of each type illustrated. It is interesting to note that many of the large machines are equipped with direct-connected motors.

ELECTRICAL SPECIALTIES.—Catalogue No. 17, of Pass & Seymour, Solvay, N. Y., is an artistic pocket-size publication containing 144 pages devoted to porcelain and other specialties for electrical installations. Where porcelain, brass and hard rubber are shown together effective use is made of colored ink. Prices are quoted on all articles illustrated.

REFLECTOR LAMPS.—The Germania Electric Lamp Company has published a 32-page catalogue illustrating and describing the various types of the incandescent lamp of its manufacture. The latter portion of the pamphlet is devoted to reflector lamps, which are very effectively shown in colored illustrations, while each type is accompanied by a distribution diagram.

TRANSFORMERS.—The Wagner Electric Manufacturing Company, of St. Louis, Mo., has issued a transformer "flyer" which replaces a bulletin, the edition of which is now exhausted. It comes between the company's regular transformer bulletin and its power transformer bulletin. It contains, moreover, a good deal of data that will be interesting to our readers as regards the history of long distance transmission.

TELEPHONE HISTORY.—The Rocky Mountain Bell Telephone Company has just issued a large and interesting pamphlet, well illustrated, telling the story of its growth from 1883 to 1907. As is well known, the system operates in a very difficult section of the country, and some of the mountains and gorges are here depicted. There are now 134 public exchanges, and the revenue in 1906 was $1,410,900.

THE MASSACHUSETTS FAN COMPANY, Watertown, Mass., has just issued an additional section of its perpetual catalogue. This section, which comprises 16 pages, and is entitled "Vertical and Horizontal Engines for Fan Driving" includes illustrations, descriptions, dimensions and horse-power tables. The entire catalogue is thus brought up to a total of 116 pages of exceptionally valuable matter relating to blowers and exhausters, heating, ventilating, drying and mechanical draft apparatus, etc.

FEED-WATER HEATING.—How to obtain more hot water from a boiler feed-water heater, where the quantity of exhaust is limited, is discussed in a circular entitled, "May We Inquire?" which is being distributed by the Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa. It shows that open heaters have the advantage over closed heaters in this respect and that they further save the condensed exhaust. The increased temperature of the feed-water from an open heater, where the supply of exhaust steam is limited, is represented by the following expression:

$$H \frac{p^2}{1 + p}$$

where H = the heat in a pound of exhaust steam above the initial temperature of the feed-water, and p = the percentage of exhaust, as compared with the total output of steam from the boilers. The argument is also made that the closed heater does not provide for the purification of the water, nor for the liberation of air and carbonic acid gas, as does an open heater; further, that the closed heater cannot serve as an independent oil separator, expansion and return tank, pump governor, hot well, etc., as can a Cochrane heater. It is further claimed that an open heater is much more easily cleaned than is a closed heater, this point being illustrated by some interesting photographs. This pamphlet is sent upon request.

THOMSON HORIZONTAL EDGEWISE INSTRUMENTS.—The use of instruments of the highest possible accuracy is essential to the economical and satisfactory operation of electrical properties. The General Electric Company, Schenectady, N. Y., manufactures a complete line of horizontal edgewise instruments for switchboard service, including ammeters, voltmeters, single-phase wattmeters, polyphase wattmeters, frequency indicators and power factor indicators. Bulletin No. 4551, recently issued by the company, illustrates and describes the various types, giving dimension sketches and a complete set of full-sized scales. The wattmeters, power factor indicators and frequency indicators are constructed on the direct-reading dynamotor principle; the ammeters and voltmeters on the well-known Thomson inclined coil principle. All the instruments are of uniform size, thus giving a pleasing appearance when installed. The horizontal, edgewise design has been adopted for the majority of high-grade work, since it was first introduced some years ago. While primarily designed for alternating current service, the voltmeters, ammeters and wattmeters can be used with good results on direct current.

Business Notes.

THE BELL ELECTRIC MOTOR COMPANY has moved its office from Prince Street and West Broadway to 120 Centre Street, New York.

THE MARINE ENGINE & MACHINE COMPANY has moved its New York office from 126 Liberty Street to 230 West Thirteenth Street. Its new telephone number is 4730 Chelsea.

WIRELESS CLUSTERS.—The Benjamin Electric Manufacturing Company, of Chicago, announces that it has authorized the Dale Company, of New York, to market wireless clusters, details of which are covered by patents owned by the Benjamin Company.

THE PEERLESS RUBBER MANUFACTURING COMPANY has recently opened its new retail department at 88 Chambers Street, New York, which connects with its present store at 16 Warren Street. Owing to its somewhat limited space it has hitherto not been able to carry a large stock, but with the additional store, it will always have on hand a full and complete line of mechanical rubber goods to fill immediate demands.

THE EXCELLO ARC LAMP COMPANY has established a branch office and distributing center at 118 West Jackson Boulevard, Chicago, in charge of Mr. G. W. Armstrong. Stock will be carried at this point for distribution to all surrounding territory, and the company will be prepared to make the Excello flaming arc lamp as prominent a factor in the lighting of industrial works in the West as it has been made in the East.

THE EXCELLO ARC LAMP COMPANY has opened a depot in the Electrical Building, No. 116-132 Jackson Boulevard, Chicago, for the convenience of the Western trade. Mr. George W. Armstrong, who has been the Western traveling representative of the company for the past two years, will be in charge of this branch, and will carry in stock at all times for rush orders a supply of lamps, carbons, globes and all other accessories and parts.

THE GENERAL ELECTRIC COMPANY'S exhibit at the third annual Trades Exposition at Chicago occupies a space of over 700 square feet in the center of the Coliseum. The exhibit is devoted principally to cooking and heating devices, among which are shown luminous radiators, coffee percolators, chafing dishes, water heaters, complete cooking and baking outfits and flat-irons. All of these articles are shown in actual use and visitors are served with electrically cooked delicacies, in an elaborately furnished dining-room. An interesting feature of the exhibit is the color booth, in which color values are compared under various artificial lights, including the enclosed arc, incandescent, Nernst and Welsbach. This is the first actual comparison of this nature that has been made at a Chicago show and should prove of interest to managers of clothing and drygoods stores. Of further interest will be mutoscope pictures of the Schenectady factory.

THE LORD ELECTRIC COMPANY, of New York, Boston and Chicago, has very recently made a marked change and improvement in its manufacturing department. It is greatly broadening the field of its activities and the scope of this department, having acquired some very valuable patent rights. It is preparing to manufacture the devices covered by these patents. The company has been actively engaged in the electrical field manufacturing and supplying rail bonds, lightning arresters, kindred devices and appliances. The thoroughness with which it has undertaken and prosecuted its work has been clearly demonstrated by the very broad field covered and the amount of trade developed. It has gained an enviable reputation and has assumed a position of importance. The success attained through its efforts has now encouraged it to take on additional valuable specialties, all of which are covered by strong patents and which, it is believed, will appeal to the operator because of their superior character and the fact that they effect a saving and thus materially increase dividends.

H. W. JOHNS-MANVILLE COMPANY.—One of the most interesting exhibits at the Chicago Electrical Show is that of the H. W. Johns-Manville Company, located in Space 15, Section E, opposite the main entrance. Last year the company exhibited for the first time its Victor combination meters, and this year it shows a complete line of both stationary and portable types. The added attraction this year is "Linolite," a new system of lighting. The company's booth is lighted by means of Linolite, which tends to show off the features of the Linolite system to excellent advantage. Linolite, which means "line-o-light," has been developed especially for window, stage and showcase lighting, as well as the illumination of desks, pictures and room interiors. It consists of an aluminum reflector 2¼ ins. wide and approximately 1 in. deep, in which fit tubular incandescent lamps 12 ins. between centers, each lamp having a filament extending its entire length. Another item of interest in this exhibit is asbestos wood, a fibrous substitute for wood, marble, slate and fibre, for fireproof construction and as an electrical insulation. This material has a wide range of uses, such as switchboards, panel boards, fireproof barriers, etc. It can be worked with ordinary wood-working tools the same as hard wood. A complete line of Noark fuses and fuse devices are also shown, as well as line material, electrotherms (electric heating pads), J-M friction tape, moulded mica, Monarch, Phoenix, Vulcabeston and Electrobestos insulations, asbestos pipe coverings, asbestos roofings, asbestos packings and asbestos household specialties. The company is represented by Messrs. H. M. Frantz, manager of the electrical department of the Chicago office; F. C. Frumweller and A. M. Chamberlin, of the Chicago office; A. M. Erskine, manager of the electrical department of the St. Louis office; H. M. Crosswell, manager of the electrical department of the Milwaukee office; G. A. Saylor, Milwaukee office, and W. F. Little, E. E., New York office.

Calendars.

THE AMERICAN CARBON & BATTERY COMPANY, East St. Louis, Ill., has issued a pleasing wall calendar for 1908. It shows a picture of a small boy with a loaf of bread in his hand and his dog looking up appealing for a share of the loaf. The picture is entitled, "We Demand a Division."

THE LAFAYETTE ELECTRICAL MANUFACTURING COMPANY has been particularly happy in the selection of a design for its wall calendar, both with respect to subject and treatment. A picture on a dark background represents a child rising in the morning, with a dog, in an attitude as if presenting a morning greeting.

THE GENERAL INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has been favoring its friends with a very attractive calendar. It is very original and quite out of the ordinary, the design having been made expressly for this purpose. A small supply was left after the regular list was covered, and as long as they last the General Incandescent Lamp Company will be glad to furnish copies of the calendar to any dealer, contractor, central station or isolated plant man on request.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 7, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

875,715. INTERCHANGEABLE ELECTRIC DISPLAY APPARATUS; Deronda Levy, New York, N. Y. App. filed April 5, 1905. Covers a keyboard apparatus for the illumination of electrical signs of that character in which any inscription can be produced by the illumination of different groups of lamps in each letter.

875,750. CARBON BRUSH FOR COMMUTATORS AND THE METHOD OF PREPARING SAME; [illegible] Van Nort, Jr., St. Louis, Mo. App. filed March 19, 1906. The process of producing commutator brushes, which consists in treating ordinary block carbons with a boiling liquid having powdered plumbago suspended therein.

875,757. MAGNETIC CLUTCH; Thomas A. Watson, Milwaukee, Wis. App. filed April 1, 1907. A form of magnetic clutch having an expansion of the driven part produced by the torsion applied to a coil member.

875,784. APPARATUS FOR THE MANUFACTURE OF COPPER ELECTROTYPES; S. O. Cowper-Coles, London, Eng. App. filed March 5, 1906. A method for producing electrotypes or copper shells for printing and other purposes. Has a revoluble drum within a cylindrical casing.

875,788. PRESSURE DEVICE FOR ELECTRIC CURRENT COLLECTORS; C. De Kando, Budapest, Austria-Hungary. App. filed May 6, 1905. A means for maintaining the requisite pressure between the trolley and trolley wire under different running conditions. Has a penumatic apparatus acting in conjunction with tension springs.

875,791. CONTROLLER REGULATOR; J. P. Durkin, Philadelphia, Pa. App. filed Aug. 31, 1907. The controller handle carries a disc having circumferential grooves in which ride a steel ball, which is also constrained by grooves in the surrounding casing.

875,706. LAMP BASE; T. W. Frech, Jr., Cleveland, Ohio. App. filed March 27, 1907. A form of lamp base having a projecting skirt coated with a closely adherent fibrous insulating material.

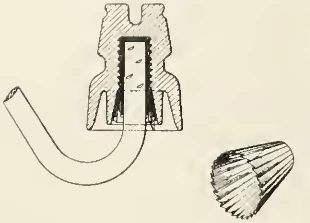
875,801. CONSTRUCTION OF INDUCTION ELECTRIC FURNACES; C. Gin, Paris, France. App. filed May 3, 1906. A form of induction furnace designed to obtain a uniform distribution of heat and uniform reactions in the different parts of the furnace.

875,810. AUTOMATIC FIRE ALARM; B. C. and F. W. Hall, Elmwood, Ill. App. filed Jan. 12, 1907. Relates to improvements in automatic fire alarm apparatus in which fusible elements are used to close an electric circuit, whereby suitable alarm devices are operated.

875,822. PRESSURE DEVICE FOR ELECTRIC CURRENT COLLECTORS; C. De Kando, Budapest, Austria-Hungary. App. filed Nov. 27, 1903. The trolley pole is impelled upward by a tension spring which can be released by a pneumatic cylinder fixed to the roof of the car. Has means for increasing the pressure when the car is operating at high speed.

875,830. SOCKET KEY CLAMP; M. Loewenthal, Newark, N. J. App. filed June 6, 1906. A means for sealing the button of an incandescent lamp in either on or off position. Includes a metallic band which clamps around the socket and embraces the turn button.

875,833. ELECTRIC ARC LAMP; J. A. Meaher, Cleveland Ohio. App. filed Oct. 29, 1906. Relates to details of construction of an enclosed arc lamp having a reflector. The regulating mechanism is designed to maintain the arc by a solenoid and a ball clutch.


875,902.—Means for Insulating the Supports of Electric Conduits.

875,843. APPARATUS FOR TRACK CIRCUIT CONTROL; J. A. Peabody, Evanston, Ill. App. filed July 25, 1907. A means for supplying alternating current to track rails for signaling purposes comprising a battery having its circuit connected to a pole changer and another battery having its circuit connected to a vibrator operating said pole changer.

875,872. WIRE-CONNECTOR; John J. Walsh, Yonkers, N. Y. App. filed April 10, 1905. Has a split bolt with a plurality of washers between which the wires are passed. In place of a nut, patentee makes use of a set screw which clamps the endmost washer.

875,900. REVERSING SWITCH; A. C. Eastwood, Cleveland, Ohio. App. filed April 19, 1906. A form of reversing switch having a pair of magnets operating solenoids to produce continuous rotation of a commutator which is engaged by spring-impelled brushes.

875,901. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; A. C. Eastwood, Cleveland, Ohio. App. filed May 22, 1906. A diagram of circuits for a train-control system having a plurality of electric motors controlled by a single pilot circuit, through contactors.

875,902. MEANS FOR INSULATING THE SUPPORTS OF ELECTRIC CONDUITS; C. E. Enger, Stockholm, Sweden. App. filed Nov. 15, 1906. An interponent for insulators comprising a plurality of separately imposed caps, the sides of which have a series of folds to impart to the caps a relative amount of fulness.

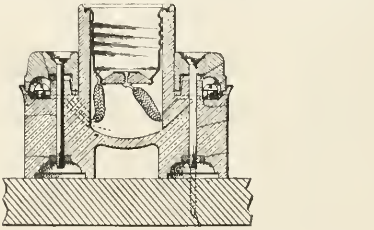
875,910. ELECTRIC CHAIN WELDING MACHINE; H. Helberger, Munich, Germany. App. filed Feb. 15, 1904. A complete apparatus for electrically welding together the links of a chain.

875,911. SAFETY SIGNAL SYSTEM FOR RAILWAYS; W. F. Herting, et al., Baltimore, Md. App. filed April 20, 1907. Railroad signal system including electrical and mechanical features. Has mechanically operated signals and electrical circuits completed by the movement thereof.

875,942. ACETYLENE LAMP AND LIGHTING DEVICE FOR AUTOMOBILES AND OTHER VEHICLES; S. M. Meyer, New York, N. Y. App. filed Dec. 21, 1905. A device including a form of controller and a pair of dry batteries designed to be located on the dash of an automobile and including circuits to the various lamps by which they can be lighted.

875,964. OUTDOOR LAMP RECEPTACLE; J. S. Stewart, New York, N. Y. App. filed June 13, 1906. An outdoor lamp receptacle having a variety of features. Is designed to provide not only a support for the lamp, but for the circuit wires as well, but the connections with the lamp are made in an absolutely waterproof way, so as to avoid electrolytic action. Patentee also overcomes the breaking strains, from the unequal contraction of the porcelain and metal in the winter.

875,978. ELECTRIC SWITCH; F. G. Baum, San Francisco, Cal. App. filed Oct. 24, 1905. A form of outdoor switch for high potential transmission circuits operating on voltages of from sixty to one hundred thousand volts. Patentee has horizontally swinging arms carried by petticoated insulators and engaging metallic clips which are fastened to other petticoated insulators. Three such circuit-breaking arms are provided for a three-phase system all simultaneously operated by a single lever.


875,964. Outdoor Lamp Receptacle.

875,981. MOTOR CONTROLLING MECHANISM; H. W. Cheney, Norwood, Ohio. App. filed June 8, 1906. Provides means whereby the starting resistance of an alternating current motor may be arranged outside of the rotor, but the final short-circuit may take place within the rotor.

875,982. MOTOR CONTROLLING MECHANISM; H. W. Cheney, Norwood, Ohio. App. filed March 30, 1907. Provides various features of a controller for induction motors by which the operating current for the short-circuiting device may flow until its work is done, however rapidly the operator moves the controller, while said current is stopped as soon as its work is done.

876,039. HAND MIRROR; H. Burrell, Sheffield, England. App. filed July 8, 1907. A mirror for opticians having an electric lamp on the surface which illuminates the object to be reflected. The mirror is rotatable on its support and has a clear space at one point and an electric lamp carried by the mirror and arranged at the back of said clear space.

876,055. SWITCH; C. H. Holley, Visalia, Cal. App. filed June 16, 1905. An oil bath switch of the type having a downwardly projecting plunger carrying depending switch elements at its upper end which dip into oil baths within the switch casing. Designed for use on outdoor overhead systems.

876,059. SPLIT KNOB; W. H. Irons, Beaver, Pa. App. filed Oct. 11, 1906. Two cylindrical blocks with registering channels between which the circuit wire is received. The blocks clamp upon said circuit wire by a central supporting screw or pin.

876,069. TELEGRAPH TRANSMITTER; Charles E. Lee, Chicago, Ill., and Lewis K. Miller, Brooklyn, N. Y. App. filed May 14, 1906. A typewriter telegraph baving operating keys and a cam impelled lever which vibrates between platinum points in a manner analogous to the ordinary telegraph key.

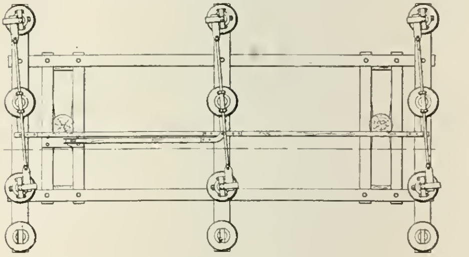
876,160. CLAMP; Winn D. Faris, Medicine Lodge, Kan. App. filed Nov. 20, 1907. A form of strain insulator including a pair of iron straps which embrace the cross arm of a telegraph pole and have pivoted between them a cylindrical insulator.

876,165. WIRELESS TELEGRAPH TRANSMITTING SYSTEM; Lee DeForest, New York, N. Y. App. filed May 11, 1904. The combination with a transmitting loop antenna constituting a closed oscillating circuit, of a closed oscillating energizing circuit associated therewith and attuned thereto.

876,169. RECEPTACLE FOR INCANDESCENT LAMPS; Gilbert W. Goodridge, Bridgeport, Conn. App. filed June 14, 1907. A sign receptacle having laterally projecting lugs in front and back with connecting strengthening ribs.

876,187. JUNCTION BOX; Harry H. Hornsby, New York, N. Y. App. filed Mav 12, 1906. A sheet metal box having a U-shaped body with end plates and adjustable ears or lugs for attachment to any supporting surface.

876,192. SIGNAL ALARM SYSTEM; Oliver B. Kaiser, Norwood, Ohio. App. filed April 30, 1906. Provides means whereby an apparatus is operated automatically to transmit a signal from a transmitting point to a central office, in which after the apparatus has been set in motion it is positively operated by power and continues in such positive operation for a limited time before the transmitting wheel is positively brought into operation.


875,978.—Electric Switch.

876,207. PUSH BUTTON ELECTRIC SWITCH; William G. Mann, Bridgeport, Conn. App. filed June 20, 1907. A push button switch having contacts for connection with more than one circuit. Has a plurality of push buttons operating separate switch blades and a single release button adapted to unlatch all of said blades whereby they are returned to normal position.

876,233. ELECTRIC LAMP RECEPTACLE; Herbert E. Plass, Newark, N. J. App. filed Aug. 1, 1907. A form of lamp receptacle adapted to Christmas tree decoration. Has a cup part containing lamp terminals with rearwardly projecting prongs, and a screw and a co-operating cap and nut threaded on to the screw and adapted to be turned by hand to hold the cap in place.

876,241. UNDERGROUND SYSTEM OF LAYING ELECTRICAL CONDUCTORS; Wilhelm Schreiber, Munich, Germany. App. filed March 28, 1907. Relates to the arrangement of the conduits of cables and the construction of the junction boxes and wear distributing devices for connecting the conductors in an underground system, and more especially to a district telephone system.

876,253. ELECTRIC SAD IRON; William J. Barr, Cleveland, Ohio. App. filed May 27, 1907. The flatiron is made hollow with a removable insulating cover and contains a removable resistance element within a separate casing.

876,273. FUSE DEVICE; Frank B. Hall, Wheeling, W. Va. App. filed Dec. 30, 1905. A construction of fuse built of flat mica plates between which the fusible element is passed. The fusible element threads through a central perforated mica plate at the middle portion of its length.

876,274. ELECTRICALLY CONTROLLED RELEASING DEVICE; Charles J. Kintner, New York, N. Y. App. filed April 20, 1906. An electrically controlled releasing device for use in connection with railway signals and provides a solenoid having a core operatively connected with a valve stem or other appliance which it is desired to release, and adapted to impart a blow to the part to be released.

876,281. COMBINATION SENDING AND RECEIVING WIRELESS TELEGRAPH APPARATUS; Albert L. New, Los Angeles, and William N. Hickman, Avalon, Cal. App. filed Sept. 17, 1906. Relates to a complete wireless telegraph system designed to prevent interference by atmospheric electricity, and to provide a double set of aerial capacities, one of which is adapted for sending and the other for receiving.

876,312. QUADRUPLEX OR MULTIPLEX TELEGRAPHY; Lawrence Connell, Jr., Portland, Ore. App. filed March 29, 1907. Provides for overcoming the false signals in a neutral relay of a quadruplex telegraph system. Makes use of steadying magnets for holding the armature steady against vibration during the moments of no magnetism.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, JANUARY 25, 1908. No. 4.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, Pres.; CURTIS E. WHITTLESEY, Sec. and Treas.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE............................1015 Schofield Building
PHILADELPHIA OFFICE.....................Real Estate Trust Building
SAN FRANCISCO OFFICE.............................601 Atlas Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico........................per year, $3.00
Dominion of Canada...4.50
Other Foreign Countries within the Postal Union..................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1906, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 16,250 copies are printed.*

NEW YORK, SATURDAY, JANUARY 25, 1908.

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THE NORTHWESTERN CONVENTION.

Among the chief matters of discussion at the Northwestern Electrical Association convention held at Milwaukee last week, were the various effects of the new public service bill which has been in effect in Wisconsin for some months, and other matters pertaining to State regulation. Wisconsin being the first of the Middle Western States to adopt regulation of public service companies by commission, much interest is manifested in the developments there by the central-station men of surrounding States as well as by those of Wisconsin, who are directly affected. The general sentiment seems to be that the effect in the long run will be good both for companies and public, in spite of any little friction there may be in getting the new machinery started. The Northwestern Electrical Association at this convention faced a situation which has been developing for the past several years. When the association was organized there was no other organization of the kind in the country except the National Electric Light Association. The Northwestern Association was intended to take in all classes of electric light, power and railway men in the States north and west of Chicago. After an era of some prosperity, the interest in the association, for various causes which it is not necessary to discuss here, began to lag. State associations of electric light companies began to spring up and thrive in what had before been considered Northwestern territory. Illinois, Iowa and Michigan formed state associations, and two ill-fated attempts were made in Indiana. The Northwestern Association for some time has, therefore, been practically a Wisconsin Association with a few attendants from Minnesota, Illinois and northern Michigan. State associations were easier for members to attend, and the state associations in some cases have played an important part in keeping members posted as to harmful bills brought up before state legislatures, so that a representative of the association could appear before the legislative committees having these bills under consideration, and in some cases various members could point out to the representatives from their respective districts the fallacy of the bills proposed. In fact, it has in some states seemed to be absolutely necessary to take some measures to prevent "fool legislation" going through in the absence of any one to point out its character. The Northwestern Electrical Association a number of years ago, through committees in various states, made an attempt to keep track of legislation in various states where it had members, but this did not yield practical results of any value, and was dropped.

In the meantime, in the past year, in the state of Wisconsin, there was organized the Wisconsin Electric and Interurban Railway Association, composed of both lighting and railway companies in the state of Wisconsin. The province of this association has been confined strictly to questions pertaining to state control, accounting and legislation. Its representatives have appeared before legislative committees on proposed legislation, and it is about to take up an important work in co-operation with the Wisconsin commission in getting up an acceptable standard form of accounts which shall be both acceptable to the commission and practicable for the companies. Many members of the Northwestern Electrical Association also have company membership in the Wisconsin Electrical and Interurban Railway Association. Both associations held meetings in Milwaukee last week, and it was but natural that the question of maintaining two associations in one state should come up for consideration, and that action should be taken looking toward some kind of a consolidation of the two associations. The Northwestern Association has some active and valuable members from Minnesota and other states, and the association put itself on record as opposing any reorganization scheme which will legislate these members out of the association. It seems likely that some scheme of consolidation can be worked out by the committees which have been appointed which will accomplish the desired end of giving members outside of Wisconsin the privileges of participation in conventions, while at the same time providing for special assessments of Wisconsin members to take care of whatever extra expenses seem necessary to properly safeguard Wisconsin interests and to co-operate with the state commission. The Wisconsin commission is establishing precedents rapidly these days in the first year of its existence, and it is important that both sides of each case coming before the commission be fully presented in order that correct precedents be established. It is evidently the desire of the commission that this be done. Each case decided involves much more than its immediate effect on the company involved in the case. It establishes precedents which all the other companies in the state must follow; hence, an association representing all the companies should be very properly represented at all hearings, and it is evidently the desire of the commission that this be so.

The Patent Office Gazette.

We cannot drop the recent discussion on the cutting down of published claims in the *Patent Office Gazette* without comment on the wide difference in the views presented. Patent attorneys have in our columns presented every shade of opinion on the subject, and some of the suggestions made were most pertinent. We think all hands will agree that upon the whole, the *Gazette* ought to be so conducted as to be of the greatest feasible usefulness to the class whose money supports it, namely, the inventors. And the chief question is, in how far is the publication of all the claims essential to this usefulness? As some of our correspondents have pointed out, none of us can properly evaluate the full scope of a patent without the full document before him. Claims are understood to be read in the light of the specification and drawings, and not merely as isolated examples of frequently very involved and unintelligible English. The inventor, however, wishes to post himself thoroughly as to the general condition of the art before going far with his work, and this he ought to be able to do without going to the expense of buying or hunting up the full class to which his invention belongs. Some inventors go so far as to send for and study the class, and even to look into the full state of the art and fortify themselves with material for defending their invention before filing an application, but as a rule they rely on the *Gazette* to put them in touch with the facts.

Hitherto the *Gazette,* while obviously imperfect, has given much useful information. It has given a drawing thoroughly typical of the construction employed, and has given the claims in full, so that their general scope is at once evident. The specification, when read, is generally found to limit the claims rather than to broaden their scope, so that in looking over the claims the inventor is likely to know the worst. The attorney also gets a full view of the face value of the claims on which litigation is likely to be based. It is the rare exception when infringement of all the claims or of (in patents with many claims) any considerable part of them is claimed. Often only two or three claims out of a dozen are involved, especially when the claims are drawn upon the permutative system affected by some attorneys. In combinational claims, built up in this fashion, it often happens that the first half dozen claims may be by themselves entirely uninstructive as to the full scope of the combination. It would certainly be extremely easy, far too easy, to make the later claims in number the really important ones; and if the present rule is kept in force it will be very surprising if there is not ample evidence of this facility. We hardly share the fear of one of our correspondents that certain large interests may by ordering patents in quantity, endeavor to keep their important claims secret through keeping the patents out of print, since this could not be done save by practical connivance of the Patent Office, which is highly improbable; while in isolated cases an edition of specifications has thus been exhausted by devious methods in the past; if it were to become a practice, rules would very quickly be made to check the abuse.

The suggestion of carefully prepared abstracts of patents for the *Gazette* has much to recommend it, could it be successfully carried out. Any one who has ever tried to abstract patents, however, or who has frequently read abstracts, must realize the practical difficulties of doing it briefly and well. It is not enough to make clear the general nature of the invention, for many an injunction has been obtained on claims which, while legitimately in the patent, are altogether subsidiary to its conspicuous main features. Indeed, in patent litigation some of the most dangerous claims are of this casual sort, their subject matter being incidentally rather than fundamentally described in the specification. Were our patents of the German description, in which the inventor is tied up very tightly, one could abstract them more easily, but the liberality of our office toward the inventor lets through at times some pretty broad claims in an apparently narrow patent. It seems, therefore, all things considered, that the old practice is an important aid to the inventor who pays the bills, and should be continued, while, as we have before intimated, a better and more complete classification of patents kept sharply up to date is needed badly.

Magnetic Leakage in Induction Motors.

As pointed out in our issue for Nov. 23, no calculation connected with the predetermination of the performance of an induction motor is of greater importance than that relating to the leakage coefficient. Of almost equal importance from the point of view of the designer, however, is a knowledge of the effect upon the leakage of the various changes that may be made in the arrangement of the active material of the machine. Although the ability to predetermine the magnetic leakage in a motor involves a knowledge of the factors of design which affect the leakage coefficient, yet the ability to select such proportion that the leakage coefficient is a minimum consistent with obtaining the required service performance from the completed machine is the true criterion of the designer's skill. In fact, it may almost be said that if the designer has so proportioned the parts of the machine that with the minimum of active material the desired efficiency is obtained and the allowable temperature rise is not exceeded, and the coils and core are so arranged as to obtain the minimum possible leakage coefficient without sacrifice of mechanical requirements, his task has been completed. That is to say, the real work of the designer is to obtain the minimum leakage coefficient when high-power factor is required, rather than merely to calculate the leakage obtained with an arrangement of coils and core which by chance may give a satisfactorily high efficiency and low temperature rise.

Our present issue contains an article by Mr. R. E. Hellmund supplementing an article which appeared in our issue for Nov. 23, 1907. In the latter article there was given a simple and convenient formula for determining the leakage coefficient of an induction motor from the known machine dimension. The article in this issue contains a discussion of the factors which influence the leakage coefficient without causing an appreciable change in the main flux of the motor. The chief value of the article resides in the practical information concerning the relative leakage around the end-connection of various styles of windings. It may be shown that the value of the main flux depends solely upon the number of conductors per phase-winding, and the distribution of the conductors in the slot, while the interlinkage of leakage flux and turns varies largely with the arrangement selected for interconnecting the ends of the conductors. Mr. Hellmund gives a well arranged classification of the several styles of winding commonly employed for induction motors with reference to the magnetic leakage, the cost of copper and the convenience in manufacture.

HUNTING OF ALTERNATORS DRIVEN IN PARALLEL.

The progress from former independent to present synchronous operation of alternators has been due to a number of causes. Firstly, alternators were originally single-phasers. Now they are nearly always polyphase machines, which are easier to synchronize and easier to maintain in synchronism automatically. Secondly, the frequency of alternation used to be over 120 cycles per second in this country. Now, it is either 60 cycles per second, or 25 cycles per second, and the lower frequency machines are easier to couple and to run coupled. Thirdly, the experience, experimental research and knowledge gained during the last 20 years in the behavior of coupled alternators has greatly improved their construction for the purpose of parallel running. Although dangerous hunting between paralleled alternators has ceased to be a dread of central-station engineers, yet occasionally conditions arise in which alternators misbehave when coupled. In these cases the whole subject is opened up afresh. In practically every case the trouble is to be found in the behavior of the engines or prime-movers, and not with the alternators, assuming the latter to be perfectly constructed.

It is evident, on consideration, that two similar alternators, each driven by a separate prime-mover at the same nominal speed, could not possibly run in parallel for any length of time if there were no electrical interaction between them tending to keep them in step. In the case, for instance, of 40-pole. 60-cycle alternators driven at 180 revs. per minute, one cycle would correspond to 18 degrees of shaft rotation, and an electrical phase-displacement of 20 degrees, or 1-18th of a cycle, would correspond to 1 degree of shaft-rotation. It would be impossible for the two independent engines to keep their respective alternator-shafts in unison to within 1 degree of shaft displacement, if it were not for the currents exchanged between the alternators through the bus-bars. Such local bus-bar currents are usually called idle currents, but they are very active in the sense of keeping the machines locked in unison. Moreover, any difference between the wave-shapes of the e. m. f.'s in the armatures coupled to common bus-bars must inevitably give rise to cross-currents or idle currents. As long as these currents are not of marked strength or periodic fluctuation they are useful and necessary. When they assume large proportions and fluctuate rapidly, they represent hunting between the machines, and may involve dangerous stresses either in the alternators, or in the prime movers, or both. Every alternator or synchronous motor possesses a natural period of oscillation when connected to constant-frequency and constant-potential mains. This period depends upon the moment of inertia of its rotor, and on the strength of the restoring electromagnetic torque which is set up per electrical degree of accidental phase displacement. The greater this restoring torque, and the smaller the rotor inertia, the shorter is this period. Many writers and experimenters have limited their enquiries to this natural electromagnetic period of alternator-oscillation, which may vary in different machines from say one-tenth of a second to ten seconds or more.

In an article by Dr. Gustav Benischke, recently printed in *Elektrotechnik und Maschinebau,* it is pointed out that no theory of alternator hunting can be complete without including the natural periods of the respective prime-movers. A mechanical model of the case is suggested, as presented by a pair of pendulums each driven flexibly through springs from a reciprocating element, but mechanically coupled by a cord carrying a certain weight. If the two pendulums have the same natural period of vibration, and if they are driven isochronously by similar reciprocations, in step, through like springs, then the coupling cord and weight will swing idly, with the weight neither rising nor falling. If, however, there be dissymmetry in any of the points specified, there will tend to be an up-and-down oscillatory motion of the intermediate weight on the coupling cord, corresponding to the cross-current through the bus-bars. In particular, if the period of oscillation of one or both prime-movers approaches the natural period of the pendulums or alternators, then very large perturbations of the weight may be looked for. This means that the natural period of the engines and governors must be kept away from the natural period of the alternators, and both should be damped as much as possible. The alternator damping is usually effected with the aid of eddy currents in the pole-faces of the alternator field-frames. The engine-governor damping is usually effected with the aid of a dash-pot on the governor mechanism.

Exhibits at the Chicago Electrical Show.

Elsewhere will be found an extended account of the exhibits at the Chicago Electrical Show this year, in which, for the convenience of the reader, the matter is classified and arranged in order that all the devices or appliances of a similar nature can be found together under a suitable head. Particular attention has been given to the new things brought out at this show or within the last few months, and only casual mention made as a matter of record of things which have been on the market for some time and which should be well known by readers of this journal. This marks somewhat of a departure from previous practice in reporting exhibitions, and, although involving considerably more work, will be appreciated by readers who have experienced the difficulty of attempting to find new devices among a number of columns of unclassified notes, burdened with invoices of staple articles.

Taken as a whole, the Chicago Electrical Show of 1908 has been well worth visiting from the standpoint of the electrical man looking for information of practical value, as new devices and improvements of old devices were to be found on every hand, as can be seen from the report we print.

The general appearance of the show this year was a great improvement over previous ones, because of the uniformity of the booth construction and decorative scheme, to say nothing of the elaborate decorative lighting. From the exhibitors' standpoint it was a relief to have the work of booth erection and moving in of exhibits all done by the Electrical Trades Exposition Company, which runs the show. The show was this year, as last, under the efficient management of Mr. Homer E. Niesz, of the Commonwealth Edison Company. The popular attendance was not as good this year as formerly, which, of course, was disappointing to the management, but it had at least the advantage that electrical men had better opportunity to look around without being crowded out by the general public, as was often the case the two previous shows.

Convention of the Northwestern Electrical Association.

The sixteenth annual convention of the Northwestern Electrical Association was held at Hotel Pfister, Milwaukee, Wis., Jan. 15 and 16. Abstracts of the most important papers and discussions will appear in a later issue. In the absence of President Edward Daniell, of Marinette, Wis., Mr. W. R. Putnam, of Red Wing, Minn., one of the members of the executive committee, presided at all sessions, proving a very efficient chairman. The report of Mr. R. N. Kimball, secretary and treasurer, was first heard. Invitations were read from the Chicago section of the Illuminating Engineering Society to attend a meeting of that organization at the Chicago Electrical Show, Jan. 17, and from the Allis-Chalmers Company to visit the works of that company. It was announced that the badge of the association would admit members of the convention to the Electrical Show on Jan. 17, and that arrangements had been made for special cars to take those attending the convention to Chicago to visit the Electrical Show after the adjournment of the convention. The Milwaukee Electric Railway & Light Company also invited the convention to inspect its very complete Public Service Building. This invitation was taken advantage of the following day, when the members visited the Public Service Building in a body and were shown its numerous interesting features by Messrs. Rau and Vaughn, of the Milwaukee Company. The nominating committee to nominate officers for the ensuing year was appointed, consisting of Mr. Irving P. Lord, Waupaca, Wis.; Mr. Ludwig Kemper, Albert Lea., Minn., and Mr. W. B. Jackson, of Chicago and Boston.

It was voted that hereafter the arrangement of programme should be in the hands of a committee, of which the president of the association shall be the chairman. In this way the practical responsibility for the success of any meeting will be in the hands of the president, and the secretary and treasurer will be relieved of some of his too burdensome duties. The chairman stated that there was a movement on foot in Minnesota to organize a Minnesota central station men's association. A meeting had been called for Minneapolis the latter part of February. Those Minnesota men who had been connected with the Northwestern Association felt that better results could be accomplished by having the Minnesota men belong to the Northwestern. Distances from Minnesota points to Milwaukee were considerable, but it might be possible to arrange alternate meetings in St. Paul or Minneapolis and Milwaukee. Mr. Kemper, of Albert Lea, also said he was opposed to establishing an association in Minnesota, where there was one already covering the Northwest. This opened up the question whether the association would better serve its members if limited to the state of Wisconsin in the future. Mr. Lord said that when the Northwestern Association was formed, central stations were not as numerous as now. As more central stations have been established, each state has become more of a unit. The necessity of each state looking after its own interests has become more apparent. Legislation has seemed to make that necessary. He thought it best for the interests of the different central stations in the states of Wisconsin, Minnesota, Illinois, Michigan and Iowa to have their own state associations; that they could accomplish more good in that way. While he had formed strong friendships with members from other states who had been at the conventions year after year, he was obliged to look at things as they are. He suggested that members from other states might be admitted as honorary members, and always welcome to take part in conventions. Mr. R. N. Kimball, secretary, said that the Wisconsin Electric & Interurban Railway Association was formed because it was decided that the Northwestern Electrical Association did not serve the purpose, because of the character of its membership. Mr. P. H. Korst expressed the opinion that the Northwestern Association could not hope in future to cover much more than the state of Wisconsin, and that the association interest would be a little closer if membership was taken exclusively from Wisconsin. In fact, on account of the Northwestern Association being composed of members from different states, it was necessary to organize another association last year to take up matters pertaining to the state alone, so that now there were two associations in the state. He did not favor excluding members from other states, but thought it would be well to have the organization such that there would be no delicacy about taking action which interested the Wisconsin members only.

Mr. Clement C. Smith, of the Wisconsin Electric and Interurban Railway Association, said that his association dealt with legislative and accounting questions and did not cover the same field as the Northwestern, but if the Northwestern should decide to confine itself to Wisconsin, he did not see why the two associations could not be together, and perhaps make a stronger organization. His association had about 25 companies as members, one-third of which were street railways purely; one-third combined street railway and lighting, and one-third purely electric lighting. The matter was laid over for discussion the following day, and in the meantime an informal meeting of the Wisconsin Electric and Interurban Railway Association was held, at which the same matter of possible consolidation was discussed. At this meeting, a committee consisting of Mr. P. H. Korst, of the Janesville Electric Company (a lighting property), and Mr. Irving P. Lord, of the Waupaca Electric Light & Railway Company, were appointed a committee to revise the constitution and make arrangements for consolidation with the Northwestern Electrical Association. The next day when the matter came up for discussion in the Northwestern Association, it was voted to appoint a committee to confer with the Wisconsin Electric and Interurban Railway Association committee and to report at the next meeting. This meeting is to be, if possible, a joint meeting of the two associations, and the committees are expected to recommend some plan to merge the two associations. A committee consisting of Mr. John S. Allen, of Lake Geneva, and Mr. W. B. Voth, of Sheboygan, was appointed. It was also voted that the sense of the meeting was that the organization be not limited to Wisconsin.

A communication was received from the secretary of the railroad commission of Wisconsin, submitting a tentative classification of accounts upon which the commission wished to receive suggestions and expressing a desire to meet with a committee of the association as soon as the January hearings of the commission are over. Mr. B. L. Parker, of Green Bay, Wis., president of the Wisconsin Electric & Interurban Railway Association, and Mr. C. C. Smith, secretary of the association, spoke in reference to the accounting system matter and favored having committees for representing the associations before the commission. It was decided to leave the matter of a committee to co-operate with the railway commission with the officers of the two associations. A question was brought up by a member as to what advantages, if any, were to be derived by a Wisconsin public service company in giving up its franchise and putting itself under the care of the state commission by operating under an indeterminate permit. This question was discussed at some length both in this session and in a later one. The principal immediate, tangible advantage stated was that a company operating under an indeterminate permit is assured against unfair or unreasonable competition, as no competing plant can be established in the same town without a careful investigation by the railroad commission and a decision that the existing company is not able or willing to properly serve the community.

At the opening of the Wednesday afternoon session, the convention listened to a paper by Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, on "Depreciation." This was discussed by Messrs. W. B. Jackson, R. N. Kimball, P. H. Korst and J. H. Harding. This is a matter of special interest at this time because of the valuation of Wisconsin properties being made by the Wisconsin commission. After this discussion, Mr. Errett L. Callahan, of the General Electric Company, presented a paper on "Central-station Load That Pays," in which he took up heating devices. This was discussed by Messrs. J. R. Cravath, of Chicago; J. H. Harding, of La Porte; P. H. Korst, of Janesville; E. F. Strong, of Chaska, Wis.; Ludwig Kemper, of Albert Lea, Minn.; and W. B. Jackson, of Chicago. Mr. W. R. Putnam, of Red Wing, Minn., chairman of the meeting, presented his paper on "The Public's Debt to the Public Service Corporation," which opened up a discussion on the matter of general treatment of the public and complaints. Mr. Neal Brown, of Wausaw, addressed the convention by request on the "Public Utilities Bill." It was announced that the Wisconsin Electric & Interurban Railway Association had appointed the following committee on accounting: H. D. Smith, of Appleton; B. G. Brood, of Sheboygan; and P. H. Korst, of Janesville. The chairman appointed a similar committee from the Northwestern Association to consist of C. N. Duffy, of Milwaukee; B. W. Lyon, of Beloit; and R. N. Kimball, of Kenosha. Thursday morning the convention took up a paper by J. L. Hecht, of the North Shore Electric Company, Chicago, entitled "Steam Notes on a Turbine Plant," which was a very clear, simple explanation of some of the fundamental thermodynamic principles underlying the steam turbine. Mr. C. W. Pendell, of the same company, presented a paper entitled "Electric Notes on Small Steam Turbine Plants." Both these papers received a good discussion. The convention then adjourned to visit the Public Service Building, which is undoubtedly the most complete thing of the kind in the United States. In the basement is a plant supplying exhaust steam heating in the down-town district during the winter season from three 1500-kw steam turbines. These steam turbines drive alternators which operate motor-generator sets feeding into the direct-current, three-wire network in the down-town district. Steam turbines were used to get the necessary capacity in the limited basement space. Steam is supplied from 5000-hp Edgemore boilers without steam drums, as the headroom in the basement is not sufficient to permit steam drums being used. The operation has been entirely satisfactory. Other things of interest about the building which were visited were the lighting department, storage rooms, display and sales room, physical and chemical testing laboratories, meter testing department, auditorium, company surgeon's office and operating room, general offices, printing office, machine shop, interurban waiting-room and interurban car house and car storage.

On Thursday Mr. Irving P. Lord, of Waupaca, read a brief paper on "Electric Lighting in Villages of 3000 People and Under." This met with considerable discussion and was followed by a paper by Mr. F. L. Kaufman, of Beloit, on "Recent Developments in Single-Phase, Variable-Speed Motors." After the discussion on this paper, several questions from the question box were taken up.

The election of officers resulted as follows: President, P. H. Korst, of Janesville, Wis.; first vice-president, Mr. John Wright, of Antigo, Wis.; second vice-president, Mr. John S. Allen, of Lake Geneva, Wis.; secretary and treasurer, Roger N. Kimball, of Kenosha, Wis. Directors: Messrs. John H. Harding, La Porte; P. V. Elevier, Superior, Wis.; Mr. L. L. Tessier, Depere, Wis.

Mr. P. H. Korst, the new president of the Northwestern Electrical Association, was one of the charter members of that association and has always been a faithful worker in the association's ranks. He was born 45 years ago at Chillicothe, Ohio. After leaving high school in 1880, he engaged in telephone work, and later became an arc expert for the Wood arc system. He took the Thomson-Houston factory expert course in 1888, after which he became manager and secretary of the Badger Electric Company at Racine, Wis. He remained at Racine 11 years until the sale of the property to the Milwaukee system. For eight years he has been manager of the Janesville Electric Company, which has been built up into one of the finest small properties of the state, having three water power plants and a large power business. Under the new arrangement the president of the association is responsible for the programme of the convention at which he presides. Mr. Korst's well-known ability to carry out, thoroughly and faithfully, work falling to his lot, gives the members of the association the assurance that next year's convention will be a notable one. The association is especially in need of careful piloting at this time when the matter of consolidation with the Wisconsin Electric and Interurban Railway Association is under consideration, and it is desired to make the association more effective in Wisconsin without lessening its value to members outside of Wisconsin.

PRES. P. H. KORST.

Chinese Telephony.

Advices to Washington state that the subscribers to the telephone system in Peking are now about 1700, and the demand for connections is more than the administration can keep pace with. At least 100 new subscribers were awaiting the installation of service.

Dinner to Messrs. Charles Kirchhoff, T. C. Martin and Rev. Percy S. Grant.

As a recognition of the honor of the bestowal by the French Government of the decoration of *Officier de l'Instruction Publique* on Mr. Charles Kirchhoff, editor of *Iron Age;* Mr. T. Commerford Martin, editor of Electrical World; and Rev. Percy Stickney Grant, rector of the Church of Ascension, New York City, all of whom are members of its Board of Direction, the American Museum of Safety Devices gave a dinner at the Aldine Club, New York, on January 15. Hon. Elbert H. Gary, of the United States Steel Corporation, presided at the dinner, for which more than 200 covers were laid.

Following the speech of presentation by Mr. John La Farge, the artist, on behalf of the acting French Consul General, M. Bonzon, the several guests of honor were introduced to the assemblage. In each case the sponsor for the guest was one who had known him throughout his whole professional life.

The introduction of Mr. Kirchhoff was assigned to Mr. Wm B. Dickson, vice-president of the United States Steel Corporation, who remarked that to all men connected with the production and utilization of iron in any form, Mr. Kirchhoff needed no introduction, because he had been a foremost figure in the iron industry for many years, and had been editor of the leading paper in its field for more than 30 years.

Mr. Frank J. Sprague outlined the career of Mr. Martin from the days of his association with Mr. Edison in 1877-1879. through his presidency of the American Institute of Electrical Engineers, of the New York Electrical Society, and of the Engineers' Club of New York, and commented upon his great influence during his 25 years of service as editor of the Electrical World.

Bishop Henry C. Potter in introducing Rev. Percy Stickney Grant pointed to the excellent work for humanity that is now being done by the ministers who appreciate the existing conditions of mankind under modern social and industrial influences, and stated the Rev. Grant has always been a leader in such work.

What otherwise would have been the difficult task of replying to an embarrassing introduction was appropriately turned by each honor guest into a delightful privilege of calling attention to the work assumed by the American Museum of Safety Devices of educating the employer to place more value upon the lives of his employees.

The concluding speech was made by Dr. Josiah Strong, president of the American Institute of Social Service, who in a convincing manner told of the enormous and unnecessary loss of life due to the lack of proper recognition of the avoidable risks in our modern industrial life.

A handsome 44-page brochure contained inserted engraved portraits of the several guests of the evening, accompanied by sketches of their professional careers. The greater part of the remaining space is given up to letters of congratulation and compliment. Among the writers of these are Mr. Andrew Carnegie, General Horace Porter and President Hugh Bell, and Past-President Robert A. Hadfield, of the Iron and Steel Institute of Great Britain, who coupled the names of Mr. Kirchhoff and Mr. Martin. Tributes to Mr. Martin alone appear from Mr. Gugliemo Marconi, Prof. W. E. Ayrton of London, Prof. André Blondel of Paris, and Dr. Wilhelm von Siemens of Berlin. Tributes to Rev. Mr. Grant were offered by Bishop Potter, President Eliot of Harvard, Mr. Richard Watson Gilder and Rev. George Hodges, and Mr. Robert Underwood Johnson contributed a poem in his honor, which was printed in fac-simile.

The final pages of the pamphlet are devoted to an account of the organization and work of the American Museum of Safety Devices and Industrial Hygiene, and announcements of prizes as follows: A gold medal annually for the best device for protecting life and limb; a gold medal, limited to the field of motor vehicles and motor boats; a prize of $100 for the best essay on "The Economic Waste Due to Occupational Diseases"; a prize of $100 for the best essay on "Economic Waste Due to Accidents." Several days after the dinner Mr. S. C. Dunham, president of the Travelers' Insurance Company of Hartford, who was a guest at the dinner, announced on behalf of his company, the offer of a gold medal, the conditions of award to be left to the council of the Museum.

Westinghouse Readjustment Plan.

The committee of creditors of the Westinghouse Electric & Manufacturing Company, consisting of James N. Jarvie, chairman, New York City; A. G. Becker, Chicago, Ill.; Richard Dalafield, New York City; Charles A. Moore, New York City; Neal Rantoul, Boston, Mass.; F. H. Skelding, Pittsburg, Pa.; and Albert Wiggin, New York City, representing holders of a large amount of the debt of the Westinghouse company, completed this week plans for the readjustment of the company's debt. The report of the plans announces that, according to the statements of Haskins and Sells, the company's auditors, the present unsecured indebtedness of the company, exclusive of interest, is as follows:

Convertible Sinking Fund, five per cent gold bonds, due Jan. 1, 1931	$18,500,000.00
Five per cent gold debenture certificates, due July 1, 1913	1,969,000.00
Bills payable	9,209,766.21
Accounts payable, about	3,952,843.13
Indebtedness of subsidiary companies, subscriptions to stocks or bonds of subsidiary companies and endorsements of notes of subsidiary companies and other obligations, for which provisions should be made, about	1,368,390.66
Total floating debt, about	$14,531,000.00
Total unsecured debt to be provided for, about	$35,000,000.00

The debt secured by collateral consists of:

Three-year six per cent collateral notes, due Aug. 1, 1910	$6,000,000
Ten-year five per cent collateral notes (French loan), due Oct. 1, 1917, about	2,750,000
Total secured debt, about	$8,750,000

It is proposed to create an issue of $35,000,000 first mortgage and collateral trust five per cent 25 year gold bonds, secured by a first mortgage upon the principal manufacturing plants of the company and by the pledge of the greater part of the company's unpledged stocks and bonds of subsidiary and other companies. Of such issue of bonds an amount not exceeding $20,469,000, face value, is to be convertible at the option of the holder or registered owner, after Jan. 1, 1910, upon such terms and conditions as shall be provided in the deed of trust. The deed of trust will provide for sinking fund payments and will further provide that the collateral notes mentioned above as debt secured by collateral shall be retired at or before maturity, and provision will be made in the deed that, as to any deficiency, holders of collateral notes may share pro rata with the holders of the new bonds in the property covered by the lien of the mortgage. The distribution of the first mortgage and collateral trust bonds at par will be as follows:

For existing convertible bonds (these bonds to be convertible into stock)	$18,500,000
For existing debenture certificates (depositors of certificates to have the right of election as between convertible and non-convertible bonds)	1,969,000
For floating debt, say	14,531,000
Total	$35,000,000

Holders of the three-year six per cent collateral notes of the issue of $6,000,000, maturing Aug. 1, 1910, and also (if they shall so elect) the holders of the issue of 14,000,000 francs of 10-year five per cent collateral notes, due Oct. 1, 1917, are to exchange them for new or modified notes of the same maturity and bearing the same interest, with modified provision for collateral and with the right to participate in the case of deficiency pro rata with the holders of the new bonds in the lien on the property covered by the mortgage, as set forth in the plan and agreement. Unless otherwise determined by the committee, the consummation of the plan is to be conditioned upon subscriptions for the payment of $7,000,000 new capital into the treasury of the company for stock. It is understood that this is being provided.

Telephone Convention in Chicago.

During the current week, in Chicago, at the Coliseum Annex, the International Independent Telephone Association will hold its annual convention, there being prospect of a large attendace, as the meeting is held at the same time as the Electrical Show. During the convention, the following papers will be presented:

"The Independence of the Independents," W. H. Denlinger, Patton, Pa.

"Independent Toll Lines," Albert Parlett, Bristol, Va.

"How to Raise Rates," L. A. Herrick, Freeport, Ill.

"Business Methods in the Telephone Business," C. H. Cheadle, Joliet, Ill.

"The District, State and International Associations," A. C. Lindemuth, Richmond, Ind.

"Best Methods of Enlarging Association Work," Manford Savage, Champaign, Ill.

"Practical Advertising—Boosting the Shield," W. H. Caman, Beatrice, Neb.

"Independent Requirements in Canada," L. Page Wilson, Toronto, Canada.

"Where the Money Comes From," Chas. West, Allentown, Pa.

"Depreciation of Telephone Properties as Compared with Other Public Utility Corporations," Geo. S. Shanklin, Lexington, Ky.

"Financing Methods to Meet Modern Requirements," L. W. Stanton, Cleveland, Ohio.

"Equitable Charges for Telephone Service," W. H. Crumb, Chicago, Ill.

"The Business End of the Business," James H. Shoemaker, Waterloo, Ia.

"What is Your Telephone Directory Worth?" W. A. Wadsworth, Chicago, Ill.

"Telephone Investments—Quit Knocking—Boost!" Max Koehler, St. Louis, Mo.

"Combating the Sub-License Company," Frank L. Beam, Columbus, Ohio.

"How the State Directory Helps Business," R. E. Mattison, Lincoln, Neb.

"Telephone Directories," C. B. Johnston, Columbus, Ohio.

"All Cable Plant—Reducing Cost of Maintenance," J. K. Johnston, Sandusky, Ohio.

"Economy in Perfect Company Organization," F. D. Houck, Harrisburg, Pa.

"Solution of the Telephone Situation," R. Max Eaton, Niagara Falls, N. Y.

"The Bankers' Opinion of Securities," E. H. Moulton, Minneapolis, Minn.

"Toll Line Advertising," J. B. Earle, Waco, Tex.

"Aerial and Underground Construction," C. H. Judson, Seattle, Wash.

"Winning Home Support in New Fields," T. S. Lane, Butte, Mont.

"The Mistake of Giving Free Toll Service," Frank E. Ebersole, Portland, Maine.

"The Situation in the South Atlantic States—The Reason," E. S. Moorer, Anderson, S. C.

"Relation of Cost of Service to Quality," John E. Casey, St. Louis, Mo.

"Telegraphing Over Telephone Wires—Money-Making Possibilities," C. Y. McVey, Cleveland, Ohio.

"Electrolysis—Cost and Prevention," C. H. Ledlie, St. Louis.

"Joint Occupation of Pole Lines," C. E. Tarte, Grand Rapids, Mich.

"Hotel Branch Exchanges," A. H. Cowie, Syracuse, N. Y.

"Slot Machines and Pay Station Signs," O. F. French, Winnipeg, Man., Can.

"Why the National Grange Favors Competition," Geo. W. F. Gaunt, Mullica, N. J.

During the convention, various important aspects of independent policy will also be discussed.

Westinghouse Company to Operate N. Y., N. H. & H. Electric Equipment.

On Wednesday morning of last week, Jan. 15, the Westinghouse Electric & Manufacturing Company placed its own men in charge of the operation of the New York, New Haven & Hartford Railroad's electrical equipment on the New York Division, extending from Woodlawn to a point 1½ miles beyond Stamford, Conn., a distance of 32 miles. In a statement issued from the offices of the Westinghouse company, it is pointed out that this does not mean that the railroad has raised any serious objection to the working equipment. The relations of the two companies were stated to be entirely harmonious, and it was at the request of the New Haven's executives that the Westinghouse Company furnished experts to assist their employees in overcoming the minor conditions of operation that have been encountered. It was denied that any serious defect exists in the equipment, and asserted that no complaints of an official nature have been made to the effect that in actual operation the equipment has not met the requirements of the contract. President Mellen authorized the statement that ever since the installation of the electric service on the New York Division of the New Haven system, the Westinghouse company has had supervision of its operation and maintenance and would continue such supervision. It has been reported that this action means that an agreement has been reached between the purchaser and the manufacturer whereby a demonstration will be made for the purpose of securing a final basis for financial settlement, this demonstration to extend over a period of six months. No official utterance, however, in support of this view of the operating arrangement has been made.

Objections to the Wireless Convention.

Last week, at Washington, Mr. John W. Griggs, counsel for the Marconi Wireless Telegraph Company submitted before the Senate Committee on Foreign Relations, a memorandum of objections of the company to the confirmation of the Berlin international wireless convention of 1906. The document says, in part:

"The convention makes it obligatory upon private enterprises like the Marconi Company to exchange wireless telegrams with all other ships and stations without distinction of wireless telegraph systems adopted by such ships or stations, and without regard to whether any business or commercial arrangement of interchange of traffic has been made or not.

"The arrangement thus proposed represents an enforced partnership to which the Marconi companies contribute everything and the German manufacturers of wireless apparatus nothing, neither invention nor capital, nor skilful enterprise. In short, the German company proposes to obtain artificially, through international legislation, the advantage of the position obtained by the Marconi companies in open competition and by private effort at private expense."

In discussing the matter with a representative of Electrical World, Mr. John Bottomley, secretary of the company, said: "There are inherent faults in the regulations. They were drawn up by a group of army and navy men, and, to my mind, they do not seem impartial for they bring the government into the field of commercial enterprise, which has always been contrary to governmental policy heretofore. We have spent seven years and a large amount of capital in obtaining our patents and perfecting our organization, both here and abroad, and now the convention comes along and proposes to make us accept messages from any vessel that cares to send them. We are to be compelled to pay land tolls with no guarantee against possible loss, and the regulations offer great inducements for outsiders to manufacture our products and sell them, notwithstanding the fact that our inventions are protected by patent rights. It is proposed to establish but two wave lengths of 300 and 600 meters, thereby rendering certain of our stations useless. The regulations of the convention, besides being unfair, are, under our commercial treaties with the leading foreign powers, unnecessary."

An Investigation of New York Electric Lighting Conditions.

For some time past there has been talk of an investigation of electric lighting conditions in Greater New York, the initiative coming from the Public Service Commission. An effort was made to get the Merchants' Association to move in the matter, but that body has declined to do so, for lack of reason and justification, except in regard to the question of "breakdown connections," upon which point it held that the policy of the New York Edison Company should be more liberal. The Public Service Commission, on the motion of its member, Mr. Milo R. Maltbie, has now taken up the subject, and at an early date will examine into the franchises, property and operations of the New York Edison Company, Brush Electric Illuminating Company, Fleischauer Electric Light & Power Company, United Electric Light & Power Company, West Side Electric Company, Long Acre Electric Light & Power Company, Edison Electric Illuminating Company, Kings County Electric Light & Power Company, Amsterdam Light, Heat & Power Company, Flatbush Gas Company, Westchester Lighting Company, Bronx Gas & Electric Company, New York & Queens Electric Light & Power Company, Queens Borough Gas & Electric Company, Richmond Light & Railroad Company, and also the Consolidated Telegraph & Electrical Subway Company, and Empire City Subway Company, Limited, and any other company engaged in the business of producing and selling electricity for light, heat or power, and having authority to maintain wires, conduits, ducts or other fixtures in, over or under any streets, highways or public places in the city of New York. It will also investigate the subject of rates and the general conditions of service. The resolution, according to an official statement of Mr. A. S. Blackman, counsel to the commission, does not involve an inquiry into the organization and capitalization of the companies. Indeed, the counsel points out that the commission is very limited by the law in its power of inquiry on its own motion or in fixing maximum rates.

In the meantime, Mr. N. F. Brady, vice-president of the New York Edison Company, has addressed a letter to the commission on the subject of break-down or reserve service charges, in which he points out that instantaneous "readiness to serve" and reliability of service are not accomplished without large operating and maintenance costs as well as fixed charges—all of which the private-plant operator desires to have available for himself without paying even the bare expense to which the company is subjected in maintaining the service.

The company has now made a "service rate" irrespective of any current that may be consumed, with the further provision that this charge may be exhausted in the use of current at the best prevailing rate, without additional cost to the consumer. In view of the great importance of this subject, the full memorandum is given below:

"It is understood that break-down connections shall be furnished to any applicant operating a private plant on the following basis:

"(a) A service charge of $30 annually for each kilowatt of installation that under any arrangement of wires, switches or other devices can be connected with the service of the company.

"(b) This does not refer to any installation or part of installation permanently segregated from the private plant and connecting directly with the service of the company. Such installation may be supplied under direct contract at the best rates obtainable by any consumer under like conditions using an equal amount of current.

"(c) In rating the installation each 16-cp standard incandescent lamp should be taken as the equivalent of 50 watts; 8-cp lamps and others of other sizes shall have a proportional rating based on their candle-power; each arc lamp shall be rated at 10—16 candle equivalents; each horse-power at 15 equivalents.

"(d) Within the service charge of $30 annually, the customer may consume electric current at the best rates obtainable in his class, without additional charge.

"(e) In all instances the customer is to provide incandescent lamps for the original installation, and renewals and carbons and trimming, and for the maintenance of any arc lamps. The company assumes no responsibility for the installation.

"(f) Service connections will be carried within the building at the vault or building line, as the company may determine. Meters will be installed at this point. Beyond this point, connections must be provided by the consumer in the usual manner. At or near the plant switchboard a throw-over switch must be installed, insuring absolute electrical separation of the plant and the Edison supply."

Marseilles International Electrical Exhibition.

As has previously been noted in these columns, an International Exhibition of the Applications of Electricity will be held in Marseilles, France, beginning April 19 of next year and continuing until Oct. 31. The city of Marseilles has placed at the disposition of the Exhibition its great park, "Rond Point du Prado," of 60 acres. The park was the site of a very successful French Colonial Exposition in 1906, and contains a "Grand Palais" and other buildings suitable for exposition purposes, which will, however, be supplemented by a number of new structures.

The exhibition, it is said, has the support of the municipality of Marseilles and of the government of the department in which it is situated. The president is the mayor of Marseilles and the two vice-presidents are the chief officials of the Department des Bouches-du-Rhone and the Marseilles Chamber of Commerce. Features of the exhibition will be brilliantly illuminated evening fêtes, with luminous fountains, and a large amusement section. Among the branches to which special attention will be paid are applications to agriculture, to domestic economy, art, etc., these being in addition to the usual departments of electrical engineering that will be largely represented. A particularly large space has been given up to electric traction, and in the department of agriculture applications to irrigation will be made a feature.

The exhibition has established a bureau in New York in the Park Row Building, in charge of M. Paul Diény, commissioner for the United States, who will supply information in detail concerning the exhibition.

New York Electrical Show.

The second annual New York Electrical Show will be held in Madison Square Garden Oct. 3 to Oct. 14 inclusive. It is stated that 60 per cent of the floor space has already been taken, having been sold to proposed exhibitors before the close of the 1907 show.

The directors of Electrical Show Inc. are as follows: Mr. Dudley Farrand, general manager of Public Service Corporation of New Jersey, and president National Electric Light Association; Mr. Arthur Williams, general inspector New York Edison Company and president Illuminating Engineering Society; Mr. W. W. Freeman, vice-president Brooklyn Edison Company; Mr. James R. Strong, president Tucker Electric Construction Company and president National Electrical Contractors' Association; Mr. James C. Young, secretary Madison Square Garden Company; Mr. George F. Parker and Mr. Walter Neumuller.

N. E. L. A. Membership.

Eleven applications from central stations for membership in the National Electric Light Association have been received since the December report, and also 14 applications for individual membership.

CURRENT NEWS AND NOTES.

NOT AUTHORIZED.—We wish to notify all whom it may concern that W. Tomson Hunt is not in our employ, and that he is not authorized to solicit or accept subscriptions, or to collect money for this journal.

NAVY YARD WIRELESS.—The chief electrician of the Brooklyn Navy Yard has received four complete sets of the Poulsen wireless apparatus, and later on various experiments are to be made with them.

SUFFICIENTLY CONCENTRATED.—In a recent speech, Secretary of War Taft, discussing adversely the proposition of government ownership, said: "Think what would happen if all those vast powers which would go with government ownership were put in the hands of a few men at Washington. Lord knows the powers are sufficiently concentrated there now."

A MOVING ELECTRIC SIGN.—A very effective advertisement seen running about the streets of Chicago during the Electrical Show was an automobile delivery wagon with an electric sign occupying the full area of each side with the words "Electric Show at Coliseum." The effect of this wagon going along a street at night was startling, even to the most hardened city resident, who is supposed to have become accustomed to all sorts of unusual sights and sounds.

AUTOMATIC SYNCHRONIZER.—A patent issued Jan. 14 to Prof. Morgan Brooks and Mr. M. K. Akers relates to the method of causing an incoming alternator to drop into "step" with the system automatically by using an impedance coil across the main-line switch. The impedance coils are designed so as never to allow excessive current to be produced in the incoming generator, even at opposition of phase, and yet to permit enough current to synchronize the generator and to maintain it in synchronism.

CONDUIT SYSTEM FOR ELMIRA.—Mr. J. Walter Ackerman, as expert conduit engineer and constructor for Commissioner Buchanan, has submitted to the Common Council of the city of Elmira, N. Y., a report on a project for a municipal electric conduit system. It is the intention to provide conduits throughout the city for the burial of all existing overhead electric wires. It is estimated that a system containing about 382,000 duct-feet and 150 standard manholes will cost $80,000. The rental for duct space at 5 cts. per duct-foot per year for about 50 per cent of the total system would amount to $9,550 per year.

RAILWAY OPERATING MEN'S ASSOCIATION.—The executive committee of the American Street & Interurban Railway Association will consider at a meeting to be held Jan. 30 the organization of a fourth association to be affiliated with the parent body. The object is to bring together in an affiliated organization general managers, managers, passenger agents, advertising managers, superintendents and other operating officials for the consideration of problems of interest to those engaged in the actual operation of street and interurban railway properties. The exact name of the new association will be determined at the organization meeting.

A TELHARMONIUM VISIT.—On Saturday, Jan. 18, the Pratt Electrical Association, composed of members of the senior class in applied electricity at Pratt Institute, Brooklyn, N. Y., paid an interesting visit to the first central station of the Cahill Telharmonic Company, at Thirty-ninth Street and Broadway, New York City. The dynamo room, with its 145 alternating-current generators, the transformer room, the new piano-key switchboard, and the oscillograph photographs, showing the various sine waves, fundamentals, harmonies, etc., which are mixed in the transformers to produce the desired tones, came in for a due share of attention. A programme of music was also rendered with experiments.

GERMAN WIRELESS REGULATION.—A bill to organize the business of wireless telegraphy in accordance with the decisions reached by the International Commission which sat in Berlin in 1903, and the International Congress which was held in 1906, was introduced in the Reichstag on Jan. 21 by the minister of posts and telegraphs. The fundamental principle of the measure is to compel navigation companies, as well as the owners of land wireless telegraphy stations, to arrange for intercommunication without regard to the system used; otherwise permission for the erection of stations for the use of wireless telegraphy on board of ships will not be given. The minister said that the enactment was intended to give the fullest scope to all systems.

TRANSATLANTIC WIRELESS.—Plans are under consideration by the Marconi Wireless Company for the opening of a new transatlantic station in the near future. As yet no definite steps have been taken in the matter, but vice-president Bottomley announces that it is intended to build the new station at some point along the coast or in the vicinity of New York City. Mr. Bottomley states that the experimental station at Glace Bay, Nova Scotia, which has been transmitting and receiving transatlantic messages since last October, has proved successful beyond all expectations, averaging between 5000 and 6000 words daily. A large part of the business has been newspaper dispatches, but numerous private messages have been sent, and the steady increase of the business will shortly necessitate operating the station day and night.

STEAM RAILWAYS IN BOSTON.—In the annual report of the Massachusetts Railroad Commissioners the remark is made: "The source to which the public may rightfully look for final relief from the smoke nuisance is the use of electricity as a motive power and the abandonment of steam locomotives. The recent successful installation of electricity on railroads in this country and in foreign countries has removed all doubt as to the practicability of its use for the transportation of passengers. There only remains for demonstration the type to be installed which will provide the public with a safe and reliable service at the lowest cost obtainable. The time is fast approaching when electricity as a motive power must be installed on railroads operating in and about Boston, at least, and to that end the work of preliminary investigation should be consummated, that the situation may eventually be met with intelligence and despatch. We therefore recommend further that studies be prosecuted and completed at the earliest possible date relative to the whole question of electric installation."

ILLUMINATING ENGINEERING.—The January meeting of the Chicago Section of the Illuminating Engineering Society was held at the Coliseum Electrical Show, in Chicago, Jan. 17. Chairman George C. Keech presided. The subject of the meeting was "The Gas and Electric Lighting of Apartments and Small Houses." The discussion was opened by Mr. George H. Jones, of the Commonwealth Edison Company, who read a description of the electrical features of the "House Electrical," which his company had erected in the Electrical Show to furnish to the public examples of electric lighting and the use of other electrical appliances. The discussion was taken part in by Messrs. Albert Scheible, E. W. Lloyd, W. R. Bonham, J. R. Cravath, G. H. Stickney, Ludwig Kemper, J. M. Strasser, W. R. Putnam, H. V. von Holst, C. R. Gilman, C. A. Howe, and others. Members of the Northwestern Electrical Association who were visiting the Electrical Show on that day, were invited to the meeting. The election of officers for the section for 1908 resulted as follows: Chairman, Mr. J. R. Cravath, of the Electrical World; secretary, Mr. George H. Jones, of the Commonwealth Edison Company; managers, Mr. Frederick J. Pearson, electrical engineer of Marshall Field & Company, and Mr. H. V. von Holst, architect.

ELECTRICAL PATENTS.—U. S. Consul-General Richard Guenther sends from Frankfort some statistics prepared by a German publication showing that about 5000 electro-technical patents were taken out in various countries in 1906. The United States is credited with 2050, United Kingdom and colonies with 750, Germany 700, France 400, Austria 200, Italy 180, Hungary 130, and Switzerland with 120.

DETROIT CAR FARES.—At Detroit, Mich., Mayor Thompson, in his message to the Common Council, referring to the early expiration of many street railway franchises there, declared the roads can obtain "no new lease of life except upon the fundamental basis of 3-cent fares for all the people all the time," the latter clause referring to the present plan of cheap tickets for workingmen for certain hours of the day.

TELEPHONY IN SOUTH DAKOTA.—At a recent meeting of the South Dakota Telephone Association, at Mitchell, S. D., Secretary Buck presented a report and gave the statistics of the telephone business of the state as between the Bell and the independent companies. The Bell people, he stated, have approximately 400 miles of toll lines in the state, valued at $100,000; they have 17 exchanges, with 3764 phones installed, valued at $282,300. The independent companies own and operate between 6000 and 7000 miles of toll lines, valued at $1,000,000, with 405 exchanges with 32,000 phones installed and valued at $1,900,000.

STOCK TICKER SYSTEM.—A patent has been issued to Mr. John C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, on an improvement in stock-ticker systems. The purpose of the invention is to provide means whereby the transmitter of a stock-ticker system in one city or locality may operate a similar system in another city or locality, the two systems being connected by a single line. The usual local transmitting and translating devices are employed, in combination with polar and neutral relays, which relays regulate the electrical impulses transmitted to the line as to sequence, duration, etc. As the impulses are received they are differentiated by means of similar instruments, thus causing the receiving instruments to perform their various operations.

PROTECTIVE TARIFF LEAGUE.—At the annual meeting in New York City last week, resolutions condemning the German Tariff Trade Agreement were adopted by the American Protective Tariff League. They declared it injurious to American labor, unfair to the honest American importer who buys in the foreign market and makes entry at the price he is compelled to pay, demoralizing to the customs service generally, and in effect a material and indiscriminate reduction in the tariff which should be made only after hearings granted, and then by the legislative branch of the government. The legality of the greater part of the agreement was also called in question and the opinion was expressed that the courts would hold it void. These officers were elected: President, Charles A. Moore; first vice-president, William F. Draper; second vice-president, John E. Reyburn; treasurer and general secretary, Wilbur F. Wakeman. Board of Managers: John Hopewell, Massachusetts; Charles Cheney, Connecticut; William F. Draper, Massachusetts; A. D. Juilliard, New York; Theodore H. Ives, New York; and Joseph R. Grundy, Pennsylvania.

WIRELESS IN CANADA.—The Dominion Government has been spending a large amount of money on the Pacific Coast in improving the telephone systems and installing wireless telegraphic systems so that in a short time all the principal points will be connected by some means of communication, proving a great and valuable aid to navigation. After completing the laying of the telephone lines between Union Bay and Dennan Island, Horby and Dennan Island, and Beaver Point, Salt Spring Island and Pender Island, the public works tug Petrel has returned to Victoria, British Columbia. During the work several miles of sea cable was laid, making the task of connecting the above islands comparatively easy work. The wireless telegraph system recently installed is proving successful in communicating with overland stations which, at first, seemed doubtful. It was expected that Pachena and Victoria would have to talk through the United States station at Tatooshe, owing to the mountain intervening. This has not been the case, however, as communication has been regularly carried on between the two stations. A new and unexpected record was recently made when the operator at Victoria picked up a message from the steamer Portland which was waiting for tide in Seymour Narrows. This message crossed a high range of mountains.

TECHNICAL TRADE EDUCATION.—In a recent public utterance Mr. Richard T. Crane, president of the Crane Company, Chicago, attacked modern technical education, stating that Mr. Andrew Carnegie might as well have thrown in a lake the millions of dollars with which he built and endowed the Carnegie Technical Schools in Pittsburg. Mr. Carnegie has made public the following pleasant and pretty reply addressed to Mr. Crane: "I have little time to devote to the defense of technical education. I do not think it needs any. It is speaking for itself, and will speak for itself, and even you will be satisfied by and by that we are on the right path. You asked me four questions. To the first I answer that when I started in business I did not know of one technically educated mechanic, but several families in Pittsburg were sending their young men to Troy, and especially to Boston. One of them happened to be a near relative, and he has made a great success, and is a partner now in one of the leading firms for special steels. I do not believe that he would have achieved this so rapidly had it not been for his superior education. If I were in business to-day the young man whom I would take into my service would be the most highly educated mechanic. This answers all four of your questions, and I should like to ask you one in return. The apprenticeship system is a thing of the past. What do you propose as a substitute? The best one, and the one better than the original, is to give instructions to young men in technical schools."

RAMSAY ON RADIUM.—In his recent Royal Society of Arts address on "A Radio-Active Gas," Sir William Ramsay gave some forcible illustrations of power of the wonderful substance called radium. Twelve grains of radium, he said, emitted enough heat to evaporate a pound of water every hour. A ton would boil away 200 pounds of water every hour, and would serve as efficient fuel to warm a house, do all the cooking, and afford plenty of hot baths for a large family, not only during their own lives, but would continue to perform these useful functions for about 20 generations without falling off. "One grain of radium," he said, "emits each hour enough heat to raise a grain of water through 100 degrees, and one grain of emanation enough to melt a grain of ice." Radium emanation changes into helium and "something else," and if dissolved in water it decomposes the water into oxygen and hydrogen. On removing the oxygen and hydrogen there is left neon, another of the inactive atmospheric gases which Sir William Ramsay and Dr. Travers discovered. Similarly radium in the presence of copper produced lithium, potassium, and sodium. Sir William, therefore, suggested that it seemed we were in the presence of the transmutation of copper into a lower element than itself. "It is probable, though not proved," he said, "that the element sodium is also a transmutation product of copper, because the residue, obtained by evaporating the copper solution, deprived of copper which had been treated with emanation is more than twice as heavy as that obtained from untreated copper sulphate." It was too early, however, he added, to propound any satisfactory theory "as to the relationship which undoubtedly exists between the properties of the atomic weights of the bodies which we have been accustomed to term elements."

New Turbine Station of the Fall River Electric Light Company.

A NEW steam turbine power plant has just been placed in service by the Fall River Electric Light Company. The station is one of the most modern in New England, and supersedes a reciprocating-engine plant, which has been in service for many years. The power house is located on the east bank of the Taunton River, at the foot of Hathaway Street, and projecting into the river is a masonry wharf 205 ft. long by 105 ft. wide so that coal may be delivered by boat.

The present new station equipment consists of the following principal apparatus: Four 350-hp Babcock & Wilcox boilers; one 500-kw Curtis turbine; two 1000-kw Curtis turbines; one Green fuel economizer; one brick stack, 10 ft. inside diameter, 145 ft. high; one induced draft fan, 11 ft. in diameter, 5 ft. wide; three sets of Wheeler condensing apparatus; one 2300-volt switchboard of General Electric design, one 2000-hp Wainwright feed-water heater; two Knowles duplex plunger feed-water pumps fitted with feed pump regulators; two Worthington duplex plunger oil pumps; two Turner oil filters with a filter rating of 12 gals. per minute; one emergency motor-driven oil pump; one 35-kw marine-type engine exciter set and one 35-kw motor-generator exciter set.

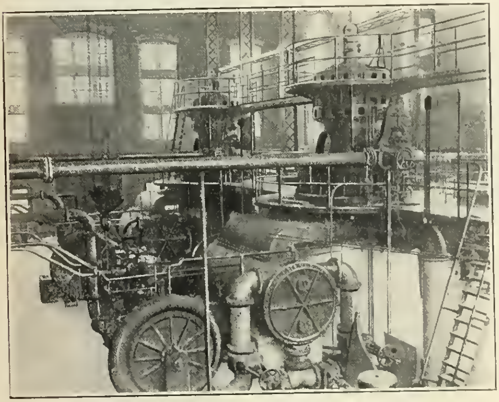

FIG. 1.—CONDENSER EQUIPMENT FOR 1000-KW. TURBINE.

The station building is a steel frame structure, having walls of brick, with white terra cotta trimmings, and granite water table and base course. Two of the walls are left unfinished in anticipation of station enlargement. The general design of the station is shown in the accompanying engravings. As at present built, the station is divided into a firing aisle, with space for a future coal pocket overhead; a boiler room with basement, and a turbine room and switchboard gallery section, no basement being beneath the two latter divisions. Most of the auxiliary machinery is located in the turbine room, where it is constantly under the observation of the operating engineers. Ample space for each branch of the station service is provided in the building design. The firing aisles will ultimately be central with respect to the boilers, as it is planned to install a second row opposite the first when the growth of the plant demands it. The main steam header is provided with blank flanges for future boiler connections. Behind the boilers is laid a floor of rolled plates. A concrete floor is laid in front of the boilers, and a similar floor is provided for the feed-water heater, which is located on a platform in the turbine room.

The condensing water conduits, walls above them, intake and discharge outlets, sub-foundations of the turbines, and the exhaust pipe tunnel of the plant are all built of concrete. The building and chimney foundations are also of concrete, and are supported on piles. All weight-carrying footings within the building are also on piles. Condensing water is taken from the Taunton River. The concrete intake tunnel is about 140 ft. long, and the discharge conduit 291 ft. in length. The intake tunnel is provided with an 8-in.-thick hard pine gate 11 ft. wide and 7 ft. high provided with a 12 in. x 12 in. filler gate, the main-gate having cast-iron wedges to force it against the concrete wall face when in closed position. The gate is operated by an S. Morgan Smith gate rigging; the filler gate stem is threaded and extends through upper cross bar and is operated by a hand wheel with collar, so that the gate may be forced down as well as lifted. The screen chamber is 10 ft. wide and 15 ft. 6 ins. high. A 1000-lb. triplex hoist is provided above the screen chamber to facilitate the removal of the screens for cleaning or repairs. After the intake and discharge tunnels enter the building, they are carried beneath the turbine room straight across the building, the inverts being 9.5 ft. below the level of the turbine room floor. Each tunnel is 6.5 ft. high and 7 ft. wide, the capacity being sufficient for the plant when extended beyond the present equipment.

The boilers are set in two batteries of two each. The row of boilers is located 12 ft. away from the 18-in. brick division wall separating the boiler and turbine rooms, leaving plenty of space for the smoke header and economizer. The chimney is located at the other end of the boiler room, but when the plant is extended, the chimney will be centrally located. The chimney is equipped with a baffle plate, which throws half its horizontal cross-section out of service for the present installation reserving it for future additions. The induced draft fan is located close to the chimney, but on the inside of the boiler room wall.

Each boiler contains 3467 sq. ft. of heating surface and a 7 ft. x 8 ft. 6 in. grate. Each boiler is fitted with white enamelled brick fronts and a Babcock & Wilcox superheater, guaranteed to heat the steam at a pressure of 160 lbs. to 470 deg. F. total temperature. The main delivery outlets of the boilers are 8 ins. in diameter. Beneath the grates are installed steel-plate, brick-lined ash hoppers arranged to discharge into hand cars which will be run out of the building when track and cars are later installed.

The smoke header is located directly behind the boilers, the cross-section being 7 ft. 6 ins x 7 ft., and the bottom 7 ft. 6 ins. above the floor. Each boiler discharges directly into the smoke header by a flue 4 ft. long. The header connections are arranged so that the hot gases can be discharged through the economizer to the stack direct or by way of the induced draft fan to the stack direct from the boilers, or through the fan; by division dampers gases from one battery may go through the economizer and those from the other direct, as may be desired. A Locke damper regulator is installed in connection with the dampers at the end of the economizer, at the end of the direct

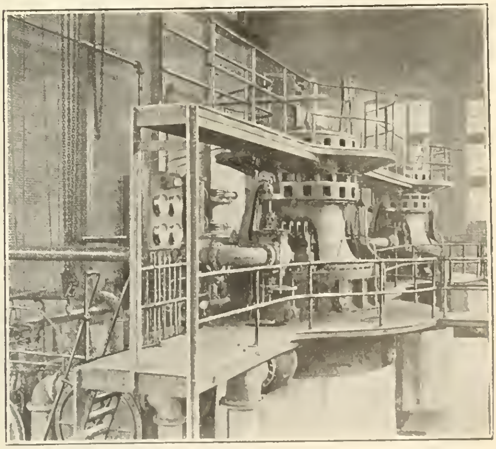

FIG. 2.—1000-KW TURBO-GENERATOR IN FALL RIVER STATION.

flue, and the regulating valve on the fan engine, provision being made for attachment of the regulator chain as desired. These dampers are also arranged to be operated by hand. The economizer contains 8976 sq. ft. of heating surface, the tubes being arranged in 68 sections. The induced draft fan has a special outlet 5 ft. x 7 ft. 4 in., and it is direct-driven by a horizontal center crank engine built for 160 lbs. steam pressure and 25 deg. superheat. The arrangement of the flues for the flexible operation desired presented an unusually difficult problem in iron work. Special ladders are provided to facilitate access to all parts of the flues and economizers. The tube scrapers are driven by two 3-hp back-geared General Electric motors through a Morse chain connecting the back-geared shaft to the economizer drive shaft. A special feature of the economizer installation is a series of soot hoppers, each inclined on three sides and forming the bottom of the economizer clean-out chamber. The hopper slopes toward a bell-mouth, from which a discharge pipe is carried downward to a point about 3 ft. above the boiler-room floor, and is closed by a special slide valve. This arrangement greatly facilitates the removal of soot and dirt from the economizer chamber. A soot chute is also provided beneath each boiler behind the bridge wall and opposite the clean-out door.

The steam piping system is flexible and direct. A 12-in. main header is carried through the boiler room basement. Each 8-in. steam line rises on an angle away from the boiler outlet, clears the boiler by a full sweep and is carried downward to the header. From the header each turbine is supplied by an 8-in. or a 6-in. line, depending on the size of the unit, which is carried by a riser into a horizontal lead running across the turbine room to the generating unit it serves. Each turbine may be supplied with steam from the battery of boilers directly opposite it by closing valves in the main header. A Holly loop system returns all high-pressure drips to the boilers.

For the supply of auxiliaries, a 5-in. main in the boiler room basement parallels the turbine steam main. Four 4-in. cross-connections are provided between the two mains. The fan engine is supplied by a 3-in. connection, and the other auxiliary connections vary in general from 1½ ins. to 3 ins.

Each turbine drives a General Electric 2300-volt, three-phase, 60-cycle alternator, the speed of the 500-kw set being 1800 r. p. m., and of the 1000-kw units 1200 r. p. m. The larger machines have a full-load current of 251 amperes per phase, and the small unit, 126 amperes. Each turbine is capable of withstanding a 75 per cent momentary overload without injury. The maximum excitation of the 500-kw machine is 8 kilowatts at 125 volts; of each 1000-kw unit it is 12 kilowatts with 80 per cent power factor and 25 per cent overload. The guaranteed

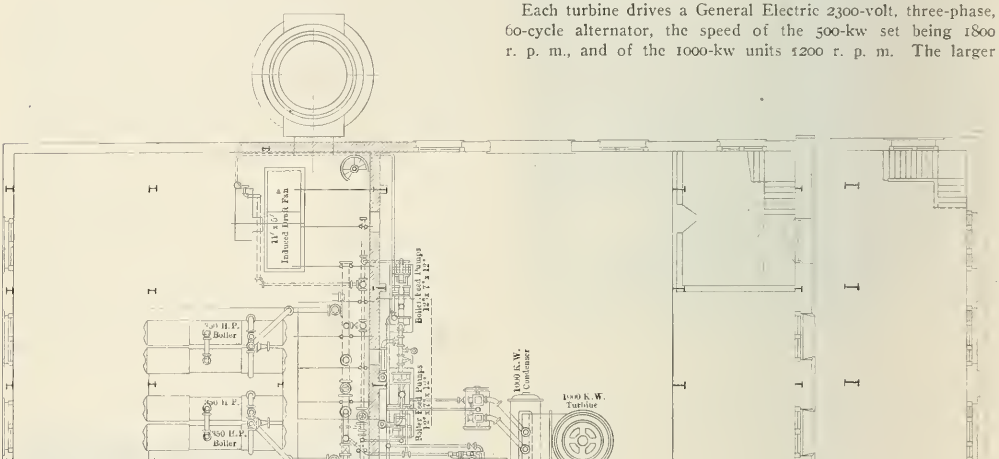

FIG. 3.—PLAN VIEW OF FALL RIVER ELECTRIC LIGHT COMPANY'S POWER HOUSE.

steam consumption in pounds per kw-hour at 150 lbs. pressure and 25 deg. superheat, with not over 2 inches absolute back pressure, is as follows:

	500-kw unit.	100-kw unit.
½ load	22.	21.6
Full load	19.6	19.6
1½ load	20.1	20.1
Variable ½ to 1½ load	21.5	21.1

Two duplex steam-driven oil-pressure Worthington pumps are provided, each pump having capacity for four 1000-kw turbines, using oil at a pressure of 500 to 600 lbs. No accumulators were installed. To guard against any failure of the steam pumps, a motor-driven triplex pump is arranged to start automatically in case the oil pressure drops. The latter pump can also be started by hand and by remote control.

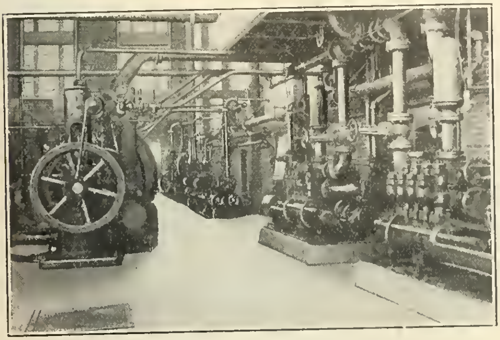
FIG. 4.—FEED WATER PUMPS IN TURBINE ROOM.

The free exhaust arrangements of the Fall River turbines are unusually simple and effective. Beneath the turbine foundations is built a concrete trench which runs across the building, parallel with the boiler room division wall, and which carries a 30-in. pipe leading by two bends to an open end above the roof. The units are arranged to deliver into this trunk line through relief valves in the 16-in. and 12-in. pipes leading downward to the main.

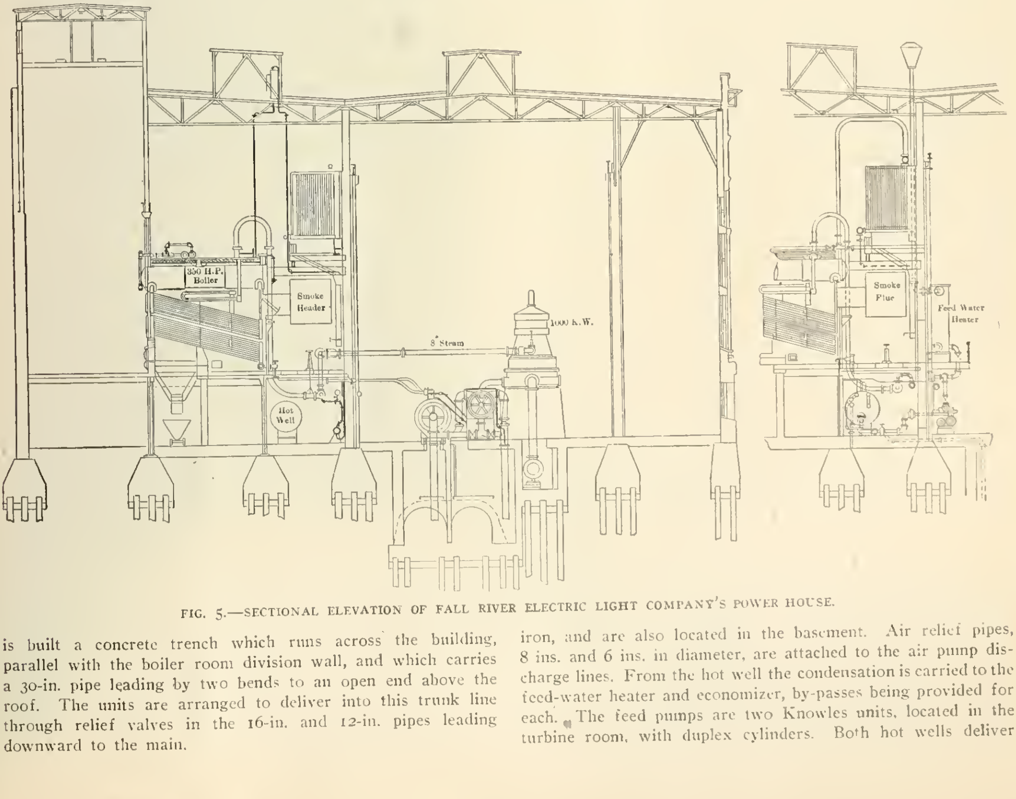

FIG. 5.—SECTIONAL ELEVATION OF FALL RIVER ELECTRIC LIGHT COMPANY'S POWER HOUSE.

Normally each turbine exhausts into a Wheeler counter-current surface condenser of the single-tube type. Cooling surfaces installed are 3600 sq. ft. for each 1000-kw unit and 1800 for the 500-kw unit. The condensed steam of the 500-kw unit is delivered to the hot well piping by an Edwards single air pump, and the condensation of the two larger units is handled by two duplex Edwards air pumps. Double suction pipes are carried from the condensers of the larger unit to the air pumps, and a single line from the 500-kw condenser. No wet or dry vacuum pumps are used, but the air pump discharges are carried into a 6-in. main in the boiler room basement from which connections are made into two hot well tanks, each 5 ft. 6 ins. in diameter and 20 ft. long. These are of wrought iron, and are also located in the basement. Air relief pipes, 8 ins. and 6 ins. in diameter, are attached to the air pump discharge lines. From the hot well the condensation is carried to the feed-water heater and economizer, by-passes being provided for each. The feed pumps are two Knowles units, located in the turbine room, with duplex cylinders. Both hot wells deliver

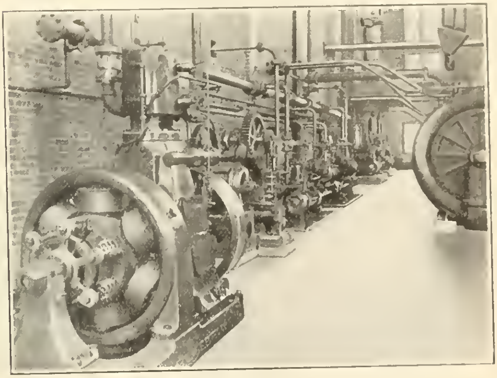
FIG. 6.—EXCITER UNIT AND OIL PUMPS.

feed-water into a 6-in. line which branches to the pumps before delivering to the heater and economizer. Thermometers are installed on the suction side of the feed pumps and on each side of the feed-water heater and economizer. The water flows on the feed pumps with a head of about 3 ft., and the discharge head is 48 ft. to the top of the economizer and across the boilers through a 5-in. loop with 2-in. branches to the boiler units. The boilers are also provided with a 4-in. cold water feed line which extends across the top of each battery, and connects with the city service. The temperature of the hot-well water varies with that of the condensed steam and make-up water.

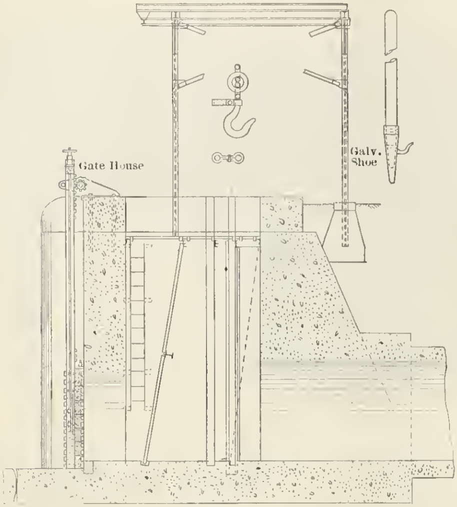

FIG. 7.—INTAKE GATE AND SCREEN CHAMBER FOR CIRCULATING WATER.

Circulating water for the 500-kw condenser is drawn from the intake conduit by an 8-in. Wheeler double-suction centrifugal pump driven by a vertical direct-connected engine. The suction opening is 10 ins. and the discharge 8 ins. Each of the larger units is supplied with circulating water by a similar 12-in. engine-driven centrifugal pump. A special feature of the condenser piping is an arrangement of the supply and discharge lines so that the direction of water circulation in the tubes can be reversed. This cleans from the ends of the tables the refuse that is too small to be stopped by the intake screens. The condensing equipment is guaranteed to maintain a 28-in. vacuum with sea water circulation at not over 70 deg. F., when condensing 10,500 lbs. steam per hour from the 500-kw set and 21,000 lbs. per hour from each of the 1000-kw units.

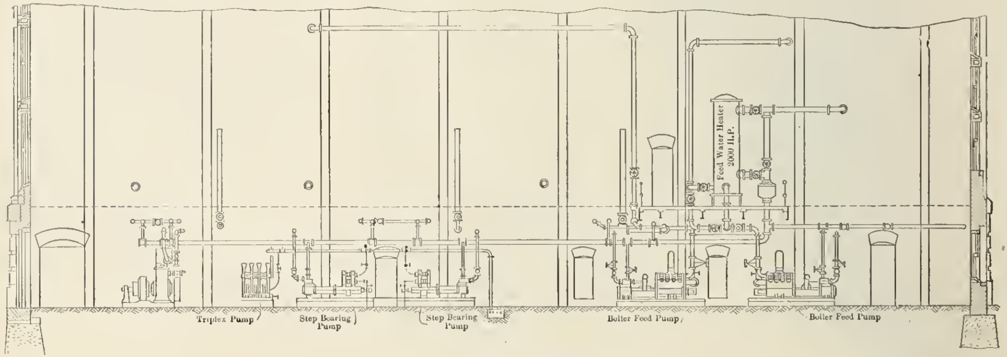

FIG. 8.—ELEVATION OF APPARATUS ALONG TURBINE ROOM WALL.

From each turbine two platforms are run to the next unit, with stairways connecting the upper and lower galleries with each other, the lower gallery to the switchboard gallery and with the floor. The upper gallery is 19 ft. 10 ins. above the floor, and the lower gallery is 11 ft. 4 ins. above the floor. At the 500-kw unit the galleries are 18¼ ft. 9½ ft. above the floor, with stairways between the various levels.

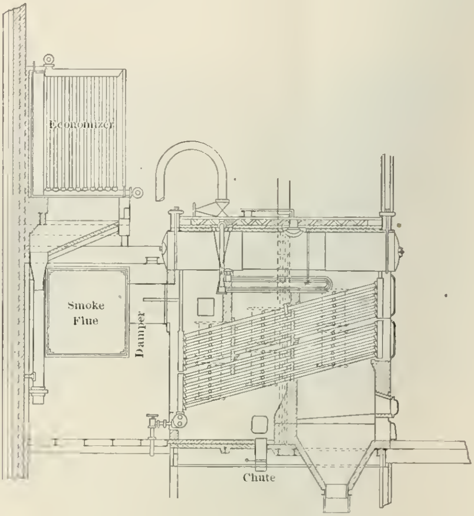

FIG. 9.—ARRANGEMENT OF SOOT CHUTES BELOW ECONOMIZER AND BOILER FURNACES.

The cables from the turbines are carried down to the floor in individual brass piping, and are then run across the plant in 2½-in. fibre conduit to the space below the switchboard gallery, whence they pass to the panel connections above. There is a pull pit between the end of the brass pipe and the beginning of the fibre conduit. Two 35-kw exciters are installed, one being engine-driven and the other motor-driven. The switchboard is carried on a long leaf hard pine timber 17 ft. long, 8 ins. wide, and 6 ins. deep, with beveled edges. This timber is set into the concrete of the gallery adjoining a 1¼-in. slate slab, through which the wire and switch-operating rods pass. Oil-switch framing is carried on similar timber strips and slate slabs are provided for the wire and rods to pass through.

The switchboard is of black Monson slate and consists of two exciter panels, three three-phase generators panels, three blanks for future units, three three-phase outgoing line panels, three blanks, one induction motor and regulator panel, and one station feeder panel. Two sets of bus-bars are provided; connection to either set being made by one of two single-throw switches for each generator and feeder.

In connection with the plant changes, a new distributing sub-station has been built about a mile and a half from the station, near the center of the business district. This sub-station contains a 19-panel switchboard, and the following services are provided at present: Three three-phase, 500-kw incoming lines, three three-unit motor-generator sets, each consisting of a 2300-volt, 450-hp induction motor direct-connected to two 150-kw shunt-wound 120-140-volt generators for three-wire service, five combination lamp and motor feeder circuits, and 14 Edison three-wire circuits. Mr. Edward B. Richardson was engineer in charge of the designing work and Mr. G. G. Shedd was in charge of the construction work as resident engineer for the consulting engineers. The new station and sub-stations were designed by Messrs. Hollis French and Allen Hubbard, consulting engineers of Boston, who received very valuable assistance from the experienced superintendent of the Fall River Electric Light Company, Mr. Harry Bottomley.

Magnetic Leakage in Induction Motors.

By R. E. Hellmund.

In the issue of the Electrical World of Nov. 23, 1907, the writer gave a formula for the leakage coefficient of induction motors. It was mentioned there that the end-connection leakage depends largely upon the style, form and arrangement of the end-connections. It may be well to give a somewhat more detailed account of the various factors which influence the end-connection leakage to any practical extent.

In considering the end-connection leakage, that is, all the fluxes which find a path around the ends of the coils outside of the iron core, one must distinguish between three essentially different kinds of fluxes:

(a) Fluxes which form around each individual coil outside of the slots. In any type of winding the coil coming out of the slot runs over a certain distance separately from any other coil, before it can be bent so as to join with the other coils to form one common bunch. The fluxes formed around the separately running coils are the chief causes establishing the individual coil leakage.

(b) There are fluxes which form around that part of the end-connections at which all or some coils of one phase of each pole run closely together; these fluxes may be called the individual phase-leakage fluxes.

(c) There are fluxes which form around such parts of the end-connections at which several coils of two or more phases run closely together; these fluxes may be called the resultant-phase leakage fluxes.

In the following discussion, consideration will be given to only such factors as so affect these various leakage fluxes that a change of the leakage coefficient—that is, the ratio of the total stationary reactance to the synchronous no-load reactance—is thereby caused. Thus such factors will be considered as influence the leakage fluxes without causing a proportional change in the main flux of the motor.

For any of the above three leakages the following factors must be taken into consideration: (1) The length of the end-connection part around which they form; (2) the resultant current volume of the end-connection part around which they form; (3) the length of the magnetic path around the end-connection part under consideration; (4) the influence of the permeability of magnetic materials through which the fluxes may happen to pass; (5) the influence of reactive currents induced in metallic parts through which the fluxes may happen to pass.

Consider now each of these factors separately. It is obvious that each of the leakage fluxes is the larger the longer the part of the end-connection around which it forms.

The current volume of each particular coil is, of course, directly proportional to the number of turns of the coil, and to the current per turn. If a number of individual coils of the same phase run closely together the current volume increases proportional to the number of coils. If a number of coils of different phases run closely together, the phase relation of the currents in the coils must be taken into consideration also. If, for instance, the current volume of one coil equals v, the effective current volume of two coils of different phases in a two-phase motor is only $\sqrt{2}v$, while the current volume of two coils of the same phase would be equal to $2v$. In a three-phase motor: Current volume of two coils of the same phase $= 2v$; current volume of two coils of two different phases $= v$; current volume of three coils of the same phase $= 3v$; current volume of three coils of three different phases $= 2v$ or 0, depending upon the way the three coils are joined.

The length of the magnetic path around the coils depends upon their active cross-section and upon their form. Considering the influence of the form of the coil, it appears at once from a simple geometrical consideration that for a given section of a coil the path around the coil is the smallest if the coil has a circular section; it is larger for a square section and larger yet for a rectangular section having a long and a short side. Within practical limits the leakage will, therefore, as a rule, be the smaller the flatter the coil is wound, if the flat form may be obtained without increasing the length of the end-connections considerably.

It is obvious that the existence of magnetic material in the path of the leakage fluxes will tend to increase the leakage flux since it decreases the reluctance of a part of the magnetic path. This tendency will, of course, be larger the closer the magnetic material comes to the end-connections and the longer the path through the magnetic material is in comparison with the remaining path through the air.

At any place where the fluxes pass through electrically conductive parts, they will induce currents which counteract the m. m. f. of the end-connections and, therefore, tend to decrease the leakage fluxes. These currents and their reactive effects are, of course, larger the lower the resistance of the parts being passed and the closer the parts are to the end-connections.

In considering the total end-connection leakage, another very important factor must be taken into consideration besides those brought out above; this is the number of coils being used per pole per phase. If the total current volume V of one pole and one phase is carried by n coils, which are separately wound, each coil carries a current volume equal to

$$V \div n$$

If, moreover, the total section of the coils of one pole and one phase is assumed to be S, the section of one coil equals

$$S \div n$$

Moreover, it may be assumed that the coils have a rectangular shape, with one side equal to a and the other equal to ka; then

$$ka^2 = S \div n, \text{ or } a = \sqrt{\frac{S}{kn}}$$

The circumference of each coil is, therefore, proportional to:

$$\sqrt{\frac{S}{kn}}\,(1+k)$$

and the leakage coefficient is proportional to:

$$\frac{V}{n}\sqrt{\frac{nk}{S}}\,\frac{1}{1+k} \text{ or } \frac{V}{\sqrt{n}}\sqrt{\frac{k}{S}}\,\frac{1}{1+k}$$

that means the end-connection leakage coefficient is inversely proportional to the square root of the number of coils running separately. The above, of course, applies exactly only when the form of the coils does not change with the number of coils. In practice this does not always hold, but it may be shown that in almost all practical cases a subdivision of the coils will cause a reduction of the leakage if the subdivision can be accomplished without increasing the length of the end-connections considerably.

Keeping all of the above factors in mind, among others there are found the following constructional and electrical details, which have an influence upon the end-connection leakage, and which should be considered in calculating new designs or altering existing designs:

The style of winding, which influences every one of the above factors. In Figs. 1 to 5 five different styles of three-phase windings are shown. In the following the respective merits of these windings with regard to the various factors will be indicated by the succession in which their numbers are given.

With regard to the length of the end-connections they range as follows: 1, 2, 3, 4, 5, which means the end-connections are the shortest for winding 1 and the longest for winding 5.

The resultant current volume is largely influenced by the style of winding. In three-phase motors with progressive windings, for instance, it happens that the resultant current volume for the longest part of the end-connections is zero, while in undivided concentric windings (Fig. 5) this advantageous action of the combination of the phases does not take place, since there are at no place more than two phases running together. In regard to the advantageous effect of the combination of the phases the five styles of winding range about as follows: 1, 2, 5, 3, 4.

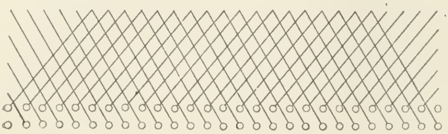

FIG. 1.—PROGRESSIVE WINDING WITH TWO COILS IN EACH SLOT.

Of course, the style of the winding largely influences the form of the coils and consequently the length of the magnetic path around them. It is, however, difficult to decide upon their respective merits, since for some of the windings the form of the coils may be largely varied. The following grouping, however, will be close to facts for most practical cases: 1, 5, 3, 2, 4.

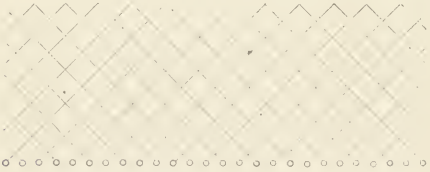

FIG. 2.—PROGRESSIVE WINDING WITH ONE COIL IN EACH SLOT.

The style of winding determines largely how close the end-connections come to metallic parts, magnetic or non-magnetic. The respective merits of the various windings cannot be determined, however, without knowing the mechanical construction of the motor.

It is evident that windings with two coils per slot require a larger number of coils than windings with one coil per slot. Windings with two coils per slot are, therefore, advantageous. Also it is obvious that a divided concentric winding is better than a concentrated winding in this respect. The windings may be grouped as follows in regard to this factor: 1, 5, 2, 3, 4.

FIG. 3.—DIVIDED CONCENTRIC WINDING WITH ONE COIL IN EACH SLOT.

The number of slots per pole per phase has a noticeable influence on the following factors:

The form of the coil section of that part of the end-connections which consists of a number of coils depends largely upon the number of slots per pole per phase. In most practical cases it is flatter the larger the number of slots per pole per phase.

The number of coils per pole per phase is directly proportional to the number of slots per pole per phase.

It follows from the above that the number of slots per pole per phase has quite a considerable influence upon the end-connection leakage.

The size of the slots influences the following factors:

An increase of the slot necessitates an increase in the length of the end-connections.

An increase of the slot requires a larger circumference of the coils.

It is to be noted that the two effects counteract and, therefore, partly or entirely eliminate each other.

The form of the slots influences the following factors:

1. The width of the slots has a certain influence on the length of the end-connections. As a rule, the end-connections are longer the wider the slots.

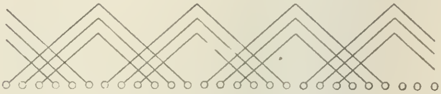

FIG. 4.—CONCENTRATED CONCENTRIC WINDING WITH ONE COIL IN EACH SLOT.

2. The form of the slots determines directly the form of the individual coil coming out of the slot and also to a certain extent that part of the end-connections which is formed by a number of coils.

It follows from the above that a deep and narrow slot is favorable for the end-connection leakage. This may partly or entirely eliminate the unfavorable influence which such a slot has upon the slot leakage.

The form of the bearing brackets and the end plates may, of course, influence most of the factors to a certain degree, since the arrangement of the end-connections in general must be so made as to fit into the bearing brackets. The following factors are especially important, however: The reduction of the reluctance of the leakage path caused by the iron of the bearing brackets and end-plates; the eddy currents produced in the bearing brackets and the end plates, which counteract the leakage flux. Since these factors counteract each other when the bearing brackets and end-plates are made of iron, their influence in one direction or the other may be hardly noticeable. In fact, the writer has repeatedly found that the removal of the bearing brackets had no measurable influence upon the leakage fluxes. In certain constructions, however, where the end-plates were entirely omitted and the end-connections came close to the laminated iron of the core, in which the eddy currents are limited, an increase of the leakage fluxes seemed to be effected thereby.

On the other hand, the use of brass bearing brackets and end-plates will possibly reduce the leakage somewhat, since in this case only the counteracting eddy currents come into consideration. From the fact that eddy currents reduce the leakage, it should not be concluded that their existence is desirable, since the advantage in regard to the leakage is secured only by additional losses in the motor.

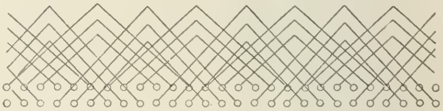

FIG. 5.—CONCENTRATED CONCENTRIC WITH TWO COILS IN EACH SLOT.

Everything said about the influence of the bearing brackets and the end-plates upon the leakage of the stator applies in a similar way to end-plates, coil-supports and band-wires of the rotor.

The distance between the windings of the two members has an influence upon the leakage flux. The larger part of the end-connection leakage fluxes must pass through the space between the primary and secondary end-connections, therefore, the fluxes will necessarily be smaller the shorter the distance between the two windings. In connection with this it should be kept in mind, however, that for mechanical reasons the distance should not be made too small.

The number of phases by which the motor is operated has an influence upon the end-connection leakage. It has been mentioned above that for certain three-phase windings the resultant phase m. m. f. is zero, while that of two-phase windings is always at least $\sqrt{2v}$. It follows, therefore. that the end-connection leakage of two-phase windings is larger than that of certain three-phase windings. The number of phases also influence the size and shape of the coil bunches per phase.

The potential of the motor influences the leakage in so far as the distance between the coils in high-potential windings must be kept large and consequently the end-connections must be long; on account of the thick insulation around the coil in the slot the active section of the coils will be smaller in high-potential motors than in low-potential motors with the same size of slots. For this reason a high-potential motor will tend to have a larger leakage than the same motor wound for low potential.

In looking over this large number of factors, constructional details, etc., it is at once obvious that it is almost impossible to calculate the end-connection leakage by a formula which is exact for all cases and fulfills, moreover, the most important condition of being simple enough for practical use.

The only factor that can be easily determined in practice is the average length of the end-connnections; therefore, this factor may be taken directly into consideration in a formula. For most of the other factors it is impossible, or at least difficult to introduce them exactly into a formula; it is especially evident that it will always be impossible to make correct assumption as to how much of the total length of the end-connections should be taken into consideration for the individual coil-leakage, how much for the individual phase-leakage and how much for the resultant phase-leakage. A further complication is introduced by the fact that the fluxes caused by the resultant phase m. m. f. differs in time-phase from the individual phase and coil leakages. It would also be difficult to determine the length of the magnetic paths around the various parts of the end-connections, and it is entirely impossible to calculate the influence of the metallic parts which come close to the end-connections.

It seems advisable, therefore, to take all the factors except the length of the end-connections into account by one single coefficient, which must be found from tests for each particular line of motors. The only variation in this coefficient which is of practical importance and which occurs in motors of the same general design features is caused by the variation in the number of the slots per pole per phase. Where it is desirable to take this variation into account, the most practical way seems to be to determine the coefficient c_1 for different numbers of slots per pole and record the result in a curve which may be used for future calculations. After such curve, which gives the coefficient c_1 in terms of the number of slots per pole per phase has been found by test, it is, as a rule, not difficult to find an approximate and simple equation for the curve. For concentrated concentric winding and a certain line of motors, the writer has found, for instance, that the following equation gives good results:

$$c_1 = \frac{5.25\sqrt{a}}{a + 3}$$

where a is the number of slots per pole of a three-phase motor and c_1 is the coefficient in the formula given by the writer in the issue mentioned above.

At this place it may be well to make a few remarks in regard to the formula for the leakage coefficient. As is well known, not only the reluctance of the leakage fluxes, but also the reluctance of the main flux path enters as an important factor into any formula for the leakage coefficient; since, however, certain values determining the reluctance of the main flux path have to be calculated anyhow for determining the magnetizing current of the motor, the formula for the leakage coefficient will be the more convenient for the designer the more it is built up upon factors which he has determined for other purposes. In order to facilitate the use of the formula in this respect the following may be stated.

In estimating the reluctance of the air-gap a large degree of uncertainty is unavoidable, because there are no exact facts known in regard to the dispersion of the lines of force at the tooth edges. Consequently, there are about as many ways of taking the dispersion into account as there are designers. For the calculation of the factor ψ, as given by the writer, an approximate way of taking the dispersion has been chosen. (It may be more exact and for most designers more convenient, however, to introduce values found by their own methods.) This may be done easily by making the value

$$\psi = \frac{Q\lambda}{l\lambda} = \frac{Q}{l}$$

where $\lambda =$ the pole pitch of the motor.

$l =$ the total width of the iron cores, and

$Q =$ the active area of the pole face as determined for the calculation of the magnetized current by whatever method is prefered. Frequently the ratio

$$\frac{l\lambda}{Q} = F_a$$

is determined and called the air-gap factor; in this case, it is of course best to set

$$\psi = \frac{\lambda}{F_a}$$

Another uncertainty in the calculation of the reluctance of the air-gap is introduced by the fact that the actual average value of the length of the air-gap is mostly different from the value which is specified on the drawings. It is, therefore, customary to assume in the calculation of the magnetizing current an average value which is different from the specified air-gap by a certain percentage, the amount of which depends upon the method of manufacturing. This same value for the average air-gap should be, of course, introduced into the formula for the leakage coefficient, in which Δ is the average length of the air-gap at one side of the rotor (not the total air-gap).

A New Universal Photometer.

By Clayton H. Sharp and Preston S. Millar.

In the course of our work at the Electrical Testing Laboratories we have felt very keenly the need of a thoroughly reliable and practical portable photometer or illuminometer. For years practically the only instrument on the market which could make serious claims to be a universal photometer, being adapted to measurements both of luminous intensity and of illumination, was the Weber photometer. Using this instrument we have made many tests, and we have been able to render this instrument much more convenient for practical work by making certain changes and additions, but it still left much to be desired. We were led therefore to design the instrument which is here described, and which, embodying features which are demanded by a thorough consideration of the theoretical and practical requirements, has proven itself in actual practice to be a most acceptable apparatus.

In a recent paper before the Illuminating Engineering Society one of us has discussed the general subject of illumination photometers and has pointed out the features which must characterize the ideal photometer, as follows: Sensitive photometric device, reliable comparison light source, the best means for varying the intensity, portability, simplicity of operation, and reasonable cost. For the measurement of illumination, a further requirement is a proper test plate to receive the illumination which is to be measured. This test plate must have a diffusing surface so that its illumination varies with the cosine of the angle of incidence of the light and must be so placed that no portion of the instrument or of the observer obstructs any rays which might fall upon it. These features have all been carefully considered in this photometer. As a sensitive photometric device a modified form of Lummer-Brodhun arrangement has been adopted. The comparison light source is a seasoned incandescent lamp; the means of varying the intensity is varying the distance between the incandescent lamp and the plate on which its light falls; portability is insured by constructing the body of the instrument of wood and keeping down the weight to about eight pounds, and also by minimizing the number of detachable parts; the conditions regarding the test plate are met by using a plate of special glass with the upper surface depolished and so placed that the light can fall on it freely from all directions.

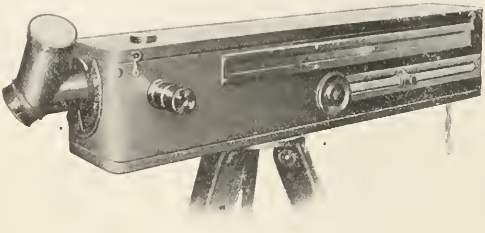

FIG. 1.—GENERAL VIEW OF PHOTOMETER.

A view of the instrument is shown in Fig. 1, and a plan and elevation, showing the interior arrangement, is given in Fig. 2. The body of the instrument is a hardwood box about two feet in length, having a hinged cover so that the entire interior is accessible. On the exterior of the box are found certain parts, the uses of which are more or less obvious. The movable part of this photometer is the comparison lamp, and not the photometric device. The lamp is mounted within a circular metal housing and is carried on a platform arranged to slide in a track lengthwise of the box. The movement is effected by means of an inelastic cord which passes around pulleys and comes to a drum which can be turned by a large external knob. This method of moving the comparison lamp is at once very simple and effective. The friction is even and slight, but still sufficient so that the photometer can be operated in any position. The variable distance method has the great advantage that its indications depend upon a known law, and that consequently a scale can be made from calculation and not as a result of various trials. Moreover, the applicability of the law of inverse squares to the photometer is less liable to question than any other law. The scale from which the indications of the photometer are read, consists of translucent celluloid and is set in a longitudinal opening in the side of the box. In order to prevent external light from having access to the interior of the box, this scale is covered with a long shutter which can be opened by means of an external knob at the rear of the box. To facilitate taking readings in dark places, a hole is cut in the side of the housing carrying the comparison lamp, so that when the shutter over the scale is raised, the light from the lamp falls on the scale and illuminates it brightly, and the pointer, being inside the box, casts a shadow on the brightly lighted scale. This little detail is a very great convenience in the practical operation of the instrument. The light from the comparison lamp falls on a milk glass plate which fills a window in the partition near the end of the box.

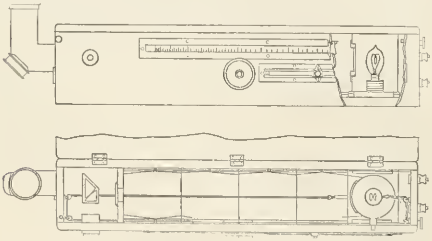

FIG. 2.—SIDE ELEVATION AND PLAN OF PHOTOMETER.

A not uncommon source of error in photometry is due to stray light reflected by portions of the instrument or of its accessories. Surfaces, even though they are blackened as well as possible with a dull black paint, reflect considerable amounts of light when the angle of incidence is large. Evidently the amount of such reflection may vary with the position of the lamp and of the photometer box, thus causing the instrument to indicate falsely. This source of error is particularly liable to be encountered in small enclosed photometers, such as the one here described, and cannot be too carefully guarded against. Even a lining of black velvet is not entirely free from suspicion, and this method of construction is for structural reasons undesirable. In the photometer here described, this difficulty is met by the use of a very simple system of moving screens which are shown in Fig. 2. The screens are of fibre, of such size as practically to fill the box. They have apertures sufficiently large to permit the rays of the lamp to pass unobstructedly, and are supported by two longitudinal brass rods, being attached to each other and to the lamp carriage by light cords. When the comparison lamp advances, its housing pushes the screens successively along ahead of it; and when it recedes, the cords pull the screens one after the other into their original position. The screening system, while affording perfect protection, is so light and simple that it adds insignificantly to the weight or to the complication of the apparatus as a whole.

The photometric device is a modified form of Lummer-Brodhun arrangement. By the addition of another totally reflecting surface, rays from opposite directions are brought to the sight tube. The field has the same form and the photometric device the same high sensibility as the Lummer-Brodhun photometer.

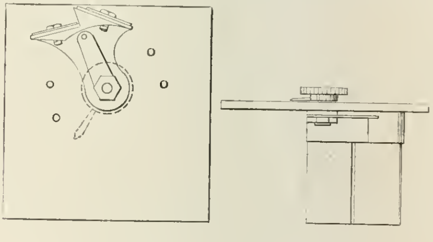

FIG. 3.—DIAGRAM OF SCREEN SYSTEM.

The elbow tube at the end of the box has a number of important functions to perform. It fits friction-tight on a collar fastened in the end of the box, and hence may be turned about a horizontal axis and set at any angle, which angle is indicated on a semi-circular scale on the end of the box. The use of a tube of this description furnishes the simplest means of measuring illumination or light coming from any direction. In the elbow of the tube is fixed a reversible plate, one side being a diffusely reflecting surface used in the measurements of candle-power, and the other a mirror used in connection with a test plate on the end of the tube for measuring illumination. In measuring candle-power, the diffusely reflecting surface is turned toward the inside of the tube, and the end of the elbow tube is open, the tube serving to screen off stray light from the plate. The distance between the plate and the source of light must be known.

The photometer being portable and the elbow tube adjustable to any angle, this arrangement lends itself to determinations of the vertical distribution of luminous intensity of light sources, and is also applicable to the measurement of the candle-power of street lamps, either close at hand or at a considerable distance from the lamps, as has been recommended in the report of the Committee on Street Lamp Specifications to the National Electric Light Association, at its last convention. Evidently the measurement of gas flames and incandescent mantle burners lies also within the scope of the instrument. To measure general illumination, the translucent illumination test plate is slipped onto the end of the tube and the plate at the elbow is reversed, making its mirrored side effective. The illumination on any required plane can then be measured, the light having unobstructed access to the test plate. It has been found that the test plate of translucent glass, ground on its upper surface so that its power of regular reflection is destroyed, is well adapted to the purpose. Its selective absorption, as shown by the results of a spectrophotometric test given in Fig. 4, is for all practical purposes nil, so that no prejudice is done to any source of light by reason of its color. The criterion for the complete diffusion effect of the plate is that its brightness shall vary directly as the cosine of the angle of incidence of the light upon it. The deviation from this law is shown by the curve of Fig. 5. The error so introduced in the measurement of diffuse illumination is ordinarily negligible.

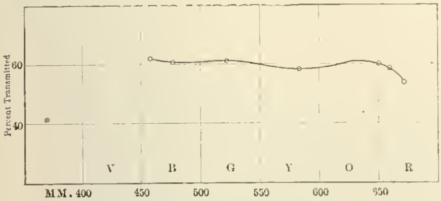

FIG. 4.—CURVE OF SPECTRO-PHOTOMETRIC TEST.

The scale may be an equal-part scale, or a direct-reading scale. It has been found to be most convenient to make the scale direct-reading in foot-candles. The same scale is equally applicable to the measurement of illumination and of candle-power. The foot-candle scale in question has a range from 0.4 to 20 foot-candles. This range can of course be increased considerably by changing the candle-power of the comparison lamp, either by altering its voltage or by using a lamp of different size; but the range given with any one lamp cannot be considered sufficient to meet all the conditions which are present in practical work. It is not, in general, advisable to change the voltage of the comparison lamp, because, first, any alteration of this kind requires the use of an electrical measuring instrument of considerable range, and requires that its error be known over that entire range instead of at a single point; second, increasing the voltage of a lamp above its normal value may cause its candle-power to change too rapidly, while lowering its voltage changes its color to an undesirable reddish hue. The change from one comparison lamp to another is an inconvenient operation. Recourse has been had, therefore, to the use of absorbing screens. Two of such screens are used, one of which transmits substantially 10 per cent of the light falling upon it, while the other transmits only one per cent of the light. These two screens are attached to a movable holder, which is not indicated in Fig. 2, but is shown in detail in Fig. 3. By turning the knurled head, which is exposed when the cover of the photometer box is lifted, either screen may be interposed between the prism and the milk glass window, or between the prism and the elbow tube, or both screens may be turned to such a position that they intercept no light. Evidently when the screens are used, the total range of measurement, with but one comparison lamp, is from 0.004 foot-candle to 2000 foot-candles, within which range all measureable lights and illuminations can be said to fall. It is to be understood, of course, that the coefficient of absorption of these screens must be determined exactly by measurement.

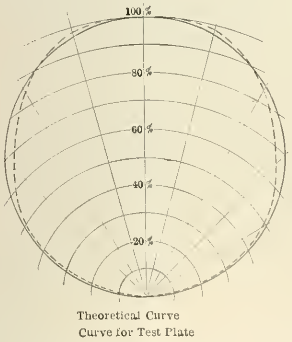

FIG. 5.—CURVE SHOWING ERROR OF TEST PLATE.

In the design of this instrument no endeavor has been made to meet the condition which obtains in most photometers, namely, that the light from the comparison lamp and from the lamp or illumination to be measured shall transverse similar and symmetrical paths, and that any absorption which is suffered by one light must be suffered by the other also. It is considered that this condition is of no importance whatever as long as the photometer is calibrated and used after the substitution method, which is undoubtedly the correct method for all photometric comparisons. The proper method of calibrating the instrument for the measurement of candle-power or illumination is by employing a known candle-power or illumination produced by a standard lamp. The voltage or current of the comparison lamp is adjusted by means of the slider rheostat on the box to such a value that the pointer on the scale indicates the known candle-power or illumination. The instrument then becomes direct reading for candle-power or illumination as the case may be, all effect of lack of symmetry, etc., being eliminated.

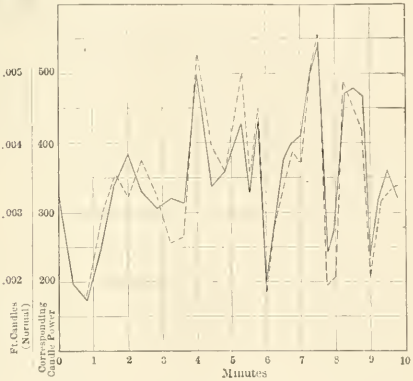

FIG. 6.—CANDLE-POWER CURVES OF ARC LAMP.

As has been said, the performance of the photometer in practice has been found to be very satisfactory. It has been used in widely different classes of work, as for instance, measurement of candle-power of incandescent lamps, laboratory measurements of arc and mercury-vapor lamps, street measurements of the candle-power of arc lamps and of incandescent gas lamps, measurements of illumination in rooms illuminated by incandescent lamps, arc lamps, Moore tube, etc. The choice of photometric device has been found to be an unusually good one, since its sensibility is so high as to enable very quick settings to be made, and it also enables extremely feeble illuminations or candle-power to be measured, such as are met with, for instance, in photometering an arc lamp at a distance of 250 feet. Moreover, the method of varying the distance of the comparison lamps is very convenient and quick, and the scale being illuminated from the inside can be read very quickly, so that a rapidly fluctuating source of light, such as the arc lamp, can be followed, and the amount of fluctuation can be determined. The capabilities of the instrument in this regard are illustrated in Fig. 6, which shows instantaneous values of the candle-power of an arc lamp, as given by simultaneous readings on two of these photometers. When one considers that the changes in the light are very rapid, it will be seen that the agreement between the curves is sufficiently good to indicate that no fictitious quantity was being measured, but that both instruments were measuring as well as could be expected the instantaneous values. As a further test of the accuracy of the instrument, one of them was used to measure the candle-power of incandescent lamps which were at the same time being tested on a standard photometer bar. Taking the indications of the standard photometer as giving the true candle-power of the lamps, the error of the portable photometer was found to be well within the limits allowed in good industrial photometric practice.

When measuring illumination in rooms lighted by incandescent lamps, it is advisable to operate the comparison lamp in the photometer box from the same circuit as supplies the lighting of the room. Thus the effect of variations in voltage is minimized. It has been found that the photometer used in this way yields very satisfactory results, and that readings made at the different stations in a room which is being investigated repeat themselves on re-test, with all required closeness.

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Growth of Electric Service at Memphis.

The Consolidated Gas and Electric Company, of Memphis, Tenn., supplies light and power to a population of about 175,000 people, occupying a territory of 20 sq. miles. Memphis is one of the most rapidly developing cities in the South; it is a commercial center and distributing point of a large agricultural area, and occupies a commanding position on the Mississippi River. In the character of its street railway service it compares favorably with any city of its size in the country that the writer has visited. Although the city is not pre-eminently a manufacturing town, a large power load has been developed by the Consolidated company during the past two or three years, until at the present time the total connected motor horse-power on the company's circuits is about 4500. Of this, 600 horse-power has been acquired since the end of June, 1907.

A single generating plant supplies all the company's customers. The power station is located at Beale and Myrtle Streets, about 1.5 miles from the business center of the city. All the machinery now in the plant is of the direct-connected, engine-driven type, with the exception of a 1500-kw Allis-Chalmers turbo-alternator, which is probably the entering wedge of evolutionary changes in the station development. Pea, nut and slack coal are burned, costing about $1.35 per ton. The calorific value of this coal averages about 11,750 b. t. u. per pound. The coal is mainly secured in western Kentucky, and is delivered to the plant on a spur track of the Southern Railway.

The boiler plant consists of four Aultman & Taylor 400-hp units and six Babcock & Wilcox units of 650 horse-power each, all the furnaces being equipped with the Jones underfeed stoker. Three steel stocks handle the products of combustion in conjunction with the fan equipment of the stoker system. The water supply at the station is drawn from six driven wells 450 ft. deep. There is one 12-in. well, one 8-in. well, two 10-in. and two 6-in. wells, all operated by an air lift supplied by two compressors of 2000 and 1100 cu. ft. per minute capacity each, at from 60 to 65 lbs. pressure. During the peak load both compressors are operated. To assist in maintaining the necessary supply of condensing water during the peak a concrete reservoir has been built outside the station walls and fronting on the street at the office end of the building. This reservoir is open to the air, is about 40 ft. deep and 80 ft. long, with a capacity of 450,000 gals.

In brief, the machinery equipment of the station consists of two 1750-kw Stanley three-phase, 2300-volt, revolving field alternators driven by horizontal cross-compound condensing engines; one 1500-kw Allis-Chalmers turbine, 2300 volts, three-phase, 1800 revolutions per minute; one 1050-kw General Electric 2300-volt generator driven by a McIntosh & Seymour cross-compound engine, and a similar 675-kw unit, with a tandem-compound engine. The Stanley machines are driven by Allis and Green-Wheelock engines. Jet condensers are used on all the engines. Two 75-kw exciter sets are provided, one motor and the other steam driven. Two sets of bus-bars are provided at the station switchboard, for flexible operation. A certain amount of 500-volt service is still necessary in the business district, and to meet this requirement three induction motor generator sets are installed at the plant. These have capacities of 500, 300 and 200 kilowatts, and are used for supplying electric elevators and other machinery requiring variable speed motors. A valuable adjunct of the station is a motor-driven machine shop beneath the switchboard gallery. The tools are group driven, and lamp repairs are to some extent carried on here.

The service from the station consists of single-phase, 2300-volt lighting; constant current arc lighting, street and commercial, 7.5 amperes; direct-current, 500 volts; three-phase power, 2300 volts; and three-phase power, 6600 volts. The last service is obtained by three 75-kw, oil-cooled, step-up transformers at the station which supply an 8-mile line of No. 4 three-phase copper leading to New South Memphis; at the latter point are a large number of manufacturing plants, some of which are entirely motor-operated. All the company's distribution service in the business district is carried underground, the area being about 6000 ft. long by 1500 ft. wide. Vitrified tile ducts are used, some of the conduits having 27 ducts. At the present time an effort is being made in Memphis to reduce the number of poles in the city, and the various public service corporations are combining in the use of poles, the cost being proportioned according to special agreement; each company erects and maintains its own cross arms and lines. The 6600-volt service to New South Memphis is carried on a private pole line owned by the Consolidated company.

The company carries a stock of Westinghouse motors on hand all the time ranging from ½ to 50 horse-power. Prospective power customers' conditions are carefully investigated, and if it appears that electricity will make a better showing than the old methods of driving, a motor is installed by the company on 30 days' trial. The company pays for the wiring and the consumer for the power. At the end of the month, if the motor installation is satisfactory, the consumer buys it practically at cost to the central station, which gives the customer the rate on the motor that is practically f. o. b. factory. So far the company has not had to remove a single motor thus placed on trial.

In the last two years the station load factor, as defined by the ratio of average 24-hour output to the peak, has been increased about 8 per cent. This has been accomplished by a careful and constant watching of power conditions, the improvement of irregular and fluctuating demands when possible, and the addition of steady loads to the system.

The rates of the company are open to the public and are as follows:

MONTHLY GUARANTEE BASIS.

Power.	Light.	Rate per kw-hour.
$10	$40	9.5 cts.
12.50	50	9. “
15	60	8.5 “
17.50	70	8. “
20	85	7.5 “
25	100	7. “
30	115	6.5 “
35	130	6. “
40	150	5.5 “
50	175	5. “
60	225	4.5 “
75	300	4. “
100	...	3.5 “
125	...	3. “
166⅔	...	3. 2. “

A guarantee of $2,000 per year for power fixes a rate of 3 cts. per unit for the first 5000 kw-hours used monthly, the balance being at 2 cts. each. There are no fixed charges and the base rate is 10 cts. An alternative power rate is 9.5 cts. on from 100 to 200 kw-hours per month, with 5 per cent discount. decreasing gradually to a rate of 3 cts. with 70 per cent discount on 9000 kw-hours or over per month. Up to 9 horse-power a monthly minimum of $2.50 is charged and $5 above 9 horse-power. The standard power service is 220 volts, three-phase.

A typical power installation at Memphis, which is a great woodworking center, is the plant of the Memphis Car Company. The capacity of this plant is 65 cars per week. All the machinery is direct connected, and driven by induction motors. The factory is located at New South Memphis, and its load factor, expressed in the ratio of maximum to connected load, is about 25 per cent. Oak and yellow pine are the materials mainly used, and the tools are designed for heavy cuts. There is not a foot of line shafting in the entire plant. The following are the principal motors and tools:

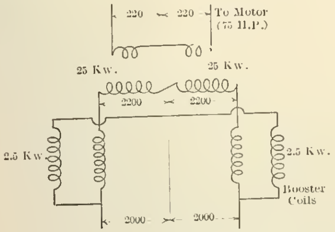


FIG. 1.—DIAGRAM OF TRANSFORMER CONNECTIONS.

Motor hp.	Tool.
30	36-in. rip saw
15	30-in. cross-cut saw
15	Horizontal mortiser
15	30-in. planer
15	Air compressor, 175 cu. ft. per minute
10	Gaining machine
7.5	8 spindle horizontal boring machines
5	40-in. hand saw
3	Radial drill
3	Boring machine
0.5	Saw grinder
0.25 to 0.5	Duntley drills

This is a new plant and the transformer equipment consists of three 25-kw units.

Another new plant in the same territory is the Conley Switch and Frog Company. This house has 65 horse-power in motors, group drive, and a load factor of 40 per cent. The machinery is entirely for metal working and it includes the largest planer in the South and the first successful air trip-hammer in that part of the country.

The American Bag Company, of New South Memphis, is operated by 15 motors ranging from 3 to 50 horse-power. These are 440-volt machines, and to supply them with current at the proper voltage six 15-kw transformers are used, all secondaries being in series and two primaries being in multiple on each phase. The total connected load of this plant is about 200 horse-power, and the load factor is about 40 per cent. The company makes cloth bags, including three-color printing, and all the drives are individual. The machine list is, principally:

Motor hp.	Machine.
2—50	2—72-in. cloth drying mangles
1—30	Starching machines
1—15	5 printing presses (two run at once usually)
1—15	Cloth handling conveyor and rollers in bleachery
1—10	Tools in engraving shop
1— 7.5	2 cutting machines
1— 5	1 baling press
1— 5	Machine shop, small tools
4— 3	48 sewing machines, each 1800 stitches per minute

A 75-hp motor installation in a cotton seed oil plant has shown marked economy over steam. In this establishment a single motor drives a No. 19 attrition mill having a maximum 10-hour capacity of 1400 sacks of meal weighing 100 lbs. each. The plant runs from October until March, about 12 hours per day at 100 per cent load factor. As this load comes on the winter peak of the Consolidated company a contract has been arranged with the owner not to use electrical energy daily between 4:30 and 9:30 p. m. During the idle months of the year the motor does not depreciate as idle steam machinery does. This installation is at the end of a long feeder circuit, and is served by two 25-kw transformers connected in open delta. The motor voltage is 220, and the line voltage at this point is raised from 2000 to 2200 by the use of two 2.5-kw booster coils connected as shown in Fig. 1. Only the inside phases of the line are approximately balanced in this case.

About 12 refrigerating plants aggregating 800-hp connected load are in service on the mains of the company, and this class of customers has been found very desirable under the conditions obtaining in Tennessee. The peak load comes in the summer, and while the winter consumption is small, each plant operates part of each day. The largest individual installation is in the plant of Armour & Company. A 50-hp motor here drives a compressor, a 300-hp unit runs a smaller cooling machine, and a 10-hp motor drives a circulating pump. In addition there is an elevator load. The maximum cooling capacity of the plant is 50 tons refrigeration in 24 hours, and the energy consumption in summer is about 10 times that in the winter season, per month. Among the other prominent power installations are 500 horse-power in electric elevators, and several grain elevator plants exceeding 100 horse-power each.

One of the most interesting applications of power on the system, and one which suggests a field worth cultivating by other central stations, is in the use of a mercury arc rectifier to charge the storage batteries of the Memphis Telephone Company's central exchange. The scheme was worked out by Mr. Otis Myers, superintendent of the Telephone Company, and Mr. Carl K. Chapin, electrical engineer of the Consolidated Gas and Electric Company. A sketch of the principal connections is given herewith. The amount of power consumed in charging the telephone company's batteries has been about cut in two by the greater economy of the rectifier over the 500-volt motor-generator set formerly used. The apparatus has been in operation about 10 months.

The Memphis telephone plant is equipped with two sets of 640-ampere-hour chloride accumulators and a duplicate set of charging apparatus, each set including a 500-volt, 12-hp motor direct connected to a generator of the same size with a range suitable for charging a 40-volt battery. A motor-generator set of the size suitable for telephone work operating under the most favorable conditions has an efficiency of only about 65 per cent. In addition to this low efficiency, when using two sets of batteries alternately, there is a loss of about 20 per cent in the batteries in charging and discharging, giving a full load net efficiency of only 52 per cent; and in plants using one set of batteries and a motor-generator, the net full load efficiency is between 52 and 65 per cent, depending upon the time the generator is carrying the load. These points show that the charging apparatus originally installed was of ample size, being designed to take care of the batteries fully equipped for 1200 ampere-hours; but when using it with the present equipment of 640 ampere-hours capacity, it is necessary to keep running at the normal charging rate, regardless of the normal capacity of the machine. When running at the normal charging rate the motor-generator carries only about half load; consequently the efficiency does not exceed 45 per cent. under the most favorable conditions. On the other hand, the efficiency of the mercury rectifier is from 50 to 85 per cent. and the latter is low in first cost, compared with motor-generator equipment.

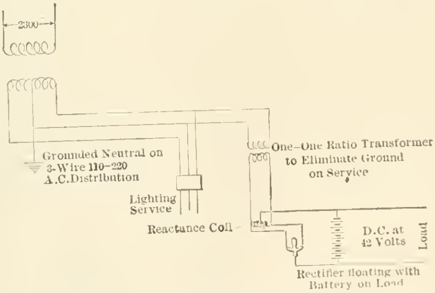

2300
Grounded Neutral on 3-Wire 110-220 A.C.Distribution
One-One Ratio Transformer to Eliminate Ground on Service
Lighting Service
Reactance Coil
D.C. at 42 Volts
Load
Rectifier floating with Battery on Load

FIG. 2.—USE OF MERCURY ARC RECTIFIER IN CHARGING STORAGE BATTERY OF MEMPHIS TELEPHONE COMPANY.

A rectifier panel was installed, the scheme being to float the batteries and rectifiers together on the discharge bus-bars, as shown in the diagram. The average discharge rate for 24 hours is about 20 amperes, and when the panel was set up it was connected to get a direct current range of 30 to 46 volts, and the controller adjusted to supply 20 amperes, the idea being to give the tube some attention during the day to make it carry the load with the battery floating as an auxiliary. It was found, however, that the inherent regulation of the tube compensated for the varying discharge, due to the counter e. m. f. of the batteries, and without further regulation the tube carried about 90 per cent of the load, running up during the peak of the discharge, and dropping down to where the arc would barely hold when the discharge was at a minimum.

The tube was left cut in for one week when it was time to give the batteries an overcharge and inspection. The other set of batteries was thrown in on the discharge and the tube started, floating the batteries as at first. This course has been followed for about 10 months, leaving a set of batteries and the rectifier on for a week, and then overcharging and leaving the battery on open circuit while the other set is floated with the rectifier. It would naturally be supposed that without some arrangement to choke down the direct-current impulses they would tend to make the exchange noisy, but the impulses are so smoothed by the counter impulses from the reactance coil that the exchange is much quieter than when the batteries were charged from the motor-generator. It was found that at the end of a week's discharge in the above way, it took but 2.5 hours to overcharge the battery and bring it to the maximum, with the charging outfit at the normal charging rate, and the statement that the rectifier compensates to carry 90 per cent of the discharge is based on actual observations.

This installation has been so successful that the company finds it has about six times as much battery capacity as it needs, and it is planned to dispose of the present batteries and install one 240-ampere-hour battery in their place. The charging rate of the new battery will be 30 amperes, and the cells can be kept on the discharge with the rectifier continually; and the weekly overcharge can be obtained by running the controller up above the regular operating position. One of the motor-generator sets will be held as a reserve in case a tube burns out. The only part subject to depreciation in the rectifier set is the tube, which has an estimated life of 1000 hours at full load and a much longer life on light load. The telephone company operates one 30-ampere tube at half load for over 5000 hours; but even on an average life of 1000 hours the tube depreciation amounts to but 1 cent per hour. The present power consumption per month is about 1000 kw-hours alternating-current input to the rectifier, including the loss in the one to one transformer used to eliminate the ground on the secondary network of the central station. The present efficiency of the apparatus from the alternating-current input at the building to the direct-current side of the rectifier is about 70 per cent. This saving, together with the nearly automatic regulation, should appeal to every operating man as a battery plant which has to be looked after every day is generally either overcharged, or not charged enough, and the battery suffers: whereas, by giving one weekly overcharge and inspection it is possible to keep them in prime condition.

New Telephone Patents.

PARTY-LINE SYSTEMS.

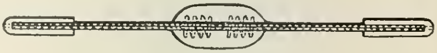
A most simple arrangement of a party line lockout system is described in a patent granted to N. S. Page, of New York City. This system is adapted to common battery lines. At each station is a very high-wound relay, whose circuit is associated with the hook switch and whose contacts control the connection of the bell with the line. These relays are so designed that when a set of talking instruments is across the line, all relays are shunted. The relay has a latch feature which prevents the rising of the hook switch when the relay is not operated. If a calling current be sent out upon the line, all relays operate, and connect in their bells. If the bell system be selective, the desired station only is rung. After the receiver is removed from the hook no other station can respond. It will be understood, of course, that the hook switch is not held completely blocked, but is permitted sufficient motion to close the relay circuit even though latched.

A selecting device for a step-by-step party line system forms the subject of a patent granted to O. F. Forsberg and assigned by him to the Western Electric Company.

A polarized magnet at each station serves to oscillate a lever arm at will to the right or left. Motion to the left advances a ratchet, while motion to the right is of no effect except at certain stated positions of the ratchet. One of these positions is at the limit of motion, while the other is adjustable and corresponds to the position of a movable stud. When a call is sent out, a number of "left-handed" impulses are transmitted corresponding with the station number. At this point the adjustable stud of the desired station rides under a lever and so raises it that an opposite impulse drives the oscillating lever against a switch bar and thereby connects this station to the line. The "left-hand" impulses are then continued until all stations have the extreme rotation, at which point the release lever has been raised to respond to an opposite impulse to be applied after conversation is completed. We now have the desired station connected for conversation and all switches set for release. When the final reverse impulse is sent, all switches return to normal simultaneously.

FUSIBLE PROTECTOR.

For a long time one of the recognized elements of complete protection for telephone circuits has been a sneak-current protector, to respond to such low currents as would only produce damage after a considerable time. The sneak-current device has almost universally been some sort of a resistance wire or medium in which sufficient heat will be generated to melt a fusible solder, thereby permitting the connections to break or short circuit. Following out this same plan, Joseph Sachs, of Hartford, Conn., has produced a protector which will fit the ordinary fuse mountings. This is shown in section herewith. Between two slabs of insulating material in which cups have been formed the wires are run from the clamping terminals at the ends to the space within the abutted cups. Here the two wires are formed up into spirals and their ends soldered together with low fusing metal. With the generation of heat the solder melts and the points separate. If it is desired this whole device may be enclosed within a tube of the appearance of the usual enclosed fuse, in which case, of course, the terminals are transferred to the fuse cartridge.


SACHS' SAFETY FUSE.

LETTERS TO THE EDITORS.

Peregrinus and Paracelsus.

To the Editors of Electrical World:

Sirs:—There is a passage in the "History of the French Revolution," by Justin H. McCarthy, which richly deserves a place among the curiosities of literature. It reads: "In the long record of rascaldom from *Peregrinus* to Bamfylde Moore Carew, no single rascal stands forward with such magnificent effrontery, such majestic impudence, such astonishing success as Cagliostro." Vol. I, p. 256.

To put it mildly, this is a very serious *lapsus calami* in which a thirteenth century pioneer of science of the first rank and patriot of an exalted type is mistaken for a charlatan of the deepest dye. The individual meant by Mr. McCarthy to serve as prototype of the Sicilian impostor of the eighteenth century was probably Paracelsus, the bombastic quack of the sixteenth.

If these lines reach Mr. McCarthy's notice and his "History" another edition, doubtless he will correct this regrettable error into which he has unwittingly fallen.

MANHATTAN COLLEGE, NEW YORK. BROTHER POTAMIAN.

Parallel Operation of Alternators.

To the Editors of Electrical World:

SIRS:—It is quite impossible for me to agree with you in your editorial comment on my article on the parallel operation of alternators, and I wish to offer evidence to support my argument concerning the inability of an alternator to take its share of the load when it loses its field excitation.

In the first place, I did not arrive at this conclusion by assuming that the synchronous impedances of the two machines were equal or constant, but, merely from the nature of the resultant field excitation in that alternator whose field is open. As for the actual result of opening the field of one machine, I wish to give the following experimental data, which were taken on two General Electric three-phase, 230-volt, 15-kw alternators with rotating fields. The generators were driven by 30-hp motors which had additional resistance inserted in their armature circuits to give them a sufficiently drooping load-speed characteristic. Generator No. 1 was operated at constant field current, while the field current of No. 2 was varied. Observations were made of the e. m. f. at the common terminals of the machines, the current in the coils of each generator, the power-factor and the output of each machine. Although the results are for only one type of machine, I consider them indicative of the general performance of any generators under like conditions.

Field Current		E. m. f. Volts at load	Current per lead, amp.		Power Factor		Output, k.w.	
No. 1	No. 2		No. 1	No. 2	No. 1	No. 2	No. 1	No. 2
3.71	3.71	165	9.2	8.8	1.00	1.00	4.6	4.1
3.73	2.00	132	12.0	12.1	0.63	0.60	3.0	2.9
3.73	0.97	111	17.3+	16.9+	0.38+	0.35+	2.2	1.85
3.73	0.00	83	24. −	23. −	0.44−	0.02−	2.6	−0.10

The generators were run at a reduced voltage so that their currents would not exceed the rated value. These results, which are correct to within 2 per cent, show a marked agreement with the theoretical results as deduced from the vector diagram. It will be observed that the alternators divide the load approximatelly equally until the field circuit of the one is opened, when the load on that machine becomes negative, and the other slightly increases, which agrees exactly with my statement regarding their behavior. The second machine did not, however, materially alter its speed, and here I wish to modify my statements in the last paragraph, first column, page 1245 of the Dec. 28 issue. As far as their actions as synchronous alternators go it is quite right; but when the first machine attempts to speed up and thus have its field poles rotate at a higher speed than the field due to the armature m. m. f., it is met by the reactive force developed by the eddy currents set up in the pole faces and the armature core. This is the effect that is often made use of in starting small synchronous motors. Of course, for ordinary variations in the field currents the division of the load is not much affected if the prime movers have similar drooping speed-load characteristics.

BOSTON, MASS. WALDO V. LYON.

[Although, as intimated above by Mr. Lyon, an alternator may not always take its full share of the total load when it loses its field excitation, this fact has no direct bearing either on our editorial, to which Mr. Lyon seems not to agree, or on his own article, which was commented upon in the editorial. In the article it was stated that if the field circuit of an alternator is opened, the "entire load is removed from its prime mover," while the editorial pointed out that "an alternator with projecting field poles can carry a considerable load when its field circuit is open." It is probable that the alternators, whose tests are reported by Mr. Lyon, are provided with projecting field poles, but the tests were not conducted under the conditions implied in both the article and the editorial. There can be no doubt that the alternator with open field circuit would have exerted considerable torque and could have carried some load if the excitation of the other machine had been such as to supply the required current for exciting the field magnets. The actual condi tions are well described by Dr. C. P. Steinmetz on page 1663 of the *Proceedings* of the A. I. E. E. for November, 1907, where it is stated that, if at constant impressed e. m. f., the field excitation is lowered from that corresponding to minimum armature current down to zero, the machine keeps in step. The field current may even be increased in the reversed direction until there is a very high reversed field excitation, and still the machine runs in step.—EDITORS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors. and Transformers.

Alternating-Current Commutator Motors.—M. OSNOS.—The first part of his paper read before the Association of German Electrical Engineers on alternating-current commutator motors with special reference to traction. The following motors are considered: First, the conductively compensated series motor; second, the inductively compensated series motor; third, the "inverted" repulsion motor; fourth, the ordinary repusion motor (Atkinson); fifth, the compensated repulsion motor; sixth, the "doubly-fed" motor (the latter term referring to single-phase commutator motors in which the stator field axis and rotor field axis form some angle between zero and 90 deg. with each other, and in which a voltage is impressed on the stator as well as on the rotor). The author first discusses the behavior at starting, and especially the volt-ampere consumption during the starting period. He shows that, with the single exception of the ordinary repulsion motor, all other types, if suitably designed, are of nearly the same quality with respect to consumption of volt-amperes per pound-foot of torque. He then begins to discuss the conditions of sparkless starting.—*Elek. Zeit.*, Jan. 2.

Reluctance of Air-Gap.—T. F. WALL.—An illustrated paper read before the Manchester Section of the (British) Institution of Electrical Engineers on the reluctance of the air-gap in dynamo machines. The author gives the results of a series of experiments on the distribution of flux with varying proportions of air-gap, tooth and slot. The tests have been made with a special model apparatus from which the results in predetermining machine characteristics are deduced.—Lond. *Elec. Eng'ing*, Dec. 19.

Operation of Alternators in Parallel.—G. BENISCHKE.—An article in which the author criticises a theory of Emde and others on the reasons which cause surging of alternators, and describes a case from practice which shows that that theory is not correct. In the case in question surging of alternators was observed, although according to the theory they should have operated perfectly well in parallel. The weight of the fly-wheel was then greatly increased, but without much effect. Satisfactory operation in parallel became possible only after changes had been made in the regulation of the gas engines. The connection of choking coils in series is not always effective.—*Elek. und Masch.*, Dec. 29.

Lamps and Lighting.

Connection of Leading-In Wire for Metallic-Filament Lamps.—An article on a British patent of the Westinghouse Metal-

Filament Lamp Company for using the aluminothermic method for making a durable conducting connection between the metallic filament and the leading-in conductors. The joint consists of a metallic alloy produced at the point of connection. A mixture of the oxides of the metals which are to form the joint, with aluminum or magnesium, etc., with a suitable liquid or flux, is placed around the connecting points of filament and leading-in conductor. The ends of the leading-in conductors may be provided with hoops or loops, and the filament is thrust into these; the connecting points are then covered with the mixture described above, and the aluminothermic reaction is started either by means of the electric current or in some other way. The aluminum combines with the oxygen of the oxides and by the heat evolved by the reduced metals are fused together with the ends of the filament and the leading-in conductors. The alumina forms a filament on the outside of the joint, which may be removed, if desired, by dipping into hydrochloric acid. The liquid or flux employed with the mixture "should be such as will not exercise an injurious effect upon the material. Thus, for example, instead of employing water with calcium, alcohol or some other organic compound should be used, and, on the other hand, with aluminum, a solution of mercuric chloride or some other suitable salt of mercury may be used."—Lond. *Electrical Eng'ing,* Jan. 2.

Radiation of Osmium.—L. Leder.—An account of a determination of the energy-flow curve of radiation of osmium in the visible spectrum. The author finds that the total intensity is that of an absolutely black body at a temperature of 2195 deg. C. absolute, and this temperature is, therefore, an inferior limit of the probable temperature of osmium. It is not very far removed from the melting point of osmium. Since the emissivity and the reflective power of osmium are not accurately known, the true temperature is difficult to determine. The author, therefore, assumes certain temperatures, and from them he calculates the emissivity with the help of the observed curves of intensity. He constructs a table showing the ratio of the actual radiation to the radiation of the ideal black body for various wave-lengths and temperatures. From this table the following figures are extracted:

Degrees, C. absolute	WAVE LENGTHS—ω ω			
	643	550	474	430
2200	0.980	0.944	0.931	0.971
2300	0.633	0.570	0.517	0.508
2500	0.293	0.233	0.181	0.161

For platinum at 1975 deg. absolute the first three figures would be 0.319, 0.340 and 0.368. These results show that the dependence of the emissivity upon the wave-length has opposite courses in osmium and in platinum. The emissivity of osmium is considerably greater than that of gold or silver, and most likely also greater than that of platinum. It is, however, unlikely that the melting point of osmium is as high as 2600 deg. C. absolute.—Abstracted from *Ann. der Phys.,* No. 12, in Lond. *Electrical Engineering,* Dec. 26.

Church Lighting.—A fully illustrated article on the electric lighting of Manchester Cathedral, giving details of the arrangement of the lamps and fittings. The fundamental principle was to render the means for lighting as unobtrusive as possible.—Lond. *Elec. Eng'ing,* Dec. 19.

Power.

Electric Power in a German Mine.—An illustrated description of the new electric equipment of the Clausthal mines. The chief features are an underground direct-current locomotive, a winding plant in one of the smaller shafts, and the main-shaft winding plant. In the latter case the peak load is delivered by the use of storage batteries and not by a fly-wheel set. —Lond. *Elec. Eng'ing,* Dec. 26.

Electric Cranes.—H. H. Broughton.—A continuation of his long illustrated serial. The author deals in the present installment with mechanical brakes fitted with electromagnetic release and describes some standard constructions of English makers. —Lond. *Electrician,* Dec. 27.

Power from Peat.—A. P. Lennox.—An abstract of a lecture before the Dublin section of the (British) Institution of Electrical Engineers on the preparation of peat for use in gas producers for the production of electrical energy. A special form of grab dredger and drying apparatus designed by the author are described.—Lond. *Elec. Eng'ing,* Dec. 26.

Gas Producer.—O. Nagel.—An article on the Jahns system of transforming solid fuel into gas. The main features of the system are that no fuel is charged into the producer during the time of gasification and that a number of producers are connected by means of channels to one unit. The arrangement is fully illustrated by diagrams.—*Electrochem. and Met. Ind.,* January.

Traction.

Train Resistance.—C. A. Carus-Wilson.—An abstract of a paper read before the (British) Institution of Civil Engineers. The resistance equation is of the form $R = A + Bv + Cv^2$ where v is the speed. The resistances included in A are independent of the speed and include journal friction, rolling friction and track resistance. The resistances comprised in Bv include the resistance caused by flange action, which varies directly as the speed. The resistances comprised in Cv^2 include all forms of air resistance, which vary as the square of the speed. The author then discusses the determination of the constants in this equation and finally arrives at the following practical conclusions: The real value of roller bearings in railway traction is shown to lie in the reduction of running resistance and consequent saving of energy, and not in the reduction of starting effort. The results of tests with roller bearings on the Eastern Bengal State Railway are given, the saving actually obtained being 1 per cent greater than that calculated by the use of the resistance formula. The resistance of a coach is shown to depend largely upon the wheel base of the truck, and the relation of the weight of the bogie trucks to that of the whole coach. The weight of the motors and the extra weight of the motor trucks in electrically driven coaches increases the flange action and the total resistance of such coaches. The resistance of electrical motor coaches is in some cases as much as 54 per cent greater than that of trailing coaches running at the same speed under similar conditions. The influence of the bogie on train resistance is shown to be greatest in the case of drays. Since flange action depends upon the ratio of the weight of the bogie to that of the whole wagon, it must follow that the resistance per ton of a loaded bogie wagon must be less than that of the same wagon empty. The ratio of the mean draw-bar pull in two cases was found to be 0.56. The energy expended in overcoming flange resistance is represented by the wear of tires and rails. It is shown that by giving the bogie a lead, as is done in Timmis's bogie lead, the flange action of the bogie can be reduced, and that the saving depends upon the ratio of the bogie wheel base to the distance between the bogie centers, and also upon the ratio of the bogie weight to the total weight. The amount of play between the flanges and the rails is an important factor in train resistance. The resistance of the air with a train of bogie coaches, running at 60 miles per hour, amounts to about one-half of the total tractive effort required to haul the train. The experiments conducted by the St. Louis Electric Railway Test Commission show that a large reduction can be made in the front and rear air resistance by properly shaping the ends, and that by this means a saving can be effected of 10 per cent of the total tractive effort with a long passenger train, and 30 per cent with a single coach.—Lond. *Electrician,* Dec. 27.

Single-Phase Traction.—V. E. Walters.—A paper read before the Birmingham and District Electric Club on recent developments on single-phase motors for industrial purposes (lifts, cranes, etc.) and traction. The author describes various new industrial applications of the single-phase motor and discusses the principal different types which have been developed. —Lond. *Electrical Engineer,* Dec. 20.

Single-Phase Railway.—An illustrated description of the new Brembana Valley single-phase railway in Italy, which has been mentioned in the Digest.—Lond. *Electrician,* Dec. 27.

Berlin Subway.—E. C. Zehme.—An article discussing the project of a sudway in Berlin, with reference to reports of Kemmann and Cauer.—*Elek. Zeit.*, Dec. 19.

Installations, Systems and Appliances.

Electric Monopoly in Germany.—Budde.—Notes on a proposed electric monopoly in Germany have appeared in various German newspapers and the scheme appears to be favored by officials of the government and an influential political party. It is proposed that the German government should undertake the generation and distribution of all electrical energy used in Germany for lamps, motors, tramways, etc. (the telegraph and telephone system being already in the hands of the government). The manufacture of electric machinery and apparatus would, however, not be taken over by the government. The writer shows the great dangers of such a proposition, and urges that in these times of bad financial crisis the industry, as the biggest taxpayer of the country, should be treated with more consideration and caution, and should be left alone.—*Elek. Zeit.*, Jan. 2.

Derby.—During the last years the growth of the demand for electric energy at Derby has been so rapid that a new station had to be erected. The old station contained some 4500 kilowatts of equipment, part of which generates single-phase alternating current at 40 cycles per second, and part continuous current at 2 × 230 volts for lighting in the central portion of the town, and 500 volts for the traction load. The new station, which is on a site adjoining the old one, will at first be equipped only with direct-current plant, which will be run in parallel with the three 300-kw direct-current turbo-generators erected in the old station in 1904, and a 500-kw set erected in 1906. When these latter were put in, the central portion of the distributing network was converted from the alternating-current transformer system to the three-wire direct-current system. No new alternating-current plant is being put in, and the radius of the direct-current area is being gradually increased. The equipment of the new plant is described and illustrated.—Lond. *Elec. Engineering*, Dec. 19.

London.—Details of the proposal, which is to be submitted to the British Parliament, for placing the whole of the electrical supply companies of London under one management. The bill, which is promoted by the companies themselves, provides for the working of all these undertakings by a joint committee, and the ultimate purchase in 1932 or 1952 by an authority to be created by Parliament for the purpose. Particulars are also given of an alternative scheme promoted by a new company, independent of the above proposal, and not having the support of the existing companies.—Lon. *Elec. Eng'ing*, Dec. 26.

Troppau.—O. Armknecht.—The first part of an illustrated article on the electric station of the city of Troppau, in Austria. The plant supplies energy for lamps and motors, as well as for traction. On account of the comparatively small area to be covered, the three-wire direct-current system has been chosen. There have been installed two 155-kw dynamos and a battery of 95 kilowatts maximum output, and for traction two 55-kw generators and a battery of about 50 kilowatts maximum output.—*Elek. Zeit.*, Jan. 2.

Rules and Regulations.—An English translation of the recently revised rules of the German Association of Electrical Engineers for overhead wires, cables and electric wiring.—Lond. *Electrician*, Dec. 27.

Wires, Wiring and Conduits.

Alternating-Current Transmission in Cables.—C. V. Drysdale.—A continuation of his long paper. In the present installment he gives the simple exposition of A. E. Kennelly's methods of calculating the transmission of an alternating current over a long cable.—Lond. *Electrician*, Dec. 27.

Electrophysics and Magnetism.

Relation of Mass to Energy.—D. F. Comstock.—A highly theoretical paper. "The electromagnetic mass of an isolated, symmetrical, purely electric system possessing any structure which on the average remains the same, and any internal motions or constraints, is expressible in terms of its velocity as a whole through space, together with its 'transverse energy,' and the derivative of the latter with respect to the velocity. If second-order terms in the velocity be neglected, the mass is a simple constant multiplied by the total included electromagnetic energy." If the mass of ponderable bodies has an electromagnetic origin, then the inertia of matter is to be considered merely as a manifestation of confined energy. From this point of view, matter and energy are thus very closely related and the laws of the conservation of mass and energy become practically identical. The loss of mass, inevitable on this view, which takes place when energy is lost to the system, is large enough to be detected in the case of radioactive changes. If we assume the disintegration theory of the elements, this loss of mass affords a ready explanation of the general, small irregularities to be found in the list of atomic weights, and thus removes a serious difficulty from the path of the disintegration theory. For this loss of mass to take place, however, it is not necessary that the whole of the mass be electromagnetic. If material mass be electromagnetic, and if lighter elements are formed from heavier ones through violent energy changes, it follows that gravity acts between quantities of confined energy, and not between masses in any other sense. Several speculations are indulged in as to the results of assuming gravitation between quantities of energy.—*Phil. Magazine*, January.

Heusler Alloy.—A. D. Ross.—A paper read before the Royal Society of Edinburgh on Heusler's copper-manganese-aluminum alloy, and the effect of different heat treatments on its magnetic properties.—Lond. *Electrician*, Dec. 27.

Electron Theory.—G. A. Schott.—A highly mathematical paper on the electron theory of matter as applied to the explanation of magnetic properties.—*Phil. Magazine*, January.

Magnetic Induction.—D. N. Mallik.—An account of an experimental determination of magnetic induction in an elongated spheroid.—*Phil. Magazine*, January.

Electrochemistry and Batteries.

High-Grade Steel in the Electric Furnace.—In an account of a paper by Thallner on the possibility of absolutely controlling the slag in an electric steel furnace for the complete purification of the metal, the diagram reproduced in Fig. 1 is given, showing the consumption of electrical energy necessary to refine one ton of steel in the Heroult furnace, both when starting with cold and molten material. The curves give the consumption of energy for different sizes of the furnace and under different conditions of operation. The great economy of starting with a molten material from the converter or open-hearth furnace is shown, also the decrease of energy with the size of the furnace. In the electric furnace it is possible thoroughly to dephosphorize, desulphurize and deoxidize the metal.—*Electrochem. and Met. Ind.*, January.

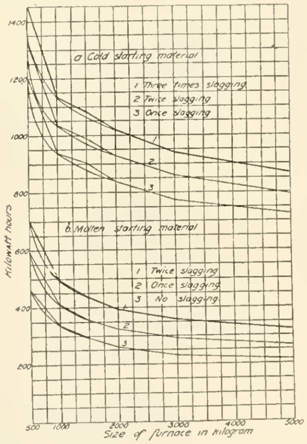


FIG. 1.—ENERGY CONSUMPTION CURVES.

The Evolution and Devolution of the Elements.—A. C. and A. E. Jessup.—From the recent observations on radioactivity it appears that some elements are degrading into simpler forms of matter, elements of high atomic weight changing into such of lower atomic weight. On earth we have not yet any evidence of the reverse process, namely, evolution of elements with low atomic weight into other elements with a higher atomic weight. The authors endeavor to produce evidence of such an evolution from astrophysical observations. The nebulae contain only a few elements of low atomic weights, but as the nebula becomes more compact and assumes the form of a star, more complex elements appear. If we consider Mendeleef's table of periodic system, it may be assumed either that the elements evolve in order of atomic weight along horizontal lines of the table of the periodic system, or that they evolve in groups; that is, down its vertical columns. The authors think that they have strong reasons for believing that the second method has most evidence in its favor. They have drawn up a modified table of the periodic system.—*Phil. Mag.*, January.

Electrochemical Analysis.—A. M. Fairlie and A. J. Bone.—A fully illustrated article on a system of electrochemical analysis with rotating anodes as developed for the routine practice of a large industrial laboratory.—*Electrochem. and Met. Ind.*, January.

Units, Measurements and Instruments.

Weston Cadmium Cell.—A paper from the (British) National Physical Laboratory. He thinks that the method of making mercurous sulphate used as a depolarizer is immaterial provided that certain conditions are observed, and his guiding principle in the manufacture of the salt and the preparation of the paste is to prevent hydrolysis by keeping the salt in contact with dilute sulphuric acid (1 to 6), or with saturated cadmium sulphate solution. The size of the crystals of the depolarizer has an effect. The uniformity in the size of the crystals is most marked in samples prepared by the method of chemical precipitation, mercurous nitrite being added to sulphuric acid, and this is recommended as a standard method of preparation of the salt. The lag of e. m. f. with temperature coefficient for the range, from 10 deg. C. to 30 deg. C., is given by the following equation:

$$E_t = E_{17} - 3.45 \times 10^{-5} (t - 17) - 0.066 \times 10^{-5} (t - 17)^2$$

That is in very good agreement with the formula given by the Reichsanstalt.—Lond. *Electrician,* Dec. 27.

Determination of Self-Induction Coefficient.—The method of determining inductances by connecting the coils in series with non-inductive resistors and noting the voltage drop across each when a sinusoidal alternating current is passing, may be simplified into a single reading by employing an electrometer connected differentially, as shown in Fig. 2. Quadrants 2 and 4 are connected together and to the needle, as well as to the junction point *B* of the inductive and non-inductive resistors and to earth at *E*. The end of the resistor *A* is connected to quadrant 1, and that of the inductances *C* to quadrant 3. When the potential difference between *A* and *B* is equal to that between *B* and *C*, two equal and opposite torques act on the needle *N*, and it, therefore, rests in the zero position. This result is attained by adjusting R_1. The R_1 and *R* (the resistance of the inductance coil) being known, as well as the frequency *n*, the coefficient of self-induction *L* can be found from the expression $L = \frac{1}{2 \pi n} (R_1^2 - R^2)$. The sensitiveness of the instrument increases with the voltage between *A* and *C*, so that the method does not permit of great accuracy when dealing with low resistances. For determining the inductance of telegraphic coils, induction coils, etc., it is, however, very suitable. The current supply may be advantageously obtained from a small alternating current generator at from 20 to 30 volts.—Lond. *Elec. Engineering,* Dec. 20.

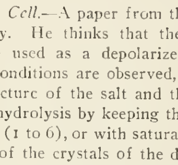


FIG. 2.—DETERMINATION OF SELF-INDUCTION COEFFICIENT.

Improved Current Balance.—A description of the new current balance, which has been erected at the (British) National Physical Laboratory, and which has now been in use about two years. The design is due to Ayrton, Mather and F. E. Smith. The instrument consists of a sensitive physical balance with a 20-in. beam, carrying about 5½ kilos and turning with 1/10 milligram supporting from each end a coil with vertical axis; these coils hang coaxially within fixed coils carried from the base. Details of the winding of the coils are given. The mutual inductance of all the coils was computed at 51,922.47 cm., which leads to the result that one ampere on reversal in the two sets of coils causes a change of balancing mass of 14.9928 grams.—Abstracted from *Proc. Royal Soc.*, December; in Lond. *Elec. Eng'ing*, Dec. 26.

Variable Mutual Inductance.—A. Campbell.—His (British) Physical Society paper in full, which has already been noticed in the Digest, on the construction of coils, variable mutual inductances and their use for certain measurements.—*Phil. Magazine,* January.

Induction Variometer.—H. Hausrath.—An illustrated description of two types of variable self-induction apparatus for measurements by a differential method.—From *Zeit. f. Instrumentenkunde,* 1907, No. 10, abstracted in Lond. *Electrician.* Dec. 13.

Determining the Power Factor.—F. Kuderna.—An article describing a brief graphical method for determining the power factor from the readings of the two wattmeters employed in the measurement of the power of a three-phase system.—*Elek. und Masch.,* Dec. 22.

Telegraphy, Telephony and Signals.

Sound for Controlling Operations at a Distance.—J. Gardner.—An illustrated article describing a method of closing or opening an electric circuit at a distance by means of sound. The method seems to be especially suitable for submarine signalling to warn vessels of their position in relation to fixed points. For this purpose water is the transmitting medium, and it is very effective. For shorter distances air is also a suitable medium of transmission. The transmitting apparatus is a bell or something similar. The receiving apparatus consists primarily of a vibrator, preferably in the form of a strip of steel tape mounted by one or both ends upon a part, such as the plating of a vessel, which is exposed to the arriving sound. The vibrator is tuned to the distant sound and reacts strongly only to this pitch. A carbon pencil microphone is mounted on the sound-receiving vibrator and the pencil is given such weight and dimensions as will permit it to vibrate with the strip upon the reception of any note not corresponding with the natural period of the strip, but to remain stationary relatively to the vibrator when this is affected by a sound which it is prepared to amplify by resonance. With silence or with an unsuitable note, the pressure of the pencil is, therefore, constant, but upon the arrival of a sound in agreement with the pitch of the vibrator amplification follows, and the intimacy of contact of pencil and vibrator is diminished. Both of these parts are in circuit with a source of very low voltage, and with the winding of the magnets of a polarized relay of very high resistance. The relay is so adjusted that the full or normal current existing during quiescence of the microphone is just sufficient to hold the tongue in the position in which, in ordinary telegraph work, the local circuit governed by the relay would be closed. In case of disturbance of the microphonic contacts the tongue is released and the local circuit is closed and remains closed as long as the proper sound reaches the vibrator and the disturbance in the microphone continues. Drawings are given of the apparatus and in a note the editors state that they can vouch for the inventor's statements as to the working of the model of the apparatus.—Lond. *Elec. Review,* Dec. 13.

Propagation of Telephone Currents.—H. Abraham and

Devaux-Chardonnel.—A paper presented before the French Academy of Sciences on the propagation of telephone currents in underground lines. The object of the experiments was to examine whether the propagation on real lines is presented with sufficient exactness by the classical formulas of theory. The tests were made with alternating currents at from 250 to 500 cycles per second, and the e. m. f. applied was of the order of one volt or less. The experiments were made on the underground lines of Paris consisting of copper wire, 1 mm. in diameter, insulated with paper. The results are in a remarkably good agreement with the theoretical formulas.—*L'Industrie Electrique,* Dec. 25.

Automatic Telephone Exchange.—F. Lubberger.—An article describing some recent applications of the Strowger automatic telephone system for extending and reconstructing some existing telephone exchanges.—*Elek. Zeit.,* Dec. 12.

Undamped Oscillations.—H. T. Simon.—A note on the action of the magnetic field in the production of undamped electric oscillation with the aid of an arc. The author points out that anything which increases the potential at which the arc is started must increase the energy of the oscillations. Cooling of the electrode, use of a hydrogen atmosphere, and the employment of a magnetic field, all act in this way. The magnetic field blows ions out of the field and lengthens the conducting path into a long arc of increasing resistance until the direct path from electrode to electrode becomes again the easier one and a new arc is started.—*Elek. Zeit.,* Dec. 26.

Magnetic Oscillators.—J. A. Fleming.—His full (British) Physical Society paper on the closed or magnetic type of oscillator, as distinct from the usual open or electric type, and its use in wireless telegraphy. The effects observed vary in a remarkable degree according to the positions of the transmitter and receiver in relation to one another and in relation to the earth.—Lond. *Electrician,* Dec. 27, Jan. 3.

Gasoline-Electric Car for Railway Service.

The gasoline electric car illustrated herewith has been built by the General Electric Company and subjected to service tests on the Delaware & Hudson Railroad, between Schenectady, Delanson, Albany, Troy and Mechanicsville. The car was designed throughout with special reference to the service required, the main object in view being to secure the maximum carrying capacity with minimum weight, and at the same time to have a car of great strength. The shape of the ends is parabolic in order to reduce the air resistance to a minimum when traveling at high speeds. The framework of the roof and sides is made of T-irons, while the exterior is of steel plate.

The car is equipped with two 60-hp direct-current motors fed with energy at variable voltage obtained from a special generator.

Principal interest in the equipment centers around the generator and its driving engine. The engine is an eight-cylinder gasoline machine, which at 550 r. p. m. develops 100 horsepower. The cylinders are placed at 90 deg. to one another, and at an angle of 45 degrees to the horizontal, as shown in Fig. 2. The cranks are so set as to give a satisfactory system for balancing purposes. An effectual means for overcoming the difficulties of starting the engine from rest has been found in the use of a special breech-block mechanism, which allows a charge of black powder to be fired into one of the cylinders.

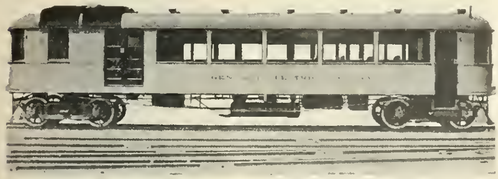


Fig. 1.—Gasoline-Electric Car.

The generator is a 90-kw, 8-pole, separately-excited unit, which has been specially designed with a view to procuring the lightest possible machine for the necessary output, and at the same time keeping the temperature rise to within a reasonable figure. It is provided with commutating poles, which, in conjunction with the potential type of control, gives a great flexibility of output. The advantage of this arrangement will be readily appreciated when it is pointed out that at starting the field excitation is weak, and that large currents are required to give the necessary starting torque. The normal pressure when running at 550 r. p. m. is 250 volts, at which time the current may amount to 360 amperes, but at starting a current of 800 amperes can be secured at a corresponding decrease in voltage. It would be impossible to commutate so large a current in a machine with so great an output per pound without the use of commutating poles.

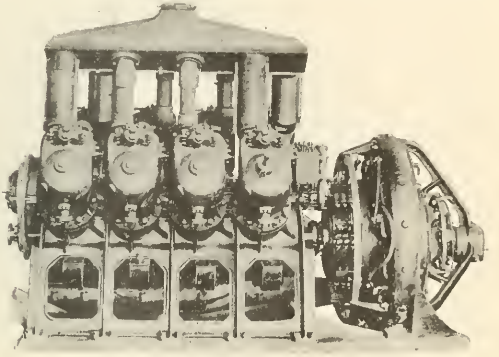


Fig. 2.—Gasoline Engine Direct-Connected to Commutating Pole Generator and Separate Exciter.

The total weight of the generator, including the 3-kw shunt-wound exciter, is only 2740 lbs., while a standard 90-kw machine weighs 8800 lbs. As is only natural in a machine where the weight has been so materially reduced that the temperature rise is higher and the efficiency lower than in standard apparatus of the same output. The higher temperatures are fully provided for by the type of insulation employed; there is no paper or muslin used anywhere in the machine. The armature coils are insulated with mica, the commutating pole coils with asbestos, and the field coils are wound with enamelled wire. The armature leads to the commutator are riveted as well as soldered, although the precaution has been taken to use pure tin for soldering, the melting point of which is over 200 deg. C. Air ducts of ample dimensions are provided to insure a large volume of air being circulated through the core. The efficiency is 88 per cent, being only about 3 per cent lower than a standard machine having a temperature rise of 35 deg. C.

A storage battery, which is connected permanently in shunt with the exciter generator, is used for supplying energy to the lighting circuits. A Tirrill regulator holds the voltage constant on the lighting circuits, while a rheostat in series with the field coils of the main generator allow its voltage to be varied at will. The two motors are connected in series or in parallel, according to the speed desired, but the usual series resistance is omitted.

During a recent test of the car over 78 route-miles in the neighborhood of Albany, Schenectady and Mechanicsville, fully loaded with passengers, the speed varied from 23 miles per hour on a 1.3 per cent up-grade to 56 miles per hour on a .25 per cent down-grade, with 50 miles per hour on a level track. The operation of the equipment was satisfactory in every way, neither vibration nor sound of the engine reaching the passengers. The car was heated readily from the exhaust system, although the day was cold and the air keen. The two motors were under such perfect control of the operator that the acceleration was noticeably smooth and free from jerks.

Electric Welder.

The welding machine illustrated herewith is so arranged that an enormous value of current at very low voltage exists at the abutting ends of the pieces to be welded. The heat produced at the high-resistance point of contact quickly raises the temperature to the welding point. The machine receives its supply of energy from alternating-current circuits at any convenient potential. The following table gives the power, the time and the energy required for welding various sizes of iron and steel:

Round in. dia.	Power. hp.	Time. sec.	Energy, hp-sec.
.25	2.0	10	20.0
.50	6.5	21	136.5
.75	13	31	403
1.00	22	40	880
1.25	33	50	1650
1.50	45	60	2700
2.00	68	81	5508

The power stated above is the value at the generator while the time is that required solely for the use of the electrical energy.

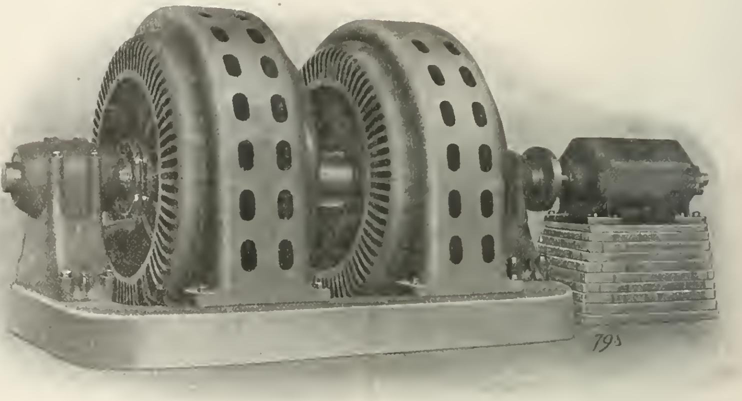
SINGLE ELECTRIC WELDING MACHINE.

A square piece requires from 25 to 50 per cent more power and from 12 to 50 per cent more time than does a round piece equal in diameter and the side of the square. Copper pieces require from two to three times as much power and only from 50 to 70 per cent as much time as does an iron piece of the same size.

The above described welder is built by the Warren Electric Manufacturing Company, Sandusky, Ohio. Machines are made both for single welding and for double or T-welding.

Frequency Converter.

The accompanying illustration shows a Crocker-Wheeler frequency converter set installed in the Pennsylvania Steel Company's plant at Steelton, Pa. The set consists of a 14-pole synchronous motor mounted on the same shaft with a six-pole alternating-current generator and directly coupled to a direct-current starting motor. It is used to change the frequency from 60 cycles to 25.7 cycles. It is driven by energy received from the circuits of the York Haven Power Company, and generally carries a part of the load of the steel company's plant independently of its power plant.



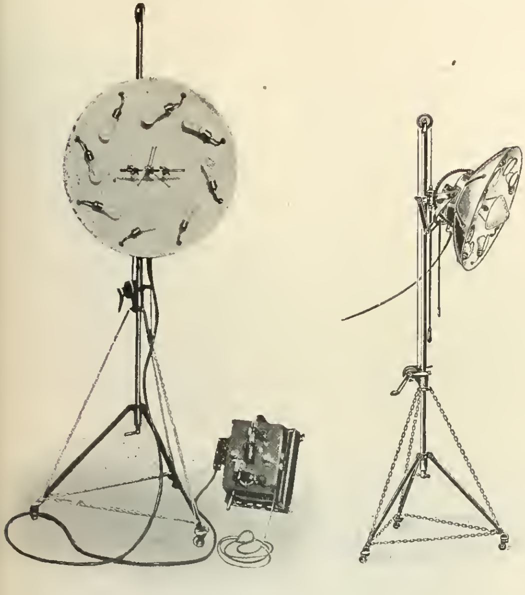
FREQUENCY CONVERTER WITH STARTING MOTOR.

Arc Lamp for Photographic Purposes.

The accompanying illustration shows the Jupiter lamp for photographer's use introduced by Felix Hamburger, of 78 Fifth Avenue, New York. The lamp differs from other lamps used for this purpose in that the light is produced by a brilliant flash across a pair of arcs, thus making it possible to take instantaneous photographs in the dark or indoors, a feat hitherto possible only outdoors on a bright day and indoors by the use of some form of flash powders, which filled the place with objectionable smoke. The series of operations by which the arcs are struck is automatically performed by the lamp mechanism and follows when the operator presses a bulb at the camera.

As shown in the illustration, a parabolic reflector has eight 32-cp frosted bulb incandescent lamps arranged around its circumference and at the focus of the parabola, a double arc having three carbons in the same horizontal plane. These are held by three arms, the two outer arms being adjustable through regulating mechanism at the rear. The arcs are struck through the intervention of an electromagnet for snap-shot work and for time exposures the carbons may be fed by hand by means of a flexible shaft. Another flexible shaft is provided for tilting the reflector, which is capable of universal adjustment. The lamps are connected by a cable to the regulating apparatus, which is suitably mounted in an iron box. The switching and regulating apparatus consists of a suitable resistance, the regulating mechanism for time exposures and the switching devices for snap-shot work. The last is an electrically operated contact maker which cuts out a great portion of the lamp resistance.

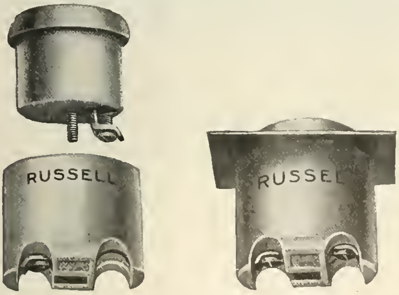
The great brilliance of the light from the two arcs is responsible for a high development of actinic rays, while the rapidity of the exposure precludes the possibility of any movement on the part of the sitter from effecting the plate. The arcs are shielded by a conical, frosted-glass screen, and since the focus is taken by means of the eight 32-cp lamps, the eye of the sitter accommodates itself to the brilliance so that when the arcs flash the eye does not shut nor possess that startled appearance so noticeable in flash-light work. Moreover, the effect produced by the focusing screen is almost identical to the effect produced by the arcs, so that this may be taken as that produced on the photographic plate.



FIGS. 1 AND 2.—ARC LAMP FOR PHOTOGRAPHIC PURPOSES.

Labor-Saving Sign Receptacle.

The receptacle illustrated herewith is used for metal-faced signs, or for outlet boxes to be fastened to the covers. It is installed by placing the smaller porcelain piece through a hole in the face of the sign, or in an opening in the cover, and the larger piece is slipped on at the back, and the central contact screw is then tightened. All contacts are thoroughly protected.



FIGS. 1, 2 AND 3.—RUSSELL RECEPTACLE.

It is stated that the receptacle is weatherproof, and can be used to great advantage on account of the small surface occupied.

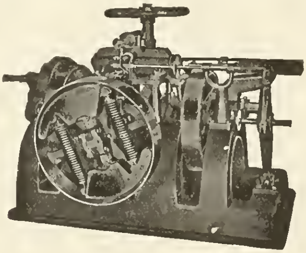
The Russell sign and outlet box receptacle has been approved by the Underwriters. It is manufactured by the E. H. Freeman Electric Company, Trenton, N. J.

Water-Wheel Governor for Large Units.

The two types of improved governors which the Holyoke Machine Company, of Worcester, Mass., has had upon the market for the past five years, have met with such success that the company has just placed on the market a larger model which will be known as Type "C." Owing to the increased size of hydroelectric units installed or under construction at the present time, the company decided to build governors powerful enough to handle these units and thus to keep abreast of hydroelectric developments. The new and larger type of governor is capable of exerting 75,000 ft. lbs. of energy in four seconds and it is possible to increase this energy to 100,000 ft. lbs. by increasing the time element of the governor, or in other words by making the governor act in about six seconds.

The governor is designed with a special hand wheel arrangement which will make it practicable for one man at the hand wheel to apply a force equal to that exerted by the governor in case it is necessary to operate the gates of the wheels by hand in emergencies.

The governor is designed along the same general lines as the other governors built by the company. One of the principal advantages of the Type "C" governor is the fact that although the governor exerts a large amount of energy, the size of the pumps and cylinders used in connection with the friction clutches, have not been increased. Other advantages are as follows: The governor is provided with a special device which is arranged so that the relaying effect may be varied at various stages of the gate opening, thus making it possible to handle the hardest kind of load changes and maintain a close speed regulation of the unit. The device is also designed so that the time element of action may be varied to meet the different conditions caused by the action of water flowing through long feeders. The time required by the governor to open or close the gates can be considered in connection with the proper speed at which the gates should be moved, in order that the gates shall move no faster than the water will follow under natural conditions. This timing element obviates the tendency to race and the governor may be installed without endangering the feeders by the action of the water, caused by rapid closing of the wheel gates. The governor is provided with a synchronizer which may be operated from any desirable point in order to phase machines, and also has attachments so that it may be made to run in parallel with other machines. The governor may be provided with an electrical stop which will enable the operator to shut the unit down in case of emergency, from buttons located at various points about the power plant or mill. Lately a device has been added which is used when the water-wheel is running in connection with steam units so that the water-wheel will use all the available water up to the capacity of the wheels on which the governor is in use and not allow any to pass over the dam.



WATER-WHEEL GOVERNOR.

This allows the engine to supply the necessary power and to keep the speed at normal, making the water-wheel governor open the gates only the amount necessary to use the available water.

Exhibits at the Chicago Electrical Show.

For the convenience of readers the following report of exhibits at the Chicago Electrical Show has been arranged to bring together, so far as possible, descriptions of exhibits of the same class:

INCANDESCENT LAMPS.

The tungsten lamp exhibits were the great features of the show from an electrical man's standpoint. The first exhibit of American made tungsten lamps was at the 1907 show. The 1908 show marks the placing of the lamp on the open market in quantities showing that the year has brought the lamp from the curiosity stage to that of a regularly manufactured article, with a good number in stock in Chicago houses.

The National Electric Lamp Association engineering department flooded its exhibit and vicinity with light from a large number of 40-watt, 32 horizontal candle-power tungsten lamps. This is the size of tungsten lamp which the companies of the National Electric Lamp Association are turning out in the largest quantity. Most of these tungsten lamps were shown in bowl Holophane reflectors, as a deep reflector is almost imperative with the high candle-power and high intensity of the tungsten lamp, in order to reduce the brilliancy to a comfortable point. Some tungsten lamps were also placed on the festoons over the booth which formed a part of the regular decorative lighting scheme of the Coliseum. The color of these lamps was in marked contrast to those of the common carbon filament lamps in the rest of the building and was noticeable from all parts of the building. The color contrast between the tungsten lamp and the common incandescent was further even more strongly brought out by various color tests offered to visitors in the booth. Several boxes were provided in which there were dry goods, which could be lighted by either common carbon or tungsten filament incandescent lamps. By means of a snap switch the tungsten lamps would be turned on one instant and the common carbon lamps the next instant. In another piece of apparatus a part of a picture would be shown under the light from the tungsten lamp and another part was shown under the common incandescent lamp. Pictures and goods containing much blue were shown much better under the tungsten lamp. In fact, the common carbon lamp appeared to almost kill the color effect of some delicate blue tints. It was thus practically demonstrated that, in addition to a reduction of 40 per cent in current required over the most efficient common carbon filament lamps, the tungsten lamp has another important advantage in having a color approaching nearer to daylight.

The General Electric Company showed principally tungsten lamps of 100 watts and 80 mean horizontal candle-power, this being the size which the Edison Lamp Works have so far been principally turning out. Some of these were shown in enameled bowl reflectors which gave a beautiful diffusion.

The G. I. tungsten lamps in 40 and 60 watt sizes were on exhibition in M. B. Austin & Co.'s booth, which company now has a stock of these lamps in Chicago.

The Moline Incandescent Lamp Company exhibited 100, 75, 50, 40 and 20 candle-power Gem metallized filament lamps.

The Excelsior Supply Company exhibited six-volt four-candle tantalum lamps. These lamps are supplied with current by storage batteries and are intended for use in making repairs on automobiles or for temporary lighting in house closets or wardrobes or other confined space where the use of matches introduces a fire risk.

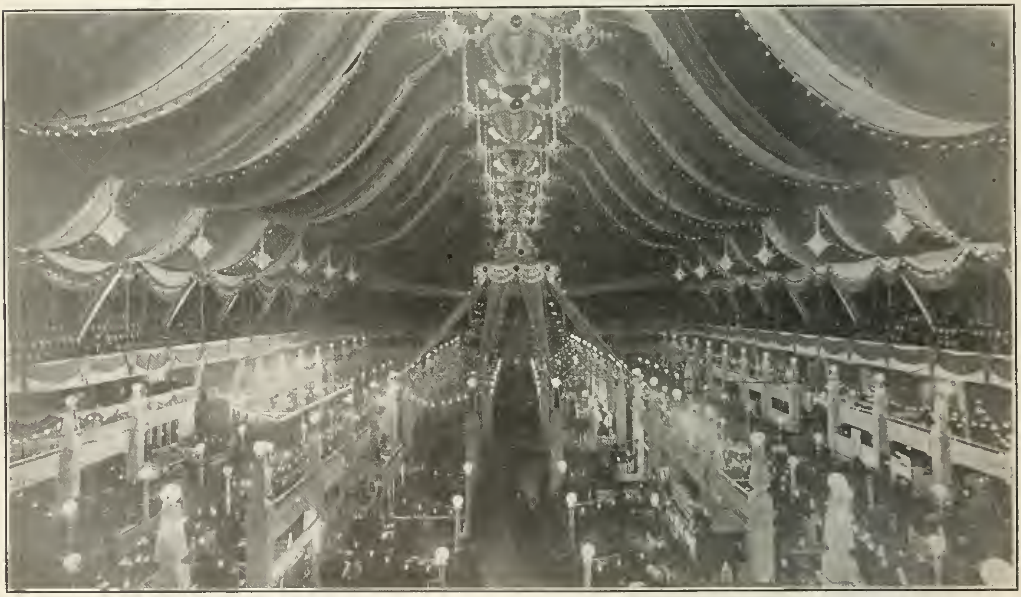


FIG. 1.—GENERAL VIEW OF CHICAGO SHOW; CENTER AISLE.

The "Linolite" tubular lamp, which has been manufactured in England for some time and has just been put on the market in this country, was exhibited for the first time as an American product by the H. W. Johns-Manville Company. In the "Linolite" system the lamps consist of tubes, with brass terminal caps on each end. The filament extends from one end of the lamp to the other, with anchors at two points and a slight spiral in the middle to provide for contraction and expansion. The lamp fits in between terminal blocks, every alternate block being positive and the others negative. The terminal blocks were fastened in an aluminum trough reflector, the edges of which are curled over to form a metal conduit for the wires. The arrangement is very compact and substantial. The system is specially adapted to the lighting of show cases, pictures and book-shelves, where the size of ordinary trough reflectors is objectionable. Each lamp is 1 ft. long and is the equivalent of a common 16-cp incandescent lamp in wattage. A common carbon filament is used in the lamp.

The American Electrical Novelty & Mfg. Company had on exhibition for the first time a high candle-power "Osram bulb," a miniature lamp connected to a dry battery for use in mines, etc. The company claims for this lamp an increase in candle powers of from 500 to 600 per cent over the average run of lamps of this kind.

The Central Electric Company had 40 and 60-watt tungsten lamps on exhibition.

ELECTRIC COOKING AND HEATING.

The Simplex Electric Heating Company showed a new quick-heating tea kettle in which the heating element is incorporated with the bottom of the kettle. A 10-gal. water boiler for connection to a piping system was also among the newer heating devices. A complete line of new chafing dishes of new design with copper finish were shown. A 250-watt food warmer, 10 x 14 in., was another new addition to this company's heating line.

The General Electric Company has brought out recently a number of new heating appliances which make its line of this class of goods more complete. The luminous radiator has been adapted to an ornamental grate with a pressed brass back, so arranged that, while the effect of a grate is obtained, all of the heated air is thrown out into the room and is not allowed to escape up the chimney. An improvement which will be welcome to the many central-station companies and users which have had trouble with flatiron cord terminals is the new spring contact flatiron cord terminal, which insures a better electrical contact and provides better for unavoidable inaccuracies of manufacture than did the former type, which had rigid plug receptacles. The new receptacles, which fit over the regular standard cartridge terminals of the iron, are so provided with springs as to allow for wear and for variations in manufacture. An improvement recently made in the oven is to use flat heating units in top and bottom similar to the quartz enameled units used in the water boilers and similar utensils. The oven bakes more rapidly than the former type. A combination cereal and vegetable cooker and steamer which has before been made in 2-qt. sizes was also shown in the new 4 and 6-qt. sizes. A chafing dish table is now sold in connection with heating appliances. This is a small, finely-finished table for dining room use, provided with two receptacles and push flush switches. The heavy aluminum glue pot which the company now makes is meeting with much success, as it is of high efficiency, the makers claiming that only one-sixth of the wattage necessary for the ordinary electric glue pot is needed for this. The large radiating surface automatically protects it against overheating the glue, so that a double pot with water jacket is not needed. The company is sending out 25,000 circular letters to glue pot users all over the country, in the hope of assisting local central-station companies in the introduction of this glue pot. Other new heating devices were tea kettles of 2 and 4-qt. sizes, a corn-popper, and a shaving cup in which the cup proper is white enamel. Tailors' irons of 12, 15, 18 and 24 lbs. were also among the new devices shown.

The Geen Electrical Manufacturing Company exhibited a line of electrical novelties, which included the "Never Fail Cigar Lighter." This device consists of an alcohol lamp which is lighted by a wire heated sufficiently for the purpose by a small battery.

HAIR DRIERS.

A notable thing about the hair drier exhibits was the increasing number of small portable hand devices suitable for general popular use wherever current is available.

The Shelton Electric Company, Chicago, showed a new 2¾-lb. hand motor drier, with a 20-watt fan motor blowing air through a short pipe containing a 180-watt heating coil. The motor is the same as used on the Shelton hand motor vibrators. The fan blower is of the centrifugal type. A three-point switch is mounted on the motor.

In the bathroom of the house of the Commonwealth Edison Company hair driers made by Halliwell, 109 East Twelfth street, New York, and M. Thome, of Chicago, were shown. Both these driers employ large fans placed in a box on a pedestal or stand. Among the small driers in the same house were the Shelton and the Arnold, both using small hand motors operating tiny fans.

The C. F. Birtman Company exhibited an electric hair drier, which consists of a small motor-driven fan, which discharges the air through a tube containing an electric heater. The device is mounted on a pedestal, and the tube may be adjusted to different heights and positions. The hair drier consumes 220 watts and it is said will dry the heaviest head of hair in from 5 to 10 minutes.

VACUUM AND COMPRESSED AIR CLEANING.

A self-contained electric renovator was exhibited by the Illinois Electric Renovator Sales Company. The device consists of a motor and fan together with a dust receptacle mounted on a small truck provided with a handle similar to that of the lawn mower. The plant is built largely of aluminum and weighs about 100 lbs. Mounted in a suction case at the front is a motor-driven brush, which acts similar to a carpet sweeper except that the suction of the air assists in cleaning the floor and also draws dirt and dust away from the brush. The heavy dirt is dropped into a box. The finer particles are carried through a screen and into a dust receptacle. The two centrifugal fans are driven by a half horse-power motor at 350 revolutions a minute. The device is provided with a hose connection, to which different cleaning attachments may be connected through hose.

The General Compressed Air & Vacuum Machinery Company made a large exhibit of motor-driven vacuum and combination vacuum and compressed air house and carpet cleaning outfits. The smallest shown was equipped with a 5-hp motor.

The Chicago Pneumatic Tool Company exhibited a vacuum cleaning and scrubbing machine for use in homes. The entire plant is contained in a box about 2 ft. 6 ins. high, 2 ft. 6 ins. long and about 15 ins. wide. The box is mounted on a small truck. The vacuum is produced by motor-driven bellows. Current is taken from any lamp socket, as the consumption is only about 200 watts. The device draws in about 25 cu. ft. of air per minute with a 3-in. vacuum. In scrubbing a floor soap is forced down through the brush and the suds and dirt is sucked into a tank in the machine.

Wallace Brothers, 110 Indiana Street, Chicago, had on exhibition in the "House Electrical" a portable vacuum cleaning apparatus, equipped with a 1-hp alternating-current motor. This apparatus is sufficiently portable so that it can be moved from one room to another in a house and upper floors can be reached by extra lengths of hose. The amount of current required is small enough so that no elaborate provisions have to be made for current supply, and it is, therefore, valuable not only to those who wish to purchase such a device and make it a permanent part of the house equipment, but to those who would make a business of house-to-house cleaning among customers having electric light service.

INSTRUMENTS AND METERS.

The Wagner Electric Manufacturing Company had on exhibition a complete line of its re-designed alternating-current and direct-current instruments. The new instruments have cases more suited to present day requirements. Among the instruments shown was the new type B illuminated dial switchboard voltmeters and ammeters, which are mounted on the front of the switchboard.

A pocket instrument shown by the Jewell Electric Instrument Company weighs three pounds and measures approximately 3½ ins. x 5 ins. x 1½ ins. x 1¼ ins. It is built with an aluminum case. Each instrument is provided with a leather carrying case, similar to a camera case. It has two scales for voltage readings and one for amperes. The movement is of the D'Arsonval type. The scale is uniformly divided and is 5 ins. long. The 150-volt instruments of the Jewell type have an internal resistance of 20,000 ohms. The company also exhibited a new type of illuminated dial instrument. The Jewell company also showed its new line of alternating-current "baby" instruments. These instruments are of the round type with cases 6 ins. in diameter and are dead beat. They consume approximately three watts. There was also shown a four-reading laboratory instrument for both alternating and direct current.

FIG. 2.—GENERAL VIEW FROM SOUTHEAST.

The Universal Manufacturing Company, which makes flat rate controllers for taking the place of meters with flat rate electric lighting customers, has made important improvements in these devices the past year. The controller consists of a switch which is made to periodically interrupt the circuit when the maximum load contracted for is exceeded. The latest controllers have no springs and instead of a flat contact gravity switch a regular knife switch with spring contacts has been substituted.

The Fort Wayne Electric Company exhibited a meter testing device which is a master meter connected in multiple with the meter to be tested. The watts passing through the instrument in a given time are determined by counting the revolutions of a dial and multiplying by a constant. The device was recently described in the Electrical World.

The H. W. Johns-Manville Company exhibited some new types of the Victor electric meter which reads in volts, amperes and kilowatts, or horse-power. This meter is already well known as consisting of a voltmeter and an ammeter, each with a dial, but with pointers crossed so that the point of crossing indicates the kilowatts. A new inspector's meter of this type was shown which, by the use of easily inserted shunts, can be used on any current up to 750 amperes.

The Bristol Company showed for the first time a complete set of portable Bristol recording instruments. With the ordineary type of Bristol recording instruments for electrical measurements of temperatures and pressures, users are already very familiar. There has been an increasing demand, however, for portable instruments which could be carried from place to place and left temporarily for record purposes at different points on an electric distribution system. The portable instruments are furnished complete with ink and chart holders in a carrying case. The movable coil which actuates the pointer is locked to prevent injury while the instrument is being carried.

Duncan meters with several improvements were exhibited by the Western Electric Company.

The Electric Appliance Company exhibited several types of Sangamo meters. Both alternating and direct-current meters were shown. All were provided with glass covers so that the working parts could be observed.

AUTOMATIC AND TIME SWITCHES.

A time switch without clockwork or clock was a novelty brought out by the Universal Manufacturing Company, of Chicago. Details of the mechanism were not yet given out, but it was stated that it could be set so as to operate either at a given hour or at a different time every day for a week.

The Albert & J. M. Anderson Manufacturing Company exhibited the improved Anderson time switch.

The Electric Manufacturing Company exhibited the M. & R. high potential cut-out, which is installed near the point at which the service wires enter the building. The switch is so designed that when a potential 100 volts higher than that of the service is thrown on the circuit the switch is opened. The device is intended to protect low potential circuits from damage due to crosses with high potential circuits or due to leakage from such circuits.

LINE AND CONDUIT CONSTRUCTION MATERIAL.

The United States Conduit and Construction Company exhibited a new multiple conduit. The conduit is made of concrete in short sections, the sections being split at the horizontal diameter of the opening. The sections interlock both ways. All exterior joints are laid up with mortar, and two or more sections when laid form a complete self-contained conduit. The construction insures alignment, and if desired the cables may be installed as the conduit is led.

The McRoy Clay Works exhibited its standard line of underground conduit. Six, four, three and two-duct conduits with bends were shown.

The American Conduit Company had on exhibit samples of its bituminized fiber conduit and illustrations of the proper method of installing the same. The company also demonstrated the adaptability of its products for other uses in the electrical industry.

Included in the very complete exhibit of lineman's tools made by Mathias Klein & Sons was a new device known as the "Chicago grip." This grip is so designed that the wire may be passed through it without bending, and holding power of the grip, it is claimed, is increased considerably by the design.

The H. W. John's-Manville Company exhibited a new manhole cut-out box for enclosed fuses on 2500-volt circuits. Iron case service fuse boxes for 250 to 600 volts were shown with a new arrangement for filling fuses, which is an improvement on the former claw arrangement. By this one or all of the fuses in the box can be reached when the box is open. There is also a device for preventing fuses from being left with improper contact between the blades and fuse.

FIG. 3.—CENTRAL CANOPY.

B. S. Barnard & Company exhibited a complete line of underground vitrified clay conduits, embracing every type known in the trade. Mr. E. F. Kirkpatrick, who recently became vice-president of this company, with headquarters in Chicago, represented his firm at the exposition.

H. B. Camp had an exhibit of underground tile conduit ranging in size from nine duct to single duct. A tile cable support for railway feeders was also shown.

The Vote-Berger Company exhibited the D. & T. (drive and twist) guy anchors. The anchor, after being driven to the required depth, is twisted to spread the blades on the lower end.

ELECTRIC SIGNS.

The Solar Electric Company exhibited canteen signs, which consist of globes made in the shape of army canteens, in which the lamps are placed. The letters are on the globes in translucent colors. Color caps for incandescent globes were also shown.

The Federal Electric Company had a very large exhibit of electric signs of its regular enameled steel construction, with federal receptacles.

MOTOR-DRIVEN HAND AND MACHINE TOOLS.

The McDowell-Stocker Company exhibited several types of motor-driven machine tools. Included in the exhibit were two types of engine lathes, punch press, rivet-spinning machine and shaper. Motors are mounted directly on the machines. The motor for the rivet-spinning machine is of the vertical type and is connected direct to the spindle. The shaper was driven by a Lincoln variable speed motor.

The Chicago Pneumatic Tool Company exhibited a machine for driving screw spikes in railroad construction. The machine is built similar in many ways to the electric drills put out by the company, but with a socket at the end of the shaft for receiving the spike head. A magnet switch is supplied, which breaks the circuit when the spike is driven home. The company also exhibited a new line of large size drills. These are built for alternating current for drilling 2-in. holes and in direct current type for 3-in. holes.

MOTOR CONTROLLERS.

Erwin & Co. exhibited an automatic starting switch, which is used in connection with pumping systems for supplying high buildings. The water is stored in an automatic pressure tank in the basement, and the motor-operated pump forces the water directly into the tank. The switch is pneumatically operated and is set for maximum and minimum pressures.

The American Electric Fuse Company presented the Allen-Bradley controller. The resistance is of a new type, consisting of columns of graphite discs. These, however, are not made of plain graphite, but of a special mixture. The company claims for these controllers an extremely fine regulation and great durability. They are made in sizes from 3½ to 50 hp. Parts are interchangeable and all visible, and the condition of the mechanism can be ascertained at a glance. The company also produces a line of motor starters and battery charging rheostats based on the same principles.

The Wagner Electric Manufacturing Company exhibited a new type of induction motor starters for polyphase motors. The switching device is in an entirely separate case from the auto transformer part of the starter and it is so arranged that the running fuses are cut out for starting, or separate starting fuses may be provided.

ARC LAMPS.

American-made Q-I flaming arc lamps were shown by the Central Electric Company. The operating parts of this lamp are of a very compact design and solidly connected together, so that they can be instantly removed and the whole mechanism replaced without taking the whole lamp back to the shop.

Felix Hamburger exhibited the Siemens flaming arc lamps and also a new electric flashlight, "System Schmidt," a German product, in the booth of the Monarch Electric & Wire Company, with whom he occupied the booth jointly. The flashlight proved the drawing card of the exhibit. It is intended to take the place of the commonly used powder flashlights for photographic purposes, thereby doing away with the obnoxious features of smoke, smell and the danger of explosion, besides eliminating the services of an assistant. It consists of a couple of arcs in series, with a pneumatically controlled rheostat, which allows a momentary current of about 30 amperes to pass when a bulb is pressed.

STORAGE BATTERY APPLIANCES.

A signalling hydrometer with other appliances necessary to make its operation reliable was shown for the first time by the Electric Storage Battery Company. This hydrometer placed in the liquid has a compensating feature incorporated in it whereby the indications of the hydrometer are corrected for temperature. The hydrometer is connected mechanically with a relay in a glass case on top of the pilot cell. Whenever the specific gravity falls above or below certain limits this relay makes contact and rings a signal bell to warn the battery attendant. The relay can be adjusted to make contact at any specific gravity desired. Another feature necessary to make the signalling hydrometer a success is an automatic cell-filling device which keeps a constant level of the electrolyte in the cell. A glass tank of electrolyte is placed at a higher level than the cell and has a glass drip nozzle, which allows electrolyte to drip into the cell, except when a float closes the nozzle by pressing a piece of rubber upward against it. With the combination of signalling hydrometer with the compensating feature and the automatic cell filler, the signalling hydrometer can be made to give very reliable records. In addition to being made signalling, it may be made recording, so that the voltage of the cell can be continuously recorded on a piece of paper fastened on a drum.

A device for charging small storage batteries was exhibited by the Vivax Storage Battery Company. The generator, which has a capacity for 3½ amperes when attached to the running gear of an automobile and connected to the batteries, eliminates the necessity of removing the batteries for charging.

The Vivax Storage Battery Company also exhibited a small portable storage battery connected to a bracket lamp adapted for use in houses not wired for electricity. One battery shown had a capacity of 175 amperes at 6 volts.

WIRES AND CABLES.

The American Electric Fuse Company put on exhibition samples of its new black enameled wire, which it recommends in place of silk covered magnet wire. The company claims that the enameled wire is considerably cheaper and its insulation better than silk. When wound on a coil it will stand more current and will not char from heat, as does silk. The enamel is tough, elastic and continuous, not affected by water and insoluable in solvents, such as petroleum, alcohol, benzine, turpentine, etc.

The American Steel & Wire Company presented a very attractive exhibit, with a number of new features. Among these was a submarine power cable for 25,000 volts. Worthy of attention was a new type of a crown rail bond, for which this company claims specially good conductivity and long life, by reason of an exceptional solid union between the crown and the conducting portion. An electrically operated rail bonding tool was shown, in addition to the above-mentioned features.

The Duplex Metals Company exhibited Monnot copper clad products, consisting of a mechanically welded surface of copper or steel wire for telegraph or telephone work and power transmission.

Included in the exhibit of John A. Roebling's Sons Company, which consisted of the company's standard line of bare and insulated wire and cables, was some extremely small wire, one thousandth of an inch in diameter. One ounce of this wire has the length of four miles.

INSULATING MATERIALS.

The H. W. Johns-Manville Company, in addition to its asbestos lamp and transite board, had on exhibition a new product called asbestos ebony wood. This is asbestos impregnated with a black compound, which will allow it to take high polish and prevent absorption of moisture. Tests were shown giving a very low percentage of moisture absorption for this material. It will not, of course, stand the high temperatures that unimpregnated asbestos compounds will, which will absorb a larger percentage of moisture.

Some interesting insulators made for recent high tension railway and tunnel installation by the Electros Manufacturing Company were exhibited by F. W. Pardee, general sales agent at Chicago.

A. Grothwell exhibited Mogul insulating paints and varnishes, including armature varnishes, acid and alkali proof compounds, electrical compound and boiler and stack paints.

FAN MOTORS.

The Robbins & Myers Company, of Springfield, Ohio, brought out a new 9-in. fan for direct and alternating current circuits. This fan meets the demand for a fan motor of low wattage for use in residences and in small offices where the 12-in. fan is larger and more vigorous than necessary. The motor used is a small commutator type motor both for direct and alternating current. The workmanship of the fan is equal to that on any of the larger fans, but, being of small size, it is possible to make the price low enough to insure its popularity. The motor has bronze bearing sleeves and wick oilers. The base is provided with a starting and stopping switch and a rheostat giving two speeds, approximately 1000 r. p. m. and 1700 r. p. m. At the slower speed the fan is practically silent. The weight complete is only 7 lbs., so that it is much more portable than larger types of fans. This company's oscillating fans are now made for both alternating and direct current. The oscillating feature greatly increases the cooling efficiency of the fan, because it can cool a much larger area than can be covered by a fixed fan. These oscillating fans are made in 12-in. and 16-in. sizes.

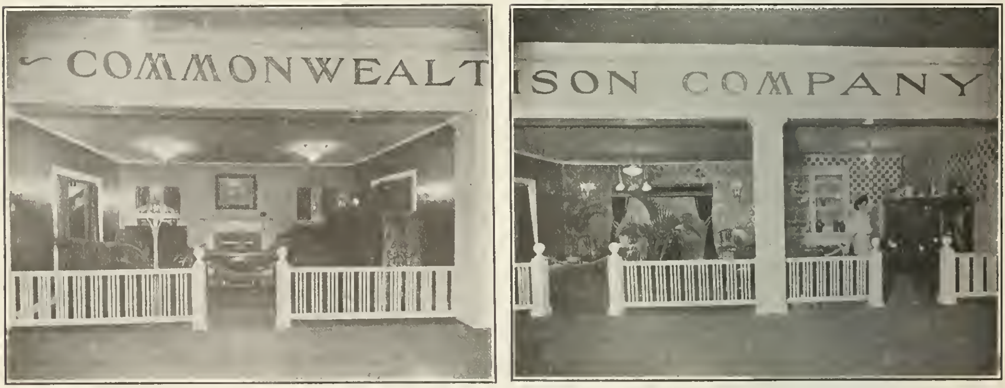
Dr. G. W. Haverstick exhibited "ocean breeze" fans. An electric fan of the ordinary type is placed behind a cylinder approximately 3 ft. long. An extension from the shaft of the motor operates an additional fan at the further end of the cylinder. The inside of the cylinder is provided with small open tubes, which are kept filled with water by a water spray. Water also fills the bottom of the cylinder. The air, in passing through the spray and over the water in the tubes, is delivered pure and fresh into the room. It is claimed that the temperature of a room may be quickly reduced to approximately that of the temperature of the water. The water is supplied to the cylinder from a hydrant through a small tube contained in a larger one, which serves as a discharge and overflow.

INTERIOR WIRING AND CONSTRUCTION.

Under this head are included devices of interest to the interior wiring contractor and engineer.

A new current tap exhibited by the Benjamin Electric Manufacturing Company has a rotating sleeve, which makes it unnecessary to turn the device to which the cord is attached when screwing the plug into the socket. The cord can be led out at any angle, and the tap may be fixed in any position. The tap has a well-protected porcelain base, and it may be obtained with any finish desired.

The Manhattan Electrical Supply Company exhibited a floor tread for use in the dining room or vestibule for operating an electric bell. The tread may be placed under the rug, and the circuit is closed by a slight pressure with the foot at any point. The bottom is covered with felt to protect a polished hardwood floor. The company also exhibited a combined socket and attachment plug for tapping current from a light fixture to operate a fan motor, drop light, flatiron or other electrical device without disturbing the light from the lamp remaining in the socket. The Mesco separable attachment plug, which is so designed that it will separate at any angle and without damage to the socket or cord was also shown. It is built with spring contact clips of gun metal bronze.



FIGS. 4 AND 5.—LIVING ROOM, DINING ROOM AND PANTRY; COMMONWEALTH COMPANY'S EXHIBIT.

The Spaulding-Bates Company exhibited the Bates globe cleaner and adjuster. This is a device for cleaning and removing lamps placed at a height which would otherwise be accessible only by the use of a ladder. A lamp holder is fitted to a long rod, and the lamp is unscrewed or screwed into the socket by turning a handle at the lower end of the rod. The lamp is cleaned by placing cloth washers in the holder, then revolving it by means of the crank. The device is built to reach ceilings 20 ft. high or higher.

FIG. 6.—KITCHEN; COMMONWEALTH COMPANY'S EXHIBIT.

W. N. Matthews & Bro. exhibited several new designs of "hold fast" lamp guards. The new types are made of stronger and heavier wire and with clips across the ribs. The guards are also made longer, so as better to protect the end of the lamp.

The Chicago Fuse Wire and Manufacturing Company exhibited its standard line of enclosed fuses and blocks, fuse wire and links, union outlet boxes and conduit boxes.

Arthur O. Einstein exhibited for the Pratt Chuck Company a new line of galvanized conduit junction boxes. Special merits are claimed for these boxes in that they are galvanized instead of enameled, like other boxes on the market. The covers for the same can be put on and removed without taking out the screws, which feature represents a saving to the contractor, and is patented.

The new Benjamin separable wireless cluster, described in the Jan. 4 issue of the Electrical World, was exhibited by the Benjamin Electric Manufacturing Company. The cluster consists of two principal parts, separably connected. The separate base may be installed and the cluster proper screwed in position afterwards. When it is desired to clean the glassware or reflectors these may be removed without disturbing the wire or connections by simply unscrewing the cluster proper.

The Gillette-Vibber outlet boxes for use on moulding as well as the type caps and ground clamps of the same company were exhibited by M. B. Austin & Co.

A new attachment plug exhibited by the Benjamin Electric Manufacturing Company has a rotating sleeve which obviates twisting the cord. The plug is unusually small, neat in appearance, and there are no detachable parts to become lost or broken.

The Sterling flexible steel conduit and Thomas & Betts bushings and boxes were exhibited by M. B. Austin & Co.

The Appleton Electric Company made a special display of "unilets," which are outlet boxes not employing metal bushings or lock nuts.

The J. Lang Electric Company had the McWilliams metering panel board mounted in a cabinet containing also a bank of meters and showing how this new panel board can make it possible to connect any desired combination of circuits to a meter, as in a large office or flat building, where a number of meters are located at one point. The large number of connections on this new metering panel board is accomplished by the removal or insertion of screw plugs. In this way the usual mess of meter wires is done away with. This company also showed its universal panel boards.

FIXTURES AND DECORATIVE GLASSWARE.

The Federal couch bracket shown by the Federal Electric Company is a new, handsome design of electric portable lamp employing a half shade. This bracket is adapted also to use as an upright, after the manner of a candlestick, in which case it can be equipped with a silk shade. It can also be used as a piano lamp or as a portable wall bracket hung on the wall.

The Colonial Art Glass Company, of Chicago, had a magnificent display of art glass designs in domes of various sorts, box fixtures and table lamps, the design of C. E. Parkhurst. Besides the shades actually on exhibition, illustrations of various other handsome designs were shown.

A porcelain enameled steel ceiling fixture for porch use was shown by the Federal Electric Company.

The Phœnix Glass Company exhibited some of its new designs in plain and colored glass shades and reflectors.

VIBRATORS.

Vibrator exhibits were noticeably numerous.

The Shelton Electric Company showed, besides its regular line, a new vibrator operated by a flexible shaft from a motor mounted on a table or pedestal. The motor is of the same design as those used on Shelton hand motor vibrators, being a commutating motor for operation on direct or alternating current.

The Moon Vibrator Company exhibited vibrators for use on direct or alternating current or for operation from a portable battery. A standing offer is made by this company to give any responsible party two weeks' free trial. The retail price of the vibrator to operate from electric lighting circuits is $15, the machine being intended for popular use.

The Swedish Electric Vibrator Company had an exhibit showing hand vibrators and a vibrating chair.

The Manhattan Electrical Supply Company exhibited the Morrison vibrator, which consists of a motor, on the shaft of which is a disc which may be set off-center, varying distances to increase or decrease the amplitude of the vibration. The vibrator is intended for either direct or alternating current and is also furnished with dry batteries for use where other current is not available.

The C. F. Birtman Company exhibited a pedestal vibrator of the eccentric type. The vibrator is made either in portable form or is mounted on a pedestal.

The Lindstrom, Smith Company showed a vibrator consisting of a motor entirely enclosed in a shell. An attachment is supplied with the vibrator for securing it to a chair.

MOTORS.

Roth Brothers showed several sizes of their new type S motors. These are of steel and are built very compact. The pole pieces are laminated.

ELECTRIC CLOCKS.

The United Clock Company showed a new mantel clock built without a pendulum and on the principle of a watch. The clock will run a year or more without attention, being automatically operated by dry batteries. The clock is built in Gothic style with mahogany finish and sells for $30.

The company also showed a new line of synchronous clocks operated through wires from a master clock.

The American Clock Company exhibited a new electric time recorder. It automatically changes each minute and the impression shows the exact time to the minute that an employee enters or leaves. The recorder is entirely separate from the clock and connected with it by a flexible cord or wire, so that the operation of the recorder does not in any way affect the clock. Any number of recorders may be connected to the same clock, thereby insuring uniform and accurate timekeeping throughout the system. This company also exhibited a new electric clock especially designed for street and advertising purposes. It also exhibited a regular line of electric time stamps, secondary clocks and self-winding clocks.

DEVICES FOR DEFECTIVE HEARING.

The International Telephone Manufacturing Company exhibited its recently evolved "Auricuraphone" for the use of people with defective hearing. The device consists of an extremely sensitive transmitter, made up in convenient form of such a size that it can be carried by men in the vest pocket or under a lady's jacket. A small receiver connected to the transmitter is held to the ear. The transmitter takes up conversation in an ordinary tone at as great a distance as a good ear will receive it and the sound is amplified in transmitting so as to compensate for the defective hearing.

The Stolz Electrophone Company exhibited a device to assist those with defective hearing. The electrophone consists of two parts—a transmitter and an ear piece, with a total weight of 12 ounces. The transmitter contains the batteries and fits into the average vest pocket. The electrophone, it is said, differs from other electrical hearing devices on the market in that it is an amplifier of articulation as well as a sound amplifier.

TELEPHONE EXHIBITS.

A new party line telephone known as the harmonic telephone was demonstrated by the Stromberg-Carlson Telephone Manufacturing Company. With this system four to eight parties may be connected on the same circuit and any one of the parties may be called selectively.

A new automatic push-button telephone was shown by the Stromberg-Carlson Telephone Company for the first time.

An eight-way Hargis splicing joint was exhibited by W. N. Matthews and Brother. This joint is intended for use at points where the wires of a trunk cable are distributed through smaller cables in various directions.

A new wall telephone shown by the Swedish American Telephone Company has the dry batteries installed in the hinged door carrying the transmitter.

The Monarch Telephone Manufacturing Company showed several new designs of desk telephones having separate boxes for the batteries.

The International Telephone Manufacturing Company made a special feature of a loud-speaking telephone equipment. By the use of an equipment the grand opera at the International Theater was transmitted over the line of the Chicago Telephone Company to the booth and thrown out through a megaphone. There was also exhibited a "telephograph" for transmitting phonograph music over long distance lines.

The Swedish American Telephone Company exhibited a coil removable drop. The coil may be removed with the shutter attached by simply raising a spring with the finger. When the coil is removed calls are not interfered with as they come in on the clearing out drop.

The Vote-Berger Company had in operation a section of a 32000 line multiple ballast common battery switchboard complete, with power plant, storage battery and harmonic ringing telephones. The board was without relay ballast, lamps being used to take up overload.

The Monarch Telephone Manufacturing Company had on exhibition a complete four-party, direct-current, selective telephone system. The system operates without the use of a ringing machine. Instead of the usual machine, a 50-cell dry battery is installed at the exchange. The system is similar to the old pulsating system, except for the substitution of the battery for the ringing machine. The company also exhibited, for the first time, a new line of common battery equipment, including release jacks and keys.

The Automatic Electric Company exhibited in a very complete manner its automatic telephone system.

A new plug restoring drop type board was exhibited by the Stromberg-Carlson Telephone Manufacturing Company.

S. H. Couch & Company exhibited a complete line of their apparatus for interior communication.

Frank B. Cook displayed a complete line of his well-known protective appliances for outside as well as inside purposes. Conspicuous was a new form of central office protecting apparatus; also a line of self-welding wire joints.

The American Automatic Telephone Company had on exhibit one section of a 5000-line automatic exchange board, with banks and multiples. A model central energy automatic exchange, with 'phones, both direct and party lines, was shown in operation. It also exhibited a new line of telephone instruments for wall and desk, as well as a new harmonic ringer. The company uses a two-wire system, with a full metallic circuit, omitting ground in connection with calling.

MISCELLANEOUS.

The C. F. Birtman Company exhibited an electric manicuring set. This consists of a tool, head driven through a flexible shaft by an electric motor. The head is designed to be fitted with saws and other tools for buffing and polishing the nails.

The Ozone Company of America, 141 South Clinton street, Chicago, showed a set of apparatus for purifying water for offices, schools and factories by ozone treatment. It also showed an air-purifying apparatus. In both these types of apparatus a small fan motor is used for securing the necessary air circulation, the air being then treated by the electrical discharge from a high-tension coil.

The Excelsior Supply Company exhibited the Dow Comet Magneto, which is of the high-tension type and which eliminates the necessity of batteries or coils when used with gas engines.

The Joseph Dixon Company exhibited its standard line of motor brushes, crucibles, resistance rods, lubricants and other graphite specialties.

The Studebaker Manufacturing Company exhibited its newer types of electric automobiles, together with a mercury arc rectifier connected for charging the vehicles.

The Nungesser Electric Battery Company exhibited dry batteries, including the "1900" battery and pocket batteries.

F. W. Pardee, of Chicago, showed the Rock Island dry cells.

The exhibit of the Crane Company proved of great interest to those connected with the design or operation of central stations by affording them an opportunity to inspect the latest improvements in valves and steam specialties, especially for high pressures. They found there exhibited a new line of valves and fittings for superheated steam made of cast steel. The seats and stems of the valves are made of pure nickel. The company claims that neither the body nor the trimmings of its steel valves are affected by excessive temperatures. The purely electrical feature of the exhibit was a gate valve operated by a motor attached directly to the stem. The motor is stopped automatically when the opening or closing movement is completed.

F. D. Pearne exhibited a typewriting telegraph outfit. The transmitter consists of an instrument provided with an ordinary typewriter keyboard. This is connected with the receiving device by a line wire and possibly a ground wire. The receiving device consists essentially of a motor driven typewriter, and messages are written automatically on the machine. The connections between the transmitting device and the receiver are similar to those of a quadruplex telegraph system. A polarized line relay is employed.

The Radio-Telephone Company exhibited a combination wireless telephone and telegraph set. Receiving and transmitting stations were installed, one in the company's booth in the main floor and another in the gallery of the building. The device was described in recent issues of the technical press and is identical with that in service on Admiral Evans' fleet, which is now on its way to the Pacific Ocean.

The Wagner Electric Manufacturing Company exhibited its new type of transformer, known as "the high efficiency and standard lighting" type. These transformers are of the shell type and have several new features in the design and the arrangement of the iron and the coils.

The Kellogg Switchboard and Supply Company exhibited a railway telephone of new design. The instrument is housed in a strong box of malleable iron, which when the door is closed effectually protects it from the weather. The telephone proper may be removed from the box and used as a portable instrument.

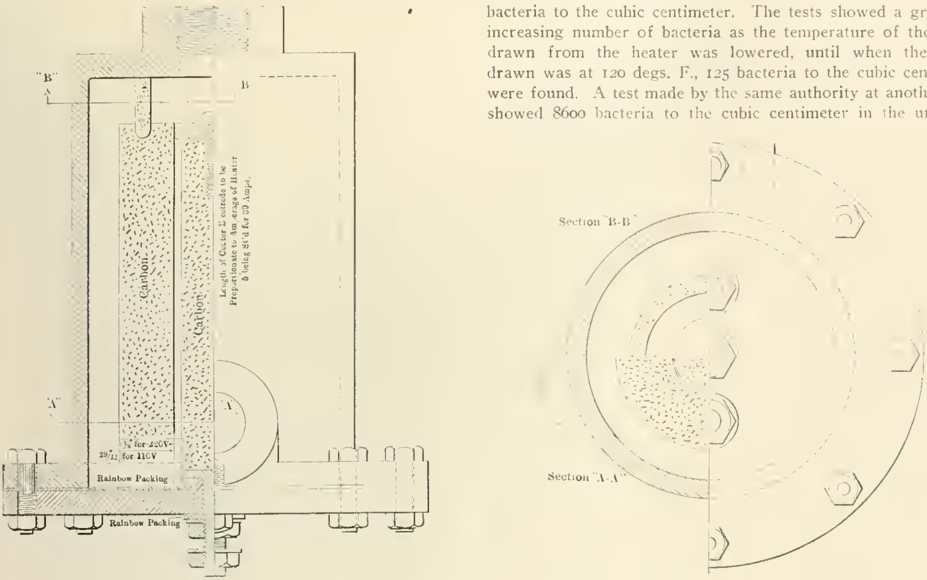
In the exhibit of the Kellogg Switchboard & Supply Company one of its new No. 25 condensers was placed across a motor-operated switch, which broke continuously a current of 5 amps at 220 volts. The presence of the condenser practically eliminated the spark. The condenser is built to withstand 1000 volts and has an insulation resistance of 100 megohms. Its capacity is 2½ microfarads.

The Kellogg Switchboard and Supply Company exhibited an oscillograph used in the design of its telephones to investigate the four-party harmonic system, voice currents, transmitters and receivers and other telephone parts.

Instantaneous Water Heater at St. Louis.

The Union Electric Light & Power Company, of St. Louis, has recently installed for a number of its customers, and also in its model apartments in its salesrooms, a new type of electric water heater which is stated by the company to have given excellent satisfaction. This heater is the invention of Dr. Harry Hill, of St. Louis, and differs from other hot-water heaters in which the current flows through a solid resistance material such as wire. In the Hill heater the current flows directly through the water to be heated, from one carbon electrode to another. In a cast-iron shell are placed two carbon electrodes, as shown in the sectional drawing, Fig. 1. One is a hollow cylinder and the other is a solid plug of carbon. The solid electrode is inserted into the cylinder with an intervening gap of ⅛ to 3/32 inch around, and through which flows the water drawn from the mains. The water acts as a resistor, and thus takes up the heat units directly. An efficiency of 99 per cent is claimed. The wiring connections are made to terminals extending through the bottom plate of the casing or casting, both, of course, being well insulated from the case and connected to their respective carbon electrodes. The plumbing connections consist simply of the intake or supply pipe at the base of the shell. The water flows out through a connection at the top of the shell.

When the heater is applied directly to a bathtub, wash-basin or sink, as in Fig. 2, a Fuller hopper is used in connection with a faucet handle, which handle is connected by a stem to an ordinary snap switch, the internal mechanism of the switch being charged to make a sliding contact. The same stem opens and closes the Fuller cock, and simultaneously opens and closes the circuit. Thus, no energy is used when the water is turned off, but turning on the water closes the circuit. When applied to a house tank, where the supply of hot water is, of course, stored in the tank, the automatic switch is not used, but the meter can be controlled by a switch placed in the kitchen or bathroom, or any other convenienet place in the house. The same plumbing connections are made to the tank as in the case of ordinary gas or coal heater. At St. Louis these heaters in 440, 660 and 1100-watt sizes have been connected to an ordinary hot-water radiator, the radiator being filled with water and the energy supply obtained from the ordinary lighting circuit. The heater in this case serves as an efficient form of room-heater, the radiator, on account of its large radiating surface, giving, it is claimed, superior heating results to an electric air heater of the same wattage. In this case, the radiator is furnished with a small cup at the top to provide for the expansion of the water. It would, of course, be possible to connect a large electric heater of this kind to the hot-water heating system of a house as a substitute for the hot-water heaters requiring coal as fuel. In fact, this has been done in the case of some electric railway cars in St. Louis piped for hot-water heating.



FIGS. 1 AND 2.—SECTION OF ELECTRIC METER HEATER.

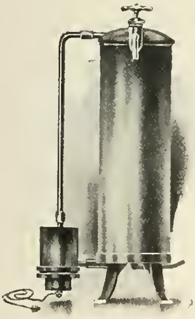


FIG. 3.—HILL HEATER ON HOUSE TANK.

It is claimed that the water passed through this heater has all germ life within it destroyed, and hence that it acts as a purifier as well as a heater. Tests made by Dr. R. B. H. Gradwohl, professor of bacteriology in the Marion-Simms-Beaumont College of Medicine, St. Louis, Mo., are reported as follows: It was found that in the tap water drawn from the city mains at a temperature of 70 degs. F., which had not passed through the heater, there were 15,400 bacteria to the cubic centimeter. Water taken from the heater at 190 degs. F., showed eight bacteria to the cubic centimeter. The tests showed a gradually increasing number of bacteria as the temperature of the water drawn from the heater was lowered, until when the water drawn was at 120 degs. F., 125 bacteria to the cubic centimeter were found. A test made by the same authority at another time showed 8600 bacteria to the cubic centimeter in the unheated water, and only two, three and four bacteria after passing through the heater. Dr. Carl Fish found the city tap water to have 8000 bacteria to the cubic centimeter, 97 per cent of which were destroyed by passing through the heater. The inventor states that the resistance of water used by various communities varies so little that a heater built on this plan is practically suited for all city water. The heater is made in various sizes, the largest being for 20 amperes at 220 volts for house-tank heating purposes, and the smallest for 4 amperes at 110 volts for faucet use. The Union Electric Light & Power Company has the St. Louis rights for the heater. It is controlled by the Hill Electrical Manufacturing Company, 402 Century Building, St. Louis, Mo.

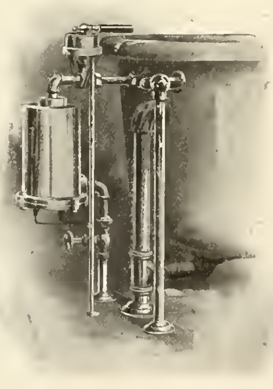


FIG. 4.—HILL HEATER ON BATH TUB.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—A survey of the financial, commercial and industrial situations indicates improvement along conservative lines, although it is probable that a relatively smaller volume of spring trade will be done. A further easing off in the financial situation and very general reports of improvement in collections were the leading features of the week. In trade lines colder weather and snow helped retail distribution somewhat, and wholesalers and jobbers report sentiment improved. The trade demands, however, are still below the normal. One of the best features of the week was the broader market for commercial paper. Buyers are coming into the leading markets in large numbers. Manufacturers are increasing production gradually, conservatism being general, but many industries are not operating more than fifty per cent of their full capacity. Readjustment of wages is still contemplated by many producers before machinery will be started. Railway earnings continue to shrink, and industry is still rather inactive. More life was shown in the pig-iron markets, the principal demand coming from makers of cast-iron pipe. Prices are about steady. In finished lines trade did not develop to any extent, but sentiment as to future demand has improved. Business in steel rails was dull, and demand for structural material continued light. Domestic business in copper was moderately good, but the European demand dominates the situation. It is reported that something like 20,000,000 pounds of electrolytic copper have been sold within the past week for foreign account at a price equal to or better than 14c., and that recent sales have reduced stocks to a point slightly below normal. The closing prices were a little higher, Lake being quoted at 13⅞c., electrolytic 13¾c., and casting stock 13½c. Railway earnings in December, as indicated by preliminary reports, showed a decrease of 4.5 per cent from December, 1906; the preliminary reports for the full calendar year, however, indicate an increase of 7.7 per cent on identical roads. The number of business failures continues high, *Bradstreet's* reporting 431 for the week ending Jan. 16, as compared with 435 for the previous week, and 235 in the corresponding week of 1907.

SHIPMENT OF 25,000-HP ENGINE.—A visitor to the West Allis works of Allis-Chalmers Company one day last week, would have been arrested by the sight of two seventy-five ton cranes engaged in picking up, piece by piece, a million and a quarter pounds of metal, and loading the various parts on flat cars for transportation to the mills of the Carnegie Steel Company, at Sharon, Pa., where they will be reassembled into an engine of no less than 25,000-hp capacity, the largest ever installed in any country of the world. Some idea of the size of this engine may be gained from the fact that two of the castings for it weighed, after machining, 118 tons each, with other parts in proportion, requiring for their transportation the special reinforced 100-ton cars built in the Chicago, Milwaukee & St. Paul shops, at Milwaukee, for Allis-Chalmers Company. The engine, as a whole, weighs 550 tons, without foundation-plates or fly-wheel. It is a horizontal, twin-tandem rolling mill engine, with cylinders 42 in. and 70 in. x 54 in. stroke, designed to operate condensing at 175 lbs. steam pressure, and a speed of 150 to 200 r. p. m., developing its maximum power at the highest number of revolutions. Being used to operate the rolls in a steel mill, it has to be quickly reversed at the end of each run, and the load varies within a few moments from nothing to the maximum power exerted. The reversing mechanism used for changing the direction of the engine is of the Reynolds-Marshall type, and run by a small independent engine with oil cylinder lock. Another small engine is also employed in operating the steam throttle valves, all of these units being under the perfect control of the one engineer. Only a few seconds are needed for the act of reversing.

PLANT FOR RICHMOND, VA.—An Allis-Chalmers steam turbine and generator of 3250-kw capacity, on normal load, constituting the largest electric generating unit thus far installed in the State, is now being placed by the Virginia Passenger & Power Company in its Twelfth Street Station, at Richmond, Va. This unit will operate at a speed of 1800 r. p. m., and is designed to deliver three-phase, 60 cycle current at a pressure of 2300 volts. From the generator bus-bars the energy, after passing through the switchboard, will be stepped up to the transmission voltage and transformed through new 1000-kw motor generator sets located in a sub-station, whence it will be distributed over the trolley lines at the operating voltage. Under the control of the receivers, Messrs. Wm. Northrup and Henry F. Wickham, represented by the present officers of the company, of which Mr. S. W. Huff is general manager, the Virginia Passenger & Power Company has had the most prosperous period in its history; and, with the authority recently granted by the Federal Court, liberal expenditures for improvements are now being made, with the object of still further increasing the earning power of the system. Thus far the principal dependence of the company has been upon hydro-electric power derived from the river, supplemented by steam plants including five generators driven by Allis-Chalmers tandem-compound vertical engines; but the rapidly growing traffic has necessitated the purchase of this new steam turbine unit, which, with its large overload capacity, is expected to provide ample power for some time to come.

NATIONAL CONDUIT & CABLE FIRE.—Fire, starting as nearly as can be learned, from spontaneous combustion, gutted entirely the enamelled wire experimental building of the National Conduit & Cable Company, at Hastings, N. Y., last week. There were but three employees in the building, which is 50 ft. x 50 ft. and three stories high, at half-past 9 in the morning when the blaze was discovered. One of them was slightly injured in jumping from the second story to the ground. The National Conduit & Cable Company has one of the largest plants in the State, and its twenty buildings cover an area of more than a square mile. A fire wall surrounds the experimental station, and the 1000 employees in the other buildings did not leave their work while the firemen were overcoming the flames. At the offices of the company it was said that the damage done would not amount to more than $20,000, and was fully covered by insurance.

HYDRAULIC PLANT FOR CALIFORNIA.—A 9700-hp Francis type hydraulic turbine built by Allis-Chalmers Company, Milwaukee, has just been placed in regular operation at the Centerville plant of the Valley Counties Power Company, owned by the California Gas & Electric Corporation, of San Francisco. This installation is unique among hydro-electric plants, from the fact that never before has a Francis wheel been designed for the extremely high head of 550 feet. Results of early tests have shown that the high efficiencies and smooth running qualities expected have been fully realized. A governor-operated relief valve is working perfectly in the service, discharging the 190 cu. ft. of water per second, turned off suddenly from the turbine by the governor, without exceeding a pressure rise of 7½ per cent above the normal pressure in the pipe line.

GREAT FOREIGN TRADE.—December's exports of merchandise from the United States, according to the monthly statement of the Bureau of Statistics issued last week, exceeded all other monthly records, the total value being $207,170,000, compared with $190,400,000 in December a year ago. Imports of merchandise on the other hand fell to a total of $92,288,000, smaller than that of any month since August, 1905, it being the smallest December total of the past four years. The export excess for the month, $105,000,000, like the export total, also established a new monthly record. The total for the year was $1,923,498,434 of exports, and $1,423,326,680 of imports, an export excess of $500,171,754, the largest excess since 1902, and the largest total foreign trade of any year, $3,346,825,114. Our excess import of gold was only $88,182,385.

THE STERLING ELECTRIC COMPANY, of San Francisco, Cal., has been formed to take over the business of the Century-Kline Company, dealers in electrical supplies. F. M. Greenwood is president and W. S Goodman, vice-president.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular and showed a tendency in some parts of the list to react on the preceding sharp advances which followed the recent improvement in money conditions and the elimination of the New York bank deficit in reserve. Pool manipulation was apparent in a number of stocks, notably Reading, while New York Central recovered ground sharply on the success of the subscription for its 5 per cent equipment bonds. An important development of the week was the renewed ability to borrow money on time at less than 6 per cent, the supply of such funds being very large. Some attention was paid to statements that the steel situation is improving in respect at least to the placing of new orders, although there was a general consensus that United States Steel Corporation's showing of earnings for the December quarter will represent a marked contraction. Some attention was also paid to poor railway earnings now being reported as a result of the panic and shrinkage in business. The cutting of the Amalgamated Copper dividend had no special effect on the market. A good business was transacted in electric and traction stocks, and all these show substantial advances over the previous week's quotations. On the curb market moderate improvement was shown in sympathy with the exchange list, but no considerable outside interest was developed. Following are the closing quotations of Jan. 21:

NEW YORK.

	Jan. 14	Jan. 21		Jan. 14	Jan. 21
Allis-Chalmers Co.......	6½	6⅛	General Electric	123¼	120
Allis-Chalmers Co. pfd.	21¾	19⅛	Hudson River Tel.....	—	—
Am. Dist. Tel..........	—	—	Interborough Met. com.	7¼	7⅝
American Locomotive...	41½	38	Interborough Met. pfd..	20¾	20
Amer. Locomotive pfd..	90	91	Mackay Cos.	58	56¼
American Tel. & Cable..	—	—	Mackay Cos. pfd......	62¾	62¼
American Tel. & Tel...	106	107	Marconi Tel.	—	-
Brooklyn Rapid Transit.	43½	44⅛	Metropolitan St. Ry...	—	—
Electric Boat	—	—	N. Y. & N. J. Tel......	—	—
Electric Boat pfd......	—	—	Western Union Tel.....	58	57¼
Electric Vehicle	—	—	Westinghouse com......	50¾	48
Electric Vehicle pfd....	—	—	Westinghouse pfd......	—	—

BOSTON.

	Jan. 14	Jan. 21		Jan. 14	Jan. 21
American Tel. & Tel...	107	108	Mass. Elec. Ry. pfd....	50*	48
Cumberland Telephone..	98	99	Mexican Telephone......	1¼	1½
Edison Elec. Illum.....	212	209½	New England Telep....	113½	117
General Electric	—	—	Western Tel. & Tel.....	5	6
Mass. Elec. Ry........	12	11¾	West. Tel. & Tel. pfd...	62	65

PHILADELPHIA.

	Jan. 14	Jan. 21		Jan. 14	Jan. 21
American Railways......	43	43	Phila. Electric	6⅜	6⅛
Elec. Co. of America...	8⅝	8⅝	Phila. Rapid Transit....	17½	16
Elec. Storage Battery...	32	29	Phila. Traction	86⅝	88
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Jan. 14	Jan. 21		Jan. 14	Jan. 21
Chicago City Ry........	150	140*	National Carbon	50	53
Commonwealth-Edison ...	84	87	National Carbon pfd....	103	103¼
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.......	118½	115	Union Traction pfd.....	—	—
Metropolitan Elec. com..	17	17			

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*Asked.

THE COLUMBUS, OHIO, EDISON COMPANY has placed on the market $100,000 of 6 per cent cumulative preferred stock that has been in the treasury for some years. It is stated that the money received from this stock will be used to pay the Columbus Railway & Light Company for improvements that have been made on the plant. The stock will be sold at par to holders of common stock in proportion to the amount owned. A call has been issued for a meeting of the board of directors, when, it is said, the capital stock will be increased from $1,000,000 to $1,500,000, of which $200,000 will be 8 per cent cumulative preferred and the other $300,000 common stock. The business of the company has shown such rapid growth, it is said, that quite a large sum of money must be expended to bring it up to the capacity needed. The Columbus Railway & Light Company, which leases the plant of the lighting company, is said to have expended large sums of money in improving the property and that as soon as the stock is sold this will be repaid. The present stock has been taken rapidly, and the Cincinnati men interested have proposed to take all that is not sold to the stockholders direct. A rumor that the company would purchase the property of the Columbus Public Service Company has been denied by the officers of both corporations. The idea was that the additional money secured from the stock now being sold and that to be issued would be used in taking over the property of the competitive company. The special meeting of stockholders will be held on March 1.

CANADIAN BELL TELEPHONE.—The stockholders of the Bell Telephone Company of Canada, at a special meeting in Montreal, on Jan. 10, ratified the sale to the provincial government of the company's lines, buildings, equipment and other assests contained in the Province of Quebec. The $3,000,000 worth of 40-year 4 per cent bonds which the company will receive from the province will constitute a trust fund, which can be utilized to pay for improvements to the company's present system. C. F. Sise, president, stated that he considered the bargain a good one for the company as some important reservations were made, for instance, the Bell Company had the right to operate lines over the province connecting Saskatchewan and Ontario, and it also had the right to connect with the Manitoba Government lines on through business.

ST. LOUIS MORTGAGE.—A refunding and extension mortgage dated Dec. 1, 1907, by the Union Electric Light & Power Company, to the Bankers' Trust Company, of New York, and the Mississippi Valley Trust Company, of St. Louis, as trustee, was filed for record in the Recorder's office Thursday. The mortgage secures bonds to be issued by the Union Company from time to time, as authorized by law, the total issue not to exceed $50,000,000, to bear interest not exceeding 5 per cent. The mortgage reserves new bonds to cover all existing mortgages on the property of the company and collateral trust notes, and provides for immediate issue of $4,000,000 additional bonds for improvement. The mortgage covers all the property of the company now owned, and all it may acquire hereafter.

DIVIDENDS.—Directors of the Western Telephone & Telegraph Company have declared a regular semi-annual dividend of 2½ per cent on the preferred stock. Directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 1. Directors of the Amalgamated Copper Company have declared a quarterly dividend of ½ of 1 per cent. This is a reduction comparing with 1 per cent three months ago, 2 per cent six months ago, and 1½ and ½ per cent extra a year ago. The Conestoga Telegraph & Telephone Company, Pennsylvania, has declared a dividend for the year of 5 per cent. The Twin City Rapid Transit Company has declared a quarterly dividend of 1¼ per cent on the common stock, payable Feb. 15.

ROCHESTER TELEPHONE STOCK.—An increase of the capital stock of the Rochester Telephone Company from $500,000 to $1,000,000 has been stopped by injunction. It is understood that the Buffalo Consolidated Telephone Company is the chief factor behind the injunction, although the restraining order was granted upon application of David Decrow, of Buffalo, a stockholder in the Rochester Telephone Company. This company fears that should the Bell Company secure control of the Rochester Telephone Company, which carries with it control of the Syracuse, Utica and a number of smaller operating companies, it would have complete dominance over the telephone system between Buffalo and Utica and the Buffalo corporation would be cooped up in that city.

FRENCH WESTINGHOUSE.—At Pittsburg, Jan. 16, on an order issued by United States Judge Ewing, the receivers for the Westinghouse Electric & Manufacturing Company have returned to France six checks for a total of $306,000, received from the Société Anonyme Westinghouse, the French Branch of the Westinghouse interests. Each of the six checks was for $51,000, and all were dated Oct. 22, after the concern went into the hands of the receivers, and it was for that reason that the receivers asked that they be returned.

BRITISH WESTINGHOUSE.—In the United States District Court at Pittsburg an order has been made allowing the receivers of the Westinghouse Electric & Manufacturing Company to exchange a claim of $875,000 against the British Westinghouse Electric & Manufacturing Company for shares in the Traction & Power Securities Company of Great Britain at par and interest, provided the British Westinghouse Company secures bona fide subscriptions to a bond issue of £250,000.

NORTH AMERICAN DIVIDENDS.—It is now understood that the policy of the North American Company will be not to resume dividends in the immediate future. Dividends have been earned at the rate of about 5 per cent, but in the recent financial stringency it was found better to use surplus earnings as advances to the subsidiary companies for their necessary extensions and improvements. In the long run the company will be all the stronger for the conservative methods adopted.

TWENTY PER CENT WESTINGHOUSE DIVIDEND.—The Westinghouse Brake Company, Limited, of Great Britain, has announced a dividend at the rate of 20 per cent per annum for the six months ending Dec. 31, 1907, with a bonus of 5 per cent for the year.

GENERAL NEWS

Construction News.

ENON, ARK.—The Enon Telephone Company has been organized to build rural lines in the vicinity of Enon. Thomas J. Davis is manager.

LITTLE ROCK, ARK.—Plans are being made to install an electric light plant in the Niemeyer mill, just west of this city. The plant will have an output of 150 kilowatts and will furnish electrical energy for lamps and motors for the mill and also for lighting the residences in the vicinity of the mill. Contracts have already been placed for the machinery.

PRESCOTT, ARIZ.—Plans have been completed by the Arizona Power Company for the construction of a hydro-electric plant on Fossill Creek Falls, 50 miles distant, to furnish electricity to various small towns and mines throughout the county. R. L. Masson is electrical engineer.

TUCSON, ARIZ.—E. B. Reeser, secretary and treasurer of the Mineral Hill Consolidated Mining Company, states that the company has made arrangements to erect a large concentrating and electric light plant at once.

VEGREVILLE, ALB.—It is reported that an electric light plant will be erected in this town to furnish electricity for both street and commercial lighting.

ARCATA, CAL.—The California Barrel Company is planning to enlarge its factory and will equip its plant to be operated by electricity.

GOLDFIELD, CAL.—Owing to protest of the Goldfield Chamber of Commerce and the Merchants' Association of this city the Nevada-California Power Company has agreed to reduce the rates in Goldfield for electricity for lamps from 25 to 30 per cent.

GROVELAND, CAL.—The Golden Rock Ditch Company will soon commence work on the erection of an electric plant. The National Park Electric Company will also soon begin work on the construction of its proposed electric plant.

RICHMOND, CAL.—The Trustees have granted a franchise to John Nicholl to erect an electric street railway.

SAN JOSE, CAL.—Owing to the excessive charge in the bid submitted by the United Gas & Electric Company for one-year lighting contracts, the Common Council has decided to put through an ordinance providing that rates shall be fixed by the Mayor and Common Council, based on sworn statements from the company. The Mayor and the Common Council are also considering an ordinance providing for the disfranchisement of the San Jose Railroad Company, which have been in bad condition for the past two years.

NEW BRITAIN, CONN.—The stockholders of the Stanley Works Company have voted to adopt the amendment to its charter granted by the last Legislature, which gives the company authority to transmit electricity from Kent to operate and light its plant in New Britain. The amendment also authorizes the company to increase its capital stock from $1,500,000 to $3,000,000. The company is planning to erect a hydro-electric plant on the Housatonic River at Kent.

WILMINGTON, DEL.—Bids will be received by the Street and Sewer Department until Jan. 28 for lighting the streets of the city. The specifications call for electrical energy for not less than 350 arc lamps and 428 incandescent lamps. The new contract is for a term of five years beginning July 1, 1908.

ACKWORTH, GA.—Application has been made to the City Council by Austyn Granville, of New York, N. Y., for a franchise to construct an electric railway through the city. It is proposed to operate the electric railway from Ackworth to Kenesaw, Lena Elizabeth, thence to Marietta, and north to Cartersville. Part of the track has already been laid and orders have been placed for part of the machinery.

COLUMBUS, GA.—W. S. Greene, receiver of the Columbus Water Works Company, is contemplating installing an additional unit at the water works pumping station. Arrangements have been made with the Columbus Power Company for additional energy.

LAFAYETTE, GA.—John A. Clements, city recorder, writes that the citizens on Jan. 7 voted to issue $10,000 in bonds for the construction of an electric light plant.

LA GRANGE, GA.—J. R. Black, superintendent of the municipal electric light station, writes that plans are being considered to enlarge the plant, the cost of which is estimated at from $10,000 to $20,000.

BOISE, IDAHO.—Plans are being made by the Capital Electric Light, Motor & Gas Company to commence more active work on the Ox Bow project on the Snake River, near Huntington. It is stated that work will soon be started on the construction of a transmission line 65 miles in length to connect with the plant near Huntington, which will connect Meridian, Emmett, Payette and Weiser. It is proposed to build an additional line from Weiser 50 miles in length to make complete connection with the plant after the first line has been constructed. O. F. G. Markhus is manager of the company.

DES MOINES, IA.—The Mutual Telephone Company, of Des Moines, is contemplating the absorption of the telephone lines in the southern part of the State, which are valued at nearly $1,000,000. The largest of these companies are the Hawkeye Telephone Company, the Southern Iowa, the Knoxville Electric, the Boone County Telephone companies and the Jasper County lines, and also the lines which cover the territory around Atlantic and Red Oak.

RICEVILLE, IA.—The stockholders of the Riceville Electric Light & Power Company have appointed a committee to consider the question of installing a new plant. B. N. Hendricks is a member of the committee.

CAIRO, ILL.—The City Council has granted the Cairo Terminal Traction Company a franchise to build an interurban road into Cairo.

DECATUR, ILL.—E. S. McDonald, Mayor, writes that the city does not expect to rebuild the electric light plant this year.

LEROY, ILL.—It is reported that T. L. Parks has sold the Leroy telephone system to B. F. Baker, of Glenavon, for $20,000, who will take charge of the system March 1.

MORRISON, ILL.—The capital stock of the Whiteside Farmers' Mutual Telephone Company has been increased from $10,000 to $20,000.

OQUAWKA, ILL.—The local electric light plant has been purchased by the town and will be operated as a municipal plant. The price paid for the plant was $4,500.

GRANDVIEW, IND.—The town officials are anxious to have an electric light plant installed in the town and are ready to promise financial assistance in the way of patronage.

ROANOKE, IND.—The Town Council has passed an ordinance granting a 99-year franchise to the Fort Wayne & Wabash Valley Traction Company to light the streets and do a commercial lighting business in Roanoke.

SPRINGPORT, IND.—The capital stock of the Rural Telephone Company has been increased from $4,000 to $6,000.

QUASQUETON, IOWA.—S. B. Howard has petitioned the City Council for a franchise for a water works and electric light plant.

GRISWOLD, IOWA.—The Griswold Light & Power Company has been granted a franchise to construct and maintain an electric light plant. The proposed plant will cost about $3,000. R. C. Prather and J. M. McAvoy are interested in the enterprise.

IOLA, KAN.—The Department of Public Utilities is contemplating extending the lighting circuits of the municipal electric light plant to the residence portion of the city. N. E. Stone is chief electrician.

LECOMPTE, LA.—We are informed that bids will be received about March 1 for the construction of the new municipal electric light plant. The cost of the plant is estimated at about $10,000. B. Wood, of New Orleans, is engineer.

NEW ORLEANS, LA.—The People's Brewing Company will soon commence the erection of its plant, which will include the construction of an electric power plant and ice plant. The company will also install a system of electric delivery trucks.

NEW ORLEANS, LA.—Captain R. H. von Ezdorf, of the United States Public Health and Marine Hospital Service, in charge of the Federal quarantine station, is planning extensive improvements to the station, including the installation of an electric light plant.

ANDOVER, MASS.—The Smith & Dove Manufacturing Company is contemplating the erection of a new power plant in the spring.

CLINTON, MASS.—Plans are being prepared by the Bigelow Carpet Company for the construction of a new power house, which will furnish light and heat not only to the new mill, but the old plants as well.

HAVERHILL, MASS.—Announcement has been made by the Haverhill Electric Company that it will commence the work of placing its wires underground in the spring as soon as the weather will permit. The cost of the entire work is estimated at $200,000.

MANSFIELD, MASS.—The Boston & Providence Interurban Electric Railway Company has filed with the Selectmen of Foxboro and Mansfield the plans for the location of the road. E. J. Wood is engineer.

ELLSWORTH, ME.—The new dam of the Bar Harbor & Union River Power Company is practically completed, and it is expected to have the power house in readiness to put the plant into operation early in February. The local service will be transferred to the new power house, and the present electric light station will be used as a pumping station for the city water supply; extensive improvements will be made, including the installation of another 600,000-gal. pump. The pump will be driven by an electric motor, already installed. The steam plant will be held as an auxiliary plant to be used in case of emergencies. This plant was described and illustrated in ELECTRICAL WORLD for Sept. 21, 1907.

HOULTON, ME.—On Jan. 1 the town took over the plant of the Houlton Electric Light & Power Company and will operate the system until the plant at Aroostook Falls is started. B. B. McIntyre is superintendent.

NEWPORT, ME.—The committee on electric lighting has decided to replace arc lamps on the streets with clusters of incandescent lamps of 32 candle-power each.

PITTSFIELD, ME.—It is reported that a new company will soon be organized by George H. Morse and Elmer D. Smith and others to take over the property of the Pittsfield Electric Company and the Pittsfield Manufacturing Company.

PORTLAND, ME.—The United Illuminating Company, of Boston, Mass., which holds the controlling interest in the subsidiary companies doing business in Fort Fairfield, Belfast, Farmington, Dexter and Eastport, is restrained from making a common-law assignment by an injunction issued by Judge Strout of the Supreme Court, on petition of a number of stockholders, who desire to place the business in the hands of a receiver.

SHARPSBURG, MD.—A committee has been appointed by the Town Council to carry on negotiations with John Livers, of Shepherdstown, W. Va., in connecting with granting the latter a franchise to construct an electric lighting system in the town. Electrical energy for operating the system will be supplied from Shepherdstown and Martinsburg, W. Va.

WESTMINSTER, MD.—The exchange of the United Telegraph & Telephone Company was burned Jan. 12. The switchboard was destroyed, and the subscribers will be without telephone service until a new switchboard is installed.

IONIA, MICH.—The contract for municipal lighting has been awarded to the Ionia Water Power Company for a term of one year.

REED CITY, MICH.—It is reported that the electric plant of the Reed City Electric Company has been sold to George Westover, of Cadillac.

WOLVERINE, MICH.—The Village Council has granted B. F. Stiffler, of Birmingham, an electric light franchise.

MINNEDOSA, MINN.—Negotiations have been completed by the Minnedosa Power Company for the purchase of the local electric light plant, and arrangements have been made with the town for the commencement of the construction work on the proposed power plant of the company. H. F. Maulson is president of the company.

ORTONVILLE, MINN.—The citizens are considering the question of making additions to the equipment of the municipal electric light plant. J. F. Swiener is superintendent.

HALE, MO.—The electric plant of the Citizens' Light & Power Company at this place has been sold to Edgar Jackson, of Carrolton, who will erect a new power station and install a new engine.

ST. LOUIS, MO.—Application for an electric light and power franchise covering all parts of St. Louis County has been made to the County Court by the Clayton Electric Company. The application was filed by R. H. Stevens, of Clayton.

AXTELL, NEB.—The telephone exchange of the Bell Telephone Company in this place was recently destroyed by fire.

BEATRICE, NEB.—The plant and property of the Wahaska Electric Company in this place have been sold by the receiver to C. A. Snyder, of Auburn, who is dismantling the plant and selling the property.

FREMONT, NEB.—Frank Hammond, secretary of the Board of Public Works, writes that the contract for erecting the power station for the water works and electric light plant has been awarded to G. A. Damerer, of Chicago, Ill., for $22,500.

WAHOO, NEB.—The telephone lines owned by O. M. Tharp, of this place, covering the territory of Weston, Malmo, Prague and Morse Bluffs, in Saunders County, have been sold to J. Jamison, of Alvo, the consideration being $160,000. Mr. Jamison took possession Jan. 2.

CLINTON, N. C.—The Clinton Electric Light & Power Company has been reorganized and the capital stock increased. New machinery will be installed in the power plant. The officers of the company are: A. D. O'Brien, president; D. L. Bonny, vice-president; A. McD. Graham, secretary and treasurer.

FAYETTEVILLE, N. C.—A survey of the Cape Fear River has been made for two or three miles below the Buckhorn Falls, and the engineers report to the Phoenix Construction Company (successors to the Cape Fear Electric Power Company) that 18,000 horse-power is available by development, in addition to the 4000 horse-power now generated. The Holt-Morgan, Holt-Williamson and Lakeview Cotton Mills have installed extensive electrical machinery, and will operate their mills by electrical energy supplied by the Buckhorn Falls plant.

FAYETTEVILLE, N. C.—The Carolina Telephone & Telegraph Company has awarded a contract for the erection of its new building in this city. A. C. McCleare is general manager.

SILVER CITY, N. M.—The New Mexico Light, Heat & Power Company is installing additional machinery in its plant, including a 100-kw, 2200-volt generator. The present building will be enlarged, and the changes in the plant will require the complete reconstruction of the transmission lines.

BATH, N. Y.—E. J. G. Tower, president of the Citizens' Electric Service Company, writes that it is proposed to construct an electric light plant to supply electricity in Bath, Kenora and Avoca. The cost of the plant is estimated at $75,000.

CHATHAM, N. Y.—The village trustees have made a contract with the Chatham Electric Light, Heat & Power Company to light the streets of the village for a term of five years. The company agrees to furnish nine arc lamps at $85 per lamp per year, five arc lamps at $75 each per year, and not less than 100 incandescent lamps of 25 cp at $1.30 per lamp per month.

HUDSON, N. Y.—The Common Council has made a contract with the Albany & Hudson Railway Company to furnish electricity for lighting the streets and buildings for four months. The Council on Feb. 28, 1907, awarded the contract for city lighting to Jonathan T. Rider, of Hudson, who submitted a bid to furnish arc lamps at $49 each per year, and incandescent lamps of 32 candle-power for $10 per lamp per year. The contract with the Albany & Hudson Company recently expired and a temporary contract was made to furnish the energy for lighting until the plant of Mr. Rider is completed. Under the temporary contract the city is paying $84.75 per year for each arc lamp and 10 cents per kw-hour for lighting the public buildings.

MINEOLA, N. Y.—The New York & North Shore Traction Company has made application to the Supervisors of Nassau County for a franchise to construct an electric railway from Mineola to Westbury.

LOWVILLE, N. Y.—The Black River Telephone Company has commenced the extension of its lines from Deer River to Carthage, where the company proposes to maintain an exchange.

WATERLOO, N. Y.—The Village Board is considering the question of extending and improving the street lighting system and substituting an all-night service in place of the present service, which extends only till midnight on a moonlight schedule. The Geneva-Seneca Company has submitted a proposition to the board as follows: The company offers to furnish 26 enclosed arc lamps for $70 each per year, and 117 incandescent lamps of 30 candle-power at $18 per lamp per year, making the cost of the street lighting $4,066 per year, as against the present cost of $3,512. The company agrees to furnish one arc lamp and 30 incandescent lamps free of charge. All the lamps, apparatus and most of the wiring will be new. The contract is for a term of five years and provides for an all-night and every night service.

AKRON, OHIO.—Arrangements are being made for extensive improvements to the system of the People's Telephone Company in Cuyahoga Falls. A complete new telephone system, including switchboard, will be installed during the coming year.

BATAVIA, OHIO.—The Citizens' Telephone Company was placed in the hands of a receiver Jan. 13. In the application for a receivership made by W. Guy Jones, a stockholder, it was alleged that the company was $211,000 in debt and that business was being conducted at a net loss. The capital stock of the company is $150,000.

CUYAHOGA FALLS, OHIO.—A franchise has been granted to the Falls Rivet & Machine Company to construct a power plant on the Cuyahoga River.

MASSILLON, OHIO.—The Massillon Electric & Gas Company, recently incorporated, will take over the plant and holdings of the Massillon Light, Heat & Power Company. Robert R. Choate, of Knoxville, Tenn., will succeed Warren E. Russell as manager of the plant.

MECHANICSBURG, OHIO.—The Mechanicsburg Light & Power Company is contemplating installing a 15 or 20 kw. direct-current, 220-volt vertical generator in its plant. T. J. Long is president and manager.

MIDDLETOWN, OHIO.—The Middletown Telephone Company has purchased a site on which it will erect a new exchange building. The automatic system will be installed.

WEST MILTON, OHIO.—L. A. Pearson writes that it is proposed to build a hydro-electric plant of about 200 horse-power the coming summer. The dam will be about 400 feet long with a head of from 14 to 16 feet

PAULS VALLEY, OKLA.—The business men of the city have secured an engineer to make a survey of the river near the town with a view of developing the water power and installing an electric light plant for the city.

GRESHAM, ORE.—The Mount Hood Railway Company and the Portland Railway Light & Power Company, of Portland, have applied to the City Council for franchises for a term of 25 years. The latter company asks for electric light and power privileges in the city.

MIDDLETON, ORE.—A company, under the name of F. Vandivort & Co., has been formed by F. Vandivort and others to install an electric lighting system to light the streets and residences of the town. Electrical energy for operating the system will be taken from the Swan Falls transmission line. A 24-hour service will be given and meters will be installed. Several farmers are contemplating installing motors for irrigation. F. Vandivort has charge of installing the system.

PORTLAND, ORE.—The United Railroad Company has filed an application with the County Commissioners for a 25-year franchise to operate an electric railway to the Clackamas County line. A. C. Emmons is counsel for the company.

SCIO, ORE.—The City Council has recently placed an order with the General Electric Company, of Schenectady, N. Y., for a generator and accessories for the municipal electric light plant. The cost of improvements to the plant is estimated at $1,500.

DALLAS, PA.—Plans are now under way for the construction of an electric light plant to furnish electricity to light the Raub Hotel. It is proposed to erect a plant of sufficient size to supply electrical energy to light the towns of Shaverton and Trucksville.

HANOVER, PA.—The Hanover & McSherrystown Street Railway Company has filed with the State Department a notice of an increase of bonded indebtedness from nothing to $500,000.

LANCASTER, PA.—The Conestoga Traction Company has been granted a franchise by the Borough Council of Christiana to construct an electric railway through the borough. The company will soon commence work on the construction of the line from Christiana to Atglen, a distance of five miles.

PITTSBURG, PA.—The contract for lighting the city with arc lamps has been awarded to the Allegheny Light Company. The contract calls for $90 per lamp per year where underground circuits are used and $72 per lamp with overhead wires.

WARREN, PA.—The Warren & Jamestown Street Railway Company has filed a notice of an increase of bonded indebtedness from $300,000 to $400,000.

PROVIDENCE, R. I.—A bill has been presented in the Senate by Senator Cole, of Hopkinton, providing for the construction of an electric railway system between Westerly and Ashaway. The charter as proposed names Leveritt A. Briggs, William J. Battey, Alexander B. Briggs, Frank Hill and John W. Sweeney as the incorporators, and the capital stock is placed at not exceeding $100,000. It allows the acquisition of property by condemnation proceedings, and also permits the proposed corporation to engage in the generation and sale of electricity for heat, light and power.

SENECA, S. C.—The citizens have voted in favor of issuing bonds for the construction of an electric light plant.

SUMMERVILLE, S. C. The Town Council has granted the Charleston-Summerville Electric Railway the right of way through certain streets in the town for the operation of its railway. Ogden Edwards, of Summerville, is president of the company.

NASHVILLE, TENN.—The City Council is considering the question of making an appropriation of $100,000 to build an addition to the power house and install new machinery in the municipal electric light plant.

CAMERON, TEX.—The Southwestern Telephone Company is planning to make improvements to the local system and will install complete new equipment.

CLARENDON, TEX.—A telephone company has been organized by William Gray, George W. Washington and T. L. Benedict to establish an exchange in Clarendon. The cost of the system is estimated at $20,000.

DALLAS, TEX.—The City Council has granted E. L. Swaine and R. P. Boyer, of San Angelo, Cal., a franchise to construct a telephone system in this city.

PARIS, TEX.—We are informed that the Paris Transit Company is contemplating the purchase of an electric fountain for Warlick Park, and also proposes to install a 400-hp water tube boiler and to build 800 feet of single track. John A. Porter is manager.

DENTON, TEX.—The City Council is contemplating increasing the equipment of the municipal electric light plant by the installation of an additional engine and generator.

MARBLE FALLS, TEX.—Plans are being made by Dallas and New York capitalists to construct a hydro-electric plant at Marble Falls, on the Colorado River, for the development of electrical energy to be transmitted to Austin and San Antonio, a distance of 150 miles. It is planned to construct a concrete dam across the Colorado River 1012 ft. long and 17 ft. high above the falls. The plant will have an output of 12,000 horse-power. It is stated that a contract has already been placed to furnish the city of San Antonio with 1000 horse-power. John W. Maxcy, of Houston, has been awarded the contract for the engineering and construction work.

SHERMAN, TEX.—The Southwestern Telegraph & Telephone Company has applied to the City Council for a franchise to place its wires underground in Sherman. J. E. Farnsworth is vice-president and general manager.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has filed with the City Recorder its acceptance of the franchise passed by the Council Dec. 2.

SALT LAKE CITY, UTAH.—Announcement has been made that the Utah Light & Railway Company will erect a hydro-electric plant at Devil's Gate, 18 miles from Ogden, work on which will commence early in the spring. The plant will have an output of 2000 horse-power and will cost $300,000. The company will also construct a large steam plant in the city, at a cost of about $250,000.

STOWE, VT.—The Mt. Mansfield Electric Railroad, which runs from Stowe to Waterbury, a distance of 10½ miles, has been purchased by Arthur H. Soden for $20,000. Mr. Soden contemplates extending the line to Morrisville, a distance of eight miles.

MIDDLEBURY, VT.—A new boiler is being placed in the plant of the Middlebury Electric Light Company.

BLACKSBURG, VA.—It is reported that the Blacksburg Power & Supply Company will install an electric light plant.

RADFORD, VA.—The Radford Water Power Company is planning to purchase a water turbine from 400 to 500 hp. J. A. Baird is secretary of the company .

RICHMOND, VA.—The Virginia Passenger & Power Company has placed contracts with James Leffel & Company for a pair of 56-in. Sampson turbines to be direct connected to a 750-kw, Allis-Chalmers alternator.

SUMAS, WASH.—The Whatcom County Railway & Light Company is planning to increase the output of its plant from 3200 to 10,000 horsepower. Surveys are now being made for the route of a large flume to the plant at Nooksack Falls.

EAU CLAIRE, WIS.—The Common Council has authorized the city clerk to advertise for bids for gas and electric lighting for the city.

SUMAS, WASH.—A new 75-kw, three-phase generator is now being installed in the local electric light plant, which will more than double the present output. Arc lamps will soon be placed on the streets.

KEWAUNEE, WIS.—H. G. Steingraeber, city clerk, writes that the citizens on Jan. 14 voted in favor of establishing a municipal electric light plant.

RACINE, WIS.—The City Council has granted the Milwaukee Electric Railway & Light Company a franchise to build a street car line on Second Street, from Main Street to Lake Avenue.

WATERLOO, WIS.—Extensive additions are being made to the municipal electric light plant, including the construction of a new power house and extension of transmission lines. Eugene Porter is chief engineer.

REVELSTOKE, B. C.—Plans are being considered for increasing the equipment of the municipal electric light plant, which includes the installation of a 400-hp gas engine and a gas producer plant; also a 150-kw generator for furnishing electricity for motors. The present plant will be used for lighting only. C. H. B. Topp is city engineer.

LONDONDERRY, N. S.—The Londonderry Iron & Mining Company contemplates developing power at Nixteaux Falls to be used for the operation of its mines.

GANANOQUE, ONT.—The citizens have voted in favor of the by-law authorizing the town to issue $10,000 in debentures to complete and to pay for debts already contracted for the electric light plant.

GODERICH, ONT.—The citizens have voted in favor of the by-law to transfer the guarantee of the bonds of the Maitland River Power Company to the Ontario West Shore Railway.

HAVELOCK, ONT.—The Northumberland-Durham Power Company contemplates making an application to the Dominion Government for permission to develop power at the Upper Healy Falls. It is stated that 14,000 horse-power can be developed there.

PORT ARTHUR, ONT.—It is reported that the Pigeon River Lumber Company has applied to the city for electrical energy to operate the large pulp mills which it proposes to erect.

PORT ARTHUR, ONT.—Smith, Kerry & Chace, Confederation Life Building, Toronto, are preparing plans for developing the water power on Dog Lake at Silver Falls, for the city of Port Arthur. As soon as estimates are completed a by-law will be submitted to the citizens to secure funds for the work.

PORT HOPE, ONT.—The by-law authorizing the Town Council to proceed with the construction of a municipal electric light plant was carried.

STRATFORD, ONT.—The City Council is contemplating an issue of $35,000 in electric light debentures.

WINNIPEG, MAN.—The Provincial Government has appointed a commission of three to take charge of the Bell telephone system, which it recently purchased. The commissioners appointed to have charge of the system are: F. C. Patterson, chairman, and W. H. Haynes and H. J. Horan.

WOODSTOCK, ONT.—John Morrison, city clerk, writes that the citizens have voted in favor of the proposition to issue $27,500 in bonds to establish an electric light system in connection with the Hydro-Electric Power Commission of Ontario. The work will not be undertaken until 1909.

New Industrial Companies.

THE ROYAL EASTERN SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $35,000. The directors are Francis E. Neagle, Eugene Congleton and Edward J. Ryan.

THE ROTARY INTERNAL CONSTRUCTION ENGINE COMPANY, of Newark, N. J., has filed articles of incorporation, with a capital stock of $200,000. The incorporators are: John Hokanson, Moritz Hoffman and Oscar Anderson.

THE PARAGON ELECTRIC COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $125,000, by W. E. Groves, R. Warren Caster and others. The company proposes to manufacture electrical lamps, lighting apparatus, specialties, etc.

THE HOUSTON ARMATURE WORKS, of Houston, Tex., has been incorporated, with a capital stock of $10,000. The company proposes to carry on a general mechanical and manufacturing business. The incorporators are: F. E. Ward, L. E. Ward and E. T. Barden.

THE AMERICAN AMUSEMENT & CONSTRUCTION COMPANY, of Memphis, Tenn., has been incorporated, with a capital stock of $50,000, by James L. Glass, S. Trauerman, O. D. DuBose, E. Susman and John Wright. The company proposes to construct amusement devices, build street railways and power plants.

Company Elections.

CEDAR RAPIDS, IOWA.—At the annual meeting of the Cedar Rapids & Marion Telephone Company the present board of directors and officers were re-elected.

IOWA CITY, IOWA.—At the annual meeting of the North Liberty Mutual Telephone Company held recently the following named officers were elected: Alex. Moreland, president; Harry Gill, vice-president; L. L. Stoner, secretary and treasurer.

MEDIAPOLIS, IOWA.—At the annual meeting of the Mutual Telphone Company held Jan. 7 the following named officers were elected: Henry Breder, president; Herman Walker, vice-president; John L. Jones, secretary, and A. E. Miller, treasurer.

LOUISVILLE, KY.—At a meeting of the stockholders of the Kentucky Electric Company held Jan. 8 the following named gentlemen were elected officers for the ensuing year: Robert E. Hughes, president; Lawrence Jones, vice-president, and Byron Allen, secretary. Mr. Hughes, president of the company, states that the power house will be completed and in operation within three months.

SAGINAW, MICH.—At the annual meeting of the Saginaw Valley Telephone Company held Jan. 14 the following named officers were elected: E. T. Carrington, president; John L. Jackson, vice-president; E. P. Waldron, secretary, and J. F. Brand, treasurer.

LITTLE FALLS, N. Y.—At the annual meeting of the Interstate Telephone Company held recently the following named officers were elected: Eugene Walrath, president; John Hurley, vice-president; George G. Hakes, secretary, and George D. Smith, treasurer.

ROME, N. Y.—At the annual meeting of the Home Telephone Company held Jan. 8 the following-named officers were elected: J. S. Wardell, of Rome, president; D. M. Hall, of Rome, vice-president; W. Roy McCane, of Rochester, secretary, and Charles H. Poole, of Utica, treasurer.

FERNWOOD, OHIO.—At the annual meeting of the Farmers' Telephone Company held Jan. 13 the following-named officers were elected: John J. Gault, president; John T. Martin, vice-president and general manager; W. Reid Scott, secretary, and J. R. Hine, treasurer.

ALLENTOWN, PA.—At the annual meeting of the Lehigh Valley Transit Company held recently the following-named directors were elected: R. H. Stevens, Col. Harry C. Trexler, E. M. Young, George O. Albright, of Allentown; Mayor Tom L. Johnson, of Cleveland; George H. Frazier, William F. Harrity, Edward B. Smith, C. E. Ingersoll and John C. Dawson, of Philadelphia. R. H. Stevens was re-elected president and John C. Dawson was elected vice-president.

DALLAS, TEX.—At the annual meeting of the Dallas Consolidated Electric Street Railway Company held recently the following-named officers were elected: J. B. Wilson, president; W. C. Connor, vice-president; Edward T. Moore, secretary and treasurer.

DALLAS, TEX.—At the annual meeting of the directors of the Metropolitan Street Railway Company the following-named officers were elected: George W. Owens, president; B. M. Burgher, vice-president; C. F. Kirchaine, secretary, and P. P. Thomas, treasurer.

GLENWOOD, WIS.—At the annual meeting of the Western Wisconsin Telephone Company, held recently, the following named officers were elected: W. H. Park, president; A. J. Vanderheiden, vice-president, and R. A. Cleveland, secretary and treasurer.

New Incorporations.

IOWA CITY, IA.—The Lincoln Telephone Company has been incorporated with a capital stock of $1,500 to build a telephone system in Lincoln Township.

SOLON, IA.—The Morse & Solon Telephone Company has been incorporated with a capital stock of $2,000. William Cahill is president of the company.

KELLOGG, IDAHO.—Articles of incorporation have been filed for the North Idaho Telephone Company with a capital stock of $25,000 by W. F. Goodard and others.

CHICAGO, ILL.—The Southern Street Railroad Company, of Chicago, has been incorporated, with a capital stock of $10,000, to operate street railways in Cook County. The incorporators are: J. C. Cleary, John Early and E. J. Stevens.

NEW ATHENS, ILL.—The Point Lookout Telephone Company has been incorporated with a capital stock of $350 by A. Sturm and others.

PINKSTAFF, ILL.—The Farmers' Pioneer Mutual Telephone Company has been incorporated with a capital stock of $2,500 by J. Deer, J. W. Childress and R. W. Kingsbury.

SEYMOUR, ILL.—The Seymour Telephone Company has filed articles of incorporation, with a capital stock of $2,500. The incorporators are: A. S. Cott, W. E. O. Christe and William Osborn.

MOORESVILLE, IND.—The Mutual Telephone Company has been incorporated with a capital stock of $7,000 by E. Stone and others.

FOREST CITY, IOWA.—The North Madison Telephone Company has been organized and the following named officers elected: Leonard Steiff, president; W. H. Ellsworth, vice-president; E. C. Howland, secretary, and A. E. Howland, treasurer.

FLINT, MICH.—Articles of incorporation have been filed for the Genesee County Telephone Company with a capital stock of $125,000. The directors are Joseph W. Martin, Thomas Ahearn and John N. Anhut, of Detroit. The company has been formed to take over the telephone franchise granted by the City Council several weeks ago.

BOZEMAN, MONT.—The Bozeman Home Telephone Company has been incorporated with a capital stock of $80,000 by J. S. Haley and others.

CATHAY, N. D.—Articles of incorporation have been filed for the Cathay Central Telephone Company with a capital stock of $10,000 by B. W. Taylor and others.

TRENTON, N. J.—The Eureka Power Company has been incorporated, with a capital stock of $100,000, by Theodore G. Kitchen, J. D. McNeal and N. Van Fleet. The company proposes to operate electric plants.

BROOKLYN, N. Y.—The Economy Electric Company has filed articles of incorporation, with a capital stock of $25,000. The directors are: H. F. D. Kelsey, of Freeport; George P. Fall, of New York, and Donald Bayliss, of Brooklyn.

BUFFALO, N. Y.—The Keyes Electric Company has filed a certificate of incorporation with the Secretary of State, with a capital stock of $12,000. The company proposes to furnish electrical energy for heat and light in the villages near Buffalo.

BUFFALO, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Electric Navigation Company, with a capital stock of $100,000. The directors are: William J. Larkworthy, A. Stuart Allaster and Alexander McDougall, of Buffalo, N. Y.

JEFFERSON, N. Y.—Pierce & Peaslee Rural Telephone Company has been incorporated with a capital stock of $9,000 by Seymour J. Pierce and others.

NEVADA, OHIO.—The Nevada Telephone Company has been incorporated with a capital stock of $30,000 by Abe Swartz and others.

STIDHAM, OKLA.—The Oklahoma Telephone Company has been incorporated with a capital stock of $1,000 by Virgil E. Hill, Frederick L. Smith, Robert E. L. Crowson, Thomas C. Beeler and Henry A. McDaniel.

PIERRE, S. D.—The St. Paul, Minneapolis & Seattle Electric Railway Company has filed articles of incorporation with the Secretary of State, with headquarters at St. Paul. The incorporators are William C. Webber, of Rochester, Minn.; David Phillips, of Mazeppe, Minn.; Samuel A. Philips and James W. Mossop, of St. Paul, Minn., and Glenn W. Martens, of Pierre.

DIXON SPRINGS, TENN.—The Dixon Creek Telephone Company has been organized with a capital stock of $700.

Legal.

NOT CONTRIBUTORY NEGLIGENCE FOR LINEMAN TO STEP ON SPAN WIRE.—A recent action by the administrator of the estate of a lineman, who had been in the employ of a telephone company, against an electric light company, brought out the following facts: The telephone company and the defendant light company made use of certain poles together and on one of these poles the defendant company maintained an arc lamp, which was supported by a span wire attached to the pole and to another pole on the opposite side of the street. Passing under this span wire, about midway between the two poles, were strung two highly charged feed wires. As originally installed, the span wire was about two feet above the feed wires, but by reason of the negligent removal of a guy wire some two weeks before the accident, the pole tilted so that the span wire became slack and sagged to such an extent that a contact was formed between the span wire and the feed wires, by reason of which the span wire became heavily charged. The lineman, while ascending the pole, without knowledge that the span wire was charged, stepped upon it and at the same time came in contact with a telephone wire owned by the telephone company, causing his death. The claim of the defense was that the lineman was guilty of contributory negligence in stepping upon the span wire, but it was held that that was a question for the jury to determine, and the jury decided against the company and held it in damages. Leque vs. Madison Gas & Electric Co., Supreme Court of Wisconsin, 113 N. W. Rep. 936.

ELECTRICAL COMPANY HELD FOR INJURY RESULTING FROM DEFECTIVE TRANSFORMER.—As a result of the failure of the transformer placed outside a blacksmith shop to properly perform its functions, the company owning it was held liable for $1,700 damages to one who was injured by taking hold of one of the flexible wire cords, with incandescent lamps attached, with which the blacksmith shop was equipped. From the evidence it appeared that the plaintiff, a boy of 17 years, had been employed at intervals in the shop, and had frequently carried the lamps on the flexible cords from point to point in the shop to aid in the shoeing of horses. The injury in question occurred early in the morning, after a heavy rain. Upon arriving at the shop the blacksmith, whose name was Rogerson, found the doorknob charged with electricity, and could not open it; nor did a passerby who tried succeed in doing so, but it was finally opened by a man wearing rubber boots. When Rogerson picked up his leather apron, after gaining admission to the shop, he received a shock. He discovered, also, that some iron horseshoes hanging on the wall were charged with electricity, and, as the plaintiff and others came into the shop that morning, some sport was made by having them touch the shoes, resulting in slight shocks, more or less irritating, according to the physical condition of the person, but no one sustained any injury. After a time it was observed by some one in the shop that the beam from which one of the drop lamps hung was smoking, and that the wire at that point was sparking. The attention of Rogerson being directed to this, he called upon the plaintiff to assist him in moving the wire. As the plaintiff grasped the cord the current broke through the insulation and rendered him unconscious, necessitating the amputation of three of his fingers. One of the men in the shop discovered, after the accident, in attempting to tie a horse to the iron ring on the pole to which the transformer was affixed, that the ring was so charged that he could not tie the horse; and another who undertook to tie the horse was unable to do so, but succeeded in tying the strap around the pole. Under these facts the company was held liable. Rice vs. Wheeling Electrical Company, Supreme Court of Appeals of West Virginia, 59 S. E. Rep. 626.

TWO-CENT FARE UNCONSTITUTIONAL.—An important decision on rates has just been rendered by the Supreme Court of Pennsylvania, which has confirmed the decision of the lower tribunal, the Common Pleas Court of Philadelphia, in finding the two-cent fare law unconstitutional. The upper court stood 4 to 3 on the matter and said: "The court below found that the act does injustice to the corporators, in that it reduces the returns from the property to such an extent as to render it unremunerative. The corporation is entitled to make a fair profit on every branch of its business, subject to the limitation that its corporate duties must be performed even though at a loss. The conclusion of the court below that the enforcement of the act of 1907 against the complainant would do injustice to the corporators is beyond just criticism."

Business Notes.

BURNLEY BATTERY.—Geo. M. Mayer, 1085 Old Colony Building, Chicago, designing electrical and mechanical engineer, has taken the agency of the Burnley Battery Manufacturing Company.

SWITCHBOARD EQUIPMENT COMPANY, of Bethlehem, Pa., informs us that Mr. Walt W. Geisse is now handling the "S. E." circuit breaker in the northern half of Wisconsin and the states of North and South Dakota and Minnesota. The Engineering Equipment & Supply Company has taken the agency for the breaker for eastern Canada.

THE STANDARD PAINT COMPANY, of 100 William street, New York City, has during the past year added to its line of insulating compounds and varnishes a high-grade impregnating compound to be used in connection with the vacuum process. It has also made somewhat of a new departure in that it is supplying, where called for, its old P. & B. compound in a form from which the strong odor and gases are entirely eliminated. The distinctive smell of P. & B. compound is well known to every one in the electrical line, and the company says that in some instances where the stock is to be employed in closely confined locations this feature is somewhat of an objection. It is to meet such conditions that it has prepared the P. & B. in this special manner and is in a position to furnish it or the regular stock, as called for.

THE LORD ELECTRIC COMPANY has taken over all rights, titles and interest in patents granted and pending Mr. W. P. Cosper, covering controller regulators. Mr. Cosper has been awarded the agency for the Central Western territory, making his headquarters at Chicago, Ill., instead of being located at New York, as originally announced. Mr. Cosper is to assume the position of Central Western representative of the Lord Electric Company. His controller regulators are, it is stated, unique and cover all desirable features of a regulator to control positively the acceleration of motors. Many new features are embodied in these devices appealing to the railway manager. The Lord Electric Company is preparing to fill orders now in hand and accumulate stock for future demands.

THE GOODMAN MANUFACTURING COMPANY, Chicago, announces that the A. W. Wyckoff Company, 2323-24 Farmers' Bank Building, Pittsburg, Pa., has been appointed exclusive selling agent for its electric coal mining machinery in the states of Pennsylvania, Ohio, New York, Maryland and in the B. & O. district of West Virginia, and has assumed charge of its Pittsburg office, now located at the above address. A. W. Wyckoff, president of the A. W. Wyckoff Company, is well known in electrical circles, having represented electrical companies in the Pittsburg section during the past few years. Mr. W. B. Clarke, former manager of the Pittsburg office of the General Electric Company and who for many years was with its power and mining department, has associated himself with the A. W. Wyckoff Company and will devote his time especially to the electrical coal mining and haulage machinery. Mr. L. L. Brande, former engineer and manager of the Pittsburg office, remains in Pittsburg and continues his work with the A. W. Wyckoff Company.

Obituary.

MR. EDWIN BAILEY, one of the incorporators of the Patchogue Electric Light Company, died Jan. 11 at his home in Patchogue, N. Y., of pneumonia. He was born in England in 1836 and came to this country when 12 years of age. He was also interested in banking institutions and other enterprises.

MR. WILLIAM M. MALLETT, formerly of Rochester, N. Y., died at the Presbyterian Hospital, New York, N. Y., Jan. 12. He was the first manager of the Bell Telephone Company in Rochester, N. Y., and had charge of the construction of the system. He has been in New York City since 1905, where he has engaged in the real estate business.

Personal.

MR. ROBERT HUGHES was elected president of the Kentucky Electric Company, of Louisville, Ky., to succeed Mr. Donald McDonald, who resigned.

MR. C. C. BAIRD, formerly with the H. B. Camp Company at its New York office, has resigned his position with that company and is now with the McRoy Clay Works in Chicago as their sales representative.

MR. OSCAR C. TURNER has resigned as vice-president and general manager of the Southern Electrical Company, Nashville, Tenn., to join the staff of the Warren Electric & Specialty Company, of Warren, Ohio.

MR. WILLIAM LOEB, JR., secretary to President Roosevelt, has been elected a director of the Washington Railway & Electric Company, and it is rumored will resign as secretary June 1 in order to take the presidency of the system.

MR. GEO. H. PORTER, who has been in the sales department of the Electric Appliance Company, Chicago, for the past two years, has resigned to associate himself with the Diamond Rubber Company. Mr. Porter will be connected with a new department of this company, which will engage in the manufacture of insulated rubber covered wires and cables.

MR. F. A. HARMON, of Fremont, Neb., has been appointed general manager of the Fremont Power Company, of Sumpter, Ore. Mr Harmon succeeds Mr. John Thomsen, who has had charge of both the Fremont Power Company and the Red Boy Mining Company. Mr. Thomsen will now devote his entire time to the Red Boy Mining Company, of which he is general manager.

CAPTAIN HUBERT S. WYNKOOP, for some years past commissary of subsistence of the Twenty-third Regiment of infantry, N. G. N. Y., has been appointed commissary of subsistence, with rank of major, on the staff of General John G. Eddy, commanding the Second Brigade. Captain Wynkoop has served for thirteen years in the New York National Guard and had served previously in the national guard of Minnesota, Illinois and California. He is well known in the electrical and mechanical circles of Greater New York.

MR. EDWARD P. BURCH, electric railway engineer, is giving a course of lectures to the senior electrical engineering students at the University of Minnesota on "Electric Traction for Heavy Railway Service." These lectures supplement the regular course in electric railways by Prof. Springer, and include the following subjects: Introduction, advantages of electric traction, characteristics of steam locomotives, characteristics of electric locomotives, problems of electrification, load factor, cost of steam and water power, power plants and transmission lines, plans of complete electrification and data sheets.

MR. W. W. NICHOLSON.—Manager W. W. Nicholson, of Syracuse, N. Y., has completed 25 years of service with the Central New York Telephone & Telegraph Company. Mr. Nicholson has been the recipient of felicitations from friends near and far. Mr. Nicholson is also general manager of the Empire State Telephone & Telegraph Company, which operates in seven counties west of Syracuse. His headquarters are in the general offices of the company at Syracuse, although for a long period he was located in Utica. His brothers are H. H. Nicholson, division superintendent, with headquarters at Utica, and W. S. Nicholson, superintendent of plant of the Hudson River Company, at Albany.

COL. W. PRESTON HIX, of New York City, who was at one time very prominent and active in the electrical field, and has more lately been engaged in acetylene development for the Commercial Acetylene Company, of New York, of which he was manager, is returning again to electricity. In 1881 he went with the old Edison Electric Light Company, which sent him West, and while there he made the famous contract for lighting the Louisville Exposition with 5000 Edison lamps. After that came similar work at the New Orleans, St. Louis and other expositions. He then went actively into the business of company organization, and founded Edison companies in Topeka, Kansas City and St. Paul. The largest piece of work of this kind was the formation of the Philadelphia Edison Company with a capitalization of $2,000,000. This generally fatiguing work was followed by a rest of two or three years, when Col. Hix took up the development of later inventions, and then joined hands with Com. E. C. Benedict in pushing the use of acetylene gas, now so widely known. Col. Hix believes, however, that electrical development is now reaching a new stage of expansion, and that the opportunities for new appliances or apparatus of merit are greater than they ever were in the old days, when circuits were so few and far between or did not exist at all.

Late Items, Unclassified.

RICHMOND, CAL.—The East Shore & Suburban Railway Company has recently purchased one 500-kw motor generator set, complete with switchboard, and three 200-kw transformers, from 10,000 to 440 volts, from the General Electric Company.

SUFFIELD, CONN.—The Village Water Company is contemplating establishing a day service for motors if the demand is sufficient to warrant it.

AUGUSTA, GA.—Bids will be received until Feb. 25 by the commanding officer of the Augusta Arsenal for furnishing and delivering a switchboard, motor generator sets, motors, air compressors, metal working and wood working machines, electric and hand-over cranes, etc.

BARNESVILLE, GA.—The citizens voted recently to issue $45,000 in bonds, $4,000 of which is to be utilized to increase the output of the municipal electric light plant.

VINCENNES, IND.—The City Council has granted a franchise to the Hydro-Electric Company, which proposes to build a dam on the White River at Decker to develop power to generate electricity. The franchise provides that the company shall use conduits for wires and to furnish electricity free for lamps for all city buildings and public school and library buildings, and to furnish 2000-cp arc lamps until midnight for $4 a month, or all night for $5.50 a month; and to furnish electricity for incandescent lamps at a flat rate of 6½ cents per kw-hour. Eugene Rush, who is at the head of the Hydro-Electric Company, states that 75,000 horse-power can be developed at Decker. The company proposes to furnish electricity to all the towns and cities in southwestern Indiana.

CLINTON, IA.—The City Council has passed an ordinance requiring that all the telephone wires be placed underground in the city. The Iowa Telephone Company has announced that it will erect a new telephone building and place its wires in underground conduits throughout the city at a cost of $175,000. The wires of the Tri-City Telephone Company will also be placed underground.

BAY CITY, MICH.—The City Council on Jan. 14 voted to award contracts for machinery for an entire new electric lighting system in this city, which will involve an expenditure of approximately $48,000. The machinery in the old plant, which is inadequate to meet the present demands, will be sold.

COLUMBUS, MISS.—The City Council has granted the Columbus Railway, Light & Power Company permission to construct a street car line on the Military Road. The new line will be about three miles in length.

OXFORD, MISS.—The Board of Mayor and Aldermen will soon offer for sale the $15,000 in bonds recently authorized for the construction and equipment of an electric light plant, work on which will commence as soon as the bonds are sold.

ARCADIA, MO.—The plant of the Arcadia Creamery has been purchased by Louis Miller. Mr. Miller proposes to install an electric lighting plant to light the towns of Arcadia and Ironton and to enlarge the ice plant.

JOHNSON, NEB.—The citizens are contemplating installing an electric light plant and are considering an offer made by the city of Tecumseh for part of the machinery of the old plant in that place. The machinery is in good order, but has been discarded, owing to a change of equipment in the new plant.

ORANGETOWN, N. Y.—Following the recent action of the Orangetown Town Board, which asked the State Commission of Gas and Electricity, now abolished, to change the electric lighting rates from 20 cents, 10 cents and 5 cents per kw-hour for the first, second and subsequent hours, to a flat rate of 15 cents per kw-hour, the Orangetown taxpayers met at Tappan last week to take action against the new rates, which had almost doubled the cost of electricity to the consumers. As a result of the meeting, petitions are being circulated throughout the town, which will be sent to the Public Service Commission.

CHARLOTTE, N. C.—Electrical energy from the plant of the Southern Power Company, at Great Falls, S. C., 104 miles distant, is now being transmitted to the town of Statesville, N. C., where large contracts have been placed for furnishing electricity for lamps and motors, etc. The local interests of the company will be in charge of D. J. Cochrane.

HIGH POINT, N. C.—A movement has been started here to have the city get possession of the local electric lighting plant before the expiration of the private lighting contract, which runs about two years longer.

SALISBURY, N. C.—The Whitney Company will build a sub-station in Albemarle, 15 miles distant, for the purpose of furnishing electrical energy for several cotton mills in the town. Surveys of the route for the transmission lines will be made at once.

MINER'S MILLS, PA.—An agreement has at last been reached by the borough of Miner's Mills and the Standard Electric Light Company, of Parsons, whereby the streets of the borough will be lighted by electricity, which have been in darkness since December, 1906. By the terms of the contract the company agrees to furnish electrical energy for 22 arc lamps at a cost of $1,400 per year, and for incandescent lamps at the rate of one-half a cent an hour, upon the condition that the company is to be free from paying taxes on its poles and wires.

GREENVILLE, S. C.—Announcement has been made of the completion of plans and the securing of the necessary capital for building an electric line from Greenville to Williamston, S. C.

SPARTANBURG, S. C.—The Town Council has granted a franchise to the Electric Manufacturing & Power Company to erect transmission lines in the town. The company is to reserve 500 horse-power for the city for three years, while the city may place a contract for lighting the town for ten years. The energy will be brought into the city from the new plant on Broad River, built by Pittsburg capitalists.

METALINE, WASH.—J. M. Welty, of Metaline, has applied to the Board of Commissioners of Stevens County for a 30-year franchise to build a telephone line between Metaline and Colville.

MONCTON, N. B.—At the coming session of the Legislature the city of Moncton will make application for permission to construct and operate a street railway in Moncton and Shediac.

RICHMOND, N. B.—The York & Carlton Telephone Company has been incorporated with a capital of $5,000 to build a rural telephone system in York and Carlton counties. The incorporators are J. Y. Flemming, J. F. Merrithew and B. D. Hoyt.

FORT WILLIAM, ONT.—The city is applying for the right to issue bonds to the amount of $50,000 for the purpose of building a municipal street railway system. Address Mayor Whalen. The City Council has offered the city of Port Arthur $75,000 for all the street railway lines and barns within the limits of this city. The offer also includes the purchase of half the rolling stock owned by Port Arthur. Address Commissioner Fortune, Fort William, Ont.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 14, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

876,326. AUTOMATIC ELECTRICAL RELEASE STARTER; Anthony J. Burns, Oswego, N. Y. App. filed March 15, 1907. Construction of automatic release starter adapted for use in connection with alternating-current motors for starting the same and opening the circuit in case of failure of current. Has a weight-operated trip.

876,330. PROCESS OF MAKING INCANDESCENT LAMP FILAMENTS; Walter G. Clark, New York, N. Y. App. filed Oct. 4, 1906. The herein-described process of making incandescent lamp filaments, which consists in heating a filament by passing a current of electricity through it in the presence of a volatile compound containing carbon, and a volatile compound containing silicon and chlorin, and also in the presence of a substance having a greater affinity for chlorin than has silicon.

876,331. PROCESS OF MAKING ELECTRIC LAMP FILAMENTS; Walter G. Clark et al., New York, N. Y. App. filed Nov. 30, 1906. The herein-described process of making filaments for incandescent lamps, which consists in passing an electric current through a filament, in an atmosphere containing marsh gas, olefiant gas, and a reactive agent containing oxygen, together with a volatile silicon compound.

876,332. PROCESS OF MAKING INCANDESCENT LAMP FILAMENTS; Walter G. Clark, New York, N. Y. App. filed Jan. 14, 1907. The herein-described method of making electric lamp filaments, which consists in heating a carbon filament base in the presence of a volatile carbonaceous compound, a volatile silicon compound containing chlorin, and a substance having a greater affinity for chlorin than has silicon or the combination of silicon and carbon.

876,346. PROCESS OF PRECIPITATING METALS; John E. Greenawalt, Denver, Col. App. filed April 3, 1905. The herein-described process of precipitating gold and silver from their chlorid or bromid solutions, consisting in passing the solution through a mass of metallic lead shavings formed by alloying 1 per cent or less of zinc with the lead and then finely dividing said alloy.

876,383. MEANS FOR PRODUCING ELECTROMAGNETIC WAVES; Joseph Murgas, Wilkes-Barre, Pa. App. filed Jan. 4, 1905. Renewed Nov. 26, 1907. Complete diagram of circuits including spark gap directly in aerial.

876,384. AUTOMATIC FIRE-ALARM; Samuel Murray, Dublin, Ontario, Canada. App. filed April 20, 1907. A fire-alarm device having a bent compound metal band fixed at one end and connected at the other end to a lever so as to make a contact.

876,390. INCANDESCENT ELECTRIC LAMP; Herschel C. Parker and Walter G. Clark, New York, N. Y. App. filed Jan. 24, 1906. Has a relatively high-resistance conductor and a contacting member lying against and making a side contact therewith, said contact member being graduated from a higher to a lower resistance along its length.

876,391. TELEGRAPHIC KEY; Roy K. Patterson, Chicago, Ill. App. filed Dec. 29, 1906. Telegraph transmitting instrument having two keys, both of which move vertically as usual and one of which forms dashes and the other dots.

876,400. ELECTRICAL DISTRIBUTING RACK; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 17, 1903. A distributing rack having a plurality of identical sections placed side by side so as to make one long rack or board.

876,413. POLARIZED RELAY; Chester H. Thordarson, Chicago, Ill. App. filed March 31, 1904. Construction of polarized relay in which the work to be performed is accomplished through the attractive force exerted by an electromagnet upon its armature, the direction of application of the work being controlled by the attractive force exerted upon the polarized armature.

876,419. SYSTEM OF AUTOMATIC BLOCK SIGNALING FOR RAILWAYS; Samuel M. Young, New York, N. Y. App. filed Nov. 1, 1907. Block-signaling system for railways divided into block sections, the track rails constituting conductors for the signaling current. Is designed to be proof against operation by stray currents from accidental sources.

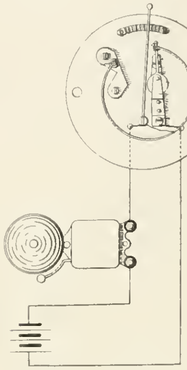
876,423. DEVICE FOR INDICATING THE POSITION OF WATER OR SLUICE GATE VALVES; Francis E. Adams, Boston, Mass., and Christian W. Kragh, Madison, Wis. App. filed Sept. 7, 1905. Indicator designed to be located at a distance from the gate valve which controls a flow of water and electrically connected thereto, whereby the position of the valve is indicated upon a suitable dial.

876,434. NON-INTERFERING PARTY-LINE TELEPHONE SYSTEM; William R. Brown, La Fayette, Ind. App. filed Jan. 18, 1907. In a telephone system, the combination with a party telephone line, of a generator at each sub-station wherewith the parties on the line may selectively signal either central office or the other parties on the line, and means depending upon the position of the switch-hook for changing the selective apparatus from one condition tó another, substantially as described.

876,441. MOTOR CONTROLLING DEVICE; William E. Date, Westfield, N. J. App. filed March 14, 1907. A controllor for electric motors designed to stop the motor at a predetermined point and which provides for reversing the direction of the motor at predetermined intervals.

876,445. ELECTROLYTE FOR ALKALINE STORAGE BATTERIES; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed May 10, 1907. An alkaline electrolyte for storage batteries employing lithium hydroxid.

876,489. ELECTRIC RAILWAY SYSTEM; Samuel B. Rappleye and John J. Devine, Philadelphia, Pa. App. filed Nov. 22, 1906. Patentee has a specially constructed U-shaped insulating trough extending outward from the web of the track rail and on the under protected side of which is supported a trolley wire or conductor.



876,384.—Automatic Fire Alarm.

876,492. TROLLEY POLE CONTROLLER; Oscar A. Ross, Chicago, Ill. App. filed Jan. 12, 1906. The trolley pole is pivoted on a swiveling support on the car roof and has a trip connection with its operating spring so that it drops in case of an undue upward movement.

876,503. SAFETY DEVICE FOR ELECTRIC CRANES; Marius R. Suliot, Salem, Ohio. App. filed July 24, 1907. A means for preventing overwinding or overlowering in the operation of electric cranes. Includes a cut-out switch operated by stops on the working cable.

876,511. PUSH-BUTTON SNAP SWITCH; John A. York, Hartford, Conn. App. filed July 29, 1907. Snap switch of the type having two buttons and a spring impelled part displaced thereby with an abrupt movement. Has a novel form of cam displaced detent.

876,512. FIRE-ALARM SYSTEM; Martin A. Abrahamson, Copenhagen, Denmark. App. filed Feb. 1, 1905. Designed to register distinctive trouble, signals when a line is grounded or the voltage has fallen off, etc., so that the inability of the apparatus to transmit an alarm is indicated.

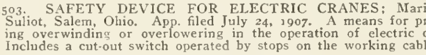
876,515. ELECTRICAL BINDING CLIP; Bradbury L. Barnes, Providence, R. I. App. filed Dec. 17, 1906. A form of nut having a sheet metal receiver and designed to be threaded on to the end of a conduit pipe so as to cover up the rough edges thereof.

876,552. SOCKET SHELL; Harvey Hubbell, Bridgeport, Conn. App. filed March 5, 1907. A socket shell comprising members having interlocking threads, one of said members being provided with a guide collar separated from this threaded portion by an annular space to receive the other member.

876,555. AUTOMATIC SWITCHING DEVICE FOR USE IN FLASH ADVERTISING; Leonard K. Joh, Notting Hill, London, England. App. filed Dec. 27, 1905. A contact cylinder is rotated step by step by solenoid operated ratchet mechanism.

876,568. DYNAMO-ELECTRIC MACHINE; Charles E. Lord, Norwood, Ohio App. filed June 7, 1905. In a dynamo-electric machine, a stationary core made up of groups of laminæ spaced apart to form ventilating passageways therebetween, a rotatable member, means for forcing a blast of air through said passageways, and means for preventing said blast of air while passing through said stationary core from entering the air gap between the rotatable member and stationary core.

876,594. CONTROL SYSTEM; G. B. Schley, Norwood, Ohio. App. filed Dec. 31, 1906. A multiple unit train control system having pneumatically operated main controllors operated by a master controller of the engineer's valve type.



876,390.—Incandescent Electric Lamp.

876,600. TROLLEY GUARD; C. W. Sheehan, Lubec, Me. App. filed Oct. 11, 1907. The trolley harp has spring-impelled arms adapted to move upward on either side of the wheel to prevent displacement thereof from the wire.

876,602. CEMENT-BURNING FURNACE; W. E. Snyder, Nazareth, Pa. App. filed March 11, 1907. Cement is sifted rotatably through a circular path having series of carbon electrodes.

876,619. JUNCTION BOX FOR ELECTRIC WIRES; L. P. Bliemeister, Buffalo, N. Y. App. filed July 20, 1906. A junction box comprising a telescoping body portion and a telescoping cover, said portion having openings for the introduction of circuit wires.

876,639. ELECTRIC SAD IRON; W. M. Harwood, Ontario, Cal. App. filed May 27, 1907. A hollow flat-iron having passages to receive prismatic resistance elements which are secured by a single clamping plate.

876,641. VOLTAMETER; H. S. Hatfield, Hove, England. App. filed Oct. 14, 1907. Has a system of calibrated tubes by which the amount of gas in an accumulating gas voltameter can be measured.

876,659. ELECTRIC RAILWAY; O. D. Prescott, New York, N. Y. App. filed May 25, 1906. Construction of spring-impelled shoe for engaging the underside of a third rail.

876,669. TELEGRAPHIC TRANSMITTER; D. S. Troth, Fruitvale, Cal. App. filed April 6, 1906. A transmitting typewriter of the kind having a continuously revolving cylinder and key-operated detents for clutching different circuit-closing elements into action.

876,684. BLOCK-SIGNAL APPARATUS; A. Bevah, Providence, R. I. App. filed March 8, 1907. System adapted for use on single-track trolley roads to warn cars from entering a block from opposite directions. Is applicable to "space" cars or trains on double-track roads. Has circuit-closing devices actuated by the trolley wheel.

876,686. MEANS FOR OPERATING ALTERNATING-CURRENT MACHINES IN PARALLEL; M. Brooks and M. K. Akers, Urbana, Ill. App. filed Jan. 18, 1907. The combination with a plurality of alternating-current machines connected in parallel circuit, electric transformers, primary coils for said transformers included in series circuit with the respective machines, and the secondary coils of a given phase, for said transformers connected in a closed series circuit with one another, and self-synchronizing reactance coils in circuit with the respective machines.

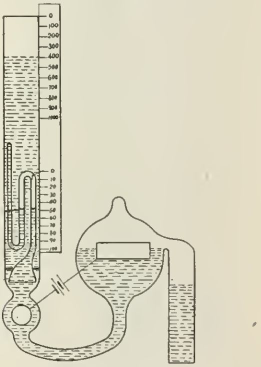
876,700. TROLLEY HARP; B. L. Dresser, Uxbridge, Mass. App. filed March 19, 1907. A trolley harp removable from the pole by releasing a pair of spring detents and having springs engaging the wheel to make good contact therewith.

876,701. ELECTRIC SWITCH; H. Drewell, Charlottenburg, Germany. App. filed March 9, 1907. Means for closing an optional branch of a multiple branch circuit by means of a limited number of switches.

876,722. TROLLEY; J. H. Kroen, Monaca, France. App. filed July 23, 1906. The trolley harp has upwardly projecting arms carrying vertically pivoted rollers on either side of the trolley wheel.

876,773. MERCURIAL THERMOSTATIC CIRCUIT CLOSER; F. Cossor, London, England. App. filed Aug. 15, 1907. The mercury column has a break filled with rarified air and electrical connections for different portions of said column located upon the opposite sides of said break.

876,809. ELECTRIC SWITCH OR CUT-OUT; I. Kitsee, Philadelphia, Pa. App. filed Oct. 14, 1905. A circuit interrupter for high potential circuits including a wooden trough tiltable longitudinally and having a little car movable therein by gravity from end to end. The car unwinds a flexible cable behind in its movement. The trough contains oil which is agitated at the time of circuit closure by the motion of the trough.



876,641.—Voltameter.

876,828. INSULATOR; R. C. McNutt, Mendota, Ill. App. filed March 21, 1907. A construction of armored insulator having a sheet metal casing connected to the insulator by metallic rivets.

876,877. WALL BOX FOR ELECTRIC SWITCHES; R. W. Hollis, Atlanta, Ga. App. filed June 18, 1906. A wall box for electric switches having a specially constructed fastening with the lathes of a partition, whereby its surface shall be flush with the plastering.

876,882. CIRCUIT CONTROLLER FOR ELECTRIC MOTORS; J. M. Joy, New York, N. Y. App. filed March 1, 1906. An electromagnetically operated controller for printing telegraph motors. Has both manual and automatic operating means.

876,883. CIGAR CUTTER AND LIGHTER; A. Von Kaspis, Pittsfield, Mass. App. filed Dec. 14, 1906. A construction of cigar lighter having a standard containing a dry battery and a base containing an induction coil. Has a swinging oil receptacle and wick.

876,886. CABLE TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed March 3, 1906. Means for relaying or translating true reversals impressed upon lines of comparatively large capacity.

876,910. ELECTRIC SWITCH; C. G. Perkins, Hartford, Conn. App. filed Feb. 19, 1906. Construction of a knifeblade switch having receptacles for cartridge fuses between a pair of switch blade elements.

876,918. CIRCUIT BREAKER; P. H. Thomas, Montclair, N. J. App. filed Jan. 6, 1905. Renewed Feb. 19, 1907. A circuit breaker for alternating currents having a mercury vapor tube shunt for the switch, which automatically interrupts the alternating current at the zero of the wave.

876,922. ELECTRIC LAMP; J. De Martino, Breesport, N. Y. An electric lamp consisting of a top; a base-ring secured to said top and formed with a groove the walls of which are perforated; a carrier-ring mounted in said groove and formed with a perforation adapted to register with the perforations in the walls of said groove; means for detachably securing said base-ring and carrier-ring together; a globe mounted in said carrier-ring, and a filament carried by said top and inclosed by said globe.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, FEBRUARY 1, 1908. No. 5.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, Pres.; CURTIS E. WHITTLESEY, Sec. and Treas.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Schofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
SAN FRANCISCO OFFICE....................601 Atlas Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....................per year, $3.00
Dominion of Canada....................4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1906, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 25,000 copies are printed.*

NEW YORK, SATURDAY, FEBRUARY 1, 1908.

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DEPRECIATION.

"The subtraction of ordinary or current operating expenses and taxes from gross earnings does not represent net earnings available either for interest on bonds or dividends on stock. It is high time that the electric lighting interests of the country awaken to the full realization of this fact." With these ringing words, Mr. C. N. Duffy closed his paper on "Depreciation" before the Northwestern Electrical Association Convention at Milwaukee last month. Depreciation is an item which has been most skilfully dodged and manipulated in central station bookkeeping for many years. The day is soon coming when it must be reckoned with in a more practical way than in the past. As a matter of fact, a great many of the smaller electric lighting companies of the country have been taking care of depreciation for a number of years without really maintaining a depreciation item on their books. This has been done by putting back into a property for enlargements and improvements a percentage of the profits each year. The practical effect of this has been to keep the property at its original value or even to increase this value; so that while depreciation there was continuous, the property was nevertheless made better by enlargements and improvements paid for out of receipts from operation. In other cases depreciation has simply been neglected in order to make large dividends. The second method is, of course, financially indefensible and sure to result in grief sooner or later, while the first method, while financially sound, is likely to result in trouble when questions of equitable rates are raised.

In short, depreciation should be called by that name and not by some other. If a company has not been recognizing depreciation on its books, it is in a poor position to argue before a public investigating committee or commission that such depreciation should be taken out of net profits before the real profits available for dividends are figured. To be sure, if a commission of competent experts is called upon to pass on the question, it will recognize depreciation in any event, whether the company has recognized it in its bookkeeping in the past or not. The company is in a decidedly difficult position when it attempts to explain to a body of non-technical men why depreciation should suddenly be recognized when it has been ignored for years. The company which keeps a proper depreciation account and actually lays aside and invests in good securities its depreciation reserve year by year, or if it invests that reserve in its own bonds, issued to pay for improvements in its own property, it is of course no better off as to tangible assets than if the same amount of money was simply put back into the property and charged to the general expense account of each year. There would be this important difference, however, that the company with a separate depreciation account would be in a position to tell much nearer where it stood as regards its provision for depreciation and that it would be in a position to invite investigation as to rates and profits. The apparent profits would not be so large—nor indeed the real profits, for depreciation is a vital item to include.

Interior Wiring.

Until we reach an era of wireless electric lighting, which is certainly not in prospect or in present conception, we shall continue to have house-wiring and house-wiring troubles. Not even the millennium would be likely to eliminate them completely. On the other hand, however, the science and art of industrial house-wiring have made very great strides since public electric lighting commenced, and there is every reason to expect that they will continue to advance. The article by Mr. W.' J. Canada, elsewhere in this issue, summarizes the conditions that exist in the widely scattered lighting districts of the Rocky Mountain region, as viewed from the insurance inspection standpoint. The territory referred to has an area of nearly half a million square miles, a population density of about ten per square mile, a large number of scattered villages and small towns, but only a few large cities. The problem of maintaining a proper standard of wiring and equipment in such a territory is clearly very different from the corresponding problem before a city like New York with its four millions of inhabitants.

In the electric lighting business we have four different parties involved; namely, the central station, the wiring contractor, the householder and the fire insurance underwriter. If each building were completely detached from its neighbors and were owned by its occupant without insurance, the problem would be simpler, but more primitive. If the householder wired his house in a recklessly dangerous way, so that at some time an accident was thereby invited and the house damaged by fire, he would have none to blame but himself for his loss of property. This consideration would be likely to make the householder more careful as to the class of workmanship and material which he employed in wiring his house. When, however, the fire loss is distributed over a large section of the community through the mechanism of the fire-insurance corporation, the conservative self-interest of the individual householder in inspecting his own house-wiring is naturally reduced and is delegated to the insurance underwriter. This introduces the fourth party into the transaction, with increase in liability to friction, but with better ultimate sociological results. The object of the householder is now to get his house wired at the minimum expense, including fire insurance. The wiring contractor, in the absence of the insurance inspector, would be obliged to reduce the cost of material and labor in house-wiring down to the lowest terms either because of business competition or because the householder would not otherwise accept the contract. Consequently, if the insurance inspector did not set limits to the quality of the material and labor on which the insurance risk would be accepted, the business tendency would be to force the contractor into a cheaper class of work than he would desire of his own will to install. On the other hand, not every insurance inspector is qualified to pass upon the merits of a wiring installation. An imperfectly qualified inspector is able to create a large amount of hardship and vexation to the wiring contractor by insisting on some details that may be very difficult to alter. No playwright seems yet to have discovered the opportunity that is afforded for a ludicrous farce by the opposition of interests between an unbusinesslike insurance inspector and an unbusinesslike wiring contractor; but the possibilities in this direction are well known to those who come into contact with the wiring business.

In general, the four-party system has worked much better than might have been supposed. The modern house-wiring installation in the large cities is manifestly much better and safer than it used to be 15 years ago, while the cost per outlet to the house owner has not increased in anything like the degree of improvement in construction. The difficulties to be adjusted between the work of the four parties involved have been largely settled by mutual compromise, invention and experience, so far as concerns the wiring of houses in large cities, and the National Code has done good service in this matter. The main difficulty has now shifted from the big cities, where the business is systematized, to the small towns and villages, where good inspection is more difficult to secure and good wiring is also hard to obtain. One comfort is that if wiring conditions are apt to be more lax in the small towns and country districts than good workmanship secures in large cities, yet the buildings are likely at the same time to be more scattered. Consequently, although defects in wiring may give rise to occasional fires, the fires are not likely to be as disastrous as in the big cities.

Modern German Arc-Lamp Photometry.

As noted in our Digest column this week, an account has appeared recently in the *Elektrotechnische Zeitschrift* of the photometric arrangements in a modern arc-lamp factory in Germany which possess features of special interest. The equipment is placed in two fairly large rooms, one dark and the other light. The dark room contains the principal photometric apparatus, while the light room enables the floor illumination produced by different ceiling lamps to be studied comparatively. The apparatus used for spherical candle-power measurements is a large metal globe about 10 ft. in diameter. The observer stands on the outside of this globe and takes a photometric reading through a peep-hole in the globe casing. The globe contains the arc lamp under test, suspended near the center, although not necessarily just at the center. The inner surface of the globe is painted a dull white, so that the light falling upon any point may be absorbed as little as possible and scattered as much as possible. The luminous intensity of any part of the internal wall will then be proportional to the total amount of light emitted by the arc lamp; or, in other words, to the spherical candle-power of the same.

In this country, when the mean spherical candle-power of an arc lamp is measured at a single observation, which is not so very often, the Matthews apparatus is usually employed with a number of inclined mirrors, all directing beams of light at different angles into the photometer. The arc lamp is looked at, as it were, in the photometer, from eight different elevations at once, and the proper mean spherical candle-power is automatically deduced from the joint observation. The Ulbricht globe may be described as an apparatus with an infinite number of such mirrors, each of microscopic size, formed of minute particles of a crystalline substance like plaster of Paris. At the same position that the observer takes to look into the highly illumined sphere, a small image of the arc is capable of being seen independently. The image of the arc is projected on the wall of the room, behind the observer, through a suitably placed orifice, and this image can be viewed by the observer through a mirror in front of him. In this manner he is able to observe the arc at any time during the test, without straining his eyes, and to satisfy himself that the arc is behaving satisfactorily at the time the spherical candle-power is being observed.

Gas Photometry.

The report of the candle-power committee of the American Gas Institute, an abstract of which is given in the Digest, is one of the ablest and most exhaustive scientific reports that it has ever been our fortune to read. It is really a model of painstaking and accurate work and should be filed away as of permanent value to everyone interested in photometry. In reading it the enormous difficulty of the situation from the standpoint of the gas engineer is made evident. The photometrist who deals only with electric lamps has no proper conception of the troubles that confront his confrère. Reading this report his attitude should become more sympathetic. At the beginning rises the fact that the only legal standard used in this country is the British candle, whatever that may be, and with state and municipal gas inspectors the candle, for that reason, retains its supremacy. It is known to be a bad standard both for primary and secondary purposes, yet from its legal recognition it must be taken seriously until some better standard shall have replaced it. We will not attempt to rehearse its failings, which are many, referring the reader to the original report for a full account of them. Of late many gas companies have adopted the 10-cp Hartcourt lamp, intended to equal 10 British candles, but it is worthy of note that only three official inspectors have followed the practice, so that the candle still reigns.

The fundamental trouble in gas photometry is that the thing measured is a flame which is subject to considerable variation in intensity according to the character and composition of its air supply. Any variation in temperature, density, CO_2 content. humidity and so forth is at once powerfully felt. Hence the obvious necessity of comparing flame with flame in order to compensate to as great an extent as possible for these variations. It is quite certain that flames almost universally differ among themselves in the absolute effect of these disturbing elements, so that the most that can practically be done is to choose a standard flame which will reduce the corrections to a reasonable limit when comparisons are made with a gas flame. The incandescent lamp, otherwise by far the most desirable working standard, is objectionable in gas photometry on account of introducing too large corrections; that is, corrections of the full value of those applied to the gas flame and not merely differential values, as in comparing one flame with another. The need for uniform atmospheric conditions necessitates extreme care in providing ventilation and uniform temperature in the photometer room, resulting in the very complex specification for photometer room construction set forth in this report. And the fact that flames are being compared, which may flicker and vary slightly, handicaps the photometrist by making it difficult to use without undue fatigue the Lummer-Brodhun screen. The Leeson screen, which seems to be the favorite, is a pretty good one, but in electric lamp photometry the Lummer-Brodhun has a very considerable advantage in precision, so that the number of settings necessary to bring down the probable error to a minimum is greatly decreased. For this reason the Lummer-Brodhun screen will very soon pay for itself in time saved. Most observers consider it more tiresome than a Bunsen or Leeson disc which is observed with both eyes, but it thereby avoids the serious errors due to variation as between the eyes.

The search for something better than candles as a standard has led gas photometrists to a rather general preference for the Harcourt lamp, while the electric contingent has rather favored the Hefner. The conspicuous virtue of the Hefner is that its rather moderate corrections have been more exhaustively studied than in the case of any other primary standard, and that certified lamps are easily obtained. Intrinsically it is not a good standard for practical comparisons, being of inconveniently small intensity and of peculiarly troublesome color. The Harcourt lamp appears to be less well-determined in corrections, but is incomparably more convenient to work with in comparing it with gas flames. Especially, it has the very great practical advantages of convenient intensity and excellent color. Probably, primarily on account of its British origin, it has been adopted by most if not all of the English engineering bodies concerned with lighting, including both the Institution of Electrical Engineers and the Institute of Gas Engineers. It is therefore most unfortunate that the value of the conventional British candle, determined as one-tenth of the Harcourt, should differ by about 4 per cent from the value of the candle as derived from the comparisons with the Hefner and used as the electrical standard in this country. Some years ago the A. I. E. E. committed itself, in lack of better, to the Hefner as a standard, taking it as .88 of the British candle in view of the comparisons then available. It has therefore come about that the electric and gas interests in this country are, so far as now seems probable, nearly 4 per cent apart in the value assigned to the British candle, our only legalized standard.

It is unfortunate that the subject of units of light has been approached by those interested with so little unity of action There has been no international work on the subject in which the gas and electric interests have concurred. Some years ago the Violle platinum standard was solemnly accepted by an International Electrical Congress, only to pass into *innocuous desuetude*. Later the International Photometric Commission appointed on the initiative of a Gas Congress took up the work, and it was this body that reported at Zurich last summer. Here in America there is good prospect of some concerted action, since a joint committee of the Illuminating Engineering Society, the American Gas Institute and the A. I. E. E. has now been organized for the purpose of agreeing upon a programme which will bring all the interests into joint action as regards the actual unit of light to the extent, it is hoped, of getting real international action before the issue is decided. If all hands could only settle upon a unit of light, by whatever name it should be called, then the matter of a concrete primary standard could be left to settle itself, as each country would define the unit in terms of its own favorite standard, pending at least further action. There would then be a certain definite unit in use everywhere, and it would be possible to have something like a definite nomenclature in matters of illumination. So far as gas photometry goes, it will always, so long as gas flames are used, have to fall back on flame comparisons. The very general use of mantle burners introduces a new complication in the way of getting a suitable flame as a standard; but with a definite unit once adopted there would at all events be a general agreement as to the amount of goods delivered, and the selection of a method for their measurement could be trusted to settle itself in due time.

A STUDY OF THE ILLUMINATION OF INTERIORS.

On account of the present interest in illuminating engineering we print elsewhere in this issue some interesting figures, taken from a thesis written by Messrs. Legg and Townsend at the University of Wisconsin in 1901. The two most prominently instructive features of this thesis are the figures given on the effect of dust on lamps and reflectors, and on the conditions existing by night and by day in several public libraries and other buildings. We do not imagine that the figures given on the effect of dust represent anything extraordinary, but are probably somewhere near average conditions in the down-town districts of large cities, where the janitor service is not exceptionally efficient. These tests show losses due to dust varying from 75 per cent to 8 per cent, the average reading at seven stations being 28 per cent. It is also interesting and instructive to compare the daily illumination in the various buildings with the artificial illumination. As would be expected, the average daily illumination was very much higher than the artificial, the average of artificial illumination on the library tables being 1.98 foot-candles, as against 15.7 for daylight. This shows that artificial illumination has far to go before it reaches the average of daylight illumination. It also shows that the human eye can work with comfort over a very wide range. Until we get better methods of diffusing the light from artificial illuminants than we have commonly at present, an attempt to increase artificial illumination to make it nearly equal to daylight is sure to prove diastrous. There is a great difference in the quality of the diffused light received by day from the sky and clouds and that received by night from powerful sources of artificial light placed within a room. As to the range within which the human eye can work with comfort, the average values of artificial and daylight illumination just quoted do not begin to tell the whole story. Daylight illumination as high as 104 foot-candles was observed in one case, while in the same room on the same day at about the same time an observation was made as low as 3.4 foot-candles, this great variation being due to the sun breaking through the clouds at intervals. An observation of less than 1 foot-candle on a library table in daytime was also recorded.

CHANGING SHOW-WINDOW LIGHTING TO FLAT RATES.

The account, in this issue, of the work that is being done by the central station at Dubuque, Ia., to change show-window lighting from flat to meter rates is interesting as showing what can be done in small cities in the way of increasing revenue from this class of business and putting it on a better basis, both for the central station and the merchant. There is nothing new about the proposition of changing show-window and sign lighting to flat rates, but it should be kept to the front as a matter of practical financial importance to central station companies. There is no question that a merchant's show window is one of his best forms of advertisement. Many people do a large part of their selection of goods from what they see in show windows, which is supposed to represent the latest and best in every line which a merchant has to offer, as well as to call attention to special bargains. In other words, it tells the passer-by in a few glances what it might take him considerable time to find out otherwise. To have show windows dark in the evening is to lose their advertising value for some of the most important hours of the day. A well-lighted show window at night is more attractive than the same window is by day. In a small town where all show-window lighting is connected on a meter basis, it is likely that when the store is closed up the window lighting is turned off. This is especially true in the case where the merchant does not feel like providing for turning off window lighting at 11 p. m. or later. Even where someone is detailed to turn off these lamps, there is a temptation for the merchant to economize by leaving his windows dark on some of the duller nights of the week. The most practical way out of the difficulty is the one which has been adopted in so many places—namely, to disconnect the window lighting from the meter and take it on a flat-rate contract, under which the merchant agrees to pay a certain flat rate per month for lighting of his windows a certain number of hours each evening, the turning on and off to be performed by the company. The company determines the rate on the basis of kw-hours, but because of the greater number of hours' use of the window lighting, it can afford to make a lower figure than for other commercial business, unless a readiness-to-serve or a maximum demand system is in vogue, in which case the same basis can be used. Such a system of rates at once incites interest, and as at Dubuque, many are willing to provide better window lighting under its favorable terms. This has its effect on other merchants, the general standard of show-window illumination in the down-town district is raised, and dark windows become more conspicuous by their darkness. While the general lighting of a store interior in a small town, where early closing is the rule, is not a remarkably profitable proposition for the central station, owing to its poor load-factor, lighting of the show windows is an excellent kind of load. It is the kind that it pays to spend money to cultivate. It is much better spent on this than on trying to increase the maximum demand from the lighting of the interior of the store.

THE AGE OF THE TINY FAN.

Anyone visiting recent electrical shows like that at Chicago last month could not fail to be impressed with the increasing popular use of the tiny electric motor as applied to vibratory massage, hairdrying, polishing and other popular uses. These appliances, while they cannot be figured upon to produce any certain great volume of revenue to a central station, nevertheless aid in popularizing central-station service, and where used add a little to the income from a number of customers. It is probable that there are many more useful applications of very small motors which have not been developed as yet. In this connection it is rather remarkable to note that for many years fans operating from electric lighting circuits were all of such size as to be entirely too strenuous for the ordinary desk use of a single person, except when running very inefficiently at slow speeds. Recently smaller sizes have been increasing in popularity, and justly. In spite of the fact that the electric motor has been a commercial article for so many years, it is only in the beginning of its use as a household servant in its smaller sizes.

RENEWALS OF EXPENSIVE LAMPS.

With the advent of the tungsten lamp, a very important question comes up in central station policy as to whether these lamps shall be purchased by the customer or whether the central station company, which has heretofore furnished free lamp renewals, shall supply them on some kind of a basis which will enable the company to make a profit. In the case of the tungsten lamp selling at over $1, the furnishing of free tungsten lamp renewals is usually out of the question. On the other hand, if the customer furnishes tungsten lamp renewals entirely, there will be a tendency to get away from some of the fundamental advantages of the free lamp renewal system. It is generally recognized that one great advantage of the free lamp renewal system is that it gives the customer a better quality of lamps than he would be able to purchase in the open market in small quantities with no means of testing their quality. It also has the advantage of relieving the customer from inconvenience and of keeping the lamp sockets of his installation filled with good lamps, where otherwise some would remain empty. Probably one of the best solutions suggested of this problem of renewals on tungsten lamps is to furnish the lamp renewals free, provided the customer agrees in return to pay a certain additional rate per kw-hour. Such contracts as this would naturally be made only with some of the larger and more important customers, who would appreciate that the actual saving or the increased illumination resulting from the use of the tungsten lamp justified the arrangement, which could not very well be made with small customers. For large customers who understand the conditions thoroughly, a maintenance charge of a certain amount per kw-hour for tungsten lamps, the lamps to be renewed free by the central station company, should prove a very satisfactory arrangement. As the prices of tungsten lamps are reduced, this maintenance charge could be reduced in the same proportion.

It should be, on the whole, much more satisfactory for the large customer to pay for lamp renewals in this way than to purchase lamps direct. Unless he is a very large customer, indeed, he has no facilities for testing or keeping records of lamp performance, and to have this testing done would be an expense out of proportion to the size of the installation. The central station, on the other hand, is in a position to look after the matters of checking and testing much better than the customer. Besides this, the central station would buy in much larger quantities, and hence get a better price. If the customer contracts for lamp maintenance at a certain price per kw-hour, he has a definite idea what his illumination will cost him. If he purchases lamps in the open market, there is considerable uncertainty, even if he gets the advice of technical men, unless this advice can be followed up with a rather cumbersome system of records and testing. In the case of the small customer with a mixed installation of tungsten and old-fashioned carbon lamps, the practice already in vogue in some companies of supplying the more expensive lamp at the difference in price between the common carbon lamp and the more expensive lamp, will probably work out the best. There is no reason why both of the policies outlined cannot be pursued by the same company, giving the customer his choice. To companies which are not now furnishing free renewals, none of these lamp-renewal problems present themselves; but the fact remains that it is well for any company to keep as firm a hold of the quality of lamps placed on its lines as it possibly can in order that satisfactory service may be received by consumers.

RATIONAL FIXTURE DESIGN.

The paper on "Fixture Design from the Standpoint of the Illuminating Engineer" recently read before several sections of the Illuminating Engineering Society apparently met with a very favorable reception by the rank and file of the members of that society who are seeking for practical suggestions as to methods of improving illuminating results with existing fixtures without varying too much from the well-beaten paths of fixture design. It has sometimes been said that the illuminating engineer has too little regard for the artistic. Such papers as that referred to show that a great many of the common artistic ideas in fixture design, be they right or wrong from an artistic standpoint, are not by any means inconsistent with good illuminating design, provided the proper details are carried out. For example, we frequently hear art-glass fixtures condemned by the wholesale as being contrivances of the evil one with which it is impossible to produce good illuminating results under any circumstances. There is no inherent reason why art-glass fixtures cannot be built which will give excellent illuminating results for certain conditions, and at the same time resemble so closely those now commonly seen that the ordinary observer would notice nothing unusual about them. The art glass may in some cases be very useful as a diffusing screen to keep glare out of the eye. The box type of fixture is capable of great development along scientific lines, care being taken either to leave the bottom open or to cover it with a diffusing glass which will not absorb much light. The same principles can be applied to art-glass lanterns, provided the design of the lantern is such as to let out useful light through the bottom, utilizing the art glass sides simply as shades and diffusers.

In ceiling hemispheres we have a very satisfactory means of diffusing and softening light and of obviating the necessity of conflicting with the ideas of the architect through the use of obtrusive hanging fixtures. Unfortunately, the ceiling hemisphere has commonly been used in a very inefficient manner in the past, and without any attempt to recover and utilize the 50 per cent of light which goes upward from the incandescent lamp when used without a reflector. The use of efficient reflectors inside of ceiling hemispheres would seem to be the most obvious improvement. Such a practice has been advocated by various illuminating engineers for some two or three years. So slowly do progressive ideas percolate among fixture manufacturers, however, that it is only with considerable trouble and annoyance at the present time that the average customer can procure ceiling hemispheres with proper interior equipment. It is unfortunately true the country over that fixture makers and dealers are taking little or no interest in illuminating engineering. They are rather waiting for customers to demand and drive them into making improvements which will secure better illuminating results. One would think that before this any number of enterprising fixture houses would in their own interests have begun to look after effective illumination for the sake of standing well with customers, but such does not appear to be the case. It seems rather to be a case of the fixture dealer blaming the architect and the architect the fixture dealer. In the meantime we must look for most of our improvement in illuminating results to central-station men and electrical contractors, who usually have some appreciation of technical points and who, by dint of much insistence, may be able to get the fixture men to supply what they specify, even though the fixture man may, as is often the case, make strenuous efforts to substitute some stock standard of inefficient design. When the day comes that efficient designs become the regular stock articles instead of the special exceptions, as now, efficient illumination will be much more common.

International Independent Telephone Association Convention.

The International Independent Telephone Association held its annual convention in the Coliseum Annex at Chicago, Jan. 21, 22 and 23, during the last week of the Electrical Show. But one session was held daily. The first meeting was called to order at 2:20 p. m., Jan. 21, with President Theodore Gary, of Macon, Mo., in the chair. An address of welcome to the city was given by Assistant Corporation Counsel Miller, representing the mayor of Chicago. In this address he indicated that the present city administration was endeavoring to dispel the idea fostered by the previous administration, that the city of Chicago had a club out for all corporations. Speaking for the present administration, he said that it was in favor of a square deal for all interests. Mr. M. L. Clawson, of Indianapolis, responding for the association, appealed to Chicago to grant a franchise to an independent telephone company, pointing out that independent telephones in surrounding states reached a larger number of subscribers than Bell telephones.

President Theodore Gary then gave his annual address. He announced that the association had just been incorporated under the laws of Illinois. He suggested a publicity campaign to encourage greater use of the telephone, to cost $25,000 a year. Such a campaign would be along the co-operative lines suggested by Mr. J. Robert Crouse, of the Co-operative Electrical Development Association, for central station companies. He mentioned the equipment stamps sold by the association to manufacturers of independent telephone apparatus and supplies, for attachment to equipment furnished by independent telephone companies. He suggested that these stamps had not been as generally used as they should be, and that hereafter instead of having them placed on the goods themselves, they be attached to the invoice, and that all independent operating companies request that such stamps be affixed to invoices.

The report of Assistant Secretary Mr. J. A. Harney was heard, and he announced the removal of the headquarters of the association from Cleveland to 629 Monadnock Block, Chicago, since the last annual convention in June. He said the state and local associations had paid but a small percentage of the assessments levied against them. Some figures he had compiled as to the percentage of duplication of Bell and independent subscribers in 12 cities showed this duplication (that is, the number of subscribers having both telephones) to be less than 8 per cent. The greatest percentage of duplication seemed to be in large cities. For example, cities of 6000 to 8000 inhabitants have a duplication of only 5 per cent, and those of from 50,000 to 100,000 ten per cent.

The advisory board made a report in which it recommended that inasmuch as the assessments levied on various state and district organizations under the rules had not been fully paid, these assessments should be reduced, as they are too high. He introduced a resolution reducing the assessment to two mills per unit on all independent telephones in the territory. One unit consists of one telephone instrument or one mile of toll line. Only 13 per cent of the assessments levied have been paid. The manufacturers' contributions were also found fault with. A resolution was recommended to the effect that stamps to the value of one-tenth of 1 per cent of the amount of each invoice be attached to all invoices by manufacturers selling telephone supplies, and by publishers of telephone journals, where the amount of the invoice is less than $500, and one-twentieth of 1 per cent for amounts over $500; and that all member telephone companies be requested to insist that such stamps be affixed. These stamps would be sold by the assistant secretary of the association. The recommendation and resolutions of the advisory committee were adopted. The convention then listened to the reports of the various state and provincial organizations. All of those heard from reported a good increase in the number of independent telephones. The delegate from Indiana spoke of a general raising of rates among telephone companies in that state. In fact, the raising of rates by telephone companies has become so common that they ceased to attract attention. The state of Indiana, outside of the large centers, was apparently almost given over to independent telephony. At this session a paper entitled "The Banker's Opinion of Securities," by Mr. E. H. Moulton, of Minneapolis, Minn., was read, in which the author expressed the opinion that telephone securities were gilt-edged, being based on a public necessity which is not likely to be dispensed with in hard times.

The Wednesday morning session was largely taken up with matters pertaining to the raising of money and conduct of the association, and with the question of whether delegates should be recognized or not where state associations they represented had not paid assessments in full. Nearly all of the states were more or less delinquent. A compromise was fixed up whereby each state association would be represented by delegates to the amount it had paid.

Mr. F. D. Houck, of Harrisburg, Pa., stirred up the convention by a paper on "Organization and Co-operation," in which he did some very plain talking to the effect that in the last few years the association had been doing little of practical benefit for the independent telephone movement, although if properly conducted it should be very useful. As a matter of fact, its meetings consisted simply of a display of oratory, but nothing practical came from it. He favored a business-like organization with a strong man of ability at its head, this man paid a sufficient salary to devote his entire time to directing association affairs and given facilities for carrying on the work. The present arrangement, with only an assistant secretary and a stenographer giving their entire time to the association, was entirely inadequate for an organization representing $300,000,000 invested capital. True, the association had not been able to raise money. He believed the reason was there were many companies like his own which were not able to see that they could get any good out of the association the way it had been run. He offered to be one of 100 companies to give $100 each for a $10,000 fund to start out the association at once to doing business the right way. This paper brought on a great deal of discussion, nearly all those taking part agreeing that more money should be spent if it could be raised. Finally the plan was decided upon of asking the various larger companies represented to guarantee to make up a certain percentage of whatever deficit there might be in a $15,000 fund for the coming year. It was understood under this arrangement that these companies would not be called upon to make up much deficit should the assessments of the various state associations be paid. This fund was guaranteed in a few moments by large and small companies and state associations.

Tuesday morning at 10:40, after an invocation by Rev. Jenkin Lloyd Jones, a paper on "The Business End of the Business" was read by James H. Shoemaker, of Waterloo, Ia. Some of the things he called attention to were the reduction of the cost of collections and the importance of adopting some unit by which the cost of service and its efficiency could be measured. He suggested as such a unit of quantity in the telephone business the "minute message mile." He also intimated that charges for making service connections would be in order, as such charges are expected by many new subscribers and are so recognized as just. He discouraged the practice of trying to cover too much territory with a limited capital and also the practice of putting earnings back into extensions and passing dividends to the detriment of the financial standing of the stock. It was announced that the guarantee fund of $15,000 pledged verbally in convention the day before had been subscribed to in writing since the last session, and was then up to 108 per cent. This was later raised still further by voluntary subscriptions during this session of the convention. A short address on "Why the National Grange Favors Competition" was made by Mr. George F. Gaunt, of Mullicka, N. J. He said that this strong organization of farmers was thoroughly in sympathy with the independent telephone movement, and so expressed itself at its convention, because the independent movement had been the means of putting farmers into telephonic communication with the outside world.

Mr. R. Max Eaton, of Niagara Falls, N. Y., read a paper on "The Solution of the Telephone Situation." He took up first the two-telephone problem which had bothered many subscribers in cities where two exchanges existed. He held that this existence of two telephones in many subscribers' premises was not due simply to the shortsightedness of the Bell companies in years past in failing to extend and develop the telephone business as it should have been developed previous to the independent movement, nor was it due simply to prejudice against the Bell monopoly. It was due, he thought, to a fundamental economic principle of telephone work which is that the message cost increases as the number of operating units connected to the exchange increase. Thus, in New York City, the cost of telephone service is necessarily higher than in smaller cities of New York State. Although not specifically stated, the inference drawn from his remarks was that subscribers could be more economically served by two systems of small size than by one large system. The cost of service depended on the number of subscribers connected to a system. The ideal system would provide an increased rate as the number of subscribers increased. Measured service was unquestionably the proper thing if rightly carried out. He then discussed some of the defects of common methods of measuring service and advocated measuring the time that a subscriber's instrument is in service and charging upon that basis. This, he thought, would overcome the practical difficulties of other methods. He urged manufacturers to promote the production of something of this kind. He favored more complete use of the copper circuits which are now erected. He pointed out that there was enough copper in the shape of telephone and telegraph lines to enable the country at present to handle much more business than is now transacted if proper use were made of these circuits to get the most out of them. To do this it might be necessary to make some kind of a consolidation or working agreement between telephone and telegraph companies so as to use lines simultaneously for telephony and telegraphy.

"The Independence of the Independents," by Mr. W. H. Denlinger, of Patton, Pa., was the subject of the last paper read. A number of other papers were presented by title only and ordered printed.

The election of officers resulted as follows: President, A. C. Lindemuth, of Richmond, Ind.; vice-president, P. C. Holdogel, of Iowa; second vice-president, E. B. Fisher, of Michigan; third vice-president, J. F. Demers, of Quebec; fourth vice-president, Arthur Wright, of California; secretary, J. B. Ware, of Michigan; treasurer, Manford Savage, of Illinois.

Controversies Over Electric Rates.

A controversy of much interest and importance to electric light companies the country over has been going on for several months at Minneapolis, and is not settled at present writing, though the sky is clearing. The city officials started out with the proposition that the rates of the Minneapolis General Electric Company were entirely too high, and that the same rate per kw-hour should be made for all consumers without regard to conditions of load, except for quantity discounts. The Minneapolis General Electric Company had, of course, been following the example of all safely managed large central station companies and had put in force a system of rates under which customers having the best load factors (that is, using current the largest number of hours per day) were given much the lowest rates. It appears from the reports of the early stages of the Minneapolis controversy that the city officials were chiefly concerned with lowering the maximum rates charged by the company for short-hour business. As a result of this controversy between the city and company, several expert investigations have been made of the company's affairs. The result of these investigations have all been to uphold the correctness of the company's theory of readiness-to-serve charges in connection with electric light and power business. It is, of course, inconceivable how any expert familiar with the business could come to any other conclusion after a careful study, but the Minneapolis case will be of value to all electric light and power companies in helping to establish more firmly the correctness of the principles which are most likely to be questioned by city officials and others not familiar with the business. The experts at Minneapolis, who included such men as Prof. Mortimer E. Cooley, of the University of Michigan; Messrs. D. C. and W. B. Jackson, of Madison and Boston; Andrew Rinker, city engineer, and Mr. C. L. Pilsbury, of Minneapolis, all agreed that the rates given to any individual customer should be dependent upon the fixed charges on the investment necessary to serve him, plus operating expenses, rather than on the average expense of serving all classes of customers. However, as a concession to the smaller customers, it seems to have been generally agreed both by the company and the experts that the maximum rates should be a little lower than those to which the smaller short-hour customers would be strictly and scientifically entitled, although a reduction of these maximum rates to small short-hour customers could be advocated scientifically only on the ground that the large number of small consumers by the grace of which the company has the use of the streets and public alleys for the distribution of its current, are entitled to receive compensation in this way for the franchise, and that larger consumers are not entitled to receive compensation in the same proportion. The reports of the various experts employed at Minneapolis taken alone should be sufficient to show any body of city officials that a uniform rate per kw-hour to all consumers is unfair, and that when this issue is brought up for decision by competent authorities, the uniform rate contention is certain to be defeated.

But the Minneapolis case is only the last of a series of important decisions that have been rendered on this subject, all of which have pointed the same way. In the Columbus, Ohio. case of 1906, the electric light rate question was thoroughly investigated by the courts and the principles outlined above were upheld. In Chicago, in 1906, the Arnold and Carroll report on electric lighting rates gave very cold comfort to the advocates of the uniform rate idea.

In the expert arbitration of 1907 on rates for Boston street lighting, the arbitrators at the outset rejected the proposition that the rate for one class of service should be based on the average cost of serving all classes of customers. The position was taken that the rate should be based on the cost of giving the particular kind of service under consideration. The Wisconsin state commission in recently authorizing an increase of electric light and power rates in the city of La Crosse upon advice of its experts, endorsed and authorized the readiness-to-serve system of charging. In Massachusetts, where the electric light commission is of many years standing, Boston furnishes a conspicuous example of a logical rate system based on the investment and operating expenses necessary to serve each individual class of customers rather than on the average expense of serving all. Now comes the Minneapolis case, further establishing the sound principles of rate making. It is not now to be anticipated that in the future any intelligent court or board of arbitration will reverse all of these decisions.

Some important gas and electric interests in this country have expressed fear that the results of the establishment of state electric lighting commissions and of the review of rates by outside authorities would be to abolish the so-called discrimination between different classes of customers and require the establishment of a uniform rate per kw-hour to all. In view of all these cases cited, these fears are entirely unfounded, and it is doubtful if there is a case where either a competent board of expert arbitrators or a state commission has ruled that a uniform rate per kw-hour to all customers was required to prevent discrimination. It has been rather held that it is discrimination against some customers to grant a uniform rate to all, and that the only kind of discrimination which should be abolished in the electric lighting business is that which gives a low rate to a customer who is not by virtue of the character of his load entitled to it.

In addition to the foregoing questions, other things of interest and instruction to the public of Minneapolis have come out of the rate controversy. Prof. Cooley pointed out to the committee that a limited term franchise costs the consumers more than a perpetual franchise because the company must figure on completely paying off its stock and bondholders at the end of the limited franchise, and this, of course, means higher fixed charges and higher rates than if the franchise were perpetual with proper safeguards. In addition to this, as recently pointed out in an editorial in the Minneapolis *Journal*, a corporation that is not under the menace of having to go out of business at a fixed time can sell its bonds at a lower rate of interest than would be possible if its franchise was for a limited period. It would, for instance, the *Journal* thinks, probably be possible for the Minneapolis General Electric Company to float 4 per cent bonds on a perpetual franchise, whereas with a limited franchise it pays 5 per cent. It points out that Prof. Cooley and other authorities believe in the idea of perpetual franchises, with the public's interests carefully safeguarded, and recommend a clause giving the public the right of purchase at any time after due notice of appraisal. Still another device that makes the perpetual franchise highly desirable is a profit-sharing agreement whereby the city can enter a partnership with the company. This is a prominent feature of the Chicago traction agreement. Such an agreement, which properly looks after both the company and the public interest, should be far preferable to many of the uncertainties attending public service franchises at the present time.

Engineering Education.

At a special meeting of the American Institute of Electrical Engineers, held under the auspices of the educational committee on Jan. 24, two papers were presented on the subject of engineering education. A paper by Dr. C. P. Steinmetz contained criticisms of the important defects in present educational methods for the purpose of urging their elimination. This paper is reproduced elsewhere in this issue.

A paper by Mr. Chas. F. Scott was in reality an introduction to a digest prepared by Prof. H. H. Norris of the papers on engineering education that have been presented before the American Institute of Electrical Engineers during the past 16 years. Mr. Scott stated that the problem of arranging an engineering course is largely one of elimination, because, if all of the studies were included which have been suggested as essential or desirable in the training of a student, the college period of four years would have to be increased to possibly 20 or 30 years. In the arrangement of subjects and courses, the following questions arise: (1) The relative attention to be given to the practical or industrial, the scientific, and the cultural. (2) The relative proportion between subjects which are valuable for imparting technical knowledge and those affording training in scientific and logical methods. (3) The relation between school instruction and practical work; whether one should precede the other, and if so which one should come first, or whether they should alternate. (4) The importance of current engineering practice; of lectures by practicing engineers; of discussion of current topics in local meetings of the Institute. (5) The degree of desirable differentiation in courses or methods on account of differences in the characteristics of individual students or in the fields of work they expect to enter. (7) The sequence of subjects—whether the theoretical groundwork should be laid during the first few years and the practical subjects reserved until the latter part of the course, or whether an intermingling of the two in accordance with the concentric method outlined by Prof. V. Karapetoff at the 1907 convention is to be preferred. Mr. Scott expressed the opinion that although the concentric method clashes with time-honored educational ideals, it presents arguments which are so rational that the existing method must assume the defensive.

In abstracting his own paper Dr. Steinmetz said that while mathematics is the most important tool of an engineer, it is useful and valuable only as long as it is employed as a tool, and ceases to be useful as soon as it becomes a purpose. It is merely a shorthand method of recording physical intuition and physical reasoning. It becomes positively dangerous when the one using it does not fully see the physical meaning of every mathematical step. In dealing with mathematics it must be recognized that it is only an empty formalism to one who does not realize its purpose as a tool.

DISCUSSION.

A communication by Mr. L. A. Osborne was read by Prof. H. H. Norris. Mr. Osborne expressed the opinion that 50 per cent of the technical graduates that present themselves to be employed might better never have undertaken their profession. He stated that engineers to-day are too self-centered; too bound up in details of their profession. Their perspective is too narrow, largely because their early training did not stimulate them in the right direction. There should be injected into the engineering courses something that will stimulate the powers of generalization.

Prof. H. E. Clifford remarked that an attempt to broaden the training may result in a tendency to standardize education, and standardization cannot be applied to educational methods. A distinct step forward will be taken if an attempt is made to eliminate from the student body those men who lack ability for their chosen line of work.

Prof. F. B. Crocker said that the proposed concentric method of teaching engineering possesses at least one almost fatal difficulty in that it would not tend to eliminate the students who are unfitted to become engineers.

Mr. H. W. Buck contended that in the development of engineering science the physical action must be clearly pictured before the theoretical treatment can be intelligently pursued. When practical applications are not made of mathematical equations the mind of the student becomes filled with a maze of symbolic relations, and a proper conception of what mathematics is for is lost.

Prof. W. S. Franklin said that the curriculum of a technical school should be so planned that the student covers the subjects of physics and chemistry in a comparatively brief course with the idea of accentuating the really fundamental things, and then this course should be followed by more elaborate courses in technology.

Mr. L. B. Stillwell expressed the opinion that in nine out of ten cases mere professional information acquired in the technical school is of comparatively little value to the graduate. The ideal education of the engineer who hopes to be more than a private in the ranks is a broad one. It cannot very well be too broad. Whenever possible a technical course leading to a degree in engineering should follow a four years' course leading to the degree of Bachelor of Arts, or Bachelor of Science. In other words, engineering courses should be regarded as professional courses and should perform the same function in the education of the engineer that the law school fulfills in equipping a graduate in the course of arts for the practice of law The men who rise highest in the engineering profession, generally speaking, are the men of broader education. Chief engineers and managers have little trouble in finding draftsmen and less in finding competent calculators, but the demand for "all around men" always exceeds the supply.

Prof. Albert F. Ganz said that the college should teach those things which the engineer must know and which he cannot readily obtain in practice.

Mr. J. G. White stated his belief that the college professor is too much inclined to go to lectures and too little inclined to depend on well-planned text books. The students' time should not be wasted in making notes and going through the mechanical operation of copying them without understanding the subject. There should be fewer text-books, fewer elective studies, and the studies should be confined to particular studies rather than to general information.

Prof. W. E. S. Temple called attention to the fact that no hard and fast rule can be made as to lectures, because the rapid progress now being made in electrical engineering demands that certain subjects be taken up in lectures. However, preliminary features should be taught by means of text-books.

Mr. L. A. Ferguson said that a premium should be placed upon the development of reasoning power rather than the mere memory of the student, and any subjects that he must know in his practice after graduation should be kept constantly before him throughout the entire course, so that he may carry his knowledge, once acquired, with him into the world. In order to prevent narrowness of view and mental fatigue among the teachers, the faculty of an engineering college should be made up of men graduated from as wide a range of colleges as possible.

Dr. Samuel Sheldon remarked that the advantages which are claimed for the concentric method of teaching should be obtained if possible. However, the method of accomplishing the object need not be so radical as the one proposed by Professor Karapetoff. For example, the physical laboratory work can be laid out so as to constitute a course in experimental electrical engineering.

Mr. Percy H. Thomas said that during the college course time should be spent on things that cannot be learned later, but not on subjects such as commercial designs of apparatus, constants of design and the relative merits of different makes.

Prof. W. L. Robb called attention to the relative lack of preparation of men who enter technical schools. Under the present condition of things, culture subjects have a place in a technical school, but they have only a transient place, because a course in English or history or political economy has no more place in a technical school than in a medical college or law college. The entrance requirements of technical schools should be brought up to the entrance requirements of the latter colleges.

Mr. C. O. Mailloux, in discussing the relative merits of lectures and text-books, said that the ideal method is to combine the two. The text books should be small, and should cover few points but cover them thoroughly. The student should not be required to take notes except when absolutely necessary. More use should be made of applied mathematics and less of pure mathematics.

Prof. D. C. Jackson said that it is better to carry general studies throughout a man's college career than to carry them to a certain point and chop them off and start a new line of education.

President H. G. Stott thought that a cure for many of the present ills will be found in raising the standard of entrance examinations, and teaching fundamental principles and not engineering practice.

Mr. C. F. Scott expressed the opinion that the concentric method is to be commended rather than objected to, because it is logical and psychological.

Dr. Steinmetz said that he thoroughly believes in Professor Karapetoff's concentric method. It is somewhat disadvantageous, however, in that a student who goes over a subject first in a practical way and then goes over the same subject theoretically and more thoroughly, is liable to neglect it and think he knows enough about it. A large part of the defects of the present college education are really defects inherited by the college from the high school and the primary school, and there is where the lever must be applied to improve conditions.

The State Right to Fix Lighting Rates.

Last week hearings were had at Albany, N. Y., in the appeal of the Saratoga Gas, Electric Light & Power Company against the order of the old Gas and Electric Commission fixing certain rates for gas and electricity. The case is considered as a most important one by lighting interests, the order having been supported in the lower court by a vote of three to two. The argument of the lighting company that the order in question was void, falls into two divisions: First, that Chapter 737 of the Laws of 1905 (creating the Gas Commission), taken as a whole, presents a legislative plan and is based upon principles essentially unconstitutional. It is therefore wholly void. Second, that Section 17 of this act, and its complementary section, 19, are unconstitutional and are therefore no authority for the order appealed from.

The attorneys for the company contended under the first head that:

First—The practical and underlying purpose of the act is to transfer to a non-elective body of three, not a local agency of government and not mentioned in the constitution, substantially all the police powers of the state and all the legislative discretion and functions of the Legislature, with respect to the control, management and restriction of the business of supplying gas and electricity, whether conducted by individuals or corporations.

Second—An essential part of the theory of the act is the delegation to the judiciary of non-judicial powers as to the details of the gas and electric government and restriction and the fixing of maximum rates of sale.

Third—One of the integral designs and effects of the act is to prevent, without compensation or due process of law, individuals and corporations engaged in the gas and electric business from exercising some of the most essential and valuable rights of property.

The points under the second head were as follows:

First—The power delegated to the commission to fix maximum rates is, in so far as it relates to the village of Saratoga Springs, a legislative and not a judicial, administrative or ministerial power.

Second—An essential part of the design of the Legislature in delegating to the commission the power to fix rates was to direct not only a review by the Appellate Division of the decision of the commission, but also the substitution of the discretion of the Appellate Division for that of the commission

Third—By authorizing the commission, when fixing rates or ordering improvements in the methods, manufacture, transmission of supply, to proceed upon the ex parte investigation of its members, officers, agents or inspectors, Section 17 deprives those engaged in the gas and electric business of their property without due process of law.

Fourth—By depriving individuals and corporations engaged in the gas or electric business of the right to apply for an alteration of a rate once fixed by the commission, while conceding this important privilege to their opponents, Section 17 denies to them the equal protection of the laws.

In enlarging upon these points the attorneys declared: We say without hesitancy that the gas commission law of 1905 has brought this court squarely to the parting of the ways in the matter of government by commission. If the Legislature can delegate to a body not mentioned in the constitution absolute and unrestricted powers as to gas and electricity, it can do so to every other industrial occupation or business affected with a public use.

It can thus practically abdicate its own most important functions, and instead of having one Legislature sitting at Albany, the state may in fact have a hundred different legislatures, each a non-elective body not directly responsible to the people, and each wielding the full police power of the state over the particular occupation committed to its control, and each, under the guise of rules and orders, passing such laws and adopting such policies as may seem to it good.

The act is an unprecedented experiment in state socialism, and the next logical step is the open assumption by the state of paternal power over all the attributes of private property invested in these industries—namely, the legal taking of such property without compensation.

This court therefore should deliberate long and earnestly before upholding the novel principle represented in the gas commission law, which, however popular for the time being, is in reality part of a bureaucratic and not of a democratic system of government, and may lead to infinite mischief in the future.

This is government ownership without the burdensome detail of paying for the property.

After going into the various points raised by counsel for the gas company, Deputy Attorney General Decker said: This is the first proceeding, under this statute to reach this court. It is believed that no public regulation of rates has ever been annulled in a special proceeding such as this. No precedent for annulling such public action should be established on a record like this, which fails to raise a reasonable suspicion that the rates in this case are unfair to the appellant. The act of fixing rates to govern in the future is in its very nature experimental. When a commission after a painstaking investigation has fixed rates on their face reasonable the public servants should be relegated to a suit or defence wherein the court asked to annul rates as confiscatory may have the solid ground of proved experience before visiting its condemnation on action taken under legislative authority within the admitted sphere of legislative jurisdiction. While the statute under consideration has been repealed, the special attention of this court is invited to the importance of this case as the precursor of attacks upon the validity of the public service commissions law, undoubtedly to follow.

Report of the New York Up-State Commission.

The Public Service Commission of New York State, for the second or up-state district, has just filed its first annual report to the Legislature. It deals almost entirely with traction and transportation questions. It has regulation over railroad properties capitalized at over $2,000,000,000, and lighting properties, gas and electricity approximating $500,000,000. In its review of work done in the lighting field, the report says: "The commission is engaged in the inspection of electric meters upon consumers' complaints and the inspection of testing systems at electric stations. The testing of all meters furnished to consumers has not been undertaken. The commission, after thorough investigation, is convinced that the tendency of electric meters is to under-register. The intent of the law is undoubtedly that no electric meter shall be furnished for use, or having been furnished, shall remain in use, without bearing the seal of the commission guaranteeing its correct registration. The destruction of such stamp, if a seal, would require the meter to be again submitted for verification. The difficulties attending the actual testing and sealing of all consumers' electric meters in the state are stated, and the report of a committee of representatives of the electric companies in the state is set forth under this heading. Six tests of consumers' meters upon complaint have been made in six cases.

The commission states that it will insist on the keeping of a depreciation account relating to all classes of lighting property.

Indiana Engineering Society Report on New Illuminants.

During the meeting of the Indiana Engineering Society, held Jan. 16, 17, 18 and 19, the committee on central station light, heat and power, of which Mr. J. B. Nelson was chairman, presented a report dealing with the relation of central stations to the high-efficiency illuminants. The committee held that the introduction of the new lamps will be slow so long as the present high prices are maintained. The central station man has been unable to bring himself to believe that he is under moral obligation to advise his patrons to install the high-efficiency lamps, thereby reducing his income, while the less energy cost to the consumer is counterbalanced by the additional cost of the new lamps.

According to the retail prices set by the Association of Lamp Manufacturers, a 16-cp, 56-watt, carbon-filament lamp is listed at 20 cts.; a 20-cp, 50-watt, graphitized-filament lamp is listed at 25 cts.; a 20-cp, 40-watt, tantalum-filament lamp is listed at 60 cts.; a 32-cp, 40-watt, tungsten-filament lamp is listed at $1.50. Since the metal tungsten is not rarer or more valuable than the metal tantalum, Mr. Nelson expressed the opinion that the cost of manufacture of the tungsten lamp is not appreciably greater than that of the tantalum lamp. The future general use of the tungsten lamp will depend upon a material reduction in the present price.

High-Efficiency Lamps in Kaiserslautern, Germany.

By L. J. Auerbacher.

The town of Kaiserslautern, Germany, with a population of 55,000, has its principal streets lighted by alternating-current flaming lamps and with excellent results. The lamps are so suspended from cables as to hang in the middle of the street and are swung 30 ft. high and from 150 ft. to 300 ft. apart. The illumination even at these long distances apart is excellent. The lamps take 650 watts each. The cost for a year of 3000 hours is stated to be $90. Coal is $3.50 per ton, but labor is very cheap, firemen receiving $1 per day, engineers $2 per day, and the general superintendent $1,100 per year.

The alternating-current flaming arc is found to work best with an initial voltage of 65 volts and a resistance to cut this down to 55 volts at the arc. With only 55 volts at the terminals much unsteadiness is caused. They are also operated well two in series on 110 to 120 volt circuits.

The plant, which is a municipal one, is in competition with a gas plant owned by private capital, which installs the latest type of inverted gas burners free of charge to customers. To meet this competition the electric people use the Osram lamp of 50 hefners (45 candle-power), and use also many 100 hefner (90 candle-power) frosted. Their load is now fully one-third Osram lamp. The lamps are sold to the customers at 87 cents for the 50 hefner and $1.25 for the 100 hefner, which includes a profit of 25 per cent. Experience with this lamp has been very satisfactory. The factory replaces lamps received in a damaged condition. The percentage of breakage is less than 5 per cent. If the lamp burns well for 50 hours, it is found that the life will continue to 800 or 1000 hours. Lamps that are blackened within 50 hours are replaced free of charge; discoloration is due to the material in the joint where the filament is made fast to the leading-in wires. The charge for electrical energy is 7½ cents per kw-hour for the first 300 hours, and 2½ cents thereafter. The rates for power and light are identical. About 700 kilowatts in motors and 1800 kilowatts in lights are connected.

The Just wolfram lamp is also very largely used. They are now made for 16 hefners for 110 volts, and also 50 hefners for 220 volts. The factory replaces breakage, and their use is very general. As yet very few of the illuminating companies furnish free high-efficiency lamp renewals. The Strassburg plant is an exception, as it not only furnishes free tungsten lamp renewals, but wires up free provided a three-years' contract for current is made. The Strassburg company, which pays good dividends, is noted for its progressiveness.

Consumers are getting used to the larger illuminating unit of the metallic-filament lamp and the old 16 candle-power is falling into disfavor. In Paris the few stores without the high candle-power tantalum lamp look as though they were out of business. The large sewing-machine factory of G. M. Pfaff, at Kaiserslautern, uses 220-volt Just wolfram lamps and also Nernst lamps and flaming arcs. There are no low-efficiency lamps of any kind in the factory, which also employs the electric drive exclusively.

Municipal Lighting Conditions in Massachusetts.

A letter to the editor of one of the suburban papers near Boston is of particular interest in regard to municipal ownership. This letter is as follows: "Mr. Editor: I would suggest to the present committee on street electric light equipment that they have a clause inserted providing that respectable, straight poles be put in various parts of the town and painted as in other towns and that the poles be put in so as to do as little damage as possible to private property. Also that these poles and wires shall be placed with especial regard for the trees."

The interesting point about this is that the town owns its own street lighting system and the majority of the poles. The Boston Edison Company has a transmission line through the town and supplies a few commercial customers and also supplies electrical energy to the street lighting distribution system. Outside of the transmission line more than three-fourths of the poles belong to the town.

The town has recently voted to sell its distribution system to the company and hereafter to have the Edison Company do the distribution of the street lights as well as supply the current. So long as the town owned the poles, the citizens were satisfied with comparatively poor service, but the moment a private company is to become responsible, the town demands far better service than it has ever demanded from its own lighting board.

The case is similar in another town near Boston, which ran without any reserve and whenever a breakdown occurred let one-half the town have current Monday, Wednesday and Friday and the other half Tuesday, Thursday and Saturday; or, in another town in Massachusetts, which ran without even sufficient capacity to carry the load and managed to pull through by never putting on the street lights until after the stores had closed. The price per lamp is not the only criterion. The quality of service has a great deal to do with the cost.

Depreciation.

Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, and for many years a prominent figure in American street railway accounting matters, read an important paper before the Northwestern Electrical Association, at Milwaukee, Jan. 15, on the depreciation of electric lighting properties. Some extracts from this timely statement follow, together with an abstract of the discussion which it brought out:

The Public Utility Law of Wisconsin provides that "Every public utility shall carry a proper and adequate depreciation account whenever the commission after investigation shall determine that such depreciation account can be reasonably required. The commission shall ascertain and determine what are the proper and adequate rates of depreciation of the several classes of property of each public utility. The rates shall be such as will provide the amounts required over and above the expense of maintenance, to keep such property in a state of efficiency corresponding to the progress of the industry. Each public utility shall conform its depreciation accounts to such rates so ascertained and determined by the commission. The commission may make changes in such rates of depreciation from time to time as it may find to be necessary."

For the purpose of the paper "depreciation" was defined as a "lessening of value," and the treatment of the subject confined to broad general questions, briefly touched upon, as applicable to the electric lighting business.

This "lessening of value" may be brought about, in so far as the physical property is concerned, from the following causes:

(1) Deterioration due to the ravages of time and the effects of the elements. (2) Wear and tear incident to use. (3) Displacement by reason of obsolescence or supercession, resulting from the development of the art or the evolution of the business.

The determination of the measure of depreciation necessary to provide, by reason of "deterioration" and "wear and tear," can possibly, with some degree of accuracy and satisfaction, be arrived at; the effects of obsolescence and supersession, practically unknown quantities, judging by the history of the past, presents a most complex question of the greatest importance and most far reaching in its consequences.

Broadly speaking, the most correct and sound method to pursue would be to arrive at the estimated average life of the different kinds of physical property dealt with, determining this life on the basis of type, methods of construction and installation, as well as the character and extent of its use and the conditions under which it is used.

The different kinds of physical property of an electric lighting system to be dealt with, in considering "depreciation," may be broadly classified as follows:

(1) Buildings and fixtures.
(2) Generating station equipment.
(3) Transmission system.
(4) Sub-station equipment.
(5) Distribution system.
(6) Transformer installation.
(7) Meter installation.
(8) Lamp installation.
(9) Tools and appliances.
(10) Miscellaneous equipment.

The measure of "depreciation" to be provided for, as finally determined on the basis previously outlined and suggested, reduced to or expressed in dollars and cents, and worked out in detail for each class of physical property, on the kw-hour unit, should be taken up in the accounts monthly. This may be done, as a matter of detail, by one of the following methods:

(1) "Operating expenses," in the appropriate accounts, should be debited and "depreciation reserve" credited, with the monthly proportion of the total annual "depreciation charge," based on the kw-hours unit cost.

(2) The monthly proportion of the total annual "depreciation charge," based on the kw-hour unit cost, could be treated as a deduction from the "net earnings from operation," and the amount so deducted credited to "depreciation reserve."

(3) The monthly proportion of the total annual "depreciation charge" (regardless of what the charge may be, based on the kw-hour unit cost) could be treated as a deduction from "net earnings from operation," based on the percentage said charge bears to the estimated "gross earnings," for the year and the amount so deducted credited to "depreciation reserve."

If the "depreciation reserve" so created is to be something more than a mere "bookkeeping" reserve, and the amounts thus set aside actually invested in interest-bearing securities, the interest earned on such securities should be credited to "depreciation reserve."

It should be understood, of course, that when replacements and renewals of physical property are made, the cost should be charged against "depreciation reserve."

If the first method suggested is followed, the "depreciation charge" introduced in "operating expenses" should be specifically stated and shown in the appropriate "operating expense accounts." If this is not done, there will be no way of showing "ordinary maintenance charges" separate and distinct from "depreciation charges," and "operating expenses" will not clearly show actual results.

Unquestionably, the first method proposed is more rational than the second or third, but the two latter will be found easier to work out and apply.

Either of the three suggested will accomplish the same results, in so far as ascertaining, on the same basis, what the "net income" is, applicable to "return on investment." The "measure of depreciation to be provided for" is the vital question; the method of its application, if sound and correct, is of secondary importance.

The Milwaukee Electric Railway & Light Company has, since Jan. 1, 1898, down to the present date, followed the third method suggested. Mr. John I. Beggs, president and general manager of our company, is a pioneer in recognizing and providing for "depreciation." He not only had the wisdom and foresight ten years ago to recognize "depreciation," but the courage of his convictions, in the administration of the property, to carry out the policy of providing for it in the accounts and finances.

AMORTIZATION.

In addition to providing for "depreciation," as previously defined and treated, provision should be made for a shrinkage in the value of the physical property, if, through necessity, it is disposed of as junk or scrap at the expiration of limited-term franchises. The amortization of capital liabilities, for which there may be no tangible assets, should also be provided for, or sufficient "return on investment" be assured to justify capital assuming the risks attendant on the business.

"Depreciation" and "amortization" must be reckoned with in determining the cost of furnishing electric current, together with interest on investment, as well as the cost of generation and regeneration, the cost of distribution, the general expenses incident to the conduct of the business, and taxes. Indeed, to this cost should be added adequate charges to cover reserves for unliquidated damage claims and provision for contingencies before the true cost of electric current delivered to the consumer can be fully and absolutely determined.

The subtraction of ordinary or current "operating expenses" and "taxes" from "gross earnings" does not represent "net earnings" available either for interest on bonds or dividends on stocks. It is high time that the electric lighting interests of the country awakened to the full realization of this very important fact.

In the discussion of Mr. Duffy's paper, Mr. W. B. Jackson was asked to make a statement as to the methods of figuring depreciation used by him and his associates in the recent appraisal of the property of the Minneapolis General Electric Company. He said that after very careful consideration they came to the conclusion that a fair duplication value of the property would probably give the most simple method of arriving at a figure upon which fair investment charges for electric light and power could be based. This was done because it was concluded that the depreciated value of a plant would of necessity come to a figure somewhere between 70 and 80 per cent of its original value, because if the value had been permitted to drop below about 70 per cent of the cost of duplicating the plant, the plant would probably have been allowed to run down to a point that it could not give fair and reliable service to the city. It was, therefore, decided to take the cost of duplicating the plant, less a certain amount of depreciation, and add to it that value of any property which is inherent in it as a growing concern; that is, the value which is due to the fact that the business has been worked up from nothing to that of an efficient and reliable organization where the company is doing business well and economically. They arrived at the conclusion that a figure of 2.9 to 3 per cent per annum should be allowed for depreciation upon the duplicate value of the entire property, including land and water power. This depreciation figure would be higher if only figured on the operating features of the plant. The only fair way to arrive at the year's depreciation for this property was to take each of the different factors separately.

Mr. P. H. Korst, of Janesville, Wis., said that his company had attempted to take care of depreciation by charging all improvements of the plant of whatever nature to an improvement account. At the end of the year a committee is appointed by the directors to go over this improvement account and decide what proportion of each item should be charged to depreciation. In some cases the improvement account would be wiped out by the depreciation allowed.

Mr. J. H. Harding, of La Porte, Ind., said his company's practice was to charge to stock all materials bought and from there they are charged to renewal of plant or to plant extension, as the case might be. In the case of replacing an old generator with a new, the amount received for the old generator was deducted from the cost of the new generator, and part is charged to expense account and the balance to plant account No fund is set aside especially for depreciation.

Mr. Jackson explained further in connection with the Minneapolis appraisal that in getting the depreciation value they figured the different parts of the plant as being construction by sub-contractors. Then they added a percentage for engineering and general contracting work, and also half of 1 per cent of the cost of the entire construction for insurance. They added a percentage for law organization and general incidental expenses, and also 6 per cent on the value of the plant for one year, and 8 per cent for the cost of selling or disposing of the securities. The figures upon which they based their final estimate, therefore, gave all of the several items that must enter into getting such a plant going.

Mr. R. N. Kimball, of Kenosha, raised the question whether if a company originally did not make a charge to depreciation account the state commission in considering applications for reduction of rates would make an allowance for depreciation, even though the company had not in the first years of its existence kept its books so as to recognize depreciation. For example, his company had originally put down any excess over interest and operating expenses as surplus. Part of this surplus was, of course, really depreciation. Out of this surplus money had been put back into the plant from time to time which had taken care of what we would now call depreciation, but which at that time the company did not call by that name. He asked whether the Wisconsin commission in any of the cases so far decided had given an expression of its opinion on the items of depreciation on different classes of apparatus or whether any decisions recognizing depreciation had been rendered thus far.

Mr. Duffy said that the Wisconsin commission had recognized the principle of depreciation in a decision on the application of the Merrill Railway & Lighting Company for authority to change its rate for electric lighting. Mr. Duffy said we should not be carried away with bookkeeping methods. We must recognize the principle and apply the principle as it should be applied. There is no justification for depreciation being at one time treated as surplus and at another time some other way. For instance, if you are going to charge the difference between a displaced generator at its value when displaced and the cost of a new generator as depreciation, he would like to ask what became of the operating expenses during the month or year when it stood that abnormal charge. He wished to say for the state of Wisconsin and for the railroad commission that they not only recognized the principle of depreciation, but they applied it in a just and equitable way. In the electric lighting business it is difficult to draw the line between repairs and replacement.

For example, a company would have to replace a pole now and then, or a wire, or a meter, or a transformer. This ought to be dealt with liberally, and, to his mind, was maintenance, but there would come a time when the company would have to lift out 100 poles or take down miles of wire, notwithstanding these current ordinary repairs and these incidental replacements. If you have not recognized that and provided for it by taking out of the surplus such a sum as is necessary to replace that property, you have certainly made a mistake. In two specific cases in Massachusetts, with the consent and approval of the railroad commissioners, the fare was raised from 10 cents to 12 cents on an interurban railway. The cost of operation and taxes subtracted from gross earnings never makes interest applicable on bonds and surplus. The one who does not set aside a sufficient sum to take care of depreciation, but charges these expenses direct to operation, attains the same results, but attains it at the expense of upsetting his correct results for that month, which is unfair to that month and to that year. Answering the question as to whether the Wisconsin commission had recognized depreciation, he quoted from the Merrill Railway & Lighting Company decision as follows:

"To the above expenses should be added something to the depreciation and interest on the investment." The applicant places the depreciation at about 6 per cent on the total value of the plant. Good engineers place it at from 3 to 10 per cent. The former figure is, perhaps, too low and the latter too high. It is quite probable that it should be placed above 5 per cent. While depreciation is figured at a certain per cent per year during the life of the property, it is undoubtedly increasing with the age of the same.

The rate of interest that should be allowed on the investment in such plants is also a matter that has not been definitely fixed. By many authorities it is placed at from 6 to 8 per cent, and by others again as high as 10 to 15 per cent on the cost of the plant. Those who invest their money in undertakings of this character are undoubtedly entitled to interest at the current rates, and possibly something besides, to cover risks and contingencies.

Mr. Duffy said one of these contingencies is the obsolescence that he spoke of in his paper. In addition to other things, there can be strikes, fires, etc. These are contingencies. Unless these are allowed for, investors would not be likely to put their money into such plants. He then quoted further from the Merrill decision, showing the position of the commission with reference to depreciation.

Mr. Neal Brown urged that if the principle established in the Merrill case that "reasonable profits" should be an ordinary interest-bearing rate and possibly something more, it will not be very encouraging to investors. If the railroad commission should establish a rule that practically the interest-bearing rate of money should be the measure of profit, one could never develop an electric light and power property. Men who go into manufacturing or make loans on farm property for 6 or 7 per cent would not invest their money with the well known hazards that may come to a public service corporation. The state does not guarantee the investor 5, 6 or 7 per cent if the company loses, but, on the other hand, the intimation has been made that the legal interest will be the practical limit on the investment. However, he thought the railroad commission to be made up of very fair-minded men, and if the matter ever came before them fairly, they would decide correctly and they would hold that men engaged in pioneer development work should not be placed, with respect to their investments, on a common interest-bearing basis. The term "reasonable profit" is one that is relative. There are manufacturing interests in Wisconsin that have been making from 25 to 100 per cent profit during the last 25 years. The term "reasonable" should be interpreted and construed with reference to the surrounding business conditions. He had in mind a water-power plant that he had been interested in where $100,000 had been invested in purchasing the lands necessary, to say nothing of the development of the power. If he had said to his associates when he went to them to get money to buy up this land, "Well, you will be cut down to a 6 per cent interest basis if you develop that power," they would not have put a dollar into it.

Mr. W. R. Putnam, chairman, suggested that there was one difference between the public service and a manufacturing business in that in one sense of the word the people are in partnership with the companies. They grant certain rights in giving franchises which the ordinary manufacturing corporation has not, and in return for those rights the companies must take them into consideration in figuring what a reasonable profit is. Mr. Brown said that this was a proper inquiry, but the position was not well taken. He said, "You say we enjoy these great privileges. Well, some of us enjoy them and some do not. I have not had any great enjoyment out of the franchises and privileges that I have had."

Meeting of the Pittsburg Section of the A. I. E. E.

The Pittsburg Section of the American Institute of Electrical Engineers met Wednesday, Jan. 8, 1908, in the Carnegie Institute Lecture Hall, for the purpose of discussing "Illumination." One of the principal papers of the evening was given by Arthur J. Sweet, of the Westinghouse Lamp Company, of Newark, N. J. Mr. Sweet first reviewed the theoretical factors of good illumination, classifying them under the following subjects: Efficiency of illumination, intrinsic brilliancy of light source, color, intensity, steadiness and efficiency of light distribution, size of illuminating source and the temperature to which it is possible to raise the incandescent solid. All these subjects have to be studied by the illuminating engineer in order to understand the physiological process of good visual perception. Visual perception is the thing to be considered more than candle-powers. The visual perception of an object lighted with an illumination of two foot-candles is very different when the field of vision is surrounded by intense light than when surrounded by a soft, weak light. In other words, very light reflecting walls should not be highly illuminated from a small, intense light source, but from a larger light source of lower intensity.

Different colored papers absorb different amounts of light, and that which is absorbed is lost. The percentages of light reflected by different colored papers are: White, 80; orange, 50; yellow, 40; light pink, 35; light blue, 25; emerald green, 18; dark brown, 10.

The following table gives a comparison of the physical properties of the most common forms of electric lamps:

Kind of Lamp.	Mean spherical candle power.	Watts per candle.	Candles per kw.
Common 56-watt carbon-filament incandescent lamp, rated at 3.5 watts per candle, 16 horizontal candle power	13.2	4.24	236
Common 50-watt carbon-filament incandescent lamp, rated at 3.1 watts per candle, 16 horizontal candle power	13.2	3.78	264
Three-glower, 264-watt Nernst lamp	81.	3.26	307
Gem, 125-watt, graphitized-carbon-filament lamp of 50 horizontal candle power	40.7	3.07	326
44-watt tantalum lamp, rated at 22 horizontal candle power	16.0	2.75	364
Direct-current 5.1-ampere enclosed-arc on 110-volt circuit, 1.5-in. carbons	213.0	2.63	380
Alternating-current enclosed 5.7-amp. arc, taking 388 watts on 110-volt circuit, .5-in. carbons	152.0	2.55	392
60-watt, 110-volt tungsten-filament, lamp burning at 1.25 watts per horizontal candle	37.0	1.62	617
Luminous 8-amp. arc, 440-watt, two in series on 110-volt circuit	1020.0	.431	2320

Mr. Sweet stated that the filaments of tungsten lamps are now spring-anchored, and the lamps can be used in any position. He said that a tungsten lamp can be operated at double voltage for over an hour without burning out, while a carbon-filament lamp would last only a few seconds.

Mr. G. M. Little, of the Westinghouse Electric & Manufacturing Company, gave a very clear description of the art of making arc lamp electrodes, from the Jablokoff candle down to the latest flaming arc and magnetite lamps, illustrating his talk with lantern slides. He said that when the enclosed arc came into vogue carbon manufacturers feared that the arc lamp designer might go a step farther and enclose the electrodes in a vacuum, which would make them last indefinitely. However, when the experiment was tried it was found than an arc could not be supported in a vacuum and there was joy in the camp of the carbon manufacturers once more. Arc lamps are now made with a specific consumption of .2 watt per candle. The manufacture of electrodes has been gradually perfected through a great many more difficulties than are generally known. Many different kinds of coke and mixtures of coke and lamp black were tried and analyzed, and refinements were made, even down to extracting small quantities of iron impurities which made the carbons magnetic and blew the arc to one side.

Mr. George Loring, engineer of the National Electric Lamp Association of Cleveland, Ohio, gave an impromptu talk on the latest development of the tungsten lamp, and remarked that they can now be shipped without danger of breaking. He also called attention to the improvement in the quality of light delivered by a tungsten lamp over that of the ordinary carbon-filament lamp. The tungsten lamp gives a light closely resembling sunlight, while the carbon-filament lamp light corresponds with that given by the spectrum from the green down. A variation in e. m. f. above or below the rated normal does not make such a variation in the light emitted from the tantalum as it does with that emitted from the carbon-filament lamp. The 32-cp, 40-watt, 110-volt tantalum lamp is now a commercial article, and appears to be well suited for general needs. Mr. Loring stated that it is a mistake to assume that the use of the tantalum lamp will cause a reduction in the receipts of the central station. It is the present poor light obtained from the carbon-filament lamps that has caused many people to use Welsbach lamps when they would prefer electric lamps. Moreover, the cheapening of anything makes its use much more general. Thus the customer will not be as anxious as formerly to turn off the light as soon as possible, and more lamps will be used for advertising.

Mr. Skinner called attention to tests made by the Allegheny

County Light Company, which found that its customers were using old lamps that were originally rated at 16 cp, but had deteriorated so that some of them did not give more than 6 cp.

A letter was read from Mr. A. J. Wurts, who was confined at home on account of illness. He made the suggestion that all lamps should have two ratings—a photometer rating and an illuminating power rating. The latter should be based on the well-known 16-cp lamp as a unit.

Mr. Martin, of the Allegheny County Light Company, read a short discussion on lighting, prepared by Mr. Muller. The principal points brought out were that the central station man is now deriving a good income from electric heaters, small motors, etc., in addition to lamps. He gave a table comparing the renewal cost with the consumption of all the different styles of incandescent lamps on the market.

Gas and Electric Consolidation in Massachusetts.

The subject of the consolidation of gas and electric properties is considered in a report of the Board of Gas and Electric Commissioners of Massachusetts to the State House of Representatives, following an investigation made at the direction of the General Court.

Relative to the acquirement of companies by the Edison Electric Illumination Company, of Boston, the board says: "By its decision in Evans vs. Boston Heating Company, the Supreme Court held that a heating company might mortgage its property. * * * Assuming that if a corporation may mortgage, it may also sell its property, it has been contended that an electric light company may purchase the property of another electric light company and obtain in its own behalf from the proper public authorities locations for the street structures so purchased. Acting upon this theory of its rights, the Edison Electric Illuminating Company, of Boston, has acquired the property and under locations duly obtained therefor where necessary is supplying electricity in the several territories formerly served by the Milton, Dedham, Blue Hill, Natick, Framingham, Woburn, Somerville, Greendale, Medfield, Medway, Church Green, and D. S. McDonald companies."

The board says instances of virtual consolidation, in which two or more gas or electric light companies occupying adjoining territories have been brought under a common control, are increasing in number. They exhibit, both as to financing and as to physical relation of the respective plants involved, many of the features of actual consolidations without the direct and positive advantages to consumers which should result from such actual consolidations as are in the public interest.

From the facts disclosed by its investigation, the board reaches the following conclusions:

That any proposed consolidation will present a situation differing in some degree at least from those which have previously received the sanction of the Legislature or of the board or official to which this discretion may be delegated.

That there is an undoubted opportunity for advantage both in economy of investment and operation and in efficiency in favor of a large gas or electric light plant to serve a given territory over several small plants serving different sections of the same territory. The facts suggest not only the probability of further consolidation of lighting companies, but also the desirability of some such consolidations as in the public interest. It is important, however, in the opinion of the board, that the general policy of the Legislature in regard to them shall be clearly defined.

That if the legal theory under which the Edison Company has acquired other companies is correct, there seems to be no substantial reason why an electric company may not on the same theory purchase the property of a gas company. Furthermore, if the prohibition of the act of 1886 applies to the transfer of the franchise of a gas company and not to its property, the same legal theory might enable one gas company to buy the property of another and thus virtually to consolidate. In either case, no public official or board passes upon the advisability in the public interest of such purchases and sales as a condition precedent to their validity.

The board is of the opinion that, unless the authority to pass upon the advisability of such consolidations is to be retained by the Legislature, it should be delegated to the board, so that no consolidation shall be valid until the board has first decided that it is consistent with the public interest. The board is also of the opinion that this question is of so much importance to the stockholders of the respective corporations involved that such purchase and sale or consolidation shall not be authorized by the vote of a majority only, as it may be under the present practice, but upon a vote of two-thirds in interest of the stockholders of each corporation interested.

The board submits with its report a draft of a bill which it recommends, entitled "an act to authorize the purchase, sale and consolidation of gas and electric light companies."

Cazin Metallic-Filament Incandescent-Lamp Patents.

Three patents were issued Jan. 24 to Francis M. F. Cazin on methods of manufacture of the type of incandescent lamp filaments on which he has previously been granted a number of patents. One of the specifications cites a long line of patents covering the work of Mr. Cazin in the use of the rare metal oxides for incandescent lamps. The earliest of these patents was granted in 1892, and additions to the list were made almost yearly to date. The present patents relate more particularly to details of the manufacture of filaments for incandescent lamps.

In one of the specifications the filament is described as consisting of four separate elements, as follows: 1. A core for electrolytic deposition, preferably of carbon, and of the shape of the finished lamp filament. 2. An electrolytically deposited coat on such core. 3. A second electrolytic coat of metal, the oxygen or nitrogen compound of which is a solid, and for which the metal has only a normal affinity. 4. A surface metal of a metal compound, the result of chemical reaction on the surface metal.

In another specification it is stated that instead of covering the core with an oxide, metals of the ruthenium-osmium class may be used. For the first coating a mixture of osmiate of potash and chloride of iridium is also referred to. Instead of the core being of carbon, it may be of a metal or other material which may be subsequently eliminated. Before immersing the core in the electrolyte, it is prepared for the deposit of osmium-iridium by a primary coating of zinc. On the osmium-iridium there may then be coated a metal of the rare-metal class.

The specifications, which were evidently in the language of the inventor, are in places quite polemical, and the matter is so discursive and the treatment so disconnected that it is very difficult to obtain a definite idea of the essential details of the inventions. Turning to the claims, those for the first patent in order of issue relate to the details of the process of plating or metallizing carbon filaments. The claims of the second patent are similar except that the term "conductive filament core" is used instead of carbon filament, though in one claim the term has the qualification "preferably carbon core"; several concentric layers are mentioned, the one on the surface containing titanium. The claims of the third patent relate to a core of carbon surrounded by an electrolytic coating of metals, the several materials of which the complete filament is composed being so proportioned that after it has been subjected to heat it will consist partly of carbon, partly of the product of the reaction between carbon and the metal, and partly of the metal. Another claim states that the filament consists finally of a central core of carbon, a concentric layer of a mixture of carbon and metal, an adjoining layer of metal of the ruthenium-osmium group, and a layer of rare metal oxidized on the surface.

CURRENT NEWS AND NOTES.

NEW YORK ELECTRICAL SOCIETY.—The next meeting of the New York Society will be held on board of the Cunard steamship *Lusitania* at 8 p. m. Wednesday, Feb. 5.

A MONSTER TELEPHONE.—It is stated, but we had not had the curiosity to test the assertion, that if all the Bell telephones made each year were blended into a single instrument, it would be nearly 300 miles high and weigh 4000 tons. This seems like tall talk.

OHIO ELECTRIC LIGHT ASSOCIATION.—At an executive meeting of the Ohio Electric Light Association, held at Columbus, Ohio, last week, it was decided to hold the next convention Aug. 25, 26 and 27, 1908. The place has not been definitely decided upon.

UNDERGROUND CONDUIT CONSTRUCTION.—Mr. Bernard C. Groh, formerly conduit engineer with the American Telephone & Telegraph Company and now engineer of the American Conduit Company, addressed the Chicago branch of the A. I. E. E., Jan. 21, on "Electrical Subway Construction."

TELEGRAPH RATES.—Senator La Follette, of Wisconsin, has introduced at Washington a bill to regulate the interstate transmission of telegrams. He believes that the interstate business of telegraph companies should be under the Interstate Commerce Commission, as interstate railroad rates are regulated. The bill also prohibits government employees from accepting telegraph franks.

ILLUMINATING ENGINEERING.—The next meeting of the New York Section of the Illuminating Engineering Society will be held at the United Engineering Societies' Building, 33 West Thirty-ninth Street, Thursday evening, Feb. 13, at 8:15 o'clock. Mr. George Leland Hunter will present a paper on "Light and Color in Decoration." An invitation is extended to readers of this journal to be present.

MAKING DIAMONDS.—Great interest continues to attend the charges against Lemoine for obtaining money fraudulently under pretence of making diamonds electrically. A sensation has been caused by the testimony of diamond dealers in Paris that Lemoine bought stones from them through his wife at the time of his alleged successful experiments, and that the stones are identical with those which he claims to have been the product of his furnace.

ALUMINUM STORAGE BATTERY.—Dr. Otto Reinhold, of Newark, N. J., claims to have produced a storage battery the weight of which is only 20 per cent of that of a lead battery for the same amount of electrical energy stored. Constructive details have as yet not been disclosed, but the inventor states that in the plates use is made of aluminum and iron oxide immersed in a solution that is harmless to aluminum. It is claimed that, in addition to being extremely light in weight, the battery possesses a high efficiency, can be charged at a high rate and is inexpensive in operation.

COOLING OF TRANSFORMERS ON RAILWAY CARS.—In a patent issued Jan. 21, Mr. Walter S. Moody proposes to increase the air circulation through a transformer on a railway car, by connecting the intake pipe of the air-compressor, which fills the reservoir with air for the operation of the car brakes, to take air from the interior of the transformer. By this method the air circulation through the transformer is increased in an advantageous manner, because the brakes are used most frequently and consequently the air pumped most rapidly by the compressor when the car is running at comparatively low speed and when therefore the circulation produced by the motion of the car proper is least noticeable.

CARNEGIE INSTITUTE STUDIES.—The marine observations in the Pacific Ocean, conducted by the Carnegie Institute, of Washington, during the last year, lead the officials to believe they can save the great ocean liners from $1,000 to $2,000 on each voyage. According to the year book of the institution, just issued, measurements of magnetic declination, dip and intensity were made, and a new magnetic chart, correcting errors in former charts, has been made, and mariners, it is said, will now be able to steer much straighter courses. The Galilee, the vessel employed in the survey, according to the year book, has traversed over 50,000 miles along courses where few magnetic observations have been previously made.

COMPENSATING WINDINGS FOR SINGLE-PHASE COMMUTATOR MOTORS.—Since the m. m. f. of the current in the compensating winding of an alternating-current commutator motor should equal the m. m. f. of the current in the armature, a large number of turns will be required for the compensating winding if the current through these turns has a value no larger than the armature current. In a patent issued Jan. 21 to Mr. E. F. W. Alexanderson means are disclosed for obtaining a current equal to at least twice the armature current for use in the compensating windings. The scheme proposed consists in connecting a plurality of armatures in parallel and connecting the compensating windings in series. The object in employing a small number of turns in the compensating winding is to save the extra space required for insulation in the slots in the pole-faces when more than one conductor is placed in each.

EIFFEL TOWER WIRELESS.—A special cable dispatch from Paris of Jan. 25 says: "The Government has begun the installation of an elaborate apparatus for wireless telegraphy in the Eiffel Tower, by which it hopes to be able to communicate directly with New York. General Picquart, the Minister of War, is convinced that on account of the splendid results attained by the wireless system, by means of which messages were sent here direct from Morocco, a distance of about 2000 kilometers, the establishment of an instrument in Eiffel Tower would prove most useful as a part of the national defense in time of war. Lieutenant-Colonel Chales, Director of the Military Telegraphs, said to-night that he expected important results from the contemplated arrangement. He pointed out that with the great height of the Eiffel Tower a message should theoretically go around the world, returning to the tower." The idea is to keep in direct touch with French warships in any part of the world.

ATLANTIC WIRELESS SYSTEM.—A special cable dispatch from London, of Jan. 21, says: "Before his departure for Ireland to-night Mr. William Marconi said that the transatlantic wireless system will be opened to the public on Feb. 1 or 2, and that in the beginning the service will be between London and Montreal only via Clifden, Ireland, and Poldhu, Cornwall, on the eastern shore of the Atlantic, and Glace Bay, on the western shore. Montreal was chosen as the beginning point for the transmission of business and private messages because Canada has subsidized the wireless system to the extent of $80,000. In explaining the effort of the American telegraph companies to stifle the wireless company, through fear of its competition, Mr. Marconi said: 'The telegraph companies placed a grave obstacle in the way of our success by refusing to accept at press rates messages filed in New York for transatlantic transmission via Glace Bay, thus adding from 3 to 4 cents a word to the cost of an east-bound message, while the regular press rates from New York to Glace Bay were only 1 cent a word. This difficulty was solved by the New York editors with reference to west-bound messages by appointing me their Nova Scotia correspondent.' The rate on private messages between London and Montreal will be only 12 cents a word. It is understood that no attempt will be made, at least for the present, to lay private wires to the wireless terminals."

MINNESOTA CENTRAL STATION ASSOCIATION.—The first meeting of the Minnesota Central Station Men's Association will be held at Hotel Nicollet, Minneapolis, Feb. 28 and 29. Mr. A. H. Lane, superintendent of the Glencoe Electric Light Company is temporary chairman.

BOSTON BRANCH ILLUMINATING ENGINEERING SOCIETY.—At an election, held Jan. 14, the following officers of the Boston Branch of the Illuminating Engineering Society were elected: President, Mr. J. S. Codman; secretary, Mr. Ware; managers, Messrs. W. H. Blood, Jr., and T. H. Piser.

CIVIL SERVICE.—The New York State Civil Service Commission will hold examinations on Feb. 15 for an assistant electrical engineer, salary $600 to $900 per annum, and maintenance. The last day for filing applications is Feb. 8. Full data and forms can be obtained from Mr. Charles S. Fowler, chief examiner, Albany, N. Y.

PAINLESS ELECTROCUTION.—A special dispatch from Paris states that Dr. Leduc, a professor at the School of Medicine, in Nantes, who has been experimenting in the slaughter houses of that city on the electrocution of animals by intermittent low tension currents, is about to repeat his experiments in the Parisian Abattoirs at Vaugirard. He claims that the system is painless, the central functions of perception being first destroyed and then those of respiration and circulation, and that there is consequently neither suffering nor reaction from the animals thus killed.

TELEGRAPHY IN CUBA.—Mr. A. Campbell Turner, chargé d'affaires of the American legation at Havana, forwards copies of three decrees of the provisional governor of Cuba establishing state telegraph offices, to be connected with the postoffices in the following places in Pinar del Rio province: Orozco, Quiebra Hacha and Cabanas. In these offices the postmaster is to be required to pass an examination as telegraphist and is to fill both posts. It is proposed in the future, in all the smaller towns in the interior of the island where the work of the postoffice will so permit, to combine the offices of postmaster and telegraphist and to make applicants for these positions pass an examination in telegraphy before receiving their appointment.

A DEAF OPERATOR.—If the Kennebec, Me., *Journal* is be believed, Peter A. Foley, the "lightning taker" of Portland, is the most wonderful telegraph operator in the world. He is totally deaf, an affliction which ordinarily would be supposed to make ordinary telegraphy an utter impossibility to him, but since he became deaf eight years ago, Foley has developed what may be called a sixth sense and by touch and sight he can detect the finest movements of the instrument and interpret them. His nervous system is a part and parcel of telegraphy and by means of the sense of touch in his finger tips he takes messages. He can read a message by watching the sounder, it is alleged. With his left forefinger placed lightly on the sounder, he can by his sense of touch take a message as accurately as any man in the office.

FRUIT CROP PROTECTION.—The United States Weather Bureau has just put into operation a plan by which it is thought fruit growers throughout the orange belt of San Bernardino, Riverside and Los Angeles counties, of California, will be given ample protection from damage to crops by frost. In this district sudden changes in temperature are not unusual during winter months, and it has been found that the printed charts issued by the Weather Bureau do not insure sufficient protection, especially in the remote portions of the great orange belt. Arrangements have been completed by which it is possible to send warnings by telephone at any hour of the day or night. Sub-stations have been established, to which warnings will be sent, and from these sub-stations the warnings will be sent to growers, nearly all of whom have telephones and can be reached quickly. Whenever a sudden drop in temperature is expected it will be known in ample time for the growers to protect their crops by smudging or in other ways. A clerk will be on duty at the Los Angeles office of the Weather Bureau at all hours to send out such warnings.

COMPETITION IN BRAZIL.—U. S. Deputy Consul-General J. J. Slechta, of Rio de Janiero, states that the latest phase of the competition between the Brazilian company and the Canadian-American interests supplying electricity in all of the larger Brazilian cities has resulted in the decision of the former company to construct a rival power plant in the city of Sao Paulo, with the hope of in some way finding a loophole in the monopoly of the tramway system held by the foreign company. In the meantime they propose to construct an electric line between Sao Paulo and Santos, thus competing with the existing steam railway and menacing the success of the proposed extension of the Sorocabana Railway, which is controlled by the same group of capitalists interested in the tramway system. The Brazilian company is also making a hard fight to invade the territory of the foreign rival by securing such legal decision as to its respective rights in the matter as will permit the former to compete with the foreign concern in supplying electrical energy to the government consumers in the Federal capital. Both companies have large water-power plants, adequate in capacity to supply all the electricity needed by the city at the present time.

LONDON SUBWAYS.—Mr. W. B. Parsons addressed the Columbia University Engineering Society last week on "Some Engineering Things That Are Not Engineering." He said: "When I was appointed chief engineer of the Rapid Transit Commission in 1894 I was sent abroad to investigate the rapid transit systems of the European cities. At that time the London tube had just been completed, and seemed to be a success. The press of this city and a large number of influential men had declared that the solution of New York's difficulty lay in a similar tube. When I returned I had seen the only tube in existence and two others that were in course of construction From my observations I had grave doubts that the tube would be a success in London, but I had no doubt that it would not be a success in New York. Our public would never put up with its inconveniences. But what was I to do? On the one hand was the backing of the press and of many influential men. I had nothing but my own conviction that I was right. I had no reputation; what I was to have depended on my decision. I tell you I walked the floor, but I finally determined to stick by my opinion, and recommended a shallow subway. Since then I have had the honor of writing a report for the London Commission."

MOTORS FOR BIRMINGHAM.—U. S. Consul Albert Halstead, of Birmingham, writes as follows in regard to the conduct of the electric light and power plant owned by that British industrial city: "The electrical supply committee of the Birmingham City Council has been authorized to expend £20,000 ($97,330) for the purchase of motors. The idea is to increase the use of electricity as a motive power among small manufacturers by permitting them to hire motors from the city for power purposes. This, I believe, is a new departure in municipal business activity. At the same time there has been a reduction of the scale of charges for electricity for power purposes. Birmingham has expended several million dollars in erecting its modern electric power houses. It furnishes electricity not only for lighting and power purposes, but for the electric street cars, which the city also owns and operates. An additional plant has to be provided at an estimated cost of £231,285 ($1,125,548). There is friendly rivalry between the electric supply committee and the gas committee of the Birmingham City Council for business, each committee endeavoring to promote the use of its lighting and power facilities. The rivalry is keen, and it would seem as if it should be of advantage to both committees by leading to increase in the use of their supplies."

High-Tension Energy Transmission in Peru.

It might seem that the western coast of Peru, with an entire absence of rain and lightning, offers to the engineer an inviting field for high-tension work. On the contrary, however, the heavy, damp fogs that drift up from the sea during the winter season penetrate to every part of the insulator and pin. During the balance of the year the insulator is covered with dust, which with the fog forms a thick coating of muddy paste that only periodical washing by hand can remove. A curious fact has been noticed in the regular manner that the dust particles arrange themselves at right angles to the axis of the copper conducting wire on the under surfaces of the insulators.

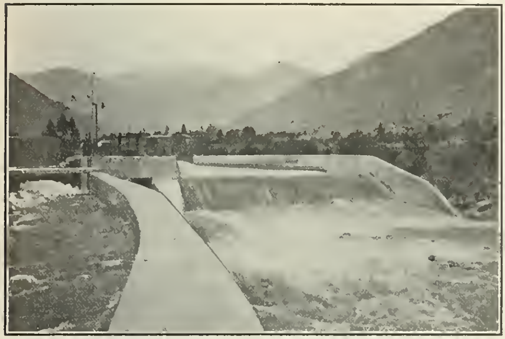


FIG. 1.—DAM AND CANAL FOR YANACOTA STATION.

The first energy transmission system in South America was started in Peru in 1904. The line is 26 miles long, running from a power house, located at Chosica, to a power house at Lima. Misplaced confidence in the climatic conditions and the failure of the glass type of insulator selected were responsible for the difficulty experienced at first. After a heart-burning experience of several weeks' duration in trying to keep lines in use, the e. m. f. was reduced from 35,000 volts to 23,000 by a delta-star connection of the transformers. This voltage was maintained at the lower value until new insulators arrived. It was found necessary to change about 8000 insulators on one pole line containing two circuits of three No. 4 wires without interrupting the service. At the time of changing the insulators a second pole line was erected and each was made a single circuit.

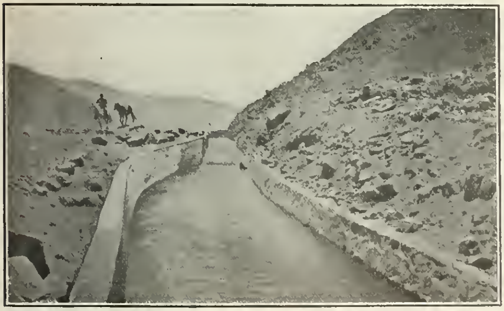


FIG. 2.—POWER CANAL FOR YANACOTA STATION.

The new insulators are of Locke make, tested to 80,000 volts, and cemented to iron pins. Wooden braces are used to support the cross arms in the place of the iron formerly erected. The iron braces offered a low resistance for the current to reach the pole, burning it at point where the arm was bolted on. The telephone wires that were located 5 ft. below had to be removed for the time being, as the transpositions, which were made every five poles, offered an easy path for the current and in many cases the poles were burned off at this point.

It was found that dry cedar poles when once afire will smolder away for hours. Thus should a top arm burn off at the point of fastening and fall away, the pole continues burning to the ground. The glass insulators would break off at the tie wire, split vertically, inside wooden thimble fastening insulator to iron pin would burn away, allowing the insulator to drop over to one side. A hissing noise made by the leaking current could be heard from two to three poles away. At night there was visible what the superstitious natives called "blue devils." With the new porcelain insulators cemented to iron pins no trouble has been experienced, although regular thorough cleaning each three months is the only guarantee of safety.

The hydraulic station at Chosica consists of three 400-kw and two 800-kw General Electric units direct-connected to Pelton water-wheels having a speed of 150 r. p. m. The wheels are of the deflecting-nozzle type controlled by Lombard governors. The effective head is 150 ft. The Rio Rimac is dammed two miles above the station and all the water during the dry season is used; excess at other times goes over the dam.

From three head-gates, located at the side of the dam, a flume or canal 6000 ft. long leads to a masonry forebay from which run the two steel pipe-lines 5 ft. in diameter to a receiver. The hydraulic grade of the canal is one-half of one per cent—rather more than is usual, but necessary here because the water carries large amounts of sand and gravel. With this grade the canal keeps itself clean and the sand does no harm to the bucket of the wheels. At the entrance to the canal, some 800 ft. from the head-gates, there is located a settling-basin for the sand and rock. A waste gate here is kept open during the wet season; this takes out a greater part of the sand and gravel.

The dam is a solid block of concrete built to withstand the heavy increase in size of the stream during flood. Ordinarily the flow is 10 to 12 cubic meters per second, but at times it reaches 200 cubic meters per second. Some 1500 ft. away, the Santa Eulalia River has been dammed and connected by a canal that empties into the Rio Rimac above its dam, thus utilizing both streams at low water. At such times both of the river beds are dry below the dam.

The Chosica station is a solid stone building, 40 ft. x 190 ft., with a separate transformer room, 16 ft. by 50 ft., in which are located the high-tension switches, transformers and lightning arresters. It is so arranged that all of the power can be carried on either of the transmission lines or on the two in parallel.

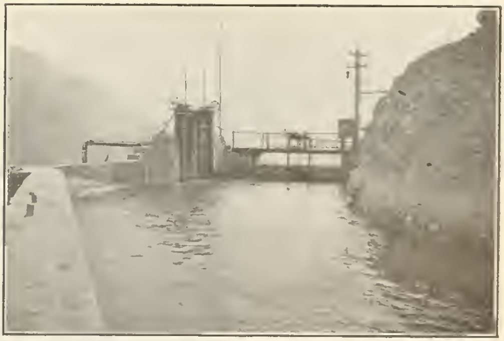


FIG. 3.—FOREBAY FOR YANACOTA STATION.

At the station the e. m. f. is raised to 33,000 volts by two banks of transformers of oil-immersed and water-cooled type. At the Lima end the e. m. f. is reduced to 2300 volts, at which value energy is distributed for public and private lamps and motors. It is again raised to 10,000 volts for operating two suburban railway lines 8 and 10 miles from Lima. The first, which runs between Lima and Callao, carried 3,000,000 passengers last year. The latter serves the suburban towns of Miraflores, Barranco and Chorrillos.

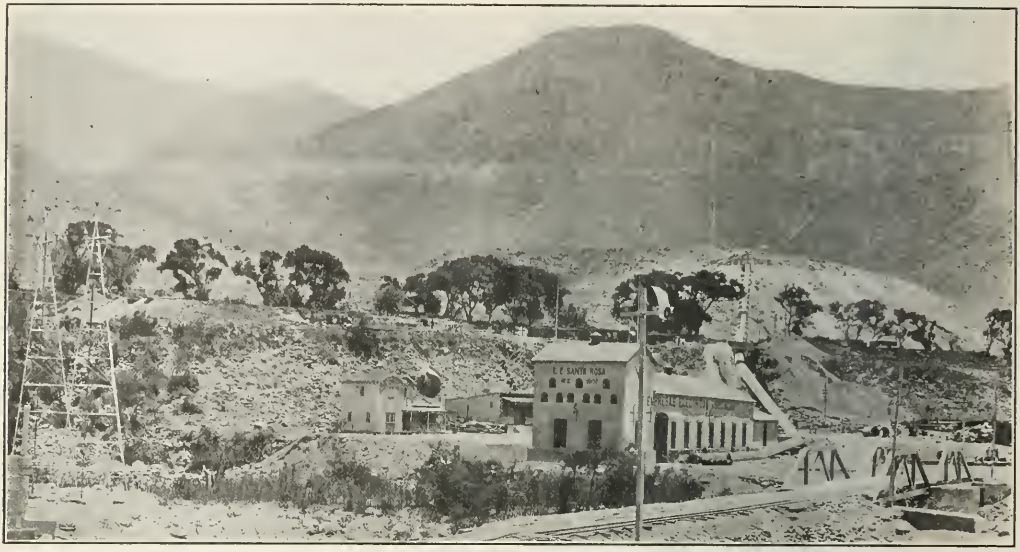


FIG. 4.—GENERAL VIEW OF YANACOTA STATION, SHOWING PIPE LINE AND STEEL TOWERS.

A third transmission line, 26 miles long, is being built between Chosica and Lima, to consist of three No. 1 copper wires, carried on 50-ft. triangular steel towers, spaced 12 to a mile. The legs of these towers are imbedded in concrete, made of a mixture of 1 — 3 — 5, and 6 ft. deep. A very careful record of the cost of the steel towers, as compared with white cedar poles, has been kept in this work. While the first cost is about 15 per cent higher, the result is decidedly in favor of the towers. A comparison of the cost of the two shows that while a cedar pole costs $10, a steel tower 50 ft. high would cost $35. The steel towers require three barrels of cement for forming a concrete basis, but it has been found that a gang of six men can erect six of these towers in a day, costing for labor 75 cents a day, or 50 cents for each tower. Each steel tower is packed in its own case separately and is much easier to transport. No cross-arms or pins are required, as these are included with each tower. While an insulator of slightly higher resisting strength is required for the steel poles, the additional cost is not noticed, owing to the lessened number required.

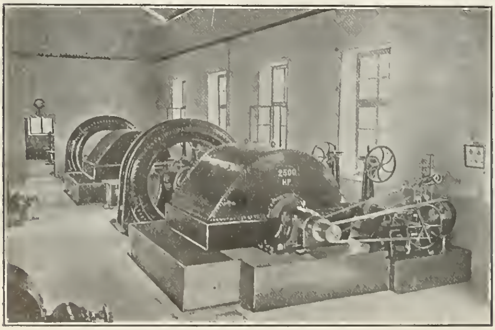


FIG. 5.—INTERIOR OF YANACOTA STATION.

The Lima station contains a combined steam and hydraulic equipment consisting of two 27-in. McCormack wheels direct-connected to 400-kw generators. The head is 85 ft., and a 5-ft. steel pipe line 2000 ft. long carries the water to the wheels from the reservoir. A 5-ft. stand-pipe 70 ft. high and the same diameter acts as a relief valve to the pipe line. Lombard governors are used.

The steam section of the [illegible] station comprises seven 500-hp B. & W. boilers. McIntosh & Seymour and Westinghouse vertical compound engines are used. A 1000-hp Curtis steam turbine has just been installed. The fuel used is crude oil from the Peruvian oil fields. This costs at the furnace $12 in gold per ton.

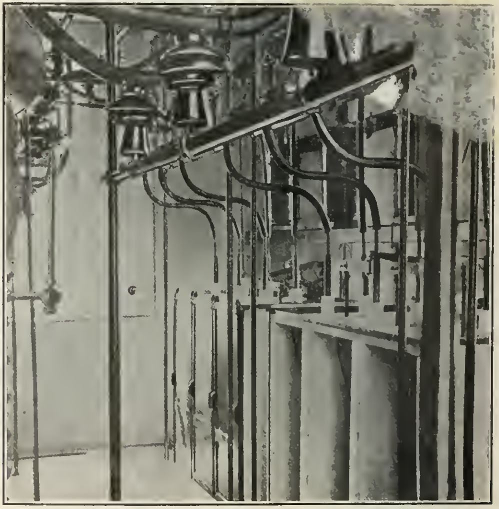


FIG. 6.—HIGH-TENSION SWITCHES IN YANACOTA STATION.

The heat from the oil is very intense, so that a special construction of furnace is required in order to prevent the rapid destruction of the boiler tubes. An extension front to the furnace is used, 5 ft. long, containing from three to six burners of the steam and oil-blast type. Just in front of the bridge wall several arches are built of specially shaped fire brick in sections, the number depending upon the burners that the boiler uses. The distance from the mouth of burner to back arch is 12 ft. The back sections, which are 18 ins. deep, just come up to the bottom of the boiler flues. They receive the direct blast of the burning oil, which then spreads to the tubes. Before the present arrangement was adopted the tubes in the boilers were rapidly destroyed, owing to the intense heat from the oil flames.

The generators at the Lima station are operated in parallel with those at the Chosica station, 26 miles away. A third hydraulic station, at Yanacota, the cornerstone of which was laid by Secretary Root during his recent South American visit, has just been completed, and is now supplying energy in parallel with the other two stations. When not acting as generators, two or more of the Lima generators are operated as synchronous motors for the purpose of raising the power factor of the system.

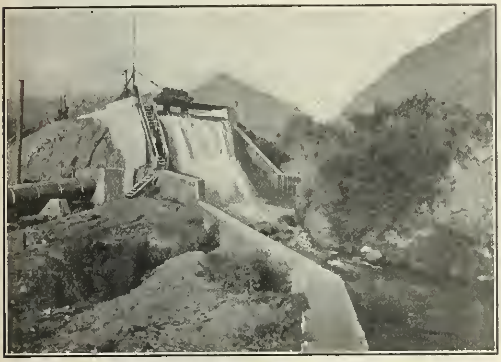


FIG. 7.—OVERFLOW OF CANAL AT FOREBAY FOR CHOSICA STATION.

A concrete dam [illegible]0 ft. high has been built below the Chosica station, and the same water is used over again. The canal is three miles long, 6 ft. in height by 18 ft. wide and has a hydraulic grade of 3 ft. to the mile. For about one-third of the distance the canal is excavated out of the rock of the mountain side. Some 20,000 barrels of cement were used in this canal, inasmuch as a large part of the canal had to be lined.

From the forebay a steel pipe line 6 ft. in diameter and 1300 ft. long conducts the water to the station. An effective head of 250 ft. is secured. The station contains three General Electric, 1250-kw units, direct-connected to 2500-kw Pelton waterwheels. Lombard governors are used. The building is constructed of reinforced concrete 35 ft. x 150 ft., with steel roof, and is perfectly fireproof. Two banks of transformers and all high-tension apparatus are located in a separate room. The transformers are of the oil-immersed and water-cooled type. This equipment is worked in parallel with the other stations, the demand for electrical energy throughout the territory served increases.

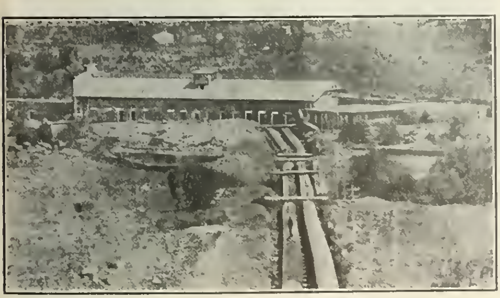


FIG. 8.—PIPE LINE TO CHOSICA STATION.

The Lima distributing station supplies energy during the day to innumerable small factories, some large cotton and woolen mills, flouring mills, and three electric roads. The tramways of Lima have just been equipped for electric operation and are running 60 Stevenson open eight-bench cars, having two 25-hp motors. The cars are fitted with air brakes. On the two suburban roads the cars use two 50-hp motors, partly multiple control. Each road has from 15 to 20 cars of the Brill and John Stevenson manufacture, seating 40 passengers. Use is made of air brakes and automatic storage batteries that switch on the car lamps in the event of the trolley leaving the wire at night. Each of the sub-stations of the three electric roads is equipped with from three to five 300-kw General Electric rotary converters. The two suburban roads have double tracks and give a five to eight minute service. The fare in the city is 5 cents silver or 2.5 cents gold.

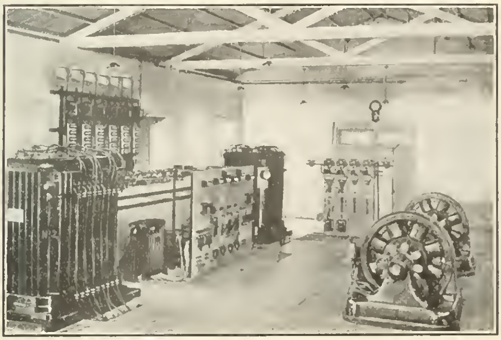


FIG. 9.—SYNCHRONOUS CONVERTER STATION FOR LIMA AND CALLAO ELECTRIC RAILWAY.

The rates for energy for lamps are 15 cents in gold per kw-hour; for motors the rates are $4 per month per horse-power or 2 cents per kw-hour. This low rate encourages manufacturing and keeps the peak down. Fuel is quite expensive in this territory, coal selling at $12 per ton and crude oil at the same price.

There is very little coal produced in Peru, and such as there is contains a large percentage of ash. The Cerro de Pasco Mining & Smelting Company is mining coal which makes good coke, after being washed. Electric energy, being much cheaper, has gradually superseded steam, alcohol, kerosene and gasoline, all of which were hitherto quite extensively used.

Peru has shown marked advancement during the past five years and the investment of some $15,000,000 by New York capitalists in copper mines and smelters during the past three years is only a single evidence of confidence. During the past year, through the efforts of Dr. Mariano I. Prado-Ugarteche, manager of the Empresa Electrica de Santa Rosa and the Lima & Callao Electric Road, and Messrs. Joaquin and Emilio Godoy, managers of the Ferro-Carril Electrico Lima-Chorrilos and the Ferro-Carril Urbano de Lima, a consolidation of all the electric lighting, gas, power and railway interests was effected. The capital stock is $7,500,000 in gold, all of which is Peruvian capital except $1,000,000 in bonds sold in New York.

All of the electrical and hydraulical work in connection with this first energy transmission system in South America for the past seven years has been planned and executed by Mr. A. L. Kenyon, chief engineer, to whom we are indebted for the information contained in this article.

Artistic Illumination—Murray's Restaurant, New York City.

By H. Thurston Owens.

THE New York public, which, of course, includes its visitors, is fickle regarding its choice of restaurants as it is in other things; and its latest hobby is "Murray's." Many go there out of curiosity, some to see the other people, others for the music, and a few to enjoy the excellent cuisine. The building is on the south side of Forty-seond Street, between Seventh and Eighth Avenues, an admirable location, for it is surrounded by theaters, the nearest ones being the Liberty, Hackett, Lyric, Belasco's and the New Amsterdam.

The ouside appearance, with its illuminated lettered sign and two blinding, flaming arcs over the doorway, is not in keeping with its reputation for attractiveness. The entrance doorway, shown at the left of Fig. 1, is unpretentious, but upon entering, the observant will be struck by the handsome bronze figure of a flower girl in a niche at the side of the lobby, the flowers of branch which she holds being miniature electric bulbs. The foyer beyond appears to be a room of some size, as shown in Fig. 3, with a beautiful mosaic glass table with suspended ball above, in the center of the room. Both are illuminated by means of lamps behind the glass, the effect of this being decidedly novel and effective.

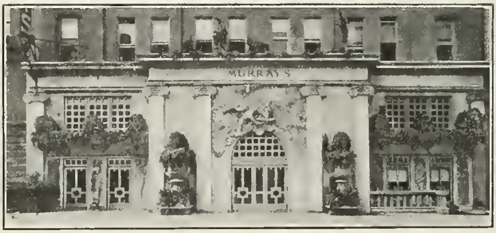


FIG. 1.—ENTRANCE TO MURRAY'S RESTAURANT.

A closer investigation shows that the half of the room at the left of the photograph is mirrored, and that there is only half of a table and a hemisphere above. The deception is, however, so skilful that it is probably detected by few visitors passing through. Upon leaving the foyer you are immediately ushered into the main dining room, after being deftly relieved of your coat, and you begin to wonder whether you are in a restaurant or a garden of some "Nouveaux riche" American, who is entertaining an informal gathering. Here is a fairyland of lamps, a fountain splashes over crystals of blue, stars blink in the sky, and the clouds roll by, all to the accompaniment of sweet music and the hum of conversation.

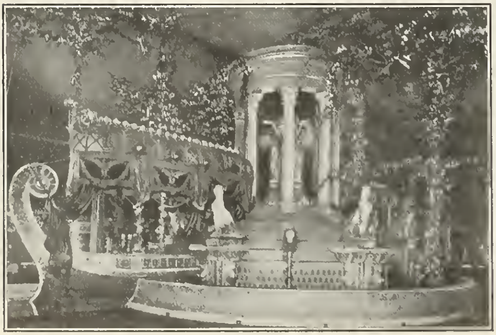


FIG. 2.—FOUNTAIN IN MAIN DINING ROOM.

People appear to be moving about in the adjacent rooms and you are the only one not quite at ease, for no maze, whether it be one of crystal, which may be seen in gay Paris, or one of flowers and shrubs as in Golden California, ever pleased you quite as much as this one does. You have hardly regained your composure when you are startled by a soft red glow coming through the table cover of spotless linen and naturally you can obtain no definite conception of the size and proportions of this dining place. It would be hard to realize that, in fact, there are no adjacent rooms and the total dimensions are only 75 x 60 x 24 ft. A portion of this room is shown in Fig. 5.

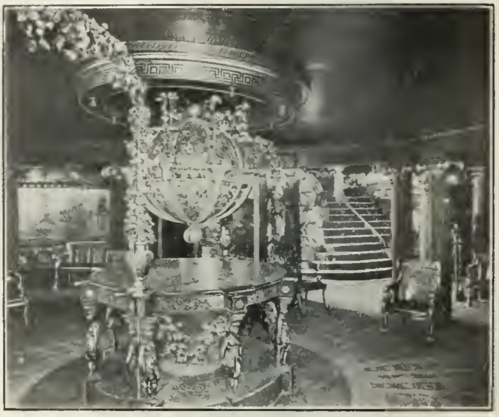


FIG. 3.—FOYER; MURRAY'S RESTAURANT.

The design is in Roman style, and the effect is that of a garden, with trees, plants, and myriad colored lamps. The apparent great size is produced by the south and west walls being mirrored to the ceiling and the north and east furnished with balconies and decorations. The columns, caryatides, statues, urns, vases, etc., are of concrete of dull gray color, the ceiling is deep blue, the mural paintings and the fountain are illuminated with blue light, bunches of grapes made of glass and enclosing lamp bulbs, hang from the vines along edge of balcony; there are chandeliers, pendant balls, and table lamps with mosaic glass of many shades and hues, and the general effect is gay and brilliant but not at all hard on the eyes. Here is an example of concealed lighting of the highest order and an arrangement of mirrors which could hardly be surpassed.

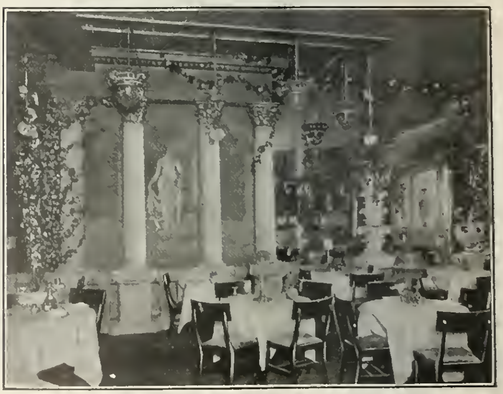


FIG. 4.—PART OF THE BALCONY, LOOKING WEST.

Fig. 6 shows a portion of the main dining room, under the balcony, which illustrates the method used to produce the effect of distance in this brilliantly lighted room. All light from

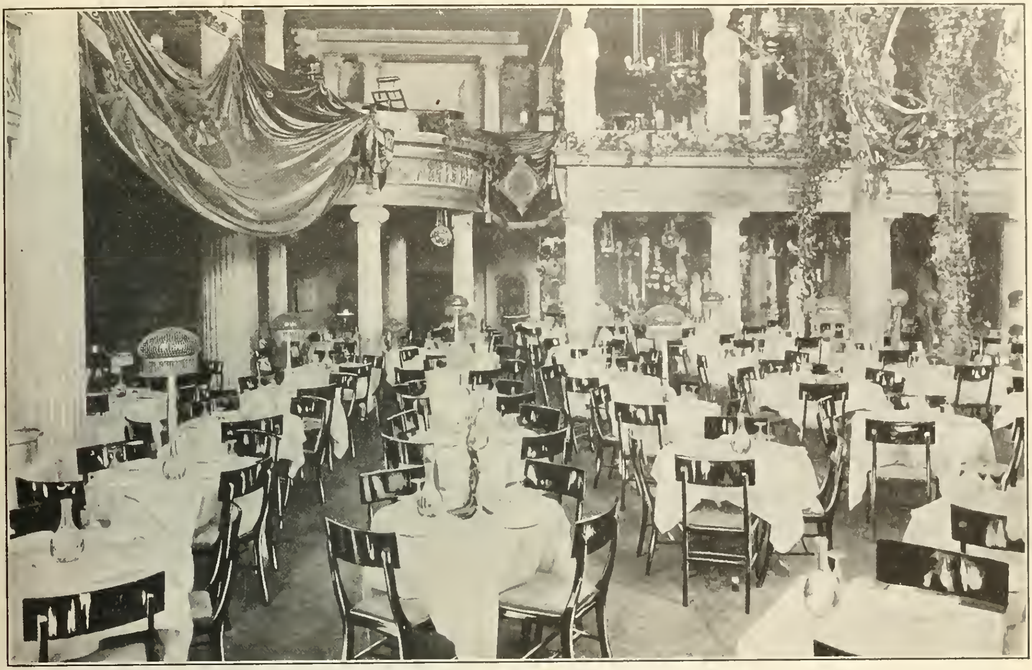


FIG. 5.—GENERAL VIEW OF MAIN DINING ROOM AND BALCONY.

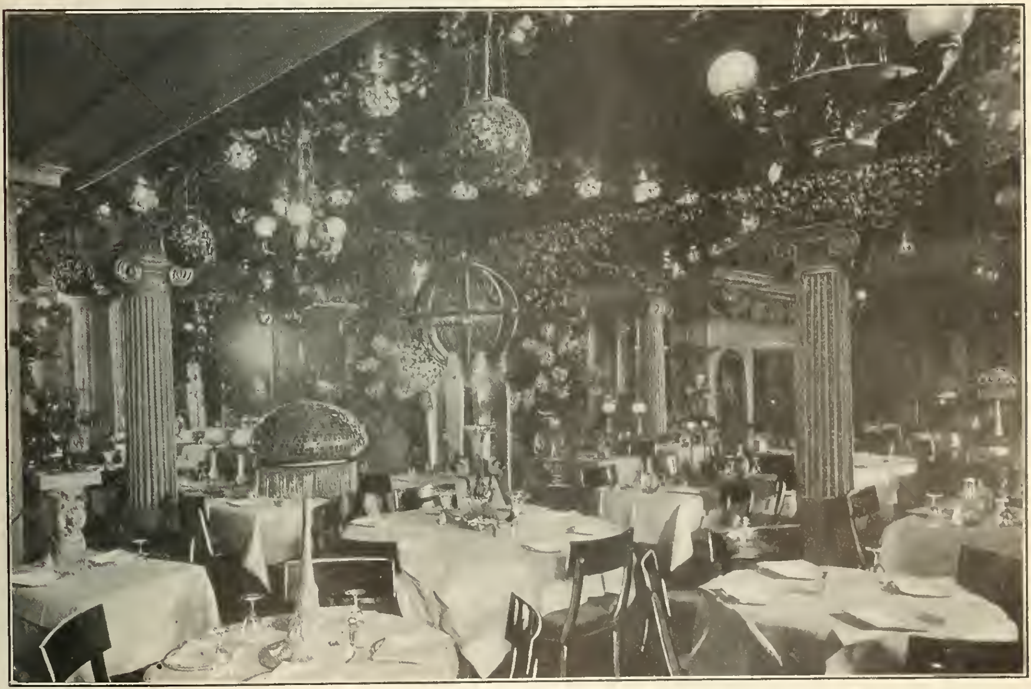


FIG. 6.—PORTION OF THE MAIN DINING ROOM, UNDER THE BALCONY.

ARTISTIC ILLUMINATION IN MURRAY'S RESTAURANT.

ceiling fixtures is either thrown up against the ceiling or thoroughly diffused, and the reverse effect obtained with the table portables. Were there direct reflection from the mirrors from unconcealed lamps the effect would be spoiled.

Fig. 2 shows the fountain, all made of mosaic glass, the predominating color being blue. There are clusters of clear incandescent lamps under the glass and inside of the ball supported by the figures at the top. Back of the surrounding wall, which is also of mosaic glass, are blue incandescent lamps.

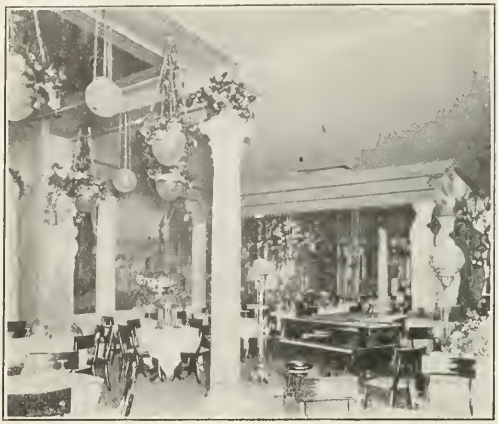


FIG. 7.—PORTION OF THE BALCONY.

In addition to these lamps, there are three 100-cp spot lamps with blue gelatine over lens, which add to the blue color effect of the fountain. These are not of sufficient power to give a satisfactory result and one arc lamp is to be substituted. The stars in the ceilings are 4-cp clear lamps in "skeedoodle" sockets placed above frosted glass. The cloud effect is produced by means of an arc with moving photographic plates. Some of the tables have tops of plate glass with two 16-cp red lamps underneath.

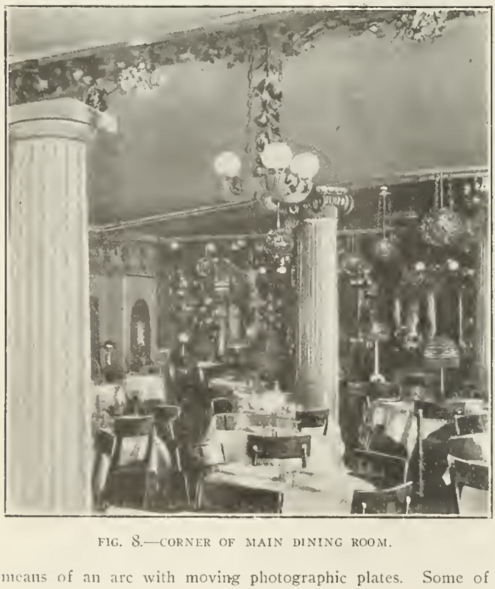


FIG. 8.—CORNER OF MAIN DINING ROOM.

Since the building was completed, a few beaded ball fixtures of clear glass have been added, but they kill the color effect and spoil the distance effect in mirrors These, however, are to be removed.

The balcony is a mezzanine floor of irregular shape, extending over the main dining room, as previously mentioned, and is furnished in three types of architecture: Roman, Greek and Egyptian. The decorations are all very ornate as in the dining room below, but there are no mirrors.

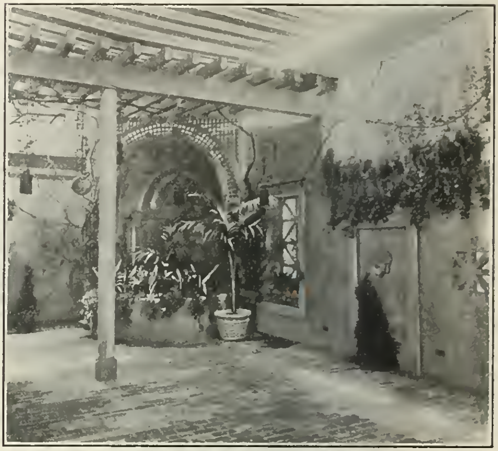


FIG. 9.—FOUNTAIN ON ROOF GARDEN.

There are seven distinct types of lighting fixtures upon this floor and two schemes of indirect lighting as well. There are chandeliers with hemispheres of blue-green mosaic glass, suspended spheres of green mosaic glass, chandeliers with three upright frosted globes tinted green, standards in the form of Egyptian tripods, with blue-green mosaic glass shades, round frosted ball lamps forming part of decorative figures on the ceiling, table lamps with red silk shades, and others with shades of yellow silk; and all of the mural paintings are illuminated by means of blue lamps in tin trough reflectors, and clear lamps in reflectors are placed behind the windows of mosaic glass.

Figs. 4 and 7 show two portions of the balcony and many of the types of lamps in use. There are a number of mural paintings similar to the one shown and all are illuminated by means of blue lamps. Still another feature of the lighting installation is shown in Fig. 6 for, although the chandeliers are quite near the mural paintings, there are no cross lights, as all downward light is well diffused. Figs. 8, 12, 13 and 14 show

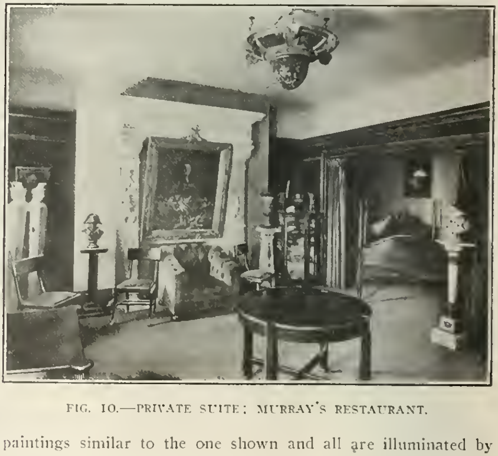


FIG. 10.—PRIVATE SUITE; MURRAY'S RESTAURANT.

several of the lighting fixtures in detail, and the originality and equipment is thoroughly in keeping with the other furnishings.

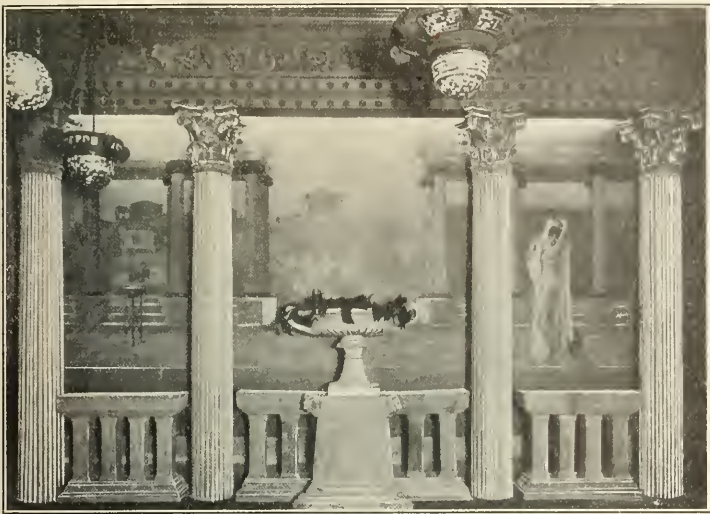


FIG. 11.—BALCONY, LOOKING EAST, SHOWING VIEW OF ATHENS.

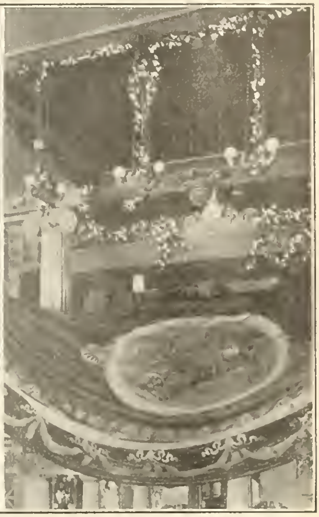


FIG. 12.—CORNER OF BALCONY

The remaining public rooms for dining purposes are located upon the third floor, and are known as the Peacock Room, Banquet Hall and Private Dining Room; the first two are adjoining and are decorated in Egyptian style, the last being in Gothic.

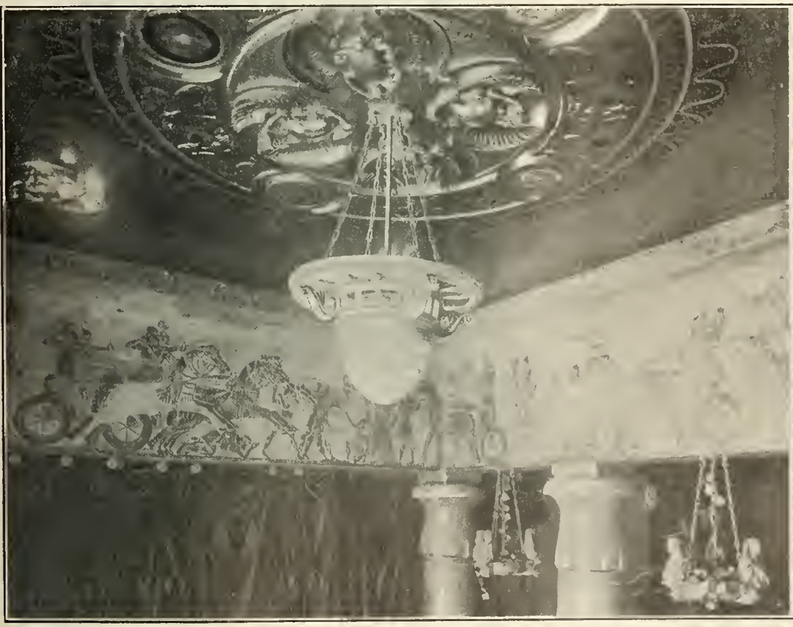


FIG. 13.—CHANDELIER IN EGYPTIAN BALCONY.

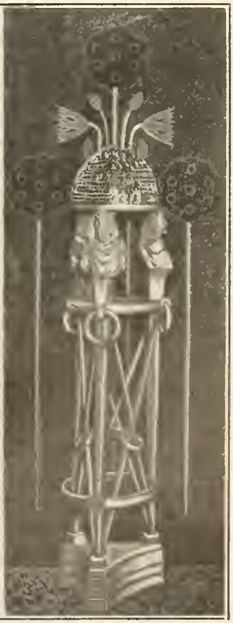


FIG. 14.—EGYPTIAN STANDARD.

The Peacock Room is 68 x 25 ft., and the Banquet hall 28 x 26 ft. Both are 12 feet high, and the color scheme is peacock blue and gold. Only table d'hôte dinners are served here and the lighting effect is very soft and restful, in great contrast with the dining room and its balcony. The same scheme of indirect lighting is used in these rooms, but as the walls and ceiling are dark in color the amount of reflected light is small.

The private dining room is in Gothic style, its size being 22 x 22 x 12 ft., with walls in tapestries, and paneled ceiling; the lighting fixtures are ceiling clusters of 8-cp frosted lamps, consisting of four 4-cluster and one 12-cluster fixture.

The roof garden is on the same floor as the Peacock Room, being 75 x 34 ft., and is in Pompeian style, with walls in concrete of natural dull gray color. The two fountains are of especial merit, having been designed by the late Stanford White. The illumination is furnished by means of pendant fixtures as shown in Fig. 9, and in addition a number of spot lights are thrown upon the plaster models of famous statuary to be found here.

The bar is on the Forty-second Street side and is in Egyptian style with wood work of mahogany, the general color effect being red. It is equipped with inverted hemispheres similar to those used throughout the building, and in addition there are ceiling clusters of bare lamps. These latter provide the "glare" without which no American bar is considered to be complete.

The remainder of the building consists of bachelor suites, one of which is shown in Fig. 10. The service portions of the building are lighted by means of clear 16-cp bare lamps on flexible cords and have no reflectors.

The energy is furnished from the mains of the Edison Company, the total installation being the equivalent of 1600 16-cp lamps. There is a panel board on each floor and individual switches on the portables and the large chandeliers. All lamps which are unconcealed are frosted, being nearly all of 16-cp with some 8-cp; all concealed lamps are clear 16-cp. The wiring cost over $12,000.

That the lighting features of the place have "caught the town" is evident by the fact that the dining room was reproduced as the final scene of one of the popular burlesques on Broadway, and the lighting effects were as much praised as the cleverness of the copy. The lighting of this building is far from the realm of foot candles, efficiency and other commercial terms, for it is probably the most elaborately lighted restaurant in the world. It is an installation which is well worthy of the attention of illuminating engineers, for it is not merely a novelty—it is a decided step forward in the art of illumination.

A Study of the Illumination of Interiors.

In 1901 a University of Wisconsin thesis was submitted at graduation by Messrs. E. F. Legg and H. I. Townsend entitled "A Study of the Illumination of Interiors," and dealing chiefly with measurements of illumination made in libraries and public buildings. Had this thesis been given five years later when more attention was being paid to illumination it would undoubtedly have attracted much wider attention, although the tests showing the detrimental effects of dirt on lamps and reflectors have been quite extensively quoted as being, for a long time, the only data obtainable taken from commercial conditions. Besides these tests other interesting facts were brought out by the authors as to the relative amount of natural (daylight) and artificial illumination commonly existing in the buildings studied.

The tests were made with a Weber portable photometer, with a benzine lamp for a standard. Although the results may be open to objection due to the unsatisfactory nature of such a flame standard for field work, there is nevertheless much to be learned from the figures, even considering them as rough approximations.

The following tests show the effect of dust on lamps and reflectors in the Chicago Public Library reading room. The tests were made on the reading tables, first with the lamps and reflectors in the condition in which they were found at the time the test was made, and, second, after cleaning the lamps and reflectors. The reflectors employed were the common green-plated conical opal desk shades so frequently found on the reading tables of public libraries.

	Candle-feet, before.	Candle-feet, after.	Difference.	Per cent increase
	2	3.15	1.15	75
	1.75	1.90	.15	8.6
	1.60	2.05	.45	28.2
	1.50	1.73	.23	15.3
	1.55	1.80	.25	16.2
	1.60	2.10	.50	31.3
	1.40	1.70	.30	21.4
Average,				28.0

The general artificial illumination was measured in a number of the buildings studied. The following figures are the average of a number of readings taken in the places specified.

In gallery reference room, Milwaukee public library	.8
General delivery of above	1.1
In art room, Chicago public library	.74
In small reference room, Chicago public library	.8

The following is a comparison of the daylight and artificial illumination in a number of locations in the three following libraries: Newberry Library, Chicago; John Crerar Library, Chicago; State Historical Library, Madison, Wis.

	Candle-feet. Daylight.	Candle-feet. Artificial.
At small tables in stacks	5.0	3.0
Among stacks	2.2	0.6
Corridors	1.5	.4
Stairways and rotundas	11.2	.8

The illumination on reading-room tables was measured by night and by day in a number of libraries with the following results, which are the averages in each case of a number of readings:

	Candle-feet. Night.	Candle-feet. Day.
State Historical Library, Madison, 1:30 p. m., May 18; clear	3.50	5.5
Milwaukee Public Library, cloudy day, February	1.60	11.8
Chicago Public Library, clear; 3:30 p. m	1.67	21.0
Newberry Library, noon, Feb. 11; cloudy, with sun at times	1.65	35.0
John Crerar Library	1.48	5.3
Average of library tables	1.98	15.7

The following measurements were taken near walls in two art galleries by night and by day:

	Night.	Day.
Art Institute, Chicago	1.0	8.6
Layton Art Gallery, Milwaukee	...	10.6

In the State Historical Library reading room, at Madison, Wis., the foot-candles on the reading tables by night were 7 as a maximum and 1.6 as a minimum. The tables are lighted with the table lamps under the usual green plated conical opal desk shades, supplemented with general lighting from high side brackets. Tests of the daylight illumination on the same table showed 9.5 foot-candles maximum and 1.6 foot-candles minimum. The daylight tests were made at 1:30 p. m., May 18, 1901. The day was clear. The curtains were partly drawn.

Tests in the Milwaukee Public Library reference room showed a maximum artificial illumination of 2.52 foot-candles and a minimum of 1.3. The daylight illumination was 4.3 maximum and .7 minimum. The daylight tests were taken on a cloudy day in February.

In the Chicago Public Library reading room, which extends across the north end of the building, daylight tests made at 4 p. m., with the west curtains half drawn, showed a maximum of 31 foot-candles and a minimum of 2.6 foot-candles Tests under artificial illumination showed a maximum of 3.6 foot-candles and a minimum of .7 foot-candle.

In the Newberry Library, Chicago, night and day tests were made in the general reading room, which has windows on the south facing on a park. Tests of the day illumination were made on a day in which there were rapidly moving clouds, with the sun breaking through at times. The maximum daylight illumination was 104 foot-candles and the minimum 3.4. The great variation was, of course, due to the intermittent clouds. The night illumination was a maximum of 2.5 and a minimum of 1.22 foot-candles.

A number of readings were taken in the Studebaker Theatre, Chicago. The average of these readings was 1.44 foot-candles; the maximum being 2.3 and the minimum .6. Very few readings were below 1 foot-candle.

Readings in the Illinois Theatre, Chicago, showed an average of .6 foot-candle, the maximum being 1.2 and the minimum .2. Many readings were below .7 foot-candle.

Some of the authors' conclusions and remarks are as follows:

Readers in a library seem to prefer a room with dark or dull finish. The Newberry and Crerar libraries, in Chicago, were the most effectually illuminated of those studied. These are finished in dark colors and have a low general illumination—less than .3 foot-candle. The authors think that .5 foot-candle is ample for the general illumiation of a reading room, leaving the rest to be supplied by shaded table lamps. They also conclude that readers prefer the lowest illumination consistent with ease of seeing.

Electrical Engineering Education.

At the special meeting of the A. I. E. E., held in New York on Jan. 24, Dr. C. P. Steinmetz presented a paper dealing with those features of our electrical engineering education which he considers unsatisfactory.

Dr. Steinmetz stated that in general the conditions for a good electrical engineering education in the United States are far more favorable than anywhere else; for an electrical engineering industry developed to a higher degree and to a greater magnitude than in any other country offers a very large field of application to the graduate engineer, thus supplying an incentive to enter this profession. Unlike other countries, where some opposition to the college-trained man, as unpractical, still lingers, the electrical industries here prefer, and in many instances demand, a technical college training for their engineering staffs. There is a tendency now to demand this training even for administrative and commercial positions. This leads to a close co-operation between the electrical industry and the engineering college. The leaders of the industry take a close and active interest in technical educational work, while teachers of engineering consider it as their foremost duty closely to follow and keep informed of the advances of the electrical industries, sometimes even are actively engaged in industrial work; and as early as possible the students are introduced to the industry by visits to factories, inspection trips, etc., which become more and more an important part of the college education. This is as it should be, and probably constitutes the strongest feature of American engineering education.

While many, especially smaller colleges, are not financially strong, in general the means available to the American college of engineering are far superior to those abroad, and especially in erecting engineering buildings, laboratories, etc., much has been done.

The great defect of the engineering college is the insufficient remuneration of the teaching staff; the salaries paid are far below those which the same class of men command in industrial work, and as a result the college cannot compete with the industry for its men, but most of the very best men are out of reach for the colleges. The teaching forces of the colleges, therefore, consist of: 1. A few of the very best men, who are especially interested in educational work to such an extent that they are willing to sacrifice financial returns for it. These men have made the engineering college what it is; but even many of these men are ultimately forced by considerations of family, etc., to leave college work and enter industrial employment. 2. Many younger men interested in teaching, enter college work to give it a trial. Some of these remain, but many return to industrial work, when they are forced to realize the small prospect of financial return offered by the college. 3. First-class men who devote a part of their time to the college and a part to industrial work, usually consulting engineering. This arrangement is probably the best for the college, handicapped as it is by the policy of salaries which may have appeared sufficient in branches in which no industry competes, but which are suicidal in the engineering department. Still it would be far preferable if the colleges could get the benefit of the whole time and the undivided interest of these men.

It appears, therefore, that a vast improvement could be made in electrical engineering education if a large part of the sums which are now devoted to marble engineering buildings and fancy laboratory equipments could be devoted to offer such salaries as to make available to the colleges the undivided time and interest of the best men in the field. The name of the donor may just as well be perpetuated by the professorship which he endows, as by the pile of marble which he erects for the college. After all, engineering buildings and college laboratories are of very secondary importance compared with the qualifications of the teacher and his assistants.

To the subjects taught and the methods of teaching very grave objections may be made. The glaring fault of the college curriculum is that quantity and not quality seems to be the object sought: the amount of instruction crowded into a four years' course is far beyond that which even the better kind of student can possibly digest. Memorizing details largely takes the place of understanding principles, with the result that a year after graduation much of the matter which had been taught has passed out of the memory of the student, and even examinations given to the senior class on subjects taught during the freshman and sophomore years, reveal conditions which are startling and rather condemnatory to the present methods of teaching.

It stands to reason that with the limited time at his disposal. it is inadvisable for a student to waste time on anything which he forgets in a year or two; only that which it is necessary to know should be taught, and then it should be taught so that at least the better student understands it so thoroughly as never to forget it. That is to say, far better results would be obtained it half or more of the mass of details which the college now attempts to teach, were dropped; if there were taught only the most important subjects—the fundamental principles and their applications—in short, all that is vitally necessary to an intelligent understanding of engineering, but this taught thoroughly, so as not to be forgotten. This, however, requires a far higher grade of teacher than is needed for the mere memorizing of text-book matters, reciting them at the end of the term, passing an examination on the subject and then dropping it. The salaries offered by the colleges are not such as to attract such men. When the student enters college he is not receptive to an intelligent understanding, for after a four years' dose in the high school of the same vicious method of memorizing a large mass of half and even less understood matters, the student finds it far easier to memorize the contents of his text-books than to use his intelligence to understand the subject-matter. After graduation, years of practice do for the better class of students what the college should have done—teach them to understand things. It is, however, significant that even now young graduates of foreign universities, in spite of the inferior facilities afforded abroad, do some of the most important electrical development work of this country. Men who never had a college education rise ahead of college graduates. This would be impossible if our college training gave what it should, an intelligent understanding of electrical engineering subjects.

The cause of the fault is perhaps the same that leads to the erection of engineering buildings and laboratories while underpaying the teaching staff, the competition among the colleges. To the father who looks up a college for his boy, marble engineering buildings and fancy laboratories are impressive, and so is an extensive curriculum; the result is a rapid increase in the number of students; but it is not to the benefit of the student, since the faster a subject is learned the faster also it is forgotten, and to become and remain thoroughly familiar with a subject, it is necessary to keep up the study of it for some years. While it is a good feature to insure application of the student by term examinations, etc., this becomes harmful if it leads to dropping the subject at the end of the term. The least that can be expected from the college is that at the time of graduation the student still knows all that he has been taught during his college years. To accomplish this it is necessary to keep up the study of every subject to the end of the college course. This is not the case at present.

The different colleges vary between the school teaching the trade of electrician, and that attempting to give an intelligent electrical engineering education. At the one extreme is the college which dropped from its curriculum everything not required in electrical engineering. Such a school covers a large ground in electrical engineering, and may even consider shortening the course to three years. The graduate of such a course is a full-fledged electrical engineer, capable to ply his trade, just as a plumber or bricklayer when graduating from his apprentice years, and just as helpless and useless when any occasion arises requiring general knowledge to enable him to understand matters beyond his trade. The unavoidable result of such training is, that when with the development of the industry subjects become of importance which were not considered as pertaining to the trade of electrical engineering during his college years, his usefulness is impaired, younger men rise above him, and he cannot hope to rise beyond a subordinate position. Fortunately, the better technical colleges realize that the first requirement of an electrical engineer is a thorough general education, and begin to realize that for this purpose it is not sufficient to require general subjects for college entrance and relegate their study to the high school; for even if the average high school were what it should be and not what it actually is, much of the general knowledge required by an educated man cannot be taught in the high school, since during the high-school years the intelligence of the boy is not sufficiently ripe for its grasp, and a review in the college is necessary.

However, even if an attempt is made to teach or to review general subjects, the work is not carried sufficiently far. Mechanical engineering, physics, chemistry and some civil engineering subjects are recognized as legitimate subjects of teaching in the electrical engineering course in many colleges, together with literature, some history, etc., but physiography, physical geography, meteorology, mineralogy, astronomy, etc., are also of importance in a general engineering education. The failure to recognize this may sometimes be a severe handicap to the electrical engineer, and that in the not very far future, judging from the present trend of development. In this direction the student, as well as his parents, is frequently antagonistic, and cannot see why subjects should be studied, which, to his limited horizon, appear unnecessary.

The instruction given in those branches of science, a knowledge of which is required by the electrical engineer, but to which only a limited time can be devoted, as chemistry, civil engineering, etc., frequently is very unsatisfactory, being unsuited to the requirements of the electrical engineer, and, as result, of very little if any value to him. A general knowledge of these branches is required, so as to familiarize the electrical engineer with the general problems, methods and purposes of the science; to enable him to understand subjects dealing with these sciences. The ability actively to practice the science is not required. To illustrate in the case of chemistry: the electrical engineer should have a knowledge of the laws of chemistry, a familiarity with the elements and their compounds, and a general knowledge of the methods of analysis and synthesis. Such a course must, therefore, necessarily be largely descriptive, and the experimental work largely illustrative. The same course is frequently given to the electrical engineer as in the first few terms of the chemistry student; general inorganic chemistry of the most important elements, and qualitative analysis. While a first-class beginning of a course of chemistry, such a course leaves the engineer with a knowledge altogether too fragmentary to be of benefit to him, and the time spent in mastering the mechanism and the details of the qualitative analysis is largely wasted, since the electrical engineer will probably never be called upon to make an analysis. If he attempted to do so he would probably fail. The beginning of a chemist's training is not suited to the chemical training of the electrical engineer, and the same applies to all other sciences to which a limited time is devoted in the electrical engineering curriculum. To give a general view and working knowledge to the electrical engineer of such an allied branch of science, theoretical discussions, especially mathematical, are usually very little needed and, therefore, undesirable. A characteristic case of spoiling a science to the students by mathematics is that of astronomy. Astronomy is one of the most interesting and fascinating of subjects. But where taught as a part of the general educational programme, it frequently is all mathematics, and so hopelessly dry and repellent. It should be given descriptively, for in a short course on astronomy it is just as ridiculous to delve deeply into mathematics as it would be to start the teaching of geography with a course of spherical trigonometry. In the teaching of allied sciences our colleges and schools are still greatly inferior to those abroad; the result is very marked in the product of the colleges, in the inferiority of the general education possessed by our graduates.

It goes without saying that in all teaching the strongest endeavor should be made to correlate the different subjects, to show the students the close relations which exist between all the branches of science, no matter how different they appear at first sight, and to interest him by bringing home to him the practical importance of what otherwise would appear dry theory; for instance, by using in the teaching of mathematics, problems taken from engineering; to have him handle and operate machines before proceeding to their theoretical investigation, then to derive the constants of the theoretical investigation from experimental tests of the apparatus, and from these predetermine the performance of the apparatus under different normal and abnormal conditions and experimentally verify it.

In conclusion, the main defects in the present electrical engineering training in some of our colleges appear to Dr. Steinmetz as follows:

1. The insufficient remuneration of the teachers, which makes most of the best men unavailable for educational purposes and is, therefore, largely responsible for the other defects.

2. The competition between colleges, which leads to a curriculum marked more by the quantity of the subjects taught than by the thoroughness of the teaching. The graduates are sent out with a mass of half understood and undigested subjects, quickly forgotten and deficient in understanding of the fundamental principles and in the ability to think.

3. The tendency of some colleges to teach the trade of electrical engineering rather than educate intelligent and resourceful electrical engineers.

4. The unsatisfactory state of the teaching of allied sciences, which gives instead of general view and understanding of the science, a fragmentary knowledge of some details.

Interior Wiring Progress in the Rocky Mountain Districts.

By W. J. Canada.

The progress toward safety and permanency of inside electrical construction throughout the Rocky Mountain territory in the last 20 years has been marked by phases which are peculiar to a new, rapidly growing country, of natural wealth as distinguished from commercial wealth. The buildings have been erected in haste to meet emergencies, and hence embody many constructive defects, and especially defects in a form of construction so little understood generally as wiring for electricity. The building cost has often been kept down to figures which are the despair of architects. In other words, a reckless spirit has been here added to the very usual ignorance of what will produce safety and permanency in electric wiring.

This hurried and unstudied construction is still, so far as the better materials now on sale will allow, very frequent, especially in the newest towns. Firestone, a farming town of 400 inhabitants, for instance, has been in existence just seven months and is now installing a municipal street lighting plant and the 60-odd dwellings and stores are being wired for electricity by the cleverest "Jack of all trades." Cases of this kind happen many times each year, and practically all the towns and cities of this district had almost every building wired in this way. In other localities competitive bids for the town plant and the town wiring lower the class of construction, because supervision is not anticipated before the bills are paid.

The first attempts to bring about better electrical conditions were, as usual, made by the underwriters having jurisdiction. They were undertaken because of the large number of fires reputed to be caused by electricity. Doubtless many so reported were from other causes, but in the main the troubles were apparent, and the necessity for action clear. The remedy: standard materials and "Code" construction was also clear, but the method of application of this remedy was a question involving a great many considerations. From the difficulties experienced in eastern states in grappling with the problem, the many failures, and the growth of the electrical fire list, coincident with the increase in electrical applications, it was expected that at least as much difficulty would be encountered in a more rapidly growing section. And here is where additional and almost unsurmountable difficulties arose. In an attempt to school an electrician in the comparatively safe construction called for by the Code, personal attention and supervision must be given to the individual installations. In a territory 1100 miles long and 400 miles broad, with poor railroad facilities and with the inhabitants scattered in a number of small towns or cities, the condition of personal supervision by the underwriters appears a thoroughly impracticable one in most cases.

In this belief the underwriters applied their first efforts to the adoption of ordinances governing electrical construction in the larger cities. In this they were successful in that such ordinances were passed in Denver, Pueblo, Colorado Springs, Trinidad, Boulder, Fort Collins, Longmont, Loveland, Fort Morgan, Silverton, and in some other cities clauses requiring "Code" construction were inserted in the building laws. The success of these ordinances has varied greatly.

In Denver this plan of supervision first fell into the hands of politicians and was discredited at once as ordinary graft. Conditions were bettered somewhat by the class of material pushed by supply houses who were not aware of the real conditions of supervision. In 1903 wiring conditions had become so unbearable that the interest of the general public was enlisted and the appointment of a competent and honest inspector was secured. Despite political enemies, and those enemies gained by the honest enforcement of the ordinance, he obtained amendments in the ordinance to allow for a sufficient number of inspectors and a fee system for supporting the increasingly expensive inspections, with the result that electric installations were put in better than ever before. Many serious mistakes were made in the interpretation of the "Code" by this department, but the tendency was good, and has been improving gradually ever since.

Denver now stands in a very advanced position as to its electrical construction. It possesses a large, well equipped inspection department, that inspects every new wiring installation and posts a notice before work can be concealed. Except in special classes of wiring, the quality of installation is now excellent. The ordinance requires the wires in all new buildings, except single dwellings, to be installed in iron conduit, and thus eliminates the frequent troubles from careless plumbing or other repairs on knob and tube wired buildings. Outside wiring on or against buildings must now be placed in conduit and signs are required which meet the conditions in the "Code." When it is considered that Denver has more display outline and sign lighting, per capita, than any other city in the country and that most of this obtained by a free installation—low flat-rate contract proposition, the former construction being open wiring and wooden molding, the above gains in construction may be considered very encouraging to many a city facing a similar problem.

Other good advances have been made in Denver during the last six months. The Rocky Mountain Fire Underwriters' Association has recently established an electrical department and obtained an engineer of experience to assist in cutting down electrical hazards in the territory. Theatre wiring had never been given special treatment. The Denver city department had been recommending knob construction and scatter cut-outs, and the moving-picture machine hazard, which has become so prominent of late, had received scant attention. Since the beginning of the year every moving-picture machine in Denver has been made to conform to the Code requirements, and is regularly inspected by the city authorities. The operator must be a licensed electrician, and the whole matter, including booth specifications, is cared for by a city ordinance. This practice has extended to all the cities of the state. Theatres are now being wired in conduit, and the Majestic, just completed, fails only in minor details of being in accordance with the new rules for theatre wiring. Other theatres are being rewired to meet the new conditions.

The contractors of Denver have in general been somewhat slow to adapt themselves to the new methods of wiring, principally because the city inspectors have been chosen from workmen whose entire experience has been gained in Denver. This has resulted in the persistence of several serious faults. The needs of Denver are now not far from those of the ordinary city of its size. It has had a somewhat longer period of inaction as to supervision than most Eastern cities, and a consequent larger number of buildings exist whose wiring is a continual trouble and a constantly increasing fire hazard. Where such buildings have additional wiring installed, the political difficulties of either securing a rewiring in safe and permanent manner, or of refusing permission to install additional wiring, have been great. The fee charged has probably contributed to this bad condition, which will be remedied by causing all the additions in buildings already wired to be installed as separate circuits from the point of distribution. At present the methods of installing additional wiring are haphazard, and frequently result in overloading the original system.

Show-window wiring is mostly in molding and a canvass of some 180 stores using this window construction recently revealed the fact that in 34 cases tacks, nails or screws were hammered in the molding and in most cases pierced the insulation. The flat-rate plan of the electric light company offers some difficulty in the way of bettering window conditions in old buildings by installing conduit, as the rate would need to be increased.

It is due the Denver Gas & Electric Company to note that its effort has been to get permanent and safe construction in all cases. When the city department was first started its loose methods met with strong opposition from this company, but the management has been for some time thoroughly in harmony with all movements toward better installations. The company has begun a systematic grounding of secondaries. The business-getting force is well schooled and instructed to recommend only safe devices, and frequently consults with the underwriters on special matters. That a pursuance of such a policy is compatible with the best financial results, a comparison of Denver's connected load per capita with that of any other city in the country would readily prove.

In Pueblo a very different set of influences has been at work and electrical wiring conditions are poor and unpromising. For three years an ordinance has required all wiring to be in accordance with the National Electric Code. This ordinance has not been rigidly enforced, however. There is a large motor load throughout the city still connected to a grounded railway circuit, and giving frequent trouble. The cost of wiring is also excessive.

The result of such a situation is an under lighted city, a low appreciation, if not distrust, generally of wiring, and a comparatively low connected load per capita. There is a probability of a crusade for permanent wiring construction and better protection. A recent rerating of the city under the analytic schedule of rating, which brings the defects of building construction into prominence and makes corrections of these defects a condition of lowered insurance rates, has given an additional impetus to this public movement. The public press has also done much in this direction.

Colorado Springs is undergoing the same impulse toward good permanent construction. The development has been very great in wiring construction during the past year. But here the contractors have been very progressive, both in handling high grade materials and in demanding careful workmanship from their wiremen. Outside wiring has been greatly improved, and the electric light company has given the best support to all movements of this kind. In Colorado Springs the fire chief, who is the official electrical inspector, by frequent consultation with the underwriters' electrician is obtaining safe and permanent construction of new wiring.

Trinidad was once poorly wired and many installations were hazardous. This condition was largely due to the competition of two antagonistic service companies and the incompetency of the wiremen in general. A general electrical inspection of the city brought these conditions strongly to the attention of the public. Since that time the worst feature of the situation has been eliminated in that the Las Animas Light & Power

Company plant has been discontinued, and the wiring has been done by wiring contractors, who have shown a real interest and a steady improvement in the class of their work and in the materials used. The city's ordinance, which includes the National Electric Code, is being enforced by the fire chief. Now many of the more important buildings are rewired in standard manner, and several are wired in iron conduit. The outside conditions have been improved in many respects, at the suggestion of the underwriters. At present several buildings are under construction and are being wired in iron conduit throughout. An intelligent city government and the strong protest made by the underwriters against conditions have here been productive of the best results in wiring.

A general campaign throughout Colorado, Wyoming and New Mexico has been made by the Rocky Mountain Fire Underwriters' Association, especially in Colorado, east of the mountains, where some supervision is possible. The results have been especially good in the "Horn" cities, Boulder, Longmont, Loveland, Fort Collins and Greeley, where a previous campaign by the same association had already procured ordinances. In these cities, local inspection is at present discredited, and the more important building contractors require the inspection of the underwriters. The gains in these towns have been in the practical abolishment of unapproved materials and practices.

A general tendency toward better and more permanent wiring and the supervision that produces this result has been growing. The establishment of an electrical department by the underwriters has assisted this growth. A number of bulletins have called attention to prevailing conditions, and these bulletins have been followed by correspondence on the general condition, on individual building installations, and frequently by personal inspection by the underwriters' electricians, and explanations of defects to wiremen, service companies and city councils.

Improvement has been rapid in the newer installations in all the territory where actual inspections have been made in this manner. In Cheyenne the action of the city authorities has been a very positive one. A number of the worst buildings, electrically, have been condemned by the city engineer and the wiring ordered reinstalled. Moving-picture machine shows have been given a limited period within which to install standard booths for their machines and the necessity brought sharply before the contractors to make their electrical installations in a standard manner.

There is a very pronounced increase in the number of grounded secondaries all through the Rocky Mountain region, because a number of deaths and accidents to persons, as well as some property loss, have been traced to ungrounded secondaries. Some opposition to grounding has been experienced, however, owing to a somewhat prevalent belief that grounding invites transformer troubles.

In the way of fires the territory offers great obstacles to the gathering of statistics. Out of a number of mining property fires, none was reported as originating from electrical causes. Eight electrical fires in Denver, four in Pueblo, one in Trinidad, and some six scattered about the states make the list. The most frequent cause was the wearing away of insulation against pipes and other wires, seven fires resulting from this cause. Four fires were due to melted fuse wire, where fuses were not enclosed in cabinets. Three fires were caused by the films of moving-picture machines. The remainder were from scattered causes.

The educative influence of the central station company is of prime importance, and as control of these companies is being gradually centralized and vested in interests which employ engineers of ability and far-sightedness, the impetus given by the underwriters is assisted greatly by the service company's advertisements and example. The most advanced position in this regard on the part of the electric light company, that of not connecting to any installation which has not received the approval of a thoroughly competent and disinterested inspector, has been practically impossible in the smaller towns.

The main business of a central station company, is, of course, to make reasonable returns on capital invested by the sale of electricity and to increase this return by any legitimate means. The main interest of the wiring contractor is to realize fair profits from the installation of wiring. The increase of business for both is to be obtained in the satisfaction of its customer. The interest of the public is almost invariably to obtain both wiring installation and subsequent service with their least respective cost. It has required a certain education for each of these interests in the past to bring them to a point where each respects properly the position of the other. In the less developed localities this respect is often confused with a general cheapening of electrical construction to a point where the danger from fire is unreasonably excessive. Under such conditions the underwriters have frequently been compelled apparently to antagonize all these interests, in demanding a better class of materials and more care in installation. This, by increasing construction costs, may for a time operate to hamper the sale of energy, to curtail the amount of electrical construction and to appear to burden the property owner. The proof that this is a mistaken belief is to be found in the much greater proportion of energy per capita, the more frequent and lucrative calls upon the electrical contractor, and the final satisfaction in safety and permanence of construction by the public, in those cities where electric wiring is most carefully supervised and where the Code standard is most fully observed.

Electrical Development at Jackson, Miss.

The year 1907 was a remarkably favorable one for the growth of electric motor application in Jackson, Miss. At the beginning of the year the Jackson Electric Railway, Light & Power Company had little or no motor load of consequence. Jackson is a residential city of about 30,000 inhabitants; it is the capital of the state, and has a considerable commercial development, but comparatively few manufacturing plants. By aggressive campaigning for new motor business during the year about 300 horse-power in connected load was secured in a total of about 18 installations. The power plant is a steam turbine station of 1000-kw rated generating capacity, Illinois slack coal being burned under three 350-hp boilers. The motor rates begin at 10 cents per kw-hour, and a sliding scale is in effect which somewhat more than cuts this two-thirds in the case of very large consumption. All the energy included in the above total is furnished by 220-volt, three-phase induction motors, and the variety of the service illustrates how much can be made of motor business in a small city whose main interests are not in factory work.

Representative installations made during the year are headed by an 80 horse-power application of motors in the plant of the Central Cottonseed Oil Company. In this establishment a cotton gin is driven by a 50-hp motor, a round bale press by a 25-hp motor, and a ventilating outfit by a 5-hp motor. The reduction of standby steam losses to zero and the convenience of the electric drive in this case have been so gratifying that the future of electricity in this branch of the cotton industry is undoubted. At the works of the Mississippi Fertilizer Company, a closely related industry bearing upon the work of cotton raising, a saving of about 50 per cent over the cost of operation by steam engine has been experienced. A 25-hp motor in this plant drives the mixing outfit. Aside from the saving in fuel cost, there has been a material reduction in labor cost, and the convenience and absence of idle depreciation are significant in face of the fact that the plant seldom runs over four months in a year.

The Mississippi Seating Company, makers of school furniture, installed 15 motors, aggregating 72 horse-power, early in the year. These machines vary from 2 to 15 horse-power each and drive special woodworking tools by individual belts. Other applications are in saw and planing mills, in bakeries driving dough mixers, in bottling works driving bottle washers and carbonated water pumps, in a carriage factory, mattress shop, and for forcing gas from retorts into the holder at the local gas works. A number of printing establishments and the daily papers enjoy press and linotype drives by electricity. A 20-hp motor is in service driving pattern-making tools in a foundry, and in one of the large public schools a 10-hp ventilating fan drive has been installed.

The company expects shortly to be in shape to handle a large increase of business, and at the present time a second 500-kw Curtis turbine is being installed at the generating station on Tombigbee Street. The average 24-hour load upon the plant is now about 300 kilowatts. Mr. F. G. Proutt is at present general manager of the company.

The Law of Electric Light Companies.

By John E. Brady.

The use of public streets and highways for the distribution of electricity for lighting purposes is essentially public in its character, and it is a use to which the streets and highways may very properly be devoted. State vs. Murphy, 134 Mo. 548. Nevertheless, the consent of a municipality is generally made necessary by its charter or by a general statute before its streets can be used either above or below the surface for the purpose of running electric wires. A. & E. Encyc. of Law, Vol. X, p. 866. In the State of Massachusetts there is a statute which provides that "in any city or town, in which a company is engaged in . . . the manufacture and sale of electric light, no other company shall lay or erect wires over or under the streets, lanes and highways of such city or town for the purpose of carrying on its business, without the consent of the mayor and aldermen." A company, which was organized after the enactment of this statute, proceeded to place its poles and wires in the streets of the city of Boston, without first having obtained this consent, and in an action then brought to restrain the company from furnishing electric light it was claimed for the defense that, the company having succeeded in putting its lines in running shape, it could not be restrained from using them, as the statute prohibited only the erection of the poles and wires and made no reference to using lines already up. The court refused to make such a distinction and held that the prohibition to put up the electric light lines amounted to a prohibition to use them after they were constructed. It was then claimed that the company did not come within the meaning of the statute as it was not engaged in the business of selling electric light, but was merely selling electricity, inasmuch as the apparatus at the customer's end of the system was in each case owned by the customer. But this was also too finely drawn a distinction for the judicial mind of the court and an injunction against the company issued. Attorney-General vs. Walworth Light Company, 157 Mass. 86. It has been held that the right to lay gas pipes does not include the right to erect electric light appliances. The city of Newport, Ky., granted to a corporation the privilege of using the public streets for the purpose of laying gas pipes to supply the city and its inhabitants with gas light and it was provided in the act which conferred the privilege that the company might adopt any other means equal to the means for supplying gas, provided the same could be done at no greater cost to the city. Under this authority it was held that the company did not have the right to use the streets for the erection of appliances necessary for the introduction of electric lights, and that, if the company wished to embark in the electric light business, it would first have to gain the consent of the proper municipal authorities. Newport vs. Newport Light Company, 89 Ky. 454.

VESTED RIGHTS.

It is possible for an electric lighting company to gain a vested right in the streets of a municipality, one which neither the municipality, nor any person acting under its authority, can destroy or interfere with. Where a municipal corporation, acting with lawful authority, grants to an electric lighting company the privilege of placing its poles and wires in the streets of the municipality, and the company proceeds to expend money in the erection of its works upon the faith of such license, the company gains a vested right to the use of the streets which the municipality cannot impair. A. & E. Encyc. of L., Vol. X, p. 868. In Rutland Electric Light Company vs. Marble City Electric Light Company, 65 Vt. 377, the plaintiff company, in 1886, had entered into a contract with the trustees of the village of Rutland, under which it erected its lines and commenced business. Subsequently, the defendant company, by permission of the trustees, erected its poles, in some places very near those of the plaintiff, and placed its wires in such close proximity to those of the plaintiff, which carried 110 volts, that during severe storms or in case of accident there was considerable danger of contact between the wires of the two corporations. And, as the defendant employed a different system of lighting, its wires carrying a current of 1000 volts, which was reduced where the wires entered buildings by the usual appliances, a contact between the two sets of wires was very likely to result in damage for which the plaintiff company could be held liable. It was held that, the village having granted, by competent authority, the right to install the plaintiff company's system, and, the company having acted upon that authority to the extent of placing itself in position to carry on business, the company had acquired a vested right in the streets of the village, which the latter could neither revoke nor interfere with. An injunction was accordingly granted enjoining the defendant company from maintaining its wires so as to impair the service of the plaintiff.

In the case of Lewis vs. City of Newton, 75 Fed. Rep. 884, it appeared that the city had granted, by duly enacted ordinance, the privilege of erecting "such poles and wires as may be necessary to transmit electric power and incandescent electric light," and it was held that, inasmuch as the city had not reserved the power to withdraw the privilege, the ordinance could not, in the absence of constitutional or statutory authority, be repealed or modified by the City Council.

EXCLUSIVE RIGHTS.

Unless the Legislature has bestowed upon a municipal corporation the requisite authority, the municipality cannot grant to an electric light company the exclusive right to use its streets for the purpose of supplying electric light to the municipality and its inhabitants. The proposition is supported by the case of State vs. Murphy, 134 Mo. 548. As shown by the facts in that decision, the city of St. Louis, having power under its charter to "regulate" the use of its streets, enacted an ordinance purporting to grant to an electric company the right to occupy the streets of the city for a period of 50 years by subways and equipments necessary to install wires "to be used for the transmission of electricity for any and all purposes." The evidence showed that the object to be accomplished in granting this important franchise was to vest in one company the right to build suitable conduits and to require all telegraph, telephone and electric light companies to lease the use of the wires from the favored company or its successors. As the ordinance stood the company was under no obligation to permit any electric light or other company to make use of the wires and it was thus given the right to control the use of the streets in this manner for its own private benefit. At the time of the grant, the company was not engaged in the business of transmitting electricity for lighting purposes, or for any other public purpose, and the ordinance did not require that the company use the privileges for the benefit of the general public, nor was any right of control over the works of the company reserved. It was held that the grant was for a private use and, therefore, invalid. Julia Building Association vs. Bell Telephone Company, 88 Mo. 258. Under the power to regulate its streets a city has the power to permit their use for the erection of poles and the stringing of wires, or for the installing of conduits, gas pipes, etc., so long as exclusive privileges are not granted. In the case above referred to it was contended that inasmuch as the company had gone to great expense, with the knowledge of the city, in constructing its subways the city ought not to be allowed to deny the validity of the franchise. This argument would have been good but for the fact that the granting of the franchise in such exclusive form was an act entirely beyond the powers of the city. The rule is that where a municipal corporation enters into a contract which it has the power to make, the doctrine of estoppel applies to it with the same force as to a private individual. By virtue of its general power to regulate the use of its streets a city may lawfully permit uses, which do not materially interfere with the public travel upon the streets. But a city may not authorize the appropriation of any part of its streets for private purposes. In another instance, the city of Grand Rapids, Mich., having the power by its charter to make, amend and repeal any ordinance deemed desirable for lighting its streets, but not having, by express grant, exclusive control of the streets, passed an ordinance attempting to grant to the Grand Rapids Electric Light & Power Company the exclusive right to use the streets of the city for a period of 15 years. It was held that the city had no power, express or implied, to give an exclusive right in its streets. Such a right could only be granted by the sovereign power of the state, or by the municipality, in case the power had been granted to it by the state. Grand Rapids Electric Light & Power Company vs. Grand Rapids Edison Electric Light & Fuel Gas Company, 33 Fed. Rep. 659.

In Crowder vs. Town of Sullivan, 128 Ind. 486, it appeared that the State of Indiana had conferred upon the municipal corporations within its jurisdiction authority to contract for electric lights. Under this authority the town of Sullivan passed an ordinance which, it was claimed, granted an exclusive right to an electric light company. In passing upon the validity of the ordinance the court said: "It is unquestionably true that a municipal corporation cannot grant to a private corporation the exclusive privilege of using its streets for the purpose of supplying the corporation or its citizens with light, water, fuel or the like. If the ordinance before us is to be construed as granting an exclusive privilege it must be adjudged void insofar, at least, as it attempts to make such a grant."

CONFLICTING RIGHTS.

It often becomes the duty of a court to decide which of two electric companies, both of which claim the right to the use of the same street, has the prior right. The general rule is that, where a company, which, in the operation of its business, uses wires for the transmission of electricity, has, with the requisite authority, occupied a reasonably sufficient space for its works along a street border, it thereby acquires the right not to be molested in its possession. The company first occupying the street, however, cannot claim more space than is reasonably sufficient for the safe and successful operation of its works. A. & E. Encyc. of L., Vol X, p. 867. Consolidated Electric Light Company vs. People's Electric Light Company, 94 Ala. 372. In the case cited it was said: "Monopolies are not favored and are never sanctioned unless a necessity for their tolerance is shown, or unless the necessity springs out of the very circumstances of the case, or the transaction." In an action brought by a telephone company against an electric light company to enjoin the latter company from erecting its poles and wires upon the same streets with those of the telephone company, the evidence showed that the electric light company, after the passage of the ordinance which authorized it to use the public streets, decided upon what streets it would occupy and submitted the proposed plan to the officers of the telephone company who pronounced it satisfactory to them. The electric light company then commenced the work of erecting its poles and shortly afterwards the telephone company began to place its poles upon the same streets and sought to oust the electric light company. It was held that the electric light company, having been the first to occupy the street, was entitled to remain. Nebraska Telephone Company vs. York Gas & Electric Company, 27 Neb. 284.

RIGHTS OF ABUTTING OWNERS.

The great weight of authority is to the effect that an electric light company cannot erect its lines along a rural highway or country highway without first gaining the consent of the abutting owners or acquiring the right by the process of condemnation. The proposition is supported by the decision in the case of Palmer vs. Larchmont Electric Company, 6 N. Y. App. Div. 12, where the question was presented whether an electric company, having a contract with the proper town authorities to light a public highway, might erect poles and wires upon the highway without the consent of the abutting owners. The question was decided in the negative and the decision was based upon the fact that the fundamental idea of a highway is a place for the uninterrupted passage of men, animals and vehicles, and to afford light, air and access to the property of abutting owners; that, in the latter respect, an abutting owner has a greater interest in the highway than the general public; and that, consequently, any permanent or exclusive use of any part of the highway by any person or corporation is illegal. In the opinion the court said: "A pole which supports wires cannot, like the underground pipe, be placed in the roadway, nor can it stand on the sidewalk if there be such. From necessity it must be placed between the two or upon the side of the roadway where the owner has substantial rights. Unlike the lamp post, the hitching post or the hydrant, it does not occupy a small space, but it carries wires along the whole length of the street. It intereferes (in a small degree, perhaps) with the access to the property. But it does interfere with and perhaps destroys the legal right of the owner to plant and grow shade trees and to use the side of the road, and the use made of the street is of a permanent and exclusive character. As was said in Eels' case: Such a use is 'wholly at war with that of the legitimate public easement in the highway.'"

On the other hand when the question has come up with reference to the right of an electric light company to occupy a city street, it has been held that it may do so, with proper municipal permission, without compensating the owner, unless it is the intention of the company to supply light to private persons only and not to furnish light for street illuminating. In a Montana case it appeared that an electric light company, which had a contract with the city of Butte to light the streets of that city, erected one of its poles in the middle of a sidewalk about 20 ft. from the entrance to a saloon. The pole did not interfere with the light or air to the saloon, or the access thereto, but the proprietor wished to have it removed and brought an action to accomplish that purpose. It was held that the erection of the pole in a city street was an act of which the abutting owner could not complain. This distinction between urban and rural highways was recognized in the case of Johnson vs. Thomson-Houston Electric Company, 54 Hun. (N. Y.) 469, where it was said: "It must be admitted that the streets of a populous village or city are subject to greater burdens and to a greater variety of uses than a rural highway, and that the extent of an easement in a street is to be measured by the necessities of the public." But, in a recent Court of Appeals decision (Osborne vs. The Auburn Telephone Company, New York Law Journal, Nov. 13, 1907), it has been held that the owner of the fee in a city street may restrain a telephone company from placing its poles in front of his property. And there is no apparent reason for believing that the decision would have been different had the party in interest been an electric light corporation instead of one engaged in the telephone business. In fact, it was said in Palmer vs. Larchmont, supra, with reference to the rights of abutting owners against companies appropriating the highway for the placing of poles: "Upon that theory of the law it is impossible to make any distinction between poles intended to carry telegraph or telephone wires and poles intended to support electric light wires." The Auburn Telephone Case, cited above, appears to be in conflict with previous decisions, for there the court said: "The learned Appellate Division appears to have entertained the view that there was a distinction between rural and urban property. It is undoubtedly true that the use of highways is many times greater in cities than it is in country towns. We had occasion to consider this question to some extent in the case of Palmer vs. Larchmont Electric Company, and in addition to what we then said we only wish to remark that the fee to lands in the city is as sacred to the owner as it is in the country, and that in either place he is protected by the constitutional provision to the effect that property shall not be taken for public purposes without compensation."

Electric Elevator Conditions in the New England Central Station Territory.

One of the most perplexing problems in connection with central station service over wide areas of distribution is the sale of electricity for elevator motors. From some points of view, the elevator motor is not an unmixed blessing to the central station manager, particularly if it must be supplied off a lighting circuit of modest cross-section. The farther one goes from the generating plant, the more difficult becomes the problem of profitable supply of energy. On the other hand, in some industries electric elevators are operated mainly during the hours when the lighting load of the station is lowest, and in such cases the load can be generally made profitable if the rates are calculated with care and are well maintained. In order to secure the points of view of a number of central stations in New England and vicinity upon the electric elevator problem, inquiry was made as to the conditions prevailing at the present time among several active operating companies, and the results of this investigation are summed up in the following paragraphs.

In answer to the inquiry whether an electric elevator load is considered desirable the Lowell Electric Light Corporation; the Narragansett Electric Light Company, of Providence; the Salem Electric Light Company, and the Montreal Heat, Light & Power Company emphasized the importance of supplying energy for elevator motors from circuits independent of the lighting mains and branches, and the Salem company stated that it had never experienced any trouble or interference from electric elevator service with its lighting or motor load. The Haverhill Electric Company, the Malden Electric Company, and the United Electric Light Company, of Springfield, Mass., did not consider the elevator business desirable. The Worcester Electric Light Company has very little load of this kind, as most of the elevators in that city are run by water. Worcester does not compete with water power, but charges the regular motor rates for what little elevator service exists. It is not considered a desirable load under the conditions prevailing at Worcester.

The connected elevator motor loads are about 100 horse-power at Springfield; three installations of 10 horse-power each at Malden; 140 horse-power at Salem; 2500 horse-power at Montreal, and 250 horse-power at Haverhill. In the latter city there are some 30 installations, mostly in shoe factories. The motors are in constant use, running all the time. The only company that feels the effect of the elevator load at special hours is the United Electric Light Company, of Springfield, which notes a considerable load at the time when the office buildings of the city close, about 4:30 to 6 p. m. The elevator service in the city of Pittsfield, Mass., is almost entirely hydraulic, the pumps being driven by 500-volt, direct-current motors. The Pittsfield Electric Company has a connected load of about 50 horse-power for elevator service, charged at regular motor rates ranging from 3 cents to 4 cents per kw-hour. As the pumps run continuously and are automatically by-passed, the load is steady. Few unusual conditions were found in the installations. The Salem Electric Lighting Company, however, has one large lift in a storage warehouse.

In Springfield, electric elevator motors are allowed on 500-volt, direct-current circuits; in Salem, a few direct-current elevator motors are running, but all new motors must be designed to use alternating current; the direct-current elevator motors will soon be changed. In Malden and Haverhill, all electric elevator motors are supplied with energy from three-phase motor circuits. The Montreal Light, Heat & Power Company allows elevators on both alternating-current and direct-current circuits, as do the electric light companies at Lowell and at Providence. Little restriction exists as to hours of use. In Salem, the use of electric elevators is expected to stop between 10 p. m. and 7 a. m. The companies at Springfield, Malden, Haverhill, Providence, Montreal and Lowell furnish continuous service for elevators.

Elevator motor rates at Montreal are $50 per horse-power per year for direct-current passenger service, and $40 per horse-power per year for alternating-current freight service. These rates are based on the average maximum of starting current and running demand. In Lowell the rates are 10 to 7 cents per kw-hour. In the past all the elevator motors in Montreal have been supplied on a flat-rate basis, but a new basis of charging by meter will soon be in use there. The new charge will probably be in the nature of a readiness-to-serve and a meter charge, the idea being to base the readiness-to-serve charge on the rated capacity of the motors, while the meter charge will be determined with regard to the peculiar load-factor conditions which obtain in elevator motors. In Lowell the rates are based on the tested starting current. In Providence no special rates exist for elevator motors. The charge for energy for motors is 10 cents per kw-hour, with a sliding scale of discounts. Where other energy is used by the same customer, gross bills are combined for purposes of discount. Tests of starting current are not used in Providence as a basis of rates. In Springfield the rate for energy for elevator motors is about 4 cents per kw-hour. It should be borne in mind that the Springfield and Montreal companies enjoy in a degree the advantages of water-power generating plants, the latter city depending almost entirely upon the transmission of electricity from hydro-electric stations. The Malden and Haverhill companies charge the standard motor rate for energy for elevator service. In both these cities the rate is made up with a service charge based on the maximum demand ascertained by Wright demand meters. The Salem company, depending on steam plant production, charges 6 cents per kw-hour for energy for elevator motors; this, however, the management considers too low a rate. In Springfield all the energy is metered.

The United Electric Light Company, of Springfield, competes with other kinds of elevator service by showing a lower cost of operation. The company does not advertise for elevator business, however. A hotel elevator load is here preferred to one in an office building or a residence. The Narragansett Electric Light Company, of Providence, solicits elevator business the same as other motor load, making no distinction between elevator and other business. The company competes with the hydraulic and steam elevators by obtaining all the other load in the building and making it impracticable to maintain steam boilers for elevator service alone. Water rates are too high in Providence, and the pressure too low to operate elevators from city water economically. The company does not object to electro-hydraulic elevators. It prefers the office and hotel load. The Salem Electric Lighting Company does not advertise for elevator loads, has no competition to face, and takes any kind of load it can obtain. The Malden Electric Company and the Haverhill Electric Company do not have much competition in the elevator field, and make no special effort to meet it. The Lowell Electric Light Corporation advertises for and solicits elevator customers. In competing with steam and water, the company endeavors to furnish a motor to pump the water if it cannot get the contract otherwise. The Lowell Company prefers the office building type of load. In Montreal practically all the elevators in the city are electrically or hydro-electrically operated. The company does not have any preference as to the character of the installation.

In regard to running special circuits for elevator motors, the Montreal Company will run a separate outside connection, but not a special circuit. The Lowell Corporation would wire separately, possibly, under extreme conditions, and the Providence, Malden, Salem, Haverhill and Springfield companies would not put up separate lines. Alternating-current elevator motors are in service in Providence, Lowell (in factories), Montreal, Salem, Malden and Haverhill. All electric elevator motors in Springfield and Worcester are of the direct-current type, and a few direct-current machines are in use in Haverhill. The alternating-current elevators are doing good work in Malden, Salem, Haverhill, Providence and Lowell. The companies at Lowell, Providence, Montreal, Malden, Haverhill and Springfield do not install elevator motors for customers, but the Salem

Electric Light Company handles this kind of business. Little demand appears to exist for electric elevator service in suburban territory. The Springfield Company would not attempt to supply a suburban elevator service; the companies at Malden, Lowell and Haverhill have no demand, while the companies at Providence and Montreal would supply alternating-current service for this class of work. The number of stories in the highest building supplied with electric elevators in the various cities is as follows: Providence, 12; Montreal, 10; Malden, 4; Haverhill, 8; Springfield, 6; Lowell, 6, and Salem, 4. Practically all the companies make no distinction between elevators and hoists, except that the Montreal Company counts a hoist as a freight conveyor. The Providence Company's sliding scale discounts vary from 5 per cent off $14 to 45 per cent off $70 on a 5 horse-power basis, and from 5 per cent off $14 to 45 per cent off $100 on a 10 horse-power basis.

Summing up the electric elevator situation as evidenced by the above notes, it would seem that there is room for a closer standardization of practice in this field. Given the proper rates adjusted to the commercial considerations of distance of load from centers of distribution, magnitude of starting current and average demand from the supply system, time of use, and competition with steam and water power, it ought to be possible to work out a satisfactory charge, and it is certainly desirable to secure this class of business. In the smaller cities the electric elevator problem is of comparatively small moment, and it is only in the cities where high buildings are multiplying that the question broadens out into a special branch. No central station company will make a mistake in accumulating a considerable quantity of data in regard to its elevator motor practice, for there is money to be earned in supplying these motors with energy at equitable rates. It is gratifying to note the entrance of the alternating-current motor into the elevator field, and this means whenever a suburban territory demands elevator service, it can be given it without prohibitive cost of copper in the supply circuits. The three-phase motor is widely applied for factory elevator service in connection with stations generating alternating current only, but the single-phase motor is already crowding the three-phase machine in some localities. The future of the electric elevator seems assured, but more technical data are needed as to the conditions of service, cost of operation and profit to be derived from given installations. Acknowledgment is hereby made with thanks for the courtesy of the companies mentioned in supplying the foregoing information.

A Good Arrangement of Furnace Fan.

The use of small fans for assisting the air circulation in hot-air furnaces has been frequently described and otherwise referred to in this paper. This is destined to be a very important application of electric fans, especially in the Northern States. The principal use of the fan in the furnace is to shorten the time required to bring the house up to a comfortable temperature in the morning after it is cooled down during the night By forcing the circulation of air through the furnace and up through the hot air pipes and registers, the time required to bring a house to a comfortable temperature in the morning in practice is found to be about half that required with natural circulation. Aside from the comfort this involves, it makes possible considerable saving of fuel, because the furnace fire does not have to be worked with drafts wide open and excessive heat losses up the chimney for as long a period as otherwise. It should be clearly understood that the fan is not used in any way to force the fire, and in no way affects the temperature of the fire. It simply increases the rapidity of circulation of hot air around the furnace shell and up through the hot air pipes and registers, causing more heat units per minute to be taken from the hot inner shell of the furnace and transferred into the rooms of the house.

The place for the fan is in the air intake pipe of the furnace. The illustration herewith shows one of the best arrangements of furnace fan that has been suggested. The fan, which is an ordinary desk motor fan, is placed inside of a box. One side of the box is open, except where it protrudes out of the cold air box, and the other side is closed with a piece of sheet iron, except for a round hole the size of the fan which is directly in front of the fan. The object of this is to prevent the air forced by the fan from coming back in eddy currents around the sides of the box and so reducing the amount of air delivered to the furnace. The box in which the motor is placed slides up and down in guides and is provided with wire cable, pulleys, and a counterbalance weight so that it can be easily raised or lowered. In the illustration the fan box is shown raised out of the cold air box in the position in which it should be when the fan is not in operation. The air is then circulating naturally through the furnace. The reason for hoisting the fan out of the cold air box when it is not in operation is in order to avoid obstructing the cold air box with the fan box. For example, if a 12-in. fan is used only a 12-in. or 13-in. circular opening would be provided for the natural circulation of air with the fan lowered in place, because the rest of the opening is closed by the sheet iron. This would not be a sufficient opening for the proper natural circulation of air without assistance from the fan. The counterweight, consisting of scrap iron, can be seen in the foreground. In this particular case a 16-in. fan is used, and on account of its size, the motor had to be turned base upwards and screwed to the top of the box rather than to the bottom. A 12-in. or even a 9-in. fan is sufficient, however, for any ordinary hot-air furnace, and is to be recommended rather than a 16-in. fan because of the smaller amount of energy required and the greater ease of getting it into a cold-air box. It would, of course, be possible to make a further refinement of this arrangement, so that the motor could be raised and lowered by a chain from upstairs. The raising and lowering could also operate a switch which would put the motor in operation when the box is lowered, and out of circuit when the box is raised

FURNACE FAN RAISED OUT OF USE.

Besides the use of the fan in shortening the time required to heat a house in the morning, it is also very useful when there is difficulty in heating certain rooms on the side of the house against which a strong wind is blowing. With a fan the air can be thrown into these rooms so that they can be heated when other means fail.

Electrically Operated Switchboards.

By S. Q. Hayes.

In practically all alternating current generating stations of a rating of 10,000 kilowatts or over, and in many smaller ones, it has been found necessary to control the main circuits by electrically operated switches and circuit breakers, owing to the amount of energy to be handled, the number of circuits to be controlled, the high voltage used, the advisability of concentration or for other reasons.

Such a switching equipment can be considered most readily under the following divisions: (1) The panels, desks, pedestals, etc., on which the controlling devices, instruments, etc., are mounted. (2) The circuit breakers, switches and controllers with the detail devices used in connection with such an equipment. (3) The arrangement of the structures for circuit breakers, bus-bars, etc., in the station, and the relative location of generators, transformers, feeders, etc.

This article will deal with the first division, viz., the panels, desks, pedestals, etc., and will take up some recent examples of such equipments to illustrate what has been done in this line, as well as some older ones to show the evolution of the designs.

Almost invariably the control apparatus, meters, etc., are mounted on slabs of marble or slate which form the panels, top of desk, face of pedestal, etc., although in some instances the entire switchboard, desk, etc., has been made of steel or other material.

The material of these panels, when of marble, is usually of the grade known as blue Vermont or blue Florentine, although occasionally white Italian or pink Tennessee is used. This is ordinarily bevelled and polished, although often enameled or provided with marine finish. Slate is almost invariably enameled or given a dull black oil or marine finish.

PANEL BOARDS.

Where the panel type of board is used, the panels are simply modifications of those required for lower voltages and the usual equipment of instruments for the generators, transformers, feeders, etc., is mounted on the same panels as the controlling devices.

Fig. 1 shows the switchboard supplied to the Louisiana Purchase Exposition in St. Louis in 1904, which was used for the control of three 125-volt exciters; four 2000-kw, 6600-volt, three-phase, 25-cycle generators; two 4000-kw incoming feeders; and 17 outgoing feeders. These panels were provided with the usual equipment of instruments, etc., similar to a hand-operated board, but instead of placing the oil switches or their handles and mechanism on the panels, they were placed at a distance, made electrically-operated and their controllers and indicators located on the switchboard panels.

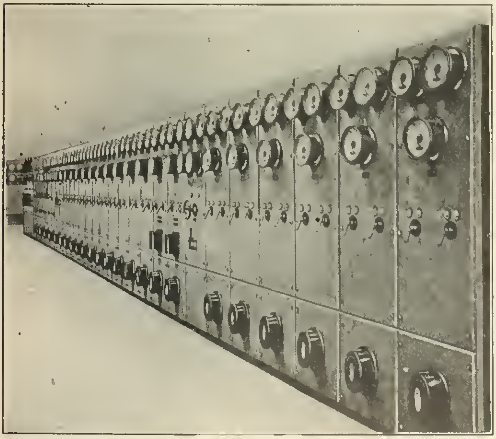


FIG. 1.—SWITCHBOARD USED AT THE LOUISIANA PURCHASE EXPOSITION.

Fig. 2 shows the switchboard recently supplied for the new union station at Washington for the control of four 500-kw, 2300-volt, three-phase generators and nine three-phase and six single-phase feeder circuits. While the rating and voltage of the machines would have readily permitted the use of a switchboard with hand-operated, oil, circuit-breakers; other considerations caused the adoption of electrical operation for the circuit breakers, etc.

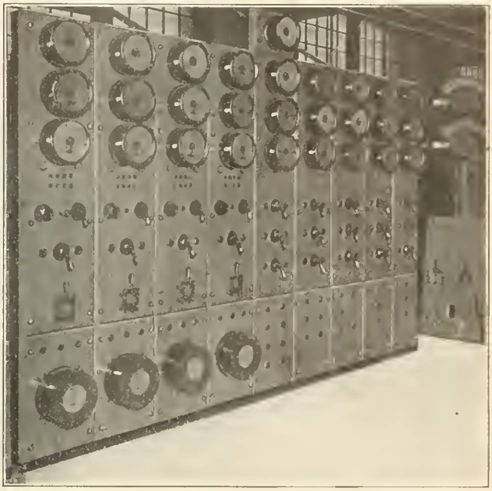


FIG. 2.—SWITCHBOARD FOR UNION STATION AT WASHINGTON, D. C.

As shown by Fig. 1 and Fig. 2, the panel type of switchboard for electrical operation does not differ very materially from that for hand-operation, and these two examples will suffice to show their general design.

Where a more compact arrangement is desired the switchboard panels are replaced by control pedestals or control desks, although often pedestals or desks are used for the generator circuits and panels for the feeder circuits.

PEDESTALS.

This type of control is ordinarily used in plants where the number of generators is small in comparison with the number of feeders. In this case the generators are controlled from pedestals, while the feeders are ordinarily controlled from standard switchboard panels.

One of the earlier types of control stand is illustrated in Fig. 3, which shows the gallery with control stands and generator instrument panels installed in 1901 in the Third Avenue power house of the Brooklyn Heights Railway Company, for the control of six 2700-kw, 6600-volt, three-phase generators, which have lately been recommended for 11,000 volts.

The field rheostat for the generator was operated by means of a large handwheel connected by bevel gear with a face plate mounted underneath the resistors located on a framework in the switchboard gallery. Placing the face plate near the resistor instead of on the pedestal, greatly reduced the length of the rheostat leads and simplified the wiring. The two-pole hand-operated field switch, with extra jaw for the discharge resistance, was mounted on the front of the pedestal shown in Fig. 3. This pedestal consisted essentially of a cast-iron frame with marble slabs arranged as shown to form the front, back and top of the stand, while circular marble slabs on the sides of the stands were used as a support for the handwheel, the reverse-power relay, the knife switches, etc.

As shown in Fig. 3 the station attendant on the switchboard gallery, while standing in front of the pedestals would face the generating room and could readily see over the pedestals and underneath the panels on which were mounted the instruments in the generator circuit. Each generator control pedestal was provided with the necessary rheostat handwheels, field switch, controllers, indicators, synchronizing receptacles, governor switch, etc., and on the instrument panel directly in front were mounted the various indicating and integrating meters, synchroscope, signal devices, etc.

Each of the feeder panels located on the same gallery as the generator pedestals was arranged to control two three-phase feeders and it was provided with the proper meters, controllers, indicators, relays, etc., for the control of the circuits.

The next step in the pedestal design was to standardize the arrangement of the apparatus and to make the pedestal a cast-iron column with marble slabs on the front and top and removable iron doors on the back. The field rheostat was made sprocket-operated and the field switch was of the knife type. As the generators grew larger the rheostat face plates and field switches were made electrically-operated and the controllers for them were placed on the pedestals with the other apparatus.

With these later pedestals it became the practice to mount the instruments for the generator control on a cast-iron post arranged to stand in front of the pedestal. This post is hollow and the leads to the instruments are brought up inside. Railing sockets are also provided, as the posts are usually located on the edge of the gallery overlooking the engine-room.

In addition to the generator instrument post a station instrument post is supplied. This station instrument post is usually provided with three alternating-current voltmeters, one for each of two sets of bus-bars and one for an incoming machine, one illuminated dial direct-current voltmeter to show the voltage on the exciter bus-bars and one synchroscope. The upper portion of this post is swivelled and provided with a handwheel so that it can readily be turned in any direction in order to make it visible from either end of the gallery or the generator room.

Fig. 4 shows the arrangement of a switchboard gallery for the Union Electric Light & Power Company, of St. Louis, for the control of 11 6600-volt, 25-cycle, three-phase generators of various ratings. As may be noted the generator instrument posts are arranged to form the columns of the railing of the gallery. The generator instrument stands are located directly in front of these posts and the feeder panels are back of the stands. The station instrument post is moved in a short distance from the edge of the gallery so as to be more plainly visible from either end.

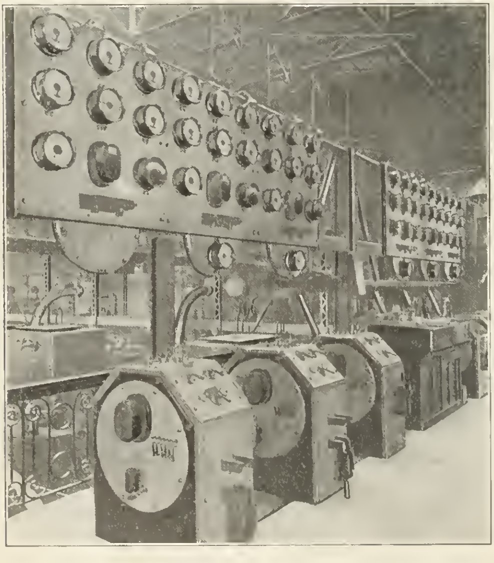


FIG. 3.—EARLY TYPE OF CONTROL STAND.

With this pedestal and post arrangement it is often desirable to use a synchroscope of such size that it may be readily visible from the extreme end of a large power house. For this purpose it is customary to furnish a post with a synchroscope which has a 36-in. dial illuminated by two lamps back of the letters "F" and "S," indicating fast and slow. The pointer of the synchroscope is formed of a tubular lamp and the motion of the pointer is readily visible either night or day. The post is provided with a swivelled top so that the synchroscope may be turned in either direction.

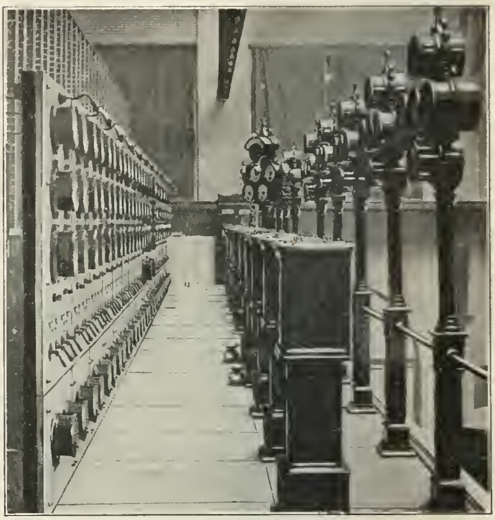


FIG. 4.—SWITCHBOARD GALLERY OF THE UNION ELECTRIC LIGHT & POWER COMPANY.

One of the latest control pedestals is that shown in Fig. 5, one of six now installed in the distributing station of the Ontario Power Company at Niagara Falls, Ontario. Each of these pedestals takes care of one 7500-kw or 9000-kw, 12,000-volt, 25-cycle, three-phase generator and one bank of three 3000-kw step-up transformers. On this pedestal, in addition to the oil circuit breaker controllers with their indicating lamps, a miniature bus has been placed showing exactly what connections have been made by the circuit breakers. With each of these pedestals is provided an instrument post containing the various meters required in the generator and transformer circuits. On a slab near the bottom of the post are mounted testing jacks to enable the various meters to be calibrated in position.

CONTROL DESK OR BENCH BOARDS.

Where it is desired to reduce the length of the operating board to a minimum it is usual to install a control desk or bench board and to mount on the top of the desk the various controllers for the circuit breakers, electrically-operated field switches, field rheostats, governor motors, etc. Wherever possible, the instruments for the various circuits are mounted in such a position relative to the sections of the control desk as to indicate clearly to the station operator the instruments belonging to particular circuits.

With a control desk the instruments can be mounted either on independent switchboard panels, on panels forming the back of the control desk, or in an instrument frame back of and usually higher than the top of the control desk, or an instrument post.

Where independent panels are used with a control desk the panels usually occupy a greater amount of space than the desk and it is possible for the station operator to become confused in determining what instruments belong to a certain generator or feeder whose controlling devices are on the desk. As a rule, card holders or name plates are placed both on the desk and the panels and the grouping of the instruments is made as far as possible to correspond with the grouping of the controlling devices.

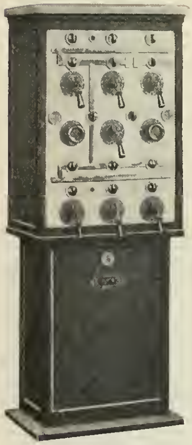


FIG. 5.—PEDESTAL.

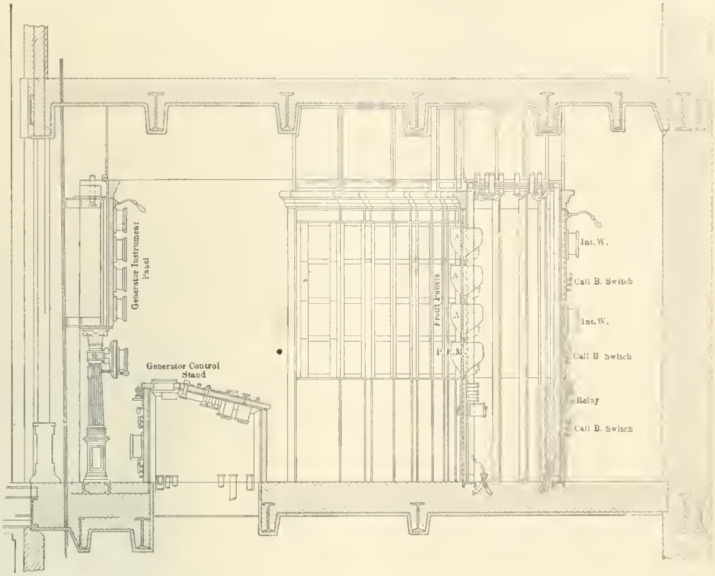


FIG. 6.—CONTROL DESK IN WILLIAMSBURG STATION OF THE BROOKLYN RAPID TRANSIT COMPANY.

Where the instrument panels form the back of the control desk the instruments are arranged to correspond in location with the controlling devices for the same circuits.

One of the drawbracks of this type of control desk is the fact that the instrument panels which form the back of the desk shut in the view of the operator so that normally it is necessary for the operator to have his back towards the station.

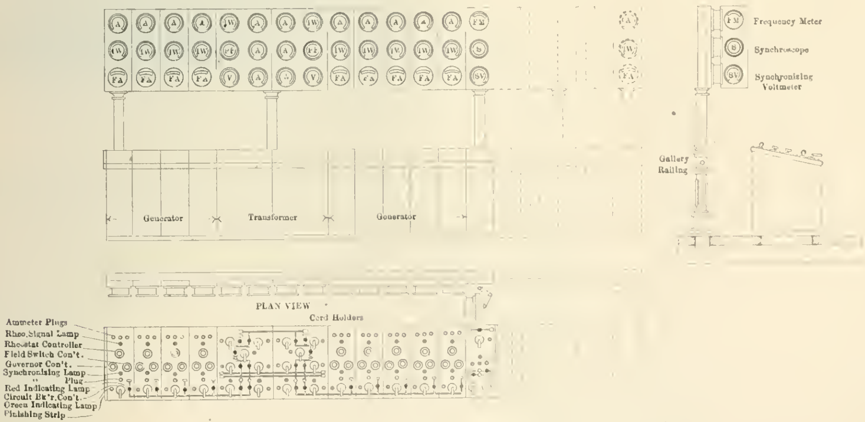


FIG. 7.—GENERATOR AND FEEDER CONTROL FROM SAME DESK.

Fig. 6 shows the control desk installed in the Williamsburg generating station of the Brooklyn Heights Railway Company and at present used to control three 7500-kw turbo-generators and two 10,000-kw turbo-generators with provision for future extension up to a total of nine generators. This arrangement of the desk permits the station attendant to face the generator room and readily observe the operation of the machines he intends to control. An independent instrument frame is provided back of and above the control desk and its height is such that the operator looks over the top of the desk and under the bottom of the frame.

The feeder panels for this installation are arranged to form an arc of the circle. By the use of vertical, edgewise instruments a very compact arrangement has been secured. The recording instruments, relays, calibrating switches and such similar apparatus that the station attendant does not need to be continually watching are located on independent panels back of and concentric with the feeder instrument panels.

Where the number of feeders is comparatively small in relation to the number of generators, it is often possible and advisable to control the feeder circuits from the same desk as the generator circuits as shown on Fig. 7. This desk is used for the control of nine 2500-kw, 6600-volt generators, two banks of transformers, each comprising three 4000-kw, 6600 to 66,000-volt units delta connection low-tension and star connection high-tension and two 110,000-volt outgoing feeder circuits. The ultimate installation will comprise 18 generators, four banks of transformers and four transmission lines.

As shown by the miniature bus on the top of the desk the generators will normally be operated in groups of four or five and these groups can be connected to either of two sets of bus-bars. The transformer group will be operated from either of these two sets of bus-bars and the high-tension connections are so made that normally each transformer bank will feed out over its own transmission line, but can be connected to a high-tension bus.

The control desk is intended to be located at the edge of the switchboard gallery and the post for the instrument frame will also form the post for the railing of the gallery. The various sections of the desk are provided with the controllers, meters, etc., necessary for the proper operation of the various generator, transformer, line and tie circuits. On the portion of the instrument frame back of and above this tie panel is located a pivoted panel on which is mounted a frequency meter, synchroscope and synchronizing voltmeter. This desk, like most of those where only a portion of the ultimate plant is to be installed at first, is made on the unit system and new sections can be added without disturbing the symmetry of the arrangement and without interfering with the operation of the plant.

It may be of interest to note that this control desk is to be installed in a plant of approximately 50,000 kilowatts ultimate rating and that there will be three of these plants operating in multiple and distributing energy at 110,000 volts over a large section of country. Owing to the low-head available at two of the plants, 2500-kw units will be installed, while at the third plant 5000-kw units will be used.

Where a very compact arrangement is desired a control desk with vertical, edgewise instruments can be used for the purpose, as shown in Fig. 8, which illustrates the equipment being furnished to the Rio Janeiro Traction, Light & Power Company for the control of six 5000-kva generators and six banks each of three 1700-kw, 6600 to 88,000-volt transformers and four 88,000-volt transmission lines. In this plant an electrically-operated, oil circuit-breaker and a double set of disconnecting switches are provided for the high-tension side of each of the six transformer banks so that they can be connected to either of the two sets of high-tension bus-bars. These two sets of high-tension bus-bars are divided in the middle so that there are practically four sets of bus-bars, which can, however, be tied together through electrically-operated, junction circuit-breakers.

An electrically-operated, oil circuit breaker and a double set of disconnecting switches are provided for each of the four outgoing transmission lines so that the line can be connected to either of two sets of bus-bars. With this arrangement a very flexible combination of generators, transformers and lines may be obtained and it is possible to operate the four transmission lines entirely independent. Marine finished slate is used for the top of this desk and planished steel plates for the ends, front and back. These plates are light, strong and readily removable to obtain access to the interior of the desk. A steel instrument frame is provided and the unit idea has been carried out to allow for future extensions.

A miniature bus system, with red and green lamps to indicate whether the circuit breaker is open or closed, is located on the top of the desk and miniature disconnecting switches are placed in the mimic bus-bars as the double-throw system on the high-tension circuits is obtained by means of disconnecting switches. After closing or opening any of the high-tension disconnecting switches, the station attendant reports the fact to the switchboard operator so that the latter can set the miniature ones to correspond. This scheme furnishes the operator with all necessary information as to the conditions of the high-tension connections which are not apt to be changed from day to day.

The electrical control in the Rio Janeiro plant is extended to the field coil and exciter circuits as well as to the generators, transformers and lines, all of the controllers, etc., being mounted on the top of the desk and the instruments being in the switchboard frame. Vertical, edgewise meters are used throughout with the exception of the synchroscope and power factor meters where a 360-deg. scale was desired.

A complete set of graphic recording ammeters, voltmeters, wattmeters, power-factor meters, frequency meters, as well as polyphase watt-hour meters is provided for each of the four outgoing 88,000-volt lines. In the receiving station of this plant, the control desk for the line and transformer circuits is somewhat similar to that for the generating station with some slight changes.

Small green telephone lamps are placed in the miniature bus system on the desk in place of the miniature disconnecting switches and these lamps are connected in series with standard incandescent lamps and snap switches located in the passageway from which the disconnecting switches are to be operated. The station attendant, after pulling out the disconnecting switches, closes the snap switch and in this manner lights the green lamp on the desk and the standard lamp near the switch. In a similar manner, after closing the disconnecting switch, the snap switch is turned to extinguish the light. Failure of the telephone lamps will indicate that disconnecting switches are closed.

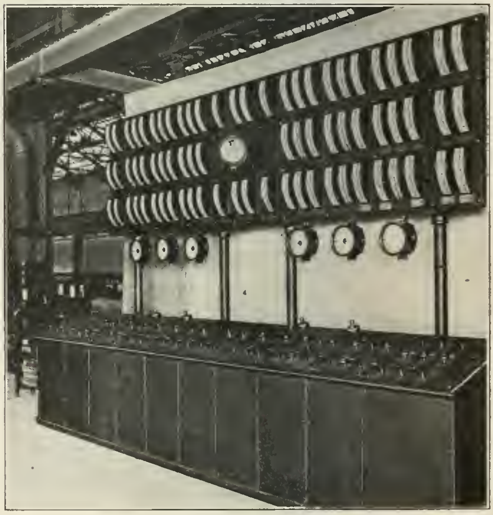


FIG. 8.—CONTROL BOARD FOR RIO JANEIRO TRACTION, LIGHT & POWER COMPANY.

As it will be difficult in this receiving station for the attendant to see whether the oil circuit breaker whose disconnecting switches are to be operated is open or closed, red and green lamps are installed opposite each set of disconnecting switches and these lamps are operated by a signal switch on the oil circuit breaker in the same manner as the red and green indicating lamps on the control desk.

While the switchboard equipment of every large station presents special features that have to be embodied in its arrangement to suit local conditions, it is hoped that the examples given, although all taken from the designs of the same manufacturing company, will be of interest and value to engineers connected with the design and operation of stations embodying some of the features mentioned.

Direct-Current Motors: Their Action and Control—IV.

By F. B. Crocker and M. Arendt.

SHUNT MOTOR SPEED CONTROL.

While for many classes of work a practically constant speed is called for, there are also many tools and machines for which it is necessary or desirable to vary the speed. We have many ways by which to obtain this speed variation, and the particular method to employ depends upon the amount of speed variation requirêd, the cost of electric energy and the total cost of the motor and equipment. There are two general conditions of speed control; the first giving adjustable speeds at constant torque (if desired); the second giving adjustable speed with variable torque. The first group depends primarily on variation of the applied armature voltage, and the second depends on change of field flux.

Armature Rheostat Control.

1. The first method which naturally suggests itself is the variation of armature voltage by means of a resistance in series with it. The current-carrying capacity of this regulating resistance must naturally be greater than that of the ordinary starting box, since it may be in circuit for long periods. The accepted design is such that it will not heat up to more than 100 deg. C. on continuous service with rated load current. The large current capacity is obtained by making up the resistance units in plate form, since in this manner large radiating surface is obtained. Consideration of equation IX

$$V = c.\ e.\ m.\ f. + I_a R_a + D_b + I_a R_x$$

shows that if the ohmic drop is increased, the c. e. m. f. must naturally decrease to maintain reaction equal to action, and, as already shown, when the c. e. m. f. is reduced, the speed diminishes in the same ratio, hence the armature rheostatic control of a motor is a method of speed regulation which can only decrease the speed of the machine.

Speed-Control Rheostat.

For the sake of simplicity in the following problems, the stray power losses will be assumed to be the same at no-load and full-load—in fact, as already shown, the change affects the efficiency by only a very small amount. Assume that it is required to design a resistance box to be employed as a speed controller for the 10-hp motor, and this control is to give a speed variation in four steps from one-quarter to rated speed, at rated torque and for continuous service at any of the four speeds. Since rated torque is to be developed, we should consider the motor armature as operating "hot," hence its resistance R_a is .28 ohms and the speeds desired are 206, 412, 619 and 825 r. p. m., respectively, the last being the rated speed. Tabulating the conditions of torques and speed desired and recollecting that $I_a R_x = V - (c.\ e.\ m.\ f. + I_a R_a + D_b)$ we obtain the following results:

	A	B	N		
Speed Desired r.p.m.	c.e.m.f. = $\frac{\text{r.p.m.}_x}{\text{r.p.m.}_r}$ 218.2 V.	Armature Drop $I_a R_a$ 37 × .28 Volts	Brush Drop D_b Volts	External Drop = 230 — (A+B+N) $I_a R_x$ Volts	External Resist. R_x Ohms
¼ = 206	54.55	10.4	1.41	163.6	4.4
½ = 412	109.10	10.4	1.41	109.1	2.9
¾ = 619	163.60	10.4	1.41	55.6	1.5
rated = 825	218.20	10.4	1.41	0.0	0.

Knowing the value in ohms of the various resistances required in the controller, it is still necessary to determine the size of box that will allow the needed emitting surface to be obtained. The temperature rise usually permitted in speed regulating rheostats is 100 deg. C., and with the temperature limit known, the surface of the resistance units can be calculated, because the heat energy produced must equal that emitted; that is

$$.24\, I^2_a R_x = hAt \tag{10}$$

In which I_a is the rated current, A the surface of the resistance metal in sq. cm., R_x the total resistance of the rheostat, h the emissivity of the resistance metal (*i. e.*, gram-calories emitted per sq. cm. per degree C.), and t the difference between room and rheostat temperature in degrees C. The controller resistance R_x as calculated is 4.4 ohms, the current I is 37 amperes, the emissivity h of nickelin (the resistance metal employed) is .000506, and the difference in temperature t is 100 deg. C. Substituting these values in equation 10 we have $A = \frac{.24 \times 37^2 \times 4.4}{.000506 \times 100}$ or 28,600 sq. cm. That is, the nickelin wire employed must have an emitting surface of 28,600 sq. cm. so as not to increase in temperature more than 100 deg. C. at rated load. Knowing the resistance required and the radiating surface, the length of the resistance wire can readily be calculated if the cross-section be decided upon. Assuming a circular wire, the following formulae of resistance and length apply: Surface area $= 2\pi L r$ and $R_r = \frac{\rho l}{\pi r^2}$; where area $= 28{,}600$ sq. cm., l the length in cm.; r the radius in cm., R_r the total resistance (4.4 ohms) and ρ the specific resistance of nickelin (*i. e.*, .00005 ohms per cm. cube). Substituting these values in the above equations we have:

$28{,}600 = 2\pi l r$ or $l = \frac{28600}{2\pi r}$; and $4.4 = .00005 \frac{l}{\pi r^2}$ or $l = \frac{4.4 \pi r^2}{.00005}$. Equating these values of l and solving for r, we obtain $r = .253$ cm.; from which $l = 18{,}000$ cm. That is, the nickelin wire required would have a diameter of .506 cm. (No. 4 B. & S.) and a length of 180 meters.

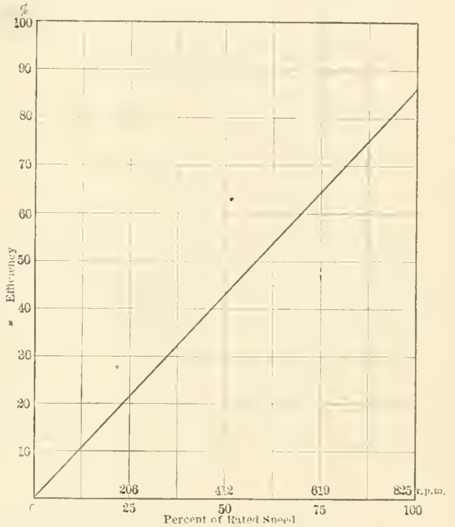


Fig. 1.—Efficiency Curve of 10-hp Motor, Rheostat Control.

A simple method of constructing this box is to employ resistance units in the form of helices. A helix 4 cm. diameter requires π4 or 12.5 cm. of wire per turn, or 1 meter of wire would make eight turns. These turns should be about .5 cm. apart, which is equal to the diameter of the wire, so that eight turns require 8 cm. height, and each section of resistance (1.47 ohms) would be 60 meters long, forming 60 × 8 or 480 turns. Hence, each section if made up in one helix would be 480 cm. high. In order that a section should not be too long, let us divide it into 12 units, each 40 cm. high. For the complete box 36 units are required, each 40 cm. high and 4 cm. in diameter. These coils should be placed so as to have 1 cm. space between them for ventilation, and to avoid short-circuiting, hence the box would be 6 × 5 or 30 cm. wide and of the same thickness. The dimensions of the finished box would accordingly be 40 × 30 × 30 cm., containing 160 meters of nickelin resistance wire No. 4 gauge.

Discussion of Speed Control by Armature Rheostat.

The efficiency, of such a combination for obtaining motor speed control at the various r. p. m. selected, is determined as follows: The stray power losses affect the efficiency at the various speeds so slightly that for this calculation we assume them as constant at their value for rated load and speed; correction can, however, be made, as shown later.

A motor operating at a constant torque will have an output directly proportional to its r. p. m.; hence, we have the following tabulated results:

Efficiency of Speed Control by Armature Rheostat, at Rated Torque.

Constant Total Input Watts	R. P. M.	Output Watts	Efficiency Per Cent
230 × 37 + 230 × 1 = 8740	825	7550	86.5
" " " " 8740	619	5662	64.8
" " " " 8740	412	3775	43.2
" " " " 8740	206	1887.5	21.6

If we plot these efficiency values as ordinates and the speeds as abscissæ, we have a straight line, as shown in Fig. 1. Hence it is sufficient to calculate one value and draw a line through this point and the origin. A study of this method of speed control will bring out the following objections:

(*a*) *Bulk of Rheostat.* This may not be very objectionable if only a few motors are so controlled, but for a number, the extra space becomes a factor, and in many cases it is difficult to find sufficient room near the motor.

(*b*) *Inefficiency of the System.* The same amount of power is supplied at all speeds, but at low speeds only a small part of it is converted into useful work, the balance being wasted as heat. Thus, with the 10-hp motor the useful work at one-quarter speed is only 21.6 per cent of the total input.

(*c*) *Poor Speed Regulation with Varying Loads.* Since the impressed voltage at the armature terminals is equal to the line voltage minus the resistance drop in the regulator ($V_t = V - I_a R_x$), any change in the current drawn by the motor produces a change in the terminal voltage, the c. e. m. f., and, therefore, the speed. The changes in speed likely to occur with load changes may be very great, and are best brought out by a specific example. Consider the 10-hp motor and controller box just designed for it, and assume that the motor is driving a lathe at rated torque (37 amperes) and at one-half speed. That is, the motor is running at 412 r. p. m. and a full cut is being made; suddenly, however, the machinist so changes the depth of cut, that the torque falls to one-quarter of the rated value—that is $I_a = 9.25$ amperes—and the increase in speed will be very considerable, as follows:

The total IR drop in the armature circuit is at this reduced current equal to $9.25 \times .28 + 9.25 \times 2.9 + 1 = 30.4$, or the c. e. m. f. $= 230 - 30.4 = 199.6$ volts. Hence, r. p. m. $= \frac{199.6}{218.2} \times 825.0 = 755$, or the speed rises suddenly from 412 to 755 r. p. m.

Convenient Tests for Central Station Operators.

By W. M. Hollis.

INSULATION RESISTANCE.

In power houses where there is a full complement of testing apparatus, various electrical measurements are ordinarily made without much trouble. Where very accurate measurements are required, sensitive apparatus is necessary, and usually a great deal of time and not a little calculation.

The insulation resistance of the various dynamos and motors should be measured from time to time, and in such cases only rough values are necessary in order to determine whether the insulation is greater or less than the predetermined value. The method outlined is also adapted for ascertaining the insulation resistance of wires. Suppose, for example, that the insulation resistance of a dynamo between the armature core and the armature wires is required: this measurement may be taken with an ordinary voltmeter, as shown in Fig. 1. Having a constant potential, 110-volt, direct-current service at hand, two readings are necessary. First, the voltage across the line; and then the voltage with the voltmeter in series with the resistance to be measured, both being connected across the line. In the illustration, the voltmeter is shown connected for obtaining the insulation resistance between the armature wires and the armature core. V equals the voltage across the line, and V' the voltmeter reading when the instrument is in series with the insulation to be measured, R_v equals the resistance of the voltmeter, and R the insulation resistance. I' equals the current in the voltmeter when the latter is connected in series with the insulation. In the latter case $I' = V \div (R_v + R) = V' \div R_v$ and $V \times R_v = V'(R_v + R)$ and $R = (\frac{V}{V'} - 1) \times R_v$.

In cases where many resistances have to be calculated, a table may be compiled, or, better still, a curve plotted from a number of values of the resistances calculated from a number of voltmeter readings. For instance, with the line voltage constant, substitute various values for V', as 10, 20, 30, etc., to the full scale voltmeter readings in the equation $R = (\frac{V}{V'} - 1) \times R_v$, and tabulate the results. For approximate values and for all ordinary uses, with a device of this character the insulation resistance for values of V' between the tabular values may be estimated. The values of V' and corresponding values of R may be arranged in parallel columns, the voltage, of course, always being at the value first used and kept constant at the original value of V when readings are taken.

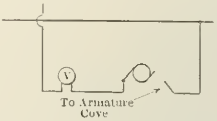


FIG. 1.—INSULATION RESISTANCE MEASUREMENT.

WALL TESTING APPARATUS.

In many electrical repair shops or places where new apparatus is tested, a scheme similar to that shown in Fig. 2 may be used for a variety of purposes. The connections shown are arranged for a circuit having a potential of 2000 volts, but, of course, may be used for a considerable range of voltages if due regard is given to proper wiring and insulation, and extra precautions are taken where high voltages are used.

In the sketch 20 incandescent lamps are shown, arranged in series upon a suitable base, with taps taken out at every second lamp. A switch is arranged between the lamps and the line. A dial contact device or rotary switch having ten contact points and a lead from every second lamp is connected to one of these contacts. Tapped from one of the main wires just beyond the series of lamps, and beyond the switch, is a lead connected to the second switch, as shown. Another lead is connected to the pivot of the dial switch at one end, and to the second switch at the other end. A pair of heavily insulated cables of such length as to reach conveniently to all parts of a suitable testing bench have at their ends a number of insulated handles, the leads passing through the handles and terminating in pointed metal rods, extended some distance beyond the handles. For convenience, ordinary insulated flexible cables covered with rubber tubing may be used for the flexible leads.

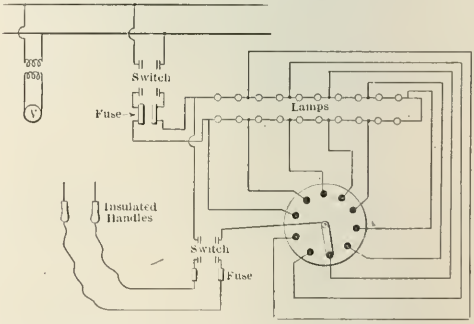


FIG. 2.—WALL TESTING APPARATUS.

When the dial switch is rotated, the voltage at the terminal points is varied in steps of 200 volts. Proper precautions must, of course, be taken to have the various leads and lines well insulated from the ground. The lamps and dial switch should be near together to save the complication in wiring, and both should be near the testing bench upon which the devices to be tested are placed. Those familiar with handling high voltages will understand the necessity for proper precautions, both in insulating the device and in using the same.

LOCATING GROUNDS IN CABLES.

A convenient method of locating the point on a cable where a ground exists, necessitating the use of a milli-voltmeter, is illustrated herewith, and the method outlined may be used where the ground is a substantial one and there are other ungrounded cables adjacent to the faulty one. The cables should be connected together, as shown at *c*, near the testing point and at *d*, beyond the ground, *B* representing the grounded cable and *A* another cable near the same. A known variable resistance, *R*, of such value as to give a convenient deflection on the milli-voltmeter, is placed successively in circuit in cables *A* and *B* and readings taken. At the point *d* the cables are connected to constant potential mains, one side of which is grounded through a lamp or other suitable device. The distance of the fault *X* from *d* or *c* may then be calculated approximately, as follows:

Measuring from *d*, let *l* represent the length of the cable in feet between the points *d* and *c*, and let *n* represent the length of the cable in feet between the point *c* and the fault, and let *m* represent the length of the cable in feet between the point *d* and the fault. The resistance R_a is equal to the resistance of the cable *A* to the fault, or $l+n$, and the resistance R_b is equal to the resistance of the cable *B* from *d* to the fault, or *m*. Hence, $R_b \div R_a = m \div (l+n)$ and equals the voltmeter reading in *A* divided by the voltmeter reading in *B*.

Calling the voltmeter readings in cable *A* and cable *B*, *G* and *G'*, respectively, $m \div (l+n) = G \div G'$. Now $l : l+m+n :: G : G+G'$ and since $l+m+n = 2l$, $m : 2l :: G : G+G'$; whence $m = (2l \times G) \div (G+G')$ or $m = 2l\left(\frac{G}{G+G'}\right)$

To obtain the insulation resistance with the above apparatus, with a weak spot in the cable *B* as indicated, place the known resistance *R* in circuit with the cable *B* and connect to the 110-volt mains as before, attaching the milli-voltmeter to *R*. If *V* is the reading of the voltmeter, and *I* the current in the cable *B*, and *R'* the resistance used with the voltmeter, and R_b the resistance of the cable to the fault including *R*, and R_x the insulation resistance at *X*, *E* being the applied voltage, then $I = E \div R = E \div (R_b + R_x)$. R_b being negligible compared to R_x the equation may be written: $I = E \div R_x$. Hence $R_x = E \div I$ and $I = V \div R'$. First get the highest resistance measurable on the apparatus; assume *R'* equal to 500 ohms, and 0.005 the readable deflection. Then $I = 0.005 \div 500 = 0.00001$ ampere. Inserting this value in the equation $R_x = E \div I$, $R_x = 110 \div 0.00001 = 11{,}000{,}000$. Hence, any resistance less than 11 megohms will give a readable deflection. For a full-scale deflection (1 ampere), $I = V \div R' = 1 \div 500 = 0.002$ ampere, and $R_x = E \div I = 110 \div 0.002 = 55{,}000$ ohms. Now, $R_x = E \div (V \div R) = (ER) \div V$. Hence, $R_x = (R \div V) \times E$, and since *E* is a constant, in this case 110 volts, R_x varies with $R \div V$.

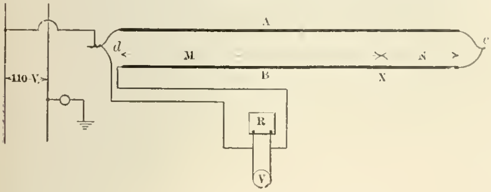


FIG. 3.—LOCATING GROUNDS IN CABLES.

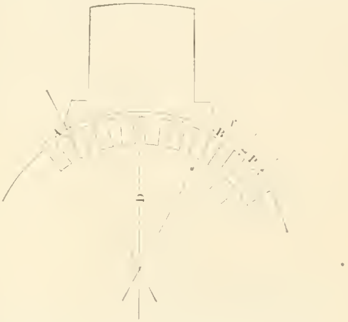
By varying the resistance used with the milli-voltmeter, or using a larger milli-voltmeter, other ranges of resistance can be measured. Hence, by substituting the proper values for *R* and *V*, the apparatus may be arranged for measuring the insulation resistances required. Ordinarily extreme accuracy is not desired, the measurement being made merely to ascertain whether the insulation is sound.

Noisy Operation of Dynamos.

By Nathaniel R. Craighill.

One of the most troublesome of the minor difficulties encountered in the design of direct-current motors and generators where laminated magnet cores are used is that due to noisy running. Many methods have been tried to eliminate this defect, such as chamfering the poles, toothing the tips, or varying the air-gap from center of pole to tip, but all of these expedients are of more or less doubtful utility, and even at best are only trial methods the success of which can not be predicted.

As a matter of fact, however, it is possible by means of calculations based upon the dimensions of a machine to predict with a great degree of certainty whether or not it will be noisy. In all cases where noiseless operation is required, it is necessary as a first condition to keep the pole face density below a certain amount, which for medium and large-sized machines should not be over 50,000 lines per square inch, and for small ones considerably less. When this density is exceeded, it is practically impossible to prevent noise.



CUSTOMARY SHAPE OF LAMINATED POLE TIPS.

It is well known that with few slots per pole there is much more likelihood of noisy running than is the case with relatively many, and where they number 15 or more there is usually no trouble. Large air-gaps are also conducive to quiet operation, but, unfortunately, large air-gaps require excessive field circuit copper, and, therefore, are not to be considered.

It can be shown by experiment that the pitch of the note given out by a machine depends upon the number of teeth in the armature and the speed of the machine, and that the possibility of having noisy running at all depends upon certain relations between the slot pitch and the length of the pole arc. It is not difficult to determine the pitch of the note that a machine emits by the help of a tuning fork.

For the convenience of those who wish to experiment for themselves, the following table showing the number of vibrations per second corresponding to various notes is given:

C_1, 264; D_1, 297; E_1, 330; F_1, 352; G_1, 396; A_1, 440; B_1, 495; C_2, 528; D_2, 594; E_2, 660; F_2, 704; G_2, 792; A_2, 880; B_2., 990.

As an example of the application of the foregoing table, a machine having 47 slots at a speed of 1125 r. p. m. (18.75 r. p. s.) emitted a note corresponding almost exactly to A_1 (880 vibrations per second). Now, $880 \div 18.75 = 47$. Similarly another machine having 40 slots and running at 660 r. p. m. (11 r. p. s.) gave out the note of A_1 (440 vibrations per second) $440 \div 11 = 40$.

In each case, the noise was entirely eliminated by trimming off the pole tips slightly. In any case, where a machine runs noisily, it can be quieted by trimming the pole tips a trifle; still further trimming will result in alternate noise and quiet. The same result can be obtained by changing the number of slots and leaving the length of the polar arc the same. In other words, there are certain relations between pole arc and slot pitch which produce noisy running and certain other ones which do not. It seems, therefore, that the more nearly the ratio between pole arc and slot pitch lies midway between two whole numbers, the less tendency there will be for a machine to be noisy, which conclusion appears to be well borne out by experiment. Expressed in the shape of a formula this would be pole-arc $\div$ slot-pitch $=$ an integer $+ \frac{1}{2}$, for quiet operation, and pole-arc $\div$ slot-pitch $=$ an integer, for noisy operation.

When the pole tips are rounded, as shown in the accompanying illustration, which is the customary shape for laminated pole tips, the effective length of the pole arc must be used in the formulas. Experiment shows that if the length of the pole arc is taken along the air-gap circumference $(A - B)$ and the radius of the pole tip is r, then the effective pole arc is $AB - 0.81r$. If D is the air-gap diameter, and n the number of slots, the slot pitch P at the air-gap circumference will be $P = \pi D \div n$.

The formula, then, for practical application will be $(AB - 0.81r) \div P = K + \frac{1}{2}$, for quiet running, and $(AB - 0.81r) \div P = K$, for noisy running, where K is an integer.

Numerous experiments have shown that when the quantity $(AB - 0.81r) \div P$ is equal to an integar plus a value ranging from $-.10$ to $+20$ the machine is noisy, while when the quantity is equal to an integer plus a value ranging from $+30$ to $+60$ the machine runs quietly.

The Operation of a Small Electric Plant.

By W. H. Wakeman.

MOTORS AND LAMPS.

There are many manufacturing plants in which a portion of the energy required is transmitted by belts and shafting; but for convenience of operation, motors are used to drive some of the machines, and the engineer is expected to take care of the whole outfit, keep it in first-class order and get the best possible results from its operation. If the steam plant has been in use for a long time it may consist of a low-speed engine to drive the shafting, while a modern high-speed engine drives a direct-connected dynamo or generator that supplies the necessary electricity.

Other plants have a partial combination of the above-mentioned units, the engine running at a medium speed of say, 100 r. p. m., transmitting a portion of the energy by belting, and driving in addition a generator which supplies electric energy to the motors.

The commutator and brushes on a motor require the same care and attention as those on a dynamo in order to give good results, although there seems to be a general idea among engineers that a motor requires much more scientific knowledge and a practical application of it. One great difference between the practical operation of a dynamo and a motor is that as a general rule, the former is located in the engine room where it is under the immediate care of the engineer at all times, but the motors are in many plants located where they can drive various lines of shafting, or separate machines most conveniently. In fact this is important, as the energy can be easily transmitted to the motors even at the most distant part of the plant without excessive loss, and the several motors are then near the machines they operate. The natural consequence of this arrangement is that the motors are started by the person nearest to them at the time, and they may be left running until the circuit is opened at the main switchboard in the engine room.

Whenever one person starts a machine in ordinary service and another must keep it in repair, the machine usually needs more repairs and renewal of parts than if one person had entire charge of it, and the reason for this condition of affairs is not difficult to find, because the person starting and stopping the motor has no further interest in the matter, hence these operations are not carefully performed.

A motor ought always to be started slowly, and as it gains speed more resistance can be switched out of circuit until full speed is attained. The motor is then ready for its maximum load.

Fig. 1 illustrates a starting box frequently used for starting motors. The lever ought to be brought over until the pawl holds in the first notch. If the machinery is in good order this will start the motor and run it at low speed. Moving the lever to the next notch cuts out more resistance, but the lever should not be moved further until the motor has attained the speed due to the current thus permitted to pass, and this process should be continued until the highest speed required is secured. The average mill or shop hand will throw the lever over until the pawl reaches the third or fourth notch, then after waiting a few seconds will move it over as far as it will go. The ammeter indicates just what transpires under such conditions, as the pointer will jump far above its normal position, thus showing that much more current is demanded where proper care is not exercised in starting the machinery.

When a motor is to be stopped, the switch near it ought to be opened, then as soon as the magnet which holds the pawl in place loses its attractive force, the starting lever flies back automatically under the action of a spring on to the rubber buffers, thus operating as another switch thrown out, provided every part is in good order, but, unfortunately, this is not always the case as the bearing where this lever is pivoted may be dry and the resulting friction prevents it from operating easily in such a case. The sliding shoe, which comes in contact with the stationary bars, may be actuated by a spring that is too stiff, and it is possible for this to prevent free action of the lever, consequently it will stay just where it was when the motor was running. This does no special harm so long as the circuit is open, but the person who starts the motor may close the switch before he notices the lever, consequently the armature of the motor is subjected to a rush of current at starting 20 or more times the normal number of amperes.

Somewhere in the line there is, or ought to be, a fuse and a circuit breaker, in order to insure the opening of the circuit before damage is done. The circuit breaker will probably open first, as it acts quicker than a fuse, provided it is set to act at the limit of the latter. One advantage of a circuit-breaker is that it can be reset as soon as the defect which caused it to go out is removed. It does not take much longer to put in a fuse, provided there is one at hand; but under average conditions it will require several minutes to find one, and there is always some danger attending the insertion of fuses.

If fuses blow out frequently under unreasonable conditions, there is a great temptation on the part of the operator to insert a piece of copper wire that will carry the load; but this is not good practice, because it may carry the load too well and cause damage somewhere else. In case of frequent failures of a fuse it may be well temporarily to insert a larger fuse, because that will still place a limit on the load that can be carried, while a piece of wire practically removes this limit or places it too high to be safe. Care should be exercised to remove the cause of the overload if this is the cause of the blowing of the fuse, or if the fuse is too small, to ascertain whether a larger fuse is permissible in connection with the size of wire used.

Link fuses are stamped with the capacity of each in amperes, and a comparison of several makes shows that the sizes vary greatly for a given capacity, or fuses of the same size have widely varying capacities. This difference is due to the fact that they are composed of different combinations of metals so that one may consist largely of metal that melts at a low temperature, while a smaller one contains an alloy that requires much more heat to melt it.

Fig. 2 illustrates this point as it shows two fuses made by different manufacturers, the comparative sizes of which are accurately presented. One is rated at 150 amperes, and the other is rated at 200 amperes, therefore one will carry 33 per cent more current than the other. Several of each kind of fuse in use in a plant should always be kept ready for use. If a fuse blows it is exasperating to be obliged to wait 10 or 15 minutes for the engineer to find the right one to replace it, and after it is found he may have to file out the tips so that they will go into place. It is much better to have this done in advance.

Fig. 3 illustrates the wiring on a compound-wound direct-current motor, and after these wires are properly located it is necessary that they be kept in place. This does not necessarily mean that they are liable to become misplaced in regular service, but it may be necessary to take them down to clean or repair the motor, hence each one should be marked with a sharp prick punch in order that mistakes in replacing them may be avoided. To illustrate this point, a certain engineer removed the wires from a motor without marking them as above suggested, as he assumed that he knew enough about the matter to put them back properly. After replacing them he closed the circuit and the ammeter immediately indicated 400 amperes, although the motor only required about 75 amperes.

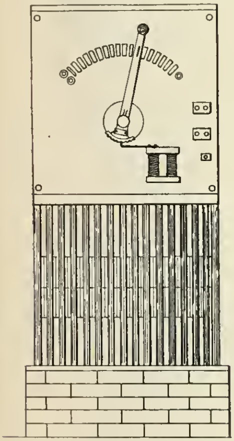


FIG. 1.—MOTOR STARTER.

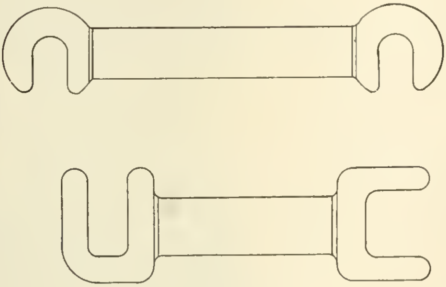


FIG. 2.—LINK FUSES.

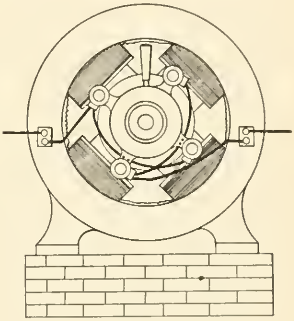


FIG. 3.—COMPOUND-WOUND MOTOR.

If the wires are purposely misplaced by some mischievous person to test the ability of the engineer to correct such evils, the marking process is an excellent way to avoid trouble and annoyance. While such things are not naturally expected, they have happened, and it is a good idea to be prepared for them, especially when it can be done so easily.

Where motors and lamps are on the same circuits, the circuits require more careful watching than where lamps only are used. Wherever it is practicable it is a good idea to start the motors first, as every engineer who takes pride in his plant and the results secured from it, wishes to keep the voltage at the lamps as steady as possible. If the motors are running steadily the lights may be extinguished without causing disturbance of the service, provided the complete line is properly divided into separate circuits, each with its individual switch. On the contrary, if the lamps are placed in circuit first, the light may flicker when the motors are started, and this is always to be avoided if possible. For the same reason the lights should be extinguished first, then the motors can be stopped without causing sudden changes that are apparent to everybody in the building. If for any reason the motors must be stopped first, the lever provided for each, as shown in Fig. 1, can be slowly moved backward one notch at a time until the motor is running slowly, then the switch can be pulled out without affecting the voltage badly.

When considering the operation and care of incandescent lighting circuits, there are three main points that should be remembered:

1. A complete line must be maintained from the commutator to the positive bus-bar, and from the negative bus-bar back to the commutator.

2. Each separate circuit must be kept intact at all points from the switchboard over the positive wire to the most remote lamp, then over the negative wire back to the switchboard.

3. The copper wires composing these lines must be kept free from connection with each other and from grounds.

The first deals with larger parts and more compact service, yet when the terminals of a small cable are firmly clamped to other metal parts perfect contacts are not always secured, because the metal surfaces must be free from foreign matter that is not a conductor of electricity, and if they touch at a few points only the imperfect contact, which cannot always be readily detected, may cause the temperature to rise high enough to melt solder.

With reference to the second point, breaks occur that seem to be unnecessary, and some of them are concealed by the insulation provided for the protection of the wires, or by changes in the wood work, or other unforeseen conditions. Vibration of buildings causes chafing and wear that weaken wires where they are uncovered until they break more readily than when new. A rosette is fastened to the ceiling and a binding screw on each side of it clamps the wire, but if one of them becomes loosened, or is taken out, no electricity can pass until the defect is made good. Rosettes contain places for two small fuses that are held in place by screws, but sometimes one of these fuses is broken by being wound around the screws and pulled apart as the last screw is tightened, although it is not discovered until the lamp fails to light and a careful search is made for the defect.

A socket which is extensively used for incandescent lamps is illustrated in Fig. 4, and it does not require a very close examination to show that there are several places where contacts are made when the appliance is new and in good order, but after the key has been turned an indefinite number of times these small parts become worn, bent or broken until the contacts are imperfect and soon the parts are separated, causing a break in the circuit. It is best to throw away these sockets and put in new ones.

Sometimes a lamp will fail to burn because contact between the base and the socket is imperfect, but the same lamp may burn perfectly when put into another socket, hence this change should be tried before the lamp is discarded, provided the filament is not broken.

Sometimes the filament in a lamp is drawn to one side until it touches the glass and breaks it, and its successors soon share the same fate. This action denotes electric attraction due to a swiftly moving belt, or something else of a magnetic nature nearby, which cause should be removed or guarded against.

Fig. 5 illustrates a receptacle for an incandescent lamp that is designed to be fastened directly to the ceiling or walls of a room. It is a very simple device, but if the lamp base is too large the lamp will not touch at the bottom, therefore, only one connection is made and no light results. If the lamp base is too small, a thin strip of brass may be forced in between the porcelain and the circular fitting, thus pressing it inward and causing the threads to hold.

In many places lamps if not protected are easily broken, but the wire guard shown in Fig. 6 prevents these accidents.

When lamp cord becomes badly worn, especially where it is frequently looped up to raise the lamp, there is danger of direct contact of the two wires, and where a socket is torn off by accident, leaving the ends of the wires exposed, the latter may be easily brought together and cause trouble. When putting on a new socket one strand of the lamp cord may become separated from the others, and if this touches the other wire it may be sufficient to cause a short circuit. If an insulated wire is allowed to rest on a gas pipe, vibration may wear away the insulation until the wire touches the iron pipe, thus causing a ground.

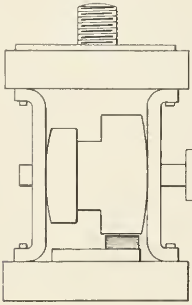


FIG. 4.—LAMP SOCKET.

Combination gas and electric fixtures are a source of trouble and annoyance unless the internal wires are carefully insulated and there are no sharp edges left on the brass tubing to cut through the insulation and thus make a short-circuit. In some cases this work is done very carelessly, hence when the circuit is closed on a five or six-lamp chandelier and there is a flash near the ceiling it is evident that the fuse has blown. It is an easy matter to replace the fuse, but it is evidently not a good idea to close the circuit again and repeat the experience without removing the cause.

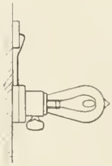


FIG. 5.—RECEPTACLE FOR WALL LAMP.

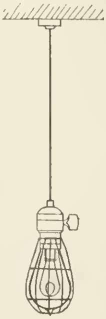


FIG. 6.—LAMP GUARD.

The rules for electric wiring allow the omission of fuses near the ceiling, as fuse plugs in the junction boxes are deemed sufficient, and so far as safety is concerned they are, but there are other points to be taken into consideration. Several chandeliers or groups of lamps are fed through each plug, therefore without the separate fuses a short-circuit on one chandelier extinguishes all of the lights, making it difficult to tell where the cause of trouble is located. Furthermore, no light can be secured from any of them until the defect is found and a remedy applied. Such an accident may happen when light is badly needed and at a very inconvenient time to repair the break. For these reasons separate fuses near the ceiling are preferred, as a short-circuit disables but one chandelier. When a direct-current arc lamp is to be installed on a direct-current circuit care must be taken to connect the wires to the proper binding posts in order that current may travel through the mechanism in the right direction. There may be no way to determine this point except by experiment. Connect the wires to the binding posts, close the circuit for about one minute, then open it again and watch the carbons. If the upper one remains red longer than the lower, current was passing in the right direction, showing that the connections are properly made. If the lower one remains red after the upper has turned dark, the connections must be reversed.

When trimming arc lamps set the lower one in place, then put in the other. The latter should stand central with the former. Revolve the upper one a number of times and see if it remains in line while turning. If it wabbles it ought to be adjusted until it remains in line. These precautions should be taken to prevent the upper carbon from slipping by the lower one.

If an arc lamp flickers excessively when placed in circuit, the plunger in the dash-pot is probably too loose. If the plunger is too tight, it will stay in one place and fail to feed properly. When the upper carbon remains down on the lower it usually indicates that the small clutch which is intended to grip the carbon is not in good order. All of the parts should be kept as free from dust and dirt as possible.

The engineer in charge of an electric plant that is used in a mill, shop, or factory should profit by the experience of others in similar situations, and thus prepare for emergencies before they arise, not only learning to avoid accidents, but studying problems concerning what may happen and thus know what to do when trouble does come.

Fittings for Superheated Steam.

While there is some question as to the exact economy effected by the use of superheated steam, due to lack of accurate data as to the extra amount of coal required to obtain a given amount of superheat, there is little doubt that superheating in moderate amounts, say, up to 200 deg., pays in connection with steam turbines, and it is quite practicable to work to this degree of superheat by the use of suitable materials and properly designed apparatus. On this point, Mr. A. H. Kruesi gave some valuable information at the last annual meeting of the Association of Edison Illuminating Companies.

Experience with turbines especially designed for such service indicates that they require no additional attention or maintenance due to the use of highly superheated steam. Superheaters themselves have been a source of considerable trouble in many plants largely on account of leaky joints occasioned by variation of temperature through wide limits. It is an essential requirement in a successful superheater that it shall be readily drained of water. It is desirable also that the flow of steam shall be continuously downward through it and from it; that is, that it shall neither contain water pockets within its structure nor constitute a water pocket as a whole.

The feature of the plant which requires most attention in design on account of superheat is the steam piping. Experience in plants at Schenectady and Lynn and elsewhere with superheat up to 300 deg. F. indicates that the piping must be radically different for satisfactory operation, as compared with that which has been considered good practice in connection with saturated steam, piping of the latter kind having failed under superheat in a considerable number of cases. This is partially due to the high temperature involved, but probably in the largest degree to variation of temperature. Observations by thermometer and by recording pyrometer on the outlets of individual boilers and in headers carrying steam from a number of boilers show that the temperature in the header receiving steam from a number of boilers may remain fairly constant while the temperature of steam from individual boilers, even under steady load on the plant, varies incessantly in a large degree. In a particular plant, equipped with boilers and combined superheaters designed for 125 deg. superheat over 180 lb. pressure it was found in test with a perfectly steady load, that the superheaters actually gave averages of 89 deg. at one-half load, 139 deg. at full load, and 142 deg. at 50 per cent overload. In actual service with hand firing under variable load the superheat varies 50 deg. in almost any 20-minute period which may be selected. The superheat frequently reaches a value of 225 deg., and from this to zero at the time of cleaning fires.

From his experience, Mr. Kruesi is convinced that under such variable conditions, cast-iron and so-called semi-steel are unfit for use for flanges, fittings, valve bodies or other essential parts required to withstand the steam pressure and temperature in all pipe lines 4 ins. in diameter and larger. It appears that cast-iron fails more on account of lack of elasticity than because of insufficient strength, and this failure is due to incessant and rapid variation in temperature rather than to high temperature. The fact that grate bars and stove plates warp and crack is a matter of common observation and is due to the wide range of temperatures to which they are subjected. Cast-iron has been known to enlarge in volume as much as 40 per cent and in linear dimensions as much as 8 to 10 per cent when heated through wide ranges in temperature, such as occur in annealing ovens. Mr. Kruesi has removed cast-iron fittings which had taken a permanent set, increasing in length from 1 to 2 per cent inside of a week's time. Numbers of valves of the globe type made of semi-steel have increased in dimensions to such an extent that the seat ring of a 6-in. valve, for example, originally threaded tight in the body, could be lifted clear of the threads when cold, representing an enlargement of the diameter of the body at the seat ring of over 3 per cent. It is generally believed that water may exist in the presence of superheated steam under certain conditions, and it is probable that such difficulties with cast-iron parts are chiefly due to the occasional spraying of highly heated interior surfaces with water carried by the steam, resulting in extremely rapid local cooling of considerable extent, which would fully account for radial cracks in the flanges, generally the first evidence of distress. This belief is confirmed by the observation that in a certain header receiving steam from individual boilers through side openings in cast-iron header manifolds, so that steam and entrained water impinged on the sides of the manifold opposite the openings, replacement of the manifolds has been necessary. Semi-steel angle valves in which water, when present, can impinge on the inside surface of the bonnets, have failed similarly. On the other hand, straight cast-iron fittings carrying the same steam have proved satisfactory, the only difference being that they are arranged vertically; and, the flow of steam through them being parallel to the sides of the fittings, there is no impingement or local cooling.

It is undoubtedly true that cast iron has given satisfactory service in superheated steam lines in a number of plants, and this will not appear contradictory to the experience in other plants where it has been unsatisfactory, if the explanation offered above is correct. It is wrong to regard cast iron as safe, because it has in many instances given no trouble. The rapidity with which it will go to pieces will depend largely on the nature of the service as regards fluctuation in load and consequent fluctuation in temperature and priming of boilers. That it will ultimately become unsafe for use seems inevitable, but the danger may not be discovered until serious results ensue, for the reason that such fittings are usually completely covered with heat insulating materials. It cannot be assumed that cast iron is safe for use up to the time that large cracks occur and are detected. Fittings have been found in which the most careful examination would disclose only minute cracks, but the fittings could, however, be readily broken up with a light hammer.

As stated it seems probable that smaller piping, say 3½ inch and less, can safely be made with cast-iron flanges and fittings and other parts as well as valves of brass of good composition. The reasons for the more satisfactory behavior of these materials in such small sizes are probably as follows: such lines are generally remote from the boilers; and, on account of radiation, the superheat of the steam they carry is generally less, consequently the temperature variation which they undergo is materially reduced. These small lines usually contain many bends and fittings; and, being more removed from the boilers, sufficient time probably elapses for water carried over with the steam to be more or less completely evaporated into steam. The bends and fittings undoubtedly contribute to the evaporation of such water. The effect would be to lower the superheat, and such fittings having smaller flanges and thinner walls will be of more nearly the same temperature inside and out when water happens to strike them.

Attempts have been made to find a clue to the reason for cast iron being unsatisfactory, in the chemical analysis of parts which have cracked or warped badly; but the reason will probably be found in the lack of elasticity inherent to all cast iron.

Cast steel has been in use for fittings and valve bodies for a considerable number of years and has, in some cases, caused trouble on account of cracks, splits, blow holes, sand holes and other foundry defects which were not at first apparent, but which manifested themselves after the lapse of time. The trouble in some instances was due in part to making steel castings from patterns designed for cast iron; but such difficulties are now infrequent and can be minimized by correct design. Open hearth castings are preferable to converter castings because of their higher elastic limit.

Gate valves of various makes have proven in many instances practically worthless after short periods of operation under superheated steam. This is often due to their being used incorrectly. A gate valve with solid plug will seldom seat truly unless placed in a horizontal pipe line with the spindle vertical and the hand wheel on top. Any other arrangement of the valve is practically certain to cause the plug to rotate about its center line so that its faces will not be parallel to the seats, hence it cannot close tightly. Any warping of the valve body on account of its very unsymmetrical shape will have the same effect, and gate valves are open to objection on this account even when made of steel. It therefore becomes an object to return to the use of globe and angle valves wherever possible, it being generally practicable to re-grind or re-face the seat of such valves in place without breaking joints. The discs can, of course, be readily removed and re-faced in a lathe. Stems, seats, discs, and other internal parts are frequently made of bronze or nickel bronze. These materials become very "short" at the temperatures under consideration and have a coefficient of expansion approximately 50 per cent greater than that of steel or iron and hence quickly become loose and lose their fit. The operating valves of Curtis turbines have for some years been made of mild steel, seating on seats of the same material, and have after extensive experience proved most satisfactory. These seats have the same coefficient of expansion as the steel bodies in which they are mounted and have never become loose. It is well known that steel retains its elasticity practically unimpaired at the temperatures commonly employed in superheated steam work. Experience may prove that nickel steel alloy containing a high percentage of nickel is preferable for seats and discs on account of less corrosion, but nothing in the writer's experience indicates that this will be the case.

The statements concerning cast iron and steel apply to pipe flanges as well as fittings. Gaskets of corrugated copper are in common use, but these have not stood up well in superheated steam work, chiefly because copper anneals at a temperature as low as 600 degs. F. or about 220 degs. superheat above 180 lbs. pressure. Corrugated gaskets of any kind are open to the objection that careless pipe fitters in making up a joint can readily overstrain the bolts and flanges. Gaskets of asbestos and rubber compounds or other organic material, while often temporarily successful, can seldom be regarded as permanently satisfactory. The most satisfactory gasket is one of thin sheet steel not more than ⅝ in. in radial width, so that heavy pressure can be brought on it with bolts and flanges of ordinary weight; the steel being soft annealed so that it can be pressed into the rough surface of the abutting flanges with a reasonable tension on the bolts.

LETTERS ON PRACTICAL SUBJECTS.

THE GENESIS OF A DAY-CIRCUIT.

The importance, to the central station, of a day-circuit for the operation of motors, heating devices and other modern conveniences and necessities is now well recognized, much more so than in the beginning of the industry. The writer recalls the difficulties under which such a circuit was begun, and believes that a brief account will not be without interest.

Early in the nineties a small Edison station in Ohio was struggling to make ends meet, under the pressure of gas competition, and handicapped by an inefficient generating system and lamps. The station was operated from sunset to sunrise, and the idea of day operation had not entered the minds of those in charge. An electric railway having just been constructed, the station contracted to operate the generator for the railway company; this made it possible to use the boiler plant 24 hours a day.

At this juncture a business man, whose office was unusually hot and poorly ventilated, desired to be furnished with a fan motor. He was informed that it was not possible, as the railway voltage was too high for the satisfactory operation of a desk fan, and it was out of the question to run a 100-hp engine to provide 110-volt current for one fan motor. He was not to be put off, but insisted that in some way it ought to be possible to supply his need. The superintendent of the plant had recently been studying the theory of the dynamo, and it occurred to him that as the railway generator was in operation all day it might be possible to put a third brush on the commutator, at such an angle in advance of the negative brush as to have a voltage of about 110 above the negative brush.

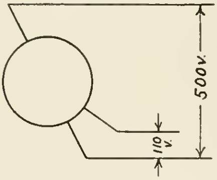


FIG. I.—THREE-BRUSH ARRANGEMENT.

This was done, as shown herewith, the proper position being found by trial. To avoid excessive sparking, the brush was made of carbon and filed every day very narrow at the tip. In spite of this precaution, the commutator heated considerably more when this brush was used.

The fan motor was in the same block as the station, so the wiring was easily accomplished and the service was begun. The voltage regulation proved to be unusually bad, very much worse than that of the main voltage of the generator. This was due to the shifting of the neutral point with changes of load. While very objectionable, it did not prevent the service from extending and soon several desk fans and a ½-hp motor were in regular operation. This last was in a restaurant with a day and night service, so it was necessary to change the motor circuit over from the railway generator to the Edison system when the latter was started in the evening. It was desirable to change to the Edison system whenever the latter was in operation (as on a cloudy afternoon) on account of the steadier voltage. To make the change automatically a switch was constructed having U-shaped copper links which dipped into mercury cups. Two such links were used, one at each end of a pivoted lever, which was loaded so as to drop at one end, putting the day circuit in connection with the third brush of the railway generator. On the other side of the pivot was hung an iron core which entered a solenoid below. This solenoid was connected to the Edison circuit, and when the latter was started up the solenoid tipped the lever and transferred the day circuit to the Edison system. This device operated quite well for a while, but as the load on the day-circuit increased, trouble occurred in the shape of arcing, which made it necessary to discard the automatic switch for an ordinary knife switch.

The increase of load made it more difficult to keep the narrow third brush in good order, and as a ¾-hp motor was on hand, it was belted to the railway engine and used as a generator, a compound winding being added to help the regulation. This gave much better regulation than the third-brush scheme, though the service was still far from good. This small generator was overloaded at the start, and the load kept on increasing. To keep the armature from burning up a small fan motor was arranged to blow a current of air on it; by this means it was possible to carry more than 100 per cent overload. The commutator showed considerable wear, but as the machine was the first of its kind to be operated in the station, there was no knowledge as to the safe depth to which the bars could be worn. One day the engineer came hastily into the superintendent's office with the rather startling announcement that the little generator was slinging its commutator bars out on the floor, but was still carrying the load. A hasty inspection showed this to be very nearly true; the machine was still carrying the load, although the voltage was not fully up to normal. Commutator bars, in halves, were scattered over the floor, and the brushes were sparking considerably. The brushes had cut the bars deeply in the center of their lengths, the half-bars thrown out were the outer halves, the inner halves being held in place by the leads and the bands over the leads; the brushes were running on the remaining half of the commutator. This state of affairs continued for five or ten minutes when the half-bars next to the leads commenced to get out of place and the long-suffering machine went out of business.

In the meantime, however, a contract had been made with one of the local newspapers for the installation of a 3-hp motor, and this had been purchased and was on hand, as well as a 6-kw bipolar Edison generator, which was to run the day circuit. This latter machine was quickly put in position and set to work.

A short time later the new printing press was installed and the 3-hp motor set up to drive it. Here a new difficulty arose. While the 6-kw generator was compound wound and would give good service when driven at a steady speed, it could not give a steady voltage with the wide variations of speed of the railway engine, which was of only 100 horse-power. The factory expert who set up the printing press tried to operate it with the motor, and on discovering the large and sudden variations of speed, promptly notified the lighting superintendent that he would never "hook up" his press to such a motor, as the press would be "racked to pieces in less than a week." This was a serious situation; two machines had been bought for the work and failure here would probably end the day-circuit. As the press expert further announced his intention of leaving the next day without connecting the press to the motor, the situation was clearly critical, and something had to be done. As a forlorn experiment, a man was stationed at the field rheostat of the 6-kw generator, with instructions to hold the voltage as near constant as possible; the press man was then invited to try the motor again. He reported it still unsatisfactory. It was evident that something must operate which was quicker than hand control. The superintendent burned the midnight oil later than usual that night. Early the next morning he procured a supply of heavy insulated line wire, removed the keeper joining the upper ends of the field cores of the 6-kw generator, and wound one layer of the heavy wire over the existing winding. The ends of this new winding he carried over to the 60-kw railway generator and connected them to the ends of the series field of the latter, so that when a heavy load came on the railway generator part of the current would flow through the auxiliary winding on the 6-kw generator. By disconnecting this auxiliary winding the range of voltage variation without it could be noted; on connecting it, it was found that the regulation was considerably improved. So another layer of thick wire was put on the 6-kw generator field coils and put in parallel with the first.

The regulation was still better, but not quite good enough, so a third layer was put on; this gave a very satisfactory result. The printing press man was now notified that a change for the better had been made. He connected the press to the motor and declared himself entirely satisfied.

This generator, thus compounded for variable speed as well as variable load, ran for a considerable time and gave no trouble. The effect upon the regulation of the 60-kw railway generator was not determined, but no one expected any sort of regulation from it, so there was no complaint.

From this on the day-circuit began to prosper. Small job printing offices were equipped with motors, and the electric fan motor began to get a good grip on the company's customers. The demand for larger motors became such that it was considered feasible to operate the day-circuit from one of the regular engines used for lighting service at night, especially as a favorable flat rate for fuel had been obtained from the natural gas company.

The day load of this small station, as operated from the three-wire Edison circuits, now averages over 60 kilowatts, and is recognized as a paying part of the load. There are about 300 horse-power of motors installed. The town is a manufacturing one, with a number of small industries which can use electric motors to advantage, but which are located in the outlying districts beyond the reach of the direct-current system. The lighting of these districts has been done in the past with the 125-cycle system. Recently, however, the company has thrown out its 125-cycle machine and put in two 60-cycle, three-phase machines, so as to be able to push the motor business in the outlying territory, the value of the motor load being fully recognized.

Washington, D. C. H. B. Brooks.

SOME NOTES ON FURNACE ARCHES FOR WATER-TUBE BOILERS.

Central station engineers, particularly those who have to encounter during certain parts of the day big loads which test the capabilities of the boilers to their uttermost, will have at one time or another experienced the disastrous effects which result from the falling in of the furance arches. It is, therefore, perhaps useful to consider a few points which regulate the proper construction of these arches, more especially as the work is often left to the tender mercies of the average bricklayer, whose sense of responsibility is usually not so great as it might be.

When building the arch, whether for grates 3 ft. or 6 ft. wide, the bricks should not only be accurately fitted onto the template before being built into the boiler, but it is necessary to rub down each brick so as to make a true face with its neighbor. By doing this it is possible to make the fireclay joint very thin, and as nearly all of the failures of arches occur through bad jointing, the importance of this point can be easily seen. The bricks being faced true to one another enable the arch to stand a long time and to keep from dropping even if slight bulging takes place, due to intense heat and strain on the boiler setting. Great care should be taken that the skew back bricks, which take the thrust of the arch, are properly bedded. A common failing of inexperienced bricklayers is to pack these behind a considerable amount of fireclay. If the bricks crumble away at all, or shift with the heat, the lumps of fireclay are not in themselves able to resist the strain and the arch itself will fall. The proper way to build an arch, if it is intended to last, is to construct two arches, one above the other, each of 4½-in. brickwork, the two arches being quite independent of one another. This can be done as follows: First, build the lower ring on a wooden form in the ordinary way, then spread evenly all over this a layer of dry fireclay, or, better still, sand, to a depth of three-quarters of an inch; on this sand build the second ring of brickwork. When the job is completly set and hard the layer of sand or dry fireclay between the two arches can be raked out, thus leaving a clear air space. This has two advantages; the first being that the upper ring and the brickwork above it are kept much cooler than with the solid arch, and the second one being that if the lower ring burns out and drops, a new one can be built at comparatively small expense without disturbing any of the other fireclay. The writer is now building all his arches on this plan, and whereas the renewal of solid arches used to cost about $50 per year per boiler, one arch now lasts two years and even then has to have the bottom ring rebuilt, which costs about $15 every other year. There is therefore, a saving of $42.50 per boiler per annum.

When building the side walls of the furnace in a new boiler an excellent plan is to include in the firebrick lining an arch springing from the back end of the grate and rising to about the bottom row of tubes. It is really a part of the sidewall and is, of course, built in with the other brickwork, but the object of this construction is that if the side walls burn away beyond the end of the arch, they can be cut away and renewed without incurring the danger of the side lining walls falling. As is well known, if these walls fall it is a very expensive matter to rebuild them, inasmuch as it involves cutting away the outside walls of the boiler, owing to the fact that it is impossible to rebuild the lining from inside, the tubes being in the way. The construction, therefore, of an arch, such as described, is a great money-saving contrivance in the up-keep of a boiler.

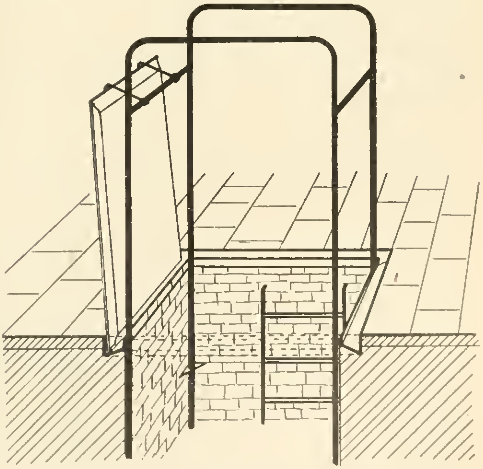
Common salt should always be mixed with the clay when building furnace arches or walls, as it glazes the bricks when subject to the intense heat of the fire and prolongs their life to a very considerable extent. The correct proportion to use is about 10 lbs. of salt to every hundred weight of wet fireclay.

Attention to the above points when constructing and rebuilding furnaces for B. & W. and similar types of boilers will get rid of a good many of the troubles which sometimes worry the life of an engineer in charge of a central station and throw discredit upon the supply given.

New York. S. A. J. Blackett.

THE INSPECTION OF MANHOLES.

In the provision of an underground network of electric cables in a city an important point which has reference to the cost of maintenance is the ease with which the system can be inspected. In modern equipments the provision of inspection boxes in the street is almost universal, and the covers of the boxes being small, can easily be operated by one man. When, however, the growth of the system necessitates the placing of underground transformers at various points, the case becomes different. The openings into the streets have to be sufficiently large for the admission into the chamber below of any transformers or regulating gear that have to be placed therein, and the work of lifting the covers for a manhole of this sort is



MANHOLE GUARD.

considerably harder than in the case above-mentioned. In the old-fashioned type of cover, which has to be removed or tilted back, and which was sometimes too heavy for a single man to handle, an inspection of the system by a single individual was an impossibility without calling in the aid of any chance passer-by to lift the cover and guard the hole in the pavement. The illustration shows an arrangement whereby, with a light cover and an easily constructed lifting guard, a quick inspection of a manhole by one man is easily possible. The cover is so constructed as to rest in any one of the small grooves which surround the manhole in order to drain the water, and is held in position by two hooks attached to the lifting frame. The frame or manhole guard can be made from ordinary gas pipe in order to secure lightness, and is fitted into angle pieces in the masonry work of the chamber in order that it can be pulled up or pressed down. When the guard is down it lies close to the wall out of the way of gear, when this is being lifted by slings up or down the opening, and when up can be arranged to be pinned up or alternatively can be held up in position by the hooks which hold the manhole cover vertical. It will be seen that this cheap and easily made device prevents all possibility of passersby falling down the opening.

Newcastle-on-Tyne, England. J. A. Seager.

INCANDESCENT LAMP EFFICIENCY.

A little experiment which I made the other evening has resulted in my looking up data pertaining to incandescent lamp illumination, which I give with the thought that it may benefit others to the same extent that I myself have been benefited.

I recently had my residence wired and in equipping the sockets with lamps I purchased 50-watt Gem lamps of 20 candle-power each. Taking a notion to ascertain the difference between this high-efficiency lamp and ordinary 16-cp lamps, I obtained four of the latter, and shutting off all lamps throughout the house the 16-cp lamps were placed in sockets and the revolutions of the revolving disc in the meter counted for one minute. The result was that the discs made eight revolutions per minute with four 16-cp incandescent lamps burning. The 16-cp lamps were then removed, and the Gem 20-cp lamps placed in the circuit with the surprising results that the revolving disc made but six complete turns to the minute, which indicated beyond doubt that it is more economical to operate four 20-cp Gem lamps than to operate four 16-cp lamps with the ordinary filament. To say that I was surprised goes without saying.

As I have never noticed how many revolutions of the disc are made per kw-hour, I am unable to state just what the saving will be in using the one type of lamp in preference to the other. It is evident, however, that a considerable saving will be brought about in a year's time when the illumination of the entire house is taken into consideration and the 50-watt Gem lamps are used.

In looking up information regarding the efficiency of lamps I found that the amount of energy used by the Gem metallized filament type of lamp is considerably less than that consumed by any low-efficiency lamp, which proves that the experiment as tried, and which was repeated several times, was correct.

TABLE, SHOWING SAVING BY THE USE OF HIGH EFFICIENCY LAMPS.

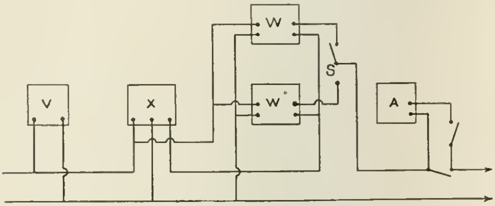
	Carbon.	Carbon.	Gem.	Tantalum.
Candle power	20	20	20	20
Watts per candle, nominal	3.5	3.0	2.5	2.1
Watts per candle, actual	3.48	3.04	2.5	2.1
Total watts	69.6	60.8	50.0	42.0
Hours' total life	1040	520	560.0	600
Cost of lamp	$0.16	$0.16	$0.20	$0.54
Cost of renewals per year of 1000 hours	0.154	0.308	0.36	0.90
Cost of energy per year of 1000 hours, at 10c. per kw-hour	6.96	6.08	5.00	4.20
Cost of energy and lamp renewals per year of 1000 hours	7.11	6.39	5.36	5.10
Saving over 3.5 W.P.C. lamp	.....	0.72	1.75	2.01
Saving over 3.0 W.P.C. lamp	.....	....	1.03	1.29

The table shows the saving by the use of high-efficiency lamps. The figures given in line five are not guaranteed, but are taken as an average figure; some lots of lamps being less efficient than others, which, of course, will make a different average for each lot of lamps. The Gem lamp, according to my observation, gives a practically white light with but a slightly yellowish tinge, while we all know that the carbon incandescent light at normal voltage gives a yellowish white light, and when below voltage an orange to an orange-red light.

Turtle Creek, Pa. James Ashburner.

TESTING WATT-HOUR METERS.

In reference to the plan of meter connections shown in Fig. 1, page 45, of Electrical World for January 4, Mr. Fred Dubell states that "If it is desired to use the upper indicating wattmeter, open the single-pole switch, and when using the lower instrument close the single-pole switch." It will be seen that with the switch closed the current coils of the two indicating wattmeters are in parallel, and hence the current will divide between them inversely as their resistances. The current coil of the lower wattmeter, of five amperes range, would thus be shunted by the much lower resistance of the 25-ampere current coil, and the test at light load would be greatly in error.



TESTING WATT-HOUR METERS.

The plan of connections may be modified as shown in the accompanying illustration, by substituting the double-throw switch *S* for the single-throw switch shown by Mr. Dubell. When using the upper wattmeter this switch is thrown up, and when the lower wattmeter is needed the switch is thrown down. In all other respects the plan shown herewith is identical with that of Mr. Dubell.

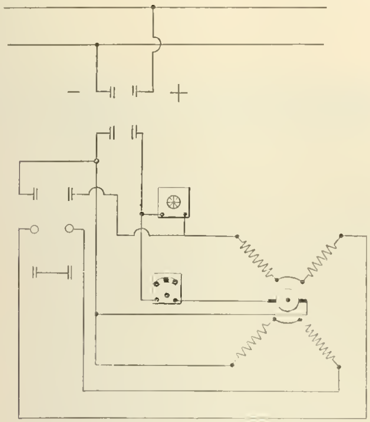
Washington, D. C. H. B. Brooks.

MOTOR SPEED VARIATION.

In some places where electric motors are used the speed variation required is not very great and for constant speed a small starting resistance only will be required in the armature circuit. There are many cases, however, in which a wide variation of speed is required and the motor must be kept at such speeds for considerable periods. Therefore the resistance, if any are used for speed regulation, must be designed to carry the current continuously without danger of burning out or overheating. For speed regulation within narrow limits, such a method might be practical; but where a large speed variation is desired, the resistances needed are ordinarily too expensive and cumbersome.

In shops where there are many large machine tools, separate motors are used for each tool, and in such cases, where a wide speed variation is required, a different method of control is used. Sometimes a three-wire system is used with 220 volts across the outer wires and 110 volts between either outer and the center wire so that a motor may be driven at either full or half speed and speed control given at both speeds. Another method calls for the use of two motors on each large machine tool on a two-wire circuit and various motor combinations in series or in multiple with or without series armature resistances. A wide speed variation may be obtained by this means; but the method is ordinarily expensive and complicated.

A convenient and simple arrangement for a wide speed variation, either with or without the use of the three-wire, double-voltage method, is shown herewith. A field resistance and an automatic armature starting resistance are used. Two switches are provided—one a double-pole, single-throw, main switch from the line and the other a double-pole, double-throw switch for the field coil circuit beyond the main switch. A four-pole motor is indicated and the field coils are in a divided circuit, two coils to a circuit. By means of suitable connections, the field coils may be arranged in multiple or in series and with the proper resistance adjustments in the field coil circuit and with an arrangement such that this change from multiple to series connection will give a wide variation in the field strength, a corresponding variation in motor speed results. The adjustments should be such as to have the field cores near saturation when the field coils are connected in parallel. Of course the starting resistance in the armature circuit should be arranged to be open circuited when the motor is at a standstill, and this should preferably be brought about by means of any of the well-known forms of starting boxes which are arranged to open the circuit automatically.



CONNECTIONS FOR VARYING SPEED OF MOTOR.

As shown in the diagram the field coils are in series when the double-throw switch is in the lower position and in multiple when the switch is in its upper position. With the field coils in series the speed is approximately double the speed with the field coils in parallel. This presupposes a well-designed motor. With many makes of motors this change in connections may result in sparking at the commutator owing to the weakened field. However, many makes of motors are on the market with speed ranges of 3 to 1 obtained by weakening the field, and these operate quite satisfactorily.

Brooklyn, N. Y. H. M. Willis.

A WASTEFUL ECONOMY.

Some time since, in a large electrical manufacturing plant, the writer noted that the water pipes in all of the sinks and drinking places through the factory had recently been fitted with self-closing bibb valves. It was also noted at the same time that every man who came to the faucet to take a drink would stand for three to five minutes at the sink, holding the faucet open and letting the water run a stream the full size of the opening until the water became cool enough to drink.

The extreme newness of all the bibb valves led the writer to become somewhat curious and to make inquiry as to the reason therefor. He at once ascertained that until very lately the water pipes had been supplied throughout with globe stop-valves, and that the water had been allowed to run in a continuous, though small stream all day, in order that it might be cool enough for drinking purposes.

It was noted that every man who came to drink held the faucet open from one to five minutes, no matter if the last man had but just gone. Upon inquiry it was found that the manager had found the water in three or four places all running streams as large as a lead pencil, and had straightway ordered self-closing valves placed upon all the sink pipes. It was also ascertained that the water cost 35 cents for 1000 gals., and that the manager read a grievous lecture to the superintendent upon the very great waste of water in the factory.

The writer became considerably interested in the matter of the economy secured by the use of the bibb valves and made a few experiments to obtain data from which to calculate the actual saving secured by putting on the bibb valves. First, one of the bibbs was blocked open to pass a stream about the size of that, which, according to the superintendent, used to flow from the old valves. The stream thus flowing was timed for a minute and the water caught in a bucket and weighed. It balanced the beam at exactly 4 lbs. Next, one of the new bibbs was held open as the last man up had held it, and the bucket failed to hold a full minute's run, therefore the valve was held open for 12 seconds, and upon weighing, 8 lbs. of water was found in the bucket.

Calculating from the above data, it is found that the water will run 240 lbs. an hour, 2400 lbs. a day of ten hours, amounting to 288 gals., which at the usual rate of 35 cents for each 1000 gals. would amount to the princely sum of 10 cents a day. To make a possible saving of 10 cents each working day, the management went to the expense of $1 for each of the bibb valves. It was found that the average time spent at the valve while waiting for the water to run cold was three minutes, and that a mechanic came five times a day, making 15 minutes each man spent at the faucet. The ten men would spend 150 minutes daily, or 2½ hours, holding that valve open. The men averaged about 20 cents an hour, making the valve-holding cost amount to 50 cents each day. Here was economy—the saving of 10 cents already cost 50 cents, with more expense to be estimated.

The water flow of 8 lbs. in 12 seconds equals 40 lbs. a minute, 240 lbs. an hour—just equal to the entire day's water expenditure with the steady stream. This gives $1 a day for cost of water with the water-saving bibb valves. Added to the 50 cents cost of time, the total expense is $1.50 a day, against the small expenditure of 10 cents. "But," says the manager, when confronted with the figures given above, "it is by no means certain that the permanent stream would always be as small as a pencil and flow only 4 lbs. each minute. The men would as soon leave the valve wide open as nearly closed."

It is very easy to arrange the piping so that no more than 4 lbs. a minute can flow, no matter how the valve is left. Just remove the valve, place a plug in the pipe, with a hole through the plug as large as desired, and no more water can flow, after the valve is replaced, than can get through the opening in the plug.

Stopping the small leaks around a power plant or a factory is something to be commended in any manager, but sometimes the matter needs very close study in order to make the proposed amendment of greater economy than the old arrangement—another place where brains are at a premium.

Scranton, Pa. John Scott.

SETTING OF DYNAMO BRUSHES.

Mr. Wakeman in his articles in the December and January issues, entitled "The Operation of the Small Electric Plant," leaves an erroneous impression as to the correct setting of dynamo brushes, since he states that these should be adjusted until the desired voltage is obtained. When setting dynamo brushes; the correct method is to move them back and forth while the dynamo is running until a position is reached where the brushes do not spark at all: or if they spark the amount

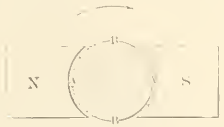


FIG. 1.—GENERATOR, WITHOUT LOAD.

in that position is a minimum. This is called the neutral point and the brushes are set in this position without regard to voltage. Fig. 1 represents a bipolar dynamo running in the direction indicated by the arrow, at no load. Under this condition the lines of force flow through the armature as indicated by the dotted lines. The greatest voltage, therefore, is generated in the coils at *AA*, directly opposite the poles; and in the coils *BB*, which are at right angles to the coils *AA*, no voltage is generated. This position is called the neutral position at which the brushes should be located in order to provide sparkless commutation. Fig. 2 represents the same dynamo under load, and because of the current flowing through the armature winding, the lines of force will be displaced as indicated. The maximum voltage, therefore, will be generated in the coils at *cc*, and consequently the neutral position will be at *dd*. It will thus be seen that the neutral position varies somewhat as the armature current varies. This variation being smaller, the stronger the field is in proportion to the armature reaction.

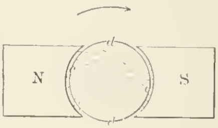


FIG. 2.—GENERATOR, WITH LOAD.

WYOMING, MINN. CARL GARDEEN.

ERRORS IN CONNECTIONS WHEN REPLACING AN OLD DYNAMO.

The accompanying wiring diagram shows the connections found by the writer a short time ago when called on a "trouble notice." A new generator had been installed in the place of an old one, and the old wiring was used. The generator had apparently started all right. A light load only was available and this load was put on the machine. The meters indicated in the right direction so that the machine was left as being properly connected. When the charging switch for the storage battery was closed the next day, the "fireworks" began. The trouble was speedily remedied; the generator fields were reversed and leads 1 and 2 were interchanged.

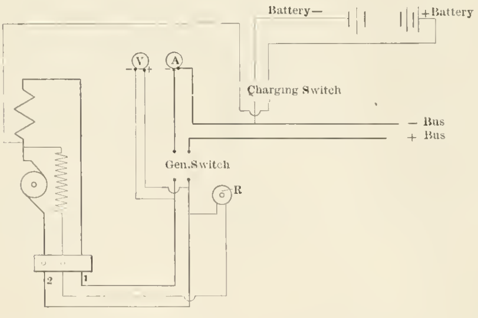


DIAGRAM OF GENERATOR CONNECTIONS.

WORCESTER, MASS. C. W. KENNEY.

SERVING ROPE ENDS.

Judging by the attempts recently witnessed by the writer of the attempts by an electrical worker to serve the ends of several cords or ropes used for suspending arc lamps, a little instruction in that simple matter may not come amiss. The worker in question said he was "winding rope ends," but the proper nautical term for the process is "serving."

The ropes in question were ½-in. in diameter, and the worker was trying to wind about 1 in. of the rope, close to the end, using light string for the purpose. But trouble came when he attempted to fasten the ends of the winding string. The rope was secured in the vise during the winding operation—something unnecessary when the proper method of serving a rope is followed. The process of serving is as given in the following description.

The rope end is first closely wound, twisted and packed together, a very necessary operation if the rope has been somewhat frayed before the serving operation is commenced. After the rope strands have been all laid in place, tie a bit of string very close to the end of the rope, to hold the ends until the serving fastens them. Select a piece of string about 50 diameters of the rope in length—this string is for the permanent serving.

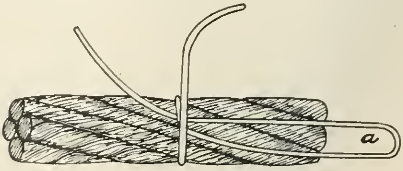


FIG. 1.—BEGINNING THE "SERVE."

The worker, while under observation by the writer, tried all manner of ways of fastening the strings—all except the right way, and he would begin with one end of the string fastened, wind, and then attempt to half-hitch the other end of the string. Again he would commence in the middle of the serving string, wind both ends alternately, crossing them over each other at every turn. At the end of the winding, a square knot was tied, which presented a lump so ugly that it only required an opportunity to break off and let the serving fall off.

The proper way to start a rope-serving is as shown by Fig. 1, the string being given a single turn around the rope and the end made into a loop as shown at *a*. The successive windings hold the loop securely and after the winding has progressed to the end of the rope, the winding end is passed through the loop, as shown in Fig. 2, then the string is cut off and the beginning end of the string is pulled tight, causing the winding end to be pulled under the winding, as shown in Fig. 3, until it is half way through the winding.

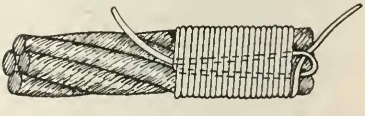


FIG. 2.—ENDS READY FOR FASTENING.

Care must be taken lest a too sudden pull on the string should cut it in two just inside the loop. When the string pulls heavily, a little pulling of the ends, back and forth, will so loosen things that the loops may be pulled halfway through the winding without danger of breaking either of the string-ends.

The illustrations herewith presented show the application of soft wire serving to the ends of wire cable. This operation is performed in exactly the same manner that the rope serving is done, and the description applies alike to both operations. The cables shown in the engravings were to be used for suspending arc lamps out of doors, while the ropes mentioned in the text were used inside the factory for the same purpose.

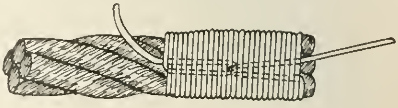


FIG. 3.—ENDS FASTENED.

NEW YORK CITY. JAMES FRANCIS.

QUESTIONS AND ANSWERS.

I have a few holes in a marble switchboard which I wish to plug up. Kindly inform me of a mixture that I may use for this purpose.
R. T. S.

Mix four parts of gypsum and one part of finely powdered gum arabic, and with a solution of borax, make a mortar. This may then be inserted in the holes in the marble. If the marble is colored and the holes are large, coloring matter to match may be added to the borax solution.

What effect has the operation of synchronous motors on a transmission line?
T. H. N.

A synchronous motor having its field excited beyond the amount that will give normal operating voltage, takes a leading current from the line. This leading current offsets or neutralizes lagging current such as is taken by induction motors or the drop in voltage resulting from the inductance of the line. In the latter case the synchronous motor acts as a capacity load. If the synchronous motor is underloaded this neutralizing of lagging current is relatively greater than when the motor is under load, so that oftentimes companies operating transmission lines have synchronous motors running idle connected to the line or offer inducements to motor users to install synchronous rather than induction motors.

In the design of electrical apparatus, is not the size of the air gap more of an electrical than a mechanical consideration? For instance, would not a machine operating under wide variation of load, designed with a large air-gap and heavy field, be but slightly effected by armature reaction?
E. N. S.

Although the effect of armature m. m. f. upon the field strength depends somewhat upon the air-gap, this effect is not of predominating importance. When commutating poles are used any effect of the m. m. f. of the armature is fully compensated for throughout the commutating zone, so that machines provided with commutating poles can be built with air-gaps as small as mechanical limitations will allow. Even in standard machines without commutating poles the air-gap is usually made as small as possible, armature m. m. f. being rendered of small importance by using a minimum number of armature turns and a maximum field strength, in order to obtain the required e. m. f. Many of the early generators, however, were built with very large air-gaps in order to prevent sparking at excessive overload.

I have a clock and some recording gear actuated by electro-magnets in a permanently air-sealed housing or box. The mechanism is assembled on its containing base and the cover is secured on the base, rubber gasketted, in a heated chamber in partial vacuum in an effort to preclude rusting of steel gear and other parts. The pinions and bearings will receive a slight coat of sperm oil. The apparatus will be mounted out of doors on a column and will be subject to the extremes of our climate, and it is my desire to keep it sealed and undisturbed for a number of years, granting the only breakdown factor to be that of frictional wear. As a further preventative, I contemplated inserting a small quantity of some salt or calcium carbide, etc., as an absorbent; but am afraid of disintegration, due to deliquescence, etc. What compound should I use?
A. A. I. E. E.

It would appear that having taken the precaution to make the case air tight, it might be filled with some inert gas. However, slacked lime, powdered carbon, alcohol, and many other substances have quite an affinity for water and any of these might be introduced into the case for the purpose of keeping moisture away from the mechanism. With the steel parts oiled and in a dry atmosphere it is not likely that they will rust. If oiling of the steel parts is not desirable try the plan suggested in the answer to J. K. in the December number.

In a ¼-hp Emerson alternating-current motor there is a device that opens a circuit by centrifugal force when a certain speed has been reached. What is this for, and what happens when it works? In wiring single-phase watt-hour meters, the potential leads have to be reversed sometimes to get the movement in the right direction, and this is also necessary in polyphase meters, which will either run wrong or not at all if the potential leads are reversed. Please explain why this is so.
T. F. E.

The motor, which is a single-phase machine, is brought up to speed by means of starting coils in the field winding. The current in the starting and running coils are out of phase with each other, so that the result is a sort of rotating field and the rotor is dragged around with accelerating velocity until it attains normal speed, when the centrifugal force acts to cut out the starting coils. A single-phase motor is not ordinarily self-starting, so that the starting coils convert it for the time being into a two-phase motor. The torque exerted in the meter is proportional to the product of the instantaneous values of current and potential. The shunt-connected coil produces a flux causing eddy currents to exist in the disk and the series-connected coil produces a flux in such a position that a driving torque results at the disc. If, therefore, the potential leads are reversed the time-direction of the eddy currents is reversed and the torque is reversed so that the meter disc revolves in the opposite direction.

How may gas leakage be easily detected? We have lately had a number of explosions in our manholes, some of which have been quite violent, although no damage was done. This we attribute to illuminating gas. How can these explosions be prevented?
F. J. K.

The method employed by gas companies in testing for leaks is to drive a bar, or "needle," as it is technically termed, into the ground over the gas main and to follow this up with a series of holes until the flow of gas becomes free, when the tester knows he is near a leak. When the bar is withdrawn from the ground, a lighted match is applied to the hole. If the hole is near the leak, the gas will ignite, otherwise it will not. The gas mains may readily be located by electrical means; such as, for instance, by the use of the ohmmeter or by employing an exploring coil and a head telephone receiver. Natural ventilation of conduit systems and manholes will ordinarily prevent explosions. If, therefore, instead of sealing the manhole opening with an air and watertight cover, the cover is left loose with openings permitting of the free passage of air or gas, the gas will be diluted to such an extent as to render it harmless except where large volumes of gas find their way into the conduit system from bad leaks in the gas mains. A modification of the ventilating cover may be adopted in the shape of vent pipes at intervals along the street, which open into the manholes.

Kindly inform me how to measure a high resistance with a voltmeter. I also desire information on a generator giving an e. m. f. of 230 volts on the commutator side, and there are some taps taken from the back of the armature which, when used with either outside wire, permit 115 volts to be obtained.
H. G.

To measure resistance with a voltmeter two readings of the instrument are necessary, one with the instrument directly across the source of current, which should also be a source of constant e. m. f.; and the other, with the instrument in series with the unknown resistance across the same source of current. If E is the reading in the first case and E_x the reading in the second case, and if R is the resistance of the voltmeter and R_x the unknown resistance, then $E_x \div E = R \div (R + R_x)$ whence $R_x = R \times (E - E_x) \div E_x$. In the generator under question points in the armature winding 180 electrical degrees apart are tapped by conductors leading to collector rings. An impedance coil having an iron core is connected to the collector rings by means of brushes. The coil is of low resistance, but its counter e. m. f. of self-induction is so great that the alternating current supplied from the collector rings is of small value and very little energy is lost due to this current. A point midway between the terminals of this coil will normally be at a potential which is midway between those of the two brushes on the commutator. A wire may be connected to this point and the receivers connected between this wire and either of the mains, thus forming a three-wire system. Any excess of current on one side over that on the other will be carried by means of the neutral wire and the impedance coil, and will be properly distributed within the winding. While the impedance coil prevents an excessive alternating current, it permits a direct current to flow unretarded.

Suggestions for Obtaining a Motor Load.

By Norman G. Meade.

The promotion of the increased and more extensive use of electric energy for the operation of electric motors as a substitute for gas or steam engines and manual labor, is a subject of much importance to a central station management. It is a well recognized fact that the day load of a power plant, if inadequate, is not conducive to economy and that a concerted movement on the part of the central station management to increase the motor load is a means of increasing the operating efficiency.

How best to secure this desirable business is a matter that should have mature consideration. A careful analysis of local conditions should be undertaken, the various business enterprises classified and a study of the need of each class made, not only as to the advantages that would be gained by the use of electric motors, but also as to the equipment that should be recommended.

In a general way, the same argument can be advanced in favor of electric drive for all purposes; that is, it eliminates belting and shafting to a large extent, reduces friction losses and increases production because of uniform speed and ease of control. These arguments while true are more or less stereotyped and the prospective customer will generally ask what specific advantages would be secured in his particular line of business should he adopt electric drive. The solicitor should give such information without first being questioned, as nothing impresses a business man more than the realization that the person addressing him understands what he is talking about and is able to state his case briefly and concisely.

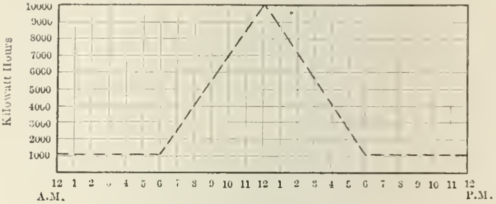
Another desirable class of customers for the central station solicitation is manufacturing companies who operate their own power plants. A small isolated plant cannot generate electricity at as low a cost per kw-hour as the management of a large, highly-efficient station can afford to sell it. When it is considered that one of the largest and most efficient power stations in this country, rated at thousands of horse-power and equipped with practically every economical device known to science, only returns a small percentage of the heat units contained in the coal, to the bus-bars in the form of electrical energy, it can be easily imagined how extremely low must be the efficiency of a small plant with a rated output of a few hundred horse-power. When a manufacturer is approached he will perhaps be skeptical as to the truth of such statements and will generally say that his average fuel bill is a certain amount and help and supplies cost so much, etc. Dividing the total amount by the average consumption in kw-hours, he obtains an attractive showing. Much, however, he has not taken into consideration, such as interest on the investment, rental value of the space occupied by the power plant, depreciation, etc. A conservative estimate of the average life of the equipment of a power plant in 20 years, including boilers, engines, condensing plant, generators, switchboard, auxiliaries, etc. For example, let the value of the complete power plant be placed at $5,000, then the annual depreciation would be $250. The interest on the investment at 5 per cent would be $250. This adds $500 to the manufacturer's figures, not including repairs, rental value, and incidentals. Let the manufacturer again figure his cost on the new basis and the rate per kw-hour will be entirely different.

These arguments are based on the assumption that the central station management is willing to make attractive rates. It may be well to analyze the cycle of operations in a station for 24 hours to see where the general operating efficiency is greatly impaired by a small day load. If a station is intelligently managed, the average cost per kw-hour to generate electricity should be known. Tests to determine such costs are generally based upon average output, and do not take into consideration the peak loads and the light loads. The operating expense with the exception of fuel and possibly one or two attendants is approximately as great during lightly loaded periods as during the peak load. In calculating the actual net profit per kw-hour this should be considered, and should also enter in the fixing of motor rates.

For example, assume that a power station has a rated output of 10,000 kilowatts at peak load. Assume that the total valuation of the equipment is $1,000,000, then the assumed operating expenses, interest, depreciation and labor would be as follows:

Interest at 5 per cent	$50,000.00	per annum
Depreciation on a twenty-year basis	50,000.00	" "
Salary for one engineer, three shifts	4,000.00	" "
Salary for three oilers, three shifts	4,320.00	" "
Salary for five firemen, three shifts	9,000.00	" "
Total	$117,320.00	

This, in round numbers, is approximately $135 per hour for 365 days in the year. Consider this station as carrying a lighting load chiefly and that the accompanying curve represents the average daily load, showing a consumption of 60,000 kw-hours for 12 hours during the peak load and 12,000 kw-hours during the 12 hours of light load, or a total of 72,000 kw-hours per day, which at a rate of 6 cents per kw-hour would amount to $4,320 per day, or $180 per hour. Allowing 1 cent per kw-hour for fuel and incidentals, this amounts to $720 per day or $30 per hour, which, added to $135, equals $165, the average cost of generating electricity per hour, leaving a net profit of $15 per hour.



CURVE OF DAILY LOAD AT STATION.

For the lightly loaded hours it will be observed that there is a load of only 12,000 kw-hours, yielding a gross income of but $30 an hour. Considering these 12 hours alone there is a net loss per hour of $135 corresponding to interest, depreciation, labor, etc., plus $5 for one hour's fuel and incidentals, or $140, from which is deducted the gross income per hour, $30, leaving $110. At the rate of 2 cents per kw-hour, a motor load of a little over 6000 kw-hours per day would pay all expenses during the lightly loaded hours. This, of course, would greatly increase the net profits during the peak load. While this business is being developed, the low rate could be maintained at some sacrifice to the total net profits, but the ultimate outcome would more than repay the losses suffered during the new motor load campaign.

The foregoing figures are assumed, but serve to illustrate that motor business taken at a very low rate is profitable if enough of it is secured.

Large motor manufacturers are now co-operating with many central stations to aid them in increasing their motor load. Several large motor manufacturers are conducting a resale department by which they endeavor to enter into contract with manufacturers of various appliances which may be adapted to motor drive, to use their make of motors whenever there is a demand for a motor-driven appliance and at the same time the motor company aids the manufacturer by advertising his appliance in connection with the latter's motors. The central station management can help the motor manufacturer by instructing its solicitors to watch closely for extensions in existing manufacturing plants or buildings, ascertain, if possible, what machines or appliances are to be installed, and then to notify the motor manufacturer.

Assume that an elevator is to be installed in a new apartment house. The motor manufacturing company will then communicate with some elevator company with whom it has a contract and the latter's representative will endeavor to secure the contract. The solicitor for the central station will, in the meantime, talk to the owner of the building regarding the advantages of electric-drive elevators and also follow up the elevator salesman, if he is successful, to close the contract. In this way three companies co-operate to install a motor-driven elevator.

It is always advisable to use high-grade motors only, because they give better satisfaction, and one satisfied customer is worth a dozen who are dissatisfied. Further, in many respects it is desirable to use motors of one make, as better deliveries are generally secured and better prices. It is always advantageous to carry a stock of motors, as the ability to install a motor at short notice is often the means of securing a new customer. Many times there will be a telephone call, and some manufacturer will ask how soon a motor can be set up and connected, as his gas or steam engine has broken down and the plant is idle in consequence. If the station manager is able to reply that the motor will be delivered as soon as a wagon can be procured, the chances are that when once in operation it will never be taken out again. Many customers are lost by poor deliveries, and to be able to say "we can place a motor at once" is a great aid to securing new business.

Business men and manufacturers should not only be looked upon as prospective customers. The housewife is invariably ready to look at popular motor applications, and is frequently susceptible to the station man's argument, especially when she is told that a large washing can be done in a very short time, without her turning the machine, at little cost and that a small motor attached to a sewing machine will run it at her convenience without manual effort.

A well equipped show room near the central part of the city, where motors and popular applications of electricity can be shown to advantage, is especially recommended. This display can, of course, be supplemented by heating and cooking appliances and various lighting fixtures.

The exhibit of popular motor applications should be as varied as possible, so as to interest a large number of people. Manufacturers of different classes of machines will often gladly cooperate with light and power companies in such an exhibit, by loaning machines for a short time at least. The majority of the business secured through the agency of exhibitions is the addition of motor and heating appliances for household and business use. The attendant draws a lady's attention to an ironing machine, and explains that a week's ironing can be completed in one-fourth of the time ordinarily required, and at a cost far less than the pay of a laundress for a similar amount of work, and that all this can be done by simply feeding the clothes in the machine. Further, all that is necessary to connect the machine is to screw an ordinary attachment plug in a lamp socket. The ease of installation, without additional wiring, is a point that always appeals to the interested person. Then there is the electrically operated carpet sweeper, the household refrigerating machines, the vacuum cleaning outfit, etc.

Successful campaigns have been conducted in several cities somewhat in the following manner:

An advertisement would appear in the daily and Sunday papers for several days reading somewhat as follows:

"Save time, strength, money, by using modern electrically driven labor-saving appliances. The Citizens' Light, Heat & Power Company requests your presence at its display rooms, No —— —— Street, Saturday afternoon and evening, Jan. ——, 19——, from 2 until 10:30 p. m. A luncheon will be served, cooked entirely by electricity, and a demonstration of many interesting electrically driven labor-saving appliances for household and other purposes will be given." As printed, the matter, of course, is in display type.

This advertisement would possibly be supplemented by neatly printed invitations mailed to a list of names selected from the city directory.

Such advertising generally brings a large attendance. After partaking of a light luncheon and inspecting the cooking and heating utensils, the visitors are shown the various motor applications, which should be in practical operation, and the advantages explained by courteous and well informed attendants. Attractively executed literature written in a popular style is distributed and everybody is invited to call again.

These little informal receptions often elicit inquiries from manufacturers concerning the merits of electric drive, which lead ultimately to signed contracts. There should, in consequence, be in attendance some representative, well informed on the merits of motor drive, to answer such questions. The exhibition brings the people into closer touch with the central station owners and creates a friendly feeling.

A word as to the personnel of the new business getting department. Men of education and address, preferably those with engineering training and experience in the electrical business should be employed at good salaries, as two or three high-priced men are worth a dozen cheap men. As a further stimulus to activity on the part of the employees, it is good policy to give an additional commission on business exceeding a predetermined amount. The commission system alone does not attract high-grade men as they are nearly always employed at a remunerative salary. Young ladies are frequently very successful in a house-to-house canvass and are often admitted where a man could not secure an interview. In making calls in the residence section, it is always well to have the name of the person one desires to see so as to able to call for him or her and present one's business card. The card should be neat and plain, as a loud or gaudy one presented to a person of refinement will often create a prejudice at the start and seriously impair the prospects for new business.

Upon being admitted the solicitor should state that the call was for the purpose of explaining the workings and advantages of some very useful motor applications for household use.

Business from manufacturing and business concerns should be solicited by attacking the proposition from the manufacturer's standpoint. The manufacturer of mechanical appliances does not care to hear a dissertation of the wonders of electricity and will, undoubtedly, give the solicitor a cold reception unless he is interested at the start by some statement concerning his business. When admitted to the office of the manager or superintendent the solicitor should explain his business and ask if his hearer would be interested in a proposition that would increase the output of his shops without increasing his operating expenses. If so, the solicitor should explain how this might be done by the use of electric motors. If the manufacturer is willing, the solicitor might go through part of his shops, call attention to a belt-driven lathe, for example, and state that by mounting a variable-speed motor directly on the machine the operator will have about five times the increments of speed and that the machine can be started, stopped, reversed and the speed controlled by a handle, conveniently mounted on the tool carriage, without the necessity of leaving the work. The solicitor should call attention to the saving in time required to shift belts and how a wide choice of speeds enables the operator to select one best suited to his work. He should explain that by the use of direct drive shafting and belting are unnecessary, friction losses are eliminated, electrical energy is consumed only when the machines are in operation, etc., etc. By bringing out as many points as possible, the solicitor will at least start the manufacturer thinking, which thinking will in time generally bear fruit.

The value of publicity work cannot be overestimated as the layman and business men in pursuits other than the electrical business do not ordinarily read the electrical papers and are generally ignorant of the progress made from time to time.

Judicious newspaper advertising calling attention to new devices is always worthy of consideration, and is to be recommended. The evening and Sunday papers are the best mediums, as business men and the ladies of the house do not, as a rule, spend enough time reading morning papers to take particular notice of advertisements.

Neat folders mailed with monthly statements frequently arouse interest in some new appliance and lead to an additional load on the house or store circuit. A monthly house organ is oftentimes useful for calling attention to improved devices and keeping the central station in the public eye.

Selling Electrical Energy.

By A. H. Keleher.

As the central station solicitor is the go-between for the central station company and the public, he should be neat in his appearance and be polite in his intercourse with the customer, if the latter is to receive a good impression of the company. Politeness and neatness should be insisted upon. The solicitor can be helpful to the customer in giving him the advantage of his experience in the lighting field, and he is often called upon to advise upon the style of illumination. Therefore, it is advisable for him to be able to discuss the various modern lighting systems and be able to give estimates of the initial and operating cost.

Many letters from customers come to the office of a company daily. Such of these as can be attended to by the solicitor should be turned over to him for action. It will be helpful for him to make a brief note of the contents of each letter, memorandum or postal on a slip of paper, a convenient size being 2½ in. x 5 in. At the top of the slip the address of the customer should be placed, immediately under it being the name. Before starting out each day these slips can be arranged in order, so that the calls can be made by going from one end to the other of the district. Whatever action is taken by the solicitor can be briefly noted on the slip, and can be recorded on his return to the office to report on the business of the day. It is important that the solicitor be out in his district getting business as long as possible each day. About two hours in the office and five in the district is a good division for a seven-hour day. Each solicitor should telephone to the office in the middle of each day, so that the manager may assign to him particularly urgent business in his district. After a little experience the agent will be able to conduct his business with the customer in a very short time, and will not forget some important detail which will necessitate a second visit. In this connection, special care should be taken to secure a correct signature to the contract. If the name of a firm is signed, there should also be added the name and position of the person signing for the firm. Any changes in the ordinary printed contract or any modifying clauses or riders attached thereto should be initialed by the customer.

Contracts are not usually binding upon the central station until accepted by the authorized officer, who is governed by the credit of the customer, the obligation (legal) of the company to furnish energy, and the cost of introducing service into the premises. During the solicitor's visit to the customer's house he will learn whether it is necessary to install a tap from the company's mains. It is next necessary to ascertain whether an extension of the company's existing lines is necessary. For this purpose use can be made of a map showing the streets of the company's territory, with lines drawn in ink showing the mains; if kept up to date by occasional additions, the map will give good satisfaction. After the acceptance of a contract the case should be again placed in the agent's hand. He then orders the service tap installed, if one is required, and arranges for the installation of the meter when the wiring is nearing completion.

Great care should be exercised in selecting a meter of the proper size, as any mistake is sure to react upon the agent and greatly impair his usefulness to the company. Meters should be set in a dry place, easily accessible for testing and reading. In general they should be placed about 8 ft. from the floor, with a clearance of 15 ins. from the center of the meter to any iron construction. The indication of meters set in the vicinity of large masses of iron is utterly unreliable on account of the distortion of the magnetic field. Vibration is equally reprehensible on account of the tendency of the meter to creep. This creeping in some cases increases the cusomer's bills greatly. The standard size for meter boards for Thomson watt-hour meters is 12 in. x 14 in. In selecting the proper sized meter, the following approximate figures, and facts concerning standard illuminants, may be made use of:

It may be assumed that a good meter will, for a short period, withstand a 100 per cent overload. Therefore it is safe in metering the load in detached houses and residences, to use a meter rated box for 50 per cent of the lamps. In places of this kind, very rarely if ever are all the lamps used at the same time. In business houses and apartments the estimate should be 75 per cent. In stores and show-windows, where all of the lamps are used at once, the estimate should be 100 per cent. No fixed rule can be adopted, it being necessary for the agent in many cases to use his judgment, founded upon actual experience. In a three-wire, direct-current system, three-wire meters should be used for 120-volt work except for particularly large installations, where it might be advisable to use two two-wire meters. The meters for a 240-volt motor service should be selected on the basis of three amperes per rated horse-power output. In calculating the number of amperes per lamp on 120-volt lighting circuits, ½ ampere for each 16-cp carbon or graphitized filament lamp may be taken as the proper value. The tantalum 50-watt lamp also takes ½ ampere. The specific consumption of lamps are about as follows: Ordinary 16-cp carbon lamp, 3.2 watts per candle-power; Gem graphitized filament lamp, 2.5 watts per candle-power, tantalum, 1.25 watts per candle-power; and tungsten, 1 watt per candle-power. A safe value for the Nernst lamp is ¾ amp. per glower for the 240-volt lamp. Each glower in a Nernst lamp gives 100 candle-power at a consumption of 88 watts. Nernst lamps for direct-current service are not yet commercially available for 120-volt systems.

A card index system for each central office, showing the progress made on each application for electricity, will be found useful for the immediate information of the solicitors, and for answering queries of the customers as to what has been done concerning their demand for electrical energy. These cards, one lamp and one motor card for each customer, should contain the following data: Name and address of customer, date of receipt of contract, date inspector notified, date accepted, "Service Ordered" (date), "Meter Ordered" (date), and "Connection Ordered" (date), with "Connection Made" and "Installation Connected" (date). On the back of the card may be entered the date of receipt of the City Certificate and the Board of Fire Underwriters' Certificate, which are required before connection can be ordered by the agent.

The use of the follow-up system and an occasional canvass of "Unused Services" will result in new business. Also keeping on good terms with the wiring contractors and getting the names of prospective customers from them will bring about good results. The importance of obtaining sign business cannot be overestimated, on account of the advertising value to the company.

A House Without a Chimney.

Mr. F. M. Sinsabaugh, secretary and manager of the Carrollton Heat, Light & Power Company, of Carrollton, Ill., has just moved into a new house, which is entirely without a chimney or provision for any kind of fire in the house. Mr. Sinsabaugh is getting heat for warming the house from the company's steam-heating system. Cooking is all done by electricity.

The building of this new house without the chimney marks the beginning of an effort at Carrollton to obtain electric cooking customers. The rates for this business will be five cents per kw-hour. The picture of the exterior of this house without a chimney is reproduced herewith by the courtesy of Mr. Sinsabaugh.

The following quotation from a local Carrollton paper illustrates some of the publicity which the electric service is obtaining by virtue of Mr. Sinsabaugh's unusual house:

"A comfortable, wholly modern residence has been erected in Carrollton without so much as the sign of a chimney, either in or upon it. This is no smoke-consuming joke. The chimneyless house is a fact, but, so far as we can ascertain, it is the only one of its kind in the State of Illinois. F. M. Sinsabaugh is the man who thought he would like to live in a house without a flue. The idea was not entirely original, for many another man has hopelessly longed for the same thing while putting up the sitting room stove. But the other fellows were not so well fixed to put their wish into execution; Mr. Sinsabaugh is manager of the Carrollton Heat, Light & Power Company. The house will be heated by steam from the company's plant—as are many of the business houses on the square—and the cooking will be done exclusively by electricity. The house combines more features of the twentieth century home than perhaps any other in Greene County. Its cost will be about $3.500. Mr. Sinsabaugh has expressed, in a practical way, his own faith in the ability of the plant to keep his household comfortable and cook his meals. To build a chimney-less house is the strongest possible expression of confidence."

CHIMNEYLESS HOUSE AT CARROLLTON, ILL.

New Business Campaign in Bayonne, N. J.

By William H. Stuart.

Bayonne, N. J., a city of some 35,000 inhabitants, is changing from an exclusive suburban town for busy New Yorkers to a city of large manufacturing interests. Being within 20 minutes of New York City, and being surrounded on three sides by the water of New York Bay, Newark Bay and Kill Von Kull River, large industrial interests were quick to see the advantages of Bayonne as a manufacturing center.

The first electric lighting done in Bayonne was in the residential districts. The old Jersey City Electric Light Company was given the right to erect its pole lines and furnish energy in Bayonne in the eighties. Business then was looked after by a solicitor sent from Jersey City. In a short time an agent was sent to Bayonne and an office established, where the few electric appliances of those days were kept on exhibition. Small circulars were occasionally distributed with the monthly bills. These as a rule were not illustrated, but contained notices of the cost of electricity, an enumeration of its advantages and generally some suggestions as to how it could be used.

In Bayonne there are two principal streets, one a business street called Broadway, and the other a residential thoroughfare called Avenue C. It was on these two streets that the greatest amount of business was obtained at first. Bergen Point, the terminal of the trolley lines, is a favorite amusement resort in summer, where swings, photograph galleries, pop-corn stalls, little five-cent shows, etc., abound. There are also five or six large hotels where shore dinners are served. These all use electricity. The hotels extend out over the water, and around the outer edge colored incandescent lamps are arranged, which at night give a very pretty and attractive appearance to the places

A few years ago a force of six men under the direction of a contract agent went through Bayonne and secured information concerning every house in the city. This information was placed on cards and filed at the office. All reports showing the necessity of a prompt return call were set aside and the matter given immediate attention. After this canvass a systematic record was kept of the territory. The cards upon which the original information obtained was placed contained the street and number, occupant's name, name of owner of property, the illuminant used, reasons for not using electricity, what kind of sign or outside lighting, if any, and notes as to whether electric signs or arcs could be used. On the reverse side of the card a space was allotted to the wants of the prospective customer. This canvass brought good results in that it reached a great many places that had not been touched in the regular work.

About the time this canvass was completed and placed on record, Bayonne's industries started to grow. Along the water front, factories ranging in size from the immense Standard Oil plant to a small machine shop have taken the place of the country houses. The new business methods of the Public Service Corporation, which now supplies Bayonne with electricity, have kept pace with the various changes which have occurred from time to time.

Speaking of what has been accomplished, the methods employed and the many obstacles encountered in building up the electrical business in Bayonne, Mr. Charles H. Randall, the agent, said: "In early days we had considerable trouble in convincing people of Bayonne of the uses of electricity and offsetting the feeling of costliness associated with it. Most of our business consisted of residence lighting, although we supplied a great many of the stores with electricity also. We have advertised consistently. Our monthly bulletin, *Light and Power*, is mailed to all interested in electricity. This bulletin contains quite a number of cuts and short notices of various installations which show just what is being done. The bulletin has been favorably commented upon by a great many of our customers. Each month we have printed on the back of our bills some interesting facts which are oftentimes illustrated and are always in season. During the summer, blower fans, etc., would be talked about, and in the fall and winter electric lamps, etc., would receive attention. Every now and then pasters are attached to the bills. These are used for the purpose of directing the consumer's attention to something special—something that would be of advantage to him, such as emphasizing the necessity of renewing dim lamps. We have placed a great many flatirons out on trial and we have been successful in selling a great majority of them. We have found that a trial absolutely convinces where a talk might sometimes be doubtful. We furnish electric signs of the panel type free of charge and have quite a number throughout the city. In our office we have a complete line of heating and cooking devices which are sold at cost. These are arranged for easy demonstration and as our office is close to the center of the city we have quite a number of inquiries concerning them.

"A few years ago the character of our business began to change. The large industries coming to Bayonne brought with them numerous workmen, so that where we formerly had a few large stores catering to the wants of the people we now have a great many small ones scattered throughout the city. The owners of small stores were at first a little afraid of installing electric lamps, but after one or two had started, it was not long before the majority were using electricity. The factories had to have both lamps and motors and we were kept busy for a time meeting this new demand. We have been favored with a large share of this business. Combined with our show or summer amusement load this gives us a very even load throughout the year. During the winter months the numerous amusements at Bergen Point are closed and the factories use considerable energy. During the summer months the factory load is quite light and the amusement load heavy During the past year we have equipped two new theaters with some 3500 lamps and an amusement park with about 40,000 lamps. All of these installations we consider very good advertising for electricity.

"In our search for new business we have encountered many hard problems which had to be overcome, such as asking for the business of a large industry operating about 18 to 20 hours every day. Satisfactory arrangements have been made whereby we have secured the business. Bayonne as a manufacturing city has only started to grow. We are aware of this fact and are on the growing move ourselves."

The present methods of obtaining new business are proving entirely satisfactory. Additional lighting is solicited by one man, and the motor load is looked after by an expert power solicitor. These men canvass the city thoroughly, keeping a record of the business on a card. The latter is kept up to date and is used for reference. The architects are visited frequently and are in thorough accord with the company. A special effort is made to render every aid that an architect may require. There have been one or two cases where electrical points have arisen when the architect was engaged in the preparation of plans, on which the company rendered assistance. New building contracts and real estate matters published in the news papers are closely followed up, and much business has been secured by this means.

Sign Lighting in Scranton, Pa.

As is probably well known, the electric lighting plants in Scranton, Pa., formerly controlled by the Electric Company of America, have recently been acquired by the American Gas & Electric Company, of which Mr. Henry L. Doherty is president. Early in February, 1907, the new management inaugurated a sign campaign, and as a result of this campaign, 240 customers were connected to the sign and outlining display midnight service. The accompanying illustration shows the sign lighting on Lackawanna Avenue, one of the principal thoroughfares of Scranton. Some of the department stores on this avenue have for many years kept their windows lighted at night, but the number of signs on this avenue was until recently very small. Scranton is a very busy city, in the heart of the anthracite coal region, and the results obtained by the Scranton Electric Company in its sign campaign shows how readily electric signs may be connected to the lighting circuits when their advantages are properly presented. Despite its size, Scranton is not a very rich city, the wealth per capita probably being smaller than that of many other cities of its size.

NIGHT VIEW OF A SCRANTON STREET.

Janesville Electric Company Offices at Night.

By the courtesy of Mr. P. H. Korst, manager of the Janesville Electric Company, Janesville, Wis., we are enabled to reproduce the accompanying striking illustration showing the appearance at night of one side of the building which houses the offices of the Janesville Electric Company. This building adjoins the Rock River, from which the company gets part of its power, and the illuminated sign which has been painted on the side of the building is on the side next to the river, so that it is in a very conspicuous place. The offices front on the main street, and everyone crossing the bridge going toward the offices cannot fail to see the illuminated sign. The location of the sign makes especially appropriate the phrase, "The Power of Rock River at Rock Bottom Price."

ILLUMINATED SIGN, JANESVILLE, WIS.

LETTER TO THE EDITORS.

Cords and Chains for Electric Light Fixtures.

To the Editors of Electrical World:

Sirs:—It has frequently been said by those interested in electric lighting that electric fixture designs have followed too closely the lines of gas fixtures. There is undoubtedly much truth in this assertion. Because a gas fixture needs a pipe to convey gas to its burners is no reason why the electric man should persistently use a rigid pipe for his fixtures also. In the abolishment of the conventional gas fixture idea, electric fixture designers will have the hearty support of architects, who are apt to consider the lighting fixture as somewhat of a nuisance. To these, electric lighting should appeal particularly for the reason that it offers the opportunity of doing away with fixtures altogether by placing lamps in recesses with suitable reflectors behind them or the use of unobtrusive hemispheres. This applies mainly, however, to the more expensive work. For cheap, every-day installations, more extensive use of cords and chains can be made with advantage than has been common practice in the past. Unfortunately, the plain drop cord has received the stamp of cheapness and inelegance, largely because of the cheap, quickly fading cord that has commonly been used and the way it has been used. Certainly, some of the round silk-covered cord now easily obtainable in the open market is no more unsightly than the brass rods which it might in many cases supplant. There is no reason why it should not be more generally used to support light lamp fixtures of most artistic design. For heavier fixtures which it is not permissible to hang from cords, the chain pendant offers a cheap, artistic and substantial solution.

Both chain pendant and drop cord offer a better mechanical construction in many places than a fixture with a rigid stem. Very few fixtures remain in use many years without becoming more or less loose at the ceiling. They are exceedingly likely to get out of plumb, and are frequently pulled one way or the other by having extension plugs and cords attached to them. The flexible suspension, which keeps itself in plumb and yields to accidental blows instead of breaking, is much more desirable than a rigid stem. At the present time, it is by no means necessary, for artistic reasons, for a prospective electric light customer to spend an enormous amount of money in fixtures. In fact, it is possible to do a large amount of high-grade work with a very small fixture bill. The old idea of fixtures with a large number of arms, each carrying a small lamp, is rapidly disappearing, except for the comparatively few locations where the decorative effect of a large number of small lamps is wanted. A fixture with several arms also finds a very useful place in rooms where the difference of requirements at different times makes several sockets necessary. But for most purposes of general illumination, the simple fixture with a few lamps, or with possibly but one, and of high candle-power is taking the place of the fixture with the centipedal effect and here is where the cord and chain are suitable.

NEW YORK. CHAS. T. ALTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Direct-Current Machines.—T. ROSSKOPF.—A mathematical article on the best utilization of the armature of a direct-current machine. In the choice of the magnetic flux density and electric current density one is limited by commutation and heating. The limitation as to commutation has now been practically removed by the use of interpoles. The author, therefore, considers only the limitation due to heating. The degree of utilizing the armature is defined as the value $\frac{D^2ln}{P}$ where D is the armature diameter, l the "ideal" armature length, n the speed and P the power in kilowatts. This value is called the "dimension constant." The author first considers the case of an armature with very large diameter and gives formulas for calculating the most economical value of amperes per square centimeter, etc. From a numerical example he finds agreement between his formulas and best modern practice. In the second part of the article the case of an armature with a smaller diameter is discussed and illustrated by a numerical example.—*Elek. und Masch.*, Jan. 5.

Ball Bearings for Electric Motors.—An article in which the advantages of the use of ball bearings on electric motors are discussed under the following headings: Decreased length of machine, no wear on bearings, no oil in bearings, less starting resistance, and increased efficiency. As disadvantages, the writer mentions increased cost and the fact that the ordinary ball bearings will not take up end thrust. Of the different kinds of ball bearings those in which the balls are kept apart by being placed in a thin ring or cage with holes to suit the size and number of balls, is considered to be the best one. The mechanical construction where ball bearings are used on motors are described and illustrated.—Lond. *Elec. Review*, Jan. 10.

Coil-Winding Machine.—An illustrated description of a coil-winding machine devised by W. Cramp, and intended to dispense with the large number of formers now necessary for winding small coils. Being adjustable in all its dimensions, independently of one another, it enables almost any size or shape of hexagonal coil to be wound for a range of machines from ¼ kilowatt upwards to 15 kilowatts.—Lond. *Electrical Engineer*, Dec. 20.

Winding Devices.—A brief illustrated description of various devices which have been developed in the winding room of the shops of the West Penn Railways for decreasing the cost of armature and field coils. Among the devices are a hot-coil press, coil clamp, insulation cabinet, commutator slotter, field-coil tester, and a baking oven.—*St. R'y Jour.*, Jan. 10.

Lamps and Lighting.

Photometry.—The very long committee report presented to the American Gas Institute at the last Washington meeting on methods of measuring the candle-power of gas lamps is printed in full. It is urged that there should be a national, or, even better, an international unit of intensity of light. The Bureau of Standards could then furnish to the testing laboratories throughout the United States electric incandescent lamps certified to concerning their value in terms of the unit agreed upon. At present the electrical people and the gas people use differ- unit of candle-power equals 100 ÷ 88 of the hefner unit under Reichsanstalt standard condition for the hefner." On the other hand, the International Incandescent Photometric Commission appointed at the time of the World's Fair, at Paris, met in Zürich in 1903, and formulated plans for a separate determina- ent units. The American Institute of Electrical Engineers has the following rule: "The luminous intensity of sources of light is expressed in candle-power. The unit of candle-power should be derived from the standard maintained at the National Bureau of Standards, at Washington, D. C., which standard tion in England, France and Germany of the ratios existing between the Hefner, the Carcel and the Harcourt pentane lamp. At their meeting in 1907 the ratio of the intensity of the Hefner lamp to that of the Harcourt was declared to be, Harcourt pentane = 10.95 hefners. The English Institute of Gas Engineers and the English Engineering Standards Committee declare that the English candle equals one-tenth of the Harcourt pentane lamp, or 1.095 hefner. The American Institute of Electrical Engineers have adopted the German relation of the hefner to the candle in which the candle equals 1.14 hefner. In other words, the unit of light adopted by the American Institute of Electrical Engineers is 4.1 per cent greater than the unit of light adopted by the English Institute of Gas Engineers. In the long discussion which followed, Dr. Hyde referred to this discrepancy in the definition of candle. Both of the different candles purport to be English Parliamentary candles. He made a suggestion that "if the gas industry is willing to come up about 2 per cent in their candle, and the electrical industry is willing to drop about 2 per cent in theirs, we will meet on a common ground."—*Progressive Age*, Jan. 1.

Arc-Lamp Photometry.—An illustrated description of the photometer equipment of a large arc-lamp factory in Germany. There are two rooms, one with black walls and the other with white walls. In the former the candle-power is determined and polar curves are plotted. Three photometers are used, a "polar mirror photometer," a "diagonal photometer," and the Ulbricht spherical photometer. Current and voltage curves with alternating current are determined by oscillographic means. In the same room the color differences of different lamps are determined by a spectrometric method. In the other room, with white walls, the illumination at different points of the floor with direct and indirect illumination is determined.—*Elek. Zeit.*, Jan. 2.

Direct and Indirect Illumination.—An article in which it is pointed out that while in certain cases indirect illumination is of great value, as in draughting rooms, reception rooms and schools, it is not necessary in by far the most cases, and is not to be recommended as it is quite an expensive method. An analysis of the losses in indirect illumination is given.—*Zeit. f. Beleucht.*, Dec. 30.

Power.

Electric Energy Supply—W. B. WOODHOUSE.—A paper read before the Leeds section of the (British) Institution of Electrical Engineers on the commercial aspect of electric energy supply. The author deals with the advantages of centralization of electric supply and gives figures showing the saving in capital expenditure and works cost by such centralization. He also discusses the production of electric energy by utilizing the gases from blast furnaces, coke ovens, etc., and shows the need of co-operation of the users of waste heat, the motor users and the supply companies. Concerning equalizing the station load by employing at times of low load the energy for electrochemical purposes, he mentions that he has recently arranged an agreement on such lines for a British supply company with a company making calcium carbide in an electric furnace. "The improved conditions under which the station will operate should show a considerable decrease in the average cost of production."—Lond. *Elec.*, Dec. 27.

Steam-Pipe Systems for Generating Stations.—J. H. RIDER.—

A long illustrated article in which the author emphasizes that a properly designed and constructed steam-pipe system is not only perfectly safe, but will give no trouble in working. Simplicity, however, is the keynote of success. The main principles underlying a good steam-pipe system are as follows: The pipes should be as short and as few as possible. The failure of any pipe should affect only one engine or one boiler (or group of boilers). The pipes should be as small in diameter as possible, to reduce the radiation losses. The pipes should be large enough to keep at minimum the fall of pressure between the boilers and engines. The joints should be as few as possible. Proper provision must be made for water drainage, also for expansion and contraction, and for cutting off various sections in cases of emergency. These different principles are discussed in detail.—Lond. *Elec. Eng'ing*, Dec. 19.

Traction.

Single-Phase Road.—E. Engelmann.—An illustrated paper on the electric equipment of the Mariazell Railroad. On account of greatly increased traffic on this steam road it has become necessary either to build a second track, which would be too expensive on account of the great natural difficulties, or to increase the speed. An increase of speed would have been impossible with steam traction, and under these circumstances it has been decided to introduce electric traction. It is possible that the line will later on be carried further into Vienna. Comparisons were made between different electrical systems, and it was found that the watt-hour consumption on level road per ton kilometer varied between 31 and 40. Under the conditions of this road, the single-phase system was found to be the best one on account of low first cost and low cost of maintaining the single overhead wire. Further saving became possible by utilizing available waterfalls. There will be in the whole three stations, of which two are hydraulic, while a third one, which acts as reserve, and is in operation only for two or three months in the year, is operated by Diesel engines. The first development will be for 5000 hp, the transmission voltage 25,000 and the voltage on the trolley wire 6000. There will be used 17 four-axle electric double locomotives, each locomotive being equipped with two 200-hp single-phase motors, and two oil-transformers for reducing the voltage from 6000 to 150 or 300. All axles are driving axles. The weight of the completely equipped locomotives will be 30 tons.—*Elek. und Masch.*, Jan. 5.

Heavy Electric Locomotives.—B. Valatin.—An article on large electric locomotives for heavy service. The author gives a comparison of a 15-cycle single-phase locomotive and a 15-cycle three-phase locomotive in weight and performance. He claims that the weight of the three-phase locomotive is only one-half that of the single-phase locomotive. *St. R'y Jour.*, Jan. 4.

One Thousand Five Hundred-Volt Direct-Current Railway.—An illustrated description of the Bellinzona-Mesocco Railroad in the Misoxer Valley, in upper Italy, which has already been noticed in the Digest from a German source.—Lond. *Elec. Eng'ing*, Jan. 9.

One Thousand Two Hundred-Volt Direct-Current Line.—J. R. Hewett.—An illustrated description of the railway system now connecting Seymour and Sellersburg, Ind., a distance of 41 miles, but finally to extend from Louisville, Ky., to Indianapolis, Ind., the distance being 110 miles. The novel features of the 1200-volt direct-current apparatus are described in detail.—*St. R'y Jour.*, Jan. 4.

Surface-Contact System.—J. T. Morris.—An illustrated paper on the "G. B." (Griffiths-Bedell) surface-contact system which is to be used on an experimental section in London. The same system has been working satisfactorily for considerable time on a line about 3 miles in length in Lincoln. A magnetized skate, attached to the car by insulating bolts, slides over a series of iron studs in the roadway along the center of the track. The skate magnetizes the stud and actuates a switch connecting the stud to a live conductor beneath it, and thus energy is supplied to the car. Immediately the skate leaves the stud, the switch automatically opens. The skate employed in the G. B. system is flexible, and in consequence allows the studs to be level with the road surface. It is made up of iron links strung on a flexible cable and supported by vertical springs in a slot running along one pole of an electromagnet. Normally the skate is 2 ins. above the road surface, but any part that is over a stud is attracted down and makes contact with it. The magnet consists of two long poles, one above the other, connected by three yokes, on which the coils are wound. The skate is attached to the lower pole. The coils are supplied with energy from the underground conductor, and a battery is provided for use when the car is standing still. The construction of the stud is as follows: From the cast-iron plate in the surface two soft-iron prongs, or cheeks, project downwards. Between these the plunger or switch-piece is supported by a vertical spring. When the stud is magnetized, the plunger is forced out from between the cheeks and a carbon block at the lower end makes contact with the underground conductor. Electricity then flows from the conductor up through the plunger by flexible leads to the stud, and thus to the car. The spring is insulated and does not carry current. It is also heavily plated to protect it against rust. If ordinary rails were used at points and crossings, the skate would be atracted to the rail as well as to the studs, and would short-circuit the 500-volt supply system. To prevent this result manganese steel is used at such positions. This steel, which consists of 88 parts of iron and 12 parts of manganeee, is practically non-magnetic. Further protection is provided in a special kind of stud.—Lond. *Elec. Engineer*, Jan. 3.

Trolley-Wire Suspension.—A detailed illustrated description of the Pringle "tangential" trolley-wire suspension.—Lond *Electrical Eng'ing*, Jan. 9.

Gasoline-Electric Omnibus.—An illustrated description of the Hart-Durtnall gasoline-electric motor omnibus. It contains a gasoline engine and a three-phase generator with small exciter and an induction motor with squirrel-cage rotor. There is also a magnetic clutch by means of which at the highest speed the driving shaft is clutched solidly with the engine shaft. At lower speeds part of the power of the engine is transmitted mechanically by means of the clutch and part electrically.—Lond. *Elec. Engineering*, Jan. 3.

Installations, Systems and Appliances.

Protective Relays.—M. C. Rypinski.—The first part of an illustrated article on protective relays used in conjunction with automatic circuit-breakers for the protection of circuits from abnormal and dangerous conditions, such as overload, short-circuit, reversal of circuits, etc. After some general remarks, the author gives a classification of the standard types of protective relays, and then discusses briefly the protection of alternating-current circuits and more in detail direct-current over-voltage relays. The standard types of protective relays include direct-current over-voltage instantaneous, reverse-power instantaneous and inverse-time-element relays, alternating-current overload instantaneous, inverse-time-element and definite-time-limit relays, and alternating current overload and reverse-power inverse-time-element relays.—*Electric Journal*, January.

Wires, Wiring and Conduits.

Slide Rule.—An illustrated description of a new slide rule made by a British company for rapidly determining the sectional area of a cable for use under given conditions. "The instrument consists of a rectangular block of cardboard, on which move two vertical slides and two horizontal slides. The horizontal slides are divided in yards, volts and kilowatts, and the vertical slides in values of power factor and per cent of loss. The rest of the block is covered with a series of curves connecting load in kilowatts and loss per cent in volts, for sections of conductors up to 6.5 sq. ins. The slide rule is readily adapted for use with any system of supply, continuous current or alternating.—Lond. *Electrical Engineer*, Dec. 27.

Cable Making.—An illustrated description of various machines used in a British cable factory.—Lond. *Electrical Review*, Jan. 10.

Graded Cables.—A full account of the fundamental patents for "grading" cables. These are an Italian patent by Piralli &

Company, of 1900, and two British patents of M. O'Gorman, of 1901.—Lond. *Elec. Eng'ing,* Jan. 9.

Enamel Insulation.—A description of a new enamel insulation of British make for which many advantages are claimed. It is said to be flexible, tough and elastic, waterproof and a good insulator, unaffected by ordinary chemicals or exposure to air. Three coatings of enamel are used on ordinary wires which altogether add less than one-thousandth of an inch to the diameter of the bare wire, and it is said that finer coating for special purposes can be applied. A modification of this enamel insulation is used when it is intended to be oil-proof, but this is not as flexible.—Lond. *Electrical Engineer,* Dec. 20.

Electrophysics and Magnetism.

Temperature-Resistivity Coefficient of Alloys.—W. Guertler.—A long paper on the formulas of Matthiessen and Barus for the temperature-resistivity coefficient of metallic alloys. It is shown that the Matthiessen rule is the only general one, while that of Barus is valid only under special conditions.—*Phys. Zeitschrift,* Jan. 1.

Electrochemistry and Batteries.

Electro-Analysis.—F. Foerster.—A review of recent progress in electro-analysis, especially in the use of strong circulation of the electrolyte by means of rotating electrodes, etc. The author thinks that the time has come to work out with greater accuracy methods not using such circulation.—*Zeit. f. Elek.,* Jan. 3.

Units, Measurements and Instruments.

Voltmeter Compensation.—W. Nesbit.—An illustrated article in which the author describes the method of adjusting a voltmeter compensation for alternating-current feed circuits so that the station voltmeter will read directly the correct e. m. f. at the distant load. Fig. 1 is a diagram of the compensator. It shows secondary windings giving 24 resistance and 24 reactance volts compensation with 5 amperes in the circuit. *C* is a potential transformer delivering at its secondary an e. m. f. proportional to and in time-phase with the station e. m. f. *S* is a series transformer producing in its secondary circuit a current proportional to and in time-phase with the main-line current. *A* is a non-inductive resistor, and *B* is a reactance coil. *A* and *B* are connected in series, and through them passes the current from the secondary of *S*. The e. m. f. between the terminals of *A* is, therefore, always in time-phase with the back e. m. f. due to resistance of line, while that between the terminals of *B* is in time-phase with the back e. m. f. due to reactance on the line. *D* is a transformer connected in shunt to *A* and yielding at its secondary terminals an e. m. f. in time-phase with and proportional to that across *A*. *B* has a secondary winding on it, so that it fulfills the double function of a reactance coil and a transformer, thus insulating the voltmeter circuit from the feeder. Both *B* and *D* are provided with ten leads, which are carried out to switch contacts, permitting the resistance and reactance volts introduced into the voltmeter circuit to be varied at will. With the proper amount of resistance and reactance volts introduced into the voltmeter circuit, the desired result is obtained, since there is from *C* an e. m. f. proportional to and in time-phase with that of the generator, and from *D* and *B* e. m. f.'s in time-phase with and proportional to the back e. m. f.'s due to resistance and reactance of the feeder circuit. The e. m. f.'s from *D* and *B* diminish the e. m. f. from *C* in exactly the same way and by exactly the same percentage as the back e. m. f.'s in the main line diminish the voltage from the station. The voltmeter will, therefore, always give an indication proportional to the voltage delivered to the load. The switch levers should be set so that at the rated current of the series transformers, which is connected to the compensators, the resistor and reactance coil in the voltmeter circuit will be equivalent to those of the line. Since both the resistance and reactance voltage of the compensator is exactly proportional to the current (the same as in the line itself) the compensator, when set for the same resistance and reactance volts as that of the line at the rating of the compensator series transformer, will furnish the proper compensation under all conditions of load and power-factor. It is in general difficult to calculate the amount of resistance and reactance in the circuit for which the compensation is intended, but it is not difficult to adjust the compensator by trial. Telephonic communication should be established between the station and the point at which the voltage is to be kept constant. When the load having the highest power-factor is being carried by the feeder (this will usually be at maximum load), the station e. m. f. should be adjusted until the proper voltage is being delivered to the load. At this time the switches on the resistance and reactance sides of the compensator should be set on points which will give the same reading on the compensated voltmeter as does the voltmeter at the load, the switches on the resistance and reactance sides being set at similarly numbered points. This setting would then be correct for all loads if the power-factor did not change. The power-factor will probably decrease as the load becomes less, and if at loads of lower power-factor the compensating voltmeter indicates a higher voltage than that at the load, not enough reactance is in the voltmeter circuit, and, hence, it will be necessary to increase the reactance until the two voltmeters read alike. If at loads of less power-factor the compensating voltmeter indicates a lower voltage than that at the load, too much reactance is in the voltmeter circuit, and it will be necessary to cut some of it out until the two voltmeters read alike. The above adjustment should preferably be made at the maximum and minimum power-factors. A new comparison of the voltmeters is then again made at maximum power factor and if there is discrepancy, adjustment is made on the resistance side, and so on. It is sufficient to remember that all the adjustments should be made on the resistance side for high power-factors and all the adjustments on the reactance side for low power factors.—*Electric Journal,* January.

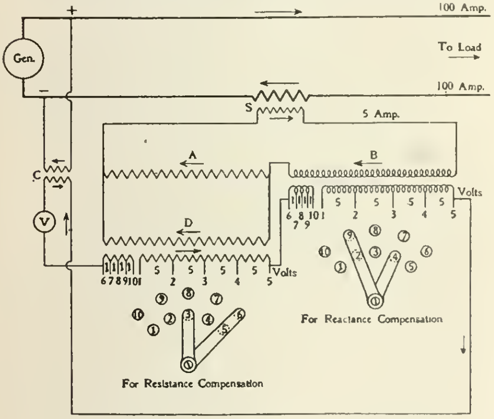


FIG. 1.—DIAGRAM OF COMPENSATOR CONNECTIONS.

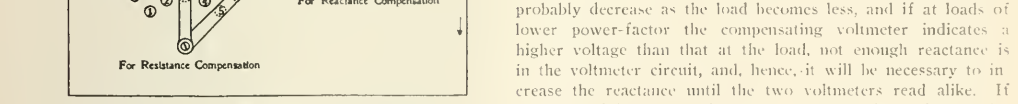


FIG. 2.—DIRECT-READING GALVANOMETER SCALES.

Direct-Reading Galvanometer Scales.—J. Rymer-Jones.—A description of a method which saves much time and calculation when the "dialectric resistances" of a number of condensers, or insulated wires, have to be measured. Of the two parallel scales, shown in Fig. 2, the lower one is divided into 1000 equal divisions, while the upper *DR* scale is so graduated that its insulation valves are in inverse proportion to the divisions on the lower scale. If, therefore, the testing galvanometer be shunted to make the testing battery through one megohm give the full deflection of 1000 divisions, and if this deflection is, moreover, made to coincide with the one-megohm graduation on the upper scale, then deflections of 500, 250 and 125 divisions should coincide respectively with 2, 4 and 8 megohms; and there should be a similar coincidence between all intermediate deflections and their corresponding *DR* values. The disc of light, with its fine dark line as an index, is reflected from the mirror galvanometer between these two scales, either of which may therefore be equally well used as desired. As the universal shunt is not always sufficiently subdivided to give exactly the full scale deflection of 1000 divisions with the testing battery through one megohm, the multiplying power (mp) of the slide reading (sr) required to give 1000 divisions is obtained by inverse proportion from the deflection (d) observed with a suitable slide reading having a multiplying power MP; that is, $mp = MP\frac{d}{1000}$, and its $sr = \frac{10{,}000{,}000}{MP \times d}$. Or if, when employing a universal shunt of 10,000 sub-divisions, a slide reading of 10, having a MP of 1000, be used, the formula can be simplified by making $mp = d$, for which the $sr = \frac{10{,}000}{d}$. Although the insulation values of a set of condensers, or insulated wires, made under the same conditions generally agree closely, and can therefore be tested with the same scale, the *DR* of other sets will differ greatly according to capacity, resistivity or temperature; consequently several galvanometer scales with widely different ranges are required. The principle of graduating the upper scale is, however, the same; but instead of the lowest insulation value ($R1$), which always coincides with the 1000 divisions, being only one megohm, as assumed above for the purpose of explanation, it will vary according to the requirements, and the slide reading (sr) used for each scale must be in direct proportion to $R1$. Numerical examples are given and methods of finding the resistivity-temperature coefficient and of graduating the *DR* scale are described.—Lond. *Electrical Review*, Jan. 10.

Alternator Test.—T. Fraser.—In a recent test of a 1250-kilovolt-ampere turbo-alternator under full load at 80 per cent power-factor, the following method of obtaining the desired inductive load was used. At the place of the test the permanent loading arrangement consists of a large water resistor which gives a non-inductive load. To obtain 80 per cent power-factor, an auxiliary alternator was used, a duplicate of the one under test. The machine was run light as a synchronous motor from the alternator circuit, and its field was gradually weakened until the required power-factor was obtained. As it was not convenient to run up to speed and synchronize the auxiliary machine, it was started as an induction motor. From the diagram of connections shown in Fig. 3 it may be seen that the stators of the two machines were electrically connected, the field of the generator separately excited, and the field coils of the motor short-circuited during starting. It was, of course, necessary to excite the generator field from an independently-driven exciter, as otherwise no voltage could be obtained until the machine reached a considerable speed. The turbine was started, and as soon as sufficient speed was obtained (about 20 r. p. m.), the motor started up. When the motor reached full speed, the field circuit was opened and the field excited. Another method of starting was also tried. This was the same as the one already explained, with the exception of the field circuit connections. Instead of being short-circuited, the field coils were connected directly across the armature of the shunt exciter, the exciter being coupled to the turbine. The field flux built up gradually, as the turbine's speed increased, the two machines running in synchrononism at all speeds. Absolutely no trouble was experienced with either method, and the power-factor could be adjusted to a nicety.—*Electrical Journal*, January.

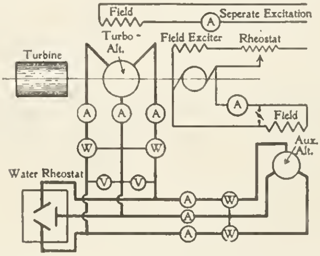


FIG. 3.—DIAGRAM OF CONNECTIONS FOR TEST OF ALTERNATOR.

Measuring the Damping in Electric Oscillation Circuits.—K. E. F. Schmidt.—The most reliable method for measuring the damping of an electric oscillation is based on the use of a very loosely coupled condenser circuit, the characteristic damping of which is brought to a minimum and the capacity of which can be adjusted. If then a resonance curve is plotted, formulas of Bjernas and Drude permit in a very simple way to find the logarithmic decrement from the curve. However, according to these formulas the curves should be symmetrical while in reality they are not. The author discusses some inaccuracies in the old theory and shows that while the theory is somewhat more complicated yet the desired logarithmic decrement can be very easily found from the resonance curve.—*Phys. Zeitschrift*, Jan. 1.

Roentgen Ray Apparatus.—An illustrated article on recent progress in the construction of Roentgen-ray apparatus. One of the most important advances is the use of tantalum in place of platinum for forming the anti-cathode of the Roentgen-ray tube. Several forms of radiometers, etc., are described, as well as a portable Roentgen-ray apparatus for ambulance service used by the military authorities in several European countries.—Lond. *Electrician*, Dec. 27.

Telegraphy, Telephony and Signals.

Efficiency of a Telephone.—F. H. Abraham and D. Charbonnel.—A paper giving some instructions concerning the most efficient arrangement of telephone lines. For a given sound, the microphone behaves as an alternator without inductance, having an internal resistance of about 10 ohms. If the line is very long, it may be regarded as a resistance R, of the order of 500 ohms, in series with a capacity C of a fraction of a microfarad. At the receiver, the line acts as an alternator, having these same characteristic constants, R and C, and an e. m. f. amounting to a definite fraction of the e. m. f. supplied. These assumptions may be made the basis of a complete theory of the transmission of a musical note along a very long telephone line. The authors specify the conditions which make for the loudest rendering. For every type of receiver the diameter of the wire must be such that the resistance of each of the two receivers shall be a little higher than one-quarter of the apparent line resistance R. In practice, this means choosing receivers with a resistance of about 100 ohms. If M is the internal resistance of the microphone, the most favorable transforming ratio is a little higher than $R \div 2M$. In practice this means a transforming ratio of 6 to 7. The impedance of the thin wire of the transformer must be decidedly greater than the apparent line resistance R. The above conditions are usually observed in good commercial circuits. As regards the efficiency of commercial telephone transformers, the authors find that to be less than 60 per cent. An efficiency of 90 per cent should be easily attainable without making the transformers too costly or too cumbrous. The authors give the following dimensions as a model: Length, 17 cm; external diameter, 3 cm; total section of iron wires, 0.3 sq. cm; turns of thick wire 550; turns of thin wire, 3300; diameter of thick wire, 1.1 mm; diameter of thin wire, 0.4 mm; resistance of thick wire, 0.9 ohm; resistance of thin wire, 24 ohms; and inductance of the same, 0.4 henry. Too much must not, however, be expected from this improvement, as the ear is not very sensitive to loudness, an increase of 50 per cent being barely distinguishable. The improvement of the microphone offers a much more promising field, and the authors believe that all existing types are capable of great improvement.—*Comptes Rendus,* Dec. 23; Lond. *Elec. Eng'ing,* Jan. 9.

Telephone Exchange.—An illustrated description of the new trunk telephone exchange in Bradford, England. The exchange embodies all the most recent devices for facilitating the utmost utilization of the trunk lines without waste of time. The description includes details of the arrangement by which a telegraph circuit is superposed on the lines for the purpose of transmitting all service directions, so that the telephone circuit is used for remunerative conversations only, and it also contains a description of the time check which has been evolved by the postoffice for assisting the operator in controlling the duration of a conversation by giving a lamp signal when the three minutes have expired.—Lond. *Elec. Eng'ing,* Jan. 9.

Selective Ringing Up.—R. Heilbrum.—A description of a simple device for ringing up one single station in a line which contains several stations. The device is essentially a hot-wire instrument. The hot wire is arranged in air within the upper closed part of one leg of an inverted U-tube, the tube being sealed at the bottom by some liquid. When the ordinary telegraph currents pass through the hot wire the expansion of the air is not sufficient to displace the liquid at the bottom materially. It is only when a continuous current exists for several seconds in the hot wire that the air expands sufficiently to make the liquid rise in the other leg to such a height that a local circuit is closed and the bell rings.—*Elek. Zeit.,* Jan. 2.

Photographing at a Distance.—A description of an apparatus suggested by S. Sivelli for the purpose of reproducing at a distance the optical image of a photographic objective. The sending apparatus consists of an ordinary photographic camera, the sensitive plate of which is replaced by a plate made up of a network of small selenium cells, insulated from one another and communicating with a constant source of electricity, the negative terminal of which is connected to earth. From each of these selenium cells there starts an insulated wire, dipping into a small mercury vessel arranged on a horizontal plane. There are thus as many mercury vessels as there are selenium cells. These vessels are arranged round the circumference of a circle, round the center of which rotates a metal index operated by clockwork, which, with a point attached to its end, will come into contact successively with each of the mercury vessels. This index communicates with a wire connected to the receiving apparatus, and insulated from the remainder of the outfit. The apparatus is to be worked in the following manner: After adjusting the focus for the image to be reproduced, the circuit is closed and the index having been set working, will traverse one after another, the mercury vessels corresponding to the respective selenium cells. The electric current from the battery will traverse the selenium cell actually in communication with the metal index, and according to the more or less considerable action of the illumination on the cell, will undergo a more or less considerable alteration in intensity. These alterations in current intensity, corresponding to the illumination of each of the selenium cells, are thus successively transmitted to the receiving station, there to be reconverted into variable light intensities. The receiving apparatus may be of various kinds; the one suggested by Sivelli is based on the following principle: a cylinder performing a translation and a rotation is surrounded by a sheet of white paper, at a short distance from which a style communicating with an electro-magnet is arranged. If everything be adjusted in order to eliminate any variation of current intensity as long as the luminous intensity in all the selenium cells is the same, each current closure will result in the production of a dash of more or less intensity, according as the selenium has been acted upon more or less strongly. The sheet of paper will thus be covered with a set of dashes reproducing with greater or less approximation the optical image by the photographic objective. The method thus outlined is obviously a purely hypothetical one. To produce an image at the receiving end that shall be coherent enough to be intelligible, the number of cells would have to be at least 1000 to the square inch; and unless vastly more sensitive means than selenium cells can be devised for converting the variations of light intensity into variations of current strength, the idea seems impossible of realization.—Abstracted from *L'Elettricita* in Lond. *Elec. Review,* Jan. 10.

Miscellaneous.

Measuring Area.—At a recent exhibition of the British Physical Society a new form of area scale was shown, which is illustrated in Fig. 4. It is made of celluloid and intended for the rapid measurement of the area of any figure, it being, of course, particularly suitable for obtaining areas of indicator diagrams. The scale is placed over the figure, the area of which is to be obtained, so that the ends of the figure lie equidistant between two of the vertical lines on the scale. A strip of paper is then placed along each of the lines in succession, and the length of the figure along such lines marked off along the edge of the paper; the total length so marked off is measured on the scales at the top of the instrument, giving the area of the figure in square inches or square centimeters, as required. For quicker and less accurate work, either only the dotted or full lines need be used, the length being multiplied by two.—Lond. *Electrician,* Jan. 3.

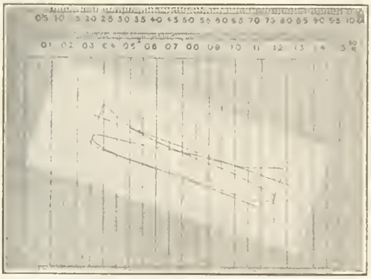


FIG. 4.—MEASURING AREA.

Electric Welding.—C. B. Auel.—An illustrated article on the use of the Benardos process for welding by means of the electric arc. The metal to be welded forms the positive terminal of a direct-current circuit while a carbon electrode forms the negative terminal. The source of supply is a direct-current dynamo rated at about 85 kw and from 100 to 125 volts. There is also required a rheostat, two water-tight barrels placed side by side being very satisfactory for this purpose. A diagram of connections is given in Fig. 5. The procedure in applying the process to the welding of steel castings, pipes and plates is described. If possible the weld should be made with one continuous application of the arc without allowing the casting to cool off, since otherwise oxides will be formed.—*Electric Journal,* January.

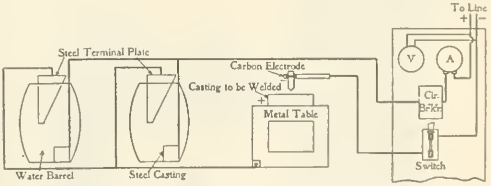


FIG. 5.—DIAGRAM OF CONNECTIONS FOR ELECTRIC WELDING OUTFIT.

Soldering Materials.—M. Corsepius and A. Lippmann.—A polemical discussion of several points in the recent article of Lippmann, with special reference to the use of "tinol" as a soldering material.—*Elek. Zeit.,* Dec. 19.

Laboratory.—An illustrated description of recent extensions of the laboratories of the University College, London.—Lond. *Electrician,* Dec. 27.

BOOK REVIEW.

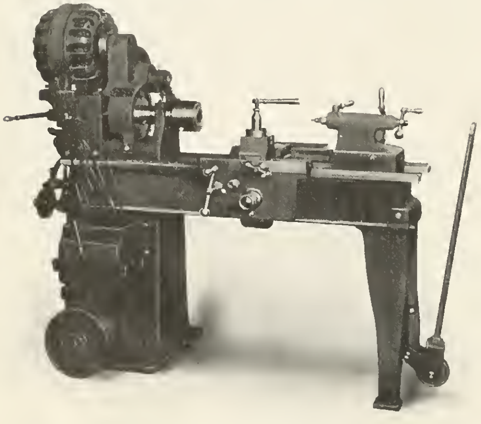
ELECTRICAL ENERGY. By Ernst J. Berg. New York: McGraw Publishing Company. 184 pages; 120 illustrations. Price, $2.50 net.

This book, which deals with the generation and transmission of electrical energy, has been compiled from a series of lectures delivered at Union University. The contents could be summarized briefly as applications to engineering problems of the equations deduced from a theoretical consideration of alternating-current phenomena. To the student or the designer of electrical transmission systems, the book will prove particularly valuable, because the statements of the inter-relations of the various phenomena are illustrated in a striking manner by applying them to the solution of problems such as are encountered in practice.

There are two sections to the book. Section I is devoted to the transmission line, and Section II to the generating station. The former section contains what is probably the most easily applied accurate solution of transmission line problems available in text-book literature. Although mathematical equations are used freely, and, in fact, the whole treatment rests on a mathematical basis, yet the systematic substitution of actual constants for the mathematical symbols allows the author to keep closely in touch with the physics involved and causes the reader to appreciate thoroughly the real phenomena being dealt with. Section II relates to generators, stationary transformers and station instruments. In this portion of the book the author has found less need for mathematical demonstrations, and has resorted more freely to descriptive methods of presentation. As in Section I, however, examples from actual practice have been selected for illustrating the physical relations being described. The book is well arranged for college classes, and will be welcomed by instructors in electrical engineering as covering many points that have not previously been given sufficient consideration in text-books.

Portable Motor-Driven Lathe.

The portable bolt-turning lathe illustrated herewith has been designed for use in locomotive repair shops. The unit is compact in design, and is mounted on wheels. It can be lifted by a crane and placed beside an erecting pit, and then shifted as desired by hand. When in working position the machine rests on the two rear wheels and the front legs. To move it the front wheel is brought into contact with the floor and the legs are lifted by simply lowering the handle, which acts as a lever.



PORTABLE MOTOR-DRIVEN LATHE.

The motor which operates the machine is of the induction type, 2-hp, 1700 r. p. m. It is connected through a friction clutch providing for either 200 or 400 r. p. m. of the spindle. Energy is supplied to the motor by means of a flexible cable. The lathe has been built by the Williams & Wilson Company of Montreal, Canada, the motor being supplied by the Westinghouse Electric & Manufacturing Company.

Metal Locker.

To the central station company or other corporation employing a large number of persons, the value of a metal locker as a clothes receptacle is generally recognized. The "Pen-Dar" metal lockers, made by Edward Darby & Sons Company, of 233 Arch Street, Philadelphia, being constructed entirely of open-mesh, permitting a free circulation of air, in consequence of which they are well ventilated and sanitary. Moreover, the contents of each individual locker can be thoroughly inspected at any time. The locker is constructed of expanded metal by a patented process. The material is made from planished steel plate, cut, expanded and then rolled in such manner that it presents a smooth surface entirely free from rough edges or corners. Each locker is equipped with one shelf, three coat hooks, individual brass number plates, and a special three-point locking device, which fastens the door at the top, center and bottom with a single turn of the lock. The lockers are finished in various colors, and each lock is provided with two non-changeable keys.

METAL LOCKER.

A Meeting of Allis-Chalmers Managers.

A meeting has just been held of department and district office managers of Allis-Chalmers Company from every industrial center of the country. During the entire meeting, which lasted four days, beginning with a tour of inspection of the works at West Allis and ending with a banquet at the Hotel Pfister, in Milwaukee, the prevailing note was that of decided optimism. With the possible exception of a single district, which depends for its prosperity upon one particular product, reports indicate that a general resumption of business activity is being brought about at the present time, and the outlook for purchases of material of all kinds, particularly power and electrical machinery, is most encouraging. Many of the district managers stated, in fact, that during the past two weeks inquiries have been very heavy, and customers are only waiting until a little more complete restoration of normal conditions to place large orders for apparatus.

One of the facts emphasized at the meeting was the advantage both to Allis-Chalmers Company and the purchaser of taking contracts for the complete equipment of power and lighting plants, electric railway installations, industrial works, such as cement mills, flour mills, saw mills, ore reduction works, stone crushing plants, etc., which the company's extremely varied line of machinery enables it to do, thereby eliminating any division of responsibility and insuring the harmonious working of all parts of the apparatus, from bearing boxes, gears and pulleys to the heaviest machinery used in the plant, of whatever character it may be, thus guaranteeing the operation of the plant as a unit rather than the performance of the individual parts.

Following is a list of the managers present: F. C. Colwell, manager, Cincinnati; J. U. Jones, manager, Dallas; E. T. Pardee, manager, Boston; M. W. Thomas, manager, Atlanta; J. F. Harrison, manager, flour mill machinery department; B. A. Behrend, chief electrical engineer; J. W. Gardner, manager, Chicago; J. Weidman Murray, manager, Pittsburg; W. L. Loveland, manager, mining machinery department; St. J. Chilton, manager, Philadelphia; F. L. Bunton, manager, St. Louis; F. C. Randall, manager, New York; Roscoe Cornell, manager, El Paso; Geo. A. Williams, manager, Cleveland; P. H. Carey, manager, Detroit; C. R. Tatem, manager, Buffalo; H. D. Scribner, manager, San Francisco; A. E. Mosier, manager, Kansas City; A. H. Whiteside, manager, electrical department; R. B. McConney, manager, Denver; L. M. Harvey, manager, Milwaukee; E. T. Adams, manager, gas engine department; J. H. Denton, manager, air brake department; I. L. Skeith manager, saw mill machinery department; M. C. Miller, assistant to the president; W. J. Sando, manager, pumping engine and hydraulic turbine departments; W. E. Dodds, manager, steam engine department; J. C. M. Lucas, manager, Baltimore; H. Schifflin, manager, crushing and cement making machinery department; W. H. Powell, superintendent electrical works; J. R. Jeffrey, secretary Bullock Electric Company.

One of the Displays at the Chicago Show

suggested to operate five series alternating-current lamps in connection with the regulator. An equipment of this kind was on exhibition and connected up so that the operation of the lamp and regulator could be demonstrated. The new Western Electric 400-volt, multiple alternating-current lamp was on exhibition, and sample 110-volt alternating-current and direct-current lamps were also included in the display of lamps. This company has recently formed a selling arrangement whereby it becomes a distributor of the Beck flaming arc lamp, and two of these lamps were on view.

An interesting feature of the supply exhibition was the "Black Enamel" wire, attractive in comparison with silk and cotton insulation, owing to the small amount of space required by the wire, the greater number of feet per pound, and the high insulating quality. A line of supplies manufactured or handled by the company was also on exhibition, including American transformers, Vulcan heating apparatus, street railway material, "Electrose" insulated material, Thomas high-tension insulators, Duncan wattmeters, D. & W. fuses, and Deltabeston wire.

The Manufacture of Insulating Tape.

Mr. F. J. Gleason, the superintendent of the Massachusetts Chemical Company, Walpole, Mass., has favored us with the subjoined practical observations on the manufacture of insulating tape:

When you receive a nicely done up package of electric tape, label executed in several colors, with an imposing trade name, handle it gingerly till you know its pedigree or you may find that another lemon has arrived. Electric tape is, in a word, the simplest and most complex product the rubber manufacturer has to deal with. It is simple because the roll is round. It is complex because thousands of dollars may be spent on machinery and material, yet lack of knowledge in the compounding and coating results in an absolute failure.

Tapes must be made on a first-class cotton base. No inferior product will do if you want first-class output and no returned goods. The cotton must be dried out until absolutely no moisture remains or the rubber will not properly impregnate. I mean impregnate, for a first-class tape must have the compound driven into every pore of the fabric under enormous pressure and low temperature (comparatively speaking). Then on top of this impregnating comes the final coating built up to accurate thickness by micrometer.

It takes expensive machinery to do all these things, also years of experience, many failures, and every bit of honesty a man can dig up to make a success of the tape business. The great drawbacks to the use of ordinary tapes are "drying out" in the roll, and improper adhesion. Some tapes have no adhesive properties at all at low temperatures and are so sticky above 80 deg. that they cannot be used. Deterioration or rotting of the fabric is another drawback. All of these faults are due either to ignorance or dishonesty, ignorance in the secrets of compounding, dishonesty in loading the compounds full of foreign substances to increase weights and decrease the amount of rubber used.

It pays to be honest in the tape business the same as it does in all other lines, for it does not improve a concern's chances for reorders if the tape ordered dries out in the storeroom or gets rotten and the linemen cuss the maker's name on the package and all his works.

Just one word in closing about white tapes. Unless one pays an almost prohibitive price, he cannot produce a good white tape. Ingredients are put in all tape to preserve them, and a colorless preservative is yet to be found that will flux properly with white rubber.

I have tried to free this article of the personal note, and the lauding of our own products as much as possible, but the history of tape in the United States might almost be said to begin with our organization, and to advance as we advance. To those who are contemplating the manufacture of tape, I would say, go straight with your eyes open and with absolute knowledge of your product or don't go at all.

New Power Plant of the Pacific Mills.

The Pacific Mills, at Lawrence, Mass., are among the largest textile mills in the country having a cotton department with 180,000 spinning machines and 6717 looms, a worsted department of 53,064 worsted spindles and 2650 looms, and a print works with 27 printing machines. With the natural increase in the size of the plant, and the constantly increasing demand for steam for manufacturing purposes, it has become necessary to reorganize the entire power plant on a comprehensive basis. At present it consists of two sets of water-wheels at the upper mill, one set at the lower mill, and several boiler plants and engines located in various departments.

The new power plant is located on Essex and Embankment Streets, about 800 ft. from the Merrimack River, from which an abundant supply of water for condensing and boiler feed is obtained, and beside the tracks of the Boston & Maine Railroad, over which coal is received. The plant is intended to operate in connection with such portions of the present power system as will remain in commission temporarily or permanently.

On the main turbine room floor are located three Allis-Chalmers turbine units of 2250 kilowatts rating on normal load, generating 60-cycle current at 2300 volts; a 75-kw engine-driven alternator capable of running in parallel with the above; a 50-kw steam-driven, a 55-kw motor-driven exciter, and a 12-panel switchboard.

The turbines are designed to run at 1800 r. p. m. Each is equipped with a centrifugal governor, and automatic overload and safety stop valves. The generators are of the revolving-field enclosed type, with forced ventilation. The air for this is sucked in by the rotating field through a duct leading to an air shaft, the opening for which is up near the roof, thus insuring a supply of clean, cool air. Each unit is supplied with oil by an oil pump mounted on its frame and direct-driven through gears. An auxiliary steam-driven pump supplies oil at starting.

In the basement are located the condensers, feed pumps, fire pumps, and feed-water heater. Two of the turbines are equipped with jet condensers having twin double-acting steam-driven air pumps. The third unit has a turbo-jet condenser set built by the Allis-Chalmers Company.

The present boiler installation consists of 12 horizontal, return-tubular boilers, arranged in batteries of four each. Space has been provided for 12 more boilers. New England roller grates are used. The steam pressure is 150 lbs. per sq. in., and the steam is to be superheated about 125 deg. F.

After leaving the superheater the steam passes into a 10-in. steel header, located in the boiler room and below the level of the turbine floor. Six-inch pipes feed the turbines direct from this header. Each turbine is provided with two valves, one at the steam chest and one at the header. The auxiliaries are fed from the header at two points.

The feed pumps normally take water from the overflow pipe from the condensers, but they may also use water from either the cistern or the city supply. Condensing water is taken from the Merrimack River through a 48-in. steel penstock provided with sluice gate and screens, into a large concrete cistern located under the west side of the turbine room basement. The sides of this cistern form part of the building foundations, and the bottom is low enough to insure an ample supply of water at all stages of the river. From this cistern the water is taken through the condensers and pumps, and is then returned to the river through another 48-in. steel penstock which discharges further down stream. Provision has been made so that later, if it is thought desirable, warm water from the condensers can be carried over to the print works for use in manufacturing processes.

The coal pocket is 209 ft. 6 in. x 52 ft. Coal is taken from this by a single-track trolley with a grab bucket. There are two lines of track for this in the coal pocket, one on each side of the trestle, the track being supported from the roof trusses. These two lines unite between the pocket and the entrance to the boiler room, so that a single line of track is carried down over the center of the firing floor inside of the latter.

All oil switches are mounted on the wall back of the switchboard, the operating levers being under the floor. The rheostats are on the basement floor. Machine and feeder leads are located on the basement ceiling. The feeder leads are taken to the north end of the turbine basement, where they are connected to the transmission cables by disconnecting switches.

The transmission system is entirely underground. All cables are three-conductor, stranded copper, insulated with varnished cambric and protected by a lead sheath. The cables are insulated for a working pressure of 5000 volts.

The conduit system is made of multiple duct vitrified tile laid in concrete, with joints wrapped with burlap soaked in cement. The manholes are generally about 300 ft. centers, with a maximum of 410-ft. centers. Racks are formed in the sides of these manholes by projecting courses of brick from the inside of the walls. They are built with concrete bottoms, 8-in. brick sides, and concrete tops, carried on old rails. Circular cast-iron covers are used.

The route of this conduit is such that it was necessary to cross the Boston & Maine Railroad tracks and Broadway, a public street, at about the same point. In order to facilitate any future work at this point, a concrete tunnel was constructed here, with its top about 3 ft. below the surface of the street and road. The cables here are carried in racks formed by projections in the sides of the tunnel.

At the outset the energy generated at the new plant will be used principally to supply what is known as the "Upper Mill" and Print Works, but provision is being made for the extensive application of electric motor drive throughout the entire establishment, divided as follows: Yarn mill, 1500 horse-power; Upper Mill, 3000 horse-power; Lower Mill, 3000 horse-power, and New Mill, 3000 horse-power.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The easier tone of the money markets made itself felt in the resumption of manufacturing activity in many lines, but the loss of purchasing power among the people has been increased by the large proportion of the unemployed. Trade and industry continued quiet, commodity prices quite generally moved downward; collections were backward; an increased quantity of railroad equipment was reported idle; less satisfactory reports as to demand come from the iron and steel and coal industries, and there was an increased disposition to discuss wage reductions as an offset to restricting production. Wholesale trade generally was slow to open, though heavy cuts in cotton goods by Western jobbers, equaled or exceeded by Eastern houses, attracted buying in these and kindred lines. Reports as to collections indicate slowness in meeting engagements. The backward movement of cotton to market is still said to be a bar to southern trade and collections, though a rather freer movement is reported at some Texas points. Additional reports of railway earnings show that the business offering the roads is declining. November, 1907, gross receipts, while larger than in 1906, were offset by increased cost of operation, and net for that month fell heavily, a gain of 3.8 per cent in gross being accompanied by a loss of 14 per cent in net. Some metal-working industries are running fuller, and lumber mills at the South and on the Pacific coast are reported resuming, but the mild weather or reducing factory consumption has caused accumulation of coal, and mine output may be restricted. While irregular, commodity prices have quite generally moved lower, prominent in this respect being wheat, cotton, and many varieties of cotton goods. Clothing manufacturers are slow to buy, pending definite tendencies in the goods market. The pig iron market relapsed into quiet following the temporary revival of the week previous. Outputs tend to slightly increase. Demand for steel rails and railway equipment was very dull, and light rails are off $2 a ton. New business in structural material was only moderate. Wire products, hoops and bands and tinplate, were in good request, and prices were firm. Copper was firmer though demand was dull, but business in finished lines showed a little improvement. Lake closed at 13⅞c., electrolytic 13¾c., and casting stock at 13½c. *Bradstreet's* reports 408 business failures for the week ending Jan. 23, against 431 in the week previous, and 252 in the corresponding week of 1907.

STATUS OF COPPER MARKET.—Inquiries among the leading consumers of copper in the electrical line during the last week brought out the facts that notwithstanding the comparatively low price of copper metal, the manufacturers are buying from hand to mouth, only enough for their immediate needs. Business stagnation is the primary cause, supplemented by lack of investment capital and a general feeling of uncertainty in regard to the copper market. The manipulations during the last half of 1906 and the first half of 1907, in its attempt to corner the market and fix the price of metal at 26 cents a pound, have not been forgotten, and rather wild rumors and reports of late, that before long it will be demonstrated that copper in large quantities can be profitably produced at prices ranging from 9 to 12 cents a pound, have contributed to make a poor copper market. "The facts are that the copper people have been playing horse with us," said a manufacturer whose company in its line is the second largest user of copper in this city, "and we are not sure where we stand. When business was booming last year and we had to have the metal, they boosted the prices. Those of us who bought in large quantities now have manufactured products on our hands which we are obliged to sell at a loss. This valve cost my house 97 cents to manufacture under the price of copper at the time the valve was made, but at the present market prices of the metal, we are obliged to sell it for 86 cents." In general, the opinion seems to be that the price of metal will not go lower. As Senator Clark has pointed out, the 13-cent copper has forced hundreds of low-grade mines to close. It is estimated that the large surplus of the Amalgamated Company has been absorbed in home consumption and foreign exports, if the reports of the exports are bona fide, and the gradual revival of business will create a demand for the metal which will force the price upwards. One close in touch with the United Metals Selling Company said last week that in all probability the price of the metal would be raised to 14 cents within the next month and at the least sign of increasing consumption on the part of the copper users, the price would be pushed higher.

NEW YORK FIRE ALARMS.—It is understood that Fire Commissioner Lantry, of New York, will soon apply for an appropriation for the purpose of replacing the old electrical equipment entirely with new wires, new alarms, new instruments and, finally, a new fireproof building for the head quarters. About $2,500,000 will be required. The New York Board of Fire Underwriters first called the attention of the department to the conditions when Nicholas J. Hayes was commissioner. Commissioner Hayes saw that conditions were dangerous, and so reported to the mayor. This was in September, 1905, but no actual steps were taken for the improvement of matters until John H. O'Brien obtained, when he was fire commissioner, an appropriation of $25,000 for the preparation of plans and specifications for a new system. These plans were submitted to the engineers of the Board of Estimate and Apportionment and of the Department of Finance on their completion in September, 1907, and were approved. Commissioned Lantry will soon ask for an appropriation, but unless the temper of those who control the municipal pursestrings changes he will have difficulty, as Chief Croker testified before the Commissioners of Accounts that the cost of the new system would be at least $2,500,000. Chief Croker said on the stand that the new alarm system was almost as necessary as an immediate supply of good hose. Messrs. J. J. Carty and K. B. Miller have given technical evidence as to the sad condition of the electrical system.

POWER IN BRAZIL.—The Sao Paulo Tramway, Light & Power Company have closed a contract with the State Government and are delivering over 500 horse-power to the authorities for operating the pumps which distribute water to various portions of the city. In this connection it is interesting to note that a recent letter to the Bureau of Manufactures from U. S. Consul-General G. E. Anderson, of Rio de Janeiro, says: "As electricity from water power is likely to be far cheaper in the near future than imported fuel, it is likely that the demand for power machinery will be confined almost entirely to electrical machines and water-power motors. There is a splendid field for water wheels, turbines, etc., all over South America. The industrial life of South America in the future is to center almost entirely about the development of its water power and the transmission of this power from falls to cities through electrical appliances. The sale of electrical appliances of all sorts ought to be pushed in Brazil immediately. The inauguration of electric-lighting services in a number of Brazilian cities within the past few months is soon to lead to an immensely increased demand for electrical specialties, lighting goods, small power plants, and everything of the sort."

THE DEAN ELECTRIC COMPANY has received an order from the Ironton Home Telephone Company for a complete common-battery exchange and subscribers' station equipment. The exchange apparatus includes equipment for 640 common battery lines and 20 magneto lines, and the ultimate number of lines provided for is 1000. The details of the specifications were determined by a purchasing committee that personally visited the Dean plant and looked over two large common-battery boards that were lined up on the assembly floor. These two boards were for Madison, Ind., and Mt. Vernon, Ohio. Other large orders lately received by the Dean Company include the following: Common-battery switchboard for the Pomeroy & Middleport Telephone Company, Pomeroy, Ohio; 25 private branch exchange switchboards for the Home Telephone Company of Detroit, Mich.; central-office equipment complete, for Oakwood and Ottawa, Ohio; and private branch boards for Sheboygan, Mich., and Schenectady, N. Y.

BUSINESS CONDITIONS.—Subjoined are two or three comments on current business conditions from well-known leaders in the electrical trade. Mrs. R. E. Gallaher, secretary for the New York Insulated Wire Company, says: "There is no need for pessimism. Business is almost at a standstill, but it is perhaps the best thing that could happen. It is a natural and normal period of retrenchment and readjustment following a wave of inflation and speculation. Business men hestitate to begin new operations on a large scale until the result of the year's crops can be forecasted and the presidential election is settled. The business world has stopped to take breath and it is well that it has done so. There is nothing the matter with Roosevelt, taken as a whole, and there is nothing the matter with the country, or with the American people. Everything will right itself if we are a little patient. Only the American people don't like to wait. Because some of them are not making to-day as much money as they were yesterday, they howl calamity. If they stopped long enough to take a rational, analytical view of the situation they would see that fundamentally the country is sounder than it was six months ago and that there is no reason in the world to feel blue." A representative from one of the leading electrical manufacturing concerns in the country, who has just returned from a trip West, speaks encouragingly of the conditions out there. "There seems to exist in the West," he said, "a feeling of optimism that, like a slowly moving wave, is pressing Eastward. As yet the business world has scarcely had time to recover from the crushing blow dealt it, but one cannot but feel in the very air the tone of encouragement, the optimistic view that prevails in that section of the country. The West has been hit as hard as the East, but they seem to have recovered more quickly out there and one hears much less of the calamity howling that seems to be in vogue here. In, Boston, too, I observed that the manufacturers and dealers in electrical apparatus have felt very little the stress of the crisis. That part of the country seems to have suffered least of all, perhaps because of the conservativeness of the people who do not go to extremes in times of prosperity and who are quick to trim sails and lighten ship at the first storm signals." Mr. J. W. Perry, manager electrical department of the Johns-Manville Company, said: "Business conditions are very slowly but very surely improving. Our orders for January will aggregate at least 25 per cent larger than December's business. Still it will be a long time before things are in the shape they were a year ago. The present number of orders from buyers is greater than at that time, but the volume of business is not as large. Consumers are buying from hand to mouth, often and in small quantities, and although I expect to see business pick up, more and more each month, I do not anticipate any marked change until after the presidential nomination has been settled."

OZONE-VANILLIN PLANT.—On Saturday, Jan. 25, fire damaged the plant of the Ozone-Vanillin Company at Niagara Falls. The works of this company are located on the property of the Niagara Falls Power Company, the buildings having formerly been occupied by the Atmospheric Products Company. Just how the fire started is a mystery, but it is thought that a still exploded. The damage is about $20,000, fully insured.

Financial Intelligence.

THE WEEK IN WALL STREET.—Notwithstanding the easier money situation, the stock market was heavy throughout the week, and the bullish speculation inaugurated immediately after Jan. 1 practically subsided, there being renewed activity on the part of bears and an increased disposition to pay attention to unfavorable factors, such as poor railroad earnings, the accumulation of idle railway equipment, the restricted demand for coal, and the expectation of unfavorable showings by steel manufacturers. One of the most cheering and important announcements of the week was the decision of a high Pennsylvania court, declaring the two-cent fare law unconstitutional. The somewhat sensational decline in American Smelting & Refining securities was naturally disquieting. Railroad earnings continue to fall off, and the managers are endeavoring to reduce expenses wherever possible. The banks made a further large gain in cash. There were many developments in the short-term note problem. The Hudson Company arranged a sale of $15,000,000 two-year 6 per cent notes; one of the sixteen railroads with outstanding short-term notes maturing this year, the Missouri Pacific, arranged to take up its loan, and two more, the Delaware & Hudson, and the St. Louis & San Francisco, entered into negotiations with the same object in view. Probably the most important development was that the reports of the railroad earnings now forthcoming display more and more decidedly the effects of the money panic, with its results of business depression and lighter railway traffic. Owing to the mildness of the season and the diminished requirements for fuel, the coal stocks were particularly weak, and, in fact, would seem to have been the objects of very decided bearish pressure. Some importance was attached to the coming quarterly report of the United States Steel Corporation, which is generally expected to make a poor showing; and this was used with some effect in bringing about a renewed depression of the United States Steel stocks. Electric and traction stocks were dull and weak, the strength noted the two previous weeks receiving a check. The result was net declines in almost every case. Following are the closing quotations of Jan. 27:

NEW YORK.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
Allis-Chalmers Co......	6⅛	6	Interborough Met. com.	7⅝	5
Allis-Chalmers Co. pfd.	19⅛	19	Interborough Met. pfd..	20	16
Amalgamated Copper...	50½	—	Mackay Cos.	56¼	55
Am. Dist. Tel.........	—	39*	Mackay Cos. pfd......	62¼	60
American Locomotive...	38	36⅝	Metropolitan St. Ry...	—	20
Amer. Locomotive pfd..	91	90	N. Y. & N. J. Tel.....	—	101
American Tel. & Cable..	—	55	United States Steel com.	—	28¼
American Tel. & Tel...	107	107	United States Steel pfd.	—	92
Brooklyn Rapid Transit.	44⅛	45⅛	Western Union Tel....	57¼	57½
General Electric	120	119	Westinghouse com.....	48	42
Hudson River Tel.....	—	—	Westinghouse pfd......	—	75

BOSTON.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
American Tel. & Tel...	108	108¼	Mass. Elec. Ry. pfd....	48	48
Cumberland Telephone..	99	—	Mexican Telephone.....	1½	5½
Edison Elec. Illum.....	209½	210	New England Telep...	117	109
General Electric	—	121	Western Tel. & Tel....	6	—
Mass. Elec. Ry........	11¾	11½	West. Tel. & Tel. pfd..	65	—

PHILADELPHIA.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
American Railways.....	43	43	Phila. Electric	6⅛	6⅛
Elec. Co. of America...	8⅝	8¾	Phila. Rapid Transit....	16	16
Elec. Storage Battery...	29	29	Phila. Traction	88	88½
Elec. Stor. Battery pfd..	—	—			

CHICAGO.

	Jan. 21	Jan. 27		Jan. 21	Jan. 27
Chicago City Ry.......	140*	166	Metropolitan Elec. com.	17	18
Commonwealth-Edison ..	87	—	National Carbon.......	53	55
Chicago Subway........	—	—	National Carbon pfd...	103¼	—
Chicago Tel. Co........	115	—			

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*Asked.

HUDSON TUNNEL OUTLAY.—The Hudson Companies, organized to build and equip the Hudson River traction tunnels and their terminal buildings, have issued $15,000,000 in two-year 6 per cent notes, secured by $22,500,000 of the 4½ per cent convertible bonds of the Hudson & Manhattan Railroad Company. President Oakman, in a letter to the preferred stockholders, in which he states that the new securities are offered at par and interest by Harvey Fisk & Sons, explains that the directors have chosen to issue the short-term notes because of their unwillingness to sell any of the treasury assets under present conditions. The proceeds are to be used to continue the work of construction. In this connection President Oakman states: "The physical work of construction is progressing most satisfactorily, and upon completion of the present financing your company will be in a very gratifying condition, and should ultimately liquidate its obligations to its preferred stockholders in a satisfactory and profitable manner." The company will have the line in operation to Fourteenth Street in a few days. Regular service between Hoboken and Fourteenth Street will begin in a few weeks. Up to the end of 1907 the Hudson Companies had spent upon the entire project, including tunnels, stations, power houses, terminal buildings, equipment, and miscellaneous outlays a total of $34,190,164.

DIVIDENDS.—The directors of the Lawrence Gas Company have declared the regular semi-annual dividend of $4 a share, payable Feb. 1. Directors of the American Gas & Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 1. The directors of the Rochester Railway & Lighting Company have declared an initial dividend of 5 per cent ($5 per share of $100 and $70 paid in) on the common stock, and the dividend has been distributed. The American Light & Traction Company has declared a regular quarterly dividend of 1½ per cent on the preferred stock and 1½ per cent on the common, payable Feb. 1. Directors of the Automatic Electric Company have declared a quarterly dividend of 1½ per cent, payable Feb. 1. The directors of the New York & Queens Electric Light & Power Company have declared a semi-annual dividend of 2½ per cent on the preferred stock, payable Feb. 10.

GENERAL ELECTRIC FINANCES.—The excellent condition of General Electric finances is brought out in the application to the stock exchange to list $9,273,500 of 5 per cent convertible gold bonds and $3,726,500 of additional said debentures from time to time. The company submits a balance sheet which shows a profit and loss surplus for the seven months ending Aug. 31, 1907, of $5,601,192. Sales in that period aggregate $41,475,763, which established a new high record. The total profit and loss as of Aug. 31, 1907, aggregated $20,711,989. The consolidated income account for the seven months ending Aug. 31, 1907, follows:

Sales	$41,475,763
Royalties and sundry profits	113,970
Interest, dividends and discount	347,658
Total	$41,937,391
Cost of manufacturing and selling	33,640,973
Interest on debentures	118,309
Dividends paid, 4 per cent	2,576,918
Profit and loss seven months, ending Aug. 31	5,601,192
Total	$41,937,391

The consolidated balance sheet as of Aug. 31, 1907, shows:

Patents, franchises, good will	$1
Factory plants	13,226,976
Cash	9,986,113
Stocks	19,087,799
Bonds	1,149,574
Real estate, other than factories	308,931
Notes receivable	3,838,723
Accounts	25,129,019
Work in progress (cost)	4,702,933
Merchandise inventories (cost)	24,001,579
Total	$101,371,652
Capital stock	65,167,400
3½ per cent debentures of 1902	2,047,000
5 per cent debentures of 1892	55,000
Subscription to 5 per cent debentures of 1907	10,492,250
Accrued interest on debentures	137,811
Accounts payable	2,760,202
Profit and loss, Aug. 31	20,711,989
Total	$101,371,652

The proceeds from the sale of such debentures are to be used for the general purposes of the corporation, and particularly to increase the working capital. They are redeemable after June 1, 1911, on 90 days' published notice, at par and 5 per cent. premium, and accrued interest, subject to the right of the holder to convert such bond during the 90-day period into stock. They are also convertible after June 1, 1911, and until maturity, June 1, 1917, at the option of the holder, into stock of the company at par. The company has stock which has been duly authorized, but not issued, to an amount in excess of $41,000,000 at par. Provision has been made for the reservation of stock to be issued in exchange for this series of debentures.

TELEPHONE FORECLOSURE SALE.—An important foreclosure sale of telephone properties will take place in the Court House vestibule, Rochester, Tuesday, Feb. 4. For more than four months the bondholders of the United States Independent Telephone Company and the Independent Telephone Securities Company have been looking forward to the conclusion of the foreclosure actions brought by the Security Trust Company, as trustee under the mortgage, and the sale of the properties. The sale of the U. S. I. properties by Referee Conklin will be held at 10 o'clock in the forenoon of the day of sale, and that of the Independent Telephone Securities properties will take place one hour later. It is provided in the order of sale that 10 per cent of the purchase price must be paid at the time of sale, while the remainder must be paid within 30 days thereafter. It is also provided that the purchaser may turn in toward the payment any bonds that he may have in his possession, pro rata as to the net proceeds. For example, assuming that the purchaser owns one $1,000 bond, and the net proceeds of the sale are on the basis of $100 per bond, the bond held by the purchaser will be accepted at $100. Under the latter provision the reorganization committee will be able to bid up to the amount of bonds assenting to the reorganization. It has been said that the amount so turned in was upward of 60 per cent of the total amount outstanding. It is understood that the amount outstanding is $13,362,000, and 60 per cent of that amount is $8,017,200. It is not likely that the highest bid of the reorganization committee will reach that figure.

SPRINGFIELD UNITED STOCK.—The United Electric Light Company of Springfield, Mass., has been granted permission by the state gas and electric light commissioners to issue $350,000 of new capital stock, the issue to comprise 2500 shares at $140, in order to pay for additions to the plant and to retire notes. The books of the company on June 30, 1907, showed the value of the plant to be approximately $1,375,000. The proceeds of stock and bonds previously issued for construction have amounted to $1,306,000. The difference between these two amounts, or $70,000, clearly represents an expenditure for construction not previously provided from the issue of securities and was included in the company's floating debt on that day. From June 30 to Oct. 30, 1907, about $80,000 was spent for a large addition to the station and equipment, and $75,000 more for other additions to the plant, making $225,000 in all. About $125,000 more will be needed for work in progress or contracted for. The outstanding notes on Oct. 31 were $435,000. The company asked for new stock for an estimated expenditure of $445,000 during the five years ending June 30, 1912, but the board did not think that the plans were sufficiently definite to justify the approval of securities for such a purpose now. Therefore an order is adopted approving the issue of new stock of par value of $350,000 for the objects named in the petition, the proceeds of 1600 shares to cancel outstanding promissory notes, and of 900 shares to cancel obligations for the generating station. The price of the stock is fixed at $140 per share.

NORTHERN OHIO REPORT.—The Northern Ohio Traction & Light report for the year ended Dec. 31, 1907, is issued. The income account compares as follows:

	1907.	1906.	1905.
Gross	$1,909,060	$1,703,340	$1,552,970
Expenses	1,095,755	1,006,842	898,830
Net	$813,305	$696,498	$654,140
Charges	513,241	483,173	471,503
Surplus	$300,064	$213,325	$182,637
Dividends	158,778	113,527	....
Surplus	$141,286	$99,797	....
Previous surplus	710,296	....	....
Total surplus	$851,582	....	....
Depreciation	100,000	....	....
Profit and loss surplus	$751,582	....	....

The surplus shown is equal to 3 per cent on the $10,000,000 capital stock.

CHICAGO RAILWAYS COMPANY.—Advices from Chicago of January 25 state that the property of the West Chicago Street Railway Company and that of the North Chicago Street Railway Company, operated under the name of the Union Traction Company, have been sold at auction to the Chicago Railways Company, a corporation formed to reorganize the two systems. The Chicago Railways Company offered separate bids amounting to $2,090,000, and bid a lump sum of $2,000,000. No other bids were made. The sale was the outcome of the traction litigation which has dragged in the courts for years and has blocked the way to improved street car service on the north and west sides of the city. The decision of the Supreme Court of the United States, handed down on Jan. 23, was the last step in the court proceedings. It is said the new company will spend $12,000,000 in rebuilding the lines.

CONSOLIDATED GAS MONEY.—The Consolidated Gas Company of New York City has sold to N. W. Harris & Company the balance of the $5,000,000 of one year 6 per cent notes which the directors authorized last week. The bankers took $1,500,000 of the issue last week and held the rest under option. A representative of the bankers states that practically all of the notes have been sold to investors. This quick sale furnished cumulative evidence of the great increase in the demand for short-term securities which has sprung up within the last few weeks. The purpose of this gas issue, it was officially stated, is to provide for new construction at the company's Astoria plant and the extension of its electrical service by the New York Edison Company, which is again feeling the impulse of new business.

FEBRUARY DISBURSEMENTS.—It is stated that the February dividend and interest disbursement will exceed $70,000,000. Up to the present date the dividends declared upon the stock outstanding of the various railroads, industrial, public service corporations, and the banks and trust companies of New York City aggregate $25,291,565 as compared with $22,519,935 paid during February, 1907, while the total interest payable upon bonds by railroads, industrials, public service corporations, New York City and the United States Government will aggregate $35,332,830, as compared with $30,670,984 for February, 1907.

UNITED WIRELESS REPORT.—The United Wireless Telegraph Company has mailed to stockholders the following financial report as of Nov. 30, 1907:

ASSETS.	
Good will and patent rights	$500,000
Treasury stock, preferred and common	6,659,110
Stock and bonds of other wireless companies	12,459,263
Works, Jersey City	23,405
Station, boat and ærogram equipment	229,988
Furniture and fixtures	4,085
Cash, accounts receivable	241,612
Total	$20,117,463
LIABILITIES.	
Capital stock	$20,000,000
Bills payable	2,534
Accounts payable	114,929
Total	$20,117,463

As the company was only formed Feb. 14, 1907, no comparison with a former period can be made. The United Wireless was organized to take over the affairs of the DeForest Company and to unify wireless interests, and the president says the progress made during 1907 was satisfactory. In that time the number of ships equipped with the apparatus of the company has been considerably augmented, and a chain of coast stations completed from New York to Galveston. On the Pacific Coast a chain of stations from San Diego, Cal., to the Canadian border is practically finished. Land has also been acquired at Vancouver, B. C., for a station, and the erection of the plant at that point will begin as soon as the necessary permit can be secured from the Canadian government. Stations on the Alaskan coast will be established this year. President Wilson reports a number of orders for equipment from ship owners, and says the outlook for 1908 is that several hundred vessels will install the apparatus. Inquiry among shipping people indicates that the service they are receiving from the United Wireless is satisfactory. From this service the company is deriving a good revenue. The company has about 12,500 stockholders.

CHESAPEAKE & OHIO TELEPHONE.—The report of the Chesapeake & Ohio Telephone Company for the calendar year 1907 has been received by Speaker Cannon of the House of Representatives. The report, which is required by law, shows that in 1907 the telephone earnings of the company amounted to $1,084,753.01, and the real estate earnings were $64,748.08, a total amounting to $1,149,501.09. The expenditures during the year were: For general administrative expenses and taxes, $90,510.27; traffic expenses, $293,326.89; maintenance, $262,852.09; rentals and sundries, $62,684.53; real estate expenses, $61,303.08; interest $180,200.73—a total of expenses amounting to $950,877.59. The company's net earnings amounted to $198,623.50, of which there was charged off on account of depreciation the sum of $123,205.13, leaving a revenue balance of $75,418.37. The receipts on account of capital were $559,409.23, being the proceeds of the company's notes. The expenditures on account of capital were for the construction of underground conduits and cables, $197,644.05, and for the construction of poles and other aerial equipment, $19,860.74. The sum of $341,948.44 was expended for central office equipment. The total expenditures on account of capital were $559,400.23. Vice-President Bethall, of the company, who signs the report, fixes the cost of the company's plant, not including real estate, Dec. 31, 1907, at $3,878,257.12.

MACKAY TELEGRAPHS.—According to well-informed financial authorities in Boston, the fiscal year of the Mackay Companies, which closes the last of January, will show some shrinkage in both gross and net earnings from the previous 12 months. This is the outcome of the strike last summer and fall, and also the result of the business depression. It is understood that while the Postal Telegraph Company will show a sharp decline in earnings from the previous year, the gross receipts derived from the 25,000 miles of submarine cable lines will be actually larger in the year just ending than in the preceding 12 months. Officials of the company state that the decrease in the dividend balances of the operating companies is not serious enough to affect in the slightest the 4 per cent dividends which are being regularly paid on the $91,380,400 of preferred and common stock. The $800,000 received in dividends from the American Telephone Company this year is equal to over 20 per cent of the entire dividend requirements of the Mackay Companies.

WESTERN ELECTRIC TRANSFER.—It is noted that the time for the deposit of Western Electric stock in exchange for the convertible bonds of the American Telephone & Telegraph Company, under the plan announced a couple of months ago has expired. No extension was announced, but it is understood that the telephone company will accept further deposits offered within a reasonable time. At the Merchants' Loan & Trust Company, Chicago, trustee under the agreement, it was stated that a little less than half of about $6,000,000 of Western Electric stock not formerly owned by American Telephone had been deposited for transfer. The offer was $250 par value in convertible telephone bonds for $100 par value of Western Electric stock, the telephone company reserving the right, however, to take the stock for cash at $225 a share. Under the exchange into bonds the holders of Western Electric stock get a return of 10 per cent on their investment instead of 8 per cent, which the shares now pay.

KEYSTONE TELEPHONE ANNUAL.—At the Keystone Telephone Company's annual meeting in Camden, last week, several minority stockholders asked questions bearing on the policy and management of the corporation, but there was no opposition to the directorate ticket, which was re-elected. George L. Maitland, one of the minority stockholders, wanted to know why no dividends had been paid, in view of the surplus earnings of $107,740 over the fixed charges for the year. James Collins Jones, a director of the company, in reply said that the company had used surplus earnings for betterments and extensions, and that the purchase of the Eastern Telephone Company, of Camden, cost $300,000, of which $30,000 has been paid off. The Keystone Company, he said, could profitably use $500,000 new capital annually for the next four years. For six months ended Dec. 31, 1907, the surplus over fixed charges was $542,598.

HOLYOKE MUNICIPAL LIGHTING.—The annual report of the Holyoke municipal gas and electric lighting department, shows an increase of 27,000,000 cu. ft. of gas consumed, or about 20 per cent. The electric branch shows an increase of 28 per cent. During the year street light prices to the city have been reduced to $60 from $80, representing a decrease of about $10,000 in the total income of the department, but made possible by the general increase in the department's income. The plant has added 11½ miles of wire and 86 new poles during the year. The total income of the department was $307,227 from gas and electricity and $7,615 from coke. This income, less expenses, shows a profit of $54,930. Announcement has been made that the price of electricity will be reduced to 6 cents per kilowatt, from 10 cents. The new rate will go into effect Feb. 1.

MEXICAN TELEPHONE.—The Mexican Telephone & Telegraph Company reports the following earnings for the quarter and nine months of the fiscal year ended Nov. 30, figures in Mexican currency:

3 mos, Nov. 30.	1907.	1906.	Increase.
Gross	$96,472	$93,273	$3,199
Expenses	51,207	50,873	334
Net	$45,265	$42,400	$2,865
9 mos. Nov. 30.			
Gross	$293,397	$274,079	$19,318
Expenses	159,197	148,526	10,670
Net	$134,200	$125,552	$8,647

For the nine months the company spent in new construction in 1907 $61,919 and in 1906 $56,653. The number of subscribers March 1, 1907, was 6176, and on Nov. 30, 1907, 5880.

CANADIAN BELL DEAL.—The stockholders of the Bell Telephone Company, of Canada, have ratified the sale of the company's lines, buildings, equipment, and other assets in the province of Manitoba, for $3,400,000. President C. F. Sise states that he considered the bargain a good one for the company, as important reservations were made; for instance, the Bell Company has the right to operate lines in the province connecting Saskatchewan and Ontario, and the right to connect with the Manitoba Government lines on through business. The $3,400,000 forty-year 4 per cent bonds which the company will receive from the province will constitute a trust fund which can be utilized to pay for improvements to the company's present system.

GRAPHOPHONE EARNINGS.—The report of the American Graphophone Company for the year ended Sept. 30, 1907, shows an increase in net earnings of $152,585 over the previous year. The total income was $994,851, compared with $842,266 in 1906. The surplus for the year was $782,433, a gain of $149,937. The payment of preferred dividends left a balance of $635,753, which was equivalent to 24.18 per cent on the $2,626,450 common stock.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

GUNTERSVILLE, ALA.—The municipal electric light plant was recently wrecked by an explosion.

LITTLE ROCK, ARK.—The city is considering the question of erecting a new electric light plant and installing equipment capable of supplying electrical energy for 750 street arc lamps. The present plant supplies energy for about 350 arc lamps.

EUREKA, CAL.—H. L. Jackman, of the Eureka Gas & Electric Company, states that during the present year the output of the electric plant at the foot of Whipple Street will be increased 150 per cent. New machinery will also be installed at the plant of the North Mountain Power Company.

FRESNO, CAL.—The city council has refused to grant the Home Power & Light Company a franchise to construct and operate an electric light plant in this city.

HANFORD, CAL.—The Board of Supervisors has granted the Mt. Whitney Power Company a light, heat and power franchise.

MARE ISLAND, CAL.—Bids will be received until Feb. 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to deliver at Mare Island, Cal., a quantity of naval supplies as follows: Schedule 709—electrical supplies, etc. Schedule 714—insulating tape, magnet wire, etc. Schedule 717—motors, hoists, etc. Application for proposals will be furnished upon application at the navy pay office, San Francisco, or to the bureau. E. H. Rogers is paymaster-general.

OROVILLE, CAL.—The Great Western Power Company has petitioned the Board of Supervisors of Butte County for a franchise to erect electric transmission lines from the Big Bend power plant over the highways in Butte County.

PASADENA, CAL.—Horace M. Dobbins, president of the Pasadena Cycleway Association, has announced that he is at the head of a company that has been organized to construct an electric railway between Pasadena and Los Angeles, at a cost of $2,500,000. The company is capitalized at $5,000,000.

PLACERVILLE, CAL.—At a recent meeting of the City Trustees, Civil Engineer White, of Southern California, submitted a report concerning the cost of installing a municipal electric lighting plant to be erected at Smith's Flat, four miles above Placerville, at a cost of $20,000.

SAN DIEGO, CAL.—The Board of Supervisors on Jan. 11 granted a franchise to P. F. Schaniel and E. W. Jones to use the tidewater of False Bay for the purpose of developing power to generate electricity.

SAN DIEGO, CAL.—The City Council has granted a franchise to F. W. Peterson to construct and operate an electric railway on certain streets in South Diego.

AGUILAR, COL.—The town officials have granted the Hawkins & Barnett Machine Company, of Trinidad, a franchise to supply electrical energy for lamps and motors in Aguilar. The company will soon begin the construction of an electric light plant of sufficient output not only to meet the local demands, but also to furnish electricity for both lamps and motors to adjacent coal mines. The cost of the plant is estimated at $25,000.

NEW HAVEN, CONN.—The capital stock of the United Illuminating Company has been increased from $1,000,000 to $1,500,000, the proceeds to be used for extensions and improvements to its plant.

SOUTH NORWALK, CONN.—The citizens of East Norwalk are contemplating installing an electric lighting system and have submitted a proposition to the City Council of South Norwalk asking that the city furnish from its municipal electric plant electrical energy for operating the system. The town of East Norwalk proposes to erect its own distributing system, and secure electricity from the South Norwalk plant to operate a 50-hp motor-generator.

WASHINGTON, D. C.—A bill has been introduced in Congress by Congressman Russell, of Missouri, asking for permission to erect several dams across the White River, in southern Missouri, for the purpose of developing the water power to generate electricity for different enterprises in that part of the state. It is said that W. H. Standish, of Aurora, Mo., is interested in the projects. Mr. Standish states that he already has the necessary capital pledged to carry on the work, if Congress will grant permission for the construction of the dams.

MIAMI, FLA.—The board of trade has presented a request to the city council that street lamps be placed over the principal street crossings in the city. W. D. Avery, of the electric light company, informed the council that the company would install all the lamps and supply electricity on a moonlight schedule for $85 per lamp per night.

MACON, GA.—It is reported that the directors of the Macon Railway & Light Company are contemplating the extension of the Bellevue car line to the race tracks at Idle Hour Farm.

BOISE, IDAHO.—The Andrews Light & Power Company is to be incorporated, with a capital of $50,000, to construct a power plant on the Lemhi River, near Salmon City.

LEWISTON, IDAHO.—Frank McKean, of Chicago, Ill., representing Eastern parties, has submitted a proposition to the people of Lewiston to build an electric railway from Lewiston to Antone and Cloverland, a distance of 45 miles, at a cost of $2,000,000.

LEROY, ILL.—The City Council is considering the proposition to replace the arc lamps now in use in the city with 60-cp incandescent lamps.

SHAWNEETOWN, ILL.—The city of Shawneetown was enjoined Jan. 15 by Judge Creighton, of Fairfield, from buying the electric light plant recently erected in this city. The City Council recently voted to purchase the plant from Judge Richard Cadle, the owner, on its completion and test, for $17,000.

TOWER HILL, ILL.—The Town Council has granted a franchise to the Mattoon-Shelbyville-Pana-Hillsboro Interurban Railway Company.

WATERTOWN, ILL.—The Village Board has granted a franchise to W. H. Downing, of Silvis, to furnish gas and electricity for lamps and motors in Watertown.

BLOOMINGTON, IND.—The City Council has granted a franchise to the Grand Central Traction Company, which proposes to construct a railway between Indianapolis and Evansville.

CLAYPOOL, IND.—H. L. Oldfather and Arthur Smith, principal owners of the Peoples' Mutual Telephone Company, have sold the plant and lines connecting this city with Burket, Silver Lake and North Manchester to A. A. Mendel. The system will hereafter be operated in connection with the Mendel Telephone Company. Mr. Mendel announces that he will improve the service by rebuilding many of the lines and will give a metallic service to the business sections of Claypool.

CLINTON, IND.—Preliminary steps have been taken to organize a company to build an interurban railway from Clinton to Danville, Ill. The Commercial Club of Clinton will endeavor to interest Terre Haute and Danville capitalists.

FRANKFORT, IND.—The promoters of the Frankfort, Delphi & Northern Traction Company are making arrangements to complete the railway between Frankfort and Delphi. The right of way has been secured for a distance of 27 miles. The company proposes to build a dam on the Wild Cat River at Prymont to generate electricity to operate the entire system. The company also plans to furnish electrical energy for lamps and motors to towns and cities along the proposed railway, having secured 25-year franchises in the towns along the route. The second section will be built between Delphi and Monticello, where a dam will be constructed in the Tippecanoe River.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has asked the Board of Public Works to amend its present franchise, extending it by a period of 14 years, so that it will expire in 1938, instead of 1923, and also is asking to be allowed to increase its charges for service.

LAFAYETTE, IND.—This city is considering the construction and equipment of an electric light plant to run in connection with the water works plant. Prof. J. W. Ersterline, of Purdue University, will prepare plans and estimates.

VALPARAISO, IND.—The Town Board has granted T. E. Bell, of Harvard, a twenty-five year franchise to operate an electric light and gas plant in the town.

FT. DES MOINES, IA. — Bids will be received until Feb. 12, by Captain John J. Boniface, constructing quartermaster, U. S. A., for furnishing and installing electric wiring, electric fixtures, etc., in the addition to subsistence storehouse and shelter for mounted guard at this post.

FORT DES MOINES, IA.—Bids will be received until Feb. 24 by Captain John J. Boniface, constructing quartermaster, for furnishing and installing electric wiring, electric light fixtures, etc., complete in a double set of captain's quarters, and two sets of lieutenant's quarters to be constructed at Fort Des Moines.

SIOUX CITY, IA.—The directors of the new State Telephone Company have authorized the completion of the extension of the twin cities line, the line on the Nebraska side of the Missouri River to Omaha and a line from Wayne, Neb., to Omaha. The cost of the construction of the above lines is estimated at about $125,000.

BELOIT, KAN.—A. Simpson, city clerk, writes that about $20,000 will be expended for a water works and electric light plant. No engineer has been selected as yet.

CLAY CENTER, KAN.—Extensive improvements are contemplated by the Clay Center Telephone Company to its system in this city, which will involve an expenditure of about $14,000.

ELKTON, KY.—The Todd County Home Telephone Company has increased its capital stock from $60,000 to $100,000. B. B. Petree is president.

MAYFIELD, KY.—The Mayfield Water & Light Company is contemplating making general improvements to its plant and installing about 30 arc lamps. C. R. Boone is superintendent.

PADUCAH, KY.—Plans and estimates are being prepared for the Paducah & Southern Electric Railway Company by the Westinghouse

Electric & Manufacturing Company for the proposed interurban railway between Paducah and Mayfield.

AUGUSTA, ME.—Bids will be received until Feb. 25 by the commanding officer of the Augusta Arsenal for furnishing and delivering electric switchboard, motor generator sets, motors, air compressor, metal working and wood working machines, some with motor drive, pneumatic hammer, electric and overhead cranes, fuel oil furnaces, testing machine, etc.

BANGOR, ME.—Owing to the refusal of the Eastern Manufacturing Company to pay $1,500 on Jan. 14 to the Bodwell Water Power Company, as suggested by Judge Putnam, of the United States Circuit Court, at Portland Jan. 11, the receivers of the Bodwell Water Power Company have closed down the plant at Milford.

BUCKSPORT, ME.—The new power plant of the Penobscot Bay Electric Company, on Alamoosook Lake, is nearing completion and will be ready for operation in about six weeks. It is expected that it will have an output of from 800 to 1200 horse-power at the start. The transmission line to Bucksport has been completed and as soon as the plant is completed the streets of the town will be lighted by electricity. William M. Shaw, of Greenville, is president of the company.

NORTHPORT, MAINE.—An effort is being made to have electric lamps installed at East Northport and the Camp Ground. C. O. Dickey is interested in the movement.

BROOKLINE, MASS.—The citizens have voted to appropriate $2,000, to be used by the committee appointed some time ago to consider the construction of a municipal electric light plant, to complete its investigations and to obtain expert advice. The Selectmen were also authorized to appear before the State Gas and Electric Light Commissioners to obtain a reduction in the price of electricity furnished to the town.

CAMBRIDGE MASS.—The city council has decided to petition the legislature for permission to construct, maintain and lease conduits for electrical wires, in the city of Cambridge.

CHARLTON, MASS.—The citizens are considering the question of making arrangements to secure electric service for lighting the residences and public buildings in the town At present the only building lighted by electricity in the town is the Town Hall, the service being supplied by the Worcester & Southbridge Street Railway Company.

GROVELAND, MASS.—The town of Groveland is now lighted from the municipal electric light plant which was started during the past week. Electrical energy for operating the system is furnished by the Haverhill Electric Company. The street lighting system consists of 230 incandescent lamps.

HOLYOKE, MASS.—Announcement has been made by the officials of the American Writing Paper Company that a new power house will be erected in this city in the near future to supply power to five of its factories here. The new building will be erected on the banks of the Connecticut River and will cost about $100,000.

IPSWICH, MASS.—Ex-Senator G. A. Schofield has filed a bill petitioning the legislature to authorize the Ipswich Electric Light Company to issue $30,000 in bonds to provide for future extensions to the plant.

SPRINGFIELD, MASS.—The State Gas and Electric Light Commissioners have granted the United Electric Light Company permission to issue $350,000 additional capital stock, the issue to comprise 2500 shares at $140 per share, to pay for additions to plant and to retire notes.

BERRIAN SPRINGS, MICH.—F. A. Bryan, vice-president of the Berrian Springs Power & Electric Company, which is building a large dam in the St. Joseph River, states that the company has secured all rights for the construction of another dam in the St. Joseph River at Bertrand, and on which work will commence as soon as the Berrian Springs dam is completed.

CRYSTAL FALLS, MICH.—Extensive improvements and additions are being made to the municipal electric light plant, including the installation of a 300-kw Fort Wayne, three-phase generator, two 300-hp Leffel turbines. Q. Stephany is manager.

DETROIT, MICH.—The public lighting commission will submit an estimate of $61,000 to the Board of Estimates for a new 2000-kw turbine unit for the municipal electric light plant.

DETROIT, MICH.—Two electric cranes have recently been installed in the plant of the Detroit Steel Cooperage Works, together with a 125-kw generator for the operation of the cranes and other tools. The equipment was installed by the Detroit Engineering Works.

EVART, MICH.—The citizens are considering the question of changing the system of the municipal electric light plant from direct to alternating current and installing gas engines and producer gas plant. Perry Leach is superintendent.

GRAND RAPIDS, MICH.—The city council is considering the proposition of the Grand Rapids-Muskegon Power Company to take over the municipal electric plant and furnish electricity for the street lighting system. According to the proposition submitted to the council the power company agrees to assume all the initial expense in the purchase and installation of electric motors and appurtenances necessary to make the change, belting the present arc generators from these motors and allowing them to remain in their present location, so that should the occasion require, they could be belted and run from the engines as at present. The power company to maintain and operate the entire plant, delivering the energy at the switchboards to the street-lighting circuits, at the rate of one-half cent per lamp-hour, on a basis of 800 lamps. At the expiration of the contract the company to turn over the plant to the city in as good condition as when it took charge, barring ordinary depreciation. The contract is for a term of three years. It is estimated that the city will save about $6,000 a year by the change. Samuel A. Freshney is secretary and manager of the municipal plant.

HOUGHTON, MICH.—The Houghton County Street Railway Company is contemplating extending its line from Wolverine to Mohawk. W. H. McGrath is manager of the company.

HURON, MICH.—The Thorne Electric Company, of Bay City, has secured the contract for installing a system of electric lamps and motor equipment in the plant of the Huron Cement Company, at Alpena, at a cost of about $30,000.

NORWAY, MICH.—The City Council is considering the question of enlarging the municipal electric light plant.

STERLING, MICH.—Plans are being made by the Sterling Elevator Company to install an electric light plant in the elevator building. Jesse S. Hamlin is manager.

BRAINARD, MINN.—The city council contemplates installing a new generator in the municipal electric light plant.

EVELETH, MINN.—It is reported that the City Council is considering the question of the erection of a municipal electric light plant.

HINCKLEY, MINN.—R. P. Runckle and J. J. Colhurne, of Cloquet, are seeking a franchise to construct an electric light plant in this place to be operated in connection with their proposed flour mill here.

COLUMBUS, MISS.—It is reported that David L. Parsons, of this city, is preparing plans for the construction of an electric light plant. The generating equipment will consist of 100 to 300 kw alternating-current three-phase machines, or 100 to 150 kw direct-current generators.

CALIFORNIA, MO.—The plant of the California Electric Light & Power Company has been leased to L. H. Ades, of Rockport, Ill., and Edwin Boyd, of Tipton. It is reported that the new management contemplates extending the transmission lines to Tipton.

FARMINGTON, MO.—An election will soon be held to vote on the proposition to bond the city for $20,000 to $25,000 to install a municipal electric light plant in connection with the water works system.

HALE, MO.—The plant of the Citizens' Light & Power Company has been sold to Edgar Jackson, of Carrollton, who will erect a new building and install a steam engine.

MAYSVILLE, MO.—At a special election held recently the proposition to isue bonds for a municipal electric light plant was defeated. Another election may be held.

MERIDIAN, MISS.—Frank Marty, of this city, is contemplating the construction of a new foundry, which will be furnished with electric motor drive.

ANACONDA, MONT.—Arrangements are being made to substitute electricity for steam power at the Washoe smelter. About 5000 horse-power will be used at the works. Electrical energy for operating the plant will be secured from the Hauser Lake dam, near Helena.

AUBURN, NEB.—It is reported that C. A. Snyder has submitted a proposition to the City Council to install an electric motor in the pumping station to pump the city water supply.

JOHNSON, NEB.—The citizens are considering the question of establishing a municipal electric light plant.

RENO, NEV.—Steamboat Springs, a summer resort, has been purchased from Colonel Hopkins by Dr. A. S. Brackett and associates. The new owners will expend $100,000 in improving the resort, which will include the building of an electric railway from Reno.

WINNEMUCCA, NEV.—The Utah, Nevada & Idaho Telephone Company, which is constructing a line from Salt Lake City to Reno, Nev., is contemplating the purchase of the Home Telephone Company's system, including the Paradise and Golconda lines. The new company is absorbing the local systems, having taken over the entire Ely County system. It is also stated that the Nevada Northern Telephone & Telegraph Company, operating in and around Lovelock, with its branch lines to Seven Troughs and Mazuma, will also be purchased by the new company.

HILL, N. H.—F. R. Woodward, proprietor of the New England Novelty Works, is installing a dynamo to generate electricity to light his factory.

RAYMOND, N. H. It is reported that the local electric light plant owned by Charles A. Fox, has been purchased by Charles F. Gardner, of Brockton, Mass.

RIVERSIDE, N. J.—The Cinnaminson Electric Light, Heat & Power Company is rebuilding its lines and making arrangements to furnish a 24-hour service, and will furnish electricity for motors for manufacturing concerns. The company also furnishes electrical energy for the Camden & Trenton Railway Company, between West Palmyra and Burlington, and is rebuilding its lines between the two places. So far the new wires have been erected between Riverside and Riverton.

TRENTON, N. J.—Warden Atschley, of the New Jersey State Hospital for Insane, has recommended the construction of an electric light plant at a cost of $20,000.

ALBANY, N. Y.—The New York Central Railroad Company is making extensive improvements to its lighting system at the West Albany shops, which will require the rewiring of all the buildings at a cost of about $25,000.

ATTICA, N. Y.—The Attica Water, Gas & Electric Company has entered into an agreement to supply electricity for lamps for the village of Attica for one year ending Nov. 1, 1908.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railroad Company has decided to construct six sub-stations at a cost of $250,000, plans for which have been completed by Ford, Bacon & Davis, of New York City.

FRANKLINVILLE, N. Y.—The Empire Electric Light Company has applied to the Public Service Commission for permission to increase its capital stock from $2,500 to $12,500. G. W. G. Ferris is treasurer and general manager.

LEITCHFIELD, N. Y.—The City Council is considering the question of establishing a municipal lighting plant in this city.

LONG ISLAND, N. Y.—O. Brown, superintendent of the Long Island Cotton Mills, writes that the development of the Buffalo Shoals water power has been postponed until business conditions improve.

ROSLYN, N. Y.—The New York & North Shore Traction Company has filed with the Secretary of State a certificate of extension of route from Roslyn to Flushing. The Board of Supervisors of Nassau County has granted the company a franchise to extend its line from Floyd's Corners, Roslyn, to the city line at Little Neck. The road will run through Manhasset, Great Neck and Thomaston.

ROCHESTER, N. Y.—The capital stock of the Rochester Telephone Company has been increased from $550,000 to $1,050,000.

ROCHESTER, N. Y.—The Rochester Telephone Company has filed a certificate with the Secretary of State showing an increase in its capital stock from $650,000 to $1,050,000.

SYRACUSE, N. Y.—The City Council has decided to increase the appropriation for street lighting sufficiently to add 75 lamps.

CHARLOTTE, N. C.—The Southern Power Company is making arrangements to double the force at once on its water-power development at Rocky Creek. The company expects to finish the plant by September. The plant will have an output of 40,000 electrical horse-power, and is to be a duplicate of the Great Falls plant of the company, two miles distant. When this plant is completed the company will have an output of 100,000 horse-power. W. S. Lee is general manager.

NEWBERN, N. C.—A direct-connected unit is being installed in the municipal electric light plant to increase the output of the plant.

COLUMBUS, OHIO.—The city authorities here are preparing to demand that all electric wires be placed underground.

WARREN, OHIO.—The City Council is contemplating having plans and estimates made of the cost of installing and operating an electric light plant in case negotiations for the purchase of the local plant are not carried out.

YOUNGSTOWN, OHIO.—The City Council is considering the question of establishing a municipal electric light plant in this city.

YOUNGSTOWN, OHIO.—The Pennsylvania Railroad Company is erecting a large power plant at Lawrence Junction to furnish electricity to illuminate its yards from West Moravia, a distance of about four miles.

PERKINS, OKLA.—An election will be held Feb. 3 to vote on the proposition of the city buying the local electric light plant.

ARDMORE, OKLA.—The Ardmore Ice, Light & Power Company contemplates extensive additions and improvements to its plant, which will involve an expenditure of from $40,000 to $50,000. An addition will be erected to the power house, an 800-hp engine and a 175-kw generator installed.

OKMULGEE, OKLA.—We are informed that the Okmulgee Ice & Light Company is planning to install a 150-kw direct-connected unit in its plant this spring. W. W. Bavington is secretary and manager.

BROWNSVILLE, ORE.—The Brownsville Dam, just above the city, has given way, putting the electric light plant of the Brownsville Electric Light Company and other manufacturing plants out of commission. The dam cannot be repaired until the low-water period, which will be several months hence.

COQUILLE, ORE.—The Coquille River Electric Company contemplates installing a 250-hp engine in its plant this year. Frank Morse is manager.

PRINEVILLE, ORE.—The Prineville Light & Water Company contemplates installing a hydro-electric plant on the Deschutes River during the coming summer. Adrian Crooks is superintendent.

GRESHAM, ORE.—The Multnomah & Clackamas Mutual Telephone Company has increased its capital stock to $10,000.

HILLSBORO, ORE.—The City Council has decided to make improvements to the municipal electric light plant, and will install a new and larger generator.

McMINNVILLE, ORE.—Plans are being made for extensive improvements and extensions to the municipal electric light plant, which will include the rebuilding of the plant and rewiring the entire overhead system. Clarence Edwards, of Newberg, will have charge of the work.

SALEM, ORE.—John McNary, acting for the Portland, Eugene & Eastern Railway Company, has filed notice of appropriation of 2000 cu. ft. of water from the McKenzie River, in Lane County. A. Welch is manager of the company.

CHAMBERSBURG, PA.—The directors of the Chambersburg, Greencastle & Waynesboro Street Railway Company have awarded the contract for the additional electrical machinery and other equipment for the extension from Greencastle to Chambersburg to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., through the J. G. Schaff Electrical Company, of Chambersburg.

LIGONIER, PA.—The Borough Council has granted a franchise to Lesley W. Moore, of Kuhn, to erect and operate a telephone system in the Borough of Ligonier.

McADOO, PA.—The Consumers' Light & Power Company has taken a lease of the municipal electric light plant for a term of 25 years and will take possession Feb. 1.

PHILADELPHIA, PA.—Plans are being prepared by Chief McLaughlin, of the Electrical Bureau, for an elaborate electric lighting system with ornamental lamps for the Broad Street Boulevard.

SOUTH PITTSBURG, PA.—Extensive additions and improvements are contemplated by the New South Pittsburg Light & Power Company, including the installation of a three-phase, 60-cycle, 2300-volt system and extending its transmission lines to Dedford, Copenhagen and Bridgeport. C. A. Sutliff is owner and manager.

SUMMIT, S. D.—A stock company has been formed to install a local independent telephone system.

WAGNER, S. D.—The stockholders of the Farmers' Home Telephone Company have decided to increase the capital stock of the company from $8,000 to $25,000.

FORT WORTH, TEX.—The Northern Texas Traction Company will resume work on improvements to its power plant at Handley, which supplies electricity for the city and interurban lines. The cost of the improvements is estimated at $150,000.

HOUSTON, TEX.—The Houston Traction Company has been granted a franchise to build an extension of its lines to Harrisburg.

ARVONIA, VA.—The question of establishing an electric power plant in this town is under consideration.

CHRISTIANSBURG, VA.—The Grayson Electric Corporation, of Graysontown, and the lighting systems of Christiansburg and Grayson have been purchased by the Vaughn Construction Company, of Roanoke, Va., and will be operated under the name of the Grayson Electric Corporation. The company contemplates building an electric railway from Christiansburg to Cambria. The officers of the company are J. L. Vaughn, president; E. S. Hagan, vice-president, and A. A. Phlegar, secretary and treasurer.

LYNCHBURG, VA.—The Lynchburg Traction & Light Company is contemplating making extensive additions to the equipment of its plant, and will install a 1500-kw turbine, 900-hp boiler and one 750-kw rotary converter. R. D. Apperson is president and manager.

BELLINGHAM, WASH.—A sub-station will be erected in South Bellingham by the Whatcom County Railway & Light Company to be supplied direct from the plant of the company at Nooksack Falls. The company is making arrangements to supply electrical energy to the new flour mill now under construction.

ELMA, WASH.—The operation of the hydro-electric plant of the Elma Light & Power Company, located on Cloquallam Creek, about three miles from Elma, was started Jan. 12, and the plant is now furnishing electrical energy for the local system.

NORTH YAKIMA, WASH.—A company will be organized to construct an electric railway from Granger to North Yakima. Walter Granger, who has charge of the Government reclamation work in the Sunnyside Valley, is one of the leaders of the project: W. A. McDonald and J. H. Thomas are also interested in the project.

PORT ORCHARD, WASH.—John T. Mitchell, of Seattle, has presented an application to the board of county commissioners for a franchise to erect electric transmission lines over the county roads from Colby to Long Lake and vicinity, where extensive plans are being made for a summer resort.

SEATTLE, WASH.—F. X. Waldron & Company, of King County, has petitioned the commissioners of King County for permission to erect and operate an electric light, heat and power plant on Vashon Island, and to construct and operate an electric railway on the island.

SPOKANE, WASH.—Mines in the eastern part of Okanogan County and the Chekapa mines on the west, and the territory reaching from the British Columbia boundary on the north to Brewster at the mouth of the Okanogan River, on the south with boundaries to Chesaw and Molson, in north central Washington, will be supplied with electricity for lamps and motors by the Similkameen Power Company, which has recently been granted a 50-year franchise by the County Commissioners of Okanogan County. The company is capitalized at $1,200,000, and has a 1500-hp power plant at the falls of the Similkameen River, where it is proposed ultimately to develop 10,000 horse-power. The company also proposes to furnish electrical energy in the towns of Chesaw, Molson, Nighthawk, Loomis, Conconnully, Riverside, Omak, Okanogan and Brewster. The officers are Monroe Harman, of Oroville, president; Charles A. Andrus, of Nighthawk, vice-president and secretary, and H. W. Johnson, of Oroville, treasurer and general manager.

BRIDGEPORT, W. VA.—The citizens are considering the question of erecting a municipal electric light plant. The present street lighting system consists of 56 arc lamps, the energy for which the town pays $4,000 a year.

HUNTINGTON, W. VA.—The city is considering the question of placing a contract to light the city for a term of five or ten years; 160 arc lamps will be required. For further information address Rufus Switzer, chairman of fianance committee.

BALDWIN, WIS.—The capital stock of the Baldwin Telephone Company has been increased from $15,000 to $25,000.

BRODHEAD, WIS.—Plans are being formulated for building an independent farmers' telephone system in Decatur, taking in Spring Grove and Spring Valley.

CASHTON, WIS.—The citizens on Jan. 21 voted to issue $15,000 in bonds for the construction of a municipal electric light plant. An old mill property will be purchased and fitted up as a power plant.

CEDAR LAKE, WIS.—The capital stock of the Cedar Lake Telephone Company has been increased from $2,000 to $10,000. John Rosenheimer, Sr., is president of the company.

COLBY, WIS.—The electric light plant in Colby was recently destroyed by fire, causing a loss of from $6,000 to $8,000.

MILWAUKEE, WIS.—The council committee has recommended to the city council that the people be given another opportunity to vote on the question of building a municipal electric light plant. When the question was voted upon last time it was understood that a plant could be built for $500,000. Now it is maintained that a plant will cost at least $1,000,000.

OCONTO FALLS, WIS.—It is reported that the Oconto Falls Manufacturing Company has decided to rebuild its plant as soon as the insurance is adjusted. The company is contemplating the construction of a dam about a half a mile below the present dam. The dam, if erected, will furnish power to generate electricity to operate motors for the mill and to light the entire property. A. C. Merryman is president.

OSCEOLA, WIS.—The Village Trustees have granted C. C. Ladd, of the Osceola Mill & Elevator Company, a 20-year franchise to furnish electricity for lamps and motors in the village.

PORTAGE, WIS.—The Portage Electric Light Company has made application to the State Railroad Commission for permission to lower its schedule of rates in this city. The present rate is 15 cents to 10 cents per kw-hour. The new rate asked for is 10 cents to 6 cents per kw-hour.

SCHLEISINGERVILLE, WIS.—The Cedar Lake Telephone Company has increased its capital stock from $2,000 to $10,000.

SPOONER, WIS.—The stockholders of the Spooner division of the Badger Mutual Telephone Company have decided to withdraw from the company and organize another company under the name of the Burnett Washburn County Telephone Company. C. L. Keinztary is president of the company.

STURGEON BAY, WIS.—Henry Fetzer, of Sturgeon Bay, is interested in a project to develop water power at Potato Rapids to generate electricity to be transmitted by cable across Green Bay, a distance of twenty-two miles.

VIROQUA, WIS.—The Viroqua Electric Light Company contemplates rebuilding its plant in the near future and installing a new dynamo and engine. John M. White is manager.

NELSON, B. C.—The Nelson Electric Smelting Company is making arrangements to handle zinc, silver and lead ores by an electrical process, and expects to begin operation early in April. The plant is for experimental purposes only, and if the new principle is worked out successfully, a larger plant will be erected next fall.

CHIHUAHUA, MEX.—Enrique C. Creel has been elected president of the Compania Electrica y de Ferrocarriles of Chihuahua. This company recently took over the entire holdings of the Mineral Railroad Company and the street railway system and electric light plant company in the city of Chihuahua. The Mineral Railroad is at present a steam line which connects the Santa Eulalia mining camp with the city of Chihuahua and the new smelter. The plans of the new company call for changing the motive power of the Mineral Railroad from steam to electricity and to operate all the city lines by electricity. A large power plant will be built to furnish electrical energy for operating the railways, and also for lamps and motors. A. C. Nash is general manager of the company.

CULIACAN, MEX.—Francis Butterfield has been granted a franchise by the City Council to build a street railway system in this city.

GUADALAJARA, MEX.—Manuel Cuesta Gallardo, of this city, who holds a concession from the Federal Government for the available water power on the Santiago River for several miles, has begun the erection of a hydro-electric plant near Guadalajara. It will have an initial output of 6500 horse-power. He will build transmission lines to the city of Guadalajara and to the mining districts situated from 100 to 175 miles distant from the site of the power plant.

LINARES, MEX.—J. M. Bonilla, of Linares, is contemplating the construction of an electric railway in this town.

ORIZABA, MEX.—The Segura, Braniff Company has been reorganized under the name of Compania de Luz Electrica y Fuerza Motriz de Orizaba. The new company has a capital stock of $1,200,000 and proposes to install an electric light and power plant at Orizaba.

PUENTE DEL PASO, MEX.—Fernando Iglesias has advised the Federal Government that he will install a hydro-electric plant on the El Clifton River, near this town.

SANTA ROSALIA, MEX.—Renato J. de Morambert, of this city, is arranging to establish an electric light and power plant in this place.

TULANCINGO, MEX.—Trinidad Herrera has entered into a contract with the municipal authorities of Tulancingo to install a hydro-electric plant at the Salto de la Granada falls near this place. The town will be furnished with electrical energy for lamps and motors by the proposed plant.

CEDAR HILL, N. M.—It is reported that the Eden Canal & Power Company is contemplating installing a large irrigation and power plant.

BRIDGEWATER, N. S.—The Micmac Gold Mining Company is planning to install a hydro-electric plant to furnish its mines with electricity, located seven miles from this town. The plant will be built on a tributary of the La Havre River, nine miles from the mines, where it is proposed to build a dam 200 ft. long and 15 ft. high. The present plans provide for the development of 400 horse-power, and provision will be made for developing additional power as needed. The company will install two water wheels, two generators, motors, turbine pumps, electric hoists, drills, tools, and will also need nine miles of wire and about 500 cedar poles. The cost of the plant is estimated from $45,000 to $50,000. Philip H. Moore, 2 Rector Street, New York, N. Y., is consulting engineer; W. B. Arnold, Boston, Mass., secretary.

HAMILTON, ONT.—Owing to a mistake said to have been made in a supplementary letter sent out after the specifications had been issued for the electric pumps and motors to be installed at the Beach, the fire and water committee has decided to call for new tenders for the pumps.

PORT ARTHUR, ONT.—The City Council has completed arrangements with the Kaministiquia Power Company for the supply of 525 kw of energy for lamps and for the operation of the street car system. Owing to the failure of the water supply it is necessary for the city to obtain electricity from other sources.

PORT HOPE, ONT.—A bylaw authorizing the Town Council to proceed with the erection of a municipal lighting plant was carried.

TORONTO, ONT.—Mayor Stewart has been informed by Hon. Adam Beck, of the Hydro-Electric Commission, that the commission is now in a position to make contracts with municipalities that have passed by-laws, and all that is necessary now is for the municipalities to state how much energy they will require.

UXBRIDGE, ONT.—The town of Uxbridge contemplates making application to the next session of the Legislature for permission to operate an electric light plant.

MONTREAL, QUE.—The Bell Telephone Company is making plans for many extensions and improvements to its system throughout Ontario. The most extensive work will be the improvement of the lines in and around Toronto.

PRINCE ALBERT, SASK.—The ratepayers have voted in favor of raising $50,000 for the extension of the electric light and water works systems. F. A. Creighton is city engineer.

New Industrial Companies.

THE ELECTRIC MANUFACTURING COMPANY, of New Orleans, La., has been incorporated, with a capital stock of $30,000, by A. G. Schrwiner, D. H. Comparett and others.

THE STIRLING ELECTRIC COMPANY, of San Francisco, Cal., has been formed to take over the business of the Century-Kline Company, dealers in electrical supplies. F. M. Greenwood is president and W. S. Goodman, vice-president.

THE RANDALL INSULATED WIRE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, by Franklin S. Randall, of Weehawken, N. J.;, Ira Mowry, of Morristown, N. J.; Bernard G. Heyn, of New York, N. Y.

THE WABASH AUTO & ELECTRIC COMPANY, of Terre Haute, Ind., has been incorporated to establish a plant for the manufacture and repair of automobiles, the manufacture of electrical supplies and to do a general electrical contract and construction business.

THE CHARLES A. SCHIEREN COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $1,000,000, by Charles A. Schieren, F. A. M. Burrell, C. A. Schieren, Jr., C. Arthur Schieren and Harry Victor Schieren. The company will manufacture leather and belting.

THE AJAX SPECIALTY COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $1,000. The directors are: Charles Smith, president and treasurer; George R. Porter and Walter B. Farmer. The company proposes to deal in telephone, electrical and mechanical appliances.

THE MASSACHUSETTS ELECTRICAL EQUIPMENT COMPANY, of New Bedford, Mass., has been incorporated, with a capital stock of $50,000. The company proposes to deal in machinery, electrical appliances, etc. The officers of the company are: Rufus B. Delano, president, and Walter M. Thomas, treasurer.

THE VAN-BERGH ELECTRICAL & MANUFACTURING COMPANY, of Winnipeg, Man., has been incorporated with a capital of $250,000. The directors are Hugh John Macdonald, H. Polson, A. Kennedy, W. McMillan, H. R. Hollinshead. J. Dobson, E. E. Yates, W. D. Pettigrew and J. MacKenzie, all of Winnipeg.

Company Elections.

MOBILE, ALA.—At the annual meeting of the Home Telephone Company held Jan. 14 the following-named officers were elected: J. C. Montieth, of Louisville, Ky., president; W. H. Bryant, of Mobile, vice-president and general manager; R. L. Douglass, of Mobile, secretary, and J. E. Bergin, treasurer.

CANTON, ILL.—At the annual meeting of the Illinois Central Electric Railway Company, held recently, the following-named officers were elected: Leslie W. Morton, president; M. W. Rafferty, vice-president; John V. Brokaw, second vice-president; W. D. Plattenburg, secretary; E. A. Heald, treasurer, and G. W. Chandler, general manager.

PEORIA, ILL.—At the annual meeting of the People's Telephone Company held Jan. 13 officers were elected as follows: B. F. Zinser, president; R. H. Truitt, vice-president, and J. S. Daily, secretary and treasurer.

BURLINGTON, IA.—At the annual meeting of the Citizens' Mutual Telephone Company held Jan. 11 the following-named officers were elected: L. F. Christy, president; Evan Evans, vice-president; Clarence Deupree, secretary, and E. K. Herr, treasurer.

TOPEKA, KAN.—At the annual meeting of the Topeka Street Railway Company the following-named officers were elected for the ensuing year: E. W. Wilson, president; L. E. Myers, vice-president; F. G. Kelly, secretary and treasurer.

AMHERST, MASS.—At the annual meeting of the Connecticut River Power Company, held Jan. 20, the following-named officers were elected: Charles F. Deuel, of Amherst, president; Philip Cabbott, of Boston, vice-president; M. A. Dickinson, of Amherst, treasurer, and C. W. Hazleton, of Turners Falls, clerk.

FALL RIVER, MASS.—At the annual meeting of the Fall River Electric Company held Jan. 13 the present officers were re-elected for the ensuing year.

GREENFIELD, MASS.—At the annual meeting of the Greenfield Electric Light & Power Company the following-named officers were elected: J. W. Stevens, president; G. W. Lawrence, treasurer; C. H. Keith, clerk.

HOLYOKE, MASS.—At the annual meeting of the Holyoke Street Railway Company, held recently, the following-named officers were elected: W. S. Loomis, president; L. D. Pellissier, secretary and treasurer.

SALEM, MASS.—At the annual meeting of the Salem Electric Lighting Company Charles H. Price was re-elected president and Henry M. Batchelder, treasurer.

HATTIESBURG, MISS.—At the annual meeting of the Hattiesburg Traction Company, held recently, the following-named officers were elected: A. F. Thomaston, president; H. S. Stevens, first vice-president; H. A. Camp, second vice-president; N. B. Blount, secretary and treasurer, and C. Z. Stevens, general manager.

FAIRMONT, NEB.—At the annual meeting of the Fillmore County Telephone Company held Jan. 11 the following-named officers were elected for the ensuing year: Otto Wettstein, president; M. Propst, vice-president; John Barsby, secretary and general manager, and E. K. Cobb, treasurer.

JOHNSTON, N. Y.—At the annual meeting of the Interstate Telephone Company the following-named officers were elected: Eugene Walrath, president; John Hurley, vice-president; George D. Hakes, secretary, and George D. Smith, treasurer.

RIVERHEAD, N. Y.—At the annual meeting of the stockholders of the Hollow & Roanoke Telephone Company held Jan. 14 the following-named officers were elected for the ensuing year: J. C. Young, president; H. R. Talmadge, vice-president; J. Frank Dimon, secretary and treasurer, and W. R. Fanning, general manager.

UTICA, N. Y.—At the annual meeting of the Ballda Electric Company held Jan. 16 the following-named officers were elected: H. S. Ballda, president; W. C. Ballda, vice-president and treasurer; F. E. Ballda, secretary, and R. W. Bryson, superintendent.

AKRON, OHIO.—At the annual meeting of the People's Telephone Company held Jan 14 the following-named officers were elected: Will Christy, president; C. W. Devoe, vice-president; Joseph S. Benner, secretary, and William F. Laubach, treasurer and general manager.

COLUMBUS, OHIO.—At the annual meeting of the directors of the Columbus Edison Company, the following named officers were elected: Otto Theobold, president; John Seibert, vice-president; Emil Kieswetter, secretary and treasurer, and L. F. Kieswetter, assistant secretary and transfer agent.

OTTAWA, OHIO.—At the annual meeting of the Farmers' Telephone Company held recently the following-named officers were elected: John Mallahan, president; P. A. Amstutz, secretary, and A. S. Hilty, treasurer.

TOLEDO, OHIO.—At the annual meeting of the Toledo Railways & Light Company held recently the present officers were re-elected.

ENID, OKLA.—At the annual meeting of the Oklahoma Rural Telephone Company held Jan. 14 the following-named officers were elected: George Raemer, of Fairmont, president; William Taggart, of Waukomis, vice-president, and Frank Bradfield, of Enid, secretary and treasurer.

DANVILLE, PA.—At the annual meeting of the Danville & Bloomsburg Street Railway Company held Jan. 13 the following-named officers were elected: Frank C. Angle, of Danville, president; Thomas B. Illig, of Reading, vice-president; W. C. Billman, of Reading, secretary, and C. E. Leippe, of Reading, treasurer.

EASTON, PA.—At the annual meeting of the Eastoo Transit Company held recently the following-named officers were elected: H. R. Fehr, president; S. H. Hackett, vice-president, and S. H. Sargeant, secretary and treasurer.

LEWISTON, PA.—At the annual meeting of the Lewiston & Reedsville Electric Railway Company the following-named officers were elected: W. H. Denlinger, president; James H. Allport, secretary, and H. F. Bigler, treasurer.

MANSFIELD, PA.—At the annual meeting of the Citizens' Mutual Telephone Company the following-named officers were elected: C. H. DeWitt, president; Finley Furman, secretary and treasurer.

MEYERSDALE, PA.—At the annual meeting of the Economy Telephone Company, of Somerset County held recently the following-named officers were elected: H. G. Will, president; R. S. Walker, secretary, and S. B. Philson, treasurer, all of Meyersdale.

ST. ALBANS, VT.—At the annual meeting of the St. Albans Electric Light & Power Company held Jan. 15 the following-named officers were elected: C. C. Chesney, of Pittsfield, Mass., president; George M. Bunting, of Philadelphia, Pa., vice-president; H. B. Hodge, of Philadelphia, Pa., secretary, and W. H. Vorce, of Dover, Del., treasurer. The directors are William E. Robertson, Frank H. Foote and W. H. Vorce.

PARKERSBURG, W. VA.—At the annual meeting of the West Virginia Western Telephone Company, held Jan. 16, the following-named officers were elected: J. H. Linger, president; J. E. Carl, vice-president; C. T. Hiteshaw, secretary and treasurer, and A. C. Davis, general manager.

LA CROSSE, WIS.—At the annual meeting of the La Crosse & Black River Falls Railway Company the following-named officers were elected: Mills Tourtellotte, president; Henry Gund, vice-president; H. J. Hirshheimer, secretary; F. P. Hixon, treasurer.

New Incorporations.

EARL, ARK.—Articles of incorporation have been filed for the Ear Light & Power Company, with a capital stock of $10,000, by C. C. Bird, C. T. Whitman, J. M. McBee and others.

DOWNIEVILLE, CAL.—Articles of incorporation of the North Yuba Electric Light & Power Company have been filed in Reno, Nev., the incorporators being Samuel B. Crane, Wm. B. Barstow and Earle Talbot. The company intends to construct and operate a power plant near the waters of the North Yuba River for the purpose of supplying electricity for lamps and motors to different cities and towns in Nevada and California. The capital stock of the company is placed at $1,000,000.

LOS ANGELES, CAL.—The Electric Construction Company has been incorporated with a capital stock of $100,000. The directors are W. F. Porter, A. C. Balch, W. G. Kerckhoff, W. W. Melviny and M. S. Graff.

NAPA, CAL.—The Vallejo Irrigation & Power Company has been incorporated, with a capital of $500,000, by Joseph A. Migliavacca, E. W. Doughty, W. G. Thompson, L. E. Johnson and Harry L. Johoson, all of this city.

SAN FRANCISCO, CAL.—The Feather River Water & Power Company has been incorporated with a capital stock of $1,000,000 by C. F. Metteer, S. A. Moss and A. E. Boynton.

ATLANTA, GA.—The Atlanta, Norcross & Gainesville Railroad Company has been incorporated by H. D. Jaquish, C. C. Sanders, W. B. Smith, J. H. Hunt, R. Smith, A. J. Mundy and others. The capital stock of the company is $15,000, with the privilege of increasing the amount as may be deemed necessary.

FITZGERALD, GA.—A charter has been granted to the Fitzgerald & Ocilla Electric Railway & Power Company, with a capital stock of $50,000, to construct and operate an electric railway between Fitzgerald and Ocilla, and to furnish electricity for lamps and motors. The incorporators are S. T. Holzendorf, of New York, N. Y.; L. C. Holzendorf, of Valdosta; C. P. Holzendorf, of Atlanta, and others.

WALLACE, IDAHO.—The North Idaho Telephone Company has been organized at Wallace, with headquarters at Kellogg. The capital stock is $25,000. The incorporators are D. W. Price, W. W. Papesh, W. F. Goddard, S. L. Shonts, Isaac Babbitt, P. P. Weber, L. W. Gay, Robert Sterling, Benjamin Carrigan, Curtis Lightner, Stanley A. Easton, W. C. Clark and A. M. Nash.

BELLEVILLE, ILL.—A charter has been granted to the Red Bud & Belleville Interurban Railway Company to construct an interurban railway from Red Bud to Smithton. The incorporators are Conrad Becker, Charles C. Smith, Herman Schryver, of Red Bud; John Keller, of Hecker, and Benjamin A. Gundlach, of Belleville.

CHICAGO, ILL.—The Western Illinois & Iowa Railroad Company has been chartered, with a capital stock of $2,500,000, by Paul A. Neuffer, Harry H. Phililps, James E. Hauronic, Charles J. Horn and Rollo M. Cole, all of Chicago. The object of the company is to construct an interurban railway in Hancock County.

HAMILTON, IND.—The New Home Telephone Company has been incorporated, with a capital stock of $25,000.

NEW ORLEANS, LA.—The New Orleans & Seashore Air Line Railway Company has been organized, with a capital stock of $1,000,000, by William F. Pinkard, Arsene Perrilliat, James W. Porch and Joho H. Menge, Jr. The company proposes to construct an electric railway from Jefferson Parish to Grand Isle.

RENO, NEV.—The Kings Hill Irrigation & Power Company has been organized for the purpose of erecting a power plant in this county. The men interested in the project are Charles and Benjamin Hammett, C. B. Hurtt, E. L. Hice and O. O. Haga, all of Boise, Idaho.

BURLINGTON, N. C.—The Burgrahaw Traction Company has been chartered with a capital stock of $250,000. Junius H. Hardin is one of the promoters of the enterprise.

SHELBY, N. C.—The Shelby Electric Light & Power Company has been chartered with a capital stock of $50,000, with the privilege of beginning business with $14,000. The incorporators are J. J. McMurray, S. A. McMurray, A. W. McMurray and J. C. Smith.

DAYTON, OHIO.—The Dayton Street Construction Railway Company has been incorporated with a capital stock of $1,000 by C. H. Bosler and others.

HINTON, OKLA.—The Cedarville Telephone Company has been incorporated by Hermann Constein, H. Z. Owen and J. Hoffman, of Hinton, and J. B. Barns, of Lookeba.

MARLINTON, W. VA.—The Marlinton & Academy Mutual Telephone Company has been incorporated by John Gay, of Marlinton; J. L. McNeel, of Millpoint; M. L. Beard and T. A. Stricker, of Academy.

Legal.

MAINE RECEIVERSHIP.—Eugene H. Mather, of Newton, Mass., general manager of the Bodwell Water Power Company, and Josiah W. Harmon, of Oldtown, were appointed receivers of the Bodwell Water Power Company, upon petition of the Central Trust Company, of New York, N. Y., which company holds a mortgage on the Bodwell Water Power Company's property for $1,000,000.

RECEIVER FOR TELEPHONE COMPANY.—The Citizens' Telephone Company, of Batavia, Ohio, has passed into a receiver's hands on the application of a stockholder, who alleged that the business was conducted at a net loss. The company controls 100 telephones, has 11 exchanges and 250 miles of wire in Clermont County. The court appointed Bailey W. Gilfian, of Columbus, receiver. Manager Baum said that the cause of the company going into the hands of a receiver was the low rates for service and the increase in operating expenses.

RIGHT OF A MUNICIPAL PLANT TO FURNISH ENERGY FOR PRIVATE PURPOSES.—A case against the village of Nelsonville, Ohio, has been taken to the supreme court of the state for a decision as to whether a municipal lighting plant has any right or authority to supply energy for private use. It is said that a number of companies, including the Cleveland Electric Illuminating Company, are interested in the case, the latter because the city of Cleveland expects to do a commercial business with the plant acquired on the annexation of South Brooklyn as a nucleus.

BAY CITY INJUNCTION.—A temporary injunction was issued by the Bay City circuit court Jan. 18 in the suit of the Bay City Electric & Traction Company against the city of Bay City, restraining the mayor and council; the Allis-Chalmers Company, of Milwaukee, Wis.; the Arbuckle-Ryan Company, of Toledo, Ohio; the Lang Electric Company, and the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., from entering into and carrying out contracts authorized by the council Jan. 13, relative to the establishment of a consolidated electric lighting plant at the old water works property on the west side.

RECEIVERSHIP IN NATCHEZ.—Acting under a decree of the Supreme Court, W. A. Pollock, recently appointed receiver for the Southern Light & Traction Company, which is operating electric light and street car systems in Natchez and Vicksburg, on Jan. 17 took charge of the local plant as trustee. The decision of the court is to the effect that the company is a trust under the laws of Mississippi, and declares the charter and franchise forfeited. Mr. Pollock will make his reports to the Chancery Court until the affairs of the company have been wound up and local companies organized to take charge.

INJUNCTION AGAINST DISCONTINUANCE OF SERVICE.—An application was filed in the Clayton Circuit Court, St. Louis, Mo., Jan. 17, by Paul D. Cable, president of the General Service & Development Company, asking for an injunction against the Union Electric Light & Power Company, the King Electric Light Company and its president, A. C. Einstein, restraining them from cutting off the electrical energy which they supply him and which he in turn furnishes to customers in St. Louis County. The application states that the General Service & Development Company contracted in 1905 with the defendants for electricity. The contract expired Jan. 18, and the defendants, it is alleged, refuse to supply electricity any longer.

Personal.

MR. R. F. RUDELL, member of the Stock Exchange firm of O'Loughlin & Rudell, has been elected secretary and treasurer of the Electric Development & Securities Company.

MRS. McINTOSH, formerly advertising manager of the Norton Company, has taken a similar position with the Buffalo Forge Company, the Buffalo Steam Pump Company and the Geo. L. Squier Manufacturing Company.

MR. G. E. MILLER has resigned as superintendent of the Union Electric Company, of Dubuque, Ia., to accept the position of general superintendent of the Chattanooga Railways Company, of Chattanooga, Tenn.

MR. A. H. VAN CLEVE, of Niagara Falls, N. Y., engineer in charge of the construction work of the Niagara Falls Power Company and the Canadian Niagara Power Company, has been appointed consulting engineer for both companies.

MR. W. B. SNOW, of Boston, has reprinted from the *Selling Magazine* for November his excellent article on exploiting the industrial application of a machine by the modern methods of publicity, and by work in a field where he is well known from his own success in such development.

MR. ARTHUR H. ALLEN, until recently connected with the Westinghouse Electric & Manufacturing Company, has opened offices at 1019 Land Title Building, Philadelphia, Pa., where he will hereafter represent a complete line of high-grade alternating and direct current generators and motors; also other electrical apparatus.

MR. P. B. DELANY, the well-known inventor and telegrapher, described and demonstrated recently before the Franklin Institute of Philadelphia, his ingenious telepost system for rapid automatic transmission of letters and other sorrespondence that would otherwise and as now go by mail. The apparatus worked very successfully.

MR. D. R. SMITH, the president of the Switchboard Equipment Company, Bethlehem, Pa., spent a large part of last week in New York City, attending to important business. He finds a very large demand for circuit breakers, and takes a very hopeful view as to the near future predicated on the sustained demand that the company had to meet even during the recent depression.

MR. J. S. McCULLOH, formerly superintendent of buildings for the New York Telephone Company, now holds the position of general contract agent in the same corporation. His former place is taken by Purchasing Agent D. C. Cox. Mr. McCulloh will have the supervision of all contracts made between the telephone company and its subscribers in Long Island, Manhattan and New Jersey.

MR. ARTHUR JACOB, of London, Eng., who for many years has been connected in turn with the British Thomson-Houston Company, the British Schuckert Company and the Siemens Brothers' Dynamo Works, Ltd., has severed his connection with the last named firm to assume control of the Commercial organization of the British Aluminum Company, of London, Eng.

MR. OSCAR C. TURNER, general manager of the Southern Electrical Company, of Nashville, Tenn., for the past three years, has just resigned to take an important position with the Warren Electric & Specialty Company, of Warren, Ohio. He will be succeeded by Mr. Harry E. Dyer, who went to Nashville with him and is in full touch and harmony with the policies he has inaugurated there.

MR. ALFRED A. WOHLAUER, consulting electrical engineer, in light and heat, has opened a professional office at 500 Fifth Avenue, New York City, and is now prepared to investigate and report upon all matters relating to electric light and heat, to design and supervise installations of that nature, and to consult as to the possibilities of new plants or the extension of old ones.

MR. H. H. VREELAND, president of the New York Railroad Club, is to be the guest at a complimentary dinner on Feb. 7, at a place to be designated later. This dinner is a highly deserved testimonial, and is in recognition of his devoted services to the club, which he has done so much to build up into a great and useful organization. Mr. W. G. Besler is chairman of the dinner committee, and Mr. H. D. Vought, secretary. A very large attendance is expected.

MR. B. F. PANKEY, of Topeka, Kan., who is president and general manager of the Independent Telephone Company, tendered his resignation at the annual meeting of the board of directors, held Jan. 16. Mr. Theodore Gary, of Macon, Mo., president of the National Independent Telephone Association of the United States and Canada was elected president of the company and Mr. W. P. Hemphill, of Topeka, Kan., was elected vice-president and general manager.

MR. CARL H. HOLLEY has resigned as general superintendent and chief engineer of the Mt. Whitney Power Company and will in future devote himself to general engineering work, with offices in the First National Bank Building, Visalia, Cal. He is associated with his brother, Mr. H. H. Holley, a civil and hydraulic engineer, and the firm will undertake any class of work in the range of modern engineering thus indicated. Mr. Carl Holley will also devote special attention to irrigation projects.

MR. WILLIAM W. POWER has recently been appointed manager of the electrical department of the Boston branch of the H. W. Johns-Manville Company. Mr. Power was formerly district manager of the Allis-Chalmers Company's Philadelphia office, and previous to that he was connected with the Christensen Engineering Company, as special representative throughout the New England States. When that company was reorganized and made the National Electric Company, Mr. Power continued with the latter concern until he became associated with the Allis-Chalmers Company. Mr. Power is well and favorably known in the New England States, and his wide experience in the electrical field will assist him in his new position.

MR. W. S. TURNER, B. S., a well-known electrical engineer and constructor, has joined the staff of W. S. Barstow & Company and has been placed in charge of their Portland (Ore.) office. He is a graduate of Knox College and Cornell University, and ever since graduation has been actively engaged, not only all over this country, but in New Zealand.

He did a good deal of the pioneer lighting and traction work, particularly for the Westinghouse, Edison and Sprague systems. For several years he was a member of the Woodbridge & Turner firm, which did a large amount of electrical design and construction. A man of ripe experience, thorough training and sound engineering judgment, he is a valuable acquisition to the Barstow forces, and he is already actively engaged on their extensive operations in the Northwest.

Obituary.

MR. W. L. TYLER.—The death occurred last week of Mr. Walter Lincoln Tyler, a member of the A. B. See Electric Elevator Company, New York City, from blood poisoning at his home in Brooklyn. Mr. Tyler was born in Brooklyn 41 years ago, the son of William S. Tyler. He was graduated from Columbia University in the class of '87. He entered the employ of the elevator firm, of which corporation he soon became a member. He was a director of the Flatbush Trust Company and vice-president and director of the Home Title Insurance Company. He was a member of the Hamilton Club and the Crescent Athletic Club, and a trustee of the Church of the Pilgrims.

Educational.

UNIVERSITY OF CINCINNATI.—A pamphlet has been issued as to the co-operative course in engineering in this university. It contains two interesting papers on the subject by Prof. H. Schneider, of the faculty, and Mr. C. S. Girgrich, M. E. of the Cincinnati Milling Machine Company.

MECHANICAL ENGINEERS AT ILLINOIS UNIVERSITY.—"More ideas to the square foot than anything I have heard for months," was the way Prof. Breckenridge characterized the address of Mr. R. D. Tomlinson before the engineering students of Illinois University. Mr. Tomlinson is one of the best-known authorities on steam engineering, particularly power-plant work, in this country, and has until lately been connected with the Interborough Rapid Transit Company, of New York City. He is now in the employ of the Allis-Chalmers Company as a specialist on steam condensers. It was on the subject of condensers that he spoke to the engineers. With the aid of lantern slides he described in detail the condenser installations in all of the chief power stations in New York City. Here the impossibility of obtaining good condensing water, combined with the necessity of "keeping things moving," make the problem one of great difficulty. The solution has been largely in the use of jet condensers, as surface condensers are rapidly corroded by electrolysis. The construction of several of the most important of these was discussed at length. Mr. Tomlinson urged the necessity for large and direct exhaust piping and the use of large-radius elbows as absolutely necessary for high efficiency with condensing engines. In closing, Mr. Tomlinson gave the students some good advice relative to getting out and doing a couple of years' practical shop work before taking up the office work side of the profession.

Trade Publications.

SWITCHBOARD PANELS for three-phase systems are illustrated, listed and briefly described in Bulletin No. 94 of the Crocker-Wheeler Company, Ampere, N. J.

OIL SWITCHES.—Bulletin No. 9 of the Hartman Circuit Breaker Company, Mansfield, Ohio, describes automatic and non-automatic oil switches for either switchboard or wall mounting.

STEAM ENGINE NOMENCLATURE.—Bulletin No. 7, series D, of the Murray Iron Works, Burlington, Iowa, gives a pictorial illustration of the nomenclature used with Murray Corliss engines.

SWITCH BOXES.—The Chicago Fuse Wire & Mfg. Co., Chicago, Ill., has issued Catalogue No. 21, dealing with "Union" switch boxes for both new and old work. These boxes are adapted for all makes of switches and receptacles.

DIRECT-CONNECTED DIRECT-CURRENT GENERATORS are briefly described in bulletin No. 1102 of the Fort Wayne Electric Works, Fort Wayne, Ind., which gives a complete list of these machines installed by the firm throughout the United States.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, has sent us its annual calendar, which is an artistic reproduction of a painting by Philip Boileau, in colors. A feature of the calendar which will appeal to central stations is the moonlight schedule which is combined with the ordinary calendar feature.

HABISHAW WIRE COMPANY, 253 Broadway, New York City, has issued a calendar for 1908 the sheets of which show views of some of the larger buildings in which Habishaw wires and cables have been used in the past few years—such as the new Hall of Records in New York City, the Hotel Belmont, the Railroad Exchange, Chicago; the Machesney Building, Pittsburg.

TAPES.—The New York Insulated Wire Company has just issued a leaflet giving prices and a general description of its friction and rubber tapes. A copy, together with samples, can be obtained by those interested by addressing a request to the company.

ALTERNATING CURRENT FANS are described in minute detail in a 59-page booklet designated as Catalogue No. 4700 of the Emerson Electric Manufacturing Company, St. Louis, Mo. All of the fan motors are of the induction type, an arrangement being made for opening the starting-coil circuit when full speed is reached.

WATT-HOUR METERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., has issued circular No. 1137, giving complete descriptions of watt-hour meters for all services. Connection diagrams are given for single-phase, polyphase, direct-current and three-wire systems.

ADJUSTABLE-SPEED MOTORS, having a speed range of from 2 to 1 to 3 to 1, of the field-weakening type, are described in bulletin No. 89 of the Crocker-Wheeler Company, Ampere, N. J. These motors are not provided with auxiliary field poles, sparkless operation being obtained as a result of special care devoted to details of design.

ARC LIGHTING SYSTEM.—Bulletin No. 1103 of the Fort Wayne Electric Works, Fort Wayne, Ind., gives an excellent description with diagrams of the Wood series alternating-current arc lighting system. One of the distinctive features of this system is the regulator which automatically varies the impedance in the lamp circuit and thereby holds the current constant.

PUMPING MACHINERY.—General catalogue K-800 of the Knowles Steam Pump Works, East Cambridge, Mass., is a 173-page publication devoted to types and combinations of machines that will meet the general requirements of pump users. Views are given of several direct-connected motor-driven pumps, a noteworthy example being an 800-hp set for lifting 1600 gallons per minute against a pressure corresponding to 1550 feet.

"COMMON SENSE" is the name of a neat monthly pamphlet about 16mo size, just begun issuance by the Electric Controller & Supply Company, of Cleveland. It is well printed and, in additional to text that is excellent literature, it embodies appropriate data about the Dinkey controllers, the lifting magnets, etc. The price of extra copies is 10 cents. The December and January numbers have been published. Mr. David Gibson is editor and Mr. W. A. Ten Winkel manager of the publicity department on behalf of the company.

MOTOR-DRIVEN FLOUR MILLS.—Bulletin No. 1205 of the Allis-Chalmers Company, entitled "Keewatin Flour Mills," contains a complete description of this mill, as well as 50 halftone illustrations showing other plants, the complete equipment of which has been furnished by the company. A distinctive feature of the recently compelted plant of the Keewatin mills, which has an output of 5000 bbls. daily, is the electrically driven apparatus. Standard induction motors are used not only in the mill, but also for operating all the machinery in the elevator building.

UTILIZATION OF EXHAUST STEAM.—The Harrison Safety Boiler Works, Seventeenth Street and Allegheny Avenue, Philadelphia, is sending out a quite unusual mail folder on "The Utilization of Exhaust Steam in Wood Working Establishments." With the exception of what is said about the use of exhaust steam in dry kilns and for steaming lumber, the points brought out apply to most steam plants, covering the use of the Cochrane open feed water heaters and the hot process system of water purification for keeping hard scale out of boilers, increasing the capacity of the boilers and saving coal and boiler feed water. The folder shows an interesting layout for engine, heater, drying and heating coils and connections.

WATT-HOUR METERS.—Bulletin No. 10, of the Sangamo Electric Company, Springfield, Ohio, gives an excellent technical description of watt-hour meters for both direct-current and alternating-current circuits. The motors in these meters are of the mercury type, the thin copper driving-disk floating upon mercury. The rotation of this disk is caused by the torque action of the current in it against a magnetic field produced in a circuit in shunt to the main supply system. Bulletin No. 11, of the same company, deals particularly with watt-hour meters for switchboard use. The company has also issued a valuable pamphlet giving information to salesmen and engineers regarding the theory, construction, installation, operation and testing of watt-hour meters.

POLYPHASE MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, has just issued a pamphlet entitled "The Polyphase Motor in the Shop." This is a description of the repair shops of the Wabash Railroad Company, located at Decatur, Ill., which installation is driven by Wagner three-phase motors exclusively. This book will appeal more particularly to the readers of this journal on account of the tables given in the back, showing the power required to drive certain machines, and the average load put upon them by certain classes of work. The tables are really of great value to a person contemplating the purchase of similar machinery, as they are made up from actual tests on the machines while working under normal manufacturing conditions.

HYDRAULIC TRANSMISSION PUMP.—A pump designed to meet the requirements of plants where steam economy is an important factor in the cost of production is the Allis-Chalmers hydraulic transmission pump, described in its bulletin No. 1604. This pump is built for any capacity desired up to 400 gals. per minute and pressures as high as 6000 lbs. per square inch. For capacities and pressure beyond this, Allis-Chalmers Company offers another pump of special design. Pumps of this type are particularly adapted for operating under conditions that entail hard and continuous service, as in mines for forcing fluids through pipe lines, or for the operation of hydraulic presses, lifting machines and cranes, riveting, bolting, forging and testing machines. In view of its wide range of adaptability, a complete description of this pump will be of interest and can be had upon application to its builders.

Unclassified Items.

IRWIN, PA.—The Irwin-Herminie Electric Street Railway Company has been chartered, with a capital stock of $35,000, to build an electric railway between Irwin and Herminie, a distance of 5½ miles. The directors are Holman R. Lynn, of Pittsburg; H. C. Mullin, of McKeesport; W. B. McCan, of Allegheny; A. E. Dubois and C. W. Schenck, of Pittsburg.

MEADVILLE, PA.—The Central Crawford Traction Company has been organized. Dennis Smith is president of the company, and Joseph H. Heard, secretary and treasurer.

NASHVILLE, TENN.—The French Broad River Power Company has been incorporated, with a capital stock of $10,000, by W. A. Boyce and others.

THE MASSACHUSETTS CHEMICAL COMPANY, of Walpole, Mass., manufacturer of insulating tapes, varnishes, etc., is about to open a branch office in Chicago, to be located at 464 Monadnock Building. Mr. Arthur E. Duclos, well known to the electrical trade in the Middle West, will be in charge.

THE STANDARD AUTOMATIC SWITCH & ELECTRICAL DEVELOPMENT COMPANY, of Brooklyn, N. Y., has filed articles of incorporation, with a capital stock of $10,000. The directors are Leonard Colson, Charles Gebauer, Sr., of Brooklyn; Joseph L. Conte, of New York, N. Y.

THE ARTHUR FRANTZEN COMPANY, of Baltimore, Md., has been incorporated, with a capital stock of $10,000, for the purpose of conducting a general electrical supply business, by William McGuineas, Robert L. Gill, William G. Speed, Arthur J. Bruen, all of Baltimore, and William H. Rottenburd, of Chicago, Ill.

THE ELECTRIC PERFECT FILTER COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, by Charles Watson, of Seattle, Wash.; E. A. Cohn and Samuel Packard, of New York, N. Y.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutacal Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring Meeting, Detroit, Mich., June 23-26, 1908.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Secretary, H. C. Lucas, 10th and Sansom Sts., Philadelphia, Pa.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St. W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual Meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckles Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electrical Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Assistant secretary, J. A. Harney, Monadnock Block, Chicago.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday, March, 1908.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Central Station Men's Association. A. H. Lane, Glencoe, Minn., temporary chairman. Next meeting at Hotel Nicollet, Minneapolis, Feb. 28 and 29.

Missouri Independent Telephone Association. Secretary, Houck McHenry, Jefferson City, Mo.

Missouri State Electric Light Association. Secretary, C. Z. Pierson, St. Charles, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, June, 1908.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting Aug. 25, 26 and 27, 1908.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Portsmouth, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio

Oklahoma Electric Light, Railway & Gas Association. Secretary, Charles W. Ford, Oklahoma City, Okla.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York.

Pacific Coast Electrical Transmission Association. Secretary, Samuel G. Reed, Portland, Ore.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting, El Paso, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 21, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

876,923. STARTING MOTOR CONVERTER; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed May 31, 1907. Relates to motor converters of the type comprising an induction motor and rotary converter with their armatures mechanically and electrically coupled. Provides starting means adapted to insure sufficient field magnetization on reaching normal speed to hold the generator set at that speed.

876,924. COMPENSATED MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed July 19, 1906. In combination, a plurality of motors of the commutator type, each having a compensating winding with a smaller number of turns than the effective turns of the armature, and means for connecting a plurality of motors with their armatures in parallel with each other and their compensating windings in series with each other and with the armatures.

876,930. DYNAMO ELECTRIC MACHINE; Sven R. Bergman, Lynn, Mass. App. filed May 8, 1907. Rotor construction for dynamo electric machines designed to obtain the advantages of both closed and open slots for the windings without the attendant disadvantages of either type.

876,939. INSULATOR; Harold W. Buck, Niagara Falls, N. Y. App. filed July 29, 1902. Cylindrical ribbed insulators are supported by metallic trunions between projecting arms on the telegraph poles.

876,943. DYNAMO ELECTRIC MACHINE; Charles E. Canfield, Norwood, Ohio. App. filed June 8, 1904. Form of dynamo electric machine adapted to be directly driven by high-speed steam turbines.

876,944. RAILWAY SIGNAL; Fred B. Corey, Schenectady, N. Y. App. filed Oct. 6, 1905. Provides means by which the discs or roundels of a semaphore signal system are prevented from being obscured by snow and sleet, and further by which they are thrown into danger position whenever the operating mechanism is disabled.

876,945. ARC LAMP; George W. Cravens, Schenectady, N. Y. App. filed Sept. 16, 1904. In an arc lamp, a pair of electrodes between which an arc is maintained, means for normally maintaining the arc directed, and means for automatically changing the position of the arc deflecting means to compensate for the change in position of the arc resulting from the consumption of the electrodes.

876,949. ARMATURE BANDING; Malcolm Dickerson, Newark, N. J. App. filed Oct. 10, 1905. A form of "banding" for dynamo electric machines adapted to prevent the excessive induced current losses due to the usual spiral wire banding. Makes use of insulating plates between the layers of the windings.

876,952. RELEASE MECHANISM FOR MORSE TELEGRAPHS; Eugene Ducretet, Paris, France. App. filed June 15, 1905. A device for automatically or manually arresting the paper feed mechanism of a Morse receiving instrument whereby the paper feed is controlled by the operation of the machine.

876,953. RAILWAY SIGNALING SYSTEM; Carl Enderlein, Cassel, Germany. App. filed March 22, 1906. Has a plurality of cam drums by which the switching and signaling circuits are completed in a proper sequence.

876,955. DYNAMO ELECTRIC MACHINE; Russell S. Feicht, Pittsburg, Pa. App. filed Oct. 3, 1905. Provides suitable resistance rings for induction motors which may be easily applied and are of ventilated construction.

876,956. GAS CAP; Richard Fleming, Lynn, Mass. App. filed May 4, 1905. A gas cap for an enclosed arc lamp having a feed opening for the movable electrode of larger clearance at the top than bottom, and a long tubular duct between the openings communicating with the inner globe.

876,970. ELECTRIC SWITCH; Walter F. Jones, Eccles, near Manchester, England. App. filed July 13, 1907. A controller comprising a conducting ring having a set of integral contact projections and an alternating set of insulated contact projections, and a frame having contact fingers to engage said contact projections, said frame and ring being relatively rotatable.

876,973. MOTOR COOLING DEVICE; Arthur F. Knight, Schenectady, N. Y. App. filed Aug. 25, 1902. Provides means for cooling an electric motor and including a form of fan secured at the end of the armature shaft.

876,979. POTENTIAL REGULATOR; Edwin Lehr, Wilkinsburg, Pa. App. filed Nov. 13, 1905. Provides a system of feeder regulation for three-phase, alternating-current systems of distribution. Is designed to properly regulate the potential between lines and preserve the relative phase relations of the electromotive force imposed upon the outgoing circuits.

876,984. ELECTRIC FUSE; Frederick Mackintosh, Schenectady, N. Y. App. filed Sept. 29, 1904. The fuse is made of tubular form in an enclosed chamber so that it will collapse by the expansion of the air in the chamber and automatically extinguish the arc.

876,988. TRANSFORMER FOR ELECTRIC VEHICLES; Walter S. Moody, Schenectady, N. Y. App. filed Aug. 10, 1904. A construction of transformer for electric motor cars designed to be of light weight and strong construction to stand the shocks of this class of apparatus.

876,993. MOTOR CONTROL; Karl A. Pauly, Schenectady, N. Y. App. filed May 18, 1907. A system for controlling the motors of a rolling mill by which the latter may be run at a plurality of speeds and at widely differing conditions of load at each speed.

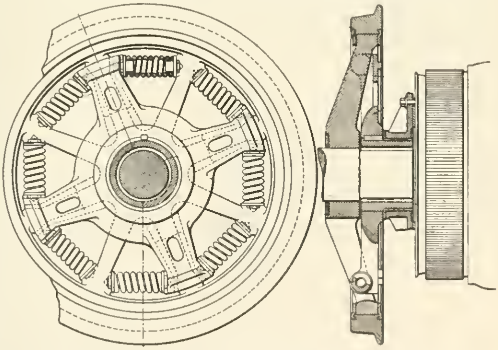
876,996. INTELLIGENCE INTERCOMMUNICATION BY MAGNETIC WAVE COMPONENTS; G. W. Pickard, Amesbury, Mass. App. filed June 10, 1907. Has closed electrical circuit of large area in inductive relation, and detector circuits, etc.

876,997. ELECTRICAL DENTAL AND SURGICAL APPLIANCE; Harry F. Pressey, Bridgeport, Conn. App. filed April 24, 1907. A miniature incandescent lamp is mounted on a rod so as to be operable as a dental tool. The apparatus includes a specially constructed resistance element by which the light can be adjusted.

876,998. MEANS FOR SUPPORTING BRUSH HOLDERS; Edward D. Priest, Schenectady, N. Y. App. filed Dec. 18, 1905. A means for supporting brush holders and associated with the propelling motors of electric locomotives. It is designed to be specially rigid in its adjustment upon the frame members.

877,002. TELEGRAPH SYSTEM; Harry O. Rugh, Sandwich, Ill. App. filed Dec. 26, 1906. Complete telegraph system having operating batteries at each station and means at one sending station and governed at another sending station for preventing the connection of battery thereat with the line.

877,005. ELECTRIC LOCOMOTIVE; Richard Schwarz, Schenectady, N. Y. App. filed Oct. 18, 1906. Has compression springs between the spokes of the driving wheel and the motor armature spider, one set of springs being hollow and partly surrounding a portion of the spokes of the other set.



877,005.—Electric Locomotive.

877,016. ELECTRIC MOTOR; Leonard A. Tirrill, Lynn, Mass. App. filed June 7, 1906. An electric motor with a power transmitting shaft coupled to the armature shaft by a motor and a speed changing mechanism.

877,017. DYNAMO ELECTRIC MACHINE WITH COMPENSATING WINDINGS; Ludwig Torda, Cheswick, England. App. filed March 8, 1907. Has a compensating device with associated elements to carry the compensating current and also the main magnetic lines.

877,018. OPERATION OF STORAGE BATTERIES IN CONNECTION WITH ALTERNATING-CURRENT SYSTEMS; Joseph H. Tracy, Philadelphia, Pa. App. filed June 21, 1907. Provides for operating a storage battery in connection with an alternating-current system through a rotary converter and distributer.

877,026. TRANSFORMING THE ENERGY OF ELECTRIC CURRENTS; E. Weintraub, Schenectady, N. Y. App. filed July 23, 1903. Renewed July 13, 1907. The combination of a vapor conductor, a plurality of electrodes, one of which is a cathode, and a magnetic means for shifting the cathode spot.

877,028. MOTOR CONTROL; Harold E. White, Schenectady, N. Y. App. filed July 25, 1906. Provides an arrangement of switches whereby the manual control of a motor may be obtained at starting and automatic control secured when the motor is up to speed.

877,030. MOTOR CONTROL; Carl E. Zix, Berlin, Germany. App. filed July 25, 1906. Relates to the control of electric motors from a distance, and particularly to the control of motors driving a member such as a railway track switch which must be reciprocated.

877,033. SWITCHING MECHANISM FOR TELEPHONE CIRCUITS; Albert K. Andriano, San Francisco, Cal. App. filed March 15, 1905. Details of construction of standard transmitter.

877,058. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Nov. 11, 1903. Covers details of cord circuit.

877,067. AUTOMATIC TRANSMITTER FOR FIRE-ALARM AND SPRINKLER SYSTEMS; James Fiddes and John F. Watt, Aberdeen, Scotland. App. filed Oct. 26, 1906. A fire-alarm and sprinkler system designed to communicate automatically with the fire brigade station or other point and indicate when automatic sprinkler or fire-alarm in a building has been brought into action.

877,069. MAGNETIC DETECTOR; Lee de Forest, New York, N. Y. App. filed Nov. 2, 1903. A magnetic oscillation detector comprising a plurality of cores and coils thereon grouped about a common axis, and a magnet mounted to turn upon a coincident axis.

877,089. METHOD OF MAKING ELECTRIC CONDENSERS; Frank S. Koch, Chicago, Ill. App. filed Aug. 15, 1904. A method of constructing condensers in as compact a manner as possible whereby they may be placed flatwise against the interior edges of the various electrical apparatus with which they are used. The condenser is subjected to very powerful pressure during manufacture.

877,101. CLIP FOR FIXING WIRES TO INSULATORS; Johann Macek, Vienna, Austria-Hungary. App. filed Jan. 29, 1907. A form of cleat for fixing conducting wires to insulators. Has a plurality of wire links which are engaged around the insulators by a thumb-nut.

877,121. TELEPHONE SYSTEM; Howard M. Post, Chicago, Ill. App. filed Nov. 11, 1903. Details of cord circuits.

877,144. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Max Vogelsang, Frankfort-on-the-Main, Bockenheim, Germany. App. filed Feb. 2, 1905. Synchronizing switch for connecting and disconnecting alternating-current generators from the main.

877,154. ELECTRICAL ABDOMINAL HEATER; Hiram D. Wood, Jr., Minneapolis, Minn. App. filed July 3, 1907. An electrical part having a spirally arranged resistance filament disposed on a spider-shaped support between asbestos layers.

877,155. ELECTRICAL FACE STEAMERS; Hiram D. Wood, Jr., Minneapolis, Minn. Relates to modifications of the above.

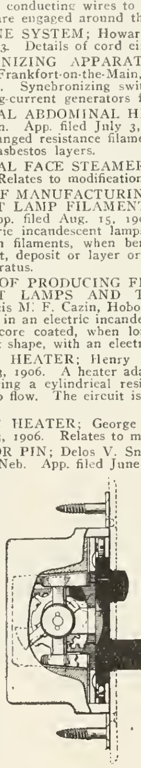
877,171. METHOD OF MANUFACTURING METALLIZED ELECTRIC INCANDESCENT LAMP FILAMENTS; Francis M. F. Cazin, Hoboken, N. J. App. filed Aug. 15, 1904. The method of producing glowers for electric incandescent lamps which consists in coating or metallizing carbon filaments, when bent into their final longitudinal shape, with a coat, deposit or layer or layers of metal in an electrolytic plating apparatus.

877,172. METHOD OF PRODUCING FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS AND THE PRODUCT OF SUCH METHOD; Francis M. F. Cazin, Hoboken, N. J. App. filed Sept. 21, 1904. A filament in an electric incandescent lamp primarily consisting of a conductive core coated, when longitudinally bent into its final and main filament shape, with an electrolytic metal cover.

877,177. ELECTRIC HEATER; Henry D'Olier, Jr., Philadelphia, Pa. App. filed Jan. 13, 1906. A heater adapted to be directly attached to a faucet and having a cylindrical resistance element past which the water is caused to flow. The circuit is completed by the usual handle of the stopcock.

877,188. ELECTRIC HEATER; George W. Elkins, Elkins Park, Pa. App. filed Jan. 13, 1906. Relates to modifications of the above.

877,242. INSULATOR PIN; Delos V. Snapp, Holdrege, and Charles W. Fraher, Lincoln, Neb. App. filed June 21, 1907. A form of insulator pin having a base bolted to the crossarm and a threaded plug thereon which receives the insulator.


877,301.—Wall Switch.

877,251. ELECTRICAL MEASURING INSTRUMENT; William J. Still, Ealing, England. App. filed June 23, 1905. A pocket indicator for batteries, etc., having a solenoid which attracts a longitudinally moving core having a pointer.

877,258. AUTOMATIC REGULATING DEVICE; Percy H. Thomas, Montclair, N. J. App. filed June 16, 1905. An electrical distribution system in which means are provided for delivering to a consumption circuit the proper amount of electrical energy for satisfying the monetary needs thereof.

877,284. ELECTRIC APPARATUS FOR THE IGNITION OF MINES; Otto R. P. Berglund, Walter A. W. E. Hjorth and Carl E. Ljungman, Stockholm, Sweden. App. filed Oct. 25, 1905. A battery operated magneto having a sector gear and a circuit completing device operated during the movement of said gear.

877,301. WALL SWITCH; John H. Dale, New York, N. Y. App. filed May 18, 1906. Designed to have an abrupt movement in completing and opening the circuit and in which the switch elements are moved through a very direct application of the operating force. For this purpose there are provided racks on the separate buttons which engage sector gears on the part which is co-axial with and throws the switch element. Has a special form of displaceable detent for insuring an abrupt spring-impelled movement of the switch element.

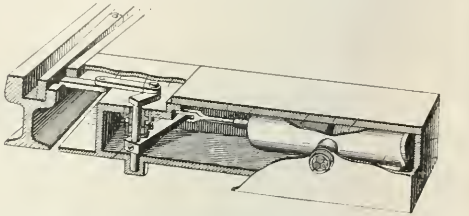
877,311. ELECTRIC SIGNALING APPARATUS; Sydney Evershed, London, England. App. filed Dec. 23, 1905. Relates to telegraphic apparatus intended for the transmission of a limited number of prearranged signals for shipboard, etc. Makes use of two circuits, the current in which is separately variable.

877,312. ELECTRICAL TRANSMISSION APPARATUS; Sydney Evershed, Chiswick, England. App. filed Feb. 28, 1906. Relates to modifications of the above.

877,319. TRANSFORMER EMPLOYED IN HIGH-FREQUENCY CURRENT CIRCUITS; Georges E. Gaiffe, Paris, France. App. filed Nov. 8, 1904. Provides resistances either alone or in conjunction with capacities and connected to the extremities of the secondary of a transformer with the object of damping the high-frequency oscillations which tend to traverse the same.

877,326. ELECTRIC LIGHT SOCKET CAP; John H. Goss, Waterbury, Conn. App. filed May 29, 1907. A means for fastening the heads to the caps of electric light sockets so as to avoid the use of washers and secure certain other functions.

877,379. TROLLEY REPLACER; George Q. Seaman, New York, N. Y. App. filed March 23, 1907. The trolley pole is pivoted independently of the spring-impelled element and has a ratchet connection therewith. This ratchet is released when the pole moves suddenly upward so that the latter falls on a "cradle" to restore the same when desired.


877,458.—Electric Track Switch.

877,383. MEANS FOR SECURING CORDS TO LAMP SOCKETS; Frederick A. Swan, Cliftondale, Mass. App. filed March 15, 1907. The cord is knotted through a chamber in the receptacle in a special way so as to take the train off the terminal screws.

877,384. ELECTRICAL FITTING; Frederick A. Swan, Cliftondale, Mass. App. filed April 22, 1907. Another construction in which the cord is received through a special cleat or plate.

877,408. MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS; Francis M. F. Cazin, Hoboken, N. J. App. filed March 17, 1904. A luminant for electric incandescent lamps, consisting of a carbon fillet, a surrounding layer of a mixture of carbon and metals, and a layer of the ruthenium-osmium metals surrounding the same.

877,427. CIRCUIT CONTROLLER; Lemuel F. Howard, Edgewood Park, Pa. App. filed Aug. 3, 1906. A circuit controller for use in connection with railway appliances, particularly for power operated switch and like movements.

877,439. APPARATUS FOR MAGNETICALLY CONCENTRATING ORES; H. Leighton, Seattle, Wash. App. filed Sept. 19, 1906. Relates to the magnetic separation of substances having magnetic permeability from ores and mixtures with which they are associated, by passing said ores or mixtures in a comminuted or granular state through a magnetic field. Has an inclined belt for feeding material into proximity to the projecting magnet poles.

877,442. LIGHTNING ROD; L. L. Mast, West Milton, Ohio. App. filed July 27, 1906. A lightning rod formed of tubular sheet metal with a longitudinally flattened portion through which the rod may be nailed to the wall of the dwelling.

877,446. APPARATUS FOR MANUFACTURING NITRIC ACID OR OXID FROM AIR; Harry Paulding, Gelsenkirchen, Germany. App. filed Dec. 18, 1905. In an apparatus for manufacturing nitric acid or oxid from air, in combination, electrodes, arranged in a plane, for producing electric discharges, a number of plates so disposed at one side of such electrodes as to cut the plane of the latter at right angles and form interspaces lying crosswise of the electrodes, means arranged at the opposite side thereof for blowing a current of gas through the space between the electrodes, and means for insulating the said plates from each other, substantially as described.

877,451. MEANS FOR RECEIVING INTELLIGENCE COMMUNICATED BY ELECTRIC WAVES; G. W. Pickard, Amesbury, Mass. App. filed Nov. 12, 1907. An electrolytic detector for wireless telegraph systems and having two substantially massive individual conductors of different conductivity in engagement with one another and in combination with a mass of fusible metal supporting the high-resistance conductor.

877,458. ELECTRIC TRACK SWITCH; R. A. Baldwin, New Haven, Conn. App. filed Dec. 5, 1906. An automatic track-switch mechanism including circuits for its operation. The switchpoint is positively moved in either direction of its throw by manipulation of the car controller, and without any necessity of the motorman actually seeing the switchpoint. Also provides for locking the switchpoint against return movement. The mechanism is so constructed that all of the operating parts are hermetically closed in a watertight casing.

877,464. RAILWAY SIGNAL; J. C. Link, Highbridge, Wis. App. filed March 25, 1907. A dispatcher's signaling apparatus by which certain telegraph messages are transmitted when the signal is set at predetermined relation.

877,467. COOLING SYSTEM FOR ELECTRIC RAILWAY APPARATUS; Walter S. Moody, Schenectady, N. Y. App. filed Aug. 10, 1904. Divided and this app. filed June 16, 1906. Employs the exhaust from air-brake system.

877,477. PROCESS FOR THE PRODUCTION OF PURE NITRIC ACID; Harry Pauling, Gelsenkirchen, Germany. App. filed April 6, 1906. The process consisting in subjecting atmospheric air to the action of electrical discharges, mixing the nitrogenous gases, thus formed, with water or aqueous vapor while the said gases have a minimum temperature of 200 deg. C., and cooling down the mixture as set forth.

877,448. PROCESS FOR THE PRODUCTION OF VOLTAIC STRONG-CURRENT ARCS; Harry Pauling, Gelsenkirchen, Germany. App. filed June 30, 1906. The process consisting in passing a gas to be acted upon by electrical discharges, in two currents between a pair of electrodes, the latter diverging in two different directions, one of the said currents passing in one of these directions, the second current in the other direction, substantially as set forth.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, FEBRUARY 8, 1908. No. 6

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. HAROLD S. BUTTENHEIM, Secretary.
A. E. CLIFFORD, 2nd Vice-President. CURTIS E. WHITTLESEY, Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Scbofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
SAN FRANCISCO OFFICE....................601 Atlas Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....................per year, $3.00
Dominion of Canada....................4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to July, 1906, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 16,500 copies are printed.*

NEW YORK, SATURDAY, FEBRUARY 8, 1908.

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ELECTRICAL EXPORT TRADE.

The figures just available for December indicate, as did those of other recent months, that heavy electrical machinery from this country continues in demand abroad, but that exports of electrical instruments have declined, although no apparent reason can be assigned for either phenomenon. The exports of electrical machinery for December were $837,811 as compared with $635,855 in the corresponding period of 1906. The total for the twelve months was $9,735,230 as compared with $8,274.753, a gain of nearly $1,500,000. Turning to electrical instruments, we find the exports for the month only $515,701 as compared with $827,646, while for the twelve months the total was $7,725,545 as compared with $8,380,757 in 1906, a decline of over $600,000. It would seem that with the growing excellence and increasing variety of electrical apparatus and supplies, this branch of trade would be easy to build up; and it is, probably. As a matter of fact, the trouble, whatever it is, appears to lie in our trade with England.

For the month the exports to the United Kingdom fell off from $219,946 to $27,597; and for the year from $2,194,085 to the small total of $800,076—in other words, were $1,300,000 less, or more than twice the whole loss for the year in this department. The loss was chiefly made up in fact by larger exports to Brazil. It would be interesting to know just what is wrong with the English trade, but the fact is generally known that last year was very dull and dead electrically in England. This year there certainly should be revival. Few countries are so poorly supplied with all the modern electrical necessities, comforts and conveniences. After all, we have here an electrical export trade of $17,460,775 per year, evidently susceptible of development and growth and touching all parts of the globe. In these days of slacker home consumption, our manufacturers might well give such business their closer attention. If they do not, others will.

ENGINEERING SOCIETIES BUILDING HISTORY.

Mr. N. M. Forney, the distinguished mechanical engineer who recently died, was one of the many who contributed to the realization of an engineering headquarters building in New York About 1894 he advocated energetically the plan of a common headquarters in New York for the several national engineering societies, carrying on the campaign through his journal, *The American Engineer*, by communications to other journals and by personal work among engineers. The time, however, was not then ripe for the idea, but the name of Mr. Forney should not be omitted from the roll of those who kept it alive and in course of progress until the opportune moment arrived for its realization. How radical the proposal seemed at that period and for some years later is illustrated by the fact that when in 1895 Mr. Carnegie offered to take up the matter of a general engineering headquarters, the plan was regarded with so little interest that no steps were taken by any of the societies to act on his suggestion. It was not until the sudden growth of the Library of the American Institute of Electrical Engineers and consequent need of quarters beyond those afforded by downtown office buildings that the idea took on a practical significance which led to its general recognition, and to its final realization through the historic A. I. E. E. Library dinner of 1903. But those who, like Forney, nurtured and fought for the idea through the discouraging years when it had few friends, and who bore the rebuffs incident to advocacy under such circumstances, should receive due credit for their disinterested labor when the object to which it contributed has been finally achieved.

Organization of Public Service Commissions.

Electric lighting and railway companies are naturally watching with some anxiety and interest the practical workings of state commissions for regulating public utility corporations which recently have been organized in several states where the plan of regulation by commission has not been tried before. Companies in states having such commissions have an immediate interest in their rulings, while companies of many other states, where commissions are likely to be established, have an indirect interest in watching which way the wind is blowing. The success of regulation by state commission must naturally depend largely on the character of men composing the commission and upon the professional standing of those employed by the commission as experts.

It is gratifying to note that in Wisconsin the recently established commission is drawing extensively for expert service on the able engineers on the University of Wisconsin faculty. The decisions of that commission so far appear to have been reassuring to the public service corporations of that state, in that they have indicated a desire to treat such companies with entire fairness. While it probably does not suit some of the politicians of various City Councils to have the corporation sandbags taken out of their hands, it is certain to result in benefit to both the public and companies of the state to have this power placed with a commission rather than with tinkering City Councils, provided the commission is always of high character.

Several weeks ago we printed a decision of the commission which has attracted considerable attention because of having authorized the raising of electric light and power rates in La Crosse, where it was shown that because of competition of two rival companies previous to their consolidation, the rates had been cut to a point where there was no profit. This decision will doubtless be of value to companies all over the country, as establishing certain principles in methods of charging which are eminently sound. Besides the question of regulation, considerable interest naturally centers around the policy of commissions in authorizing additional stock and bond issues. It is to be hoped that commissions will not rule against such issues to an extent which will hamper companies from properly extending their business. On the other hand, investment in electric light and power enterprises should not be discouraged by too low a limit on dividend rate. While the risk may be small in an established business of this kind, there, nevertheless, is some risk. The investor will not put his money in any proposition which may pay him only the common rate of interest if successfully managed, but if the business is not successful may pay less. It is too much like a game of heads I win, tails you lose.

Variable-Speed Commutating-Pole Motors.

The excellent operating characteristics of direct-current motors provided with commutating poles have been noted in our columns from time to time, and an article discussing at length the causes to which such characteristics can be attributed appeared in our issue for March 18, 1905. It is well-known that in the normal design of commutating-pole machines the voltage between the segments over the brush area on the commutator is easily kept within the proper limits, but the voltage between segments at other parts of the commutator may reach values considerably larger than is allowable in machines without commutating poles. This limiting feature of the commutating-pole machine was discussed in our issue for May 11, 1907. Our present issue contains an interesting article by Mr. A. G. Ellis giving calculations tending to show that the permissible maximum e. m. f. between segments is soon reached in variable-speed commutating-pole motors. The author finds that when the maximum e. m. f. between adjacent commutator segments is kept below the value known to result in "flashing over" with the normal machine, a many-segment commutator is required, and the machine becomes expensive to build. He has made no mention of the compensating-winding method of preventing field distortion and thereby eliminating the excessive voltage between certain segments, probably on account of the extra cost that the method involves.

In the present article the author seems not to have considered the feature mentioned on page 90 of our issue for July 13, 1907, namely, that the real limiting condition is the voltage between segments that will maintain an arc already established, and that this voltage is higher in a commutating-pole motor, in which there is no sparking at the brushes, than it is in a machine without commutating poles. It is probable that a commutating-pole motor possesses no greater tendency to "flash over" than does a motor without commutating poles having a maximum e. m. f. between segments only 75 per cent as great as that of the former machine. Moreover, the high e. m. f. that is inductively generated in the machine without compensating windings when a rapid change in the armature m. m. f. is allowed to produce a corresponding change in the air-gap flux, may be reduced to an insignificant value by the use of compensating windings, and thus the prime cause for the "flash-overs," which accompany the opening of circuit-breakers under excessive overload, may be eliminated. Incidentally it may be mentioned that flashovers may largely be prevented by placing the set of brushes in its own insulating compartment—a type of construction that doubtless will be used with extra high voltage motors

Measurement of the Inductance of a Circuit with Normal Load Current.

The inductance of a transmission line plays an important part in the regulation of pressure at points remote from the generator, although it does not directly affect the loss of power in transmission. When the reactance offered by the line to alternating currents is of the same order of magnitude as the resistance, it suffices, as a general rule, to observe the impedance offered by the lines, and to regard this impedance as the hypothenuse of a right-angled triangle, the resistance forming the base. From this construction the reactance, or perpendicular side of the triangle, follows at once. In cases where the reactance of the circuit is very much less than the resistance, the measurement of impedance is all adapted to determine the amount of inductance present, because a small error in measuring the impedance may involve a large error in the reactance deducted therefrom. Another method has to be adopted in such a case. The method suggested in the article on page 299, by Mr. C. C. Chapin, is to employ a differential alternating-current galvanometer, and a non-inductive resistance equal to that of the line. By this means the resistance drop in the circuit can be eliminated, and the reactance drop can be brought into prominent effect. This method has the advantage of separating the resistance from the reactance of the circuit, and of securing a differential balance for each independently.

The results reported of measurements on duplex wire have special interest because this wire, as is well known, is made of copper and iron associated in definite proportions. The results indicate that with relatively feeble line currents, the inductance of this wire is substantially the same as when copper wires only are used. As the line current increases in strength, the magnetic force in the iron increases, and this in turn meets with an increasing permeability in the iron, so that the inductance of the duplex wire rises steadily with the current strength. It is certainly not the first time that the variable inductance of iron wires has been brought out experimentally. Such observations have been obtained during a number of years. It is probably the first time, however, that the variable inductance of iron wires has been experimentally indicated by this particular method of measurement. It is important that data should be accumulated upon the permeability of iron and steel conductors under varying conditions of alternating-current service. It is now common practice to use steel rails as a return conductor in alternating-current traction, and the variable permeability of the steel affects the reactance of the circuit profoundly. In such cases the phenomenon is much complicated by the complex cross-sectional area of the steel rails, and also by a variable skin effect.

Luminous Efficiency and the Mechanical Equivalent of Light.

The ordinary carbon-filament incandescent lamp has, according to recent measurements, a luminous efficiency of about three per cent on the basis of white light as standard, and of about two per cent on the basis of that particular yellowish-green monochromatic light to which the human eye is most sensitive. Compared with electric motors, heaters or other translating devices, this efficiency is shockingly low. Imagine the consternation of a prospective consumer who should learn that a good device would net him only three per cent of the full possible yield. Nevertheless, in the carbon-filament incandescent lamp, the consumer has to be satisfied with three per cent utilized and 97 per cent wasted on the premises as warmth. It is true that the tungsten-filament lamp brings up the efficiency to nearly 10 per cent, which offers an enormous relative increase, and yet gives absolutely only a slight reduction in the appalling deficit. A paper has recently been communicated by Dr. C. V. Drysdale to the Royal Society on some new measurements of the mechanical equivalent of light. The power radiated from a Nernst filament was measured in watts by the use of a thermo-pile bolometer. Simultaneously, the candle-power of the filament was measured photometrically. From these observations it appeared that one watt of white light gave 8⅓ candle-power.

A similar series of observations conducted on the carbon arc lamp gave the result that one watt in white light was equivalent to 12½ candle-power. The higher candle-power equivalent of one watt in arc light is attributable to the higher temperature of the carbon in the arc as compared with the incandescing filament. The mean of the two observations gives approximately 10 candle-power as the equivalent of one watt of white light. If then we could force an incandescent lamp to radiate its energy exclusively within the visible spectrum; that is, if we could somehow prevent its throwing off invisible radiation as heat in the ultra-red region of the spectrum, we should expect to find that the lamp absorbed one-tenth of a watt per mean spherical candle-power, instead of over three watts per mean spherical candle-power. Moreover, in that portion of the spectrum between the green and yellow, where the wave-length attains a length of 0.54 micron, one watt of luminous energy produces about 17 candles, instead of the 10 candles for the more generally distributed colors of white light. If we could put some kind of screen over an incandescent lamp which would stop the escape of all radiation except just at this color, we might expect a 17-mean-spherical candle-power lamp to absorb one watt at terminals. The light would then be highly efficient but rather glow-worm like and æsthetically undesirable.

The paper indicates that the convection loss of heat from the incandescent lamp, by the movement of air, was only about two or three per cent, which is a mere trifle compared with the loss in radiation in the invisible part of the spectrum. There are two ways of regarding the existing inefficiency of luminous sources. One is to find fault with the human eye, which fails to respond to good radiation when the wave-length happens to exceed 0.76 micron, and the bulk of the radiation from a lamp generally does possess a greater wave-length. The other way of considering the matter is to bewail the bad radiative behavior of highly heated bodies from the optical standpoint. It certainly seems hopeless at the present time to expect much better performance from a hot filament than we now obtain from tungsten. Nevertheless, there is so much room for improvement that we may well hope for better luminous efficiencies in times to come. It is not ridiculous to expect luminous efficiencies of 80 or 90 per cent. We know that gases have selective rates of molecular oscillation, and do not require to be highly heated in order to be thrown into oscillation. Already the mercury-vapor lamp points to a greatly reduced waste of power in dark radiation. One thing is certain, namely that the misappropriation of the term "efficiency of an incandescent lamp" to the power consumed at terminals per mean horizontal candle-power covers a great and woful deficiency

National Electric Light Association.

The next convention of the National Electric Light Association will be held in Chicago, May 19 to 22. The headquarters will be in the Auditorium Hotel, and the sessions will be held in the Fine Arts Building, which is connected with the hotel by a covered passage. For exhibits the former dining room of the hotel will be utilized, this room being in direct connection with the meeting room in the Fine Arts Building. The banquet room in the Auditorium will also be used for committee meetings.

Proposed Ohio Public Utilities Commission.

A bill has been introduced in the Ohio Legislature for the regulation of public utilities modeled rather after the Wisconsin than the New York measure. It provides for a commission of five members whose terms of office shall be five years, with salaries of $10,000 each per year. The governor is empowered to make the appointments and may remove them for cause, although a hearing may be demanded in that case and witnesses summoned if necessary. The provisions of the bill apply to all individuals, companies, corporations or associations, their lessees, trustees or receivers and every town and village in the state that may now or hereafter own, manage or operate any plant or any part thereof for conveying telephone and telegraph messages, the production and transmission, delivery or furnishing of heat, light, water or power to the public, and all street and interurban railways.

The bill provides for indeterminate permits that shall continue so long as the corporation or company conforms to the rules and regulations of the commission and the provisions and enactments of the city and village councils, rather than for franchises that shall have a definite time to run. Just and reasonable service with fair prices are required, and companies using poles, tracks, conduits and other equipment on or under streets are required, in consideration of just compensation, to allow other public utilities to use them. If they cannot agree upon the compensation, then the question shall be referred to the commission and its decision may be reviewed by the courts.

The commission shall have power to make investigations as to the value of the property of every public utility to the end that the people shall not pay rates to cover overvalued property, and the body shall also have power to compel all companies to keep uniform accounts of their business and maintain offices in some city or village in the state where the company has property. These books shall be open for inspection.

Under this bill all companies shall carry a proper and adequate depreciation account whenever the commission requires it, and the commission shall have authority to determine the rates of depreciation. This money shall be used in improvements and betterments when necessary, but if invested, the interest returns shall be credited to the fund. In order that construction accounts shall be kept separate from operating expenses, the commission shall keep itself informed of all new construction, extensions and additions, and make regulations for the same. A public utility company may enter into reasonable arrangements with its customers, with the consent of the commission, for a distribution of its surplus earnings with consumers or employees, and for a sliding scale of charges.

Companies shall furnish the commission, at the times required, information given in figures per unit, as follows: Depreciation, salaries and wages, legal expenses, taxes and rentals, quantity and value of materials used, receipts for residuals, by-products, services and other sale separately, total and net cost per unit, gross and net profit, dividends and interest, surplus and reserve, prices paid by customers, and such other items as the commission may prescribe. All information in the hands of the commission shall be open to the public, except in cases where it is to the interest of the public, information may be withheld for ninety days.

The commission may provide for the examination and testing of the product and service of any utility and the measurement of such product, all information possible to be furnished the commission by the individual or company operating the plant. Consumers may also have any appliance used in the measurement of a product tested. All public utility companies must keep on file with the commission a schedule of the rates, tolls and charges which it has established and which are in force at the time. In this connection, the commission may compel companies to keep on file in every station or office where payments are made rates and schedules of prices charged, and these may be required to be displayed for public inspection. No change shall be made in these schedules until notice is given the commission, and violations of the rules are punishable by a fine. The commission may provide for classification of the service, and in such classification may take into account quantity used, time when used, the purpose and any other reasonable consideration.

Books and records kept by the companies either in or out of the state must be produced on request of the commission. Engineers, examiners, clerks, expert accountants and other assistants necessary to the work may be employed by the commission. Every complaint made by 25 persons, firms, corporations or associations against any public utility regarding rates, tolls or charges of any kind, must be investigated. On the other hand, any public utility company may make complaint when any rate, regulation or other change or charge affects its service, and the same shall be investigated. All the rules and regulations of the commission are subject to review by the courts.

No license, permit or franchise shall be granted any public utility in any municipality where there is in operation under an indeterminate permit a public utility engaged in a similar service without first securing from the commission, after a public hearing of all the parties interested, a declaration that there is reasonable necessity for the new company. To some extent this is in the nature of a monopoly. Representative Shuler, who presented the bill, believes that monopolies, properly regulated, serve the public better than competing companies in most instances, and only where existing companies fail to furnish proper service will it be necessary to allow competing companies to operate. In order to induce existing companies which have long franchises to come under the control of the commission, councils of municipalities will be allowed to grant franchises to competing companies. The idea is to grant the monopoly feature only to corporations which choose to operate under the proposed law.

Indeterminate permits amount to a perpetual franchise if the corporations operating under them choose to conform to the rules and regulations of the commissions and the ordinances of municipalities in which they operate. After the law becomes operative no further franchises are to be granted by municipalities. Provision is made for municipal ownership of all public utilities, but before properties shall be acquired or constructed the question shall be submitted to a vote of the people. If the majority of those voting favor the move and that majority is equal to 60 per cent of the vote cast at a regular election, then the municipality shall have authority to issue bonds to acquire or construct the properties. Such bonds shall not be limited in amount by the Longworth act. Existing limitation as to the power of taxation in municipalities shall be abrogated to the extent that the municipality shall not be hindered in acquiring or constructing public utility plants.

This bill gives the commission absolute power to regulate rates charged by interurban railways and telephone companies. It cannot affect street railways which have contracts with cities, unless they voluntarily come under the control of the commission because of the indeterminate permit proposition. The commission will also have authority to supervise the issue of bonds of public utility corporations. This feature is put into the law to prevent the watering of stock and making a charge to the public for investments that have never been made.

N. Y., N. H. & H. Electric Locomotives.

Owing to various rumors that the operation of the electric lines of the New York, New Haven & Hartford Railroad have not been entirely successful, the railroad company has issued a statement which contradicts the report that the entire system has been turned over to the Westinghouse Company and declares that there is no dispute and never has been a dispute between the two companies. The report that the New Haven road owes the Westinghouse Company between seven and ten millions of dollars is declared to be untrue, the amount due the Westinghouse Company being only such as comes under the terms of the contract by which settlements are made monthly. The entire operation, both of the power house and the trains, according to the statement, are and always have been in the hands of the railroad company. The rumor that the system had been turned over to the Westinghouse Company probably arose from the fact that owing to slight necessary changes in the locomotives which demanded expert technical supervision, the Westinghouse Company was given charge of the small machine shop where such repairs are made. But even the expense of running this shop is borne by the railroad and the Westinghouse engineers were asked to take charge merely to expedite the repair work. At no time since the inauguration of the electric service between Stamford and New York has the service been discontinued; in fact, in commercial service, the locomotives furnished by the Westinghouse Company have exceeded by 20 per cent the contract guarantee, and under certain conditions have been operated up to 100 per cent over the contract guarantee. At the Cos Cob power station certain changes were found desirable and will be completed shortly, but the full capacity of the station is much in excess of the operating requirements and has at all times been found sufficient to meet the needs of the electrical service. Both companies are stated to be working together in the closest harmony. The Westinghouse Company has never had supervision over the operation of the company's power house or its trains; its connection with the operation of the electric locomotives has been to provide experts for the instruction of the engineers in the handling of the electrical machinery.

The statement issued includes a list, with their respective designating numbers, of the 20 locomotives which run between New York and Port Chester, and the 22 locomotives which run between New York and Stamford.

An official of the Westinghouse Company corroborated the above statement of the railroad company in every particular, and added that the railroad had made even better monthly payments than actually required by contract.

Industrial Education in Ohio.

The Ohio legislature will be asked to authorize the appointment of a commission whose duty shall be to inquire into the opportunities for trade and industrial education in the state and the demand for such training as schools for this purpose will afford. Through the effort of engineering organizations of the state this matter has been brought to the attention of members of the legislature and they have been shown where the state, the fifth in manufacturing in the Union, lacks much in the way of industrial training for the young people who cannot secure a higher education in engineering. Little attention has been given in the state to this subject, although it has been taken up to some extent by the public schools of Columbus, and Cleveland now has a new and magnificent building completed. Some criticisms have been made on the course that will be adopted for this school, but it is practically certain that if a wrong start is made, it will be corrected in a short time through the interest manufacturers and engineers will take in it. Prof. W. T. Magruder, of the Ohio State University, has been greatly interested in the matter of trade or industrial schools, and it is through his work largely that the subject will be brought before the legislature. He read a paper at the annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers some time ago that was effective in awakening interest in the matter, and it was then decided that something should be done to secure schools of this kind in the manufacturing districts of the state. The idea is that children who learn a trade in these schools will be much better fitted when they arrive at maturity for taking care of themselves and those who may be dependent upon them than if they are initiated into the work in the usual way and become a part of the machinery of a shop. They will become skilled in the all round work and will have ideas of their own which they do not get when set at piece work, where they become adept in one thing and do not know much about anything else. The Ohio State University at Columbus, Case School of Applied Science at Cleveland, the Municipal University at Cincinnati and the Young Men's Christian Association are doing much to advance the higher education in the various branches of engineering, but it is contended that those who expect to become workmen would be much better fitted for their duties with a training of several years in an industrial school where they will be taught the principles of mechanics and a way opened up to them to think for themselves.

Promotion of Industrial Education.

At the convention of the National Society for the Promotion of Industrial Education, held at Chicago, on Jan. 23, 24 and 25 many interesting papers were presented. Brief abstracts of many of these papers are given below.

Mr. Theodore W. Robinson, chairman of the Illinois state committee, who acted as toastmaster at the opening banquet, announced that in 39 states committees have been organized for promoting industrial education, legislation upon this subject has been inaugurated by the states of Massachusetts and Wisconsin, while a bill has been introduced in Congress bearing upon this matter.

Dr. Chas. W. Eliot, president of Harvard University, stated that the remedy for the defects in our educational system is to have industrial schools for children between the ages of 14 and 18. The law must assist in getting the children into the schools. The teachers in the elementary schools should assist in determining the vocation which may be best chosen by the individual. "Nothing in our country is now done as it was done 50 years ago. We must guide the child into that path of life in which he may be most successful. We used to set children to doing all the things they could not do well. Now, we must seek out what the child can do best."

Mr. James W. Van Cleave, president of the National Association of Manufacturers, said that with only 5 per cent of the world's population, the United States furnishes 35 per cent of the world's manufactures. However, although our educational system makes ample provision for the professions, extremely little attention is paid to those entering upon industrial pursuits.

Dr. Henry S. Pritchett, president of the National Society for the Promotion of Industrial Education, stated that the experience of other nations shows clearly that a system of industrial training must sooner or later be grafted on to the general system of education, so that the boy of 12 may begin his preparation in the lower school. We may well expect that private initiative will lead the way by the erection of model school buildings for the various trades and callings which our industrial system demands.

Hon. Carroll D. Wright, president of Clark College, who presided at the meeting held during the forenoon of Jan. 24, remarked that the industrial revolution of the latter part of the nineteenth century resulted in the introduction of labor-saving machinery and was the beginning of the decline of the apprenticeship system. The apprenticeship system did not answer the whole demand for industrial education; neither does the industrial school furnish everything in the way of vocational equipment that can be gained by a thorough apprenticeship system. What is needed is an enlightened coördinated system. The modern idea is to perfect the apprentice in the theory and to a large extent the practice of his trade in the shortest possible time commensurate with efficiency and skill.

Mr. J. F. Deems, general superintendent of motive power for the New York Central lines, stated that the immediate and direct results of an apprentice system inaugurated on the New York Central lines on March 6, 1906, have been: Increased output (notwithstanding the four hours per week spent in class), less spoiled work, ability to read drawings, to lay out templates and to make sketches, a better grade of apprentices, increased interest in the work, suggestions as to improved methods and tools, draftsmen for company drafting rooms and apprentices for special work as needed. The officials of the railroad are already enthusiastic over the results obtained in these courses.

Dr. Leslie W. Miller, director of the Pennsylvania Museum and School of Industrial Art, at Philadelphia, expressed some doubt whether much good is to be reasonably expected from trade instruction in schools unless some definite connection with the practical work outside the school is assured before the work of instruction has gone very far.

Dr. Victor C. Alderson, president of the Colorado School of Mines, contended that the establishment of trade, industrial and engineering schools is simply the application of science in a broad, comprehensive and intelligent way to the needs of industry, and said that that nation will be the most successful, industrially and economically, which makes the best use of science as an aid to industry.

Mr. Chas. F. Perry, director of the Milwaukee School of Trades, claimed that in the present curriculum there is a lack of studies that interest and hold pupils, and as a result 96 per cent of those who enter the primary grades fail to graduate from the high school. The inherent unrest of the adolescent period leads to a repulsion for abstract book work. The boy should be led to the theoretical side of his work through the practical.

Mr. Milton P. Higgins, president of the Norton Companies, said that the trade school is for the boy who must, from choice or necessity, get about life's work early. It should take the boy after he leaves the ninth grade of the public school. A trade school properly conducted will turn out a class of skilled workmen and will raise, not lower, the standards of workmanship, and will increase wages through superior skill and mechanical intelligence.

Prof. Graham Taylor, director of the Chicago Institute of Social Service, remarked that trade schools cannot fail to promote the special interests of the whole people. In the curriculum of the trade schools there should be included, both for the sake of the employer and the employee, instruction in the history, psychology and ethics of industrial relationship.

Mr. Luke Grant, in discussing the attitude of the wage earner towards industrial education, said that while the wage earner has no aversion to trade schools that are properly conducted, he does treat with contempt such a school that advertises that it will teach a boy the plumber's trade in six months and guarantees that he will be a competent workman. The best way to abolish the bad trade schools, which are known to exist for private profit, is to establish good trade schools, conducted under the supervision of educational boards, for the benefit of the youth of our country.

Rapid Automatic Telegraphy.

In a paper read before the Franklin Institute, on Jan. 15, Mr. Patrick B. Delany stated that, although the e. m. f. of circuits for transmitting electrical energy has increased from a few hundred volts to 75,000 volts within the last 20 years, the rate of transfer of words by telegraph has fallen off during the same period, and is now about one-fortieth of what a wire is able to convey. Previous to a few years ago there was strong opposition on the part of telegraph companies to the preparation of messages on tapes preliminary to their transmission, but it is now conceded that in no other way can the speed of a circuit be appreciably increased, and the perforated tape is coming into use even for unimportant advances in telegraphy.

In an electromagnetic automatic system, specifically described in the paper, use is made of an ordinary Morse key for operating a perforator. Four operators may be employed in perforating tapes by Morse keys at a total rate of 100 words per minute, and the product of their united work sent through a mechanical transmitter and reproduced on a perforated tape at the distant station. This tape is then distributed among four local circuits, where a perfect reproduction of the original characters are ticked off on the sounder and copied on a typewriting machine by the operator, just as if the characters were coming over the wire directly from the operator's key. If the system were duplexed, it would yield 200 words per minute in perfect Morse signals, and without the slightest deviation from the regular Morse method, the sender working his key, and the receiver copying by sound, while the message capacity of the duplexed wire would be increased from about 40 words per minute to 200.

In the rapid automatic telegraph system, means are employed for overcoming the effects of static discharge, so that a rate of 1000 words per minute is obtained. The static effect is neutralized by using reverse impulses after each signal. A rate of 1000 words per minute over a single wire requires 82 persons. 40 perforating machines for transmission, 40 transcribing them by typewriters, and two tending machines.

Mr. Delany said that at a rate of from 500 to 1000 words per minute per circuit, the charges can be lowered to a point such as to compete with the ordinary postoffice service. When a letter of 50 words filed in an office in Philadelphia can be dropped in the postoffice in Chicago or any other city within half an hour for 25 cents, an enormous traffic will be speedily developed.

It will be entirely feasible for business houses or newspaper correspondents to compose their letters or reports on tapes in their own offices by keyboard machines, send the tapes in rolls to an office, where it will be forwarded without delay, and have the record tapes delivered at the other end, for private transcription. In this way correspondence would be absolutely private, for, if desired, the perforated tapes could be returned to the senders.

Hydro-Electric Plant for Tokio, Japan.

The first 60,000-volt hydro-electric plant in Japan has just been put into service after having passed the rigid inspection which is required by the Japanese Government of all electrical installations. Power is obtained by impounding the Ugigawa, a narrow and swift but deep river, such as is often found in the mountainous portions of Japan. The normal rating of the main station, which is 18,000 kilowatts, is furnished by six 3000-kw, 50-cycle, 6600-volt water-wheel-driven alternators. The generator voltage is stepped up to the line e. m. f. of 60,000 volts through three banks of three single-phase, water-cooled, 2000-kw transformers, at which potential energy is transmitted 25 miles to the Waseda sub-station just outside the city of Tokio.

In this main sub-station water-cooled, 1800-kw transformers decrease the e. m. f. to 11,000 volts, at which potential energy is transmitted underground through lead-armored cables to 11 distributing sub-stations situated in various parts of the city. In each of these smaller sub-stations oil-cooled transformers of 250-kw rating reduce the e. m. f to 2000 volts, the line potential of the city circuits.

The territory immediately surrounding the Waseda sub-station is also fed with energy at low voltage for lamps and motors. The transformer, regulating and control equipment, and the cables were furnished by the General Electric Company.

Telephonic Development in Spain.

United States Consul-General B. H. Ridgely, of Barcelona, advises that a royal order has been published in the Spanish Official Gazette inviting tenders from native firms for the installation of a large and important telephone system connecting with the French wires at the frontier towns of Irun and Portbou.

The line will start from Madrid and at Zaragoza branch off in two directions, one passing through Pamplona, Tolosa, and San Sebastian to Irun, and the other following the line through Lerida to Barcelona and Tarragona, and thence on through Gerona to Portbou on the French frontier, thus establishing communication betwen Barcelona and France. Stations will be placed at all the towns named above. The work will have to be commenced before July, 1908, and terminated within the year.

Tenders are also solicited for the construction and working of telephone systems connecting Madrid with Coruña and Ferrol, with Pontevedra by way of Orense and Vigo, on to Gijon, Santander and several other smaller towns. This will be known as the Northwestern System. Another, the Southeastern System, will connect Madrid with Cartagena, Albacete, Alicante and Murcia, Almeria, Lorca, Linares, Jaen, Granada, Baza and Motril. Another system, to be known as the Southern Telephone System, will link up Madrid with Cadiz, Seville and Jerez; with Malaga, and with Huelva, Badajoz and Zafra.

Inasmuch as only native firms are invited to compete for these contracts their interest for American exporters lies in the fact that large orders will naturally be given by the contractors for wire, posts, insulators and other material as soon as the contracts are finally signed, which it is expected will be in January. Now, the telephone companies of Spain buy their wires mainly in Germany and their apparatus in Paris and Stockholm.

CURRENT NEWS AND NOTES.

CHINA IN THE TELEGRAPH CONFERENCE.—A dispatch from Peking announces that China has appointed delegates to represent her, for the first time in her history, at the next International Telegraph Conference.

BELGIAN INTERNATIONAL EXPOSITION.—An international electrical exposition will be held at Brussels, Belgium, in 1910, beginning in April and remaining open for at least six months. One of the features will be the installation of exhibits by national sections.

BROOKLYN DEATH ROLL.—Last year 102 persons were killed by trolley in Brooklyn, N. Y., 26 were killed on the elevated electric railroads, and 6 were killed by live wires, while 83 were accidentally suffocated by gas, and 4 were "killed" by the same medium. The trolley victims were nearly all young children playing carelessly in the street.

HIGH TELEPHONE POLE.—A Seattle, Wash., paper mentions a telephone pole in Aberdeen 190 ft. high, which is claimed to be the highest one-piece pole in the world. It is a fir sapling and measures 18 ins. at the base and 5 ins. at the top. It supports wires over the harbor, at a sufficient height to permit the passage of sailing vessels.

THE SOUTHWESTERN QUESTION BOX.—Mr. Samuel Kahn, of the San Antonio Gas & Electric Company, editor of the Southwestern Electrical & Gas Association Question Box for 1908, is sending out invitations for questions for the next convention question box. The convention is to be held at El Paso, Tex., in May.

LIGHTNING EFFECT ON CHIMNEY.—Recently the high chimney of the power house of the New Jersey Training School for Feeble Minded Children was struck by lightning, and a superficial layer of brick work torn from the surface to a width of one or two feet, from within a few feet of the top to where the iron boiler flue enters the chimney at the bottom. The trace of the discharge is a wavy one, confined almost entirely to one side of the chimney.

FALLING SIGNS.—Electric signs in New York City and vicinity suffered considerably from the recent high winds. A 40-ft. section of an electric sign 6 ft. high at Forty-second Street and Sixth Avenue was torn from its fastenings and injured four persons as it fell to the street. At Coney Island an electric sign 3 ft. x 20 ft., suspended in front of the Deluge Building in Surf Avenue, was blown down. Several passers-by were struck by flying pieces, but no one was seriously injured

ELECTRIC POWER DEVELOPMENT IN INDIA.—It is reported that an American syndicate has taken the contract for the construction of a fleet of dredges for deepening the Jhelum River, flowing through the Cashmere Valley of India, the contract involving an outlay of $10,000,000. For the purpose of generating electrical energy to operate the dredging plant and also to supply electric power to a 200-mile railroad to be built, a plant initially equipped with 200 horse-power of American machinery is to be installed. It is stated that Mr. L. A. Dosy, who is in charge of the St. Lawrence River dredging work, will have supervision of the work of dredging in India.

WASHINGTON POWER PLANT.—It is announced that the Pacific Coast Power Company, recently organized by the Stone & Webster interests, will erect at the foot of Lake Tappe, in Pierce County, Wash., west of Spokane, at the cost of $10,000,000, an electric power plant having ultimately a capacity of 100,000 horse-power. The plant will be developed to 50,000 horse-power at first, and subsequently increased to its maximum capacity, in accordance with the demand for power. Current will be supplied from this plant for the interurban system which will unite the cities of Bellingham, Everett, Seattle, Tacoma, Elma, Aberdeen and Portland, Ore.

OHIO TELEPHONE REGULATION.—Representative Earl Stewart has prepared a bill to be introduced in the Ohio State Legislature which will place the telephone business under the state railroad commission with plenary powers. Schedules of rates must be filed with the commission, if this bill passes, and where rates are considered unreasonable, new rates may be fixed. An air-line charge per mile must be made for all long-distance business within the state, and interchange rates and business are subject to revision by the commission. When the Council of any city or village refuses or neglects to fix terms and conditions under which a company may use the streets and alleys for telephone purposes for 100 days, then the commission may take the matter up and fix such terms and conditions. The commission will thus have power to grant franchises. This bill is considered almost as revolutionary in its nature as the recently introduced public utilities bill that applies to railroads and traction lines.

NEW YORK STATE WATER POWERS.—The annual report of the State Water Supply Commission estimates that at present the rivers of New York State, excluding Niagara and the St. Lawrence, are capable of furnishing at least one million horse-power for industrial purposes, and that at present more than one-half of this is unutilized, because no plan for the development of its water powers has yet been undertaken by the State. Reference in detail is made to water powers of the Sacandaga, Genesee and Raquette Rivers. In the case of the first mentioned, it is stated that a dam can be built in the foothills of the Adirondacks that will render available 50,000 horse-power, and would increase the present available water power at sites lower down the Hudson by 70,000 horse-power during the six dry months of the year. A dam on the Genesee River at Portageville would render available 32,000 horse-power and increase by 14,000 horse-power the horse-power now developed in the vicinity of Rochester

NATIONALITY OF EMPLOYEES.—In one of the bills before the New York State Assembly it is provided that no corporation regulated by the Public Service Commissions shall hereafter employ any person who is not a citizen of the United States; and that violation of the law should constitute a misdemeanor.

SAPPHIRES BY ELECTRICITY.—It is noted from Paris that Eugène Maret, the French engineer, has established an electrical furnace with which he says he will be able to manufacture several pounds of sapphires daily. These artificial stones will be harder than the natural gems, and can be graded to any shade desired. The raw material used is Roman alum and chromatic acid.

TELEGRAPHIC BREVITY.—Some recent notes from Europe remark that the word "Eisenbahnbetriebstelegrapheninspektionsassistenten" would suggest German humor were it not recognized in the census of all the professions, trades and occupations which were covered in the German Empire in June last. The calling in question is that of assistant inspector in the railway telegraph service, and is one of 15,016 different occupations specialized by the census taken in that month.

ELECTRIFICATION OF CHILEAN RAILROADS.—Consul Winslow, of Valparaiso, Chile, reports that the Chilean government is considering the subject of substituting steam for electricity for the operation of the section of the State Railroad extending from Santiago to Concepcion, a distance of 350 miles. Mr. Walter T. Peck has been commissioned by the Chilean government to prepare a report on the results attained in this country by the substitution of electricity for steam in railroad service.

OHIO MUNICIPAL PLANTS.—Attorney General Wade H. Ellis has expressed the opinion that Ohio municipal electric light plants have the authority to sell current to private consumers under a law which he aided in framing some years ago. He says that the Longworth amendment did not change the law, but merely made it plain that natural gas plants may be established by municipalities also. The point is involved in a case now before the Supreme Court, that of Nelsonville, and should this be adverse to the opinion expressed by the attorney general, it is claimed that then an amendment will be made to the law, as it is believed the general assembly will enact such an amendment without opposition.

STEVENS ALUMNI DINNER.—The seventh annual dinner of the Alumni of Stevens Institute was held at the Hotel Astor, New York, on Tuesday evening, Feb. 4. About 250 Stevens men and their friends were present, and besides enjoying the usual features of a college dinner and reunion, they heard some notable addresses, among the speakers being President Alex. C. Humphreys; Dr. H. S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching; Hon. Robert P. Porter, formerly chief of the Census Bureau and now the American representative of *The Times*, of London; Colonel George Harvey; James E. Sague, of the New York Public Service Commission; Colonel Charles W. Fuller; Prof. George V. Wendell; Ernest H. Peabody and H. V. R. Scheel.

INDUSTRIAL EDUCATION.—Prof. Alexander C. Humphreys at the annual dinner of the Alumni of the Stevens Institute of Technology, held on Feb. 4, in referring to the attack by Mr. R. T. Crane on Carnegie's endowment for technical education, said that he was prepared to go a short distance along the road Mr. Crane has taken, for in his work he would prefer as a subordinate the man with a technological scholarship of 30 and an outside experience of 90 rather than the reverse. He advocated the inclusion in a technical curricula of a thoroughly practical course in economics of administration, in order that the student before graduation should be better prepared to meet the political and economic questions of the day as involved in the problems of engineering and industrial administration. He recommended the further development of the Stevens course in the business features of engineering, and urged the alumni to bring this matter to the attention of men of surplus wealth throughout the United States, that the means might be provided to enable the institute to take the lead in this direction.

THE NINE-HOUR DAY FOR RAILWAY TELEGRAPHERS.—The law, which will become effective March 4, prescribing a nine-hour day for railroad telegraphers, was the subject of discussion at a meeting at Washington a few days ago between members of the Interstate Commerce Commission and representatives of nine trunk-line railway systems. The latter informed the commission that the railroads were unable to render a strict compliance with the law, inasmuch as its requirement of a nine-hour day would necessitate the employment of 15,000 additional men. They represented that it was impossible to secure an army of men of the class desired upon short or long notice. The commission was asked, therefore, to request Congress to make such a change in the law as to meet present conditions. The commission takes the ground that it has no discretion in the enforcement of the law. Nor can it extend relief to the railroads in the present emergency, inasmuch as the law can be waived only after hearing in particular cases.

FORESTS AND WATER POWER.—At Washington on Jan. 30 governors and their representatives, other state officials, federal experts, presidents of commercial and civil associations and officers and members of a dozen forestry bodies, numbering nearly 200 and representing all the states east of the Mississippi River, except Florida, Illinois, Indiana and Mississippi, appeared as a special forestry delegation before the House Committee on Agriculture. The American Institute of Electrical Engineers also participated. Under the leadership of Governor Hoke Smith, of Georgia, the delegation made an exceptionally forceful showing of facts and figures in support of the Currier bill, appropriating $5,000,000 for the purchase of about 7,000,000 acres of mountain lands in the Appalachian and White Mountains, to be held as national forest reserves for the conservation and control of the navigable and power-producing streams of the states affected. The minimum horse-power of the Southern Appalachian streams is put at 2,740,700 horse-power for the year, and the minimum for six high-water months at 4,929,573 horse-power. The Geological Survey estimates that at least 50 per cent of the minimum is available for development.

ENGINEERING AS A LIFE WORK.—Prof. Henry H. Norris, of Cornell University, delivered an address before the students of Purdue University, Jan. 27, having for its subject "Engineering as a Life Work." He directed particular attention to the personal qualities necessary for success in an engineering career. Among these is the ability and desire to accept responsibility, and the qualities of leadership, elements of which are thoroughness and the faculty for seeing the interrelations of things and thoughts. Drawing a distinction between wage-earners and salaried employees, he pointed out that the first puts his skill, the second himself into his work: the first is paid for his labor, the second for his interest: the first is paid for overtime, while there is no overtime for the second; the pay of the first is regulated by unions, while the second is theoretically paid a reasonable living salary in accordance with the expenses to which his position subjects him: good work on the part of the wage-earners is usually recognized as results are evident, but this is not always so in the other case, as the true leader loses himself in his work. Professor Norris directed attention to the following qualifications which some technical graduates do not possess, and asked his auditors to question themselves as to their possession: Answer business letters by return mail; write a clear, brief report or letter; defend their own opinions; reason from premises to a conclusion; realize the obligation involved in a contract; inspire others to their best efforts.

ILLUMINATING ENGINEERING.—The New York section of the Illuminating Engineering Society will meet in the Engineering Building on Feb. 13 when Mr. George Leland Hunter will present a paper on "Light and Color in Decoration" with lantern slides in color. He is an authority on decoration and tapestries.

JIM CROW TELEPHONES are proposed in Oklahoma, whose new constitution is the most progressive, advanced, liberal document on earth. All telephone exchanges are required by the proposed law to have separate waiting rooms and separate telephone booths for whites and negroes, in "first-class" cities. It would appear that the offence of being black does not count in cities of lower degree.

WRECK OF "TECHNOLEXICON."—As recently announced in these columns, the German Society of Engineers has abandoned the proposed publication of the "Technolexicon," an international technical dictionary. It now appears that more than $100,000 had been spent on the work, and liabilities of $20,000 in addition will have to be discharged by the society. Work has proceeded during the past five years, and it was estimated that for completion at least 10 or 12 years additional would be required, with further great outlays of money. Anyone having had experience with this class of work can easily realize how, if not subject to strict commercial supervision, the cost can easily pass all bounds.

METRIC SYSTEM FOR DENMARK.—According to a law passed by the Danish Rigsdag, the use of the metric system is made compulsory for all government purposes not later than May 4, 1910, the date of adoption prior to the limiting date to be fixed by the king; and two years after this adoption the system is made compulsory throughout the kingdom for all purposes, with an exception in favor of apothecaries' weights and measures and scales for weighing precious stones. The exception in favor of apothecaries' use is doubtless made to provide for the compounding of older formulas, as physicians in Denmark now employ generally the metric system in writing prescriptions. In the U. S. naval service medical officers have for many years used the metric system for this purpose.

MANICURING NIAGARA.—It is stated from Washington that a plan for the preservation of the scenic beauty of Niagara Falls by the creation of the national or international reservation bordering Niagara from the rapids to the end of the gorge below the falls has been presented to President Roosevelt by the officers of the American Civic Federation. With the plan carried out the river would be lined on either side by a grove of trees, and all power plants and factories moved to the background. The plan contemplates the renewal of the Burton act for a period of ten years. This act limits the amount of electricity which may be generated by a diversion of the waters of the river. The "moving" of the power plants seems to be treated by the Federation in a spirit of levity.

ITHACA BRANCH A. I. E. E.—Before and after the Christmas vacation two special meetings of the Ithaca branch of the A. I. E. E. were held. At the first Prof. W. D. Bancroft, head of the Department of Physical Chemistry, Cornell University, delivered an illustrated talk on "The Electro-Metallurgy of Steel." The speaker gave details of the latest types of furnace used in the manufacture of steel, and gave comparisons of the cost of producing steel in this way, and by means of the converter and open-hearth processes. At the second meeting local members abstracted the papers on "The Mechanical Engineering of Power Stations," delivered in New York in December. The discussion was especially interesting to local members, as all of the students in Sibley College go through a series of elaborate mechanical engineering tests, covering many of the principles laid down in these papers. There are 127 members, associates and enrolled students in the local branch at this date.

PATENTS IN 1907.—The report of the Commissioner of Patents for the fiscal year ending June 30, 1907, has been issued. During the year there was filed a total of 66,795 applications, including 56,514 for mechanical patents; 816 for designs; 192 for reissues; 7869 for registration of trade-marks; 982 for registration of labels, and 422 for registration of prints. In addition to these applications, there were filed 1900 caveats. There were issued 33,644 mechanical patents; 529 design patents; 165 reissues; and there were registered 8798 trade-marks; 660 labels, and 325 prints. The number of patents which expired was 25.322, while 4707 letters patent were withheld for non-payment of the final fees; 14,565 applications were allowed, and awaiting the payment of the final fees. The total receipts of the office from all sources amounted to $1,859,592.89 for the fiscal year, of which there were expended $1,584,489.70, including $932,665.59 for salaries, leaving a surplus of $275,103.19, turned into the United States Treasury. The total net surplus of receipts over expenditures in the Treasury to the credit of the Patent Office on Jan. 1, 1908, was $6,706,181.64, an amount derived entirely from the fees paid since 1837. At the end of 1907 no fewer than 18,540 applications awaited examination. An increase of force and facilities is badly needed.

A COLLEGE INNOVATION.—A novel departure is noted in the fact that the post-graduate students in electrical engineering taking the course in electrical engineering practice at Worcester, Mass., have organized the Worcester Polytechnic Institute Graduate Engineering Company, doing a general consulting engineering business, with the members of the electrical engineering department as clients. The class of problems with which they have to deal is very much the same as those they would meet in a consulting engineer's office, including, for example, a report on a proposed power development scheme; a report on the cost of power in a given plant where an opportunity for making tests for efficiency and economy of operation is given, and where free access to the records is permitted; and laying out an express schedule for an interurban electric road. These problems are designed to make the student more thoroughly familiar with various matters taken up in preceding courses; and being entirely practical, and carried out in this way, are much more interesting than the sort of examples sometimes given. The office is completely organized with chief and assistant engineers, and will carry on things in a business like way, all intercourse with clients (members of the electrical engineering department) being carried on by correspondence or by special appointment.

MAIMING OF TREES.—In a recent issue, on the subject of tree lopping for aerial wires, the *New York Tribune* said: "More power and yet again more power to the already puissant elbows of the municipal authorities of Plainfield, N. J., and to those of all similarly disposed public servants. The other day four telephone linemen were observed to be slashing and mutilating shade trees along the street, according to the habits of their tribe, to make room for the easy stringing of overhead wires. At the instance of the Shade Tree Commission the police arrested them. They protested that they had a right to do as they had been doing, and showed as evidence thereof permits from the adjoining property owners to cut the trees. The chief of police declined to recognize the permits as valid and took the men to court, where the judge also ignored the permits and fined the prisoners. The principle thus established is a good one. Nobody has a right to mutilate a tree without the consent of the owner of it or of the property before which it stands. But neither has the owner of the property before which it stands the power to authorize its destruction or mutilation. It is true that he may have title to the street to its center, or its whole width if he owns on both sides, but it is perfectly obvious that he cannot do with the trees as he wills, so as to obstruct the street or to impair the rights of public usage on it. Neither can be do as he wills with the shade trees which are growing along it for general public enjoyment."

ASBESTOS SLATE.—According to German publications, a firm in Munich has succeeded in rendering asbestos waterproof and is putting it on the market in the form of asbestos slates which can be used in construction without wooden laths being necessary. The slates are said to be valuable as insulation for various kinds of electrical work.

TOKIO TROLLEYS.—U. S. Consul-General Henry B. Miller, of Yokohama, advises that the municipalization of the Tokio City Electric Railway has been agreed upon, the price being $38,750,000 gold, to be paid in municipal bonds bearing 6 per cent interest, and redeemed in installments within 27 years. The line will be transferred on March 31.

INSTITUTE MEMBERSHIP.—The Toronto, Can., section of the American Institute of Electrical Engineers is agitating the question of a subdivision of the class of Associates into two classes, namely, "Associate Members" and "Associates," to the former of which groups engineers alone could be admitted. The object is to have the institute council appoint a representative committee to investigate the question and redraft the specific article in the constitution regulating the matter.

GAS ENGINES.—The first meeting of the gas power section of the American Society of Mechanical Engineers will be held Tuesday evening, Feb. 11, in the Engineering Societies Building at 29 West Thirty-ninth Street, New York. The subjects under discussion will be "Experimental Gas Turbines in France" (with lantern slides), "A Simple Continuous Gas Calorimeter," "A Gas Engine and Producer Guarantee." Other subjects relating to the question of gas power will also be discussed.

MINING ENGINEERS.—The ninety-fourth meeting of the American Institute of Mining Engineers will be held in New York City, beginning Thursday evening, Feb. 18. The institute headquarters will be in the foyer of the United Engineering Societies Building during Wednesday and Thursday. At the opening session on Tuesday evening an illustrated paper on "Electric Power in Steel Mills" will be presented by Mr. David B. Rushmore, technical head of the mining department of the General Electric Company.

THE FALL ELECTRICAL SHOW.—Even this far in advance there is every indication that the second annual electrical show, which will be held at Madison Square Garden, New York City, Oct. 3-14, will surpass the exhibition of last year. Mr. George F. Parker, the president, announces that 60 per cent of last year's exhibitors already have re-engaged the space they occupied before. Among the exhibits will be the wireless telephone and it is hoped that arrangements can be made to bring over a gyroscopic train from England.

ELECTRIC HEATING IN SHANGHAI.—It is stated by United States Consul W. T. Gracey, of Tsingtan, China, that electrical kettles for afternoon tea are finding a sale in Shanghai; also electrical radiators in plain and ornamental styles, which are most useful in Shanghai during the damp weather, when a small and steady fire is needed for drying clothing, etc. The Shanghai municipal electrical department has a special low rate of charge for these heating appliances, and they are now being used in residences and offices to good effect.

VIENNA MUNICIPAL LOANS are rather staggering in their size, and Dr. Carl Lueger, the burgomaster, has a new one of $75,000,000. Electric lighting will absorb $17,500,000; gas, $6,250,000; tramways, $12,500,000; the municipal brewery, $500,000; and cemetery, markets, municipal coal yards and municipal undertaking of funerals yet another $7,500,000. In the improvement of the city by the demolition of old buildings and the laying out of parks and gardens, the erection of a technical museum, workhouses, asylums, a jubilee hospital and additional water service another $25,000,000 or $30,000,000 will be laid out.

JAPANESE EXHIBITION.—An international exhibition is to be held at Tokio in 1912, under governmental auspices and control, where it is hoped that the United States, with its large and growing interests in Japan, will be well represented. The site will include the Aoyama parade ground adjacent to the imperial estate, and will be about 292 acres in extent. There will be five departments—science, education, machinery, electricity and manufactured articles. For the installation of such exhibits, space will be allotted in the buildings erected by the administration, but special exhibit buildings may also be put up. Provision will be made by law as to exemption from duties, and for copyright protection.

CHICAGO ELECTRICAL SHOW FOR 1909.—Manager Homer E. Niesz, of the Electrical Trades Exposition Company, Chicago, is already sending out application blanks for space at the 1909 Chicago Electrical Show, to be held at the Coliseum, Chicago, Jan. 11 to 23. The same arrangement as regards erection of booths for exhibitors is to be made for 1909 that was so successfully and satisfactorily carried out in 1908. The exposition company did all the work of erecting booths and supplying furniture, thus relieving the exhibitors of an immense amount of exasperating detail work, as well as troubles from strikes, extortionate charges and a multitude of evils that accompany an exhibition of this kind where every exhibitor has to make his own arrangements as to booth erection and electrical wiring.

THE WIRELESS TREATY.—It is stated from Washington that the Republican members of the Senate have reached a virtual agreement to take no action relative to the wireless telegraphy treaty which has been pending before the Committee on Foreign Relations since almost the first day of the session. This conclusion is in spite of the fact that a dozen or more great powers have already approved the treaty and are now waiting for the co-operation of the United States. It is purposed to let the wireless treaty remain in the committee indefinitely while the Navy Department watches the behavior of the wireless companies. If they refuse to transmit distress signals or to show reasonable co-operation the treaty will be taken from its pigeon hole and ratified. The passage of the treaty would place all companies under international supervision.

ELECTRIC LIGHT ACCOUNTING.—The accounting committee of the Empire State Gas & Electric Association has had a number of conferences with similar committees of National Electric Light Association, the American Gas Institute, the Street Railway Association and with the statisticians of the Public Service Commissions of both the first and second districts. A classification has been prepared by the committee, which in a large number of respects has met with the approval of the statisticians of the commissions. There are, however, still some important points which are being discussed before the final adoption by the commissions of a classification for use by all the companies of the State. An interesting point is the entire absence from the classifications proposed of the word "depreciation," which has been so much discussed and which has been used to cover so many different meanings. The fund generally designated by this word will be termed either "contingent expense" or more probably "amortization." It has been the continual aim of the committee to secure the adoption of some classification which would be simple enough for the smallest company, but which could be automatically expanded so as to also provide for the largest company. The operating accounts have been reduced to the lowest possible number, but even a few of these it may be possible for some companies to omit, thus making a still further reduction. The committee's conferences with the representatives of the commission have been of the pleasantest character, and the members are optimistic as to the classification which will be finally adopted.

Electrical Equipment of the New York Custom House.

By H. Thurston Owens.

A BUILDING which will rank among the monuments of this decade, if not this century, has recently been completed in what is destined to be the world's metropolis. It occupies a square block at the lower end of Broadway, New York, and is surrounded by the Produce Exchange on the west, business buildings on the south, Battery Park on the east and Bowling Green on the north. Although it is in the neighborhood of the "skyscrapers," the site affords a vista in keeping with its imposing appearance.

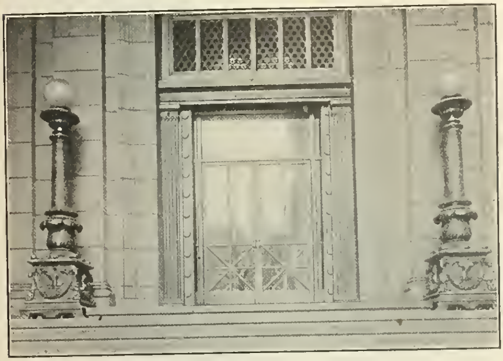


FIG. 1.—STANDARDS AT MAIN ENTRANCE.

The building is of classical architecture, cost over $7,000,000, and six years were required to complete it. The interior wiring is encased in conduit throughout, separate conduits being provided for lamp and motor circuits and for telephone, call-bell, time-detector and clock circuits. Special care was taken in the location of panel boards and outlet boxes, most of which were set in exact position by the aid of surveying instruments.

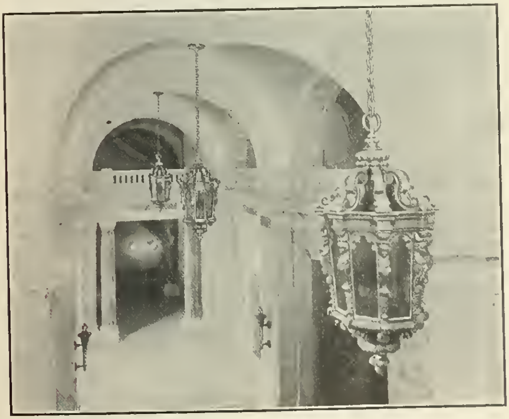


FIG. 2.—CORRIDOR AT MAIN ENTRANCE.

ILLUMINATION.

The broad stairway with the four colossal figures representing Europe, America, Asia and Africa, spell "monumental" and the building is that beyond a doubt. At the head of the stairs, at each side of the doorway, are two magnificent bronze standards, as shown in Fig. 1, and these clearly indicate the character of the equipment to be found within. Each standard has seven 16-cp clear lamps within the 14-in. frosted enclosing globe. These two fixtures cost over $5,000. Beyond this doorway is a short vestibule opening into the main corridor. To the front is the rotunda and at each end the stairways and elevators. A view of this corridor, taken from the mezzanine balcony which surrounds three sides, is shown in Fig. 2. The room is in marble of three colors, white background, brown panels and green columns. The lines are very simple and the only decorations are the beautiful bronze doorways, window sashes and the lighting fixtures.

The lanterns are reproductions of an old Italian model, being made of carved wood, with sides of old Italian amber glass. They are very large, measuring 8 ft. over all, and are equipped with 24 16-cp clear lamps. In addition to these lanterns there are four massive brackets equipped with 13 16-cp round frosted lamps, one of which is shown in Fig. 3.

Six types of fixtures may be seen from the center of this corridor (see Figs. 2, 3, 4, 5 and 7), and in addition there is one large beaded ball. In the adjoining vestibule are two bronz brackets, as shown in Fig. 5, these being equipped with six 16-cp lamps in a 12-in. frosted globe. In the foyer opposite the vestibul mentioned above are two bronze brackets similar in design to those shown in Fig. 7, but with 10-in. round frosted globes. Just why three styles of brackets are used, and of such massive size, is not apparent to the lay mind; and the equipment of those shown in Fig. 3 is entirely out of proportion to the size of the fixture. The beaded ball fixture in close proximity to the handsome lanterns seems particularly inappropriate

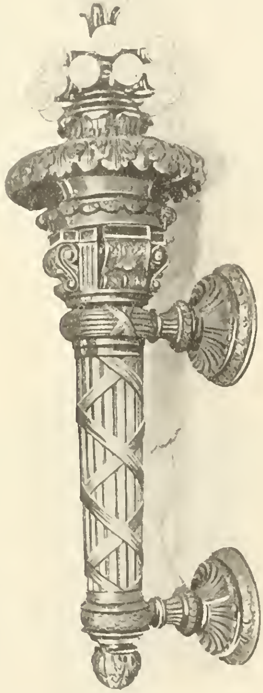


FIG. 3.—WALL BRACKET

At each end of the corridor, at the elevator entrances, are chandeliers of carved wood, as shown in Fig. 4. At the end of each of the six arms are 6-in. frosted globes enclosing one 16-cp lamp and in addition there are six 16-cp round frosted lamps clustered around the base. Just beyond are the stairways, and the fixture used is a carved wood ceiling cluster similar to the one shown in Fig. 9. There are five 16-cp round frosted lamps on each cluster.

At the western end of the main corridor is the office of the Collector of the Port. The furnishings are sumptuous, as the lighting fixtures clearly indicate, the design being the "horn of plenty." This design is synonymous with the political affluence associated with the title as well as representing the blessings of a successful government.

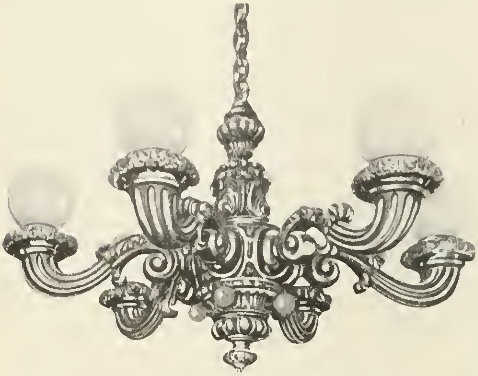


FIG. 4.—HALL CHANDELIER.

At the opposite end of the corridor is the cashier's office, shown in Fig. 6. The three bronze chandeliers each have 12 16-cp frosted ball lamps, and there are 16 brackets with five 8-cp frosted ball lamps, shown in Fig. 7. The location of the chandeliers, practically over the partition, is one of the few instances of the kind to be found in the building. They appear to be of sufficient strength to sustain a weight many times greater than that of the lamps, but they are beautiful examples of the bronze worker's art.

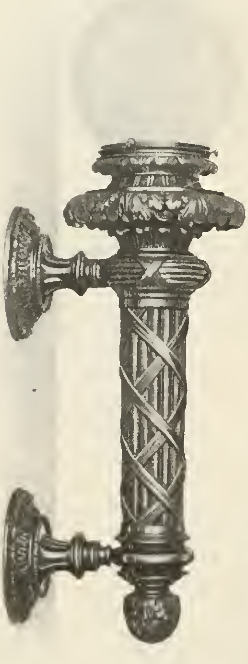


FIG. 5.—WALL BRACKET.

In the counting room or rotunda, in marble and white plaster, shown in Fig. 8, is a remarkable example of diffusing lighting, which is obtained by means of a double roof of glass, the panels shown in cut being plain glass, and above is a dome of prisms. The artificial light comes from a row of 110 16-cp clear lamps at the edge of the glass, and a row of 50 16-cp frosted lamps in the edge of the frieze.

The general interior of the building is lighted by 50-watt Gem lamps, of which there are upward of 3000 in use. Eighty per cent of the lamps have clear glass bulbs and twenty per cent have bulbs of frosted glass. The corridors of the basement and the first floor have frosted balls pendent on chains, as shown in Fig. 10, and are equipped with five 50-watt Gem lamps, pendent with nickel reflector. On the upper floors the same style of fixture is used, but equipped with one lamp with prismatic reflector. The reflectors mentioned in both cases are inside of the globes.

Light is provided upon the stairways at the landings, there being one landing between each floor. There are two lamps on each landing and a total of 50 lamps throughout the building.

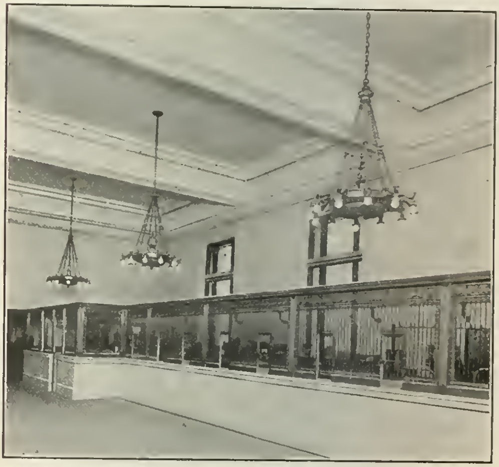


FIG. 6.—GENERAL VIEW OF CASHIER'S DEPARTMENT.

This pattern of lamp is shown in Fig. 7, the equipment in this case being two 16-cp lamps within a 10-in. frosted enclosing globe.

The post office department has a branch in the building and the lighting equipment is somewhat different to that of the general installation, the features being numerous types of lamps and reflectors where special lighting is necessary and the placing of the lamps in the chandeliers at an angle of 45 deg. The office of the Naval officer is finished in oak with beamed ceiling, and the fixtures, chandelier and brackets are of wrought iron.

The main corridor in the basement, as shown in Fig. 9, is finished in marble, and the lighting fixtures are principally for architectural adornment. There are 16 bronze standards equipped with eight 8-cp round frosted lamps and ceiling clusters in addition.

The general offices throughout the building have chandeliers which are simple in design, the lamps being pendent with holophane concentrating frosted reflectors. The chandeliers have four, six and eight arms and a corresponding number of lamps according to location and are placed from 9 ft. to 12 ft. above the floor. The result of placing the lamps at this unusual height is that the light is quite generally distributed without bad shadows from desks and furniture, but is only sufficient for general illumination.

Individual desk lamps are therefore provided, the equipment consisting of 50-watt Gem lamps and adjustable brackets with tin reflectors, green outside and aluminum inside. In the bookkeeping departments the local lighting is provided by means of stationary fixtures with lamps pendent, and conical shades.

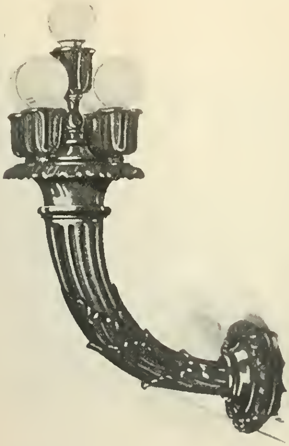


FIG. 7.—BRACKET FOR STAIRWAY LANDINGS.

Some of the rooms on the first floor have lamps enclosed in spheres instead of being equipped with reflectors. The spheres have lower halves of frosted glass, the upper halves being of prismatic glass.

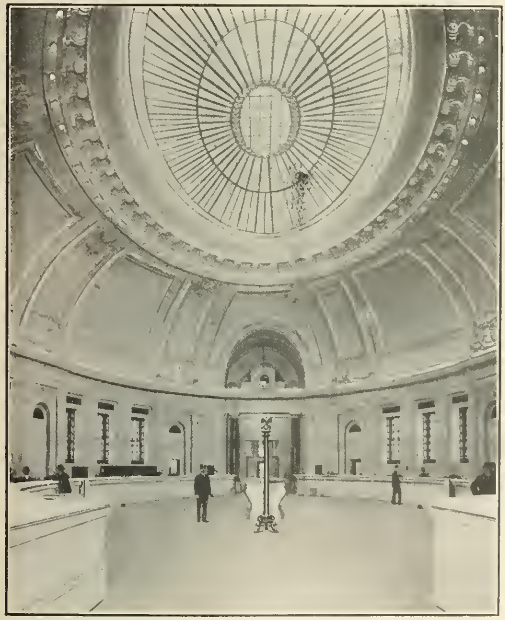


FIG. 8.—GENERAL VIEW OF COUNTING ROOM.

The corridors from the third to the seventh floor are lighted by 40-cp, 75-cp and 100-cp Westinghouse metallized filament lamps, the lower halves of the lamp bulbs being sandblasted. The corridors on the Bowling Green side of the building from the basement to the third floor are lighted by Jaeger 8-cp, 16-cp and 50-cp tipless lamps.

The lighting equipment includes comparatively few fixtures of purely ornamental value, the location of the fixtures being generally in keeping with the office furnishing. Desk lamps are plentifully provided, so that good illumination obtains.

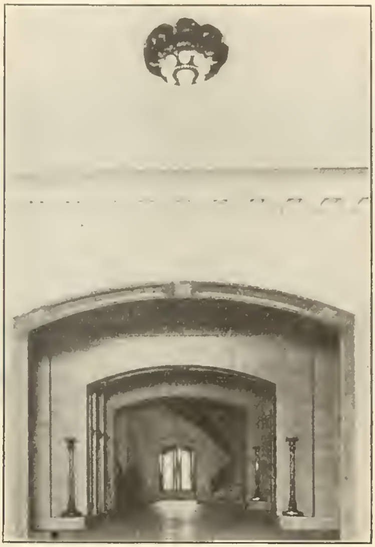


FIG. 9.—LOWER CORRIDOR ON BOWLING GREEN SIDE.

MECHANICAL EQUIPMENT.

The electrical energy for the entire building is obtained from the mains of the New York Edison Company. There are two service connections provided, one from State Street and the other from Whitehall Street. Both are brought to the main service board consisting of four panels and are there divided into two motor feeders and two lamp feeders. The energy is metered by two 1200-amp. watt-hour meters and four 450-amp.

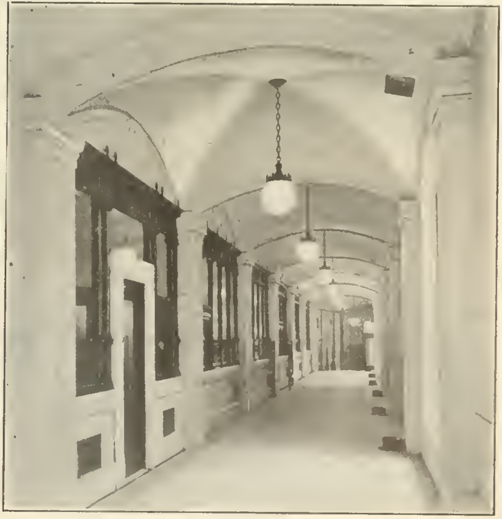


FIG 10.—LOWER CORRIDOR ON BRIDGE STREET SIDE.

watt-hour meters, the former on the motor circuits which are two-wire and the latter on the lamp circuits which are three-wire. From the main service board the feeders lead to two distributing switchboards, shown in Fig. 11, the board on the right controlling the motor circuits and that on the left the lamp circuits. The motor switchboard is equipped with fuses and circuit-breakers and the lamp switchboard is fitted with fuses and switches. There are eighteen feeders for the lamp circuits and each motor receives energy from an individual circuit. The motors are all designed for operation on 225 volts.

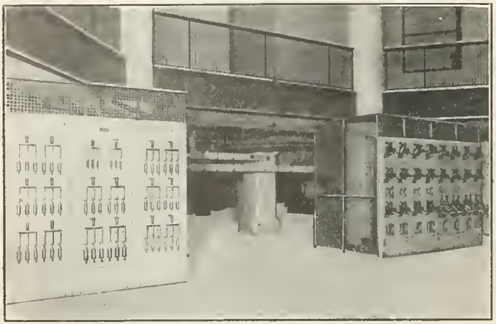


FIG. 11.—SWITCHBOARDS FOR LAMP AND MOTOR FEEDERS.

Because of the size of the building the heating and ventilating system is separated into four independent divisions, each serving a section of the building adjacent to one corner. Each division has an independent blower driven by a 40-hp motor. The air is washed and reheated before being delivered into the heating ducts and the air-washing apparatus is fed with water by two centrifugal pumps each of which is direct connected to a 5-hp motor. The water of condensation from the heating coils is fed back to the boilers by two triplex pumps driven through silent chain gear by 7½-hp motors. The motors are equipped for automatic control. The air from the toilet rooms is removed by four motor-driven fans located on the roof. All of the foregoing motors are of Sprague make.

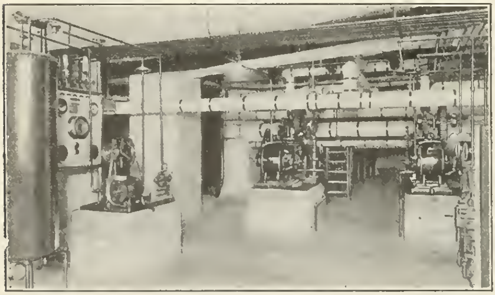


FIG. 12.—THERMOSTAT CONTROLLER AND HOUSE PUMPS.

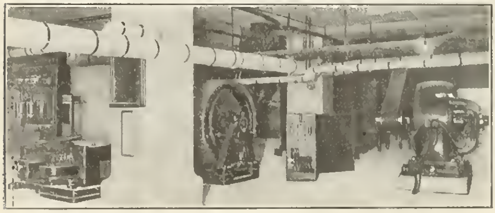


FIG. 13.—ELEVATOR AND VENTILATING MOTORS.

Automatic temperature regulation has been applied to all heating coils. The Powers system of thermostatic control is used and there are about 400 thermostats distributed throughout the building from which the supply valves and outlet dampers are controlled pneumatically. The system is operated with an air pressure of 15 lb. which is maintained by a compressor driven by a 1-hp Sprague motor.

Steam for heating is supplied by four 300-hp Heine boilers. These are designed for 125-lb. pressure and will be used for a power plant, if it is found advisable to install one at any future time. An induced draft fan of Sturtevant make is installed, and this is driven through silent chain gear by a 40-hp Sprague motor.

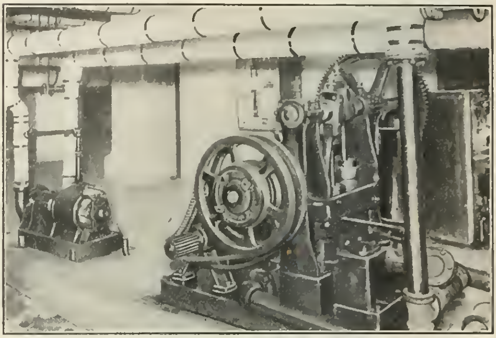


FIG. 14.—SPRAY PUMP AND RETURN CONDENSATION PUMP.

There are 10 electric elevators in use of the Otis, magnet-control type; six of these are for passengers, two for passengers and freight and two for records.

The two house pumps for supplying fresh water throughout the building are driven by 3½-hp shunt-wound Westinghouse motors. They pump the water into a tank from which it is elevated by compressed air obtained from a 9½-hp Westinghouse traction brake compressor fitted for automatic control. A sump pump for ejecting tide water is driven direct by a 7½-hp Sprague motor and two compressors for ejecting sewage from the building are driven through raw-hide pinion gearing by two 7½-hp Crocker-Wheeler motors fitted for automatic control. All of the automatic controllers are of Cutler-Hammer manufacture excepting those used in the elevator equipment. The motors are practically noiseless in operation.

Mr. Burton Harrison was the engineer who laid out the electrical and mechanical equipment and Messrs. Peet and Powers, of New York, were the electrical contractors. The ornamental lamp fixtures were supplied by the Mitchell Vance Company and the standard fixtures by the Cassidy & Son Manufacturing Company. Mr. Cass Gilbert, of New York, was the architect of the building.

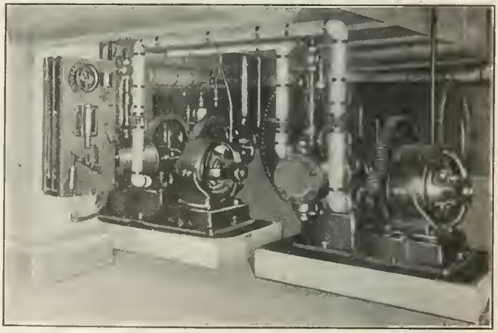


FIG. 15.—AIR COMPRESSORS FOR SEWAGE EJECTION.

Variable-Speed Commutating-Pole Motors.

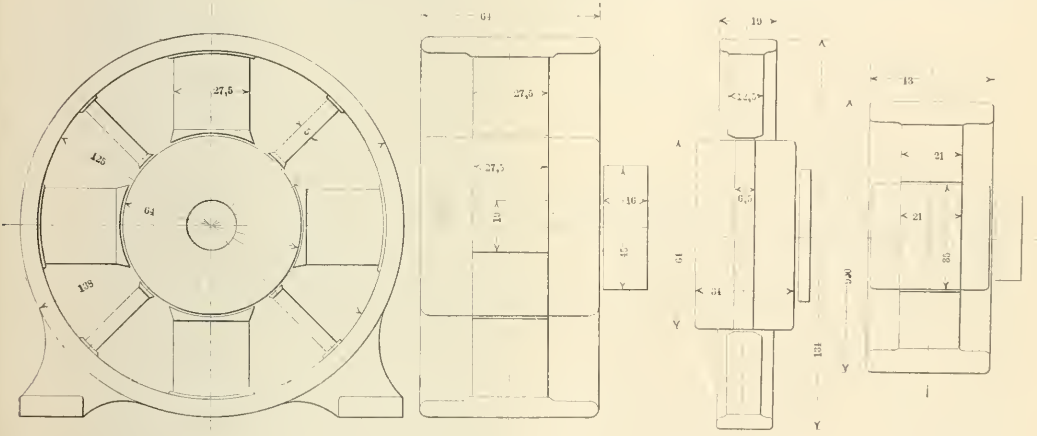
By A. G. Ellis.

The confidence with which it was generally proclaimed a few years ago that the employment of commutating poles removed all the disabilities to which continuous-current machines had been subject, has finally given place to a more guarded attitude in dealing with the design of such machines. Commutating poles are in certain legitimate fields and types the correct and most satisfactory solution to the commutation problem, but the very extensive application which accompanied their recent revival is not justified.

The impression that commutating pole designs permit of radical departures from standard lines of designs resulting in requiring less careful designing and in reduction of cost, is not borne out by a theoretical investigation of the subject nor by the results obtained.

Commutating poles are an unnecessary addition to machines which have good commutation qualities when designed on ordinary standard lines. It is better practice, wherever possible, to obtain good commutation by careful designing than by employing less careful designing and trusting to interpoles to take care of the commutation.

There are, however, certain classes of machinery where interpoles, or some similar commutating device, are a necessity in order to obtain good commutation. Such machines should, however, be designed carefully on standard lines with a view to obtaining as good commutation as practicable, and the interpoles should then be added to ensure satisfactory commutation.



FIGS. 1, 1a, 2 AND 3.—OUTLINE DRAWING OF 40-KW DIRECT-CURRENT MOTORS.

Variable-speed motors constitute one class of machine to which interpoles are a useful adjunct on account of the commutation difficulties encountered at the higher portions of the speed range. Such machines, when the variation is effected by shunt field circuit control, must be proportioned for the heavy flux corresponding to the lowest speed.

At the lowest speed the iron parts of the magnetic circuit are saturated, but at the highest speed, where the field is very weak, the flux densities are very low and the iron sections are much larger than are required to carry the flux corresponding to the high speed.

Thus, for the case of the 40-kw, 200 to 1000 r. p. m. continuous-current motor outlined in Fig. 1, the flux per pole at 200 r. p. m. is 7.5 megalines, while at 1000 r. p. m. it is only 1.5 megalines. In order to carry this flux at the densities that correspond to 7.5 megalines, the magnetic circuit for the higher speed need only be one-fifth the cross-section at all parts. Thus, an armature of one-fifth the net core length and magnet cores of one-fifth the section would be sufficient. Such a machine is diagrammatically outlined in Fig. 2, which machine is of sufficient size for an output of 40 kilowatts. At 1000 r. p. m. a normal design for this rating and speed would, however, be proportioned more on the lines of the outline in Fig. 3.

It is quite possible to obtain either of the designs in Figs. 2 and 3 without interpoles and with good commutation. When, however, the machine outlined in Fig. 1 is running at 1000 r. p. m. the commutation is poor at this high speed, owing to the reactance of the great lengths of conductor embedded in the armature core. When running at 200 r. p. m., the commutation is good, as the speed is so low, and the design is in all respects as regards commutation not an abnormal design for this speed.

The following tabulated statements of the reactance voltages permit of a good comparison of the commutating qualities in these various cases:

Design	a (Fig. 1)	b (Fig. 1)	c (Fig. 2)	d (Fig. 3)
R. P. M.	200	1000	1000	1000
Reactance voltage	1.66	8.3	2	1.5

While a reactance e. m. f. of 1.66 volts, as in design (a), is not sufficient to require interpoles, the reactance e. m. f. of 8.3 volts at 1000 r. p. m. is far too great for the machine to commutate satisfactorily without resort to interpoles or some equivalent means.

With motors for a smaller range of speed variation, the reactance voltage at the highest speed does not reach such a high value as in the present case, and, consequently, the commutation difficulties are not so great.

In designs where interpoles are required, there is a tendency to cheapen the design by employing even higher reactance voltages than are at all necessary. This is a consequence of employing comparatively few commutator segments, weak fields and many armature turns. In a design of this kind the whole dependence for commutation is placed on the interpoles. In machines designed on these lines a new difficulty is encountered. This relates to flashing over at the commutator, due to the distorting effects of the armature m. m. f. on the main field. This distortion is greater the weaker the field m. m. f., as compared with the armature m. m. f. Hence, when a variable-speed motor is running at its highest speed with the field weakest, the liability of flashing over is the greatest. A motor with a wide speed range may have at certain points of the commutator an e. m. f. per segment several times the average voltage per segment, and between certain points there may exist a voltage much greater than the actual terminal voltage.

These occurrences are illustrated in the curve of Figs. 4 to 9. The curves of Figs. 4, 5 and 6 relate to the lowest speed of 200 r. p. m., and the curves of Figs. 7, 8 and 9 relate to 1000

r. p. m., and apply specifically to the 40-kw motor. This motor, is designed with four poles and with 471 commutator segments. The machine being operated at 500 volts, the average e. m. f. per segment amounts to 4.25 volts.

This is a reasonably low value at the lowest speed; that is, at 200 r. p. m. The m. m. f. due to armature interference is then only able to slightly modify the m. m. f. emanating from the field spools, and the maximum voltage per segment is not greatly in excess of the average voltage; that is, it is not greatly in excess of 4.25 volts. From the curves in Fig. 5 it is seen to be approximately 8.5 volts.

While the armature m. m. f. is the unimportant component of the total m. m. f. at the lowest speed, namely, 200 r. p. m., it is the m. m. f. of the field spool, which is the unimportant component of the total m. m. f. at 1000 r. p. m., the highest speed so far as concerns the maximum gap density. This comes about as follows: The field spool m. m. f. at 200 r. p. m. is 5520 ampere-turns per spool, and the armature m. m. f. per pole, when supplied with energy at 500 volts and delivering 40 kilowatts, amounts to 4710 ampere-turns. Owing to the unfavorable position of the center of the armature polarity, that is, midway between the adjacent pole tips of neighboring poles of opposite polarity, the armature ampere-turns per pole are able to affect the resultant flux only to the extent indicated in Fig. 4. The curves in Fig. 4 represent graphically the m. m. f. due to the main pole field windings and the m. m. f. due to the armature ampere-turns. The combination of these two m. m. f.'s gives the curve marked "resultant m. m. f.," which produces the flux distribution in the gap shown by the black line curve in Fig. 5.

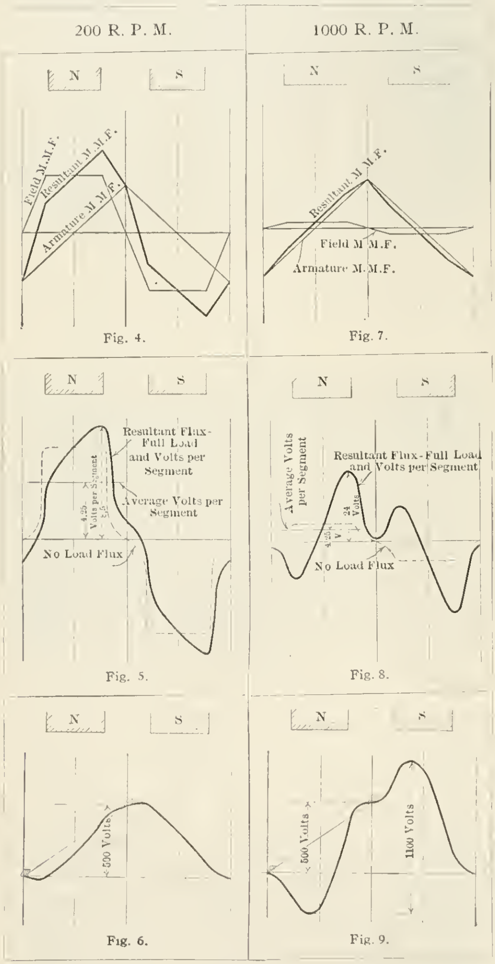


Fig. 4. Fig. 7. Fig. 5. Fig. 8. Fig. 6. Fig. 9.

FIGS. 4 TO 9.—FLUX DISTRIBUTION ALONG AIR GAP.

The dotted curve in Fig. 5 represents the flux distribution at no-load, which corresponds to the *field m. m. f.* curve in Fig. 4. At no-load the field m. m. f. is, of course, the only m. m. f. present, the armature ampere-turns being zero. The black line curve in Fig. 5 represents the flux distribution at full-load, which corresponds to the curve of *resultant m. m. f.* in Fig. 4. The ordinates of this curve are also proportional to the volts per segment. If the flux from each pole were uniformly distributed over the whole of the polar pitch area, the volts per segment would be uniform around the commutator, as indicated by the straight line curve in Fig. 5. As will be seen from Fig. 5 the e. m. f. per segment reaches at no-load a value of 7 volts, or 1.65 times the average, and at full-load a maximum value of 8.5 volts, or twice the average of 4.25 volts.

By integrating the volts-per-segment curve of Fig. 5 there is obtained a curve of commutator voltage distribution, as shown in Fig. 6. This curve shows that the maximum voltage which occurs at certain points is slightly in excess of the terminal e. m. f. of 500 volts.

At the highest speed of 1000 r. p. m., the conditions are as shown in the curves of Figs. 7, 8 and 9. Firstly, the field m. m. f. is reduced to a value sufficient to produce a flux of one-fifth that in Fig. 4. Although the flux is reduced to one-fifth, the m. m. f. necessary to produce this flux is reduced to an amount considerably less than one-fifth on account of the decrease in the reluctance of the iron parts of the magnetic circuit (principally the teeth) on account of the decreased flux densities. The armature m. m. f. is, however, the same as in Fig. 4, and is now very great in comparison with the field m. m. f. Consequently, the armature has a predominating influence on the curve of resultant m. m. f., as shown in Fig. 7. In Fig. 8 there is derived the resultant flux curve similar to that in Fig. 5. It will be observed that the flux curve is much more distorted at 1000 r. p. m. than at 200 r. p. m., and the ratio of its maximum to its average value is much greater than in the former case. Thus, the maximum e. m. f. per segment reaches in this case a value of 5.7 times the average e. m. f. per segment, or 4.25 × 5.7 = 24 volts. This value is exceedingly high.

In Fig. 9 there is derived the commutator voltage distribution curve from which, on comparison with the curve for 200 r. p. m. in Fig. 6, it will be seen that the maximum e. m. f. which occurs is considerably greater, reaching, in fact, about 1100 volts. This is due, as was noted, to the great distorting effect of the armature m. m. f. consequent upon its predominating influence. Such phenomena are most marked when dealing with so wide a speed range as 5:1, as the field in such cases is very weak at the highest point of the speed range. With smaller speed ranges, such as 4:1 or 3:1, the difficulties are not so great, since at the highest speed the armature m. m. f. does not predominate to so great an extent.

The field distortion may be decreased by employing a higher ratio of field m. m. f. to armature m. m. f.; that is, a relatively greater field m. m. f.

For the design considered above, the extent to which the field strength influences the commutator voltage distribution has been investigated, the commutator voltage curves have been derived, using a field m. m. f. twice as great as that employed in the normal design for this motor. The comparison of the two cases is shown by the curves in Figs, 10 and 11, where the curves marked *A* in Figs. 10 and 11 are reproduced from Figs. 8 and 9, respectively. It will be seen that in case *B*, the maximum value of the volts per segment is decreased from 24 to 18, or from 5.7 to 4.3 times the average. Also the maximum commutator voltage is decreased from 1000 to 750. This is still 1.5 times the terminal voltage, and is not a great improvement considering that it has required doubling the field excitation, with a corresponding increase in the amount of field circuit copper and field copper losses.

Attention has already been called to the tendency, when interpoles are employed, to design with weak fields and few segments, with the idea of effecting economy in the construction. From the above conditions, the deleterious effects of such procedure should be obvious.

If in the 40-kw design there had been employed half the number of commutator segments, the average e. m. f. per segment would have been 8.5 volts and the maximum value occurring at 1000 r. p. m., 48 volts, which would certainly lead to flashing over at the commutator. It behooves designing engineers to limit the maximum value liable to be obtained by the volts per segment, under any conditions of operation, to a low figure. This leads to many commutator segments and confirms the view put forward repeatedly by the more conservative designers, that the use of interpoles affords insufficient reason for abandoning those lines of design which have been demonstrated as sound, but that interpoles should be pressed into service only in those ranges of work where good commutation cannot be obtained by the ordinary type of design, and that when interpoles are employed they should be used in conjunction with good features in other respects. It is useless to evade the fact that this leads to expensive machines. Interpoles are invaluable in many cases, but their use does not lead to cheapness, but rather, when rightly proportioned, to superior quality.

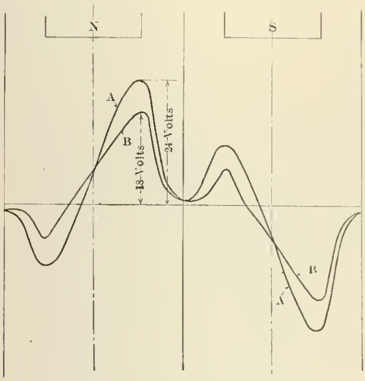
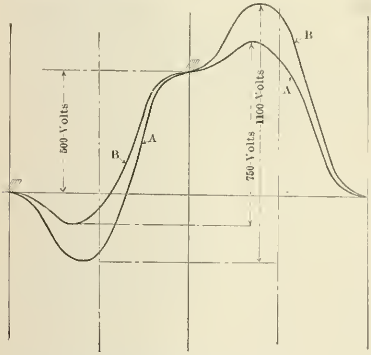


FIG. 10.—RESULTANT FLUX CURVES AND VOLTS PER SEGMENT.



A—Field strength, same as in Fig. 4.
B—Field strength, double that in Fig. 4.

FIG. 11.—COMMUTATOR VOLTAGE DISTRIBUTION.

Breslauer has stated that good results with interpoles require a wide neutral zone; that is, a small ratio of pole-arc to pole-pitch. It has already been pointed out that the pole shoe of the interpoles should span several slots, and that an interpole machine should have many slots to work well. Every one of these features leads to a design of generous dimensions, but it does not lead to cheapness. It is thus to be hoped that the precipitancy of manufacturers who have committed themselves to interpoles for all their machines, and who, having developed the designs, cannot now draw back, will produce at least the good result of having paved the way for correctly designed interpole machines with plenty of segments, liberal neutral zones, generous pole-arcs for the interpoles and liberal numbers of slots. These machines will not be cheap machines, but they will, when intelligently proportioned, be high-class machines and there may thus be set up a standard of excellence which, in spite of the higher cost entailed, will come to be regarded as normal.

In conclusion, it may be said that for certain ratings and ranges of speed variation, motors should be built with interpoles, as should also quite a wide range of high-speed continuous-current generators. For less extreme ratings, interpoles may also be used, and with suitable proportions, their use ensures extra high-class results. These proportions, however, entail considerably higher cost, and the claim that for ordinary moderate-speed and low-speed ratings the use of interpoles ensures a high-grade result at low cost, is not borne out by results.

Measurement of the Coefficient of Self-Induction of a Circuit Under Normal Load.

By C. C. Chapin.

The determination of the inductance of a circuit under an actual load presents the special difficulty that the effect of the inductance is quite largely obscured by that of resistance. Thus in a circuit in which the value of the reactance is 10 per cent of the value of the resistance, the excess of the impedance over the resistance is only ½ per cent; and if one would calculate the value of the coefficient of self induction from the formula $I = \frac{E}{\sqrt{R^2 + (2\pi f L)^2}}$ with any considerable degree of accuracy, the measurements of E and I must be made with an accuracy much greater than can be obtained with alternating-current instruments now available. It is to eliminate the difficulty connected with the use of the impedance equation, and yet to allow the circuit to be under full load during test, that the method outlined below has been devised.

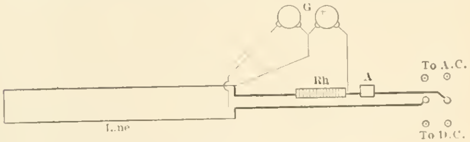


FIG. 1.—ARRANGEMENT OF TEST CIRCUITS.

The plan consists essentially of separating the counter e. m. f. of inductance from that of resistance, and measuring it alone. This is accomplished by the use of a differential galvanometer in which the counter e. m. f. of resistance of the test circuit is neutralized by that of another equal resistance placed in series. The scheme is shown in Fig. 1. The counter e. m. f. of resistance of the line under test is balanced by that of an accurately equal non-inductive resistance, R_h, placed in series with it, the connections to the galvanometer being such that the directions of the currents in the two coils are opposite. That this balance could be obtained may be readily seen by observing that the two portions of the circuit (the line and the rheostat) are in series, and that hence the currents in them must be in the same phase, and have the same instantaneous values, and give the same counter e. m. f. of resistance at all times. By impressing these two equal and synchronous potentials, due to resistance effects, on the two coils of the galvanometer in opposite directions, so that their magnetic fields oppose and neutralize, the resultant value of the counter e. m. f. of resistance acting upon the galvanometer needle will be zero, leaving the counter e. m. f. of inductance for measurement by itself.

This may be illustrated graphically in Fig. 2. When the counter e. m. f. developed in the main circuit is resolved into its component parts, and these are opposed as in the galvanometer, they have the relations indicated. Since the resistance of the two coils of the galvanometer are equal, the currents in the two will be in the same ratio as the potentials acting upon them; and since the counter e. m. f.'s of resistance impressed on the two coils are continuously equal, it is evident that the resulting galvanometer currents, due to resistance effects in the main circuit, will be continuously equal and opposite, and that their magnetic effects in the galvanometer will neutralize. In this way the counter e. m. f. of resistance of the circuit under test is eliminated, and the counter e. m. f. of inductance is left for separate measurement.

The value of the counter e. m. f. of inductance is $2\pi fLI$, and if its value E be known, then L can be determined, for $L = E \div 2\pi fI$. Here, any error which may occur in the measurement of I or E is not magnified when appearing in the value of L, as in the method involving the impedance formula.

The galvanometer used in the following test is one designed by Dr. Bergen Davis, of Columbia University, and modified by the writer for use as a differential instrument. The needle consists of a bundle of fine iron wires suspended by a quartz fibre between the two halves of the galvanometer coil, and is set in a horizontal plane with its axis at an angle of 45 deg. to that of the coil, one component of the field of the coil magnetizing it, and the other producing the deflecting torque. The whole instrument is heavily shielded from external magnetic fields by means of soft iron cylinders. For the purpose of the experiment the coil of the instrument was replaced by one consisting of two parallel circuits, permitting a differential action. The resistance of each of these coils is 56 ohms, and the sensitiveness of the galvanometer is such that 0.01 volt alternating e. m. f. placed across the two coils in series, so connected as to add their magnetic effects, gives a scale deflection of about 33 mm. Special tests have shown that its action is entirely independent of the frequency, at least within the commercial limits of frequencies.

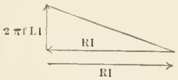


FIG. 2.—VECTOR DIAGRAM OF IMPEDANCE.

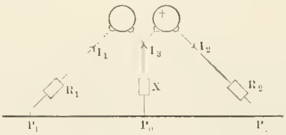


FIG. 3.—SIMPLIFIED DIAGRAM OF TEST CIRCUITS.

In an instrument of this class, in which the deflection varies as the square of the impressed e. m. f., the accuracy is much better at large deflections than at small. Hence it is advisable to keep the needle at some standard deflection well out on the scale, and obtain measurements by observing the resistance which it is necessary to place in series with the galvanometer to produce this standard deflection. When applied to a differential galvanometer this method becomes somewhat complicated, but with the arrangement shown in Fig. 3, the measurements may be made quite easily. Assume a conductor in which there is a current, and let there be potentials developed along it having the successive values P_1, P_0 and P_2, as indicated. Currents will flow in the three branches of the galvanometer circuit, depending upon the resistances R_1, X and R_2. The values may be found as follows:

I	X	R₁	K	L Millihenrys for circuit	 per mile	Variation from computations for similar copper circuit	REMARKS
3.34	30	156	.000941	.0806	1.86	+ 4 %	Copper wire, No. 9, spaced 12 inches.
3.48	34	156	.000941	.0804	1.85	+ 3 %	Length of each side of circuit, 114 feet 6 inches.
7.65	169	156	.000941	.0807	1.86	+ 4 %	L. per mile (computed for similar copper circuit) = 1.79
8.52	197	156	.000941	.0807	1.86	+ 4 %	
3.16	33	156	.000941	.0877	2.03	+ 0.5%	Copper wire, No. 9, spaced 24 inches .
3.28	36	156	.000941	.0867	2.01	− 0.5%	Length of each side of circuit, 114 feet
8.10	216	156	.000941	.0907	2.10	+ 4 %	L. per mile (computed for similar copper circuit) = 2.02
8.02	214	156	.000941	.0908	2.10	+ 4 %	
4.10	64	256	.000936	.116	2.66	+ 49 %	Monnot duplex wire, No. 9, spaced 12 inches
6.41	220	256	.000936	.135	3.10	+ 73 %	Length of each side of circuit, 115 feet
8.56	10	1056	.000936	.156	3.58	+100 %	
8.52	410	256	.000936	.157	3.60	+100 %	
2.92	17	256	.000936	.123	2.83	+ 40 %	Monnot duplex wire, No. 9, spaced 24 inches
4.20	85	256	.000936	.132	3.03	+ 50 %	Length of each side of circuit, 115 feet
6.29	244	256	.000936	.147	3.38	+ 67 %	
9.77	560	256	.000936	.175	4.02	+ 99 %	

The equations of potential for the two galvanometer circuits are:

$$P_1 - P_0 - R_1 I_1 + X I_3 = 0$$
$$P_0 - P_2 - R_2 I_2 - X I_3 = 0$$

also $I_2 - I_1 = I_3$.

Placing $R_1 = R_2$ (which condition is also imposed on the galvanometer circuits) and solving,

$$I_3 = (2P_0 - P_1 - P_2) \div (R_1 + 2X)$$

Now $(2P_0 - P_1 - P_2)$ is the difference between the potentials developed in the two parts of the main circuit, thus:

$$(P_0 - P_2) - (P_1 - P_0) = 2P_0 - P_1 - P_2$$

Or, calling this difference E,

$$I_3 = E \div (R_1 + 2X)$$

By adjusting the resistance X so as to keep the galvanometer needle at some standard deflection, the current I_3 is kept constant.

$$\text{Then } K' = \frac{E}{R_1 + 2X}, \text{ or } E = K\left(\frac{R_1}{2} + X\right)$$

As mentioned previously, $E = 2\pi fLI$; hence

$$2\pi fLI = K\left(\frac{R_1}{2} + X\right)$$

and

$$L = K\left(\frac{R_1}{2} + X\right) \div (2\pi fI)$$

The value of the constant K is determined by calibrating the instrument with each of its coils connected across one of two non-inductive carbon plate rheostats in series, in which there is an alternating current. The resistance of each rheostat is measured with a bridge, and the current noted, whence the e. m. f. impressed on the two coils is readily calculated.

For the purpose of adjusting the resistance of the carbon rheostat to exact equality with that of the line, a double-throw switch is inserted in the generator leads, as shown in Fig. 1, by means of which direct current may be used on the line. By adjusting the rheostat with direct current in the circuit until no deflection of the galvanometer is obtained, the resistance of the rheostat is made just equal to that of the line.

Several representative tests are recorded on the preceding page, each made at 60 cycles per second.

In the results given it is to be noted that the values of L found for the copper circuits are fairly constant for a given spacing, and that their variation from the computed values is smaller than that which may occur in actual practice due to distortion of the wave form. Thus D. C. Jackson in his work on alternating currents quotes Emmet to the effect that "in practice the current is usually not sinusoidal, and the actual reactance is therefore likely to be increased from 5 per cent to 25 per cent, depending on the elements of the circuit and the distortions of the current curve." The tests above on the copper circuit may, therefore, be taken as a fair confirmation of the method within the desired commercial limits of accuracy.

The tests on the Monnot duplex wire are instructive in showing the effect of the presence of iron in the magnetic field of the circuit, the inductance increasing very decidedly with increase of current. In this wire the iron of the core is centrally located with respect to the copper, and the magnetic field acting upon it is very weak, corresponding to the very low values of magnetic stress on the permeability curve. Hence it will be seen that the inductance of such a circuit follows the permeability curve of the iron (in which the permeability begins at unity and increases with strength of field, for low values of magnetic stress); and that the inductance is equal to that of a similar copper circuit, plus an added amount dependent upon the permeability of the iron and the magnitude of the current. This is more clearly shown by the curves of Fig. 4, where it will be noted that as the current approaches zero the inductance of the duplex wire approaches that of a copper, or non-magnetic, circuit. It is interesting to note that while the inductance of a circuit of this wire is somewhat greater than that of a similar copper circuit, the ratio of inductance to resistance is less than for copper, at least within the range of the current values used.

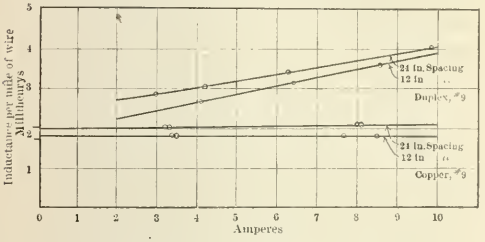


FIG. 4.—CURVES SHOWING VARIATION OF INDUCTANCE WITH THE CURRENT IN MAGNETIC WIRE.

It is evident, then, that in a conductor in which iron forms an important part the inductance will increase with the current, at least up to a comparatively high limit. And in a circuit consisting entirely of iron it would seem that the inductance might change very greatly with the current, depending upon the permeability curve of the iron and the magnetic stress upon it; and that determinations made with other than the normal load on the circuit might be far from correct.

It is believed that this method furnishes a practical means for determining the inductance of a circuit under its normal load, and with an accuracy well within the variations caused by distortions of the current curve in actual practice. It may be noted that the method is also applicable to the determination of capacity, and of skin effect.

The writer desires, in conclusion, to thank Professor George F. Sever, of Columbia University, for the excellent engineering equipment placed at his disposal for making the above tests.

Proposed Consolidation of London Electric Supply Systems.

Following the various proposals for concentrating the production of electricity in London which have been unsuccessfully submitted to Parliament during the past three or four years, three new schemes are about to be brought forward. It will be remembered by readers of the ELECTRICAL WORLD that an important scheme was put forward in 1905, with a strong financial backing, for the purpose of establishing two very large power houses in the east end of London, from which it was proposed to sell electricity for power purposes only to the numerous railway companies and manufacturers in the industrial parts of London. During the exhaustive hearing which that scheme had before committees of both houses of Parliament, by whom it was passed, a number of very remarkable facts concerning the present state of electrical supply in London and surrounding districts were made public. Particulars of these were furnished in these columns at the time and need not be recapitulated at any great length. It may be said, however, that the condition of affairs then discussed is practically no better to-day.

The supply of electricity in the London district is now in the hands of about 73 separate authorities, some of which are private companies, while in other cases the supply is given by the local town council. In many cases, and especially in the central and most profitable areas, companies are in competition with each other; but in practically every case where the supply is in municipal hands a monopoly has been granted and the right to compete always refused.

The supply is given from between 60 to 70 independent generating stations, many of which are of small size and antiquated design, containing in some cases units below 100 kilowatts in size. The average capital expenditure upon these stations has been over $250 per kilowatt of plant installed, and although the more recent stations have been erected somewhat more economically, the extensions which are now being carried out in the larger of them are costing in most cases $150 per kilowatt. Electrical energy is generated on nearly 20 different systems of frequency and voltage, and there is a corresponding variety of tariffs, the price for electricity varying from 1½ cents to 16 cents per unit, while in some cases as much as 20 cents per unit is authorized as a maximum. The average size of the plant installed is under 400 kilowatts, the average size of the generating stations being under 3000 kilowatts, and altogether over 500 separate generators are used for supplying, exclusive of exciters.

The wastefulness of this method of supply and the great economies which might be effected by concentration have long been realized. In fact, so far back as 1889, Ferranti, having acquired the rights of supply over a large area, including nine different parishes, made his historic attempt to concentrate and enlarge the scale of production at the Deptford generating station, the first place in England to use 10,000 volts and paper cables. This attempt was, however, unsuccessful, not because it was in any way wrong in principle, but mainly because the manufacturer of electrical apparatus was not at that time in a position to supply the engineer's requirements as regards size of units and electrical pressure. In short, it was before its time. Nevertheless, this important undertaking was the pioneer attempt at concentration and to its example is owing the subsequent attempts which have been made in the same direction.

After the failure of the Deptford experiment, nothing drastic was done for some years. Some of the larger companies, however, notably the Metropolitan Electric Supply Company, carried out a gradual policy of removing or abolishing their smaller and more antiquated power houses, and this company has concentrated its supply at a large power house erected on the northwestern outskirts of London, at Willesden. Another corporation, the Charing Cross & Strand Company, erected a large station at Bow, on the eastern outskirts of London; while two more, the St. James' and Westminster Companies, combined to put down a new station in the neighborhood of Regent's Park for the purpose of producing electricity more cheaply than could be done from their own power houses, situated in the heart of the West End. In none of these cases, however, was any attempt made to extend the area in which the supply was authorized to be given, neither was there any amalgamation of conflicting interests. The latter was, in fact, not possible, for the board of trade, with the object of perpetuating competition in the interests of the consumer, had from the very outset inserted clauses in the charters of the various companies making "association" illegal. Even had it been legal, it is doubtful whether the conflicting financial interests which control the various companies could have drawn together; and even if they had, complete combination was out of the question owing to the large number and varying constitutions of the municipal bodies, who also possessed rights of supplying electricity.

In 1904, however, the new company, above referred to, known as the Administrative Company, was incorporated for the purpose, not of directly consolidating the existing interests, but for putting down a very large system with power houses of greater size and on more economical sites than those in existence, with the object of supplying electricity in bulk to the existing authorities and to the individual power users. The right of supply to the ordinary lighting user, who at that time formed nearly 90 per cent of the total demand, was not sought. The hearing of that proposal was so protracted that, although it passed committees of both houses of Parliament, it just failed to become law before the close of the session of 1905. It was vigorously opposed by the existing interests, both private and municipal, which had brought forward alternative proposals of their own. In 1906 the London County Council also brought forward a proposal for establishing a great municipal system, which, however, was rejected by Parliament, only to be reintroduced in a still more ambitious form in 1907, when it again failed. Up to the present, therefore, the position of affairs in London is very much the same as it was five years ago.

In the new session of Parliament, just beginning, three schemes will he brought forward, as already mentioned. The first, known as the London Electric Supply Bill, is a proposal promoted by eight of the largest London companies. These between them have sunk 80 per cent of the capital expended by companies in electric light in London, and probably have an output exceeding all the other companies and municipal undertakings put together. In the present bill they do not propose to establish any new generating station; their main object is to secure the repeal of the present restrictions against "association" and amalgamation. They ask Parliament to give them the right of selling electricity to each other and to any other authorities in London in bulk, and they delineate a very large area in and around London in which they seek to exercise these powers of selling in bulk. They do not, however, seek any additional powers of supplying individuals, possessing as they do full powers of supply within their own areas, while in the new areas sought they are content to leave the retail distribution in the hands of the existing supply authorities, allowing the latter to purchase their supplies in bulk. The method proposed is the establishment of a joint committee of all these undertakings with power to raise capital and to do other things necessary for this purpose. As usual in these cases, their bill includes power to the municipal authorities to purchase the undertakings, in 1932 or 1952. In the former case the terms of purchase are, of course, somewhat more remunerative than in the latter case, when the capital expenditure alone is to be made good. The prices fixed by the bill at which the joint committee will be bound to supply electricity in bulk to any authorized distributor must not exceed $25 per annum per kilowatt of maximum demand and 0.7 cent per unit.

The following table gives a list of the companies joining together for this purpose, together with particulars of their output and systems for the last year for which complete records are available.

Company.	System of generation.	Kilowatts of plant installed.	Units sold.
Brompton & Kensington Company	Single-phase.	2,575	2,779,337
Charing Cross Company, Ltd.	Direct.	20,400	16,665,001
The Chelsea Company, Ltd..	Direct.	3,500	3,307,714
City of London Company, Ltd.	Direct and single-phase.	24,000	21,664,103
County of London Company, Ltd.	Direct, single and two-phase.	11,000	10,755,424
The London Electric Supply Corporation	Direct, single and three-phase.	12,800	10,544,484
Metropolitan Electric Supply Company, Ltd.	Direct, single and two-phase.	18,500	10,515,836
South Metropolitan Electric Light Company	Two-phase.	3,095	2,381,788

The above joint scheme did not commend itself to all the companies, and some of the smaller ones operating in the West End are promoting an independent scheme, which does not necessarily run counter to the one already described. In this bill, entitled the London (Westminster & Kensington) Electric Supply Companies, the powers sought are very much less than in the larger measure. No new area of supply is asked for, the rights sought being practically for granting the companies permission to interchange energy in bulk; they do not affect the consumer in any way, and in neither of these new bills is there any new generating station proposed.

The final scheme to be considered, entitled the London & District Electricity Supply Bill, is being promoted by an independent company and follows very largely the lines of the great scheme promoted in 1905 and 1906 by the Administrative County of London & District Electric Power Bill. The new company also seeks powers over a very extended area in and around London, covering in all some 400 sq. miles. It proposes throughout this area to give supplies in bulk to the existing companies, whether company or municipal, which they may retail as at present, and they undertake to give this supply, whether to authorized distributors or railway companies, etc., at the following prices:

(a) For a supply of alternating current, untransformed, at the rate of a fixed sum of $15 per annum per kilowatt of maximum power required to be supplied, and in addition a sum of 0.5 cent per unit for all units supplied to such consumer.

(b) For a supply of transformed alternating current at the rate of a fixed sum of $17.50 per annum per kilowatt of maximum power required to be supplied, and in addition a sum of 0.6 cent per unit for all units supplied to such consumer.

(c) For a supply of direct current at the rate of a fixed sum of $22.50 per annum per kilowatt of maximum power required to be supplied, and in addition a sum of 0.66 cent per unit for all units supplied to such consumer.

These are prices for bulk supply, but the new company also seeks powers to compete with the existing companies and municipal undertakings for power supply to individuals however small their demands. These powers are as follows: In brief, in cases where the maximum demand exceeds 250 kilowatts, they are classed as bulk consumers, and the company seeks to supply without any restriction as regards competition, subject always to the above prices. For consumers below 250 kilowatts, the new company must be prepared, if it wishes to supply them with power, to quote a price below that at which it is prepared to supply the existing companies in bulk by at least 1 per cent in respect of each 10 kilowatts by which the consumer's maximum demand is below 250 kilowatts. In other words, it is proposed that the existing companies and municipalities should, if they prefer, purchase in bulk and retail current to the power consumer as they are in any case entitled to do to the lighting consumer. They are obliged, however, unless they wish the power consumer to be supplied direct by the new company, to supply the power consumer themselves at a price which does not exceed the price they pay the new company for their bulk supply by more than the percentage fixed above. For example, if they purchase current at 2 cents per unit in bulk, they must be prepared to retail that current to the consumer whose maximum demand does not exceed 10 kilowatts at a price not exceeding 1.25d., and if they do not choose to do this, then the consumer is to have the right to obtain a supply direct from the new power company. The reason for the insertion of this clause is to compel the existing companies to purchase their supplies in bulk from the new company, or, if they refuse, to still enable the consumer to get cheap power.

A new generating station is proposed about 10 miles out of London, at Barking, practically on the same site as that proposed by the Administrative Company, and from here energy will be probably transmitted at 20,000 volts up to London and distributed from various sub-stations.

As the London County Council is not promoting a bill this year, the issue to be fought out is somewhat simplified and will rest between the existing companies and the new company almost entirely. It will probably be contended on behalf of the new company that for reasons of economy a new station on a large scale and with a cheap site outside London altogether, is necessary in order that electricity can be produced at very low cost, and that London may benefit from an increase in its scale of production. On behalf of the existing companies, it will probably be contended that in view of the capital which they have already expended it will be more economical to develop the existing station than build an entirely new one, and that in any case as the pioneers who have obtained experience in supplying electricity in London, they should be entrusted with the right to make the modifications now required.

The Public's Debt to the Public Service Corporation.

At the Northwestern Electrical Association convention at Milwaukee, Jan. 15, Mr. W. R. Putnam, manager of the Red Wing Gas Light and Power Company, of Red Wing, Minn., presented a brief paper on the above subject. He said that our business has grown so rapidly that the men actually engaged in its management have with difficulty followed its growth, and much less have our legislative bodies been able to devise proper means for the control of the large and small corporations which have been the outgrowth of the new conditions. Various legislative bodies have attacked this problem with a determination to solve it. Unfortunately for the investor, and for the general business world as well, their aim has been to secure "action" and to pass legislation after only a few weeks' or months' consideration to regulate systems of transacting business which have taken years to develop.

The American people are an enthusiastic body and when they set out to accomplish a purpose they are incessant in their demands. When their enthusiasm is quieted down and they give due consideration to all phases of the question, they are preëminently a fair people. For the most part, franchises, when first given, were so granted because the people were as eager to have the service as capital was willing to supply it. Such being the case, franchises did not contain provisions which properly safeguarded the rights of either party interested, with the result that there has been almost constant wrangling between both parties involved on some or all of the questions of service, rates, taxes and various rights covered by the franchise. Meanwhile the communities supplied have been rapidly growing in population and area and the people's desire for all of these conveniences and necessities have grown even more rapidly. The franchise owner has kept pace with this growth by the investment of immense sums of money, both in the manufacturing and distributing department of his plant. At the same time, he has been obliged to keep up with the rapid improvement of appliances by replacement again and again of obsolete machinery. This has been done, it is true, with the purpose of enhancing the value of the property and of securing a fair return on the investment. At the same time it has been also in response to the people's demand.

Because of the apparent ease with which the funds have been secured for the immense development of electrical plants, the public has become firmly convinced that of necessity there must be immense profits in the business. They have not studied the question thoroughly or they would have soon learned that for every dollar received in gross earnings each year, there are from $3 to $10 invested in the business; in other words, from 20 to 60 per cent of the total receipts must be used to pay interest on the investment. The United States census returns show that the net earnings of all gas and electric concerns in this country before providing the depreciation funds and before paying interest charges, are only 8 per cent on the capital stock. The public has taken it for granted that it has been unfairly and in some cases dishonestly dealt with by the owners of franchises, and now not only insist on regulation, but on penalizing the franchise owner for his unfair and dishonest acts of the past. Whenever this unfairness has existed, has not the public been as much to blame as the franchise owner in electing men to office who have been the means of this unfairness and dishonesty?

The public service manager is human, and if he ascertained that the only way he could secure legislation or even a permit necessary for the carrying on of his business was by dealing dishonestly with a dishonest representative of the people, he followed too often in the past the line of least resistance. Should not the people's fairness accede to eliminating entirely from the subject of regulation the question of penalty?

The two largest associations of public utility corporations in this country have both gone on record as strongly in favor of reasonable regulation by the people. If the people will come to a realization of the immense good they derive from electric service; will give credit for new attempts to conduct the business honestly; will drop all ideas of penalty; will concede that efforts to develop business are entitled to a fair return; will drop the tendency to regulate rates by competition, and will approach the subject in a fair, conservative way—then, and only then, will regulation be secured which will establish, with the investor, the feeling of security necessary for the further enlargement of our business.

Mr. I. P. Lord, in discussing the paper by Mr. Putnam, said that it was based upon sound truth, but just how we are going to remedy this misunderstanding or misapprehension of the public is what all would like to know. Two wrongs do not make one right. The fact that there are dishonest men in the common councils does not excuse a corporation manager or promotor for being dishonest himself. The fair, outspoken action of any man will win in the end. Secrecy is not the direct road to success in public utility matters. Do not let the public get the impression that your business is a very mysterious one.

Do not try to carry the idea to them that it is a good, nice, well-paying business, for it is not. If they ask some questions that are perhaps a little bit personal about your business, enlighten them. The trouble is that the public has looked upon an electric lighting company as a mysterious, money-making, grasping corporation which is trying to get all the money it can out of the consumer by selling something for a dollar which costs a very small portion of a dollar. Heretofore, the common councils of different cities have taken it in their own hands to regulate the corporation. That is where the trouble has been. It is well the day has come that Wisconsin has a public service commission. We are out of the hands of the people who do not understand us. Our business will now be regulated by a body of fair, honorable men who will have no personal grievances at issue. They will inform themselves as to our business, and doubtless the time is rapidly approaching when public service corporations in the State of Wisconsin will be well taken care of. They will not be bankrupted and they will not have temptations thrown in their way to become bribe givers. It will work out not only to the good of the lighting companies in the State, but to the good of the public as well.

Mr. Utley, of Watertown, agreed with Mr. Lord that the State commission was a good thing and that companies ought to co-operate with the commission and get the basis of charges and rates where they ought to be. He thought it would only be a question of a few years when investors would be pleased with this kind of investigation. Mr. Parker, of Green Bay, also talked along the same line, agreeing with the previous speakers.

Education of Customers.

At the Northwestern Electrical Association convention, at Milwaukee, Jan. 15 and 16, some little discussion was given to the matter of educating customers to understand reading the meters and other matters pertaining to their use of electric current.

Mr. John Wright, of Antigo, Wis., thought that in talking to customers it is well to give them a little education as to the meaning of kilowatts, volts and amperes, because the more they get educated, the better they will understand the company and its business will not seem so mysterious to them. He thought it a good plan to give fuse plugs to customers and show them how to put in their own fuses. He would not attempt education to the extent of boring the customers, but to educate them as far as possible in the ordinary terms, because these terms are marked on their bills anyway and it is well to give them all the information possible. He thought it would be a good plan to have small pamphlets printed and enclosed with the bills from time to time. He often thought he would do that and expected to do so very soon if he could get suitable information made out and printed on small slips.

Mr. O. M. Rau, of the Milwaukee Electric Railway & Light Company, said that his company had published a small pamphlet of the kind suggested which would no doubt be a good starter for anyone wishing to issue such a pamphlet. This pamphlet tries to explain some of the terms and the methods of conducting electric light business. When a customer makes inquiry they hand him one of these pamphlets, and they find the next time he comes around he knows much more than he did before. Some of these pamphlets were later distributed at the convention. They are chiefly devoted to information pertaining to the reading of meters which the company has on its lines, but explain other things in connection with the service, including how to apply for electric service, lighting rates, power rates, lamp renewals and some other matters. The pamphlet consists of 20 pages, a page being 3¼ ins. x 6 ins., of a size to go in a common envelope. Mr. Strong, of Chaska, Minn., said that his experience was that when people know how to read their own meters kicks disappear. He showed his customers how to keep tab on their meters by leaving with the complaining customer a meter book-leaf with the dials printed on it, marking the position of the pointers so that each month he can check his own meter and see that there is nothing tricky in the readings.

Recent Development in Single-Phase Variable Speed Motors.

Mr. F. L. Kaufman, of Beloit, Wis., read a paper on the foregoing subject before the Northwestern Electrical Association, at Milwaukee, Jan. 16. The advocate of direct-current has for many years claimed as one of its distinctive advantages the possibility of providing and maintaining satisfactory variable-speed, direct-current motors. The alternating-current system of distribution has been considerably handicapped by the difficulty of obtaining variable-speed motors. He did not, however, claim that alternating-current, variable-speed motors are yet as satisfactory in every way as direct-current motors, but thought that the time was not far off when alternating-current motors with satisfactory variable-speed characteristics will be available. He urged in favor of the single-phase system of distribution that a central station was investing money needlessly if it runs three wires and uses two transformers for a motor customer who could be supplied with two wires and one transformer. The single-phase motor, with a starting rheostat, if started as a repulsion motor, takes less current from one phase of a polyphase circuit in starting than a polyphase motor with squirrel cage rotor would take from each of the three phases. Attention has recently been called to the variable speed motor made by the Wagner Electric Manufacturing Company, furnished in sizes from ¼ to 15 horse-power for 60-cycle circuits. The motor is built to operate as a repulsion motor, and may be wound for reversible or non-reversible operation. The stator is of the regulation induction-motor type made up of laminated sheet steel punchings assembled in a rigid cast-iron frame. The armature, which is wound with a progressive wave winding similar to the usual winding on direct-current armatures, has a commutator with four brushes, short-circuited on each other. This motor operates as a repulsion motor, and with a given load the speed of the motor depends entirely on the voltage supplied to the field terminals. To obtain lower speeds a reduction of voltage may be accomplished either by a rheostat or by an auto-transformer. A speed reduction of at least 50 per cent and in many cases more, can easily be obtained with satisfactory operation. They are not suited to conditions where there is a great variation in the load on the motor. Where load conditions are constant, such as in the operation of printing presses, blowers, pumps, conveyors and refrigerating plants, they could be very satisfactorily employed.

The discussion of this paper drifted into a question of methods of changing customers' motors from a direct-current system to single-phase, alternating-current. Mr. O. M. Rau said that in Racine such a change had been made, and in one case where a customer had a number of direct-current motors. a motor-generator was put in. A year previous to the time the company anticipated making the change it informed everyone that such a change was contemplated. This prevented new customers purchasing direct-current motors, who were taken care of temporarily by the loan of direct-current motors. When the time came to make the change, the company announced that it would give the present market price for the direct-current motors and allow this on the price of the new single-phase motors. It took about three years to make the change, the company being very accommodating in its policy, and careful to meet the wishes of customers.

New Telephone Patents.

TRANSMITTERS.

A number of different designs have from time to time been developed for double-acting transmitters. These have been of various types, the simplest of which uses two diaphragms acting upon a single microphone button. Both electrodes are movable, each associated with one diaphragm. The sound passages are so designed that the two diaphragms will approach and recede in synchronism. In Fig. 1 is shown in section such a double diaphragm transmitter patented by H. P. Clausen, of Chicago, his patent being assigned to the American Electric Telephone Company. The electrodes are suspended upon auxiliary mica diaphragms and are secured to the main diaphragms. The operation is self-evident from the foregoing.

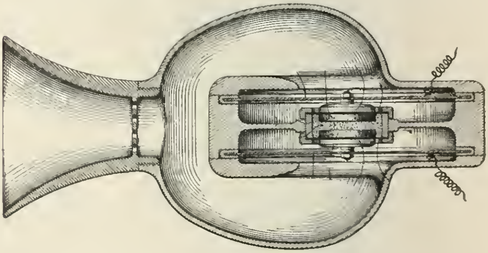


FIG. 1.—CLAUSEN TRANSMITTER.

Some time ago we noted a hand microphone type of instrument in which the microphone button is mounted upon an angle with the main diaphragm with a view to preventing the electrode faces from approaching too close to the horizontal in any position of use. It has been found difficult to shape the bent spindle required for connecting the diaphragm and the movable electrode so that it can be clamped solidly to the diaphragm without producing constant distorting strains. To overcome this, Mr. C. Umbach, of New York City, has patented an adaptation of the ball and socket joint to this purpose. The Western Electric Company is assigned the patent.

DICTATION SYSTEM.

There has recently been devised a scheme for facilitating dictation by the use of the telephone. A switching device is arranged so that any one of a number of stenographers may be signaled and who can respond through their individual telephone sets. A loud-speaking instrument is included in the set of the one giving dictation, so that the dictation may be read back as desired. Mr. J. W. Kelly, Jr., of Camden, N. J., is the inventor of this system. He has covered it by patents, the most recent of which has just been issued.

DESIGNATION PLUG.

The multiple switchboard had not long been in use before it was found necessary to provide special designations for the multiple jacks. For example, if a line be discontinued, it is necessary for a considerable time to indicate this fact to every operator having access to that line at any one of its multiple jacks. There are several other contingencies through which it becomes necessary to plug the lines. In recent years neat plugs have been manufactured for this purpose, of distinctive colors to vary the significance. White is usually used for changed numbers, and ordinarily the new number is printed upon the designation plug.

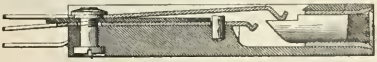


FIG. 2.—ADAMS SWITCHBOARD PLUG.

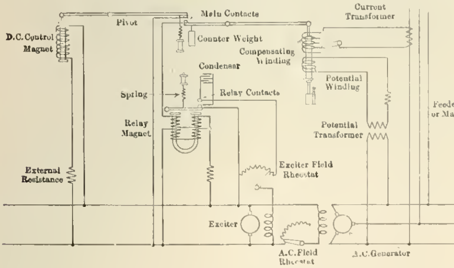
Such a designation plug is shown in Fig. 2, in position in the jack. The flat surface holds the plug from turning accidentally. Heretofore the head of the plug was maintained beyond the jack face to afford means of pulling the plug. In the present case the plug is made flush, but means are provided for forcibly turning it about its axis, whereupon the tension of the jack spring upon the sloping face rejects it. Plugs with this feature are covered by a patent granted to A. H. Adams, of Antwerp, Belgium, and assigned to the Western Electric Company.

LETTERS TO THE EDITORS.

Automatic Voltage Regulator.

To the Editors of Electrical World:

SIRS:—In your excellent digest of an article on the Automatic Voltage Regulator, appearing on page 150 of your issue of Jan. 18, I note you have copied an erroneous diagram appearing in the original and referred to in the digest as Fig. 1. In this diagram the shunt field rheostat is placed in *parallel* instead of in series with the field coils. It is evident that if the contacts of the regulator were closed the rheostat shunt coils and exciter armature would all be short circuited. I inclose a diagram which shows the correct connections of the regulator.



AUTOMATIC VOLTAGE REGULATOR.

The author's conclusions as to the reasons for the close regulating properties are mainly correct. The spring system of the lever of the direct-current control magnet is shown in the diagram as a single spiral spring. In practice there are four springs distributed lengthwise on the lever arm and so adjusted as to give a uniform pull throughout its movement. The main contacts "float" up and down as they are acted upon by the magnets opposing the downward pull of the four spiral springs on the one arm and counterweight on the other arm, and it is this vertical movement of the floating contacts that gives the desired sensitiveness.

SCHENECTADY, N. Y. A. A. TIRRILL.

Measurement of Sound.

To the Editors of Electrical World:

SIRS:—In looking up some experiments in telephony, I note a remark in an editorial in your issue of June 16, 1906, page 1237, to the effect that "Sound can also now be measured precisely." We endeavored to do something of this sort by means of a telephone transmitter, and found that the effect varied greatly with the pitch of the sound and with the diaphragm of the transmitter. As we plan to continue these studies, I should highly appreciate a reference to further discussion of the subject. We have a quantity of data showing the current strength in the secondary circuit of a transmitter, varying with the pitch of a siren, and showing peaks or turning points at approximately octaves apart. This study was incidental to a study of the relative volumes of sound from telephone ringers, in the course of which we found that the effect upon a telephone transmitter was greatly affected by the character of the hammer. From the editorial remark I infer that others have been working recently on similar lines, and I should like to get in touch with their work.

UNIVERSITY OF MINNESOTA. GEO. D. SHEPARDSON.

Engineering English.

To the Editors of Electrical World:

SIRS:—There has been much discussion of late concerning the subject of engineering education. The subject has been treated broadly by some of the participants while others have gone into specific details, morals and mathematics, shop practice, classics, salaries and simplified spelling, everything seems to have been considered.

With this introductory explanation, I would offer a few remarks respecting a detail in engineering education which is self-evidently essential in all the schools but which seems to require continual repetition and emphasis. I refer to the matter of *exactness* of expression, particularly in writing.

I have had to examine a large number of reports, specifications, and other written productions of engineers, would-be and real, and have observed much that would serve for present illustration, but I am going to be so bold as to take my text from the very pages of the ELECTRICAL WORLD itself, realizing the risk of such temerity.

In the description of the new power station of the Fall River Electric Light Company, on page 175 of your current issue, the smoke and draft connections between boiler furnaces and stack are thus described:

"Each boiler discharges directly into the smoke header by a flue 4 ft. long. The header connections are arranged so that the hot gases can be discharged through the economizer to the stack direct or by way of the induced draft fan to the stack direct from the boilers, or through the fan; by division dampers gases from one battery may go through the economizer and those from the other direct, as may be desired."

Do the boilers really discharge into the smoke header? I will pass this over because the *meaning* is clear, merely remarking that we measure you, my dear Editors, by a high standard for which you are largely responsible.

But what of the rest? The word direct is so overworked that it seems to mean direct and also various degrees of indirectness; in fact about every alternative path provided for the gases is described as being direct yet the word is used to differentiate these paths.

It would also appear that there is a difference between going "by way of the induced draft fan" and "through the fan," expressions that most engineers would consider synonymous. We are told, however, that the first provides a path "to the stack direct from the boilers," while the second is some kind of alternative thereto.

Now here is much unnecessary confusion in the description of a simple matter and it is the kind of thing likely to be fatal to the career of an engineer and that many, if not most, men are apt to fall into unless they have been thoroughly drilled in the matters of exactness and clearness of expression. The young man who has grasped that fundamental requirement of exact and clear expression will be the more thorough student and, in after life, he is not unlikely to pass men of greater natural abilities because he can write a better report.

New York. F. V. Henshaw.

[The criticism of Mr. Henshaw is well founded, both with respect to engineering English in general and the example quoted in particular.—Eds.]

The Rolling of Thunder.

To the Editors of Electrical World:

Sirs:—Referring to Mr. Groat's article in the issue of Jan. 11 describing a very interesting thunder phenomenon which he had the good fortune to observe, it must be remembered that the echo of a thunder clap will, in general, differ in time from the sound which reaches the observer direct from the flash.

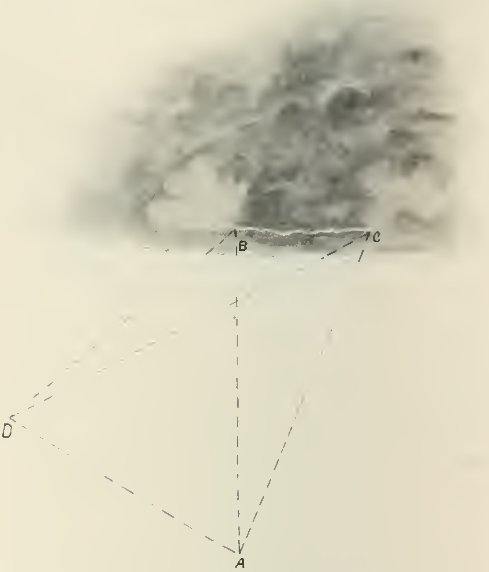
Referring to the accompanying illustration, it will be seen that with respect to the sound which reaches the listener direct from the flash, there are practically the same conditions in regard to relative effect as in the first case treated in my article in your issue of Dec. 21, and represented by Figs. 2, 3 and 4.

In the case of a flash composed of a large number of discharges, where the position of the flash is such that the beginning and end are at nearly the same distance from the observer, the sound would be of short duration, would increase very rapidly to a maximum, and then die out very quickly. The sound might be said to be similar to that of an explosion.

In the case of the echo, the relative positions would be represented by *BCD*, which correspond to Fig. 5 of the original paper. The sound would be similar to that represented in Fig. 7. It would not be so loud as in the previous case, but would be more prolonged.

If the point of observation is immediately under the middle point of a flash from cloud to cloud, so that the ends are practically equidistant from the observer, the explosive character of the sound would be a maximum; the passage of the discharge from cloud to cloud being practically instantaneous, the sound from the middle point would reach the observer first, and there would be practically the same sound that is produced where a discharge takes place from the middle point to each cloud.

Variety in nature is well illustrated by thunder and lightning. Although the principles which underlie the rolling of thunder are simple, great care must be exercised in noting details in regard to the flash itself, the distance of its ends from the point of observation, the distance of the points or reflection from the ends of the flash, and from the point of observation, and anything that would modify the sound. With these data the curves of the direct and reflected sound can be plotted, and by combining these the curve of sound can be obtained.



RELATIVE POSITIONS OF FLASH, OBSERVER AND POINT OF REFLECTION.

If in the case cited above the point of reflection was at such a distance that the echo did not reach the observer till the sound which came direct from the flash had ceased, the echo would have been entirely distinct and different from the latter. If the echo from one part of a flash reached the listener before the sound which came direct, the echo would be superimposed upon the latter.

Schenectady, N. Y. D. S. Carpenter.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Transformation from Three-phase to Single-phase.—W. S. Moody.—In a single-phase system the power delivered changes from maximum to zero and back to maximum every half cycle, while in a polyphase system the power delivered is constant. Therefore, any system, if it be capable of transforming from balanced polyphase current to single-phase current, must be capable of storing up energy during the interval of time when the power delivered to the single-phase side is less than the power received from the three-phase side. This is evidently impossible to accomplish by means of static transformers. One plan of using static transformers which has been suggested is to have three transformers, two connected in open delta and the third in reverse delta arrangement to the other two. It is shown with the aid of diagrams that this whole combination is simply equivalent to a single transformer across one or two phases of the supply.—*Gen. Elec. Rev.*, January.

Single-phase Commutator Motors.—M. Osnos.—A continuation of his analytical comparison of the behavior of the different types of single-phase commutator motors with special reference to traction purposes.—*Elek. Zeit.*, Jan. 9.

Resonance Transformers.—J. Bethenot.—The conclusion of his long theoretical discussion of the resonance transformer and those special points which are to be taken into account in its design.—*L'Elec. Electrique*, Dec. 28.

Rotary Converter.—E. J. Berg.—The first parts of what appears will become a long serial on the theory of the rotary converter.—*Gen. Elec. Rev.*, January and February.

Induction Motors.—R. Goldschmidt.—A continuation of his long serial on the leakage of induction motors. In the present installment the author discusses the leakage of the coil ends.—Lond. *Electrician,* Jan. 17.

Lamps and Lighting.

Commercial High-Efficiency Lamps in Europe.—The following data collected from the advertising pages of the last issue of the leading German electrical journal give a summary of the high-efficiency lamps now on the market in Germany, and the claims of the manufacturers:

	Watts per hefner cp.	Life in hours	Voltage and hefner cp.
Bergmann "metallic-filament lamps."...	1	1000	up to 130 volts, 25, 32, 50, 100 cp
"Metallized carbon" lamps..............	2¼	500	100 to 120 volts, 16, 25, 32 cp
Hollefreund zirconium lamps............	1	500 to 1000	"up to 220 volts," no cp given
Welsbach "osram" (tungsten) lamps	1	not given	100 to 130 volts, 25, 32, 50 cp 200 to 250 volts, 40, 50 cp
Siemens-Halske tantalum lamp.........	1.5 to 1.7	800 to 1000	50 to 60 volts, 12 cp
			65 to 75 " 12 "
			100 to 120 " 16 "
			65 to 75 " 25 "
			100 to 120 " 25 "
			140 to 160 " 25 "
			65 to 75 " 32 "
			100 to 120 " 32 "
			140 to 160 " 32 "
			100 to 120 " 50 "
			140 to 160 " 50 "
Pintsch "Sirius-Colloid" lamp (Kuzel patents)...........	1	not given	up to 130 volts, 25 cp and more

The new "quartz lamp" (recently described in detail in Electrical World from a paper of Busse), which is a mercury-vapor lamp with a quartz tube in a glass globe, is also now on the market. In its general appearance it resembles an arc lamp. It is to be used as a single lamp at 220 volts and has a candle-power of 3000 hefner candles, consuming 0.25 watt per hefner candle-power. The life is 1000 hours, and an advantage over the arc lamp is that it is not necessary to replace any electrodes. The Beck lamp (an "intense flame arc lamp without any regulation mechanism") is sold for candle-powers from 2400 to 30,000.—*Elek. Zeit.,* Jan. 16.

High-Voltage Incandescent Lamps.—C. Heim.—In an article on the best voltage for distributing net-work the author discusses the difficulties of making 220-volt lamps. The first 220-volt carbon-filament lamp appeared in England in 1897, and this type was placed on the market in Germany in 1898, but its well-known disadvantages (higher specific power consumption and shorter useful life than in the case of 110-volt lamps) have remained almost unchanged. These are in fact inherent disadvantages, since for the same candle-power and at the same temperature the carbon filament must have the same surface, but about four times the resistance for the double voltage. If the length of the filament is doubled, the cross-section must be made one-half or the diameter must be reduced to about seven-tenths of its former value. The thin filament cools more than the thicker filament for 110 volts, since the factor which determines the cooling loss is the ratio of surface to volume (or of circumference of cross-section to its area). More energy must therefore be supplied to the 220-volt filament in order to maintain it at the same temperature than for the 110-volt lamp. As a matter of fact ordinary 220-volt lamps of 25 or 16 hefner candle-power consume 3¾ watts to 4 watts per hefner candle-power against 3 1-3 to 3½ for 110-volt lamps. Further, with a thinner filament any irregularity of cross-section or structure shortens the useful life to a greater extent than with the thicker 110-volt filaments. With metallic-filament lamps the conditions are even more unfavorable. In order to make a 110-volt filament for from 25 to 32 hefner candle-power, its length must be brought to about 60 cm. and its thickness must be reduced to about 0.05 mm. The mechanical difficulties have been overcome, but naturally the cost of making the lamps is greater. It is fortunate that osmium, tantalum and tungsten do not vaporize or disintegrate at the high temperatures at which they are used, so that they have a long, useful life. The problem of making 220-volt metallic-filament lamps for 32 or less hefner candle-power offers such enormous technical difficulties that the author thinks that they will never be overcome. For candle-powers such as used by most consumers the author thinks it will be impossible to make 220-volt metallic-filament lamps (see also the abstract on 2 x 110 versus 2 x 220 volts under Installations, Systems and Appliances).—*Elek. Zeit.,* Jan. 9.

Mechanical Equivalent of Light.—C. V. Drysdale.—A Royal Society paper on an experimental determination of the mechanical equivalent of light. The method employed was to separate the visible and non-visible radiation by means of a prism, and to use a bolometer for measuring the energy. The value of 0.12 watt per candle-power for the white light from the Nernst filament agrees almost exactly with the value found by Angström for the hefner lamp. For an arc lamp the value found was 0.08 watt per candle-power for white light. The conclusion arrived at is that with 100 per cent efficiency an ideal source of white light should give about 10 candles per watt, and a monochromatic yellow-green source about 17 candles per watt.—*Proc. Royal Soc.,* Dec. 9; Lond. *Electrician,* Jan. 17.

Arc Lamp.—G. N. Chamberlin.—An illustrated description of a 220-volt to 250-volt direct-current enclosed arc lamp, specially designed for the very severe operating conditions met with in the case of the nominal 220-volt motor circuit, generally used in iron and steel mills, with its greatly varying potential and the other disadvantages of high temperature, extreme vibration and the presence of large quantities of fine metallic dust.—*Gen. Elec. Rev.,* January.

Luminous-Arc Headlamp.—G. N. Chamberlin.—An article illustrated by diagrams on the use of the magnetite arc for street-car headlamps.—*Gen. Elec. Rev.,* February.

Power.

Electric Cranes.—H. H. Broughton.—A continuation of his long illustrated serial on electric cranes. In the present installment the author deals with mechanical brakes fitted with electromagnetic release and describes a brake made by a British company in which the magnetic pull required to release the brake is obtained directly from the motor field flux itself. Alternating-current, brake-releasing electromagnets are then dealt with, and a brief description of motor-brake magnets suitable for single-phase and polyphase equipments is given.—Lond. *Electrician,* Jan. 17.

Electric Power for Printing.—F. E. Vickers.—An illustrated description of a printing-press equipment with push-button control, suitable for large printing presses and used in the printing plant of a San Francisco newspaper.—*Gen. Elec. Rev.,* January.

Niagara Falls.—G. R. Shepherd.—An illustrated description of the power station of the Niagara Falls Hydraulic Power & Manufacturing Company.—*Gen. Elec. Rev.,* January.

Coke Extractor.—M. R. Clarke.—An illustrated description of an electric apparatus for drawing coke from beehive ovens and loading the coke into a car.—*Gen. Elec. Rev.,* February.

Electricity in Mines.—F. A. Barron.—The first part of an article giving notes on wiring and wiring-supplies for mining service.—*Gen. Elec. Rev.,* February.

Steam Turbines.—W. L. R. Emmett.—A discussion of the steam turbine with special reference to the Curtis turbine, and with comparisons with the reciprocating engine.—*Gen. Elec. Rev.,* January.

Traction.

Electric Railways in Switzerland.—S. Herzog.—A summary of progress made in the erection of electric railways in Switzerland during 1907. The electric operation of the Simplon tunnel has continued to be perfectly satisfactory. Traffic has increased in the tunnel and new and stronger locomotives have been installed. On the single-phase, 15,000-volt road from Seebach to Wettingen the period of experiments is over and it is now regularly operated on schedule time. The last troubles which were experienced, due to the induction on telephone lines in the neighborhood, have been finally overcome. A typical example of a high tension, direct-current light railway is the Mesocco road from Bellinzona to Mesocco operated with direct-current at 1500 volts, there being four 66-hp motors, two 750-volt machines being connected in series. The single-phase, 5000-volt road from Locorno to Bignasco has been opened. The trolley wire is at the side of the road. The cars are equipped with motors having a total rating of 160 horse-power, which are fed with low-tension current from transformers placed on the cars. During the months in which this road has been in operation this single-phase road has given better economical results than direct-current roads, and also shows advantages with respect to first cost. It is concluded that the single-phase system has a promising future for interurban roads. Some statistical data on older electric railways in Switzerland are also given.—*Elek. und Masch.*, Jan. 12.

Single-phase Traction.—Henry.—The first parts of an illustrated article on single-phase traction on European railroads. The author describes the methods of the Oerlikon Company and the equipment of the Seebach-Wettingen line.—*L'Electricien*, Jan. 4 and 11.

Railway Power Station Capacities.—E. E. Kimball.—An article illustrated by diagrams and tables in which the author outlines briefly the general procedure followed in preparing estimates on the power required for the operation of proposed trolley roads and also presents some data in connection with train resistance and energy consumption.—*Gen. Elec. Rev.*, January and February.

Railway Signals.—F. B. Corey.—The conclusion of his illustrated serial on railway signals. In the present installment signal mechanisms which drive the semaphore arm are discussed and illustrated.—*Gen. Elec. Rev.*, January.

Switch Indicator.—F. B. Corey.—An illustrated description of a new switch indicator for use in connection with automatic railway signals.—*Gen. Elec. Rev.*, January.

Motor Cars.—A. Solier.—An illustrated description of the new motor cars of the General Tramway Company of Paris.—*La Lum. Elec.*, Jan. 4.

Parks and Tramways.—This issue contains a great many articles on the management and equipment of parks and pleasure resorts in connection with electric railways.—*St. R'y Jour.*, Jan. 25.

Installations, Systems and Appliances.

2 x 110 Versus 2 x 220 Volts.—C. Heim.—In England and Continental Europe it has become the fashion to build three-wire plants for 2 x 220 volts even in such cases where it would be possible to get along with 2 x 110 volts. This causes much trouble now after the low-voltage, high-efficiency, metallic-filament lamps have become available. The author does not think that a 220-volt, 16-cp, metallic-filament lamp will soon be placed on the market (see the abstract under Lamps and Lighting). In the design of a plant, and especially of a municipal plant, the interests not only of the producer but also of the consumer should be taken into consideration. The advantages of 2 x 220 volts are nearly all gained by the producing station. The consumer is only interested in the same as far as it is possible to lower the costs somewhat on account of the lower cost of the distributing network. Under average conditions, with equal extension of the network and equal load, however, the total cost of the plant is only 15 per cent less for 2 x 220 volts than for 2 x 110 volts, if the wires are placed overhead, and in case of underground cables it is only 10 per cent less. Although users of electric motors derive all the advantages of the lower cost of energy generation, the lamp user has almost no profit from it. The chief advantage of 2 x 220 volts is the possibility of extending the distributing network much further than with the lower voltage. Much, however, may be achieved by simply raising the supply e. m. f. from 110 to 120 or 130 volts. With alternating-current networks it is, of course, possible to connect 110-volt lamps to a 220-volt supply by using sub-divided inductance coils. In the case of direct-current it is possible to employ a battery and connect the low-voltage lamps to a suitable number of cells. Since the battery need not supply energy it is sufficient to use simple lead plates instead of formed ones, which, however, would be advantageous only in special cases. With the 110-volt metallic-filament lamps, which are very much less sensitive with respect to voltage variations than carbon-filament lamps, it is not necessary to be so careful in limiting the permissible voltage drop, and for this reason an extension of the network beyond that permissible with carbon-filament lamps is possible. For the same reason the voltage drop permitted in house installations could be increased from 2 per cent to 3½ or 4 per cent. While the saving of cost is rather insignificant, yet it might lead to the practice of selecting the wire in house installations simply with reference to mechanical strength without taking the voltage drop into consideration. Changes in the regulations concerning fuses should also be made. The general conclusions of the author are as follows: In selecting the supply voltage of municipal electricity stations the interest of consumers should be more considered than heretofore. New plants for cities of not over 30,000 inhabitants should be designed for 2 x 110 or 2 x 120 volts and not more. Even in larger cities up to about 50,000 inhabitants it should be endeavored to get along with the low voltage even if some people at the outskirts of the city must be neglected. An exception must be made in those cases in which a heavy motor load is found in the outskirts of the city. If in cities of 50,000 or more inhabitants the generation of direct-current is desired, 2 x 220 volts must be chosen. In case of high-tension alternating-current transmission with converter stations for direct-current distribution, the lower e. m. f. of 2 x 110 volts is not as economical as the higher voltage, but in cases of alternating-current transmission with distribution from transformer sub-stations the lower voltage should be chosen. In isolated plants the two-wire system at 110 volts or the three-wire system at 2 x 110 volts should by all means be selected.—*Elek. Zeit.*, Jan. 9.

Troppau.—O. Armknecht.—The conclusion of his illustrated article on the station of the City of Troppau supplying energy for lamps, motors and railways. This city has 30,000 inhabitants and it is shown that in this case the three-wire, direct-current system was the most economical one. The tramway is operated at 550 volts.—*Elek. Zeit.*, Jan. 9.

Wires, Wiring and Conduits.

Cellulose Acetate Covered Wire.—R. Fleming.—As a substitute for silk or cotton cellulose, acetate and enamel have proven to be well adapted to the insulation of copper wires. The mechanical properties of the cellulose acetate film make it desirable for use with very fine wires, from 0.003 in. in diameter or even finer to as much as 0.005 in. For larger sizes the enamel coatings are more suitable. The following tabulation shows some of the more important comparisons of data for a wire .003 in. in diameter:

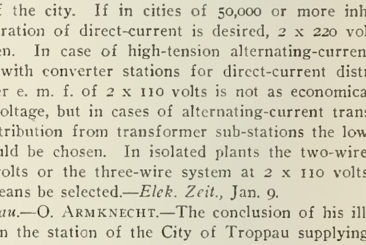


FIG. 1.—CELLULOSE ACETATE COVERED WIRE.

	Acetate.	Single Silk	Single Cotton.
Thickness of insulating film....	.0005	.0009	.00175
Wire space factor..............	.442	.313	.167
Wt. per thousand feet (lbs.)...	.033	.036	.049

For a given number of turns on a given form, the mean length of turn and the total length of wire is greatly reduced. This is clearly shown by the diagrams drawn to scale and given in Fig. 1, which relate to a diameter of spool 1 in., length of spool 1 in. and 100,000 turns with 0.003 in. diameter of copper. Another great advantage of acetate-insulated wire is that it is not affected by ordinary atmospheric conditions. It seems particularly suitable for telephones and other specialties in which the fine wires are used. The copper wire is covered with an acetate film in automatic coating machines.—*Gen. Elec. Rev.*, January.

Electrophysics and Magnetism.

Electric Waves.—W. R. Blair.—A paper on the change of phase due to the passage of electric waves through thin plates and the index of refraction of water for such waves, with applications to the optics of thin films and prisms.—*Phys. Rev.*, January.

Discharge of Electrodes.—J. G. Davidson.—An account of an experimental investigation of the conditions affecting the discharge of electrodes in phenomena of ionization.—*Phys. Rev.*, January.

Electrochemistry and Batteries.

Electrometallurgy of Iron and Steel.—J. W. Richards.—The conclusion of his Franklin Institute paper on the electrothermic production of iron and steel. The author gives the thermochemistry of a special case of iron reduction in the electric furnace and discusses the experiments with the Héroult furnace, made at Sault Ste. Marie. He emphasizes that it is important to use no more carbon than is necessary for reduction. —*Jour. Franklin Institute*, January.

Electrometallurgy of Iron and Steel.—S. A. Tucker.—The first part of a general discussion of the subject. The Héroult steel furnace and the automatic regulator used in connection with it are described. The author then discusses the Héroult process for iron ore reduction.—*Gen. Elec. Rev.*, February.

Fused Salts.—H. M. Goodwin and R. D. Mailey.—The conclusion of an account of their extended investigation on the density, electric conductivity and viscosity of fused salts and their mixtures. The results are given in tables and diagrams. One of the general results is that the specific conductance of fused salts is not strictly proportional to the temperature, but increases less and less rapidly as the temperature rises. The temperature resistance coefficient is, generally speaking, less than one-fifth as great as that for the corresponding aqueous solutions.—*Phys. Rev.*, January.

Units, Measurements and Instruments.

Induction Meter.—An official report of the Reichsanstalt by which the induction meters of the Allg. Elek. Ges., described as follows, are admitted for official calibration and certification. The meters are built for e. m. fs. up to 250 volts and for currents of 3, 5, 10 and 15 amperes in two-wire and three-wire alternating-current systems. They may also be used in balanced three-phase systems. The meter, the construction of which is shown in Fig. 2, consists essentially of a two-phase induction motor, a magnetic brake *B* and a counting device *Z*. The rotating member of the induction motor is an aluminum disc, while the inducing member is a three-legged iron core *T* above the disc and the yoke *J* below the disc. The two outer legs of the iron core *T* are wound with the shunt coils, while the series coil is placed on the shorter middle leg. For the two outer legs a magnetic shunt is provided. In the shunt coils a current is produced which is about 80 degs. behind the voltage of the network. The current flux and the voltage flux are brought into exact quadrature by means of a piece of iron fixed on the cast-iron plate *G*. The free end of this iron piece extends into the air space between the middle leg and the aluminum disc and is provided with a short-circuited copper ring. The torque exerted on the disc is proportional to the current, the voltage and the cosine of the time phase difference. The energy is consumed by the eddy currents generated in the aluminum disc by the braking magnet *B*. The connections for two-wire meters are shown in Fig. 3 and the connections for three-wire meters in Fig. 4. Instructions as to calibration are given.—*Elek. Zeit.*, Jan. 9.

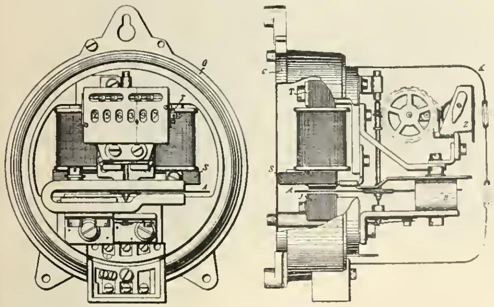
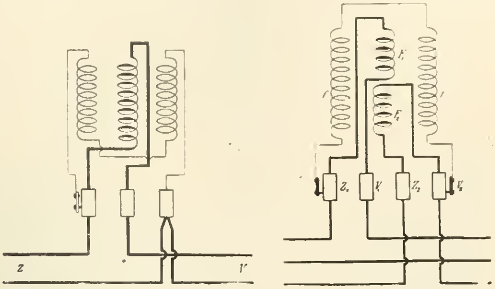


FIG. 2.—INDUCTION METER.



FIGS. 3 AND 4.—DIAGRAMS OF METER CONNECTIONS.

Cadmium Cells.—H. S. Carhart.—Evidence has recently been adduced by Heulett tending to the conclusion that the chemical stability of the Weston or cadmium cell is inferior to that of the Clark. The present author shows that whatever may be the fact as to lack of stability in the case of cadmium cells made with electrolytically prepared mercurous sulphate, his old cells made with precipitated mercurous sulphate meet every requirement of permanency. They are fully the equal of the Clark cell in this regard, and are decidedly superior when considered from the point of view of the permanency of the containing glass cell.—*Phys. Rev.*, January.

Photometry.—F. Laporte.—A very long and full account of the tests of the International Photometric Commission at the meeting in Zurich last year on photometric units. The decisions have already been summed up in the Digest.—*L'Eclairage Elec.*, Dec. 28.

Telegraphy, Telephony and Signals.

Slightly-Damped Electric Oscillations.—M. Wien.—The author formerly described a peculiar kind of "coupled oscillations" which are produced in two closely-coupled systems, if the primary is excited by means of a very short hissing spark gap. The two theoretical "coupling waves" were found to have only a low intensity while a third oscillation manifested itself more strongly, corresponding to the frequency of the uncoupled secondary system. This third oscillation was only slightly damped. Some further experiments on this phenomenon are described and the application to wireless telegraphy is suggested.—*Phys. Zeit.*, Jan. 15.

Directed Wireless Telegraphy.—J. Zenneck.—An article on the use of partly horizontal antennas for wireless telegraphy in a predetermined direction. The author endeavors to give an approximate mathematical theory of the manner in which such an antenna acts on the receiving station.—*Phys. Zeit.*, Jan. 15.

Miscellaneous.

Electric Cooking.—E. L. Callahan.—Illustrated notes on the use of electricity in the kitchen and the advisability of central stations making exhibits and demonstrations in order to attract customers for electric cooking.—*Gen. Elec. Rev.*, January.

La Lumière Electrique.—The French journal L'Eclairage Electrique has assumed, with the beginning of the year, the old name *La Lumière Electrique*, which it had up to 1894.

BOOK REVIEWS.

Electrical Engineering. By Dr. Adolf Thomälen. Translated from the German by Geo. W. O. Howe. New York: Longmans, Green & Company. 456 pages; 454 illustrations. Price, $4.20 net.

This excellent treatise covers in a masterly manner the whole range of electromagnetic phenomena usually taught to students of electrical engineering in high-grade colleges. Starting with the elementary principles of electrophysics and electrochemistry, and stating Ohm's law in its simplest terms, the author leads the student into the involved electromagnetic relations in dynamos by way of the most easily traveled routes. The actual details of machines as practically constructed are discussed merely to the limited extent necessary to show the application of the principles being explained.

In view of the excessive work that the word "induced" is compelled to perform in electrostatics and electromagnetics, it seems unfortunate that the translator should have burdened it with the task of serving as a synonym for "generated" in the description of the production of e. m. f. by causing a wire to traverse a magnetic field. The explanation of the operation of a stationary transformer is remarkably clear and accurate. The discussion of the parallel working of alternators is equally as good, and the phase-swinging of alternators is treated in an instructive manner.

The treatment of the polyphase induction motor is good, but the fact that there are given 11 different circle diagrams, not one of which is claimed to be accurate, and all of which are unnecessarily complicated, would indicate that there is room for considerable improvement in this portion of the book. The treatment of the single-phase induction motor is somewhat more satisfactory; it is based on the resolution of the flux and the m. m. f. into two fluxes and two m. m. f.s rotating in opposite direction. The resolution of the flux was proposed by Ferraris, but Dr. Thomälen introduced the resolution of the m. m. f.s. The method used is somewhat artificial, but the results obtained accord with the known facts. Single-phase commutator motors, synchronous converters and motor-converters are discussed briefly.

In an appendix, an outline is given of the symbolic method of solving alternating-current problems. Throughout the whole book the author keeps closely in touch with physics, and never allows mathematics to lead him astray. Although making no studied attempt to avoid mathematics, he has used mathematics merely to express physical relations, rather than physics to interpret mathematical equations, and has succeeded in producing a book that will be welcomed alike by the student and the instructor in electrical engineering.

Hilfsbuch fur der Elektrotechnik. By Dr. Karl Strecker. Berlin: Julius Springer. 1023 pages; 675 illustrations. Price, 14 marks.

This hand-book is divided into three parts dealing with the general physical, magnetic and electrical properties of materials and apparatus, with the testing of materials and apparatus, and with the design features and performance characteristics of stationary and rotary transformers, direct-current and alternating-current generators and motors, primary and secondary batteries, transmission systems, electric lighting and electric railway circuits. Wireless and wire telegraphy and telephony, electrochemistry are also treated. The book, which is now in its seventh edition, has been revised and rendered thoroughly accurate and up-to-date by the staff of 24 specialists who have been associated with Dr. Strecker. Moreover, much valuable material has been included in the book by reason of the friendly assistance of manufacturing companies.

Handbuch der Angewandten Physikalischen Chemie. Part 6. Ein fuhring in die Phasenlehre und Ihre Anwendungen. By Dr. Alex. Findlay. Leipzig: Johann Ambrosius Barth. 224 pages, 134 illustrations. Price, 10 marks.

This is a translation of Dr. Findlay's well-known English work, made by Prof. G. Siebert, of Wiesbaden. It is indeed strikingly illustrative of the cosmopolitanism of science that the acknowledged author of the phase rule was Professor Gibbs, of Yale, the treatise under discussion, based on Gibbs' deductions, was written by a professor in Birmingham, England, and now the German-reading scientific world gets inspiration and help from this translation. It is with pardonable pride that we see Gibbs acknowledged as the founder of this most general law of chemical dynamics, a law independent in its applications of any hypothetical or even theoretical assumption as to the constitution of matter, a veritable master key to chemistry and physics. May our German colleagues, with the help of this work, add mightily to the development and applications of the phase law of Gibbs.

Impianti Elettrici a Correnti Alternate. Semplici Bifasi e Trifasi. Second Edition. By A. Marro. Milano: Ulrico Hoepli. 774 pages, 347 illustrations, 71 tables. Price, 6.50 lire.

This handy volume has been revised and enlarged in its second edition. It contains a number of useful tables for service in electrical engineering, so that the book is a sort of cross between a text book on alternating-current installations and an engineer's pocket-book. The first three chapters deal with the elementary theory of alternating currents. Following chapters discuss respectively, industrial measuring instruments; alternators; transformers; synchronous motors; commutating motors; asynchronous motors; alternating-current lamps; distributing systems; conductors; construction of plants; economics of construction and operation; alternating-current traction. The two final chapters are on rules and regulations. The book is clearly written by an engineer for engineers, and will be welcomed by engineering students as well as all who are interested in modern Italian methods of constructing and operating electric installations.

O Concurso da Viacao Americana. (The American Street Railway in Oporto.) By Bernardo Lucas. Porto: Typographia a Vapor da Empreza Guedes. 226 pages.

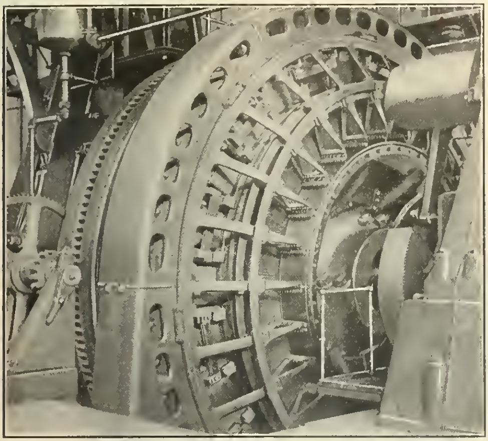
A Portuguese legal brief directed to the contention that the development of a street railway system in the city of Oporo by the municipality is in contravention of the franchise and privileges of the Railway Company of Oporto.

Commutating-Pole Generators in Station of Boston Elevated Railway Company.

Two 2700-kw commutating-pole generators, recently installed in the Charlestown and Harvard stations of the Boston Elevated Railway Company by the General Electric Company, present some interesting features in connection with the design, installation and operation of this type of railway generator. It is worthy of note that the armature diameter of these machines is about 4.5 ft. less than the armature diameter of the non-commutating-pole generators of the same rated output in the Lincoln way station of the Boston Elevated Company.

The commutating-pole generators are guaranteed to deliver full load continuously (4700 amperes at 575 volts) with a temperature rise not to exceed 35 deg. C., and to withstand a momentary overload of 100 per cent without injury. The practically sparkless commutation, which is secured under all of load by the use of commutating poles, reduces the wear of the commutator. No change whatever in the brush setting has to be made from no load to 100 per cent overload condition, and the circuit breaker can be tripped under any condition of load between these limits without appreciable disturbance at the brushes. In fact the provision for shifting the brushes is almost superfluous on this type of machine; with the brushes once adjusted for best commutation it is never necessary to alter their position. This desirable feature can be best appreciated by station attendants more or less accustomed, in times of excessive load or trouble, to the exercise of constant vigilance with respect to the brush-setting on the ordinary type of generator, to prevent flashing.

While commutating-pole machines of moderate ratings have been in successful operation for some time past, it is only recently that this feature has been applied to large direct-connected engine-driven generators operating under the severe service conditions generally met with in street railway work. It is probable, however, that this type of machine will play an important part in the future in the economic consideration of problems relating to enlargements to or the building of new generating stations for the operation of street railways.


DIRECT-CONNECTED RAILWAY GENERATOR.

Automatic Storage Battery Control Apparatus.

In order to insure the maintenance of the level of the electrolyte in the pilot cell of a storage battery at the proper height, independent of the constant evaporation of water, the automatic cell-filling apparatus illustrated in Fig. 1 has recently been developed. The principle of the apparatus is the same as that of the ordinary float-controlled valve used in water tanks. Two sealed bulbs, which act as floats, operate the moving parts of the valve mechanism. A tube closed near its lower end, which is connected by a small rubber tube to the source of water supply, forms the support for the fixed member of the valve mechanism. When the level of the electrolyte is below normal, the valve opens. When the flow of water restores the level to normal, the moving member is raised and the valve closes, thus cutting off the supply until evaporation again lowers the level.

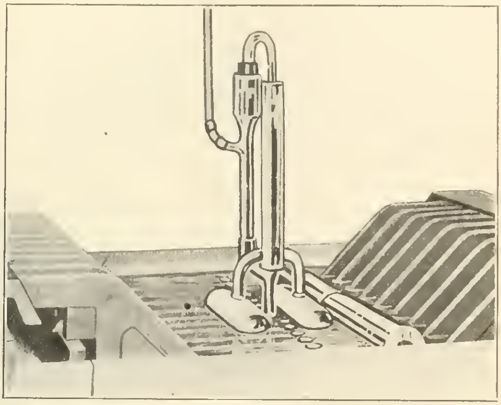


FIG. 1.—AUTOMATIC CELL-FILLING APPARATUS.

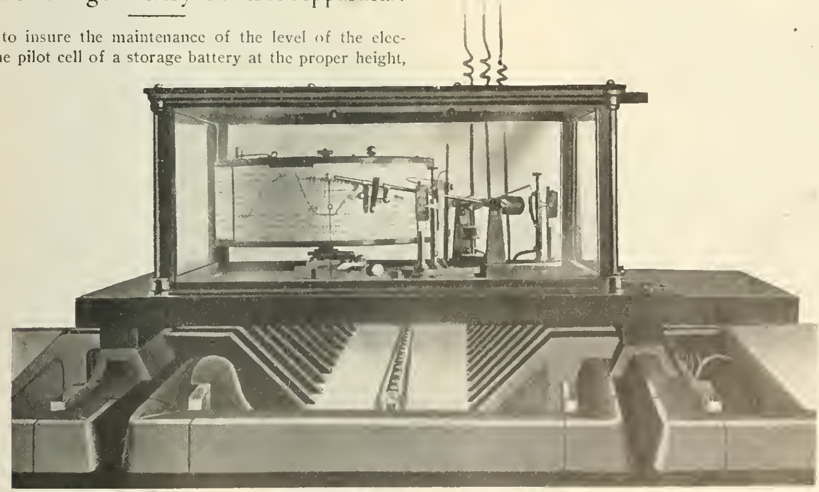


FIG. 2.—RECORDING SIGNALING HYDROMETER IN SERVICE

Fig. 2 shows a recording signaling hydrometer which has been developed for automatically tracing on a chart a continuous record of the specific gravity of the pilot cell, and for signaling by means of a bell when the specific gravity reaches some predetermined point, on either charge or discharge. The fundamental principle of the instrument is that of measuring by means of a delicate balance the varying resultant weight of a bulb of constant volume totally immersed in the electrolyte. The bulb is hollow and made of glass, with a very small opening communicating with its interior. It is filled with electrolyte, and as change of temperature of the surrounding electrolyte causes expansion or contraction of the contained within the bulb, some of it is ejected or drawn in in such amount as to cause the weight of the bulb to change inversely with the temperature. To illustrate this point, suppose the temperature of the pilot cell to rise; this causes the electrolyte in the cell to expand and its specific gravity to decrease, and hence the buoyancy exerted on the hydrometer decreases and the instrument tends to sink lower. This is counteracted, however, by some of the electrolyte in the bulb being forced out, due to the expansion caused by the rise in temperature, and, therefore, maintaining the bulb in the original position. The resultant weight, measured by the balance, is, therefore, independent of temperature changes in the electrolyte. The balance performs two functions: First by means of a pen it traces on a moving drum a record of the resultant weight of the bulb and hence of the specific gravity of the electrolyte, corrected for temperature change; second, by means of platinum mercury contacts, it closes a circuit which may be made to ring a bell.

Where it is not desired to obtain a continuous record of the specific gravity the apparatus can be arranged for merely indicating the specific gravity and for signaling, and the equipment becomes simplified by the omission of the recording devices. The above mentioned storage battery auxiliaries have been placed on the market by the Electric Storage Battery Company, Philadelphia, Pa.

Armature Disc Notcher.

The notching machine shown in the accompanying illustration is stated to contain the latest improvements in this class of presses. The various ratchets supplied can be quickly changed when required, although a given disc will afford a considerable range of indexing by varying the number of notches taken at each stroke. On the large gear is a tappet which, when the wheel has made one revolution, throws out the clutch and stops the machine, and when the wheel has been moved for a notch, a brake, operated by the same connection to the crank-shaft, prevents the gear from going beyond its proper position or overrunning when moving fast, and holds it still while the punch is descending; this brake enables the machine to be operated at a higher rate of speed than would be possible without it, up to 200 strokes on the smaller discs. The die-bed is adjustable vertically so that the die can always be set at the right height, and the depth of the notches can be accurately secured by means of the screw movement of the saddle upon the bed.

ARMATURE DISC NOTCHER.

This type of press is built by the Ferracute Machine Company, Bridgeport, N. J., in three sizes for notching discs up to 48 ins., 84 ins. and 120 ins. respectively in diameter.

Equipment of Japanese Hydro-Electric Plant.

The General Electric Company is furnishing complete electrical equipment for a hydro-electric plant in Nagoya, Japan, a city with a population of about 250,000, situated some 300 miles from Yokohama. The main generating station will be built at Yawozo, on the Naiko River, where power will be generated at 6600 volts by four three-phase, 2500-kw, 60-cycle, 360-r. p. m. waterwheel-driven generators. The generator voltage will be stepped up to the line voltage of 60,000 volts by 12 water-cooled transformers of 1000-kw capacity each, and transmitted 30 miles to the main sub-station just outside of the city of Nagoya. Here the line voltage is to be stepped down to 11,000 volts by nine water-cooled transformers of 1350-kw capacity each, and transmitted underground to the distributing station through triple conductor lead-armored cables, the city ordinances prohibiting an overhead transmission of over 3500 volts.

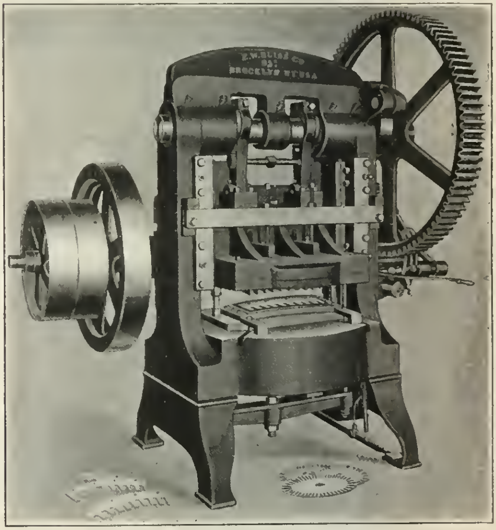
In the central distributing station the voltage will be stepped down to 3400 volts by nine water-cooled transformers of 1350-kw capacity each, at which potential it is to be distributed throughout the city by both overhead and underground cables.

It is interesting to note that from the nearest railway station the entire power apparatus for the Yawozo station will have to be transported on especially constructed wagons drawn by oxen.

The Naiko River is normally 40 ft. in depth, but in the rainy season the river often rises to 40 ft. and 70 ft. above low-water mark. This rising characteristic of the river necessitated the building of a specially designed dam to take care of the high water.

Armature Disc-Cutting Press.

In the accompanying illustration is shown an armature disc-cutting press geared as built by the E. W. Bliss Company, Adams Street, Brooklyn, N. Y. This press is designed for cutting simultaneously the outside and inside of plain discs up to 35¾ in. diameter, when the discs are not less than 3-in. wide, and up to 14 in. or 15 in. diameters when all the notches are to be cut at the same stroke. It may also be used for cutting segments or sections complete at one stroke. The illustration shows a die in position in the press for cutting segments, some of which are shown on the floor alongside, as also are some round armature punchings, which have also been made in this press. It is fitted with adjustable positive knockout devices for both the punch and the die. The slide is guided in adjustable ways of exceptional length and width so as to carry the expensive tools to be operated with perfect accuracy. Adjustment of the slide is effected by means of the Stiles eccentric adjustment, which enables the operator to raise and lower the slide quickly to the exact point required without any danger of disturbing the alignment. This type of press is built in several sizes.



ARMATURE DISC-CUTTING PRESS.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade was somewhat improved under the stimulus of more seasonable weather and a further increase in the percentage of active machinery. There is still a large number of hands unemployed, however, and retail dealers proceed cautiously in preparing for future business. Prices of commodities declined on the whole, yet products of the leading industries were fairly well maintained. Mercantile collections were irregular, despite the ease in the money market. There was little uneasiness regarding the additional bank closings, as it was realized that these suspensions were only the aftermath of the October panic and represented no new cause for alarm. Railway earnings in January were 15.3 per cent less than in 1907, and foreign commerce at the port of New York alone for the last week showed a gain of $5,466,915 in exports and a decrease of $4,669,690 in imports as compared with the same week last year. Returns of trade and industry during January show lessened sales and smaller output as compared with the previous January, the shrinkages being estimated at from 30 to 50 per cent. Iron output will probably be 50 per cent below that of a year ago, though perhaps larger than in December. The textile industries were quieter. The recent cuts of prices in cotton goods place the price of most grades at least 20 per cent below those of a year ago. Lumber and all kinds of building material were generally very quiet, despite some increase in lumbering operation. Pig iron continued quiet notwithstanding comparatively low prices. Official figures show that the output of pig iron in 1907 amounted to 25,781,361 tons, a new high record, and an increase of 1.9 per cent over the figures for 1906. At the close of 1907 there were 276 idle furnaces, as against 89 at the end of 1906. Little business has developed in bar iron, although prices are lower. During the week the leading iron and steel manufacturers decided to maintain prices. Finishing mills were a little more active but, on the whole, recovery is slow. New business in structural material was fair. Copper was firmer so far as the list prices of leading producers indicate, but there have been some resales at concessions, and therefore the actual market is probably easier. Excluding resale lots, business, domestic and foreign, is very light. Lake is quoted at 13¾c.; electrolytic, 13⅝c., and casting copper, 13½c. Business failures were fewer, the number as reported by *Bradstreet's* being 359 for the week ending Jan. 30, against 408 in the week previous, and 211 in the corresponding week last year.

PLANT FOR MEXICO.—The Compania Industrial Sabonera de la Laguna, in the town of Gomez Palacio, Mexico, has ordered from the Westinghouse Company an exact reduplication of the present electrical plant which the company installed a year ago. This plant is situated in the midst of the rich Laguna district which yearly produces more cotton than either Mississippi or Louisiana, and its output is soap, dynamite and cotton seed oil. In this part of the country water power is scarce and all the coal that is used must be imported from England in jute sacks at a cost of $16 to $18 gold a ton. About a year ago it was decided to discard steam and cut down operating expenses by using gas. An R. D. Wood gas producer was installed which fed a three-cylinder vertical, single acting Westinghouse gas engine of 200-hp capacity, direct connected to a Westinghouse 150-kw, 125-volt direct current generator, which operates the various motors in the shops from 50 hp down. The change from steam to electricity proved so successful that an exact reduplication of the plant has been ordered and shipped with a 300 R. D. Wood producer engine and a 250-hp generator. At present the plant employs between 400 and 500 men. In the same district where the Guayule plant, from which rubber is made, grows in abundance, the Compania Explotadora Coahuilense, a Mexican enterprise engaged in making rubber, has followed the example of the Sabonera Company and installed an electric system in its plant. The equipment consists of R. D. Wood producers, gas engines and four 100-kw and one 75-kw direct-current generators of 250 volts capacity, which operates all the motors in the works from 100 hp down. Direct and other connections are made to the rollers, crushers and other machinery used in manufacturing the rubber.

IN BRITISH WORKS.—A contract has just been awarded to the British Thomson-Houston Company, Limited, for the equipment of the rolling mill of Dorman, Long & Co., Limited, of Middlesboro, one of the most conservative steel-making concerns on the other side. The machinery to be installed will embrace a main mill motor, which will have a continuous capacity of 1200 hp and a maximum torque capacity up to no less than 3600 hp. For installation in the Mold Collieries large motors, designed for 500 volts, 50 cycles, three-phase, will be directly connected to turbine pumps, which will operate against a head of 600 ft. Another British contract is for the complete electrical equipment of the Moss-Hall Coal Company's underground workings, including the provision of the necessary equipment of a large generating station. This contract, which is said to be one of the largest of its description ever let on the other side, embraces several pumps of large capacity, motors, hauling gear, together with complete cable equipments for both surface and underground work. Among the orders secured for the equipment of British textile mills is one for 75 motors, ranging up to 170-hp capacity, for one of the largest plants in the Manchester district.

ARMY WIRELESS TELEGRAPH CONTRACT.—We are informed by the Massie Wireless Telegraph Company that the contract for the five sets of wireless telegraph apparatus for the U. S. Signal Corps, to which purchase reference was recently made in these columns, was awarded to that company. There were six bidders, on the same number of proposals, as follows:

Bidder No.	2 10-kw Sta. Equip. Each	2 sets wireless Equip. Each	2 10-kw Transf. Each	3 3-kw Conden. Each	3 3-kw Sta. Equip. Each	3 3-kw Tranf. Each
1....	$4,037	$4,137	$575	$159.60	$871	$325
2....	4,600				895	
3....			545			270
4....		2,480	490	130		249
5....	3,125	9,695	1,100			300
		7,175				530
6....	3,915	2,500	500	120	925	300

The final line gives the figures at which the contract was awarded to the Massie Company.

STANLEY METER SHOPS.—No great importance need be attached to the announcement that the Stanley Electric shops of the General Electric Company at Great Barrington, Mass., have closed down. Meters have been the output of the shop, but for the last year little work has been done there. The finished meters had to be sent to Pittsfield to be tested, and some time ago it was decided to make other arrangements. The closing of the shops is simply another step in the economic development of the company and has no bearing on financial or business conditions. At no time were more than 400 men employed at the Stanley works, and during the past year less than 100 employees have been at work there.

THE HAMILTON ANCHOR CO., of Hamilton, Canada, has purchased from the Atlas Anchor Co., of Cleveland, Ohio, the entire rights for Atlas anchors and setters in the Dominion of Canada. The Hamilton Anchor Co. was organized two years ago, and while it has met with flattering success with the line of anchors which it has been manufacturing, the Canadian rights of the Atlas anchor were acquired for the reason of the large surface and great strength of this type, which fit it for withstanding the highest strains.

SUPPLIES FOR EAST INDIES.—An American consul in the East Indies reports that a firm in that locality is in a position to do business in electrical supplies, and would like to correspond with manufacturers of electroliers, electric fans, etc. The current is alternating, 110 volts and 50 cycles. The address can be had from the Department of Commerce and Labor.

PLANT FOR ARGENTINE.—According to the Review of the River Plate, Buenos Aires, Argentine Republic, the La Plata Senate has approved in general the bill granting a concession to Messrs. Otto Franke & Co. for an electric railway between La Plata and Buenos Aires.

CURRENT BUSINESS CONDITIONS.—Mr. W. C. Webster, New York manager for the Westinghouse Company, sees much in the present situation to justify optimism. "The only criterion by which we can forecast the future state of the business world," he said last week, "is by observing the nature of the applications and inquiries which we are receiving from day to day. The nature of business inquiries of late have been very gratifying, for they indicate that the manufacturers and consumers who have been holding back for some time are now preparing to go ahead. Business has improved in a very marked manner during the last six weeks and I look for a good year. In fact, it is impossible for the recent stagnation to continue much longer. Light and power are being used as largely as they ever were and necessary repairs and extensions cannot be put off for much longer. The increasing activity of the business world will force into action, sooner or later, even the most pessimistic." The situation was summarized in a forceful manner by the head of one of the leading wire manufacturing concerns in the country, who said: "We are not going to have any such mad orgie of production as we have had for the last two or three years, nor, on the other hand, is the whole country going to the eternal bow-wows. In the end, after we all have had our say and we get down to tacks and figure up results for the year, we shall find that we have had a business year that will fall a trifle short of the normal business year." Mr. A. W. Burchard, of the General Electric Company, makes the subjoined interesting and encouraging remarks: "The character of the inquiries received from users of electrical apparatus since January first indicates that plans for extensions and improvements, which were suspended at the time of the acute financial crisis in October last, have been taken up and will be actively proceeded with. The diminished rate of business activity has already released and made available for investment a large amount of capital, which will in a little time clear the way for the new issues of securities which must be placed before constructive enterprises on a large scale can be proceeded with. This process is now progressing favorably. In the meantime, the managers of industrial enterprises will have the opportunity of giving adequate consideration to problems of operating economy and efficiency, subjects to which it has been impracticable to give the attention they should receive during the pressure for output under which most manufacturing concerns have been working during the past three years. The indications are that confidence in the future has been or is being rapidly restored and that the current rate of business represents the lowest mark which will be reached. From the present level conditions should gradually improve, and when the march toward prosperity has been resumed at full speed, the manufacturers generally will be in a much better position in respect to the efficiency of their plants and organizations and their facilities for economical operation than ever before."

CEMENT TRADE COMBINATION.—Announcement is made of the formation of an association of licensed cement manufacturers, which will include all the leading Portland cement concerns in the United States. Patents are owned by the association and the members are allowed to use the patented devices, and it is announced that properly equipped plants will be admitted to membership. At the same time the association purposes to prosecute non-members who are without the licenses. It is said that 70 per cent of the output of Portland cement in the United States is represented in the industry. The North American Portland Cement Company is the corporation thus formed by the Association of Licensed Cement Manufacturers, and it controls the Hurry & Seaman and Carpenter patents covering the burning of cement with pulverized coal in rotary kilns and the Edison long kiln patents. The North American Portland Cement Company was organized in the latter part of 1906, with a capital stock of $10,000,000, having among its purposes the taking over from the Atlas Company of the Hurry & Seaman and other patents and the licensing thereunder of Portland cement manufacturers. During the past year the North American Company has been extremely active in acquiring other patents for the protection of its licensees. Another marked advance in the cement industry was due to Mr. Thomas A. Edison, who devised new burning kilns, together with several unique methods of fuel consumption. In particular, he designed and had patented a rotary kiln 150 ft. long, and 7 to 8 ft. in diameter, having a daily capacity of from 700 to 1,000 barrels of cement. Until that time the largest kilns in use were 60 to 80 ft. long, 5 and 6 ft. in diameter, with a capacity of but 200 barrels a day. Edison's long kiln was universally ridiculed by the older manufacturers. But its success soon proved their criticism to be unwarranted. The adoption of the long kiln by the Portland cement industry in general, and the consequent possible infringement of the exclusive patents held by Edison covering it, proved to be a fertile source of litigation, which was only recently terminated by the acquisition by the North American Company of the patents for long kilns, burners and similar apparatus owned by Mr. Edison.

POWER PLANT STEAM TURBINES.—The extent to which steam turbines are now specified as prime movers for central power houses, municipal lighting stations and electrified industrial plants may be seen in the fact that Allis-Chalmers Company has at present on the erecting floor of its West Allis works units as follows: A 2000 kilowatt set for the Delaware, Lackawanna & Western Railroad, to be installed in its collieries at Scranton, Pa.; 1500-kw machines for the city of Jacksonville, Fla.; Youngstown (Ohio) Sheet & Tube Company; Tremont & Suffolk Mills, of Lowell, Mass.; Cedar Rapids & Iowa City Railway Company, of Cedar Rapids, Ia.; American Thread Company, for its Watuppa Mills, and the Scranton, Pa., Gas & Electric Company; 1000-kw units for the Nairn Linoleum Company, Kearny, N. J., and the Celluloid Company, of Newark, N. J.; turbines of 750 kilowatts each, for the Lawton Spinning Company, Woonsocket, R. I., and the Pacific Mills, of Lawrence, Mass., and 500-kw machines purchased by the Everett Pulp & Paper Company, of Everett, Wash.; Savannah Lighting Company, Savannah, Ga., and the Celluloid Company. Six of these are on repeat orders from as many different users, some of which have already more than one Allis-Chalmers turbine installed, and all include generators especially designed for operation with them.

THE STANDARD ELECTRIC & ELEVATOR COMPANY, 211 South Charles Street, Baltimore, has taken over the electric and elevator departments of the Crook-Horner Company, which latter will hereafter devote itself exclusively to the supply business. The mechanics and electricians employed by the Crook-Horner Company on elevator work have also been taken over. Messrs. R. P. Thomas and Guy K. Mitchell, formerly the managers of the above departments of the Crook-Horner Company, are respectively manager of the elevator department and manager of the electrical department of the Standard Company.

BALL BEARING PLANT.—The Hess-Bright Manufacturing Company, Nineteenth and Hamilton Streets, Philadelphia, informs us that it has been found necessary to make the third change to larger quarters and that it will shortly occupy a four-story building, with a floor space of 15,000 sq. ft., exclusive of the basement, which is given up to a modern construction gas producer power plant. Aside from the ball bearing division this is the largest plant devoted exclusively to the manufacture of ball bearings of only one grade, that of the annular type. The new quarters will be occupied sometime within the next six weeks.

WESTINGHOUSE ORDERS for the month of January show an encouraging increase over December, and there is a large amount of new business in sight for electrical apparatus Electric railways, central stations and power transmission enterprises are resuming work and extensions dropped when the financial troubles broke over the country last October.

APPARATUS FOR RIO DE JANEIRO.—Among other foreign shipments of the Westinghouse company are six 5,000-kw generators to the Rio Janeiro Tramway, Light & Power Company, Brazil. The plant is situated outside of the city of Rio Janeiro, with a main station in the city. A line pressure of 80,000 volts is employed.

EXPORTS TO GERMANY.—The Bureau of Statistics of the Department of Commerce and Labor notes the July-December, 1906, exports of electrical appliances to Germany as $181,536, as compared with $145,758 in 1907; and the exports of electrical machinery as $49,530, as compared with $42,126.

AUTOMATIC TELEPHONY.—The Eastern Trading Company, as agents for the Automatic Telephone Construction Company, have installed an experimental exchange, with 15 phones, in Shanghai. Efforts are being made to introduce the system in other large Chinese cities.

ELECTRICAL OUTLOOK IN WESTERN SOUTH AMERICA.—Discussing electrical conditions in Chile and the other states on the western coast of South America, Mr. Walter T. Peck, an American engineer who has recently returned from that section, sees excellent prospects for electrical development in that part of the globe during the next decade. "In, Chile, where the large electrical enterprises are nearly all financed by German capital," said Mr. Peck, in an interview with a representative of the Electrical World, "naturally, German engineers and German machinery remain in the ascendency, but English and American engineers are pushing hard on the Germans. During the last five years especially, the demand for American machinery has picked up in a remarkable manner. In Peru, the Americans had a better start than in Chile and dominate the situation. Lima, the largest city, has excellent water-power, which supplies current for the three tramway systems in the city besides current for lighting and other purposes. Among other new projects under consideration in Chile is the transformation of a large steam power plant at Santiago into a 20,000-hp hydraulic electrical plant, which will supply light and power to the city of Santiago and the surrounding districts. German capital will finance the project and German machinery will be used in the installation of the plant. One of the latest installations by Americans which is now under way is an interurban line from Talcahuano to Concepcion, the plans of which include local lines in both places. The road between the two places will be nine miles long and the electrical plant will have a capacity of about 1500 hp. Both passengers and freight will be transported when the line is completed. In passing, it might be well to note that Talcahuano is second in commercial importance only to Valparaiso. A Chilean company is financing the project, but the machinery is entirely American. The roads will be ready for operation within a few months. A somewhat smaller road which was opened last month and which is equipped with American electrical machinery, is the line from Santiago to San Bernardo. This road is also about nine miles in length and the electrical plant is operated by hydraulic power, with English suction gas producers as reserves. The work was done by native engineers and was backed by native capital. A combination of Chilean capitalists, which controls a large number of local electric lighting plants throughout the state, has in hand plans to install five other plants in the near future at various places. The combination which was entered into about four years ago controls at present the electrical plants at San Bernardo, Rancagua, San Fernando, Curico, Lo Bravo, Talca, Chillan, Los Angeles and Temuco. Unfavorable financial conditions have halted operations for a while, but the situation has improved so much of late that the work will be pushed forward in the near future. The new stations will all be operated by hydraulic power with no steam, oil or gas engines as reserves. The regions of the nitrate fields in the northern part of Chile seem to offer the best prospects for electrical development in the immediate future. There, as in other places, the high price of coal is a serious obstacle and the low pressure steam engine plants now in use are being rapidly replaced by electrical equipments with steam, oil or gas engines as reserves."

GROWING INDUSTRIAL ACTIVITY.—From various quarters come the reports and evidences of returning industrial activity. Plants in the Pittsburg district, which have been closed down or running on short time, are rapidly resuming operations in full. The Clark mills, of the Carnegie Steel Company, have started to work full time, with both day and night shifts, giving employment to 900 additional men. The seventy-two-inch mill of the Carnegie Steel Company, at Homestead, resumed last week in full, with day and night shifts. The Cannonsburg Steel & Iron Company, which has been idle for two months, has started full, as did the Standard Tin Plate Company, and the East Palestine Pottery Company, both of which have been idle for some time. At Detroit the American Car & Foundry Company put 5,000 men on full time, and the Cadillac Motor Car Company did the same for 2000 men. The Thomas Auto Company will resume on full time this week, and the Ford and Packard auto companies already are busy. The big paint companies, the Acme and the Detroit White Lead, are running on nearly full time with a full force. Berry Brothers' Varnish Company, Parke, Davis & Co. and the Frederick Stearns medicine manufacturing companies, employing thousands of men, are running full time. The Russell Wheel & Foundry Company has booked enough orders to last the winter out, and will resume operations in full next week. Reports of an optimistic nature come from Saginaw, Marshall, Charlotte, Holland, Pontiac and other places.

PLANT FOR IOWA.—It is stated that plans have been prepared for additions to the plant of the Spencer, Iowa, Municipal Light & Water Works. The city is in the market for one alternator of 120 kw, 60-cycle, three-phase, revolving field, 2300 volts, belt driven, about 550 r. p. m. with exciter and rheostat, and one alternator about 50 kw of the same type, of 2300 volts, belt driven to about 800 r. p. m., with exciter and rheostats. Bids will also be received on the same equipment with direct connection, engine running at about 250 r. p. m., for the belt driven equipment. A Corliss engine of about 70 hp will be considered, and for direct connection a high-speed engine of the same capacity. There will also be required one 150-hp open feed water heater, two boiler feed pumps, one with capacity of 1250 gals. and the other 3100 gals. per hour, the two pumps being preferably coupled, so that both can be driven together either by gear, belt or direct connection to motor or single cylinder steam engine. The purchasing committee has also under consideration the installation of a gas producer equipment of from 80 to 100 hp. The plant is managed by Mr. R. L. Taylor, and Mr. R. T. Turner is superintendent.

MOTORS FOR NECAXA.—Shipments of motors by the Westinghouse company are being made to the Necaxa station of the Mexican Light & Power Company, of Mexico City. The Mexican government is installing an extensive system of water works, which when finished will be among the finest in the world, but as yet the work is far from being completed. Water will be conducted to the city from springs 100 miles away through an 8-ft. conduit and will be pumped by electricity into a high-pressure reservoir. As the springs are but little above the city level, the water will be forced through the conduit by pumps driven by motors in four stations. The fifth pumping station forces the water into the reservoir. The electrical equipment of station No. 1 consists of two 1400-kva 3000-volt synchronous motors and nine 475-kw transformers Station No. 2 will be equipped with two 40-hp 200-volt motors. In station No. 3 there will be two 120-hp motors, No. 4 will contain two 125-hp motors, and No. 5 two 260-hp motors.

ZINC REDUCTION.—U. S. Consul L. Edwin Dudley, of Vancouver, sends the following note in regard to a new zinc reduction enterprise in British Columbia: "The Canada Zinc Company is making good progress with the completion of its plant, which should be finished and in operation by the beginning of next February. The plant is designed for electric reduction of zinc, the first of its kind on the continent, although a similar plant is working successfully in Sweden. At the present time much of the lead ore of the Slocan occurs with zinc, and a penalty is demanded by the smelters for zinc units when over 10 per cent. This frequently means that the lead mine cannot be operated because of the zinc penalty and because no values are obtainable for the zinc. The establishment of the Canada Zinc Works in Nelson means the opening up of many idle Slocan properties."

A POWER PLANT DISPUTE.—At St. Cloud, Minn., an action has been brought against the Soo Railway Company by the Pike Rapids Power Company to recover $800,000 damages. According to the claims the Pike Rapids Company owns a certain site for a dam on the Pike Rapids near Royalton, and has purchased and owns all the needed flowage rights, together with 35 acres of land on both sides of the river. It is alleged that the Soo Railway Company without the consent of the Pike Rapids Company has appropriated the said site and has constructed thereon a bridge to span the Mississippi. In addition the railway company is claimed to have trespassed on the land, and the power company claims that its property has become useless because of the construction of the bridge. It asks damages for the full amount of the loss.

THE IMPERIAL ELECTRIC COMPANY, of Akron, Ohio, has been organized with a capital stock of $180,000. It is reported that the new company will reorganize the Akron Electrical Company, as the first step taken by the promoters of the new corporation was to prepare for the purchase of the plant and equipment of that company. The plant, it is said, will be kept in operation steadily and as soon as possible the output will be increased. As is well known, motors and other electrical machinery are manufactured by the Akron Company. The incorporators of the new company are E. E. Andrews, R. E. Inskeep, William Weaver, W. C. Hall and A. C. Linzee.

THE WEEK IN COPPER.—A sharp advance in the price of copper metal, followed later by an equal drop, marked the week in the copper market. On Jan. 29 the United Metals Selling Company raised the price from 14⅛ to 14¼ cents a pound for electrolytic copper. This was the first time in months that a definite figure had been named by the trust, and it was thought that the advance indicated that the trust had once more taken the market in hand with a view to fixing the price for further advances later. The improvement of business conditions in the United States and the large foreign demand for copper seemed to justify the action of the trust in raising the price of metal. During the last four months Europe has been a heavy purchaser of copper. Following are the export figures:

September	17,157	tons
October	29,161	"
November	34,087	"
December	37,685	"
January (estimated)	28,869	"

Total for 1906, 205,460 tons.
Total for 1907, 228,708 tons.

The heavy foreign buying is for speculative purposes, and one for years in close touch with the copper situation expressed an opinion that the exportation might mean a sudden drop in price in the United States in the near future. "Whether we used foreign shipments of copper as the easiest way to raise money or whether the move is a purely speculative one on the part of the buyers, is a question whose answer we will learn shortly," he said. "If Europe was using copper at the rate the shipments indicate, the price of metal would go up in all markets. But the English jobbers are loaded up with hundreds of thousands of pounds of copper, which were bought in this country at prices considerably lower than we could purchase the metal, and it is more than likely that some one over there will get tired of carrying a heavy stock waiting for a copper market, and will liquidate at a sacrifice. Then the London market will drop and our market also, through sympathy." The advance in price by the trust was followed by a cut on the part of the independents, who dropped ⅛ off, making the price for electrolytic 13⅛, and it looked much like the situation last fall when the United Metals Selling Company "held the bag" for the independents, doggedly maintaining prices despite frequent cuts of the others. A further cut of ⅛ by the independents, however, swung the trust into line, and the market closed on Monday with prices as follows:

	Bid.	Asked.
Lake	13.50	13.75
Electrolytic	13.37½	13.62½
Castings	13.12½	13.37½

"I do not expect to see any marked change in the copper market for several months," said the purchasing agent for an electrical concern, which is among the great copper consumers in the country. "Prices should hold comparatively steady because there is nothing to start them in either direction. Raising the price of metal certainly would not encourage buyers, and I do not believe that if copper was offered in great quantities at 9 cents a pound, there would be any more buying than there is at present. The facts of the case are, that none of us have any ready money to tie up in large stocks." Inquiries among copper consumers show that there is no more buying at present than there was a week ago. Dealers are living from hand to mouth, "buying just enough metal to keep our heads above water," as one said. Houses which a year ago bought copper by the carload are now purchasing in 25,000 pound lots.

CANVASS OF BUSINESS CONDITIONS.—Replies from all over the United States to the head of one of the largest electrical supplies manufacturing houses in the country, who wrote to all his agents requesting them to give an expression of the business outlook in their immediate territory, show a healthy spirit of optimism among the electrical houses. Following is a brief summary of several of the letters received. They are selected with a view to giving the expression of feeling in the business world in diverse parts of the country.

Missouri.—A considerable increase in business is looked for within the next two months. The factories are resuming operations either fully or in part. Business is not what it should be, but is much improved as compared with the period immediately before the holidays. Business in the city of St. Louis shows a substantial increase in the last few weeks, and there is a marked improvement in the country sections.

Ohio.—The contractors are quite busy, but building operations have been impeded considerably by the financial conditions. Cincinnati and the vicinity seem to have suffered far less in the recent commercial crisis than many other sections.

Pittsburg.—The Electrical Union which went on a strike on Dec. 26 has not yet voted to return to work. Consequently electrical construction operations are practically at a standstill. In other respects the outlook is excellent.

Seattle, Wash.—Nearly all building has stopped, but the business men are confident in their assertions that the present depression is but temporary, and say that by spring Seattle and the vicinity will go ahead with the same energy as in the past.

Georgia.—The outlook is much more encouraging than at any time during the last two months. New construction work is being pushed ahead, and the general business tone is very optimistic.

Denver, Col.—Construction work has been hampered by the lack of ready money. If some way can be devised to relieve the currency stringency business should be in fine shape by summer.

PLANT FOR OSAKA, JAPAN.—First shipments for the new light and power plant at Osaka, Japan, are being made by Takata & Company. When the plant is completed, it will be the largest light and power station east of the Suez Canal. Osaka lies on the southern coast of the island of Nippon, about 350 miles from Tokio. With a population of more than a million, it ranks among the 16 largest cities in the world. Formerly the city was lighted largely by gas and by a few small power companies which have been merged into the new corporation which has been formed. The equipment for the new light and power plant consists of five 3000-kw Westinghouse steam-turbine outfits, 11,000 volts, 3-phase, 60-cycle, 1200-r. p. m. Each set is provided with a 37½-kw exciter, connected directly. The auxiliary machinery consists of two motor-generator exciter sets, 230 hp directly connected to a 150-kw exciter, 125 volts; also nine 100-kw single-phase 11,000-volt transformers and six 75-kw, single-phase, 11,000-volt transformers. There are four motor-generator sets for the sub-stations each of 15-hp. The motors are directly connected to 7½-kw, 125-volt generator. There have also been supplied a large main station switchboard and a secondary switchboard for each of the four sub-stations.

3000-HP. 20,000-VOLT PORTO RICO PLANT.—Work on the electric plant near the town of Comerio, Porto Rico, which was begun last spring by J. G. White & Company, is nearing completion. The plant is being built near the Comerio Falls which, with a head of 180 ft., will supply the necessary power. Its capacity will be 3000 wheel hp. The water-wheels are turbines of the Francis inflow type, built by the I. P. Morris Company. There are four in all, two on each penstock. The plant will supply power service and light for the city of San Juan and the immediate vicinity. It will also furnish current to operate the electric roads in San Juan, and the extension line to Caguas. San Juan is about thirty miles from Comerio, and the 20,000-volt current will be conducted by double transmission lines. The generators in the power-house are of the General Electric type. The work has been advanced by the Porto Rico Railroads Company, Ltd., and is financed by a group of Canadian capitalists.

PACIFIC COAST POWER.—Advices from Tacoma, Wash., state that, with a capital of $10,000,000, the Pacific Coast Power Company will develop 100,000 e. h. p. at Lake Tapps, 11 miles from Tacoma. The company has just been organized by Stone & Webster, of Boston. The present interurban will be extended north to British Columbia and south to Olympia, Gray's Harbor and perhaps Portland. The Lake Tapps power will be used in operating the gauge railway and for lighting and commercial purposes. Beginning at once, 50,000 hp will be developed, and the remainder within three years. The company has purchased all conflicting rights along White River and Lake Tapps. The White River will be carried by canals and flumes into Lake Tapps, situated on the shoulder of a mountain. Through steel pipes water will be dropped 500 ft. over the mountain side, driving Pelton wheels in the power houses below.

BUSINESS OPTIMISM.—J. B. Olson, of the Habirshaw Company, is inclined to take an optimistic view of financial and business conditions throughout the country. "It is the logical time for optimism," he said. "To be sure things are quiet now, but if prophets be prophets, and if we can place any reliance in indications and signs, we may believe in a speedy restoration of normal conditions. The bottom has been reached, the climax passed, and now we are on the rising grade. The upward tendency of the market, the encouraging bank statements, and the general tone of the business world, all point but one way, and that is upward."

GENERAL ELECTRIC PLANTS IN JAPAN.—The General Electric Company furnished to the Ugi River hydro-electric installation in Japan 18 water-cooled and 54 oil-cooled transformers, 81 single-phase induction feeder regulators, 149 switchboard panels, and a large quantity of lead-covered cable. It is furnishing the complete electrical equipment for a hydro-electric plant at Nagoya, Japan. There will be four three-phase 2500-kw generators, 12 water-cooled 1000-kw 60,000-volt transformers, and 9 water-cooled 60,000 to 11,000 volt 1350-kw transformers, and 9 11,000 to 3400 volt 1350-kw transformers. The transmission line will be 30 miles in length.

KELLOGG-AMERICAN BELL DEAL DECLARED ILLEGAL.—Judge Windes, on Feb. 1, rendered an opinion in the suit of Mr. Milo G. Kellogg, declaring it against public policy for one corporation to hold stock in another, and ordered that the controlling interest in the Kellogg Switchboard & Supply Company acquired by the American Telephone & Telegraph Company, amounting to 4400 shares, be sold back to the original owners, the price to be the same as that paid, with interest at 5 per cent. Meanwhile the court will exercise authority over the affairs of the Kellogg Company.

HUDSON COMPANY BONDS.—The banking firm of Harvey Fisk & Sons will immediately offer for sale an issue of 6 per cent notes of the Hudson Company, the sale of which will provide funds necessary to complete the building operations and equipment of the Hudson & Manhattan Railroad Company's system. The exact amount of issue has not yet been settled upon.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was quiet and irregular, bullish speculation having been restricted by the bank suspensions at New York and the government proceedings against the Union Pacific-Southern Pacific merger. At the close of the week there was a sharp break in prices. The market was little influenced by the fact that money continues to accumulate in the banks, and the lower interest rates. A leading feature throughout the week was the activity and strength of the bond list, and a very large and widespread investment demand was in evidence. The report of the United States Steel Corporation for the December quarter was not unfavorably received and, in fact, did not seem to create any particular bearishness on the Steel stocks. The continued appearance of heavy decreases in the earnings of railroad companies, and the reports from all parts of the country of slack traffic, also received attention. The local traction securities were also made prominent by a bullish movement in them, Interborough-Metropolitan being affected by vague talk of coming steps to reorganize that combination, while Brooklyn Rapid Transit was influenced by intimations of the probable resumption of dividend payments. The electric securities were quiet and weak, and prices generally receded. The curb market showed irregular price movements during the week, with early steadiness succeeded by general recessions. United Copper common sold down around 6, a new level. Following are the closing quotations of Feb. 3:

NEW YORK.

	Jan. 27	Feb. 3		Jan. 27	Feb. 3
Allis-Chalmers Co.......	6	6	Interborough Met. com.	5	7¾
Allis-Chalmers Co. pfd.	19	18	Interborough Met. pfd..	16	20⅛
Amalgamated Copper....	—	50⅞	Mackay Cos.	55	54
Am. Dist. Tel..........	30*	—	Mackay Cos. pfd.......	60	61
American Locomotive...	36⅝	37	Metropolitan St. Ry....	20	—
Amer. Locomotive pfd..	90	90	N. Y. & N. J. Tel......	101	100
American Tel. & Cable..	55		United States Steel com.	28¼	28
American Tel. & Tel...	107	106	United States Steel pfd.	92	92½
Brooklyn Rapid Transit.	45⅝	45½	Western Union Tel....	57½	54½
General Electric	119	119	Westinghouse com......	42	41½
Hudson River Tel.....	—	—	Westinghouse pfd......	75	—

BOSTON.

	Jan. 27	Feb. 3		Jan. 27	Feb. 3
American Tel. & Tel...	108¼	106¾	Mass. Elec. Ry. pfd....	48	47½
Cumberland Telephone..	—	108	Mexican Telephone.....	5½	1½
Edison Elec. Illum.....	210	209	New England Telep....	109	
General Electric	121	—	Western Tel. & Tel.....	—	61
Mass. Elec. Ry........	11½	11	West. Tel. & Tel. pfd..	—	62½

PHILADELPHIA.

	Jan. 27	Feb. 3		Jan. 27	Feb. 3
American Railways.....	43	43	Phila. Electric	6⅛	6
Elec. Co. of America...	8⅜	9	Phila. Rapid Transit....	16	16
Elec. Storage Battery...	29	28	Phila. Traction	88½	89
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Jan. 27	Feb. 3		Jan. 27	Feb. 3
Chicago City Ry.......	166	165	Metropolitan Elec. com.	18	18
Commonwealth-Edison ..	—	87	National Carbon........	55	55*
Chicago Subway	—	—	National Carbon pfd...	—	101
Chicago Tel. Co........	—	115			

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*Asked.

DIVIDENDS.—Directors of the J. G. Brill Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Feb. 1. They also declared a regular quarterly dividend of 1 per cent on the common, payable March 14. National Carbon Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Feb. 15. The quarterly dividend of 1¼ per cent on the American Telegraph & Cable Company is payable March 1. Directors of the American Graphophone Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Feb. 15. The Washington Water Power Company has paid its regular quarterly dividend of 1¾ per cent on the capital stock. The directors of the Susquehanna Railway, Light & Power Company have declared a regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 1. Directors of the Ohio Traction Company have declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable Feb. 1. Directors of the Chicago City Railway have declared an extra dividend of 2¼ per cent, payable Feb. 10. Directors of the Consolidated Gas Company have declared the regular quarterly dividend of 1 per cent, payable March 16.

STOCK ISSUE OF THE COLUMBUS (O.) EDISON LIGHT & POWER COMPANY.—A statement accompanying a notice for a special meeting of the stockholders of the Columbus Edison Light & Power Company states that a proposed increase of capital stock to be voted upon will be used to liquidate a debt to the Columbus Railway & Light Company, incurred through its making improvements, betterments and extensions to the plants and the systems. The aggregate of these expenditures is $466,289.44. Of the $100,000 preferred stock in the treasury, $61,300 received in cash from the sale and the remainder of the stock, $38,700, has been turned over to the Columbus Railway & Light Company. A price of 110 has been placed upon the unsold stock. The directors of the Edison Company will recommend the authorization of sufficient stock not only to take care of this debt, but to cover betterments and extensions that will be required in the future. A statement of the operation of the plants since they were taken over by the Columbus Railway & Light Company on June 30, 1903, also accompanies this notice.

MORE TELEGRAPHONE STOCK.—A circular is being sent out from a Wall Street office offering telegraphone stock at what is stated to be a reduced figure, coupled with the promise that money will be loaned to purchasers with the stock as collateral. Some months ago, as reported in these columns, the firm which formerly exploited the stock stated at the conclusion of a controversy with an agricultural journal, which had advised its readers against the purchase of the stock, that the entire issue of $5,000,000 had been disposed of and therefore it had no further interest in continuing the correspondence. Whether the stock now offered is a new issue or some of the former stock cannot be determined from the circular.

BELL TELEPHONE.—In a recent interview, President Vail, of the American Telephone & Telegraph Company, said that the coming annual report is such a good one that the company could easily pay 10 per cent on the stock if the directors desired it. He states further that the company will not need any new money for over a year at least, the appropriation for extensions and improvements for the current year already having been provided for. About $40,000,000 will be spent for betterments in this year, as compared with about $25,000,000 for the past 12 months.

INCREASE OF TELEPHONE CAPITAL.—The stockholders of the Southern New England Telephone Company have authorized the directors to issue at their discretion $2,000,000 in capital stock. This with $300,000 of new stock that has already been authorized by the stockholders but not yet issued will bring the capital stock of the company up to $10,000,000, the limit under the present authority of the Legislature.

MACKAY-BELL.—The report is denied that the Mackay Companies have disposed of part of their holdings of American Telephone & Telegraph stocks. On the contrary, they have added between 15,000 and 20,000 shares, it is said, during the past six months, making a total ownership of over 100,000 shares.

CONSOLIDATED GAS.—In the annual report just adopted, Mr. W. R. Addicks, the acting president, stated that the City of New York on Jan. 1 owed the company no less than $6,184,341 for gas and electricity supply, not including interest.

NORTH AMERICAN REPORT.—The annual report of the North American Company shows receipts of $7,962,185 and disbursements of $6,128,241, of which $5,392,346 was in dividends. On Dec. 31 there remained undivided profits of $1,996,613. During the year the company has sold to the Milwaukee Light, Heat & Traction Company the entire common capital stock of the Milwaukee Electric Railway & Light Company ($9,000,000 par value), and has received in payment therefor the capital stock and refunding and extension mortgage bonds of the Traction Company, the sale or exchange having been made in the belief that the future development of these properties can be more effectively provided for through the instrumentality of the Traction Company as the controlling company. In revaluing the assets of the company as of Dec. 31, 1907, the sum of $2,290,365 has been written off from its undivided profits. To the making of this revaluation, the board of directors have given their most careful consideration and the valuations assigned are believed to be conservative. During the year the Union Electric Light & Power Company has purchased all the assets, property and franchises of the Laclede Power Company, of St. Louis (including the Edison Electric Illuminating Company, of Carondelet, owned by the Laclede Power Company), which company owned a central electric generating station situated on the riverside adjoining the main station of the Union Company, having a rated capacity of 7000 kw, an extensive distributing system and an established business of about $500,000 a year. By the acquisition of this property, the Union Company will be enabled to avoid wasteful duplication of investment, especially in the development of its sub-station and distribution systems, and to reduce certain expenses of operation incident to competition. The increased efficiency of the combined system and the resulting economies in capital investment and operating expenses must tend to the advantage of the public, as well as of the company. The North American report comments favorably on the laws for supervision and regulation passed in the states where its various subsidiary properties are located.

TELEPHONY IN MEXICO.—Active competition has developed between American and Swedish capitalists in the telephone business in Mexico. The Mexican Telephone & Telegraph Company, a Bell concern, with headquarters at Boston, has been operating in the larger cities for several years under the Bell system, but did not hold an exclusive concession, and when the Ericsson Telephone Company, of Stockholm, Sweden, made application to install a local competing system in Mexico City, the Government granted it. The Ericssons are said to have invested over $2,000,000 in underground conduits and telephones, and now have in operation over 500 telephones. The exchange is equipped to accommodate 15,000 subscribers. The company is also extending to all the suburban towns in the federal district, and has installed exchanges at Tacu-Baya, Xochemilco, Guadalupe and Contreras. It has a long-distance line in operation between Toluca and Mexico City, about 50 miles, and has planned to cover the whole of Southern and Central Mexico. It holds concessions from the state governments of Vera Cruz and Pueblo, and work will be undertaken when plans in Mexico City are further advanced. The Mexican Telephone & Telegraph Company is also very active in expansion. It has two large exchanges in the central part of the city, local exchanges at Guadalupe, Popla, Tacu-Baya, Coyoacan and Tlalpam, all suburban towns, and will soon have a long-distance line between Mexico City and Pachuca. Mr. John Woessner, formerly American consular agent at Saltillo, is establishing a long-distance system in Northern Mexico, with Torreon as headquarters. It embraces Monterey, Saltillo, Torreon, Durango and a number of smaller towns.

BELLEVUE (O.) ELECTRIC LIGHT LITIGATION.—A. H. Smith has filed suit against the Bellevue Light & Power Company, the Bellevue Illuminating Company, John W. Moore and F. B. Carr, asking for a receiver to take charge of the Bellevue lighting plant and handle the income and profits. He alleges mismanagement on the part of the officers and directors. The petition states that the corporation was first organized as the Bellevue Light & Power Company, but that in 1903 John W. Moore secured control and managed it. It is alleged that large sums of money were spent in obtaining a second franchise. Further, the allegation is made that Moore was indebted to F. B. Carr and that the capital stock of the corporation was transferred to him. Carr then took charge of the business and, it is alleged, organized the Bellevue Illuminating Company, which move will result, he says, in defrauding the original bondholders. The petition asks that Carr be enjoined from disposing of the property. The suit is said to have been brought in the interests of all the bondholders.

WESTINGHOUSE LAMP COMPANY.—It is learned that the Westinghouse Lamp Company, manufacturers of incandescent electric lamps, and one of the constituent companies of the Westinghouse Electric & Manufacturing Company, have obtained the signatures of 99 per cent in amount of the creditors to the readjustment plan permitting a discharge of the receivership. The receivers have found the company's financial condition to be entirely sound, the assets being approximately five times as great as the liabilities. The formalities connected with the application to the court for a discharge of the receivers are now under way, and it is expected that the company will be returned to its shareholders by the first of March. The business of the company has continued without interruption during the receivership. The officials of the company are expecting to have the new plant at Bloomfield, N. J., in operation before the end of the summer. It will have a capacity of over 15,000,000 lamps per year.

PHILADELPHIA ELECTRIC.—The Philadelphia Electric Company has issued this announcement regarding the stock dividend and the cash assessment ordered by the directors: "Directors of the Philadelphia Electric Company have declared a stock dividend of $1 per share from the surplus of the company, payable March 2 to stock of record Feb. 20. The dividend will amount to $1,000,000, or 10 per cent of the paid-in capital of the company. The board also called an assessment of $3.50 per share, payable in installments of $2.25 and $1.25, on March 2 and June 1, respectively. The dividend declared may be applied upon the payment of the first installment of the assessment, so that stockholders will have to pay but $1.25 per share in cash on March 2. This is the first call made upon the stockholders for additional capital since April, 1904. Since that time large sums of money have been expended upon permanent improvements and extensions of the company's properties. The gross earnings for the year ended Dec. 31, 1907, are estimated at $4,950,000, against $4,503,878 in 1906 and $4,104,113 in 1905."

TELEPHONY IN NEW YORK STATE.—Active steps are being taken to unite all the operating independent telephone companies from the Hudson River to Buffalo, including a score or more under the United States Independent Telephone Company system. A committee of the company now has the matter in hand. The plan is the result of a meeting of United States telephone men and a committee representing the Consolidated Telephone Company, of Buffalo. It is understood that approval of the plan would obviate the necessity for the foreclosure sale of the United States company planned for Feb. 4. The proposition involves telephone properties in Rochester, Buffalo, Syracuse, Rome, Schenectady, Albany and possibly Utica.

WESTERN UNION STOCK.—It is stated that it has already been decided to pay the next quarterly Western Union Telegraph dividend of 1¼ per cent in stock, repeating the action taken in December. Western Union has outstanding, including the 1¼ per cent dividend recently paid in stock, a total of $98,587,025 stock, leaving a balance of $1,412,975 in the treasury, or only $195,950 more than would be required to pay the next dividend in stock. The reduction of the dividend rate might in reality help the stock, which is very cheap on the present basis.

MASSACHUSETTS ELECTRIC EARNINGS.—The statement of Massachusetts Electric for the quarter to Dec. 31, 1907, the first of the fiscal year, does not compare favorably with the figures of a year ago. Gross earnings were $1,780,074, an increase of $55,455; net was $459,411, a decrease of $26,401, and the balance for dividends was $22,975, a decrease of $52,545. Operating expenses showed a large increase. The showing for the current quarter, the least favorable of the fiscal year, promises to be better than usual, unless conditions change greatly.

CHICAGO TRACTION FUNDS.—With regard to the new funds required by the Chicago Railways Company, which is the rehabilitation of the various traction lines of that city, it was announced last week that N. W. Harris & Co. and the National City Bank have completed arrangements covering $12,000,000, as well as any "additional funds which may be necessary for the further improvement, betterment, extension and equipment of the property."

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

CALERA, ALA.—The local electric light plant owned by P. J. Jeminez has been purchased by F. Stein, who will improve the service.

SOLOMONSVILLE, ARIZ.—C. B. Jameson, of Kentucky, will install a power plant at either Safford or Thatcher and erect transmission lines to Solomonsville and Pima. He is at present negotiating with the towns of Safford, Thatcher and Pima for franchises to use the streets of those towns.

ARGENTA, ARK.—The overhead work on the lines of the Argenta Street Railway Company has been awarded to the Electric Construction Company, of Little Rock.

EUREKA SPRINGS, ARK.—The Interstate Hydro-Electric Light & Power Company, which is developing water power on the White River, is planning further developments, increasing the output of the plant to 5000 horse-power. The company proposes to furnish electricity for manufacturing, mining and other industrial purposes. W. D. Chesney, Rosedale Station, Kansas City, Kan., is secretary.

JUDSONIA, ARK.—A telephone company has been organized in this city with W. L. Gossett as president.

NEWPORT, ARK.—The City Council is prepared to receive bids for an electric light franchise.

ROGERS, ARK.—A movement has been started in this city for the establishment of a municipal electric light plant.

HANFORD, CAL.—The Board of Supervisors has granted a franchise to F. S. Granger to construct an electric railway.

OAKLAND, CAL.—E. H. Downer, of Pinole, representing the Great Western Power Company, has been granted a franchise by the Board of Supervisors of Alameda County to erect and maintain electric transmission lines over the county roads and highways. The company recently purchased an entire block of land in East Oakland, on which it will erect an auxiliary plant of from 20,000 to 30,000 horse-power. A site also has been purchased for a large sub-station in East Oakland.

OAKLAND, CAL.—The Home Telephone Company, of Alameda County, has applied to the Board of Supervisors for a franchise to extend its telephone system, which is operating in Oakland, throughout the county.

QUINCY, CAL.—The Quincy Electric Light Company is preparing to install a new plant.

SAN JOSE, CAL.—The City Council has awarded the contract for lighting the streets of the city to the United Gas & Electric Company for a term of five years. The company agrees to furnish energy for arc lamps with all-night service, moonlight schedule, for $3.50 per lamp per month; every night with all-night service for $6.30 each per month. The company also agrees to furnish electricity for commercial lamps at the rate of $2.50 per month per lamp until 1 a. m., moonlight schedule.

SAN BERNARDINO, CAL.—A. E. Poole is interested in a project for the development of water power in the San Bernardino forest for electrical purposes. The government has granted Mr. Poole a right of way two and one-half miles in length, and the plants will be erected within the watershed of the San Jacinto Mountains. One of the power plants will be erected at Palm Springs on the desert in Riverside County.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has decided to increase its capital stock from $500,000 to $5,000,000, the proceeds to be used to make important additions to its system.

HARTFORD, CONN.—The Railroad Commissioners have granted the petition of the New York, New Haven & Hartford Railroad Company for authority to take under condemnation proceedings land needed for the right of way for an electric road in the town of Middlebury. The property is needed in connection with an electric railway the company proposes to build from Waterbury to Middlebury, thence to Woodbury.

NEW BRITAIN, CONN.—The Connecticut Company has submitted a proposition to the Board of Public Works offering to furnish electric incandescent lamps in place of the Welsbach lamps now in use. The company offers to furnish 182 or more 25-cp incandescent lamps, in addition to the present lamps, at $20 per lamp per year for all-night service.

WASHINGTON, D. C.—Bids will be received until Feb. 15 by Elliott Woods, superintendent U. S. Capitol buildings and grounds, for electric conduit, etc., required in connection with the electrical equipment of the Senate office building.

WASHINGTON, D. C.—The contract for furnishing and installing the electric wiring for the new building for the National Museum has been awarded to the Lord Electric Company, of New York, N. Y., for $74,777. Bernard Green is superintendent of construction of the National Museum.

WASHINGTON, D. C.—The contract for the electrically driven pumps in connection with the irrigating work, known as the Garden City Project, at Deerfield, Kan., has been awarded by the Department of the Interior, U. S. Reclamation Service, to the Buffalo Forge Company, Buffalo, N. Y.

ST. PETERSBURG, FLA.—The telephone systems of Clearwater and Tarpon Springs have been purchased by A. P. Avery, Joseph Patton and H. B. Webster, which they will consolidate with the St. Petersburg system. Improvements and new lines are contemplated.

AUGUSTA, GA.—Bids will be received until Feb. 25 by the commanding officer of the Augusta arsenal for furnishing and delivering electric switchboard, motor generator sets, air compressor, metal working and wood working machines, some with motor drive, pneumatic hammer, electric and overhead cranes, fuel oil furnaces, testing machine, etc.

SAVANNAH, GA.—Announcement has been made that the Bell Telephone Company has purchased the plant and holdings of the Georgia Telephone Company. The City Council and State Railroad Commission will be asked to sanction the merger.

VIDALIA, GA.—The contract for the construction of the municipal electric light plant has been awarded to J. B. McCrary & Company, of Atlanta.

SPIRIT LAKE, IDA.—Plans are being made by the Idaho & Washington Northern Railroad Company for the construction of machine shops in this place. The machinery in the shops will be operated by electricity, generated in the company's plant, which will be erected primarily for the purpose of supplying energy for operating the planing mill of the Panhandle sawmill, now under construction. The plant will also furnish electrical energy for lighting the mill and the town of Spirit Lake.

GRANT PARK, ILL.—The City Council is reported to be contemplating installing a new street lighting system.

HAMPSHIRE, ILL.—The municipal electric light plant has been purchased by Louis Koth, who will operate it under the name of the Hampshire Electric Light Company. Mr. Koth contemplates building a new power house this spring and will install a new boiler and possibly an engine and other equipment.

DECKER, IND.—Plans are being prepared by B. von Schon, of Detroit, Mich., consulting engineer for the Hydro-Electric Company, of Vincennes, to develop the water power of the White River near this point. Eugene Rush is president of the company.

FAIRMONT, IND.—The Central Indiana Lighting Company, a company formed last year to take over the light plants of a number of Indiana cities, has secured the right-of-way for a high-tension transmission line to furnish Alexandria, Columbus, Fairmont and Jonesboro with electricity for lamps and motors. The price will be $20 each per year for 32-cp incandescent lamps.

MT. VERNON, IND.—The Common Council will receive bids until April 1 for lighting the streets of the city with electricity for a term of ten years, beginning July 1, 1909, the street lighting system to consist of 85 arc lamps of 2000 cp each. A franchise for commercial and residence lighting for 11 years will be included with the contract for street lighting. Henry Kling is city clerk.

NOBLESVILLE, IND.—The water power plant which was partially built near this place in 1904 is to be completed this year in accordance with revised plans being prepared by B. von Schon, of Detroit, Mich., consulting engineer. The plant will supply electrical energy in Noblesville.

SPENCER, IND.—E. R. Bladen, receiver, is asking for bids for all the property, including poles, wiring system and franchise, of the Spencer Electric Light Company. Bids will be opened Feb. 21.

MILLER, IND.—The Town Board has granted a franchise to T. E. Bell, of Hammond, for an electric light and gas plant for a term of 25 years.

VERMILLION, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has taken a contract to light the town. G. F. Grover, manager of the company, announces that improvements will be made on the local lines in Terre Haute this year, the cost of which is estimated at $75,000.

VINCENNES, IND.—The Vincennes Traction & Light Company contemplates extensive additions and improvements to its plant, including the enlargement of the power house and extension of service to a new factory district. The company has authorized an issue of $100,000 in capital stock.

FORT DES MOINES, IA.—Bids will be received until Feb. 24 for furnishing and installing electric wiring, electric light fixtures, etc., complete, in one double set captain's quarters and two double sets lieutenant's quarters to be constructed at Fort Des Moines. Further information furnished on application to Captain John J. Boniface, constructing quartermaster.

LEON, IA.—The Decatur County Mutual Telephone Company is making arrangements to remodel and improve the local exchange which it recently purchased.

PERRY, IA.—The Hawkeye Telephone Company is contemplating the erection of an exchange building, the cost of which is estimated at $20,000.

SHEFFIELD, IA.—The City Council is reported to be considering the question of establishing a municipal electric light plant.

BARBOURSVILLE, KY.—It is reported that the Cumberland Ice & Beverage Company has purchased the plant of the Barboursville Electric Light Company.

MOREHEAD, KY.—The City Council on Jan. 27 awarded the contract for the construction of an electric light plant, the equipment of which includes a 480-hp engine, 50-kw, single-phase generator, 80-hp boiler, etc. The plant will cost about $5,000. The Reliance Engineering Company, of Cleveland, Ohio, has charge of the construction of the plant.

OAKLAND, KY.—The City Council has passed a resolution revoking the permit and ordering the Cumberland Telephone Company to vacate the streets and alleys of the city. It is understood that the town wants the company to pay $400 for a new franchise.

ATHENS, LA.—The Athens Progressive League is endeavoring to secure the installation of an electric light system in the town. E. A. Watson is president of the league.

ASHLAND, ME.—A movement is on foot to have the town lighted by electricity to be furnished by the plant at Aroostook Falls.

BOSTON, MASS.—A bill has been filed petitioning the Legislature to authorize the construction of a 12-ft. dam across the Connecticut River at Gill, and the incorporation of the French King Rapids Power Company, organized for the purpose of erecting an electric power plant at that place to distribute electrical energy in Worcester County and the towns of Irving, Warwick, Gill and Northfield in Franklin County. The petitioners named are: Philip Young, Henry I. Harriman and Joseph O. Proctor, Jr.

BROOKLINE, MASS.—The citizens have voted to authorize the committee on municipal lighting to secure expert assistance to be used in completing its investigation, and to appropriate $2,000 to pay for the same. It was also voted to authorize the Selectmen, if they deem expedient, to appear before the Board of Gas and Electric Light Commissioners for the purpose of obtaining reduction in the prices for electricity furnished in the town by the Boston Consolidated Gas Company.

WESTON, MASS.—The Weston Electric Light & Water Company is extending its transmission lines to Stony Brook to furnish electricity for lamps.

WHITMAN, MASS.—The local electric light plant has been closed down and electrical energy for operating the local system is transmitted from the new plant just completed at East Bridgewater by the Stone & Webster Company.

MARQUETTE, MICH.—C. W. Humphrey, of Chicago, Ill., has been secured to make an examination of the municipal electric light plant, with a view of making a number of changes.

MIDLAND, MICH.—Plans and specifications are being prepared by B. von Schon, of Detroit, Mich., consulting engineer, to develop the water power of the Chippewa River near this place.

NILES, MICH.—The Indiana & Michigan Electric Company, of South Bend, Ind., has been granted a franchise by the City Council permitting the company to furnish electricity to manufacturing and other establishments in this city. The Council refused the company a franchise some time ago, but recently asked the company to renew its application. The grant is for 30 years and permits the company to furnish electricity for lamps only upon the consent of the Council, which is done to protect the municipal lighting plant.

PELLSTON, MICH.—The Pellston Light & Power Company will let contracts for the following equipment: One 200-kw alternating current generator direct connected to a water wheel; galvanized iron sheet piling, construction of cement dam and 20 miles of 25,000-volt transmission line to be used in connection with the line now in operation. The plant is situated on the Escanaba River. F. E. Hatch is vice-president and manager.

EVELETH, MINN.—A committee has been appointed by the City Council to investigate the question of establishing a municipal electric light plant. It is proposed to install engines, boilers and electrical machinery in the water-power plant to supply electricity to light the city. At present the city is provided with electricity for lighting by a private corporation, which is said to have a contract for three years, which certain factions assert can be annulled.

JACKSON, MINN.—Bids will be received until March 4 by the Board of County Commissioners, at the office of P. D. Kellar Company, auditor, for installing electric light fixtures in the new court house, the cost not to exceed $1,600.

ST. PAUL, MINN.—Edward G. Krahmer, county auditor, writes that the contract for heating and lighting the county jail and furnishing energy for operating the elevators has been awarded to the St. Paul Gas & Light Company. The contract is for three years at $3,780 per year.

GOLDFIELD, NEV.—The Nevada-California Power Company is erecting a duplicate transmission line from Bishop to Goldfield, thus insuring a continuous service and greatly increasing the supply of electricity furnished in this place and Tonopah. It is expected to have the line completed within 60 days.

PARK RIDGE, N. J.—Bids will be received until Feb. 17 for improvements to the municipal electric light plant, including the rebuilding of dyke well, re-enforcing and raising height of dam, building concrete spillway, grading and filling around storage reservoir, and installing a 30-kw, gasoline-driven, direct-connected unit. George T. Hanchett, 237 Fulton Street, New York, N. Y., is the engineer.

VINELAND, N. J.—The State Legislature has reported favorably on the petition asking for an appropriation of $20,000 for a new heating and lighting plant for the New Jersey Home for Disabled Soldiers at Vineland.

AVOCA, N. Y.—The Village Board has granted a 20-year franchise to the Bath Electric Light & Power Company to furnish this village with electricity for lamps and motors. E. J. G. Tower, general manager of the company, states that the company will furnish electricity for lamps for commercial and private use at a price not to exceed 10 cents per kilowatt hour, and for arc lamps for street lighting with an all-night service at a cost not to exceed $62.50 per lamp per year.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railroad Company has awarded the contract for the construction of the extension to its power house at Main Street and Gowanus Canal. The contract for the electrical equipment has been awarded to the General Electric Company, of Schenectady, and for boilers to the Babcock & Wilcox Company, New York. J. L. Heins is general manager of the railway company.

CANANDAIGUA, N. Y.—A new dynamo has been installed in the Littleville plant of the Ontario Light & Traction Company, which will improve the lighting service.

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 29, for one alternating-current electric elevator complete, two alternating-current electric elevator machines and three alternating-current belted motors, for the navy yard, New York, N. Y. Plans and specifications can be seen at the bureau or will be furnished by the commandant of the New York Navy Yard. R. C. Hollyday is chief of bureau.

SCHAGHTICOKE, N. Y.—The Schaghticoke Electric Company has purchased the property of the Schaghticoke woolen mills at this place, which were sold at auction Jan. 24, for $30,000. The company is developing the water power in the Hoosick River at Buck's Neck, near Schaghticoke, and will utilize the water power of the Schaghticoke mills. George E. Green, of Hoosick Falls, is president of the electric company.

SOUTHFIELDS, N. Y.—A water power is being developed on the Nombashaw near the Sterling Furnace. A concrete dam is now being constructed and the power plant will be located in the old furnace. The electrical energy will be utilized in Southfields. H. von Schon, of Detroit, Mich., has charge of the construction work.

WEST POINT, N. Y.—Bids will be received until Feb. 20 by the quartermaster, West Point, for furnishing and installing electric light fixtures in gun shed, artillery stable, cavalry stable, artillery barracks and cavalry barracks at West Point.

HIGH SHOALS, N. C.—The High Shoals Company has contracted with the Southern Power Company for electrical energy to supplement that generated by the local plant, which will enable the company to operate additional machinery.

NEWTON, N. C.—The Southern Power Company, of Charlotte, has just completed its transmission lines to this place. A sub-station has been built, and energy will be supplied to the Newton Hosiery Mills, the Catawba Cotton Mills and other industrial plants. The Ridgeway mills, when completed, will also use electrical energy.

RALEIGH, N. C.—The Agricultural and Mechanical College is installing an electric plant to furnish electricity for lamps, heat and motors to the various college buildings.

ROCKINGHAM, N. C.—The recent heavy rains completely destroyed the coffer dam at the electric power development at Bluitt's Falls, on the Great Peedee River, near Rockingham. The damage is estimated at approximately $25,000.

SALISBURY, N. C.—The Whitney Reduction Company is extending its transmission lines in all directions from this city and will complete the line to High Point, 40 miles distant, by July 1, building one direct line, and one via Salisbury, Lexington and Thomasville, in order to insure a continuous service.

CINCINNATI, OHIO.—It is reported that the plan to use the banks of the Miami and Erie Canal for an electric railway may be revived. The Supreme Court in Columbus has affirmed the decision of the lower court in the matter of enjoining the State Board of Public Works from removing the equipment of the Miami & Erie Canal Transportation Company from the banks.

DORSET, OHIO.—The capital stock of the Dorset Telephone Company has been increased from $3,000 to $10,000.

WARREN, OHIO.—The Peerless Electric Company has secured control of two dams at Newton Falls and one at Leavittsburg, on the Mahoning River, and one at Parkman, on the Grand River, which will have an aggregate of 1900 hp. It is the intention of the company to build a large generating plant which will have twice the output of its present plant in the city. The company has increased its capital stock from $500,000 to $700,000.

TOLEDO, OHIO.—An ordinance has been introduced in the City Council providing for the repeal of the heating and power franchise granted the People's Heat & Power Company, of which Homer T. Yaryan was the head. Mr. Yaryan claims that the old Council promised him an electric light franchise and failed to pass it before the members went out of office. The new Council is not bound by this promise, and, since he would not endeavor to operate without a lighting franchise, the matter will be dropped.

YOUNGSTOWN, OHIO.—Plans have been prepared by the Central Union Telephone Company for the complete reconstruction of its system in this city. The improvements contemplated include the placing of its wires underground in the business portion of the city and rebuilding the overhead lines with copper wire and replacing the old instruments with new equipment.

GOLD HILL, ORE.—The Gold Hill Canal Company will make extensive improvements upon its plant as soon as weather conditions will permit. E. C. Thompson is general manager.

SALEM, ORE.—Attorney John H. McNary has filed in behalf of the Portland, Eugene & Eastern Railway Company a notice of appropriation of 2000 cu. ft. of water per second from the McKenzie River, in Lane County.

JOHNSTOWN, PA.—Plans are being made by the Johnstown Passenger Railway Company for extensive improvements to its system involving an expenditure of about $100,000, of which $62,000 will be used to construct a new system in the Morrellville district.

PITTSBURG, PA.—Mayor George W. Guthrie, in his annual message, recommends placing the overhead wires in underground conduits, particularly in the business section of the city.

PITTSBURG, PA.—Announcement has been made by Mayor George W. Guthrie that plans will be changed for the proposed power plant at the city poor farm at Marshalsea and the contract readvertised.

ROYER, PA.—The Morrison Cove Electric Light & Power Company contemplates installing a hydro-electric plant, bids for which will probably be received in March. The plant will furnish electricity for lamps in Martinsburg and Williamsburg, and also for motors to operate the crushers at Royer and vicinity. Complete equipment for the plant and about 12 miles of transmission line will be required; also 25 arc lamps and from 1800 to 2500 16-cp incandescent lamps will be needed. The cost of the plant is estimated at $45,000. Frank W. Moore, of Indiana, is engineer.

SUNBURY, PA.—The Middlecreek Electric Company has decided to furnish electricity in Sunbury for lighting, and has placed contracts for enlarging the Northumberland plant and for the installation of new machinery. These improvements will give the plant sufficient output to furnish electrical energy for lighting in Northumberland and Selinsgrove as well as Sunbury, and also for operating the electric railway. The company is erecting transmission lines in Sunbury and expects to be ready for business in a short time.

EBENEZER, TENN.—Arrangements are being made by O. Knudson to erect an electric plant to furnish electrical energy to operate his mill and residence, and will also furnish electricity to the town of Concord, two miles distant. The contract for wiring has been let to the Acme Electric Company, of Knoxville.

NASHVILLE, TENN.—The improvement and expenditure committee of the City Council has acted on the measures appropriating $100,000 for enlarging the municipal electric light plant of this city. It is provided that the Board of Public Works, with the assistance of the Building Inspector, shall prepare plans for the addition to the plant.

SEVIERVILLE, TENN.—Messrs. McMahon & Walker will shortly establish an electric light plant here.

SWEETWATER, TENN.—The Telephone & Improvement Company is contemplating the purchase of a generator and other electrical machinery for its electric plant.

DENISON, TEX.—The Denison Electric Lamp & Power Company contemplates installing an electric driven triplex pump. N. J. Wheeler is manager.

FORT WORTH, TEX.—Work will soon commence on the improvements to the power plant of the Northern Texas Traction Company in Handley. A new 1500-hp engine, two boilers and a 1125-kw generator, together with the necessary pumps, condensers, etc., will be installed. The work will involve an expenditure of about $150,000.

HOUSTON, TEX.—The Woods Electric Company, of Houston, has changed its name to the Tel-Electric Company.

SHERMAN, TEX.—The North Texas Telephone Company, of this place, has increased its capital stock from $40,000 to $52,000.

MONTPELIER, VT.—The City Council has granted a franchise to Almon & Moody to erect transmission lines for the distribution of electricity within the city limits. The company owns an electrical plant on the Mad River in Moretown.

BARNET, VT.—The local electric light plant was recently destroyed by fire.

ARVONIA, VA.—D. W. Pierce, of Arvonia, writes that he will receive bids until Feb. 20 for the construction of an electric power plant. The cost of the plant is estimated at $175,000.

MANCHESTER, VA.—The State Legislature has passed a bill authorizing the town to enlarge the municipal electric light plant.

CHEHALIS, WASH.—The Chehalis & Centralia Railway & Power Company has purchased the power plant, cars, road, etc., of a defunct railway which now connects two small cities near Los Angeles, Cal., and will move the entire plant and equipment to Chehalis to be used in connection with its line between Chehalis and Centralia.

PROSSER, WASH.—Arrangements are being made by the Prosser Traction Company to begin construction work in the spring. The company has secured a site for a power plant on the Yakima River, a short distance below Prosser.

SEATTLE, WASH.—The Pacific Coast Power Company, allied with the Seattle Electric Company, has purchased the lands held on the White River by the Seattle-Tacoma Power Company. According to a statement made by Jacob Furth, president of the Seattle Electric Company, the Pacific Coast Company will immediately develop 100,000 horse-power at a plant to be erected on the White River, which will be transmitted to Seattle and Tacoma.

SEATTLE, WASH.—Bids will be received until Feb. 15 by C. B. Bagley, secretary of the Board of Public Works, for the construction of a system of cluster lamps on Third Avenue, the cost of which is estimated at $51,200.

SPOKANE, WASH.—The new steam power plant of the Washington Water Power Company, which has been in operation for a short time, has been closed down, as the extra energy is not needed at this time. The company's new high tension line to the Cœur d'Alenes is practically completed.

BARRON, WIS.—The Council is contemplating purchasing additional machinery for the municipal electric light plant.

BLOOMER, WIS.—The capital stock of the Bloomer Telephone Company has been increased from $1,500 to $3,000.

JANESVILLE, WIS.—The County Board has adopted a resolution instructing the purchasing committee to look into the advisability and secure estimates of the cost of installing a lighting plant in the jail building to be owned by the county.

LA CROSSE, WIS.—The La Crosse Interurban Telephone Company has purchased the lines of the Vernon County Telephone Company and has consolidated the two systems. The Vernon County lines consist of about 600 telephones with exchanges at Viola. The headquarters of the company will be in La Crosse.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has decided to make extensive improvements and extensions to its system during the ensuing year, which will involve an expenditure of $750,000. It is planned to extend the toll lines in the northern part of the state, adding circuits to existing lines and making improvements wherever needed.

MILWAUKEE, WIS.—The City Council has adopted a resolution to give the people another opportunity at the election next spring to vote on the question of building a municipal electric light plant.

MONROE, WIS.—The special committee appointed by the City Council to investigate the question of lighting the town and to make a new contract with the Monroe Electric Light & Power Company recommends that the city do its own street lighting unless better terms can be made with the electric company.

WAUSAU, WIS.—The directors of the Wausau Street Railway Company are negotiating for the plant and holdings of the Wausau Electric Company and are also contemplating the purchase of the water power of Little Bull Falls at Mosine. The Wausau Street Railway Company is planning to get possession of the principal water powers in this section of the Wisconsin River valley with the ultimate purpose of generating and distributing electricity throughout this section of the valley.

ALBERNI, B. C., CAN.—Application will be made to the Legislative Assembly at its next session for an act to incorporate a company with power to generate, transmit and distribute electricity within a radius of 12 miles of the town of Alberni, Vancouver Island; also the right to construct and operate tramways, railway and telephone systems within the said radius.

NEW WESTMINSTER, B. C., CAN.—G. H. Halse, superintendent of the British Columbia Telephone Company, states the telephone system in this city will be placed in conduits and the switchboard capacity increased to 3000.

HONOLULU, HAWAII.—James A. Coke, of Maui, is in Washington, D. C., looking after a franchise for the installation of an electric plant on Maui. The proposed power plant will supply electricity to the towns of Lahaina and Kahuli, also to several plantations, for motors.

EUGENIA, ONT. The tunnel for the water power development of the Georgian Bay Water Power Company at Eugenia has been completed and the dam and power house will be built this year. Considerable 54-in steel plate pipe will be required for this work. The electrical energy will be transmitted to Owen Sound, 35 miles distant. H. von Schon, of Detroit, Mich., has charge of the construction of the plant.

HAMILTON, ONT.—A special committee has been appointed by the City Council to consider the form of contract, the price of electrical energy, etc., in connection with the proposed municipal electric light plant also the appointment of an electrical engineer to prepare specifications to the plant.

MONTREAL, QUE., CAN.—The Trustees of McGill University are considering the question of installing an independent light, heat and power plant at the university.

SHERBROOKE, QUE.—At the annual meeting of the Sherbrooke Power, Light & Heat Company held recently, it was voted to sell the company's plant and business to the city.

VERA CRUZ.—The local government has asked for bids on electrical installation for all public buildings. It is planned to install electric lamps in the near future.

New Industrial Companies.

THE TURBINE MOTOR COMPANY, of Babylon, N. Y., has been incorporated, with a capital stock of $12,000, by Paul Keanse, Joseph Covert and David Sandman, of Babylon, N. Y.

THE ENTERPRISE ELECTRIC COMPANY, of Warren, Ohio, has been incorporated, with a capital stock of $25,000, by F. P. McBerty, C. B. McCurdy, N. H. Cobb, J. C. Ewalt and R. A. Cobb.

THE CLEVELAND SPARK PLUG COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $10,000, by H. L. Smith, J. D. Chambers, J. R. McQuigg, C. B. Riley and Louis E. Hatch.

THE ELECTRIC REALTY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,500 by William S. Paine, Louis H. Guterman and Herman Hare, of New York, N. Y.

GOOD & CRAFT, INC., of Baltimore, Md., has been incorporated, with a capital stock of $8,000, to manufacture gas and electric fixtures. The incorporators are Abraham J. Good, Elizabeth H. Good, Charles L. W. Craft and others.

THE N. S. U. MOTOR COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000. The directors are Gottleb Banzhaf, Neckarsulm, Germany; Eugene Keiherer and Carl L. Schurz, of New York, N. Y.

THE HERALD ELECTRIC COMPANY, of St. Louis, Mo., has been incorporated, with a capital stock of $2,000, by Clement G. Harrington, Anna L. Jacobs and Richard S. McCully. The company proposes to do a general electrical business.

THE MARKO STORAGE BATTERY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000. The directors are Paul M. Marko, Herman Mattfield, of Brooklyn; Charles Standt, of West Hoboken, N. J.

THE GEORGE V. LYONS MOTOR COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State, with a capital stock of $3,000. The directors are Marie A. Lyons, George V. Lyons and Andrew G. Dickson, of New York, N. Y.

THE FEDERAL SIGNAL COMPANY, of Colonie, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $2,000,000. The directors are: Frederic Pruyn, of Londonville; Augustus Veghte, of Albany, and James H. Caldwell, of Troy.

THE QUEEN CITY ELECTRIC COMPANY, of Sedalia, Mo., has been incorporated with a capital stock of $2,000 for the purpose of establishing an electrical engineering and contracting business. James A. Capen is president and W. F. Potter secretary and treasurer.

THE STANDARD AUTOMATIC ELECTRIC COMPRESSING COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $100,000. The directors are Ellis F. Browne, president; Frederick L. Hopkins, treasurer. The company proposes to deal in machinery, etc.

THE HOLLAND ELECTRIC PUMP & ENGINEERING COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State, with a capital stock of $60,000. The directors are Eugene Higgins, Leonard L. Wetmore, Englewood, and Frank W. Wetmore, of Newark, N. J.

THE GRAVITY LOCKOUT COMPANY, of Toledo, Ohio, has been incorporated, with a capital stock of $50,000, for the purpose of manufacturing a new patented telephone device for use on party lines. George A. Ford is president of the company, Floyd Oull secretary and J. V. Newton treasurer.

THE BORUM & WHITING COMPANY, of New Orleans, La., has been incorporated with a capital stock of $15,000 for the purpose of dealing in electrical fittings, etc. The officers of the company are: W. G. Borum, president; Ruy D. Whiting, vice-president, and Walter L. Parker, secretary and treasurer.

THE STEWART ENGINEERING COMPANY, of Newark, N. J., has filed articles of incorporation with the Secretary of State. The capital stock of the company is placed at $25,000 and the incorporators are Sheelman T. Stewart, Willard Demsey and Arthur M. Woodford. The company proposes to do an electrical and mechanical engineering business.

Company Elections.

SPRINGDALE, ARK.—At the annual meeting of the North Arkansas Telephone Company the following named officers were elected: D. Christian, president; Benjamin Greer, vice-president; James Steele, secretary, and Edgar Masoner, treasurer.

MILFORD, IND.—At the annual meeting of the Royal Telephone Company the following named officers were elected: J. B. Neff, president; L. M. Neher, secretary; C. A. Sparkling, treasurer.

SWEETSER, IND.—At the annual meeting of the Sweetser Rural Telephone Company the following named officers were elected: William Glessener, president; Riley O. Malott, secretary; Benjamin Shields, treasurer, and Tilden Chandler, manager.

AUGUSTA, ME.—At the annual meeting of the Kennebec Light & Heat Company the following named officers were elected: George F. West, president; Samuel Cony, treasurer and clerk, and William H. Williams, superintendent.

WINONA, MINN.—At the annual meeting of the Homer Ridge Telephone Company the following named officers were elected: O. S. Bundy, president; C. W. Merritt, vice-president; J. H. Johnson, secretary and treasurer.

ST. LOUIS, MO.—At the annual meeting of the Union Electric Light & Power Company the present board of directors was re-elected, as follows: John I. Beggs, Adolphus Busch, August Gehner, Breckenridge Jones, Charles F. Pfister, W. N. V. Powelson, G. R. Sheldon, Julius S. Walsh and C. W. Wetmore.

ST. LOUIS, MO.—At the annual meeting of the Laclede Gas Light Company John I. Beggs was re-elected president, August Gehner was elected vice-president to succeed Breckenridge Jones, and P. E. Bisland, of New York City, was also elected vice-president. The other officers are C. L. Holman, secretary; W. S. Dodd, treasurer; W. F. Kroyer, of New York, N. Y., assistant secretary, and E. B. Pray, of New York, N. Y., assistant treasurer.

BUFFALO, N. Y.—At the annual meeting of the Frontier Telephone Company all the present officers were elected with the exception of Secretary Byron L. Moore. G. Barrett Rich, Jr., was elected to succeed Mr. Moore.

PATCHOGUE, N. Y.—At the annual meeting of the Suffolk County Telephone Company the following named officers were elected: H. Clay Losee, president; Fremont Hammond, vice-president; Daniel Chichester, secretary, and John E. Ketcham, treasurer.

BLOOMVILLE, OHIO.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: Fred Hutchinson, of Clyde, president; I. C. Gray, of Bloomville, vice-president; C. C. Bronson, of Clyde, secretary; F. S. Bronson, of Bloomville, treasurer and general manager.

CLEVELAND, OHIO.—At the annual meeting of the Cleveland Electric Railway Company the following named officers were elected: Horace E. Andrews, president; J. J. Stanley and C. F. Emery, vice-presidents; H. J. Davis, secretary, and George S. Russell, treasurer.

CRESTLINE, OHIO.—At the annual meeting of the Crestline Telephone Company the following named officers were elected: Jacob Babst, president; F. A. Knapp, vice-president and general manager; Ralph Wolfram, secretary; A. H. Kinsey, treasurer.

NEWARK, OHIO.—At the annual meeting of the Newark Independent Telephone Company the following named officers were elected: Harry Swisher, president; John C. Brennan, vice-president; C. H. Spencer, secretary, and Edward Kihler, treasurer.

JOHNSTOWN, PA.—At the annual meeting of the Northern Cambria Street Railway Company the following named officers were elected: W. H. Denlinger, president; James H. Allport, secretary; H. F. Bigler, treasurer.

MARION CENTRE, PA.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: M. T. Steele, president; H. L. McCullough, vice-president; S. J. McManus, secretary.

SHAMOKIN, PA.—At the annual meeting of the Shamokin & Edgewood Electric Railway Company the following named officers were elected: Monroe H. Kulp, president and general manager; G. Gilbert Kulp, vice-president; M. H. Barr, secretary and treasurer.

YORK, PA.—At the annual meeting of the York Railways Company, the York & Maryland Line Street Railway Company, the York Steam Heat Company, the York Suburban Land Company, the Westinghouse Electric Light, Heat & Power Company and the Edison Electric Light Company, W. F. Bay Stewart was chosen president and the following directors were elected: George H. Frazier, of Philadelphia; John C. Dawson, of Philadelphia; Thomas Newall, of Philadelphia; J. C. Schmidt and Francis Farquhar, both of York.

MILBANK, S. D.—At the annual meeting of the Grant County Telephone Company the following named officers were elected: F. B. Roberts, president; John Heffernan, vice-president; J. C. Reeve, secretary, and John Nord, treasurer.

MARTIN, TENN.—At the annual meeting of the Weakley County Telephone Company the following named officers were elected: S. H. Hall, president; T. M. Ryan, vice-president; G. W. Hall, secretary and treasurer.

PARKERSBURG, W. VA.—At the annual meeting of the Parkersburg, Marietta & Interurban Railway Company the following named officers were elected: C. H. Shattuck, president; W. W. Van Winkle, secretary; C. C. Martin, first vice-president; W. W. Mills, second vice-president; Thomas Logan, treasurer.

New Incorporations.

YUMA, ARIZ.—A. H. Womble states that if the government will grant water-power concessions on the Colorado River to an English syndicate he will install a 1000-hp power plant on the river and transmit the energy to Kofa to operate a 4000-ton mill.

GRASS VALLEY, CAL.—The North Yuba Electric Light & Power Company has been incorporated, with a capital stock of $1,000,000, by S. B. Crane, W. B. Barstow and Earl Talbot.

HANFORD, CAL.—Articles of incorporation have been filed for the Hanford & Lemoore Interurban Railway Company. The capital stock of the company is $1,000,000 and the officers are: A. V. Taylor, president; F. S. Granger, vice-president and manager; W. J. M. Cox, secretary, and Judd Smith, treasurer.

UKIAH CITY, CAL.—The Clear Lake Telephone & Telegraph Company has been incorporated, with a capital stock of $50,000, by H. S. Johnson, A. H. Spurr, L. J. Shuman, M. S. Sayre and F. L. Wright.

WILMINGTON, DEL.—The West Chester & Wilmington Electric Railway Company has been chartered with a capital stock of $200,000. The capital stock of the Pennsylvania end of the line is $300,000 and a charter for that company was granted some time ago. The incorporators of the Delaware company are: Thomas E. O'Connell, C. P. Faucett, Dr. F. Harvey, Isaac C. Elliott and Howard D. Ross. It is said that the company will begin operations on the Wilmington end of the line as soon as the weather permits. It is understood that the power house will be erected at Brandywine Summit.

CŒUR D'ALENE, IDAHO.—The Rimrock Water, Light & Power Company has been incorporated with a capital stock of $150,000. The officers of the company are: George W. Mason, president and general manager; P. J. Scallon, first vice-president; C. W. Craik, second vice-president; W. W. Leeper, secretary, and S. G. Sargent, treasurer.

WEST LEBANON, IND.—The Farmers & Merchants' Co-operative Telephone Company has incorporated, with a capital stock of $30,000. J. H. Brener, W. M. White and George W. Day are the directors.

JACKSON, MISS.—The Mississippi Home Telephone Company has been incorporated, with a capital stock of $250,000. The incorporators are Geo. C. Graeber, Shamokin, Pa.; W. L. Heifenstein, Shamokin, Pa.; N. D. Smith, Meridian, Miss.; J. O. Spoots, of Jackson, Miss., and C. M. Williamson, of Jackson, Miss.

FERGUSON, MO.—The Ferguson Electric Light & Supply Company has been organized, with a capital stock of $15,000. J. Goode Cabanne is interested. The company will be co-operative, all the stock being sold to residents of Ferguson, and the rate charged will be 10 cents per kw-hour. The price now charged for electric service is 15 cents per kw-hour.

LIBERTY, N. C.—The Liberty Telephone Company has been chartered, with a capital stock of $25,000, by J. L. Hardin and others.

SEWARD, N. C.—The Doesler Telephone Company, Forsyth County, N. C., has been chartered, with a capital stock of $9,000.

PENDLETON, ORE.—Articles of incorporation have been filed with the Secretary of State for the Cottage Grove Electric Company with a capital stock of $50,000, by John H. McNary, E. N. Hall and A. Welch.

AKRON, OHIO.—The Imperial Electric Company, of this city, has been incorporated, with a capital stock of $180,000, by E. E. Andrews, R. E. Inskeep, William Weaver, W. C. Hall and A. C. Sinzee.

EASTMAN, WIS.—The Sioux Coulee Mutual Telephone Company has been incorporated by William Arlington, J. C. Stagman, E. E. Thomas, Charles R. Young and I. W. Brink.

COLDSTREAM, ONT., CAN.—The Lobo Telephone Company has been incorporated, with a capital of $10,000. The incorporators are N. A. Graham, D. A. Graham, A. J. Graham, A. Stoner, J. A. Smith, A. E. McKay, F. L. Graham, H. J. Marsh, J. Marsh and D. R. Owens, of Lobo Township.

Personal.

DR. A. G. BELL is among the bidders for the airships required by the U. S. Signal Corps for army service.

DR. EDWARD WESTON has been elected a member of the board of trustees of the Stevens Institute of Technology.

MR. ROBERT McDOBLE, the consulting and supervising engineer, has removed his office from Colorado Springs to Denver, Colo.

MR. W. DE LA BARRE, the engineer and manager of the St. Anthony Falls Water Power Company, has declined a flattering offer to go to Japan in charge of some new hydroelectric enterprise there.

MR. R. H. TILLMAN, a graduate of the North Carolina State College, has left the testing department of the General Electric Company and has joined the forces of the Rochester Railway Company, of Rochester, N. Y.

MR. EARL ENGLISH, an alumnus of Stevens Institute, has left the testing department of the General Electric Company, at Schenectady, to accept a responsible position with the Public Service Corporation of New Jersey.

MR. F. E. BOWMAN has been appointed manager of the Ada, Okla., Electric & Gas Company. He was formerly active in the management of the Huntington, Ind., Light & Fuel Company, but has a strong faith in the new West and is going to grow up with it.

MR. J. W. ALLING has been elected president of the Southern New England Telephone Company and James T. Moran vice-president. Mr. Alling fills the vacancy caused by the death of Morris F. Tyler, and Mr. Moran takes the place of James English, who declined to serve longer on account of other business.

MR. MARSDEN J. PERRY has resigned as president and general manager of the Narragansett Electric Lighting Company, after twenty years of active connection with the enterprise, which he has built up into a great institution in spite of the attention needed by his other large interests. Mr. Perry served one year very efficiently as president of the National Electric Light Association.

MR. N. MINER, who was until recently connected with the Union Electric Company in Dubuque, Ia., in the capacity of manager of the new business department, has resigned to accept a similar position with the Topeka Edison Company, of Topeka, Kan. Mr. Miner received his early training in this work with the Denver Gas & Electric Company. He was for some time with the Curtis Advertising Company, of Detroit.

MR. ALEX ROTHERT, who has been an electrical engineer on work in Russia, for the Westinghouse interests, and more recently has been engaged in other electrical enterprises in Great Britain, has made a trip to this country and will spend a couple of months studying developments in this country. He has contributed to these pages from time to time and is well known on both sides of the Atlantic for his work in connection with alternating current motors.

MR. CALE GOUGH, an engineering journalist well known from his connection with the McGraw publishing interests and more recently representing the *Street Railway Journal* in Chicago, has taken over and will operate the light and water plant at Lawrenceville, Ill., from February 1. Mr. Gough has shown great aptitude for the central station side of the electrical industry and may be trusted to develop his plant to a high efficiency.

LIEUT.-COMMANDER DAVIS, U. S. N., wireless telegraph expert of the Navy Department, fears that our Senate may refuse to ratify treaties securing general wireless intercommunication among the navies of the world. He is quoted as saying that the efforts of one of the wireless companies "to establish a monopoly in wireless telegraphy" are liable to leave our vessels "without standing in the wireless world, unable to transmit or receive important messages."

DR. E. B. ROSA, the physicist, who has had special care of the electrical work in the new Bureau of Standards in Washington and has already secured some admirable results at that useful institution, sailed last week for Europe, where he will spend three or four months in a study of the latest methods in national and university laboratories and will give particular attention to methods for harmonizing and universalizing standards of light in the gas and electric industries on both sides of the water.

MR. WALTER T. PECK, of New York, has been commissioned by the Chilean government to make a comparative study of railroads operated by steam and roads operated by electricity in this country. Mr. Peck, who graduated from the Institute of Technology with the class of 1893, came to this city from Chile, where he has business interests, a month ago, and will return to Valparaiso about the first of March. United States Consul Alfred A. Winslow, of Valparaiso, is the authority for the announcement that the Chilean government is considering the feasibility of replacing the second section of the state railroads which are operated by steam by an electrical service.' The present cost of operating the government roads is very heavy, as nearly all the coal used is imported from England. The Cordilleras mountains, with their regions of perpetual snow, furnish numerous streams that are crossed by the second section of the railroad, and which, with their ample falls, seem to furnish excellent opportunities for unlimited water power. The first section, which is about 100 miles in length, connects Valparaiso with Santiago, and the second section is about 350 miles long and extends from Santiago to Concepcion.

Obituary.

MR. WARREN F. WALWORTH, of Cleveland, Ohio, founder of the Walworth & Neville Manufacturing Company, died at his home in that city recently.

MR. DANIEL SHAFER.—On Jan. 24, Mr. Daniel Shafer, for many years one of the best known salesmen and engineers in the South, succumbed to a sudden attack of pneumonia at the Nashville Hotel, Nashville, Tenn. Mr. Shafer, who was 47 years of age at his death, had been associated for the past three years with the Allis-Chalmers Company, of Milwaukee, being attached during a portion of that time to the pumping engine department, and for the past year as sales engineer of the steam turbine department. For five years previous to taking his position with the Milwaukee company he was associated with the Hoovens-Owen Rentschler Company, of Hamilton, Ohio, during which time he acted as their Southern representative.

Trade Publications.

ELECTRIC PYROMETERS.—Catalogue No. 20 of William H. Bristol, 45 Vesey Street, New York, describes and illustrates indicating, recording and combination electric pyrometers for blast furnaces.

CAR SPRINGS for steam railroads and electric traction service are described in a catalogue issued by the Standard Steel Works, Harrison, Building, Philadelphia, Pa.

PORTABLE GAS-FLAME HEATERS for pieces that are too heavy to be removed to a furnace are described in Bulletin No. 13, issued by the Rockwell Engineering Company, 26 Cortlandt Street, New York.

"GOOD LUCK" CALENDAR.—Harvard Electric Company, of Chicago, 66 West Van Buren Street, has issued this month to its customers "Good Luck" cards, with a little calendar, which can be had on application.

ELECTRICAL CONDUITS.—A very neat little pamphlet on conduits and fittings has just been issued by Gilpin V. C., of 120 Liberty Street, New York. It is quite an interesting epitome of this class of material in which Mr. Gilpin specializes so successfully.

OHIO BRASS COMPANY, Mansfield, Ohio, has issued a booklet on its types B and C Collin pressure regulating valves. This is a new valve it has just placed on the market, and one which it believes should find considerable application in electric power plants.

SWITCHBOARD EQUIPMENT COMPANY.—Mr. J. L. Merrill, of Pittsburg, formerly district manager for the General Electric Company in the Pittsburg district, is now handling the switchboard equipment circuit breakers of the Switchboard Equipment Company, of Bethlehem, Pa.

ROPE TRANSMISSION.—The fourth edition of the "Blue Book of Rope Transmission," issued by the American Manufacturing Company, 65 Wall Street, New York, contains much practical information concerning the design, installation and operation of rope transmission system.

TELEPHONE SWITCHBOARDS.—The Dean Electric Company, of Elyria, Ohio, has issued a large and handsome Bulletin No. 105 relative to its common battery switchboards. It is an admirable piece of technical description and is well illustrated in regard to all the details of the equipment.

HOLOPHANE CLUSTERS.—In No. 4 of Vol. 1 of the "Holophane," issued by the Holophane Company, New York, much information is given concerning the adaptability of the Holophane system to old or new lighting installations. The flexibility of the Holophane clusters is also demonstrated.

GERYK AIR PUMPS.—The Pulsometer Engineering Company, Ltd., Nine Elms Iron Works, Reading, England, has issued a neat pamphlet relative to its Geryk air pumps used in incandescent lamp factories in connection with exhaustion processes, chemical and otherwise, and also for flashing the filaments.

STANDARD ACCUMULATORS.—An excellent catalogue has just been issued by the Standard Electric Accumulator Company, of 141 Broadway, with regard to the cell that was recently illustrated and described in these pages—the cell with "the plate that cannot buckle." A very complete account is given of this type of battery in the pamphlet.

LIGHTNING TRANSFORMERS.—The Allis-Chalmers Company, Milwaukee, Wis., has just issued a small four-page folder devoted to its lighting transformers for use on 1050 and 2100-volt primary circuits and are made in sixteen sizes up to 50-kw capacity. They are designed for 60 cycles, but can be operated on any frequency from 50 to 140 cycles.

BENJAMIN SPECIALTIES.—The Benjamin Electric Manufacturing Company has received official notice, under date of Jan. 20, from the Underwriters' Laboratories, that the new "Benjamin Separable Wireless Cluster," described in the ELECTRICAL WORLD of Jan. 4, and generally advertised, has been approved and is now regular National Code standard.

ELECTRIC FANS.—Bulletin No. 63 of the Robbins & Meyers Company, Springfield, Ohio, is a well illustrated publication dealing with "Standard" direct-current and alternating-current ceiling, exhaust, bracket and desk fans. The direct-current motors are of the series-wound type, while the alternating-current motors are of the single-phase, self-starting induction type.

HYATT ROLLER BEARINGS are the subject of a special bulletin just issued by the Hyatt Roller Bearing Company, of Newark, N. J. It embodies data on the tests in the locomotive shops of the Buffalo, Rochester & Pittsburg Railway, at Dubois, Pa., which has a large Westinghouse electric plant. Data are given as to the various sections of the motor-driven plant and the economies due to the reduction of friction in line shaft and countershaft.

CAMP-DUCT is the title of a handsome new pamphlet just issued in small quarto form by the H. B. Camp Company, of New York, Pittsburg and Chicago. It is an admirable publication and compilation, giving fully the requirements for conduit work in the way of specifications, contract forms, drawings of manholes, cross-sectional areas of conduits and other data. Copies can be had on application to Mr. S. A. Douglas, Flatiron Building, New York, and the other offices, and are decidedly worth securing.

VARIABLE SPEED MOTORS.—The Northern Electrical Manufacturing Company, Madison, Wis., has issued a pamphlet setting forth some facts about its single-voltage variable-speed motor system. An historical account is given of the development of the motor during the past five years, in which it is stated that the Northern company was the first to advocate broadly the system of single-voltage shunt-field control, which is claimed to be to-day the only accredited system for variable speed.

BECK FLAMING ARC LAMPS.—The Western Electric Company is about to issue a new bulletin covering this lamp, fully descriptive of the most recent and important developments and with full data covering performance. Lamps as now manufactured are suitable for use on either alternating or direct currents and have been so greatly simplified in construction that but little skill is required in operating. This line of arc lamps will supplement the already well-known line of enclosed arc lamps manufactured by the Western Electric Company.

COMMUTATING-POLE MOTORS.—The Electro-Dynamic Company, Bayonne, N. J., has issued an interesting series of circulars dealing with adjustable-speed commutating-pole motors. Circular No. 32 describes motors for general purposes; Circular No. 33 deals with motors for driving machine tools, blowers, pumps, elevators, printing presses, etc.; Circular No. 34 contains numerous illustrations of direct-connected and belt-connected motor-driven equipments, while Circular No. 35 gives dimensions of adjustable-speed and constant-speed commutating-pole motors.

MERCURY-VAPOR LAMPS for both direct and alternating current are described in bulletins recently issued by the Cooper Hewitt Electric Company, 220 West Twenty-Ninth Street, New York. Bulletin No. 15 deals with type H automatic indoor type lamps for direct current. Bulletin No. 16 is devoted to a vapor-converter outfit for operating direct-current lamps from alternating-current circuits. Instructions for installing type H and type K direct-current lamps are contained in book No. 30,162, while book No. 30,163 gives similar instructions for installing type P automatic direct-current mercury-vapor lamps.

LIFTING MAGNETS.—"Lifting Magnets and Recent Improvements in Them" is the title of a booklet just issued by the Cutler-Hammer Clutch Company, of Milwaukee, Wis., maker of lifting magnets and magnetic clutches. The subject matter of this booklet originally appeared in a magazine. This booklet, which is printed in the form of a miniature magazine, traces briefly the development of the lifting magnet, illustrates the different kinds of magnets used for handling pig iron, metal plates and other classes of material and explains, by an easily understood analogy, how the magnetic "lines of force" support weights ranging from one to ten tons. Copies may be had free by addressing the Cutler-Hammer Clutch Company, Milwaukee.

PENNSYLVANIA TERMINAL.—The New York Passenger Terminal of the Pennsylvania Railroad is the subject of a very interesting pamphlet just issued by Westinghouse, Church, Kerr & Company, of New York City. It was prepared for the recent meeting of the American Society of Civil Engineers and is now given more general circulation. It consists of twenty-three pages of cuts and illustrations and gives a clear and concise account of this great engineering enterprise, which devastating a mediocre region of New York has created in its place the greatest railroad center, terminal and tunnel system on this continent. The hole in the ground, yielding 3,000,000 cubic yards of material, is now being crowded with a stately palace of transportation, into which enter 25,000 tons of steel, while the allied structures take another 25,000 tons. The station proper will be lighted chiefly by Cooper Hewitt lamps.

GRAPHITE BRUSHES.—A twelve-page booklet has just been issued by the Joseph Dixon Crucible Company, Jersey City, N. J., entitled "Dixon's Graphite Brushes," which will be of interest to all who have used graphite brushes or contemplate their use. Even those connected with the electrical industry who are not especially interested in the subject of brushes will find the information contained worth the reading. The booklet begins with a description of the electrical installation of the Dixon Company, explaining how Dixon's graphite brushes were first tried. Under headings of "Conditions of Service" and "Variables in Commutation," the conditions are pointed out under which graphite brushes are best used and the requirements set forth which must be met in their use. There are some useful hints in the book of a general nature concerning the brush tension and how to easily measure it, the care of the commutator, etc.

TESTING SETS.—A publication recently issued by the Leeds & Northrup Company as a catalogue of portable testing sets and cable testing apparatus is in reality an excellent 119-page textbook on the subject indicated. The book has been prepared in such a way that it will not only be useful to those who use the apparatus described, but will also be of assistance in increasing exact information in regard to methods of locating faults. The directions are so worded as to be easily understood by men who have occasion to do testing but have not had the advantage of a technical school training in electrical measurements. The use of algebraic expressions has been limited to those cases where their avoidance would require a cumbersome statement which would be more difficult to understand than the algebra itself. Considering the book as a catalogue, it contains the novel feature of an index that serves as a condensed list, giving a very brief statement of the range of each instrument and its price.

SERIES LUMINOUS ARC RECTIFIER SYSTEM.—The series luminous arc rectifier system developed by the General Electric Company, Schenectady, N. Y., permits the operation of direct-current luminous arc lamps from alternating current central stations at high economy and with extreme simplicity, and is described in Bulletin No. 4556, recently issued. The General Electric luminous arc lamp and the auxiliary apparatus, consisting of oil cooled rectifier tube, constant current transformers and switchboard panels, with the necessary control apparatus, reactance coils, etc., are described and their operation explained. In the General Electric luminous arc lamp the upper electrode is a bar of hard-drawn copper, and the lower electrode is made of specially prepared composition contained in an iron tube ⅝ of an inch in diameter by 8 inches long. This lamp is claimed to be superior to other commercial lamps in efficiency, distribution of light, color of light and low maintenance cost and is particularly well suited to street lighting. The light is as white as any artificial light in commercial service to-day and it has a spectrum which is practically the same as that of sunlight. The standard switchboard sets are designed for 12, 25, 50 and 100 lights and include all the necessary apparatus, such as ammeter, plug switches for operating the different circuits, indicating lamp, starting switch, etc. One of the main advantages of the system is its adaptability to circuits of any frequency from 25 to 100 cycles. A partial list of equipments furnished by the General Electric Company gives an aggregate of over 12,000 lamps already installed.

WESTINGHOUSE AIR COMPRESSORS FOR LIQUIDS.—Westinghouse compressors, both steam and motor driven, have been found so well adapted to handling liquids that they are now extensively employed for compressing air to raise or convey liquids in breweries, tanneries, oil wells, dairies, hospitals, chemical laboratories and acid plants, in addition to all kinds of water wells. Though the problem of pumping by compressed air with given conditions is a simple one, conditions differ so widely that it is impossible to arrive at a satisfactory solution by mathematical analysis. Results of actual tests are necessary to form a correct basis of figuring. Realizing this and desirous of assisting their patrons in every possible way to obtain the best results, the Westinghouse Air Brake Company has lately completed a series of nearly 2000 tests, covering a range of from 350 to 400 different conditions of deep-well pumping, to obtain data concerning water delivered, air consumed and the best proportion and arrangement of piping and apparatus. Heretofore tests have been made on wells having fixed conditions, and the results, covering a number of isolated cases, have been the only guide in considering the requirements for all other installations. In this case, however, the tests were made with a well driven on the premises of the Westinghouse Air Brake Company specially fitted up for experimental work. So far as is known, no such wide range of tests has ever before been made upon a single well. The results place the manufacturers in a position to be of great assistance to those desiring to install compressors for direct air pressure pumping.

Unclassified Items.

BOSTON, MASS.—The Massachusetts Railroad Commission has approved an issue of $700,000 in bonds for the West End Street Railway Company, the proceeds to be used to pay the Boston Elevated Railway Company, lessor of the West End Street Railway, for additions and improvements to the property.

PORTLAND, ORE.—The Mt. Hood Railway & Power Company has installed a power plant at the site of its large Bull Run power development. The plant operates under a head of 680 ft., using water from Deer Creek, and will generate electricity to operate sawmills, planers, mixer, etc., and to furnish electricity for lighting during the construction of the plant.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company is now furnishing electrical energy from its Hen Island power plant to operate the Chicago, South Bend & Northern Indiana Railway, which connects South Bend with Mishawakee, Elkhart and Goshen.

DANIELSVILLE, PA.—The Blue Ridge Traction Company has filed with the Secretary of State a notice of extension of its road from Walnutport to Poplar Grove, Cherryville, Alliance, Weaversville and Bath; also from Alliance to Catasauqua, a total distance of 16 miles.

WHEATLAND, PA.—The Wheatland Street Railway Company has filed a notice of extension of its railway from Wheatland to West Middlesex, a distance of 2½ miles; also a distance of 800 ft. on Church Street in Wheatland.

FORT MORGAN, ALA.—Bids will be received until Feb. 27 by Captain L. F. Garrard, Jr., office constructing quartermaster, for furnishing and installing two 50-hp tubular boilers, two compound duplex pumps, one 150-hp feed-water heater and purification system, feed pump and inspirator.

NATIONAL SOLDIERS' HOME, VA.—Bids will be received until Feb. 21 by John T. Hume, treasurer, Southern Branch of the National Home for Disabled Volunteer Soldiers, for furnishing material and remodeling electric wiring in pavilion and theatre.

DAKOTA, N. D.—The citizens are considering the question of establishing a municipal electric light plant.

MILFORD, OHIO.—The Cincinnati, Milford & Loveland Traction Company is extending its transmission lines to Plainville, Newtonville and Terrace Park for the purpose of furnishing electricity for lamps in the above towns.

ELSINORE, CAL.—The City Trustees have adopted a resolution calling for a special election to be held Feb. 27 to vote on the proposition of issuing bonds to purchase the local electric light plant to be operated by the city.

LAFAYETTE, IND.—City Attorney Arthur D. Cunningham states that the question of establishing a municipal electric light plant must be decided by a special election.

SANTA BARBARA, CAL.—The power house of the Merchants' Mutual Light & Power Company on Santa Barbara Street was partially destroyed by fire recently.

HOUSTON, TEX.—Arrangements are being made by Reed & Slusher, who have charge of the construction of the automatic telephone system for the city of Houston, for the erection of the plant, work on which will soon begin. The company plans to construct at least 15 miles of underground conduits. S. D. Levings is constructing engineer.

SALMON, IDAHO.—The Andrews Light & Power Company is making arrangements to construct its plant and will require equipment for a 500-hp hydro-electric plant, including generators, water wheels, line material, etc. Allen C. Merrill is engineer.

THE ELECTRIC DRY BRUSH WINDOW CLEANER COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The directors are Alfred H. Speake, of Brooklyn; Joseph T. Willis, of New York, and Walter Ward, of Hackensack, N. J.

THE DAVID KILLOCH COMPANY, of New York, N. Y., has been incorporated with a capital stock of $6,000 for the purpose of manufacturing electrical appliances. The directors are N. Killoch, of Brooklyn, James Killoch, of New York, and William M. Greene, of Coxsackie, N. Y.

THE EMPIRE BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Charles Vincent, K. L. Franklin and Louis Rosenberg, of New York, N. Y.

THE NORMAN TELEPHONE & CONSTRUCTION COMPANY, of New York, N. Y., and Guthrie, Okla., has filed articles of incorporation at Guthrie, Okla., with a capital stock of $25,000. The directors are J. F. Faunt, R. B. Lee Roy, of New York, N. Y., and E. L. McKeown, of Guthrie, Okla.

THE FRENCH ELECTRO MANUFACTURING COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $25,000 by Theodore G. Kitchin, P. N. Van Vliet and Jonathan Kitchin. The company proposes to manufacture electrical appliances.

TUSCUMBIA, MO.—The Tuscumbia Telephone Company has been incorporated by W. D. Dickson, C. E. Noell, L. N. Musser and others.

VENUS, TEX.—The Venus Telephone Company has been incorporated with a capital stock of $3,000 by A. D. Frost, J. W. Bassett and C. L. Barker.

WATERTOWN, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Jefferson County Telephone Company. The capital stock of the company is placed at $4,000, and the directors are Charles Harth, S. V. Baker, C. E. Brown, G. R. Hanford, G. A. Lance, F. P. Rhines and N. D. Yodt, of Watertown.

AGUILAR, COL.—Articles of incorporation have been filed for the Aguilar Light & Power Company with a capital stock of $25,000 by E. G. Hawkins, Fred Bartlett and others.

STRAWBERRY PLAINS, TENN.—The Strawberry Plains Telephone Company has been incorporated with a capital stock of $5,000 by I. N. White, J. W. Brown, J. P. Cater, W. E. Parrott and Dr. H. L. Campbell.

HENRIETTA, MICH.—The State Road Telephone Company has been incorporated with a capital stock of $1,600 by Henry Lee, W. W. Ford and W. R. Garfield.

BOISE, IDAHO.—The Kings Hill Irrigation & Power Company has been organized by Charles Hammett, C. B. Huritt, E. L. Hice and others to construct a power plant.

GOLCONDA, ILL.—The Golconda Light & Water Company has been incorporated with a capital stock of $12,000 to operate a water and light plant. R. Gilbert is one of the incorporators.

BILLINGS, MO.—The Billings Light, Power & Water Company has been incorporated with a capital stock of $35,000 by S. F. Bronson, J. B. Berghaus, J. W. York and others.

HENRIETTA, MICH.—The Busy Bee Telephone Company has been incorporated with a capital stock of $1,000 by A. G. Moeckle, S. H. Clark and F. Atwood.

CHIPPEWA LAKE, MICH.—The Chippewa Lake Telephone Company has been incorporated with a capital stock of $2,000.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Cincinnati, Madison & Western Traction Company with the Secretary of State with an initial capital stock of $10,000.

MR. THOMAS K. GLENN, vice-president of the Georgia Railway & Electric Company, of Atlanta, Ga., has resigned to become president of the Atlanta Steel Hoop Company, and will be succeeded by his brother, Mr. W. H. Glenn, now superintendent of construction of the company.

MR. J. FRANK CHAPMAN, who was president of the Chapman Electric Company, of Louisville, Ky., died recently at his home, Howard Park, Ind. Mr. Chapman for years had made a business of equipping steamboats with electric motors.

Business Notes.

THE ROBBINS & MYERS CO., whose main office and factory are located at Springfield, Ohio, has recently opened a branch store in Dallas, Tex., with office and sales-room at 264 and 266 Live Oak Street, managed by Mr. W. M. Brooke. Mr. Brooke is experienced in this line and will make a good manager for this branch. All business will be done in the name of the Robbins & Myers Co., and all invoices and collections will be made from its home office at Springfield, Ohio. It will carry in stock and on display at Dallas a full line of motors which they manufacture up to and including 15-hp, and direct-current and alternating-current ceiling, desk, bracket, oscillating desk, and small exhaust fans, all known and sold as "The Standard." These goods have gained an enviable reputation and demand, and as prompt delivery is frequently a most important matter, the company will be able to take good care of the trade by shipping from the Dallas stock or from the factory. With the addition of a complete line of alternating fans to their well-known and established line of direct-current fans, it can be said that the Robbins & Myers Company has absolutely the most complete and select line of fans.

THE NEW CHICAGO GRIP, of Mathias Klein & Sons, 87 West Van Buren Street, Chicago, was shown at the recent Electrical Show, as well as their sliding wedge grip. This latter form is made of steel and has hardened jaws, and its peculiar feature is that it is so arranged that the jaws work in unison. If one is pushed forward, it carries the other with it simultaneously. This makes it a very effective grip for handling trolley or messenger wire, as it has jaws of considerable length, so that the wire cannot be injured in the least when the grip is applied.

THE ELECTRIC SUPPLY & CONSTRUCTION COMPANY, of Columbus, Ohio, will shortly move to the Schumacher Building, corner of Gay and Third Streets, where larger and more commodious offices have been secured.

MESSRS. PEET AND POWERS, electrical engineers and contractors, whose offices in the Parker Building, at Fourth Avenue and Eighteenth Street, New York, were completely destroyed by fire, have established permanent headquarters at 45 West Thirty-Fourth Street, New York.

DOSSERT SOLDERLESS TERMINAL LUGS are used throughout on all the lighting and power panels, as well as the switchboards, installed in the new eleven-story, fireproof Joseph J. Little printing building, Twenty-second Street, near First Avenue, New York City, by E. C. Tibbals & Company.

THE TOLEDO ELECTRIC SIGN COMPANY, of Toledo, Ohio, through a contract with the S. H. Robinson Company, of Philadelphia, Pa., will hereafter furnish all the all-metal scroll signs used in Philadelphia and Atlantic City. The Toledo company has also secured the contract for furnishing the scroll signs for Nixon & Erlanger's circuit of eighty-five theatres.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., announces the removal of its St. Paul office from 21 East Fifth Street to 516 Endicott Building, St. Paul. Mr. T. E. Drohan is in charge of the new office and is ready to act promptly on inquiries regarding apparatus. His extensive experience as superintendent of the Northern shops at Madison renders him especially fitted to help customers in the arrangement of motor drives for use with machines of all sorts.

ROYAL-EASTERN COMPANY.—The Royal Electrical Supply Company, of New York City, and the Eastern Electrical Supply Company have consolidated under the name of the Royal-Eastern Electrical Supply Company, and will occupy the store and basement of the new building at 114-116 West Twenty-seventh Street, New York City, where the concern will carry a stock of electrical house goods, lighting material, motors and generators. Messrs. C. P. Scott and J. D. Sweeney make the announcement for the two old companies.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 28, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

877,537. METHOD OF ELECTROLYZING SALTS; Joseph Whiting, Niagara Falls, N. Y. App. filed April 24, 1906. Renewed June 21, 1907. The method of effecting electrolytic decomposition of salts, consisting in passing an electric current through the electrolyte to a mass of liquid metal, and maintaining substantially the same mass of liquid metal as a cathode for a period of time, then, while maintaining a body of electrolyte in the decomposing chamber, withdrawing the mass of liquid metal, and replacing it with a fresh mass of liquid metal, the same angular relation between the adjacent surfaces of the electrodes being maintained throughout the cycle of operations, substantially as described.

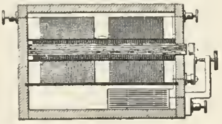
877,555. TELEGRAPHY; Patrick B. Delany, South Orange, N. J. App. filed March 25, 1905. Covers a telegraph transmitter having a key movable in a horizontal plane between two contacts and actuating relays which transmit dots and dashes, respectively.

877,576. SERIES PARALLEL POLARITY CHANGING SWITCH. Edwin S. Lincoln, Brookline, Mass. App. filed Feb. 11, 1907. Covers a double-throw switch adapted to put batteries in series or parallel.

877,656. SPARK-COIL; August R. Luschka, Chicago, Ill. App. filed Oct. 29, 1906. The coil is made in two sections, and the condenser is wrapped about the grounded or low potential section so as to prevent leakage between the secondary winding and the layers of the condenser.

877,684. ELECTRIC INSTALLATION OUTLET BOX; Wheeler H. Vibber, New London, Conn. App. filed June 11, 1907. Form of outlet box having a cover and a body portion suspended from the cover and entirely removable therefrom.

877,705. ELECTRIC CURRENT CONTROLLER; Albert E. Dion and Charles E. Ball, Ottawa, Ontario, Canada. App. filed Nov. 19, 1906. Provides means whereby if more than a certain number of lamps are put on a certain circuit the potential will fluctuate therein so that the light will be unpleasant.



877,656.—Spark Coil.

877,727. TELEPHONE EXCHANGE; Nils E. Norstrom, Chicago, Ill. App. filed Oct. 4, 1901. The combination with a movable contact maker, and a power device for giving it a forward movement, of an adjustable locking device adapted to stop the forward movement of said contact maker at any desired point, and means by which, upon a backward movement of said contact maker, said locking device will be released so as to permit a subsequent forward movement thereof.

877,739. MEANS FOR OBTAINING THIN LIQUID DROSS IN ELECTRIC FURNACES FOR METALLURGICAL PURPOSES; Hermann Rochling, et al., Volklingen-on-the-Saar, Germany. App. filed Sept. 7, 1906. In an electric furnace of the type described, a smelting hearth, damlike ridges *g*, *h*, arranged within the smelting hearth and smelting channels *d* projecting upwards to such a height above the bottom, that the top edges of the ridges may be flush with the surface of the metal bath, when melted in the furnace whereby the electric current heating the metal bath is forced to pass at these places through the layer of dross floating above the metal bath.

877,790. AUTOMATIC ELECTRIC SWITCH; Mike Mintz, Rock Island, Ill. App. filed May 15, 1906. Has a tilting switch arm moving into a mercury cup and displaced by a float or piston. Is kept at either position of its throw by a rolling ball.

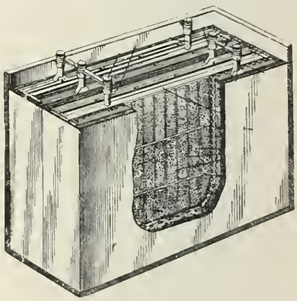
877,804. INSULATOR FOR HEAVY CONDUCTORS; Louis Steinberger, New York, N. Y. App. filed April 17, 1907. Construction of insulator for inverted third rails. The insulator has a metallic U-shaped core, by which it is strengthened and supported.

877,822. PRINTING TELEGRAPH; John C. Barclay, New York, N. Y. App. filed Jan. 11, 1907. Printing telegraph of a class having finger keys and synchronously operated commutators or "sunflowers" at both the transmitting and the receiving station; covers details of construction.

877,843. ELECTRIC HEATER; Edmund F. Hoskin, Evanston, Ill. App. filed Sept. 19, 1907. A soldering iron having a hollow interior, in which is received a spirally wound resistance element. The copper is cast around the insulated resistance element so as to exclude air therefrom.

877,844. TROLLEY; August W. Huhsman, Staunton, Ill. App. filed May 25, 1907. The harp carries vertically projecting cheeks or bearers, with engaging rollers which close together over the trolley wire.

877,857. TELEGRAPH SWITCH; Lewis H. Parcels, Hiawatha, Kans. App. filed Aug. 5, 1907. Telegraph switch for connecting a resonator sounder into one or more sets of telegraph instruments without disturbing the circuits, but allowing all local circuits to work free and clear when the resonator is cut out.



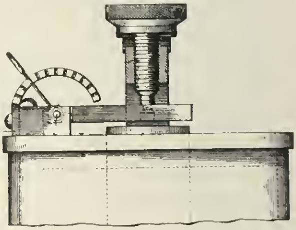
877,889.—Storage Battery.

877,877. WIRE RETRIEVING ATTACHMENT FOR TROLLEY WHEELS; William C. Althen, Columbus, O. App. filed March 22, 1907. A U-shaped frame is suspended from the trolley harp and is raised into a position to guide the wheel on the wire when tension is put on the usual holding cord.

877,880. OUTLET BOX; Harry Becker, Baltimore, Md. App. filed Feb. 1, 1907. An outlet box having a circular open face, in which is received a specially shaped bushing and a threaded ring or nut.

877,887. CONTROLLER REGULATOR; Cyrus P. Ebersole, Keokuk, Ia. App. filed Sept. 1, 1904. Provides a regulator for an electric motor controller to prevent the operator from moving the handle too rapidly. Has vertically sliding pins, which are progressively displaced by a cam.

877,889. STORAGE BATTERY; William Gardiner, Chicago, Ill. App. filed May 2, 1905. Has a lead grid with vertically disposed ribs having inwardly projecting teeth, the active material filling the spaces between the ribs and held in place by the teeth.



877,896.—Vibrator.

877,896. VIBRATOR; August R. Luschka, Chicago, Ill. App. filed Nov. 19, 1906. Has a hammer or interrupter comprising a plate of metal hinged to a fixed bracket and an adjustable spring connected thereto.

12,744. ELECTRIC MOTOR CONTROLLER REGULATOR; Paul A. Weyand, Maywood, Ill. App. filed March 18, 1907. A mechanism for preventing too rapid movement of a controller handle and including a plurality of upwardly projecting inclined teeth, which operate with a ratchet so as to procure a successively operated release thereof.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, FEBRUARY 15, 1908. No. 7.

PUBLISHED WEEKLY BY THE
McGraw Publishing Company
JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. HAROLD S. BUTTENHEIM, Secretary.
A. E. CLIFFORD, 2nd Vice-President. CURTIS E. WHITTLESEY, Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Schofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
SAN FRANCISCO OFFICE....................601 Atlas Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:
United States, Cuba and Mexico....................per year, $3.00
Dominion of Canada....................4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, FEBRUARY 15, 1908.

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PUBLIC SERVICE SECURITIES.

In the proposed new federal legislation for the issuance of emergency currency in times of financial strain, it is proposed to base such issues upon the deposit of certain classes of securities. There is a probability that some such measure will pass, sooner or later, and we desire to direct attention to well-seasoned public service securities as deserving inclusion within the scope of such legislation. Of course we refer specifically to the first bonds of electric lighting, traction, telephone, gas, water and other properties. They compare very favorably with steam railroad issues, have a remarkably small percentage of default, are in growing favor with bankers and investors, and are based upon some of the most fundamental necessities of modern civilization. Even in the worst of times, their service and their product must be used, with little falling off in consumption, and the physical properties are there in ocular evidence. With the new restrictions by Public Service Commissions against over-capitalization and watering, and with a fair margin, we cannot imagine a better basis for pledge when occasion requires than the approved, steady bonds of such properties; which would also benefit by the recognition and enjoy an even wider market than they have already found, as good investments.

THE NEW BRITISH PATENT LAW.

The new British patent law, of which a somewhat extensive account is given in our columns this week, contains some very important innovations not only in British practice, but in the general character of the provisions. So far as the grant of patents is concerned, the chief change is found in the provision for a search for anticipations. A patent can no longer be obtained practically for the asking and fees, but must stand fire from the state of the art and is liable to be turned down or limited by reference to prior British patents. As this corresponds somewhat to American practice it is not likely to work hardships to American inventors. Its exact effect cannot easily be predicted until the British habits of search and interpretation have become manifest through experience. If they at all coincide with American practice things will proceed very smoothly. It is possible, however, that the British office may take broader views of anticipation than does our own, in which case inventors who have been wont to dodge our own prior patents by ingeniously worded claims may find themselves obliged to take British patents more closely limited than they would like. Probably, if one may venture a guess, there will not be much trouble on this score, save perhaps in cases where prior American patents taken in England come into question. In this case the same patent would generally have been cited at home so that the final result would not be greatly changed. So far as securing patents is concerned, the American inventor will, therefore, be very little affected by the new regulations.

With respect to working the British patent, the situation is very different. The apparent intention of the new law is to compel *bona fide* working of the invention in the country which has granted it protection, Up to the present the provisions for foreign working have generally been fairly easy to evade so far as a genuine manufacture and sale is concerned. The new law contains provisions whereby a patentee may be brought to book after the lapse of four years from the date of the patent unless the article is really made in Great Britain for the supply of that market. It will not do merely to go through the motions and actually supply the article from foreign factories. Of course, there are chances for evasion, as for instance by assembling in England parts made abroad; but unless the temper of the British courts is in this matter remarkably softened they will not make evasion safe or easy. It is the intent to prevent foreign inventors from using the British patent merely to hold the market while other countries get the benefit of the industry. This is essentially fair, but it may hit American patents hard at times. The Americans and the Germans have been the chief sinners in this matter, and they will now have either to reform or run the risk of revocation of their patents. In the dyestuff patents, which seem especially to have been in mind, the remedy may not always prove effective. For the commercial life of a new patented dyestuff is in many cases short, but important patents of this class, in which the product has a considerable permanent value would, however, be brought within reach of the provisions of the new law. At all events, no one has just cause for complaint at being obliged to do in good faith what under the law he is presumed to do.

The most striking feature of the law, however, is its firm requirement that the reasonable requirements of the public must be satisfied and that the article must be for public supply on reasonable terms. This requirement will bear hard, as it is frankly intended to do, on certain classes of patents. In particular it will, if carried out vigorously, put a serious and well-deserved check on attempts to create a monopoly beyond the natural scope of the patent in virtue of licenses or leases on onerous conditions. This particular abuse has grown to considerable proportions under American practice and has been introduced in England with the result here found. In this country no adequate remedy has thus far been found. Our British cousins have taken the bull by the horns and are in position to compel licenses on fair terms, or in the last resort to revoke the patent. We congratulate the framers of the British law on their courage and foresight in taking up this particular matter. It is perfectly true that the immense power given under these new provisions might be used unjustly and now and then might bear heavily upon the inventor of particular things; but in point of fact we do not believe that unfair advantage will be taken of it. American inventors who fall foul of it will as a rule have brought it upon themselves by dealings essentially unfair to the public which they are supposed to benefit. It would be a mighty good thing if we could have at home some method for clearing up the litter of unused and unfairly used patents which impedes progress at innumerable points. It is no easy thing to formulate laws which properly protect both the inventors and the public, and it is a pleasant thing to see a move in the right direction.

A High-Frequency Alternator.

In alternating-current power transmission over wires, the tendency has been to reduce the frequency. In this country it was originally about 130 cycles per second. Now we have 60 cycles per second for lighting, and also 25 cycles per second for heavy power transmission. The frequency of 60 produces electromagnetic waves in air 5000 kilometers long, or half a quadrant of the meridian. Moreover, it is so low that it fails to produce appreciable radiation, just as a whip-lash moved to and fro in the air at a low rate fails to excite therein audible vibrations. In alternating-current radiation for the transmission of intelligence, that is, wireless telegraphy and telephony, it is necessary to employ a very high frequency, many thousands of cycles per second, at least. Until recently, it has only been possible to set up such frequencies by the oscillatory discharges of antennas or associated condensers, with rapid damping and extinction of the train of emitted waves. It is well known that much greater effectiveness and sharpness of tuning can be obtained by applying forced oscillations, i. e., an impressed e. m. f. of the proper high frequency to the sending mast wire.

It is not easy to make an alternator of from 50,000 to 100,000 cycles per second, although the achievement has already been accomplished. It is not easy to make a thousand poles grow in an alternator, where one grew before. In the article printed this week, on page 345, Mr. Louis Cohen suggests a building up process of attaining high frequencies from a number of alternators on a common shaft, following the plan outlined by the late Lieutenant F. Jarvis Patten, except that instead of building up in geometrical ratio, the article demonstrates that the building up is necessarily in arithmetical ratio. In fact, if we suppose that each alternator is a multiphaser, it can produce a rotating magnetic field at its own angular velocity. When the field of the second multiphaser is supplied with the first group of multiphase currents, the second armature is virtually subjected to an angular magnetic velocity compounded algebraically of its own mechanical angular velocity and that due to the rotating magnetic field of the first. The difficulty with such a battery of alternators, as pointed out in the article, would be the production of the necessary strength of high-frequency excitation currents through the various field circuits. It would be a question whether the final output per kilogramme would exceed that obtainable directly in other ways.

Magnetic Oscillation in Alternators.

All electrical engineers are familiar with the fact that dynamos hum when driven. A machine may run quietly enough when running at speed, unexcited; but when the exciting current is admitted to the field windings, the machine may hum with the noise of a nest of excited hornets. Some say, in fact, that this metaphor is tamely inadequate, and prefer the familiar buzz-saw as proper to the circumstances. Alternators are apt to be particularly self-assertive in this respect. Noisy alternators have sometimes even created cause for law suits, on the ground of public nuisance. When an alternator sounds a trumpet of spinning exultation, it is an easy matter to determine the general source of the sound. If the hum occurs with the machine unexcited, the cause is mechanical whipping of the air, by teeth or other rotating projections. If the sound comes on with excitation, it is of electromagnetic origin. If it comes on with the load, it is due to armature magnetic reaction. The mechanical type of humming is seldom found now-a-days, because constructors have long learned to construct machines that run without tearing the circumambient air into tatters. The rotors are fairly smooth, and the little noise they do make mechanically is but a drop in the ocean of central-station air-vibration. The magnetic hum is much harder to destroy. A salient cause of magnetic humming is found in the periodic variation of magnetic pull exerted between stator and rotor, due to the varying reluctance in the main magnetic circuits of the machine as the teeth pass by. The pull exerted by a field-pole upon the armature frequently amounts to the weight of a ton and is sometimes more. In general, we know that this total pull varies directly as the square of the magnetic flux between pole and armature. If the periodic variation in magnetic flux, due to the passage of successive teeth is, say, two per cent, the total radial pull may be expected to vary four per cent, and four per cent of a metric ton's weight will be 80 kilogrammes, or about 175 pounds avoirdupois. If we conceive of the magnetic pull on the rotor undergoing rapid fluctuations to this extent, we can readily understand that the whole frame of the machine, both stator and rotor, may be set into a vibration of small amplitude, and we know by telephonic and acoustic lines of experiment how small an amplitude of vibration may set up a large and ear-bewildering sound.

A paper on the subject of "Magnetic Oscillations in Alternators," alluded to in our Digest columns, was read recently by Mr. G. W. Worrall before the Manchester section of the Institution of Electrical Engineers. In this paper experiments are described on the influence of the pole-shoe arc upon the e. m. f. wave shape and other electromagnetic phenomena in an alternator. The pole-shoes were laminated, and were shortened successively by planing off the ends, until the polar arc diminished from 6 to 5.5 armature-teeth pitches. It was found oscillographically that the e. m. f. wave was smooth at a polar arc of 6 teeth and was very rippling on the crest when the polar arc was reduced to 5.5 teeth. Reasoning the matter out, it is shown that, with an arc of 6 teeth, the magnetic reluctance and main magnetic flux are substantially constant, so that there is no magnetic flux pulsation; but there will be an oscillation or swing of flux from one polar edge to the other and back again as each new tooth comes under the pole face. This flux swing does not produce much noise, but it can ripple the e. m. f. waves near their crests, because it disturbs the flux in the coils near these intervals. On the other hand, the flux pulsation at a polar arc of 5.5 teeth can only produce ripples in the e. m. f. waves near the zero line; but can produce noisy rotation.

At first sight, therefore, it would seem as though the only way to avoid magnetic hum in this alternator would be to have objectionable teeth-ripples in the e. m. f. wave crests; and *per contra*, the only way to avoid teeth-ripples, and so produce a smooth e. m. f. wave, would be to use a polar arc that gave rise to pulsation and made the machine hum. It was, however, pointed out in the discussion following the paper, that it was unsafe to generalize from this particular machine to all others. It would seem that if these were the only conditions to be faced by designers, some alternative might be resorted to, such as setting the slots diagonally across the armature. There can be no doubt, however, that it is by such experimental researches on the magnetic oscillations of alternators that progress in alternator design can be achieved. The phenomena involved are somewhat complex and there is room for much careful experimental work. But the variables must be manipulated only one at a time if we are to draw reliable conclusions.

On Ventilation in the British Isles.

We have always looked upon our British cousin as one who held godliness even a little lower than cleanliness, as traveling with a portable bath and endowed with a preternaturally keen scent for microbes. It therefore comes upon us with something of a shock to learn from so eminent an authority as Prof. Vivian B. Lewes that we have been wrong—that his countrymen eschew ventilation and are wonted to huddle in hermetically sealed rooms, perhaps even valuing the rich mousey aroma where products of gaseous production and of respiration have been for long hours happily blended. The thought is a most disquieting one, yet we can put no other interpretation upon the distressing revelations in his recent lecture before the British Institution of Gas Engineers when he defended with uncompromising valor the extraordinary thesis that "A gas-lighted room will nearly always be more healthy and pleasant to live in than one lighted by the newer form of illuminant." Prof. Lewes holds that gaslights are valuable in a ventilating function, encouraging the passage of foul air through the ceiling and walls, and proves to his own great satisfaction that while carbon dioxide diffuses rapidly out through the plaster it does not diffuse downward into the free air of the room He also solemnly avers that a large proportion of the organic matter and germs given off from the beings who enjoy his kind of ventilation are charred in the beneficent gas-flame and their mortal remains cause "that discoloration of the ceiling which is invariably found in a town atmosphere above the gas-burner."

Perish the thought! We positively refuse to believe that our kin beyond sea radiate germs at any such rate as their learned detractor would have us believe. Those who hold no brief for the dear old gas-burner have pretty well shown that this blackening, which, by the way, is commonly observed above incandescent lamps hung near the ceiling and especially over steam and hot-water radiators, is due to plain ordinary dust, coal dust in regions where soft coal is burned. Also it may not be incompetent to inform the professor that on all the known principles of diffusion through porous partitions, CO_2 would be the last thing to depart; in fact it would be selectively retained. It is pleasant to learn that British coal gas has a sufficient SO_2 content to be of material value as a disinfectant. In this country we do not consider it well fitted for breathing purposes and try to eliminate it. With all due deference we would suggest that when living rooms get into so shocking condition as Prof. Lewes indicates, formaldehyde would answer the purpose better and would be quite as agreeable. In the States we customarily provide apertures, known as ventilators, or at least have windows which can be lowered at the top, and not infrequently install power fans which actually change the air. The experiments cited by Prof. Lewes are, if possible, more weird than his theories. He was apparently able, through complete temporary lack of ventilation, to reach a condition of stratification that showed just the thing he was looking for—44 parts of CO_2 in 10,000 at the ceiling and none to speak of at the breathing level. How long this cheerful condition would be likely to remain we leave the reader to imagine. The only material fact which we have been able to discover in Prof. Lewes's manifesto is that one who is thoroughly opposed to ventilation may get a bit of an upward draft quite against his will if he lights the gas burners. May we not assume that the professor discredits the habits and intelligence of his countrymen by putting up such a shabby, disingenuous argument? When one sits down and solemnly contemplates it, it begins to acquire the flavor of a practical joke.

More Westinghouse Locomotives.

Further confirming the statement of the New York, New Haven & Hartford Railroad, published in these columns last week, to the effect that since the beginning of the electrical installation the railroad company and the Westinghouse Company, which had charge of the installation, had worked together in harmony and that the electrical system as far as it had been tried had been a success, comes the announcement that the railroad company has placed an order with the Westinghouse Company for six additional single-phase locomotives, which are to be duplicates of the 35 previously furnished by the Westinghouse Company.

Direct-Current Railway Experiment at 4000 Volts.

Some interesting experiments have recently been conducted at the works of Dick, Kerr & Company, at Preston, England, to determine the ability of the Von Zweigbergk metallic shield blow-out for opening high-voltage, direct-current circuits and incidentally the practicability of high-voltage, direct-current railway operation. The tests were made with a specially designed blow-out coil 6½-in. in diameter and weighing about 35 lbs. Direct current at 3200 volts was applied, with 12 40-hp, 500-volt railway motors connected in circuit, two in parallel by six in series, in order to give an induction discharge similar to that which would be produced by two 175-hp, 1500-volt motors in series. A current of from 75 to 100 amps. was broken several hundred times, but hardly any trace of wear could be detected on inspecting the contacts. The results have been so successful that an equipment for 4000 volts direct-current is now being built by Dick, Kerr & Company. The equipment will consist of two 1900-volt motors capable of working up to about 2000 volts and at a load of about 200-hp. These motors will be connected permanently in series to allow for a line e. m. f. of about 4000 volts. The Von Zweigbergk Controller Company, whose headquarters are in Cleveland, Ohio, is now manufacturing blow-outs for this voltage.

St. Louis Electrical Show.

The first annual electrical show of St. Louis has been announced for the dates April 18 to 26. The show will be held in the new First Regiment Armory. The Union Electric Light & Power Company, of St. Louis, has taken 3500 sq. ft. and expects to exhibit the most complete electrical house yet planned in an exhibition of this kind. The Trades Exposition Association, Ltd., which conducts the show, has offices in the Mermod-Jaccard Building, St. Louis.

New York City Meter Inspection.

The Public Service Commission of New York City has called upon the 17 electrical companies doing business in Greater New York to make reports to them not later than Feb. 17 of the manner in which electric meters are tested by each company and the types and total number of meters now in use. In order to insure uniformity in the reports, a blank form has been supplied to each company. In this form the companies are directed to answer the following questions:

Are periodic tests made of meters already installed? If so, how often? What do the results of such tests show? Are meters tested on customers' premises usually readjusted on the spot or removed and new meters installed? What is the system for testing meters on complaint and what apparatus is used? What percentage of meters tested on complaint are found fast and what percentage slow? Also what percentage are found within the requirements of the law; namely, less than 4 per cent fast? Do you use one man or two working together to make test on customers' premises? If one man, how many meters can be tested in a day? If two men, how many meters can they test in a day? Are the repairs and necessary adjustments made by these men at the time of the test? What is the length of your working day? What method is used for testing new meters? What portable test meters or other testing apparatus is used? How often and where is the apparatus calibrated? What station standards are used?

Blank statements have also been provided for the companies to fill in showing the number of meters in use, the different makes and their capacity.

Industrial Development in the South in 1907.

According to the Chattanooga *Tradesman*, the industrial development of the South in the year 1907 was little short of remarkable in the face of serious obstacles. It is probable that during the year the South has been subjected to more untoward conditions tending to retard and discourage investments in industrial enterprises than has heretofore existed since the reconstruction era, and yet the record shows an advance over all others in its history. There has been more or less of political agitation and legislation aimed at corporations, and railroads in particular, in practically all the Southern States that caused the suspension of much construction work which would have distributed hundreds of millions of dollars in addition to what was actually paid by these corporations, and yet all previous records were broken. Even in the closing quarter of the year, which witnessed the financial stringency, there was a slight gain in the establishment of new industries compared with the corresponding quarter of 1906. During the year 1907, 6483 new industries were reported in the South, compared with 6411 in 1906, which was the best record ever made. The leading states were Texas, 1383; Oklahoma, 794, and Virginia, Tennessee. North Carolina, Alabama and Arkansas, from 400 to 550 each. The use of electric power in the great staple industries of the South is constantly increasing, and a very broad central-station development is under way.

Graduate Study at Massachusetts Institute of Technology.

Among the courses of study available in the college year 1908-9 for graduate students at the Massachusetts Institute of Technology are a number of particular interest to electrical engineers. Prof. H. E. Clifford will continue his lectures on high-tension phenomena and the characteristics of alternating-current circuits. These lectures are the natural sequel to the lectures on alternating currents and alternating-current machinery to undergraduate students, for which Professor Clifford is well known. The advanced course which Professor Clifford addresses to graduate students is intended to be accompanied by a considerable amount of original investigation and research carried on by each student. This research may or may not be made a part of the work of a thesis filling part of the requirements for a higher degree, as the individual student may elect. A course of laboratory instruction adapted to accompany the lecture course will be conducted by Prof. R. R. Lawrence.

Each student in the electrical-engineering department who becomes a candidate for a higher degree is expected to follow a major course of theoretical lectures and one or two minor courses of lectures. Other courses of an advanced nature, which are particularly planned to meet the requirements of the graduate students, are given by Professor Laws on electrical testing, by Professor Shaad on the design of electric generating stations and systems of distribution, and by Professor Derr on the design of electrical machinery. Courses are also offered in subjects relating to mill engineering, the design of stationary structures, mathematical electricity, electrochemistry, etc., for those students who do not elect to take both their major and their minor subjects in the Department of Electrical Engineering. A seminar is provided for studying the trend of contemporary advance in the electrical arts and its relations to historical development. This is a departure from the usual custom of engineering institutions, but it seems the part of wisdom for men following advanced study of electrical engineering subjects to obtain a comprehensive view of the main reasons for the rate of development and improvement now affecting the electrical arts. Such knowledge may be reasonably said to be a necessary part of the training in judgment which is requisite to the highest success in the executive positions of electrical companies or other companies depending for their prosperity upon the electrical arts.

A course of instruction in the organization and management of public service companies is also provided for the benefit of graduate students. This course will include lectures by Prof. D. C. Jackson on the methods of organizing public service corporations, the legitimate expenses which enter into their organization, the problems of their management, and the relations of such companies to the public. It will further include lectures treating the public relations of these corporations particularly from the point of view of public interest as seen by the political economists, which will be given by Prof. D. R. Dewey of the department of economics. This course will be accompanied by extensive assigned reading and by examinations and comparisons of operating reports, which may be accompanied by research of a historical or economic nature in the case of students suitably prepared.

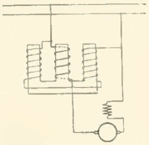
Power Plants Along the Rhine.

Power plants are multiplying along the Rhine, but in spite of the historical and almost sacred character of that famous river no one is making any fuss in opposition to such work. The energy now developed at Rheinfelden by the Rheinfelden Power Company is about 17,500 horse-power. In addition to this installation, which is the only one in full working order, there are several others whose erection has either actually begun or will be commenced during the next few months, chiefly near the Swiss-Baden and Alsatian-Baden frontiers. The most important is the station to be built at Laufenburg. The Compressed Air & Electrical Company, of Berne, investigated the position over 10 years ago, and sought the necessary rights from the Swiss and Baden authorities, whilst an independent scheme was put forward by the electrical engineering firm of Felten & Guilleaume, Karlswerk, Mulheim-on-the-Rhine. In 1899 an agreement was made between these two companies, and a joint proposal laid before the states concerned was accepted in 1905. Ten kilometers of the river, having a fall of 13.1 meters, has been taken. The available horse-power varies from 45,000 to 865,000, according to the height of the river, the average being estimated at 155,000 horse-power. The capital of the company is 25 million marks (£1,250,000), and full powers have been obtained for building another power station at Whylen-Augst, midway between Basle and Rheinfelden. The average available horse-power here is 100,000, with a minimum estimated at 29,000 horse-power. The length of the river taken is 7.9 kilometers, the fall being 8.4 meters. The matter will be carried through jointly by the Rheinfelden Power Company and the Basle municipal authorities, and it is stipulated in the concession granted to them that building operations must commence within the next 18 months and the whole plant be running in seven years.

Another plant on the Baden-Swiss Rhine is that to be erected at Rheinau, near Schaffhausen, by a syndicate consisting of the Aluminium Company, Neuhausen; the Schuckert Electrical Company, Nuremburg; and the authorities of Winterthur. The stretch taken is 11.4 kilometers long, and the average horse-power available is said to amount to 43,000. The Zurich authorities, again, intend erecting a power station at Eglisau, near Rheinau. A length of about 7.5 kilometers is required, the horse-power being about 32,000. The last station for which complete arrangements have been made lies along the Alsatian-Baden frontier, on the Hüningen-Steinenstadt stretch. The plans have been drawn up jointly by R. Köchlin, Paris; L. Potterat, Berne, and the firm of Havestadt & Contag, Berlin. The length to be taken is 21.8 kilometers, having a fall of 23.1 meters; the average horse-power available is 293,000, the maximum and minimum being respectively 1,651,000 and 86,200 horse-power. It is chiefly intended to supply electric power to the neighboring industrial district, including Mulhouse. In addition to the schemes already mentioned, for which full arrangements have been made, there are about a dozen more projects on foot in a more or less advanced stage of completion, the aggregate horse-power of which, if carried out, would amount to about a quarter of a million.

Alternating-Current Magnet.

In order to eliminate the excessive pulsations in the force exerted by single-phase magnets it is customary to build magnets as though intended for two-phase circuits and then subject the windings to currents displaced in time-phase by using "split-phase" circuits. The accompanying illustration shows a method that produces the desired results without involving certain of the difficulties of the split-phase method. The outer cores of the magnet are subjected to a constant effective value of alternating flux, which is in time-quadrature with the supply e. m. f. The central limb is subjected to a flux in time-phase with the current taken by the motor. If the current were in time-phase with the supply e. m. f., the two fluxes would be in time-quadrature. In any event, instead of the magnetic having an oscillating field, an unsymmetrical rotating field is produced, and the pull on the plunger never reduces to zero. It is claimed that this arrangement, for which a patent was issued to Mr. Christian Krämer, on Feb. 4, obviates the extra loss of energy required by the split-phase arrangement.



KRAMER ALTERNATING-CURRENT MAGNET.

The New York Electrical Society on the Lusitania.

Through the courtesy of the Cunard Steamship Company a meeting of the New York Electrical Society was held on board of the turbine steamer *Lusitania* on the evening of Feb. 5, over 350 members taking advantage of the opportunity to inspect this magnificent ship. The members assembled in the main saloon, where Capt. Watts greeted them. They were then conducted down into the bowels of the great vessel and spent over an hour among the maze of machinery. There are many reciprocating engines aboard; they are used for auxiliary purposes and are of small sizes, but the dynamos are driven by turbines. The four turbo-generators were furnished by C. A. Parsons & Company, Ltd., Newcastle-on-Tyne. Each unit is rated at 375 kilowatts at from 110 to 120 volts, running at 1200 r. p. m. Each dynamo is shunt-wound, the armature being of the surface drum-wound type. The steam consumption of these units at full-load is stated to be from 46 lbs. to 48 lbs. per kw-hour, rising to 60 lbs. at half-load. A novel feature in the construction of the commutators attracted attention. The surfaces are not straight, but broken up into a series of concave channels and these, in turn, are corrugated, the purpose of this construction being to give a larger contact surface for the wire brushes.

Some idea of the great aggregation of machinery may be gathered from the fact that it occupies a space 482 ft. along the length of the ship, exclusive of the space occupied by the boilers. During the tour of inspection, the kitchen, second cabin and other interesting parts of the ship were visited. The kitchen was particularly interesting on account of its immense size, and the orderly arrangement of its equipment, and the second cabin accommodations, it was noted, were quite as luxurious as the first-class accommodations of most transatlantic steamers.

After the inspection, the visitors adjourned to the smoking room, where refreshments were served. Before adjournment the meeting passed a vote of thanks to Capt. Watts, Mr. Vernon H. Brown, the agent of the Cunard Line, and through him to the Cunard Company for the entertainment of the society, and for the kind attentions on the part of the officers of the ship.

The Value of Institute Membership.

By David B. Rushmore.

The question of membership in professional societies is one which arises early in the career of all engineers. The desirability of belonging to such organizations must naturally be the result of individual benefit received from it. Experience has shown that those things which are desired by many individuals can best be obtained through some form of organization, and a professional society, such as the American Institute of Electrical Engineers, should supply the common desires of a professional nature on the part of electrical engineers.

The signs of the times point to the increased specialization of individuals and of professional societies. It seems as if an organization of some kind was made or in the process of making for the accomplishment of nearly everything of common desire.

The value of membership in the Institute is necessarily dependent upon the use made of it by the individual members. The transactions and proceedings contain the most valuable contributions to electrical work, and are invaluable to one who expects to keep well informed regarding his profession. Nowhere else can be found papers by the same class of men of the same high rank and containing the valuable, up-to-date information and discussion as is contained in these publications. The opportunity to contribute to them, either at the general or section meetings, is one desired by an engineer who wishes to do his part and to bring forward his own ideas.

Amongst the most valuable assets of the professional man is his acquaintance with other members of the profession, and the opportunities given at the different meetings of the organization are unequaled by other ways. The training and experience which accompany the preparation and presentation of professional papers is very desirable, and the ability to influence in this way the standards of engineering practice is quite necessary to one having responsibility or ideas of originality to bring forward.

The annual conventions offer to the members a most pleasant form of outing in connection with their professional work, and one which is of much profit as well as pleasure. By attending the different conventions which are held, a great many different places are seen, a wide and most pleasant acquaintance is formed, both amongst the organization and amongst the local representatives, and the opportunities for social diversion in connection with professional work are obtained under the most pleasant and advantageous conditions.

The formation and active growth of the sections and branches offers an opportunity to electrical engineers which very much enhances the value of the society to them by bringing it home and by allowing an active participation by members situated at different points all over the country. The outcome of the society as a whole will finally consist of a federation of its branches for strengthening the organization and allow it to offer in return to its members a great deal more than would otherwise be the case. The educational work which is being started and which will undoubtedly have a great value, will be a potent influence in the development of educational courses in technical institutions and also it is hoped in the systematizing and shaping of the work of men after graduation.

To some considerable extent the professional societies, as well as the Institute, replace the function of a fraternal organization. Many of the benefits are common to both forms of society. Full membership in the Institute should mean the assurance of a certain professional standing, and the fact that an electrical engineer does not belong to either grade of the organization is now something so unusual that it demands an explanation on the part of the individual, especially in case of application for a new position.

It is a fact that at present all classes of labor are organizing, the better to obtain ends desired in common by the members. With the probable future growth of the Institute, the profession of electrical engineering will be greatly strengthened and its growth accelerated by the reaction of this organization.

The possibility of influencing the standardization of engineering practice is one of the most attractive features to an active professional man, and the value of this to the profession at large is very great.

Just what one gets out of an engineering society depends to a large extent upon what he puts into it, and this, of course, must vary with different individuals. At present a man's professional work must consume his almost uninterrupted attention, and by and through the Institute it is possible to so round out his life that with the best efficiency he may obtain those factors necessary to a broad development in the most economical manner.

Injunction Against a Newspaper for Inciting Conspiracy and Boycott Against a Telephone Company.

The extent to which a newspaper may go in publishing articles, intended to arouse public feeling against a telephone company, has recently been judicially defined in West Virginia. The action which called for the ruling was brought by the National Telephone Company of West Virginia against the editor of the *Wheeling Majority* and others. The bill alleged that the defendants had organized a conspiracy to tie up the plaintiff company's business; that, in pursuance of the conspiracy, a strike had been ordered among the employees of the company. It was further alleged that the defendants had distributed a circular advocating that the company be boycotted and had actually cut down and destroyed lines belonging to the company. It was held that the facts justified the granting of a preliminary injunction restraining the unlawful acts. To the defendants' argument that "this is an age of combinations" it was answered that combinations must nevertheless be lawful. When a combination of capital seeks to accomplish a purpose by unlawful means, it becomes the duty of the courts to restrain the unlawful practice and to punish the unlawful acts. Likewise, when a combination of labor is formed for unlawful purposes, the courts are bound to act. Said the court: "The law knows no distinction between the rich and the poor, recognizes no distinction between unlawful acts of combinations of capital and unlawful acts of combinations of labor. The same principles applying to one must apply to the other, and when a combination of laborers is organized for unlawful purposes, or, being organized for lawful purposes, employs unlawful methods, it will be suppressed by the courts, its unlawful acts restrained, and its crimes punished as promptly and as effectively as like combinations of capital." . . . "The injunction granted does not deprive the newspaper in question of any lawful right to publish the truth or express its opinions in a lawful manner, but no newspaper has the right to publish any matter intended to aid wrongdoers in accomplishing a wrongful purpose or doing unlawful things, or to aid unlawful combinations in making effective an unlawful conspiracy. Some newspapers, certainly the one involved in this case, have misconstrued the freedom of the press until they seem to interpret the right to be a license to publish what may please them, even though the publication should be an express violation of the law. There is no intention on the part of the court to interfere with the freedom of the press, but this court is not ready to accept the theory that the freedom of the press means a right to advocate crime or to encourage the violation of the law."

Foreign Demand for Electrical Apparatus.

The consular reports of the Department of Commerce and Labor give the result of some inquiries as to the demand abroad for electrical fans and other supplies. Reports have been received from United States consuls all over the world.

The plant at Seoul, Korea, is described as growing rapidly and as importing American fixtures of all kinds. The American-Korean Electric Company, of Seoul, intends to introduce fans extensively during next summer, and electric flatirons, warming pads and other novelties will probably follow in due course. The steady market demand at present, however, is limited to motors and fixtures. On account of the power companies' method of installing fixtures and then renting them to the consumers, there are no stores in Korea carrying exclusive stocks of electrical fixtures and furnishings, as is the case in the United States. The Oriental Consolidated Mining Company, operating at Unsan, has recently installed a modern and complete hydro-electric generating plant, capable of operating their stamp-mill machinery and mine hoists. This company is using American electrical materials exclusively and is at present enlarging the scope of its plant. The electrical companies at Fusan and Chemulpo supply only current for electric lighting purposes and install fixtures, while the small plant supplying light to the imperial palace at Seoul operates but a few hundred lights. The Chemulpo company may be said to confine its material and supply accounts largely to German markets or German business connections. The Korean duty on imports of this nature is 7 per cent, with no limit to the size of packages. Shipments can only be made from New York to Kobe or Nagasaki, Japan, Kobe being preferable, thence to Chemulpo, the port of Seoul. Rates from Japan to Chemulpo, $3.98 gold per ton.

Consul-General William H. Michael, of Calcutta, reports that the electrical business is not specialized in India as it is in some other parts of the commercial world. A firm may do a general business, such as handling motor cars, motor boats and a hundred other commodities not necessarily closely connected, but each department has a head, and generally he is a specialist, to attend to the work in hand. The duty on electric goods is 5 per cent ad valorem. There are no customs regulations as to how goods should be packed. As a rule, American shippers pack their goods, apparently, without regard to long distances and the strain on packing by the ship's rolling, etc. Boxes should be strong and bound with hoop iron. The electric current for fan motors is direct, and the voltage is 225.

It is reported that at Bahia, Brazil, the current is alternating, 60-cycle, 110 volts. A duty of 15 per cent ad valorem is collected on electrical goods. At Bogota, Colombia, the current is alternating, 150 volts. At Cape Town, South Africa, fans do not seem to be in much demand, but the oscillating types have not been tried. The current is direct, 220 volts. At Kimberley the current is alternating, three-phase, 50 cycles. At Port Elizabeth it is direct, 250 volts. The duty on electrical goods, except lamps, electroliers and special fittings is 3 per cent ad valorem, and on the exceptions 15 per cent. At Durban, Natal, a direct current at 550 volts is available, and also an alternating current, 62 cycles, 110 and 200 volts.

Mr. Seirsdorfer, clerk in the Milan consulate, Italy, reports to Consul James E. Dunning that Lombardy does not seem to offer a market for American or other foreign electric fans, as instead of importing, many thousands of Italian-made fans are annually exported, two lots having recently been exported to the United States. At present practically all theaters, hotels, restaurants, barber shops, government buildings and business houses are supplied with electric fans, and the local demand therefor is very great. The electric current used for running fan motors, supplied by the electric lighting companies, in Milan is both direct and alternating. The direct current has 110 volts, and the alternating current 80 and 160 volts, and there are 42 alternations.

Consul Albert H Michelson, of Turin, reports that nearly all the electric fans entering that market come from Germany. They are packed in simple wooden boxes. The customs duty on electric fans, as instruments, is 75 lire per 100 kilos ($14.47 per 220.46 pounds), general tariff, and 30 lire ($5.79), conventional tariff, same quantity. Imports from the United States are admitted at the conventional rates of duty. The freight charges from Genoa to Turin on electric fans are 2.85 lire per 100 kilos (55 cents per 220.46 pounds). Unshipping at Genoa, 14 to 30 cents per 220.46 pounds, according to the position in the ports where the unshipping takes place. There are other small charges at Genoa for storage, hauling, government stamps on bill of lading, etc.

Dinner to Mr. H. H. Vreeland.

On Feb. 7 the New York Railroad Club gave a testimonial dinner to Mr. Herbert H. Vreeland, the president of the club. Three hundred and seventy-nine members attended the dinner, which was a most enjoyable affair and indicated the host of friends Mr. Vreeland has made. The club presented Mr. Vreeland with a large silver loving pitcher.

The toastmaster was Mr. W. G. Besler, vice-president and general manager of the Central Railroad of New Jersey, and the speakers were Mr. John F. Deemes, D. S. M. P., R. S. and M. N. Y. Central Lines; Mr. William J. Wilgus, who is actively engaged in the construction of the International Tunnel under the Detroit River at Detroit, Mich.; and George A. Post, president of the Standard Coupler Company. In acknowledging the loving pitcher Mr. Vreeland expressed his appreciation of the sentiment typified by the large gathering of his friends who are members of the club of which he has been president for the past 10 years, and said:

"Inexorable as the rule is that a man must do his own winning, there is little he can win without friends. They will not supply the elements of success—industry, integrity, ability—but even with all of these he must have friends. There must be those at hand who will say the right thing for him at the right time in the right place. No man's ability was ever great enough to give him fortune or power unless surrounding and sustaining him was the favor of a few loyal friends."

The audience was a most representative one, including President Underwood, of the Erie Railroad; President Gannon, of the Norfolk & Southern Railroad; President Shaw, of the Boston & Worcester Railroad; President G. Tracy Rogers, of the Binghamton Street Railway Company; higher officials of several score of important steam and electric railways, representatives of numerous manufacturing companies, and engineers connected with steam and electric railway work. The enthusiastic manner in which they honored the guest of the evening was a strong testimony to the high personal esteem in which Mr. Vreeland's friends hold him, and of their appreciation of his work in the club and their regard for his friendship.

The dinner committee consisted of Messrs. Frank Hedley, George W. West, Henry D. Vought, William B. Albright and Daniel M. Brady, chairman. The dinner was given at the Hoffman House.

Third-Rail Traction in Belgium.

Mr. Frank J. Sprague has received confirmation by cable from Monsieur Bertrand, Administrator of Traction and Material for the Belgian State Railways, that after long investigation it has been decided to adopt direct current and the third-rail for the initial electric railway equipment at the Parc de Laeken, near Brussels. This decision was made in accordance with the recommendations of a report by Monsieur Em. Uytborck, electrical engineer of the government railways, who some months ago visited the United States, and spent considerable time investigating the operation of the New York Central, New Haven and other installations, visiting the various manufacturing companies, and fully acquainting himself with the state of direct-current and single-phase development in this country. License has been taken on behalf of the Belgian government to use the

Wilgus-Sprague type of protected third-rail, and orders for much of the necessary material have already been placed in this country. It is stated that this decision was made in opposition to the strong technical influence of the near-by German neighbors, and in face of the claims made for single-phase operation.

Electrical Engineering at Tulane University.

The electrical engineering work inaugurated at Tulane University, New Orleans, several years ago presented one of the earliest opportunities to the young men of the industrial South for this class of training. About 200 men are now taking engineering courses at Tulane, and upward of 300 electrical and mechanical graduates are on the university's records. The electrical course is in charge of Prof. Douglas Anderson, and the equipment of the department, while not in any sense elaborate, is representative of the fundamental principles which form the backbone of the first three years of undergraduate instruction.

At Tulane the college year is about eight months long, and this, combined with the pressure necessary to give thorough training in engineering fundamentals, mathematics, physics and shop practice, leaves no time for the preparation of regular theses in the senior year. The mechanical and electrical courses are combined in one, and the shop facilities are particularly well developed. In place of the theses work, many of the students are given the opportunity to assist the professors in their consulting work outside the college.

The electrical laboratory at Tulane is a building 50 ft. x 40 ft. in size, equipped with over 20 dynamos and motors of various kinds, transformers, arc lighting equipment, steam engines and line shafting. A large number of measuring instruments and auxiliary devices are in service, and the mechanical plant of the college buildings is arranged for test purposes in addition to its regular work. All the machinery in the shops and laboratories are motor-driven. The boiler house is one of the group of new buildings on St. Charles Street. In it is located the steam plant of the university, from which all the mechanical service is supplied. The steam for heating is carried underground in a distribution system, automatic reducing valves being installed at the various buildings. The boiler plant has a capacity of 250-hp.

One boiler is arranged to operate under either natural, forced or induced draft, and its furnace is of the Dutch oven type, arranged to burn either oil or coal. An extensive oil, feed-water, fire and condensation pumping equipment is installed, and is available for tests. The water for the steam plant and other general purposes is derived from an artesian well 800 ft. deep located near the boiler house. This well overflows into a receiving cistern, from which the water is pumped into an 8000-gal. tank supported on a steel tower at a height of 51 ft. From this tank water is supplied to the buildings, and the equipment affords an excellent medium for hydraulic experiments. Gas engines and material testing apparatus are also installed. A fifth-year graduate course is offered in specialized electrical subjects.

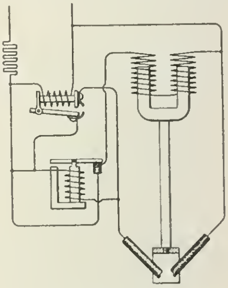
Electricity in Afghanistan.

Mr. C. M. Pepper has an article on the development of electricity in the Orient in *Scribner's Magazine* for February. He discusses a number of features of the subject already noted in these columns and familiar to our readers, and makes the following remarks as to Afghanistan: "There is a plan for utilizing the tremendous force which lies beyond the Khyber Pass in the wasted waters of Afghanistan. It is proposed to supply electricity for lighting the forts and military cantonments scattered over a large territory and also for the stations and yards along the railway lines. The enterprise contemplates the construction of trolley lines spreading out through the dense populations of northern India, and an electric railway from Peshwar up the Khyber Pass to the British outpost station there. When I write this article this project is receiving favorable consideration from the British Government. In some form within the next few years it will be adopted.

"Apropos of the Himalayas and the progress of electricity a query is raised regarding Tibet. Is the roof of the world less susceptible to this progress than Kashmir, which may be called the eaves? The answer may be given that the conditions are not the same, for Kashmir is habitable by a large number of people, in altitudes ranging from 2500 ft. to 10,000 ft., while Tibet at 14,000 ft. to 20,000 ft. could not sustain a large population. Yet should the ultimate outcome of the British political mission to Lhassa with its military accompaniment be the prospecting of the Himalayas for gold, and discoveries of that precious metal be made, the water power would be utilized as in the Kolar gold fields of Mysore."

Magnetic Deflector for Arc Lamp.

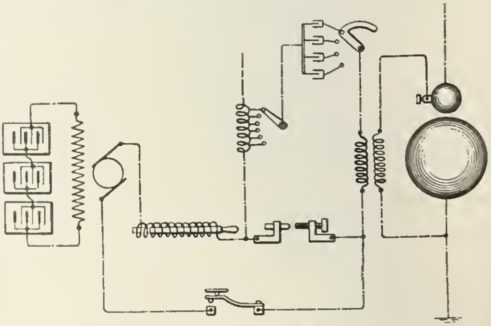
The accompanying illustration shows an arrangement of the electrodes of an arc lamp such that the arc may be properly deflected by means of a magnet. The magnet is connected to the feeder mechanism in such a manner that its position is automatically changed to compensate for the change in the position of the arc produced by the decrease in the electrodes as they waste away. The arc is so deflected as to remain substantially horizontal, or to be bowed downwardly.



CRAVENS ARC LAMP.

Murgas Wireless Telegraph Transmitter.

The accompanying illustration shows an arrangement of wireless telegraph transmitter apparatus disclosed in a patent issued Jan. 14 to Rev. Joseph Murgas. A direct-current generator with constant field excitation is connected in circuit with an inductance coil, a spark-gap and a contact-key. Shunted across the spark-gap is a series circuit containing a variable-turn inductance coil, a variable-capacity condenser, and the primary of transformer; the secondary of the transformer is connected to another circuit, which includes a spark-gap the terminals of which are connected respectively to the antenna and the earth.



MURGAS WIRELESS TELEGRAPH TRANSMITTER CIRCUITS.

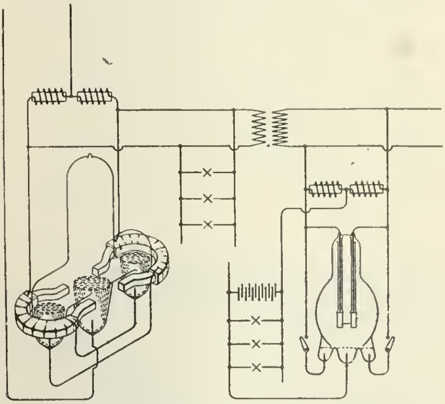
When the circuit key is closed, a spark is produced across the air-gap in this circuit after the condenser has been fully charged. When the spark is formed, the condenser discharges and produces oscillations in the transformer and in the antenna circuit. The inductances and the capacity are adjusted for syntonism at the desired transmitting frequency.

Direct-Current Transformation.

A patent issued Jan. 21 to Dr. E. Weintraub discloses means for the conversion of direct-current of one voltage into direct-current of another voltage without the use of apparatus with parts. One of the links in the chain of transformation circuits is a circuit carrying alternating-current, so that the transportation of the energy may be accomplished at high e. m. f. Use is made of two mercury-vapor converters, one of which transforms direct-current into alternating-current, and the other rectifies the alternating-current.

Principal interest centers in the former converter, which is shown to the right-hand in the accompanying illustration. There are two mercury anodes and one mercury cathode located at the bottom of an exhausted glass receptacle. During operation the arc oscillates back and forth between the two anodes and continuously to the cathode, at a frequency of from three to ten pulsations per second. The shifting of the arcs is attributed by the inventor to the fact that when a mercury-vapor arc starts from one anode its resistance so increases as to become greater than the resistance of the path between the cathode and the other anode. The arc, therefore, shifts over to the other anode, and the phenomenon is continuously repeated.

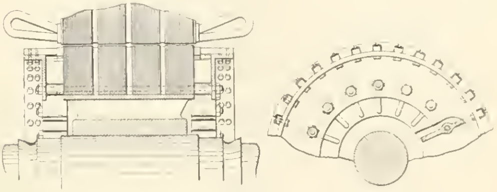
It has been found that the rate at which the arc shifts between the anodes may be greatly increased by driving the arc which emanates from the cathode spot, by electromagnetic means, back and forth so that it is first nearer to one anode than to the other, then nearer to the latter than to the first, and so on. As indicated in the illustration, two electromagnets are so located that the magnetic field produced by each extends across one of the spaces between the cathode and the electrodes.



DIRECT-CURRENT TRANSFORMATION.

Ventilated Induction Motor.

In the design of induction motors it is desirable that provision be made for supplying a sufficient volume of air against the active parts for the purpose of keeping them cool. In order to obtain the maximum output from a motor structure it is necessary that rotor be so constructed as to produce the maximum cooling effect when in rotation. Constructional details for obtaining the desired results are disclosed in a patent issued Dec. 3, to Mr. B. A. Behrend. It will be noted from the accompanying illustrations that radial blades are located in an advantageous position for cooling the rotor and stator, since they are near the conductor bars, in contact with the laminæ and between the laminæ and portions of the end rings. The latter portions do not interfere with the circulation of the air, but guide it outward.



FIGS. 1 AND 2.—BEHREND INDUCTION MOTOR.

Gas-Engine Efficiency.

In a paper presented before the British Institution of Civil Engineers, Mr. Dugald Clerk gave the following results of the test of a Stockport gas engine, 6½ ins. diameter by 13 ins. stroke, developing about 5 horse-power:

	Foot-pounds.	Per cent.
Indicated work	2690	22.0
Heat lost on explosion and expansion	3880	31.7
Heat present in gases at exhaust	5350	43.7
Heat lost on compression	320	2.6
	15.7 B. T. U. = 12,240	100.0

London illuminating gas was used, and owing to the small size of the engine, the heat losses were large.

The Washington, Baltimore & Annapolis Single-Phase Railway.

Considerable information concerning the plans of the Washington, Baltimore & Annapolis Railway Company, with reference to the electrical equipment of the railways between the places indicated, was given on page 712 of our issue for Oct. 13, 1906. The route has been graded for the whole distance, and track has been laid over most of the route. In fact, the work has so far progressed that the 22-mile section between Washington and Naval Academy Junction, and the 14-mile section from the latter point to Annapolis, were opened for the public on Feb. 7, 1908. Only a small part of the trolley wire is in place along the 16-mile section from Naval Academy Junction to Baltimore, but the work of erection is being carried rapidly forward. We are able to give below certain details that were not available for publication when our former description appeared.

The overhead trolley line is of the single-catenary construction. Although the poles along the double-track portion of the route are placed in pairs across the tracks, the side-bracket arrangement is used throughout. Instead of the usual pipe for supporting the insulators, use is made of T-iron secured in lugs on the poles, and held in position by a single iron rod braced from near the top of the pole. Where the track is laid double, the two poles on opposite sides are held together at the desired distance of separation by means of an iron wire cable containing a wooden strain insulator at the center. This insulator has been inserted to insure safety to linemen when working with the wire over one track while the other is in use. The two poles are drawn apart by guy wires, so that the completed structure possesses great rigidity as to location, but the contact wire provides a considerable element of flexibility by reason of the catenary suspension. There is used at each pull-off a link porcelain insulator, which in some cases is reinforced with a wooden strain insulator in series therewith. The insulator which supports the messenger wire is of the double-cloaked brown porcelain type, containing a groove on top in which the wire is placed along tangents, and a groove around the sides, on the inner side of which the wire is supported along curves. This insulator is so proportioned that it will not be destroyed when subjected to the inevitable blow from the small boy. The section insulators in the contact and messenger wires are of novel design. Each one is provided with an inner insulating runner which serves for guiding a wheel trolley, and two outer runners which were provided for use in case a pantagraph trolley were adopted at a later date, and which insures the desired strength for the insulator. The section insulators are rigidly supported from the bracket arm by means of double porcelain insulators. At overhead bridges, the supporting insulators, with the messenger wire, are surrounded by an iron trough, which is permanently connected to earth.

For the purpose of protecting the trolley wire from static disturbances due to lightning, a galvanized iron wire is supported along the top points of each pole line; this wire is connected to earth at convenient intervals. The railway company maintains its own telephone circuit placed on cross-arms on the side poles. Extra precaution is taken to insure that a person using the telephone shall not be injured in case the telephone wire should come in contact with the trolley wire, or a low-resistance path should be formed between the two. There is no direct metallic connection between the telephone instruments and the telephone lines. Each instrument is inductively associated with the line, an insulating transformer designed to withstand 25,000 volts between coils being used for this purpose The central e. m. f. point of both the line side and the instrument side of each transformer is permanently grounded, so that all danger of a potential rise at the instruments has been eliminated.

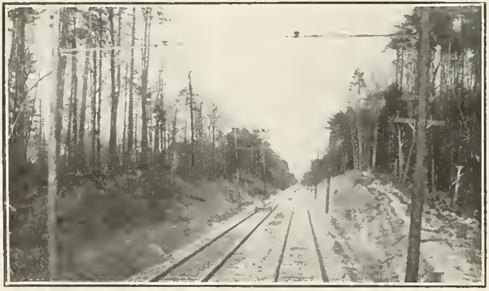


FIG. 1.—VIEW OF SINGLE-CATENARY CONSTRUCTION ALONG DOUBLE TRACK ROAD.

The poles are spaced at intervals of 150 ft. on tangents. The hangers which support the contact wire from the messenger cable are placed 16⅔ ft. apart, so that there are nine hangers between adjacent poles. A half-turn gripping arrangement on the top of the hanger, combined with a clamping device at the bottom, allowed the hangers to be placed with great rapidity. In fact, by the use of four box cars for platform for the linemen, as many as 4 miles of line have been erected in a single day.

Many unique schemes are embodied in the transmission system. Energy is obtained from the Potomac Power Company at 6000 volts, three-phase. By means of seven 800-kw T-connected transformers the energy is converted into two-phase: the e. m. f. of one phase is 6600 volts, that of the other 33,000 volts. The former phase is connected to the catenary trolley system from Washington to Naval Academy Junction, while the latter is connected to a single-phase 33,000-volt transmission line running to a motor-generator and transformer sub-station at Naval Academy Junction. In the sub-station there are four 800-kw transformers which reduce the e. m. f. from 33,000 to 6600 volts. Energy is fed at the latter voltage to the trolley lines running to Baltimore and to Annapolis.

The revolving machinery in the Naval Academy Junction sub-station consists of two 670-hp, 6600-volt, two-phase synchronous motors driving two 300-kw commutating pole direct-current generators. The latter machines are compound-wound for an e. m. f. of from 550 to 600 volts. Each motor-generator set is provided with a direct-current generator for supplying exciting current to the synchronous motor. The motors are brought up to speed as two-phase induction motors at reduced voltage. It will be noted that one phase of the motor when operated two-phase receives energy over the track circuit from Washington, while the energy for the other phase comes by a more direct electrical route over the 33,000-volt transmission circuit. Even if no cars were in use along the railway between Washington and the sub-station, there would be a considerable unbalance in the load on the two circuits when the synchronous motor was heavily loaded, due to the difference in the effective impedances in the circuits of the two phases; the unbalance evidently becomes much greater when cars are in use. However, the synchronous motor possesses the advantageous feature of supplying a flexible coupling between the two phases, so that it tends to maintain the e. m. f. on the overloaded phase, to equalize the loads on the two circuits and to improve the power-factor when the excitation is properly adjusted. The motors were not installed to perform these duties, and may seldom be used for the purpose; their chief function is to drive the direct-current generators for supplying energy at low-voltage to the cars throughout the shop yards at Naval Academy Junction and to stationary motors used in the repair shops. At the present time the motors are run as single-phase machines, after having been brought up to speed as two-phase machines.

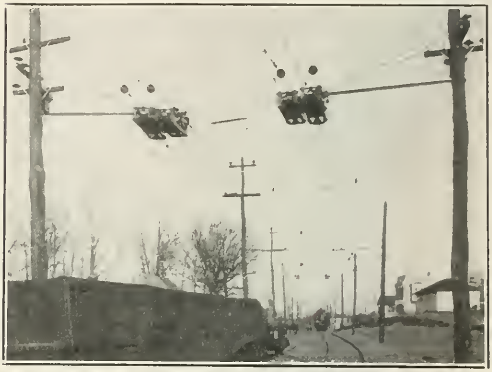


FIG. 2.—SECTION INSULATORS SEPARATING 6600-VOLT SINGLE TROLLEY FROM 660-VOLT DOUBLE TROLLEY.

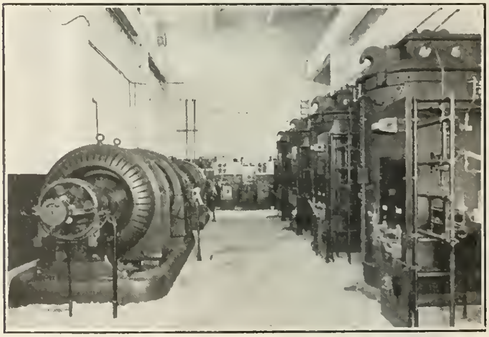


FIG. 3.—TRANSFORMERS AND SYNCHRONOUS MOTOR-GENERATOR SETS IN NAVAL ACADEMY JUNCTION SUB-STATION.

Although there are no circuits which can be considered strictly as transmission lines to connect Baltimore and Annapolis with the Naval Academy sub-station, yet energy will be transmitted from the sub-station to both of these points. The transmission will be accomplished over the 6600-volt trolley-and-rail circuit, single-phase, self-starting, split-phase synchronous motors being used to drive direct-current generators in sub-stations located at Annapolis and at Baltimore. In each of these sub-stations there will be installed two 300-kw motor-generator sets, the former to supply direct current to a No. 4-0 double overhead trolley system, and the latter to feed direct current at 600 volts to two single No. 3-0 circuits with track return. It is evident that the synchronous motors will assist in maintaining the voltage along the route.

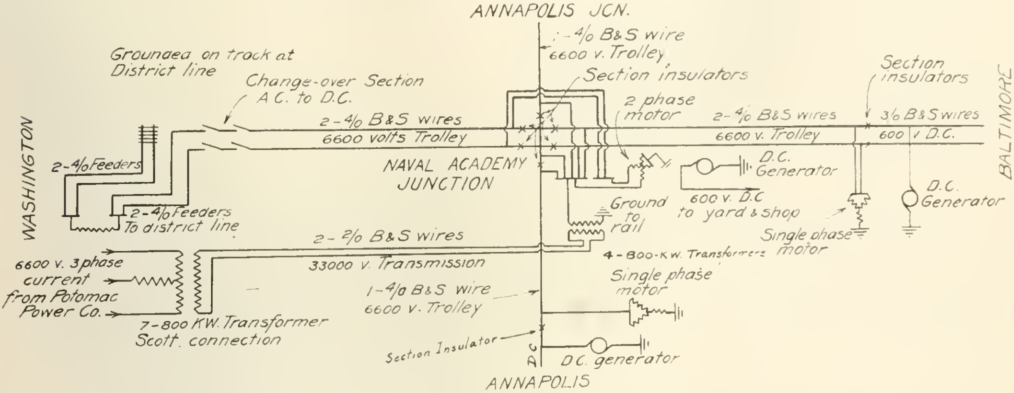


FIG. 4.—CIRCUIT DIAGRAM OF WASHINGTON, BALTIMORE & ANNAPOLIS SINGLE-PHASE RAILWAY.

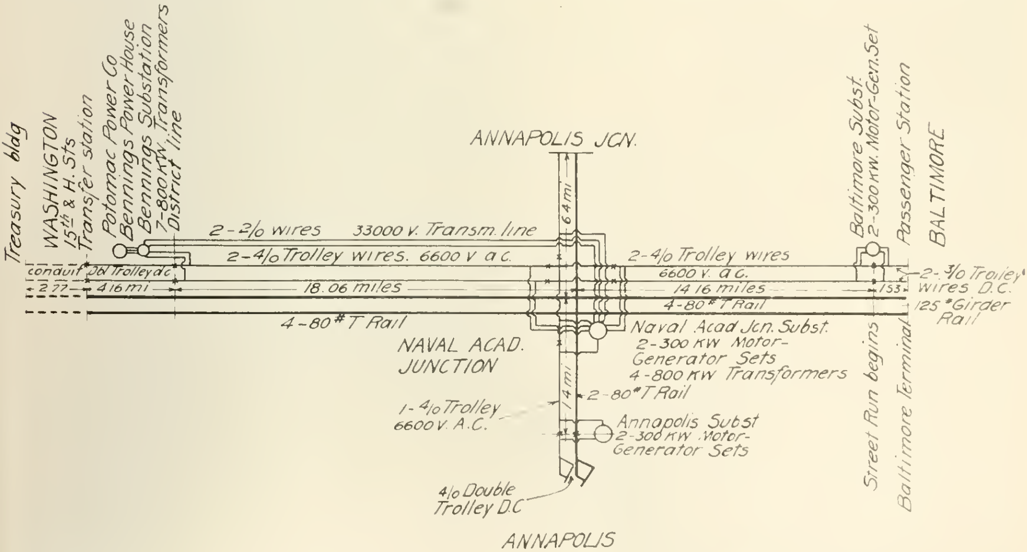


FIG. 5.—MILEAGE AND COPPER DIAGRAM OF WASHINGTON, BALTIMORE & ANNAPOLIS SINGLE PHASE RAILWAY

The motors are of the series-repulsion type, and differ in no essential detail from the machine described on page 144 of our issue for Jan. 18. There are four General Electric A-603 125-hp motors per car. During direct-current operation the four motors are connected in series and subjected to plain rheostatic control. During alternating-current working the motors are controlled in two pairs, each consisting of two motors permanently in series. However, during the actual starting period with alternating current the machines are connected as plain repulsion motors, and they are gradually converted to compensated-series motors as the speed increases. There are six points on the controller, each of which is an efficient running point for a certain speed.

Each pair of motors is supplied with energy from its own oil-insulated, self-cooling auto-transformer. In fact, the alternating-current equipment on each four-motor car can be considered as two two-motor equipments operated simultaneously from one master controller. The common circuits for the two equipments include a high-tension explosive type fuse, a choke-coil and a main circuit oil-switch, with magnetically operated tripping and closing device; the latter device receives its energy from a special auxiliary transformer which remains active even when the main switch is open. The high-tension circuits leading from the trolley poles to the auto-transformers are placed in an asbestos-lined compartment, which can conveniently be inspected at any time. The fuses and switches for the low-tension circuits are placed in a similar compartment in one of the vestibules.

When the railway system has been completed there will be 32 route miles of main line, double-track, 6600-volt No. 4-0 circuit from Washington to Baltimore, and 14 miles of single-track No. 4-0 circuit at the same voltage from the main line to Annapolis; in Annapolis there will be .85 mile of double trolley, 600-volt direct-current No. 4-0, in Baltimore 3.06 miles of No. 3-0 single trolley circuit in Baltimore, 8.32 miles of overhead and 5.54 miles of underground slot-conduit, 600-volt direct-current railway circuit in Washington.

The Roberts & Abbott Engineering Company, of Cleveland, Ohio, have acted as consulting engineers for the entire installation. The motor equipment of the cars and the electrical equipments of the line and sub-stations were supplied by the General Electric Company. We are indebted to Mr. J. N. Shanahan, of the Washington, Baltimore & Annapolis Railway Company, for numerous courtesies extended during the preparation of this article.

CURRENT NEWS AND NOTES.

ELECTRICITY IN STEEL MILLS.—At the session of the American Institute of Mining Engineers, which will be held in the Engineering Societies' Building, New York, on Feb. 18, Mr. D. B. Rushmore, of Schenectady, will read a paper on "Electric Power in Steel Mills."

A CORRECTION.—In the letter by Mr. D. C. Carpenter on the "Rolling of Thunder," printed on page 306 of the issue dated Feb. 8, the final sentence should read as follows: "If the echo from one part of a flash reached the listener before the sound which came direct *had ceased,* the echo would be superimposed upon the latter." The words italicized were omitted in printing.

IRISH TECHNICAL EDUCATION.—In December the city of Belfast formally opened its Municipal Technical Institute, the building of which cost $500,000, and which has a permanent maintenance income of $80,000 per annum. Among the departments are a course in mechanical engineering, and another one in physics and electrical engineering. There are also day courses in electrical and mechanical engineering.

LICENSING ELECTRICAL CONTRACTORS.—Mr. A. C. Masters, president of the Ohio Electrical Contractors' Association, and Mr. M. W. Hansen, director of the National Electrical Contractors' Association, have appeared before the committee on manufacturers of the House of Representatives of Ohio to urge the passage of the Reynolds bill which is designed to create a state board to examine and license electrical contractors. It is said that the fee will probably be reduced from $100 to $50 for the first year's license and the bill recommended for passage.

WEATHERING OF COAL.—Bulletin No. 17 of the Engineering Experiment Station of the University of Illinois is on "The Weathering of Coal," the authors being Messrs S. W. Parr and N. D. Hamilton. The bulletin relates to the losses in fuel values which accompany storage under various conditions. The results of tests open a way for a better understanding of matters pertaining to weathering, spontaneous combustion and other difficulties which attend the storage of coal in large masses. Deterioration was studied with samples maintained in the open air, under cover at varying temperatures, in air-tight containers, and in the submerged conditions.

MUNICIPAL PLANT COMMERCIAL SERVICE.—In a hearing before the Ohio Legislature on a bill relating to the supply of commercial service by municipal plants, Mr. G. L. Gaskill, secretary of the Ohio Electric Light Company, stated that of the 113 municipal lighting plants in the state, 82 are in towns of less than 12,000 population. Fifty-two of the municipalities have stated to him that they are selling current at 6½ cents per kw-hour, which, he said, meant financial ruin to them. This has been proven by the towns that have gotten into trouble in the past and disposed of their property. Time will always tell, as municipal plants are never operated with the same degree of economy that private plants are. He advocated an amendment whereby if municipalities are empowered to engage in commercial service they shall be required to fix a rate commensurate with the cost of production. The plan was also advocated of referring the question of establishing light plants to a vote of the people, a two-thirds majority to carry.

A. I. E. E. DINNER.—The annual dinner of the American Institute of Electrical Engineers will be given Feb. 19 at the Waldorf-Astoria. The price per plate will be $5, not including wine or cigars. As usual, ladies will be present. The dinner will be designated the "Public Service Dinner," and responses to toasts will be made by men prominently identified with public service utilities. Acceptances of invitations have been received from Chairman Stevens, of the Public Service Commission; President Shonts, of the Interborough Rapid Transit Company, and Messrs. C. R. Huntley, C. P. Steinmetz, B. A. Behrend and Walter C. Kerr. The presence is expected of President Clowry, of the Western Union Telegraph Company; Mr. George G Ward, general manager of the Commercial Cable Company; President Dudley Farrand, of the National Electric Light Association; President Alex. Dow, of the Edison Illuminating Companies Association, who have been invited as guests, together with representatives of the New York Telephone Company, New York Edison Company, Commonwealth Edison Company, Boston Edison Company and Philadelphia Electric Company.

COMPARATIVE TESTS OF INCANDESCENT LAMPS.—Bulletin No. 19 of the Engineering Experiment Station of the University of Illinois gives a comparative study by Mr. T. H. Amrine of the electrical characteristics, life, candle-power maintenance, horizontal and vertical distribution and cost of operation of carbon, graphitized carbon and tantalum filament lamps under both good and poor conditions of operation. It is based upon a series of tests in which particular attention was paid to obtain exactly similar conditions for the three types of lamps in order to give a fair basis of comparison between types. In explaining the reason for the high efficiency of the newer lamps a study is made of curves plotted between "filament temperatures" and "candle-power per square inch of filament area," and between "watts per candle-power" and "filament temperature." A consideration of these curves leads to the conclusion that the increase in efficiency of the graphitized over that of the carbon filament is due almost equally to higher filament temperature and to selective radiation, while for the tantalum filament it is due almost wholly to higher temperatures

A REMARKABLE BOILER.—A circular from one who styles himself "Inventing Architect," sets forth the claims for a boiler which, it is stated, will give "four to five times more strength than formerly with same coal," and which will render it useless to extract electricity direct from coal, as the new boiler will raise the efficiency of steam-power production to 100 per cent from the present 15 per cent. The inventor says: "My invention recreates steam power and makes it *the Imperator and the Pontifex-Maximus* of all motor power, and it is the only economical generator of electricity. Being a man of a so-called all-round high education and being very quick to see a weak point in our ever-advancing technical age, I like to cure it, as a matter of course, and I think people who say 'Let good enough be well enough' should be awakened from their lazy sleep. The latest, but weak substitutes, for the good old reliable steam power, I mean the gas and hot air engines, the oil engines, motors, etc., will consequently find an early grave in the rust-hill cemetery as soon as my Optimo boiler appears on *the high plane of modern industry.*" The reader is asked to send $2 for "the secret," and is cautioned to remit only by express.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The spring meeting of the American Society of Mechanical Engineers will be held at Detroit, Mich., June 23, 24, 25 and 26 of this year.

IOWA ELECTRICAL ASSOCIATION.—The next convention of the Iowa Electrical Association will be held at the Hotel Savery, Des Moines, Ia., April 22 and 23. Mr. W. N. Keiser, Des Moines, is the secretary.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.—The next meeting of the National Electrical Contractors' Association will be held at Chicago, July 15 next. Mr. W. H. Morton, Utica, N. Y., is the secretary.

NATIONAL ELECTRICAL TRADES ASSOCIATION.—The ninth annual meeting of the National Electrical Trades Association will be held in Philadelphia, June 11 next. Mr. Frederic P. Vose, Marquette Building, Chicago, is secretary.

MISSOURI CONVENTION.—Secretary Chas. Z. Pierson, of the Missouri Electric Light, Gas and Street Railway Association, announces that the next meeting of that association will be held at the Marquette Hotel, St. Louis, April 23, 24 and 25 next. The secretary's address is St. Charles, Mo.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION.—The next meeting of the Southwestern Electrical & Gas Association will be held in El Paso, Tex., some time during March, the exact date not yet having been determined. Mr. R. B. Stichter, Juanita Building, Dallas, Tex., is the secretary.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION.—The general meeting of the Electrical Committee of the Underwriters' National Electrical Association will be held March 25 and 26 at the rooms of the New York Board of Fire Underwriters, 32 Nassau Street, New York. Mr. C. M. Goddard, 55 Kilby Street, Boston, is secretary of the committee.

MEETING OF THE A. I. E. E.—The next meeting of the American Institute of Electrical Engineers will be held in the auditorium, Engineering Societies Building, West Thirty-Ninth Street, New York, at 8 p. m., Friday, Feb. 14. Papers relating to the rotary converter will be read by W. L. Waters, of Pittsburg, and C. W. Stone and J. E. Woodbridge, of Schenectady.

JAPANESE ELECTRICAL DEVELOPMENT.—According to the *Tribune*, of Minneapolis, Minn., Mr. William de La Barre, engineer and manager of the St. Anthony Falls Water Power Company, of that city, has declined a flattering offer to take charge for a New York engineering firm of its interests in Japan having relation to water-power electrical development in that country.

LODGE'S LATEST.—Sir Oliver Lodge in a recent lecture before the Ruskin Society came out strongly in favor of the science of ghosts, or to use his own expression, "the science of the immaterial," which he compares favorably with the "science of the material." He even goes so far as to say that "it might be as possible for one mind to use another brain as for an author to use another man's desk."

ILLINOIS UNIVERSITY GRADUATE SCHOOL.—The Graduate School of the University of Illinois was formally opened Feb. 4 and 5 with appropriate ceremonies. Among those who delivered addresses were President G. Stanley Hall, of Clark University; Dean West, of Princeton; Prof. C. H. Moore, of Harvard; President Rammelkamp, of Illinois College; President McClelland, of Knox College, and Profs. Noyes, Greenough and Kinley, of the university. Prof. Kinley is dean of the Graduate School, which is the first in the Middle West to receive a special appropriation from a Legislature, namely, $50,000 a year for two years for development of the work.

OHIO MUNICIPALITIES CANNOT SUPPLY COMMERCIAL LIGHTING.—The Supreme Court of Ohio has decided the case of Robert H. Jackson against the city of Nelsonville adversely to the municipality, declaring that it has no right to furnish electrical energy for private purposes. The decision is that the law providing for furnishing lighting and power current by municipalities was repealed some years ago, and that no other law has been enacted to take its place. This decision affects other plants in the state.

NIAGARA FALLS POWER UTILIZATION.—The Burton law, which governs the disposition of the waters of the American Niagara Falls, expires in about a year and a half, and the interests affected are strongly opposing its re-enactment by Congress. The law was a temporary measure to be superseded by a treaty on the subject between the United States and Canada, which was intended to cover also the disposition of other waters forming a boundary line between the two countries. As this agreement has not yet been arrived at, it has been proposed to extend the law for a period of ten years. Among the reasons offered against such extension is that the Canadians, because such a large part of the falls are on the Canadian side of the Niagara River, have been dilatory in the matter of a treaty, and it is claimed that should the law be re-enacted, there will be greater incentive to delay in execution of a general treaty on the part of the Canadians.

SMOKE CONSUMPTION.—The U. S. Geological Survey has printed a preliminary report by D. F. Randall on "The Burning of Coal Without Smoke in Boiler Plants," to which is attached a bibliography of the subject. The prevention of smoke is considered under the heads of feasibility, the principles of smokeless combustion, proper furnace equipment, difficulty in securing perfect combustion and indirect methods of smoke abatement. In a summary it is stated that well-designed furnaces may be expected to give smokeless combustion when burning a suitable coal, except under the following unfavorable conditions: When fires are built; when so much coal is burned on the grate that it is impossible to supply sufficient air without frequent poking; when the rate of combustion is suddenly increased, as when more coal is added and the fires are poked to get up pressure in short time; when the fires are checked by closing doors and dampers, thus cutting off the air supply.

PRODUCER-GAS POWER PLANTS.—In a recent collection of papers issued by the U. S. Geological Survey is included an account by Mr. Robert H. Fernald of the present status of the producer-gas power plant in the United States. The greater portion of the contents is given up to a report of tests on producer gas made at the government test plant in St. Louis. As a result of a visit to some of the producer-gas power plants of this country, Mr. Fernald expresses the opinion that the plants as a whole are giving remarkable satisfaction; that the most serious difficulty seems to arise from lack of competent operators to run the plants rather than from defects or troubles in the plants themselves; that inexperienced salesmen are undoubtedly to blame for serious misrepresentations and misunderstandings; and that the neglect shown by some manufacturers with respect to the plants that have been installed and paid for is not very far sighted. His final conclusion is that the situation, as a whole, at the present time seems to be favorable to the producer-gas plant, not only as to cost of installation, operation and maintenance, but also as to reliability, and he predicts an increase in the use of this form of power within the next few years that may surpass even the most sanguine hopes of the manufacturers.

Central-Station Practice at New Orleans, La.

THE New Orleans Railway & Light Company supplies a city of about 350,000 inhabitants with electricity for all purposes. The growth of New Orleans in the past few years has necessitated a continuous policy of power-plant extension, and the generating and distributing system which has been developed was recently described in these columns. It is intended in the following article to take up the commercial side of the situation and to present the particulars of the company's central-station policy in connection with representative installations.

New Orleans is probably the largest cotton, sugar, rice and banana market in the United States. It is the gateway of the Mississippi Valley, comprising 20 states traversed by 20,000 miles of navigable rivers and it has 30 miles of dock facilities. It is one of the largest lumber markets in the country and is the terminus of many important railroad and steamship lines. Its imports are already sufficiently large to rival those of some of the cities on the Atlantic seaboard. Some of the most highly developed equipment ever produced for the efficient hauling of merchandise and agricultural products between ships and railroads is in service at the New Orleans docks, and operated by central-station energy. The results obtained show that central stations in other cities might look well into the possibilities of cheap handling of raw materials and commercial products. Besides the motor applications in connection with transportation, several factory plants have been equipped, and many retail establishments have become permanent energy-users.

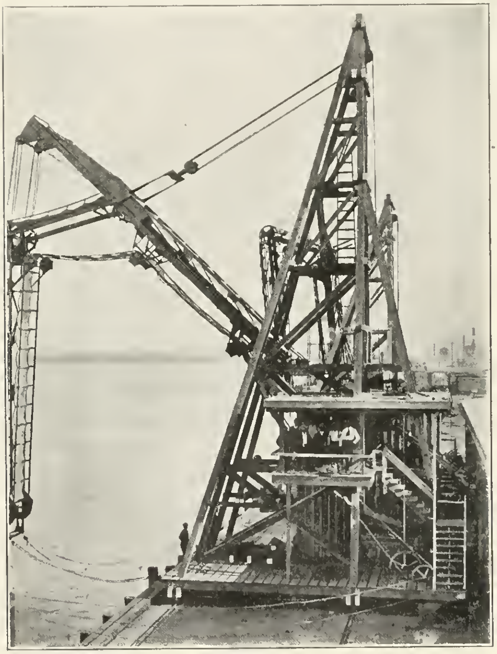


FIG. 1.—FRUIT CONVEYOR AT NEW ORLEANS WHARF.

Since the present management took charge of the company in 1902, the motor load has increased at the average rate of 20 per cent per annum. This has been due to progressive soliciting of new business and judicious advertising. On Dec. 31, 1907, the company's connected commercial load was the equivalent of 460,982 16-cp lamps, and of this connected load, 23 per cent represented motor business. The company has displaced a large number of steam and gasoline engines, and is supplying over 600 electric signs with electricity. The base rate for energy is 10 cents per kw-hour, with sliding scale discounts according to long-hour use, heavy loads bringing the minimum charge to about three cents. Signs are at present lighted on a flat rate, depending upon the consumption of energy. There was but one electric sign on the company's service in 1902. In addition to operating all the street railway lines in the city the company provides Edison three-wire, 115 and 230-volt service in the central business district, lighting service at 2300 volts, and a street arc lighting load of about 3000 constant-current, 7.5 ampere lamps.

Service feed wires are required to extend 2 ft. outside walls as a minimum, and the company does not carry lines over housetops to reach outlets. In cases where the customer desires to have the service wires enter the basement or cellar of a building the company requires the wires to be brought up outside the building in steel conduits at least 12 ft. above ground, the conduit being provided with a return bend. When two or more meters are placed on one service, the company requires the service to be enclosed in steel conduit from the outside of the building to the main switch. Separate switches are provided to control each meter. In large office buildings requiring six or more meters on each floor the company usually arranges to install all the meters for one floor at a central point, the necessary interior distribution being arranged for at the cost of the customer.

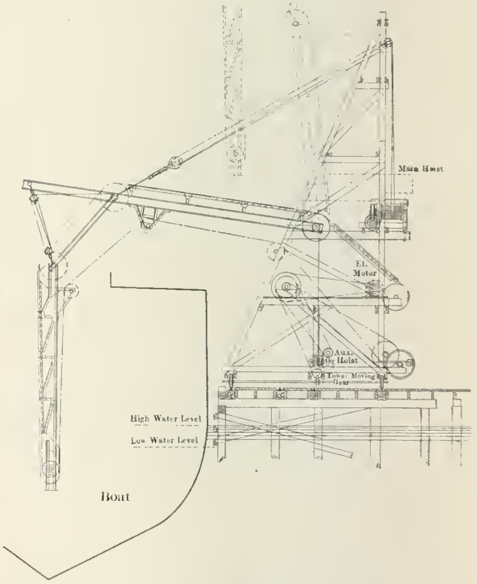


FIG. 2.—DIAGRAMMATIC VIEW OF FRUIT CONVEYOR.

The company does not allow lamps of increased candle-power to be substituted on consumer's circuits without its consent, and in case of damage resulting from violation of this rule, the consumer becomes liable for injury to transformers or meters connected with his installation. The company supplies direct-current at 230 volts in the district bounded in general by the Mississippi River, Howard Avenue, Liberty and Esplanade Streets. In all other locations the electricity supplied is 60-cycle, alternating. In unusual cases for contract work on the streets, motors are fed from the railway circuits by special arrangement.

All lighting installations are single-phase in the alternating-current districts, and all installations less than 1000 watts are on two-wire circuits. All installations of 1000 watts or more are on three-wire circuits, and no two-wire circuit is allowed

Methods of Testing Igniting Apparatus—I.

By F. W. Springer.

THE following simple methods of testing have been found very convenient by the writer while experimenting with various kinds of igniting apparatus, such as batteries, dynamos, coils, etc. It is hoped that some of them at least may interest automobile users, as well as manufacturers of igniting apparatus.

RESISTANCE MEASUREMENTS.

The resistance of the primary coil of vibrating or non-vibrating jump-spark coils and touch-spark coils can be measured by the familiar fall-of-potential method using a voltmeter and an ammeter.

The Wheatstone-bridge method may be used, but it is not so convenient or so satisfactory as the fall-of-potential method.

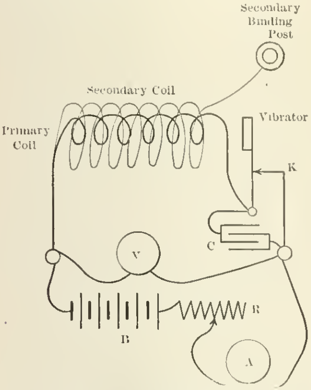


FIG. 1.—MEASURING RESISTANCE OF PRIMARY COIL.

A slide wire bridge can easily be made as indicated in Fig. 2, in which *A B* is a small high-resistance wire about 3 ft. in length; *R* is a resistor of any known resistance preferably of the same order as the unknown resistance, *X*; and *G* is a galvanometer. Close S_1, then S_2, adjusting the sliding contact, *M*, till the galvanometer shows no deflection; then,

$$\frac{\text{distance } AM}{\text{distance } MB} = \frac{R}{X}$$

from which *X* can be calculated.

Secondary coils have very high resistance, of the order of thousands of ohms. If there is available a voltmeter, *Vm*, which has a resistance of the same order as the coil, it can be connected as shown in Fig. 3. Measure the voltage of the source of current with the voltmeter at (V_1). Then connect the voltmeter in series with the secondary coil and battery as at (V_2) and again measure the voltage. Since the reading of the voltmeter is inversely proportional to the resistance in its circuit, the voltage of the source being constant,

$$\frac{V_1}{V_2} = \frac{R \text{ of sec. coil} + R \text{ of } Vm}{R \text{ of } Vm}$$

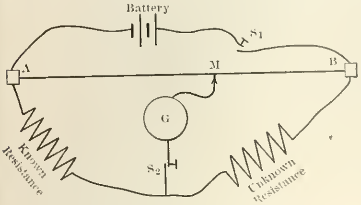


FIG. 2.—MEASURING RESISTANCE BY WHEATSTONE BRIDGE METHOD.

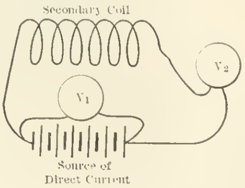


FIG. 3.—MEASURING RESISTANCE OF SECONDARY COIL.

Example, $V_1 = 110$ volts, $V_2 = 53$, and the resistance of the voltmeter being 3200 ohms, secondary coil, *R*, = 3440 ohms.

A Wheatstone box bridge with six or eight dry cells and a high-resistance sensitive galvanometer could be used for measuring the resistance of secondary coils. Moreover, a slide-wire bridge might be used.

MEASUREMENT OF MAGNETIC FLUX.

In Fig. 4 the coil *AB* should be closely wound with wire of about No. 20 in size in a single layer upon a wooden or rubber core 12 or 15 times its diameter in length. A "standard" coil might have 1773 turns of No. 24 s. c. c. magnet wire; coil length, 118.6 cm; diameter, 15.03 cm; and flux, ϕ, per ampere, 3306 lines of force. If the current in this coil, as measured by the ammeter, *A*, is *I* amperes, the flux passing through the exploring coil is approximately

$$\phi = \frac{4\pi n I S}{10}$$

in which *S* is the cross-section of coil *AB* found by taking as a radius the radius of the core plus the radius of the wire, *n* is the number of turns of wire per cm of length of the coil, *AB*, all dimensions being expressed in centimeters. On breaking the circuit at *T*, the lines of force, ϕ, will cut the *N* turns of coil *W* and cause a deflection of the ballistic galvanometer, *G*. The galvanometer deflection may thus be determined in terms of the number of lines of force through coil *W*, per ampere in coil *AB*.

A similar deflection should be obtained while using the spark coil *A′B′*, and the exploring coil *W″*. The current *I′* should be noted. Then if *D* and *D′* are respectively the deflections,

$$\phi' = \phi \times \frac{D'}{D} \times \frac{N}{N'}$$

when the current is *I′*, and *N* and *N′* are the respective number of turns in the coils *W* and *W″*.

Example, $W = 80$ turns, $W'' = 20$ turns, $I = .95$ ampere, $I' = 7.85$ amperes, $D = 4.6$ cm, $D' = 6.1$ cm, $\phi = .95 \times 3306$ lines of force.

$$\text{Then, } \phi' = \frac{80 \times .95 \times 3306}{4.6 \times 20} \times D' = 2731 \times 6.1 = 16{,}640$$

lines, or $\frac{16{,}640}{7.85} = 2120$ lines of force per ampere in the core *A′B′*.

A small standard coil made by winding No. 20 wire on a wooden cylinder 2 ins. in diameter and 24 ins. long will serve the purpose very well, but a larger current in *AB* and a larger number of turns in *W* than used above would have to be employed.

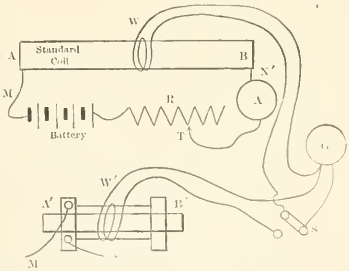


FIG. 4.—MEASUREMENT OF MAGNETIC FLUX.

It is desirable to have the resistances of *W* and *W″* as nearly equal as possible, and also the deflections of the galvanometer should be approximately equal.

The flux of a magnet may be measured by inserting the magnet into coil *W″* of Fig. 4, removing it quickly and noting the deflection on the galvanometer. The magnet should be placed in its normal position on the pole pieces about the armature, after slipping coil W' over one leg.

The following is an excellent method to use in obtaining the magnetic flux, ϕ, in the case of a two-pole, two-brush direct-current magneto-dynamo:

$$E = \frac{Z \times \phi \times S}{10^8}$$

In which E is the open circuit voltage of the dynamo when running S revolutions per second; Z is the number of inductors on the armature core, and ϕ is the total useful magnetic flux through the armature.

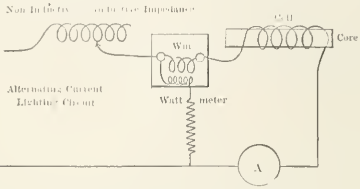


FIG. 5.—MEASUREMENT OF IRON LOSS.

Thus in an armature having 768 inductors (or 384 turns of wire) and giving 25 volts at 4800 r. p. m., the flux is 40,000 lines.

$$25 = \frac{768 \times \phi \times \frac{4800}{60}}{10^8}$$

$$\phi = 40{,}000.$$

If the self-induction and the number of turns of wire of a coil are known, the number of lines of force may be calculated For example, a certain touch-spark coil has 1300 turns of wire, N, its self-induction L, is .25 henry; to find the flux ϕ, when I is .8 ampere.

$$\text{Since } L = \frac{N\phi}{10^8 I},\ \phi = \frac{L \times 10^8 \times I}{N} = \frac{.25 \times 10^8 \times .8}{1300}$$

$$\phi = 15{,}400 \text{ lines of force.}$$

The iron loss, including the eddy-current loss and hysteresis. can be measured by placing the spark-coil core in a suitable solenoid or coil of known resistance, R, and connecting the solenoid in an alternating-current circuit as shown in Fig. 5. The watts, W, and the current, I, should be measured at a known frequency, f.

Then, $W - I^2 R =$ iron losses...

The following table shows the order of values of the iron losses of spark coils:

Coil	Amperes I_{ac}	Amperes Max I	Watts Wm	Ohms R	Watts I^2R	Watts Iron Loss	Joules Iron Loss Per Cycle
C F..	1.78	2.52	35.5	8.4	26.7	8.8	.14
C F..	2.49	3.53	75.4	8.4	53.2	22.2	.36
L B F..	1.8	2.55	1.6	0.46	1.48	.12	.0019

C F is a touch-spark coil having about 8 ohms of resistance and 0.25 henry of self-induction, and *L B F* is a vibrating jump-spark coil whose primary has a resistance of about .45 ohm and a self-induction of .0044 henry, and a core of very fine iron wire.

The above tests give only comparative values, because they do not show the actual iron loss in a spark-coil core in actual service. Since the eddy-current losses vary as the square of the rate of change of the magnetic flux, the eddy-current loss will be much greater in service than in a test with a sine wave of alternating current of the same frequency.

In the case of generators the armatures should be run at the desired speed, without any field current, or, in case of a magneto-generator, with the field magnets removed. The power will be that absorbed by windage and friction. The field should now be excited, or the magnets should be replaced and the power now required to drive the generator (without, however, taking any energy from it) should be measured. The difference between the watts thus measured will be due to the eddy currents and hysteresis of the iron. The iron loss will be found to increase rapidly with increased speed and increased field strength. A small calibrated motor is the best source of power.

A simpler method, which will give excellent results in making a comparative test of generators, is to run each as a motor and measure the watts necessary to drive it running light at the desired speed and field excitation. This power, of course, includes the iron losses, brush and bearing friction, windage and the copper losses due to the current required for running the machine.

MEASUREMENT AND CALCULATION OF SELF-INDUCTION OF COILS AND ARMATURES.

If the flux, ϕ, of a coil, and also the number of turns of wire, N, are known, its coefficient of self-induction, L, can be calculated.

For example, a certain touch-spark coil has 1300 turns (N) of wire, and gives a total flux (ϕ) of 15,400 lines of force when the current strength is 0.8 ampere. Then,

$$L = \frac{N\phi}{10^8 I}$$

$$L = \frac{1300 \times 15{,}400}{0.8 \times 10^8} = .25 \text{ henry.}$$

The coefficient of self-induction, L, of any circuit may be changed to some other desired value on the following basis:

For a certain core, L varies as the square of the number of turns; hence, if the number of turns be reduced by one-half, L will have one-fourth of its original value, etc.

For a certain coil, L varies with the cross-section of the iron core, or with the number of iron wires constituting the core. For a certain coil, and a core of definite diameter, L increases with the length of the core; especially is this true when the core is very short, other factors remaining constant. When the length of the core is approximately 20 times the diameter, the resistance of the air part of the magnetic circuit is practically zero, so that in the case of very long coils a small change in the length of the core will make no appreciable difference in the coefficient of self-induction.

Since L varies as the square of the number of turns of wire on a core, when there are two windings on the same core, N_1 and N_2, and the self-induction L_1 of N_1 is known, the coefficient L_2, when this coil is used alone, may be calculated. Thus:

$$\frac{L_1}{L_2} = \frac{N_1^2}{N_2^2}, \qquad \text{Example, } \frac{.004}{L_2} = \frac{220^2}{17{,}600^2}$$

$L_2 = 25$ henries, the coefficient of self-induction of the secondary coil.

The "impedance-method" will be found very satisfactory for measuring the self-induction in coils containing no iron. It is fairly satisfactory in coils containing iron with an open magnetic circuit, such as an ordinary type of spark coil. The result will give too large a value of L, by a few per cent, if there is the usual appreciable amount of iron loss in the core.

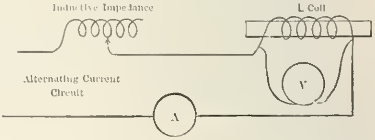


FIG. 6.—IMPEDANCE METHOD OF MEASURING SELF-INDUCTION.

In Fig. 6 the coil marked L is the one whose self-induction is to be measured. A is an ammeter or other suitable instrument for measuring alternating currents, such as a Siemens current dynamometer, such that the average current ordinarily taken by the coil will give nearly a full scale deflection; V is preferably a static voltmeter, although an ordinary voltmeter may be used where the current in the coil is large, as compared to that taken by the voltmeter. The frequency, or the number of cycles per second, of the current may be found from the number of poles and the speed of the generator.

If the voltage as read from the voltmeter be E and the amperes I,

$$I = \frac{E}{Z} \qquad \text{whence} \qquad Z = \frac{E}{I}$$

in which Z is the impedance of the coil. This is composed of two factors, namely, the effective resistance of the coil, and the reactance ohms, X, or the opposing force due to the c. e. m. f. of self-induction. The latter is, in the case of spark coils, always several times as large as the resistance. From the equation $Z = \sqrt{R^2 + X^2}$, in which $X = 2 \pi f L$, and all the factors are known except L, which may be calculated. Thus in a certain non-vibrating primary coil, $f = 62$ cycles per second, $I = 4.25$ amperes, $E = 8.2$ volts, $R = .49$ ohm, $Z = 1.93$ ohms, hence $L = .0047$ henries.

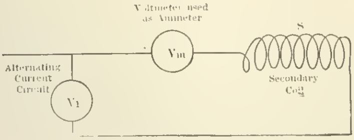


FIG. 7.—MEASUREMENT OF SELF-INDUCTION.

Owing to hysteresis and eddy current losses in the iron, the effective resistance of the coil is really larger than will be found by direct-current measuring instruments so that the value of L, calculated as above, will be too large—probably by several per cent.

The above method may be used in measuring the self-induction of a high-resistance coil, as, for example, the secondary coil of a vibrating or non-vibrating jump-spark coil. The current, however, is very small in such cases and must be measured by a very sensitive dynamometer of the galvanometer type, or by means of a low-reading electrostatic voltmeter connected in parallel with a high-resistance non-inductive shunt. In other respects the method is the same as that described above. The following modification of the above method of measuring the self-induction of such coils will often be found the most convenient.

Connect the apparatus as shown in Fig. 7, using a voltmeter to measure the current. The voltmeter should preferably be of as low a resistance as possible. The following data given in connection with Fig. 7 will illustrate the method applied to the secondary of a jump-spark coil.

The line e. m. f. as shown in Fig. 7 was 237 volts as measured by voltmeter V_1. The secondary coil, S, having 4010 ohms resistance was connected in series with Vm, a voltmeter having a resistance of 132.6 ohms.

The reading of Vm was 2.05 volts, whence the current passing through the voltmeter, Vm (used as a milli-ammeter), was

$$\frac{2.05}{132.6} = .0155 \text{ ampere}$$

then $Z = \frac{237}{.0155} = 15{,}350$ ohms. The total resistance $R = 4010 + 132.6 = 4142.6$ ohms.

Then $Z = 15{,}350 = \sqrt{4142.6^2 + (2 \times 3.14 \times 62 \times L)^2}$.

Whence $L = 38.$ henries, the coefficient of self-induction of the secondary coil.

It may be noted that the coefficient of self-induction, L, of touch-spark coils is of the order of tenths of a henry, that of primary coils of jump-spark coils of the order of a few thousandths of a henry, and that of secondary coils in the neighborhood of 25 henries. In a subsequent article condensers and the testing of batteries, generators, ignition systems, etc., will be treated at length.

A High-Frequency Alternator.

By Louis Cohen.

Among the many unsolved problems in wireless telegraphy and telephony there is probably none which is of such importance as that of the construction of a high-frequency alternator. To be able to produce a continuous train of oscillations of the frequency commonly employed in wireless work would solve completely the problem of syntony—a difficulty which has not yet been overcome satisfactorily. I understand that Mr. Fessenden has recently built an alternator giving these high frequencies and also considerable power, but to the author's knowledge there is no data available for the design of such a machine.

In his evening discourse before the British Association for the Advancement of Science on "The Arc and the Spark in Radiotelegraphy," Mr. W. Duddell* makes the following statement: "If it should prove possible to construct alternators for these very high frequencies, we shall be able to obtain a sufficient number of consecutive oscillations of the current in the aerial of definite frequency to enable very sharp syntony to be obtained. Not only will this greatly reduce interference troubles in wireless telegraphy, but such alternators will be of the greatest value in wireless telephony."

In the same address the author further points out the great difficulties that are in the way of constructing an alternator to give such high-frequency currents, and illustrates it by the following example: If it were required to build an alternator to work at a frequency of 100,000, and assuming that the alternator can be driven at the high speed of 30,000 revolutions per minute, the alternator could not have a diameter much above 6 inches for fear of bursting. Now since the alternator makes 500 revolutions per second, it will be necessary for it to generate 200 complete periods for each revolution, so that the space available for the windings and poles for one complete period will be less than one-tenth of an inch, a space into which it is quite impossible to crush in the necessary iron and copper to obtain any considerable amount of power.

It would therefore appear that in following the principles usually adopted in the design of alternators of low-frequency currents, we cannot hope to obtain a satisfactory solution of the problem; and it follows that the design of a high-frequency alternator will have to be based upon some other principle than that employed heretofore. My attention was directed to this problem some time ago and I was led to a solution which I trust will prove of some interest to those engaged in the art. Before proceeding, however, with the exposition, I wish to say that in explaining my idea to Professor Pupin some two years ago he called my attention to an article on a multifrequency alternator by the late Lieut. F. Jarvis Patten, in the Electrical World (1894), and I find that the author came very close to the same idea, except for the fact that he apparently failed to understand the underlying principle and was therefore led to a serious error, as I shall show later.

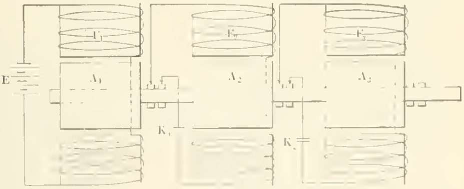


DIAGRAM OF THREE ALTERNATORS MOUNTED ON ONE SHAFT.

Let us suppose that we have a number of alternators, each having the same number of poles, mounted on the same shaft as indicated in the diagram.

If the exciting current of the first alternator is supplied by an external source of constant e. m. f. (E), then in general the induced e. m. f. in the first alternator will be $e_1 = -\frac{n_1}{10^8}\frac{dN_1}{dt}$ where n_1 is the number of conductors on the armature; $N_1 = BA \cos \phi$; B the magnetic induction and A the area of the poles. If the armature revolves with an angular velocity ω, then $\phi = \omega t$, hence,

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*Science, vol. 26, p. 815, Dec. 13, 1907.

$$e_1 = -\frac{n_1}{10^8}\frac{dN}{dt} = -\frac{n_1}{10^8}\frac{d}{dt}(BA \cos \omega t) = \frac{n_1}{10^8} BA\omega \sin \omega t = E_1 \sin \omega t$$

$$\text{where } E_1 = \frac{n_1}{10^8} BA\omega$$

The current generated by this alternator will be

$$i_1 = \frac{E_1}{\sqrt{\omega^2 L^2 + R^2}} \sin(\omega t - \phi_1)$$

If, however, a condenser is introduced in the circuit, and the constants so arranged as to obtain resonance, then

$$i_1 = \frac{E_1}{R_1} \sin \omega t = I_1 \sin \omega t$$

Let us now suppose that the exciting field for the second alternator is supplied by the first alternator, then

$$e_2 = -\frac{n_2}{10^8}\frac{dN_2}{dt}$$

but in this case $N_2 = B_2A_2 \sin \omega t \cos \phi = B_2A_2 \sin \omega t \cos \omega t$

$$\frac{dN_2}{dt} = B_2 A_2\, \omega \left\{\cos^2 \omega t - \sin^2 \omega t\right\} = B_2A_2\omega \cos 2\omega t$$

$$\text{and } e_2 = -\frac{n_2}{10^8} B_2 A_2\, \omega \cos 2\omega t = E_2 \cos 2\omega t$$

$$\text{where } E_2 = -\frac{n_2}{10^8} B_2 A_2\, \omega$$

The current generated by this alternator will be, of course,

$$i_2 = \frac{E_2}{\sqrt{4\omega^2 L^2 + R_2^2}} \cos(2\omega t - \phi_2)$$

and if we introduce a condenser into the circuit of such capacity as to give resonance, then

$$i_2 = \frac{E_2}{R_2} \cos 2\omega t$$

It is thus seen that the frequency of the current generated by the second alternator is just double that of the first.

In a similar way, if the exciting current of the third alternator is supplied by the second generator, then

$$e_3 = -\frac{n_3}{10^8}\frac{dN_3}{dt}$$

but in this case $N_3 = B_3 A_3 \cos 2\omega t \cos \omega t$

$$\therefore \frac{dN_3}{dt} = -B_3A_3\omega\left\{\cos 2\omega t \sin \omega t + 2 \sin 2\omega t \cos \omega t\right\}$$

$$= -B_3A_3\omega\left\{\frac{3}{2}\sin 3\omega t + \frac{1}{2}\sin \omega t\right\}$$

$$\text{Hence } e_3 = E_3\left\{\frac{3}{2}\sin 3\omega t + \frac{1}{2}\sin \omega t\right\}$$

$$\text{and } i_3 = E_3\left\{\frac{3}{2\sqrt{9\omega^2 L^2 + R^2}} \sin(3\omega t - \phi_3) + \frac{1}{2\sqrt{\omega^2 L^2 + R_3^2}} \sin(\omega t - \phi_1)\right\}$$

If we introduce a condenser in the third circuit of such capacity as to make $9\,\omega^2 CL = 1$, that is produce resonance for the higher frequency, then the term for lower frequency may be neglected and we shall have

$$i_3 = \frac{E_3}{R_3}\,\frac{3}{2} \sin 3\omega t$$

the frequency being therefore three times the frequency of the first alternator. Proceeding in a similar way with a fourth alternator, we shall have

$$e_4 = -\frac{n_1}{10^8}\frac{d}{dt}\left\{B_4A_4 \sin 3\omega t \cos \omega t\right\}$$

$$= -\frac{n_4}{10^8} B_4 A_4\, \omega \left\{3 \cos \omega t \cos 3\omega t - \sin 3\omega t \sin \omega t\right\}$$

$$= -\frac{n_4}{10^8} B_4 A_4\, \omega \left\{2 \cos 4\omega t + \cos 2\omega t\right\}$$

$$= E_4\left\{2 \cos 4\omega t + \cos 2\omega t\right\}$$

If we again arrange the constants of the circuits, so as to be in resonance with higher frequency, we shall have the fourth alternator generating a current of four times the frequency of that of the first alternator. Proceeding in this way we shall find that every addition will increase the frequency by an amount equivalent to the frequency of the first alternator. In other words, the frequencies are additive; thus, if the frequency of the first alternator is 10,000 say, the frequency of the tenth alternator will be 100,000.

The principle employed here is analogous to that of the ordinary frequency converter, which is essentially an alternating-current transformer, except that the secondary is movable with regard to the primary. If S represents ratio of secondary to primary frequency, or "slip," then if N is the primary frequency, SN will be the secondary frequency, $S = 1$ represents standstill of secondary coil, on ordinary static transformer. $S > 1$ represents motion of secondary in opposite direction to that produced by the force acting between primary and secondary, thus representing driving by an external force.

Lieutenant Patten made a serious error in assuming that since the second alternator gives a frequency double that of the first, then the third alternator will yield a current of double the frequency of the preceding alternator; as we have seen above, this is not the case. To quote his own words:[1] "Without going into the analyses . . . . , it will suffice to say that the machine has a series of successively connected armatures all carried by the same spindle, and each armature from the first or initial one gives a frequency just double the preceding, though all revolve in single or two-pole fields at the same speed.

"Such a machine can be made with its moving armatures so small that it can be driven by a steam turbine at 500 revolutions a second; this would mean 1000 reversals of e. m. f. a second at the first armature (assuming, of course, only a two-pole field), and the successive armatures would give frequencies respectively of 1000, 2000, 4000, 8000, 16,000 and so on up to the 10th, which would give 1,024,000 reversals a second, while the 19th, which would give 524,288,000, and the 20th over one billion reversals a second."

Now as a matter of fact, if the first machine has a frequency of 500, the tenth machine will only give a frequency of 5,000 instead of 1,024,000.

There are of course some difficulties which will suggest themselves in the construction of such a machine. For one thing, the exciting current being alternating will necessitate the use of very fine laminated iron in the field magnets; and as the frequency becomes very high the use of iron may become entirely prohibitive owing to the excessive loss due to eddy currents, and this of course will greatly diminish the power generated by the alternators. Of course, in all such cases it is pretty hard to tell *a priori* which would be the best arrangement —the use of iron with its consequent losses or the elimination of iron entirely. This can best be determined by experiment.

British Patent Law.

As has previously been reported in these columns, the patent law of Great Britain several months ago was amended in many particulars. While some of the amendments are of a purely domestic character, others are destined to affect the rights and liabilities of those inventors who are foreign to Great Britain, and who seek protection for their monopolies in England. The amendments in question, which came into force on Jan. 1, 1908, are embodied in the Patents and Designs Act, 1907. This measure now contains a complete statement of the English patent law. Much, of course, is taken directly from older statutes which are now repealed, but it also contains new provisions which affect the foreign inventor. It is proposed in the present article to deal with the rights and liabilities for inventors who are foreign to England, pointing out in passing how his position has been altered.

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[1] Lieut. F. Jarvis Patten, Electrical World, vol. 23, p. 20, Jan. 6, 1894.

WHO MAY APPLY FOR AN ENGLISH PATENT.

It is to be remembered in the first place that an application for an English patent may be made by any person who claims to be the true and first inventor of an invention, whether he is a British subject or not, and whether alone or jointly with any other person. When application is made, an official investigation of previous specifications in the United Kingdom is made, and if the comptroller of patents is satisfied that the invention claimed has been wholly and specifically claimed in any specification to which the investigation has extended, he may either require references to be made in the applicant's specification, or refuse to grant a patent. The principle of refusing a grant on the ground of anticipation has now, for the first time, been adopted in England.

With a view to preventing a patentee acquiring a monopoly and—to use a colloquial phrase—sitting on it, there has for a long time been a procedure by which he may be compelled to grant licenses. This finds a place in the new act, section 324 (1) of which provides that any person interested may present a petition to the board of trade alleging that the reasonable requirements of the public with respect to a patented invention have not been satisfied, and praying for the grant of a compulsory license, or, in the alternative, for the revocation of the patent. The board of trade are to consider the petition, and if the parties do not come to an arrangement between themselves, the board, if satisfied that a *prima facie* case has been made out, must report the petition to the court, but if the board are not so satisfied they may dismiss the petition. For the benefit of American readers it should be mentioned that the board of trade is a government department which has power and control in patent matters, but does not, as a rule, decide questions of law. These, as a rule, are referred to the courts for decision.

Where any such petition is referred by the board to the court, and it is proved to the satisfaction of the court that the reasonable requirements of the public with reference to the patented invention have not been satisfied, the patentee may be ordered by the court to grant licenses on such terms as the court may think just; or, if the court is of opinion that the reasonable requirements of the public will not be satisfied by the grant of licenses, the patent may be revoked. An order of revocation will not, however, be made before the expiration of three years from the date of the patent, or if the patentee gives satisfactory reasons for his default.

On the hearing of a petition under this section the patentee and any person claiming an interest in the patent as exclusive licensee or otherwise, must be made parties to the proceeding and the law officer (*i. e.*, the attorney or solicitor general) or counsel appointed by him may appear and take part in the proceedings.

The reasonable requirements of the public are not deemed to have been satisfied under the following conditions: (a) By reason of the default of the patentee to manufacture to an adequate extent and supply on reasonable terms the patented article, or any parts thereof which are necessary for its efficient working, or to carry on the patented process to an adequate extent or to grant licenses on reasonable terms, any existing trade or industry in the United Kingdom is unfairly prejudiced, or the demand for the patented article or the article produced by the patented process is not reasonably met. (b) If any trade or industry in the United Kingdom is unfairly prejudiced by the conditions attached by the patentee before or after the passing of the act to the purchase, hire or use of the patented article, or to the using or working of the patented process.

The foregoing provisions relating to compulsory licenses are not, in substance, a new departure in English jurisprudence. For many years there has been a procedure by which a patentee who is not working his patent so as to comply with the reasonable demands of the public could be brought to book. Hitherto, however, this procedure has scarcely ever been resorted to, chiefly because of the enormous expense required to set it in motion. There can be no doubt, however, that several British industries have in the past been seriously hampered by a practice which has grown up of taking out patents in England which are never worked in the United Kingdom. Thus, the aniline dye industry has been kept away from England by this means.

It is only recently, however, that the attention of English statesmen has been called to this very serious clog upon industrial activity. Indeed, it formed the subject of discussion at the recent colonial conference. Sir Joseph Ward, speaking at the colonial conference, said: "We absolutely object to the system which has, up to now, prevailed of an American, French or German patentee asking for registration of his patent in our country, reserving to himself the right to manufacture the article in America, etc., and keep our people in this position for the full limit of years. . . . We pay for a typewriter, for a motor car, or for something connected with a plow an exorbitant price to enable a person, who has sold his patent to somebody else at an exorbitant price, to bleed our people to death. We are not going to allow it." How far the principle of the section will be adopted throughout the empire remains to be seen. It is important to observe that paragraph (b), which is designed to prevent the attachment of onerous conditions to the working of patents in England, is new both in substance and principle. That point will be referred to again in the course of this article.

The foreign patentee should observe that instead of granting a compulsory license, the court may order the patent to be revoked. Again, if an action of infringement is commenced by him, it will be competent for the alleged infringer to allege by way of defence that the reasonable demands of the British public have not been complied with, or that unduly restrictive conditions have been attached to the working of the patent.

By section 27 important powers are conferred upon the comptroller with regard to patents granted, but not worked in England. It provides that at any time not less than four years after the date of a patent and not less than one year after the passing of the act (*i. e.*, Jan. 1, 1909), any person may apply to the comptroller for the revocation of a patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. The comptroller must consider the application, and, if after inquiry, he is satisfied that the allegations contained therein are correct, then, subject to the provisions of the section, and unless the patentee proves that the patented article or process *is* manufactured or carried on to an adequate extent in the United Kingdom, or gives satisfactory reasons why the article or process is not so manufactured or carried on, the comptroller may make an order revoking the patent either (a) forthwith, or (b) after such reasonable interval as may be specified in the order unless in the meantime it is shown to his satisfaction that the patented article or process is manufactured or carried on within the United Kingdom to an adequate extent. No such order can, however, be made which is at variance with any treaty convention, arrangement, or engagement with any foreign country or British possession.

If within the time limited in the order the patented article or process is not manufactured or carried on within the United Kingdom to an adequate extent, but the patentee gives satisfactory reasons why it is not so manufactured or carried on, the comptroller may extend the period mentioned in the previous order for such period not exceeding 12 months as may be specified in the subsequent order.

The decision of the comptroller under this section is subject to an appeal to the court.

An attempt was made by an act passed in 1902 to attain the objects aimed at by this section, but it proved unavailing. That the section is necessary from the Englishman's point of view appears to be clear from the fact that in 1906 out of 14,700 patents issued, 6500 were granted to foreigners; while in the case of patents for dyes the proportion was about 95 per cent. In many cases these inventions were worked abroad exclusively and the patented articles, or substances made by the patented processes, were imported in large quantities into Great Britain, the British patents being used merely for the purpose of closing the market to persons other than the patentee and his licensees.

Certain provisions which are new to English law will now be considered. They are designed to prevent a patentee, whether British or foreign, from placing such restrictions on the use of his invention that the public is unduly hampered in its use of it. It is provided that it shall not be lawful in any contract made after the act goes into effect (*i. e.,* after Jan. 1, 1908), in relation to the sale or lease of or license to use or work any article or process protected by a patent to insert a condition the effect of which will be as follows:

(a) To prohibit or restrict the purchaser, lessee or licensee from using any article or class of articles, whether patented or not, or any patented process, supplied or owned by any person other than the seller, lessor or licensor, or his nominees; or (b) to require the purchaser, lessee, or licensee to acquire from the seller, lessor or licensor, or his nominees, any article or class of articles not protected by the patent.

Any conditions as above shall be null and void, as being in restraint of trade and contrary to public policy.

The section is not, however, to apply if (a) the seller, lessor or licensor proves that at the time the contract was entered into the purchaser, lessee or licensee had the option of purchasing the article or obtaining a lease or license on reasonable terms, without such conditions as aforesaid; and (b) the contract entitles the purchaser, lessor or licensee to relieve himself of his liability to observe any such condition on giving the other party three months' notice in writing and on payment in compensation for such relief in the case of a purchase of such sum, or in the case of a lease or license of such rent or royalty for the residue of the term of the contract, as may be fixed by an arbitrator appointed by the board of trade.

The same section confers important powers upon the court for dealing with licenses to which onerous conditions are attached and which are actually current at the date of the passing of the act. Thus, any contract relating to the lease of or license to use or work any patented article or patented process. whether made before or after the passing of the act, may at any time after the patent or all the patents by which the article or process was protected at the time of the making of the contract has or have ceased to be in force, and notwithstanding anything in the same or in any other contract to the contrary, be determined by either party on giving three months' notice in writing to the other party, but where any such notice is given determining any contract made before the passing of the act, the party giving the notice is to be liable to pay such compensation as failing agreement may be awarded by an arbitrator appointed by the board of trade.

The section goes on to provide that the insertion by the patentee in a contract made after the passing of the act of any condition which by virtue of the section is null and void is to be available as a defense to an action for infringement of the patent to which the contract relates brought while that contract is in force.

Other provisions of the section are as follows: (a) Nothing in the section is to affect any condition in a contract whereby a person is prohibited from selling any goods other than those of a particular person; or, (b) be construed as validating any contract which would, apart from the section, be invalid; or, (c) affect any right of determining a contract or condition in a contract exercisable independently of the section; or, (d) affect any condition in a contract for the lease of or license to use a patented article, whereby the lessor or licensor reserves to himself or his nominees the right to supply such new parts of the patented article as may be required to put or keep it in repair.

Inasmuch as the principle underlying this section is entirely new to English law, it is by no means easy to foretell the effect which it is likely to have. The clause will, however, probably be interpreted in the following manner: The words "contract for the sale, lease or license" must be confined to contracts for a license, and contracts *ejusdem generis;* that is to say, contracts made by some person who has special rights under the letters patent, and of which the main object is either by sale, lease, or license to give a right to infringe on such monopoly. A contract, for example, to take a supply of cycles from a manufacturer would not be brought within this clause by it being made a condition that the cycle should have a patented form of tire, which patent was owned by third parties with whom neither of the parties had any special relation. But, on the other hand, a contract by the patentee or exclusive licensee for the sale of such tires would be within this clause.

English statesmen have considered this clause to be necessary mainly because of the action of certain patentees of bootmaking machinery. These persons made a practice of introducing their patented machines into England, but would not allow them to be worked except under certain onerous conditions. Thus, the user would not be allowed to use the patented article until he signed a document, a kind of lease, to last for 20 years or more.

During the whole 20 years he would not be allowed to use any other machinery at all at his works, although there might be a considerable improvement invented by a Britisher or by some foreigner, but still under the conditions of his lease he would not be allowed to put any other machinery into his works, although it may be infinitely better.

Regarding the matter from an English standpoint, it is not easy to resist the force of these considerations. While the "open door" has been and still is the policy of England in all matters relating to tariffs, it is manifest that the law of patents as heretofore applied in England can be made use of to hamper certain industries.

To judge merely by the number of patents applied for and granted in England during recent years is to found one's calculation as to the value of letters patent on a wrong basis. Hitherto any conceivable kind of public invention has been admitted to the roll of patents. It is not too much to say that tens of thousands of English patents are not worth the paper they are printed on. At the same time, it must not be forgotten that the new legislation is directed mainly at the compulsory and unrestricted working of inventions which enjoy some commercial value and reputation. With regard to these, however wide and inclusive the new act may appear to be, it is the man with money behind the patentee, not usually the patentee himself, who has to be dealt with. Consequently, as in the past, so in the future, anyone who desires to set the law in motion will be inclined to hesitate before he comes to grips with a capitalist who is behind the patentee.

CANADIAN PATENT LAW.

A method of escaping the meshes of this new English act may be found on examining the effect of the patent laws in other parts of the empire. That a movement is on foot in other parts of the British empire to do something to curtail the rights of the foreigner is evidenced by recent Canadian legislation. By a Canadian act passed in 1903 a patent is null and void at the end of two years unless the patentee shall commence and continuously carry out in Canada the construction or manufacture of the invention patented in such a manner that any person desiring to use it may obtain it at a reasonable price at some manufactory in Canada.

By another clause, "if after 12 months from the granting or authorized extension of a patent the patentee imports into Canada the invention for which the patent is granted, such patent shall be void as to the interest of the person so importing." The provisions as to manufacture of patented articles in Canada have, in some cases, been got over (or under) by foreign manufacturers. They simply set up their mills in Canada, and in the case of a patented invention which is made up of several parts, they make the parts in the States and assemble them in the Dominion. There is nothing so far as one can see to prevent the adoption of the same course in relation to English patents.

The Principles Governing the Design of Steam Turbine Plants.

Mr. J. L. Hecht, of the North Shore Electric Company, Chicago, read a paper entitled "Steam Notes on a Turbine Plant" before the Northwestern Electrical Association, Jan. 16, which explains in a very plain way the reasons for certain features which have come to be accepted as proper in the design of steam turbine plants, but which are nevertheless none too well understood by the engineering fraternity in general.

Superheaters, he states, are desirable with boilers supplying steam turbines for several reasons. The internal friction of the steam traveling at high velocities through the turbine has a very important effect on the efficiency of the turbine and it is known that the internal friction in the steam varies with the per cent of moisture carried in suspension in the steam. We know that ordinary dry saturated steam in expanding and doing work tends to become very moist before leaving the turbine, and, therefore, the proper degree of superheat is such that the steam will be at the point of saturation as it leaves the turbine. Unfortunately, however, the practical limits of superheat, namely, from 100 degs. to 200 degs. F., falls far short of the desired degree of superheat. In some tests made in Germany several years ago, in which steam at 150 lbs. pressure was superheated to a temperature of 1000 degs. F., it was found that the turbine efficiency increased directly with the superheat.

In some of the earlier superheated steam installations it was found that the usual bronze valve stems, discs and seats would not stand the superheat, and after some experimenting nickel steel was adopted for this work. It was observed that in a short time, cast-iron fittings and even ferro-steel fittings when exposed to a temperature of more than 500 degs. F. would change in form as well as in length. It is our opinion that the more webs and lugs there are on the fitting, the greater the distortion will be. The webs instead of giving strength tend to set up unequal strains in the fittings, which under the high temperature take on a permanent set, probably because of molecular action taking place in the iron. This trouble has been overcome by use of cast-steel fittings. It has frequently been stated that the objection to using superheated steam is that the superheater tubes burn out. Mr. Hecht said that he knew of superheaters which have been in service continuously for seven years without loosening a tube, and in fact in his experience he had never lost a superheater tube.

As to high vacuums, the steam does its work, in a turbine, in an entirely different manner from the way in which it does its work in a reciprocating engine. In an engine the potential or pressure energy in the steam does the work by exerting a direct pressure on the piston. In a turbine the work is done by the kinetic or velocity energy in the steam, and the kinetic energy varies directly with the mass or weight of steam and with the square of the velocity. Considering that the turbine nozzles or buckets, at any particular section, have a certain definite area, it is evident that the velocity will increase directly with the increase in volume of steam. At a vacuum of 26 ins., referred to a 30-in. barometer, one pound of steam occupies 175 cu. ft. If that vacuum is increased to 28 ins., referred to a 30-in. barometer, a pound of steam occupies 350 cu. ft., or exactly double the volume that it had at 2 ins. less vacuum. Since this steam must flow through a certain definite area of opening it is evident that the velocity of any certain weight of steam at 28 ins. of vacuum will be double the velocity of a like steam at 26 ins. of vacuum and it is apparent that the kinetic energy is quadrupled, and after passing the 28-in vacuum point, this increase becomes even more marked. With an increase of vacuum to 29 ins., or only one inch, the volume is doubled and again the kinetic energy quadrupled. Furthermore in a turbine high vacuums do not produce the bad effects which they do in reciprocating engines. In a turbine, for instance, there is not the alternate heating and cooling of the cylinder walls, since a turbine has a continuous flow. Also as the vacuum is increased with turbines there is no question of making large, cumbersome cylinders and pistons to take care of the excessive volumes which are encountered with high vacuums. It is apparent that the exhaust connection from a turbine to its condenser must be very large, since with the high vacuums used the exhaust steam has five or six times the volume that the exhaust steam from a reciprocating engine has, and this is a reason for placing condensers on steam turbines as close as possible to the exhaust chamber of the turbine.

Condensers are of two different types, the surface condenser and the jet condenser, and under the jet condenser there is a third type, the barometric condenser. Since the barometric condenser is always installed at a distance from its engine, or turbine, it is evident from the above discussion that it is practically eliminated from consideration for turbines of the size assumed. As between the jet and the surface condenser, the choice must, to a large extent, be the same as it would be in the case of a reciprocating engine plant. If there is plenty of good, fresh condensing water, a jet condenser would ordinarily be installed, because of its simplicity and cheapness. On the other hand, if the condensing water available is such that it would be injurious to the boilers, a surface condenser would, of course, be installed in order to save the exhaust steam for return to the boilers, there being only a small percentage of loss. The difficulty encountered in a reciprocating engine plant when operated with surface condensers is that the boiler feed water finally becomes very much charged with cylinder oil, and in spite of any filters or separators in existence, must be occasionally renewed. In a steam turbine plant this difficulty is not encountered, as no cylinder oil is used and the exhaust steam after being condensed is practically pure water. In fact, if it were not necessary to make up a certain amount of boiler feed with impure water, the feed water in a turbine plant operated with surface condensers would become so pure that it would probably be injurious to the boilers. Besides the condenser the usual auxiliaries which form part of the condensing equipment for a steam turbine are a circulating pump, for circulating the condensing water through the condenser; a wet vacuum pump, or condensed water pump, which draws the condensation from the condenser and pumps it to the feed water heater, and which in itself is usually capable of developing a vacuum of 25 ins. to 26 ins.; and a dry vacuum pump, which draws any air of vapor from the condenser which may be in it, and is responsible for the additional two or three inches of vacuum which is usually obtained in this type of condensing equipment.

It has often been stated by engineers that the energy expended in obtaining the extra few inches of vacuum in a condensing equipment of this kind, amounts to as much as the saving effected by having this additional vacuum. To those who have had experience with this kind of an equipment, it is evident that this is not so, for, as explained above, after the 28-in. vacuum point is reached, each additional fraction of an inch increase in vacuum makes a marked difference in the efficiency and capacity of the turbine: furthermore, the only additional piece of apparatus on the condensing equipment is the dry vacuum pump, and when we consider that it is possible to utilize all of the exhaust steam from the auxiliaries for heating the boiler feed water, it becomes apparent that the amount of energy consumed in getting the extra vacuum is almost negligible. In operating a plant of this kind, the internal arrangement of the condenser makes a large difference. It is easily possible to build a surface condenser so that the condensation when leaving the condenser to go to the feed water heater will have the temperature of either the exhaust steam from the turbine, or the temperature of the circulating water as it leaves the condenser. In the latter case the condensation would go to the heater at a temperature as low as 45 degs. F. in winter, while in the former case the condensation will usually have a temperature of about 90 degs. F. This is an important detail and most of the condenser manufacturers now build condensers to operate with either of the above results. It will be apparent from the above, that in any case where it is possible to make the expenditure for a surface condenser, instead of a jet condenser, it is advisable to do so with this type of plant.

The question very often arises as to whether the auxiliary machinery in this type of plant should be motor-driven or engine-driven. It is even argued that the small engines are uneconomical and rather expensive to maintain, and that on the other hand the large generating unit is economical, and that motor-driven auxiliaries will be not only simpler to operate, but more economical. This is the opinion unusually arrived at from a superficial consideration, but after going into detail, it is evident that in nearly every instance there is not only no advantage in using motor-driven auxiliaries, but in most cases a decided disadvantage. Placing motors on all the auxiliaries necessarily limits the salable output from the generator. In case of an electrical shut-down in a plant, all the auxiliaries immediately shut down, making it not only more difficult to bring the plant back into operation, but this, at times, might prove disastrous to the equipment. Further, since it is of advantage to pump the boiler feed water to the boilers at the highest possible temperature, it becomes evident that every ounce of exhaust steam from the auxiliaries can be utilized to good advantage in heating the boiler feed water, and therefore the only energy consumed in the steam-driven auxiliaries is that actually doing work in addition to the friction and radiation loss. Actual figures will show that when the exhaust steam from the auxiliaries is used to advantage in heating the boiler feed water, the actual number of thermal units consumed in driving the auxiliaries are less with steam-driven than with electrically operated auxiliaries. Some calculations recently made on the comparative cost of operating a steam-driven and a motor-driven generator for furnishing field excitation to a 3000-kw plant, show that with coal at $2 a ton, there would be a saving of $200 per month in operating a steam-driven generator. The reason for this is that every pound of exhaust steam from the steam-driven generators could be used to good advantage in heating the boiler feed water.

Two features of a turbine plant of this kind which are novel, and have not been mentioned, are the step-bearing pumps, and the accumulator. The vertical shaft Curtis turbine runs on a film of oil, the oil being pumped into the step bearing under a pressure varying in different sized units. It would be about 300 lbs. in the sizes above mentioned. The usual arrangement is to have at least two step-bearing pumps, one of which would be running at all times when a turbine is in operation. The other one would have in its steam line a throttle valve controlled by the oil accumulator, the accumulator being nothing more than a vertical cylinder loaded with iron weights, this cylinder floating on a plunger which is anchored to a foundation. The plunger is cored to the bottom where a pipe connects it to the oil pressure line. In case of any fluctuation in the steam pressure, or other cause for drop in the oil pressure, the accumulator maintains a constant pressure on the oil system for a few minutes. At the same time, if the pressure in the oil system were steadily falling, the accumulator, because of the dropping of the floating cylinder, would automatically start up the second step-bearing pump.

Aside from the step bearing there are guide bearings, which are also supplied with oil from the step-bearing pump after the oil has passed through a reducing valve. All of the oil after passing through these various bearings is filtered, cooled and again passes to the step-bearing pumps, and is thus kept circulating in a closed circuit, so that it will be seen that very little oil is lost. In the operation of a system of this kind the quality of the oil used makes a considerable difference. It has been found that certain oils, due to the high velocity of the turbine, will emulsify. Other oils which do not emulsify may not have body enough to lubricate properly. It is not difficult to find an oil of the proper kind after it is known what the necessary viscosity, gravity, volatility, etc., of the oil are.

In the discussion of this paper, Mr. Hecht added some figures on the waste of having condensers so designed and operated that the condensed water leaves the turbine at an unnecessarily low temperature. As a rough estimate, he explained that if a condenser is designed so that the condensation leaves the turbine at, for example, a temperature of 90 degs., as compared with another condenser which is designed so that the condensation leaves at a temperature of the circulating water, or say 45 degs., there would be required roughly 45 thermal units per pound of water to bring it back to the 90-deg. point. Assuming that a plant is carrying a load of 2000 kw on an average for 24 hours, and assuming a consumption of 20 lbs. of steam per kw-hour, the total amount of steam condensed would be about 40,000 lbs. per hour. Now, if we have to expend 45 thermal units per pound to heat that up to a 90-deg. point for boiler feed, 43,200,000 thermal units per day will be required. If we take an average Illinois coal giving about 12,000 thermal units per pound, costing $2 a ton, and assume an average boiler efficiency of 60 per cent, we would get out of that coal about 7200 thermal units per pound. Dividing 43,200,000 thermal units by 7200, we would have 6000 lbs. of coal used per day, or about $6 worth. This is 5 per cent interest on a $43,000 investment, merely due to a little difference in the design of a condenser, and it is just as easy to design it one way as it is the other, only some condenser people are not doing it.

New Telephone Patents.

PARTY-LINE SYSTEM.

With rural telephone lines, where there are but two or less subscribers to the mile, it becomes necessary in order to avoid a prohibitive rate, to group ten or more stations on each circuit. Such lines require, of course, some method of distinctive signaling to call the various stations. Many different suggestions have been put forward for selective ringing, but the successful system of to-day still uses the code system of ringing. Of course, ordinarily every signal throws the exchange drop whether or not the exchange is wanted, and as with such lines there is a great amount of local service, the exchange operator is put to much unnecessary labor. To avoid this there has been devised an arrangement whereby the users may at will cause their generators to signal all the stations alone, or the exchange alone. This has been accomplished ordinarily by the use of the metallic circuit for one case and a grounded circuit for the other. A push button has heretofore served to accomplish the switching. Recently, however, Mr. W. R. Brown, of Lafayette, Ind., has patented an arrangement wherein the hook switch accomplishes the switching. If the generator be operated with the hook raised, the exchange is signaled. If the hook be down, the stations are signaled. The patent for this arrangement is assigned to the Kellogg Switchboard & Supply Company.

AUTOMATIC EXCHANGE SENDER.

A sender for an automatic exchange, patented by J. G. Roberts, of Chicago, has also been assigned to the Western Electric Company. This sender is adapted to an automatic exchange system worked out by this same inventor. This system includes a series of trunking of selecting machines involved in each switch, and also a special connecting machine. The trunking machines differentiate between the various thousands, hundreds, etc. This sender is adapted to be set up with the desired number exhibited at a horizontal row of windows Then by moving a crank all digits are simultaneously started, as far as the user is concerned. The setting apparatus consists of a number of knurled discs projecting through the casing. These are manipulated until the desired number is set up. The crank then having been moved its full limit and released, begins to return under the action of a spring, and the control of a balance and escapement. The switching devices at the exchange are arranged to follow a certain sequence of operations, all under the control of a single make-and-break switch at the subscriber station, no grounds being employed. The crank shaft carries a series of arms, each of which ends in a circular segment of some length. These segment arms are all loose on the shaft save one, and each is adapted to drive the next by means of a pawl, riding ratchet teeth on the adjacent segment. In setting the numbers, a shield is adjusted over certain of the ratchet teeth, to determine the exact tooth at which the pawl will take hold. When the crank is turned forward, the first segment arm is carried with it. As soon as its pawl rides off the shield the second begins to move; the second drives the third, etc., until the last comes against its stop. The parts are now all set up in definite angular relation representing a time function proportional to the different digits of the number and the time required for certain intermediate processes. Now the handle is released, and begins to return. As each pawl is released, the member held by it flies home, causing a momentary break at the control switch. The time sequence of the return to normal of the sender members controls the selection at the exchange, this selection depending upon the length of time during which each function is allowed to continue.

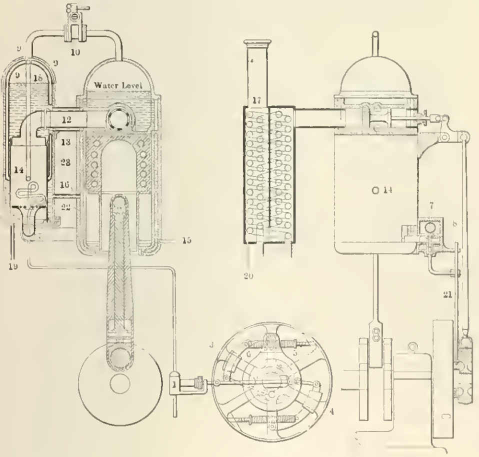
LETTERS TO THE EDITORS.

Combined Steam and Gas Engine.

To the Editors of Electrical World:

Sirs:—I read with much interest the article "Combined Steam and Gas Engine" in your issue of Jan. 11, as it related to a subject to which I have given some attention. I enclose a blueprint of a drawing which I made in September, 1898, the principles of which differ in one respect only from those proposed by Mr. S. A. Reeve, namely, instead of directing the gas flame downward into water, as Mr. Reeve proposes, I allow combustion to become complete in a chamber having a water jacket. The steam generated in the jackets of both the combustion chamber and the engine cylinder passes into the combustion chamber above the gas flame, where they are mixed after complete combustion has taken place.

The print shows a single-acting water-jacketed engine cylinder, the crank end being a single-acting water-jacketed air compressor; water-jacketed combustion chamber, a feed-water heater, an oil pump, etc. The feed-water passes first through the air compressor jacket, thence to feed-water heater, thence to engine and generator jackets. Of course, the piston valve shown would never do for temperatures of 1000 degs. F. and so later developments of this principle show a double-acting engine with double-beat poppet valves, double-acting air compressor (both jacketed) and a generator and feed-water heater of very different design than shown by this old print.



COMBINED STEAM AND GAS ENGINE.

It is true, as Mr. Reeve suggests, that this principle can be applied to existing steam engines with slight modifications, but in these cases a much larger generator would be required to generate a larger volume of steam for reducing the temperature to or below, say 400 degs. F.; while with a special poppet value and a jacketed engine in which a temperature of 1000 degs. F. could be continually worked, the generator needed would be small and the efficiency much better.

Though I have never been in a position to make any actual demonstration of this principle, I have for years believed that the increased efficiency would more than justify the little extra complication, even in small units.

Barboursville, W. Va. Luther L. Dowthat.

Hunting of Alternators.

To the Editors of Electrical World:

Sirs:—Will you permit the writer to take exception to your editorial on "Hunting of Alternators" in the issue for Jan. 25, 1908, as this editorial is not at all in accordance with the writer's experiences in alternating current apparatus.

You state that now alternators are nearly always polyphase, which are easier to synchronize and maintain in synchronism than single-phase machines. I cannot agree with this statement, and I have seen many two-phase units that would not run in multiple when operating two-phase that would run perfectly when operated on one phase only. You also state that the operating of low-frequency generators in parallel is easier than high-frequency, which is not necessarily so.

You state that dangerous hunting of alternators has ceased to be the dread of central-station engineers, yet occasionally conditions arise in which alternators misbehave when coupled. This is quite true and always will be so until engineers realize that the engine and generator must be designed as a unit.

You state that in practically every case where there is parallel operation trouble, the cause is to be found in the behavior of the engines or prime movers, with which I also do not agree, as I have seen numerous instances where the generators were at fault and in which case the cause of the trouble was entirely remedied by changes in the generators without touching the engines, although in many cases the faults in the generator design have been compensated for in damping the governor of the engine.

You also state that every alternator or synchronous motor possesses a natural period of oscillation when connected to constant-frequency and constant-potential mains, the frequency of which depends upon its moments of inertia, etc., which is misleading. That a natural period of oscillation exists in synchronous apparatus is quite true, and the successful multiple operation of generators depends upon the frequency thereof (as well as the amplitude), which is not the case with synchronous motors which have but one natural period of oscillation which always corresponds to the revolutions of the prime mover; if it be an engine, that is, one beat to each revolution of the engine.

The successful operation of the synchronous motor depends only upon the amplitude of the beat. The period of oscillation of generators is very different, as it depends upon the number of revolutions of the prime mover, the total moment of inertia, the number of alternations, the number of phases, the e. m. f. and the short circuit capacity.

The amplitude of the oscillation depends upon the sensitiveness of the engine governors, the number of cylinders of each engine and the damping effect of the generators. The more sluggish the governor, the fewer the cylinders and the greater the damping effect of the generators producing an oscillation of minimum amplitude.

It is certainly wonderful how many successful guesses have been made in the design of alternators and engines to be used in parallel operation; but the writer does not believe that the unit of the future will be designed by two people who do not collaborate in producing a unit which, when run in multiple, will produce a natural oscillation, the period and amplitude of which has not been predetermined.

Newark, N. J. C. Oscanyan.

[We fully agree with Mr. Oscanyan as to the importance of collaboration between the engine builder and the manufacturer of an alternator to be directly connected therewith, in order that the natural period of oscillation of the latter may be quite different from that of the fluctuating torque of the engine. In fact, this opinion was directly stated in the editorial referred to. The fact that when certain two-phase alternators refuse to operate in multiple when both phases are employed but run perfectly when used as single-phase machines, is scarcely proof that two-phase alternators are easier to maintain in synchronism than single-phase machines, but rather implies that in the particular case observed the natural period of the engine corresponds more nearly to that of the alternator with both phases in use than to that of the same machine with only one phase active. Since a high-frequency alternator has more poles than a low-frequency machine driven at the same relative speed, it follows that for equal angular displacements during irregular rotative speed, a 60-cycle alternator is subjected to 2.4 times the electrical angular displacement of a 25-cycle alternator, and therefore a 60-cycle machine requires a much more regular driving torque than a machine of 25 cycles. It is common knowledge that trouble is very rarely experienced from the hunting of alternators driven by water or steam turbines, but that alternators driven by reciprocating steam or gas engines almost always have a tendency to hunt. It cannot be assumed that the curing of certain generator sets of hunting by changing the alternators without touching the engines is proof that the alternators caused the hunting. Hunting, which in any event is caused by irregular driving or counter torque, reaches its maximum when the natural period of the engines is the same as that of the alternators; it may be lessened by changing the period of either the engines or the generators, or by damping either of these machines. We are unable to follow Mr. Oscanyan's outline of the difference between the natural period of a synchronous motor and that of a synchronous generator. Since a motor is in reality merely a generator with a negative load, a synchronous machine does not change its natural period—which depends upon its electric circuits and the mass of its rotating parts—when it is operated one time as a generator and another time as a motor.—Eds.]

Parallel Operation of Alternators.

To the Editors of Electrical World:

Sirs:—I read with much interest the controversy in your issues of Dec. 28 and Jan. 5 in regard to parallel operation of alternators. I supposed that the principle outlined in your editorial comment of Dec. 28 was generally accepted as established, and was surprised that it should be questioned by Mr. Lyon. I would state this principle as follows: "The voltage and frequency of an alternating-current system being kept constant, the load on any particular synchronous machine is independent of its field excitation through all ranges of field current and all loads, until conditions are reached that cause the machine to drop out of step." I would add that conditions have to become very extreme before ordinary commercial machines will drop out of step.

It occurs to me that some of your readers may be interested in the following facts bearing on the phenomenon in question: In the spring of 1906 general tests were made of the apparatus in the power house of the Boston & Worcester Street Railway Company, in South Framingham, by students of the Massachusetts Institute of Technology. At my suggestion a test run was made for the purpose of demonstrating the principle above enunciated. The machine furnishing the power was a 1000-kw. revolving-field, 13,200-volt, fly-wheel type, General Electric three-phase generator, driven by a cross-compound engine. A 2000-kw Curtis turbo-generator was run as a synchronous motor, the steam supply to the turbine being entirely cut off.

Three-phase energy was transmitted to a sub-station 10 miles away, where it was fed to rotary convertors which furnished direct current to the trolley line and feeders. The direct-current feeders were grounded through a circuit-breaker at the power house. In this way the sub-station was given a very steady but not readily adjustable load, which depended in amount upon the resistance of the trolley line and feeders and the rail return.

With this constant load upon the rotaries the field current of the 1000-kw alternator was varied from the greatest amount which could be obtained by running up the exciter voltage down to zero. The voltage of the system was maintained constant by varying the field current of the 2000-kw synchronous motor. During the entire test the load on the 1000-kw generator remained nearly constant at about 800 kw, and the machine carried this load with no current in the field circuit without giving any indications of weakness.

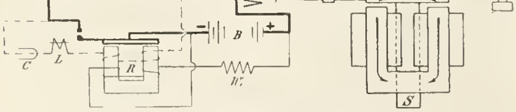
I do not believe the machine was carrying even approximately the maximum load it could carry under those conditions. Unfortunately, the value of the interchange current between the two machines under the extreme condition was off the range of the indicating instruments; but extrapolation on the curve indicated about 130 amperes as the total armature current, corresponding to about 3000 apparent kilowatts, and a power factor of about .27.

South Framingham, Mass. Milan V. Ayres.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Rectifier.—F. J. Koch.—A paper read before the Electrical Society of Dresden on an apparatus for changing alternating current into pulsating direct current, which has been in commercial use for several years in Germany, especially for charging automobile batteries and for supplying electroplater shops with direct current. The essential feature of the apparatus is the plunger of a magnet, oscillating in synchronism with the voltage of the network. This magnet plunger opens and closes periodically a contact in the main circuit. The simplest form of the apparatus is shown in principle in Fig. 1, as used for charging batteries of small rating. *G* is the alternator, the thick lines represent the main circuit and the thin dotted lines the exciting circuit in shunt. A polarized relay *R* forms the interrupter. It is so designed that the polarizing permanent magnet does not undergo any change of magnetic flux. The relay is shown in Fig. 2. The periodical opening and closing of the contact causes a pulsating current always of the same direction to pass through the main circuit. If it be assumed that the main circuit contains no source of e. m. f., but only resistance, it is sufficient that the contact be closed and opened exactly at the zero points of the voltage curve. In this case only one-half of the total wave of one period is, of course, utilized, but all the utilized half waves are of the same polarity. If the



FIGS. 1 AND 2.—DIAGRAMS OF RECTIFIER.

oscillating armature was directly connected to the alternating current network, it could oscillate in synchronism, but could not oscillate in phase with the voltage of the network on account of the self-induction of the coils, the hysteresis of the iron, etc. To compensate for this, a condenser C and the coil of variable self-inductance L are connected in series with the winding of the relay R (Fig. 1), and by their adjustment coincidence of phase can be obtained. If now a battery is inserted in the main circuit it is no longer proper to let the contact open and close at the zero points of the voltage curve and a further adjustment is necessary. This is obtained by a second winding on the relay connected to the terminals of the battery. This is shown in a drawn-out thin line in Fig. 1 in series with a resistance W_1. However, for apparatus for larger ratings a different system is used. In all apparatus of larger ratings (about 1.5 kw) it is endeavored to utilize not only one half wave of the alternating current but both half waves. The system employed for this purpose is shown in Fig. 3. It consists essentially of the combination of two devices of the kind shown in Fig. 1, the two devices being arranged symmetrically, current being taken off from the two halves of the secondary of a transformer. The author exhibited a complete charging station for automobiles for charging 60 cells with 40 amperes. Some further modifications are also described.—*Elek. Zeit.*, Jan. 9.

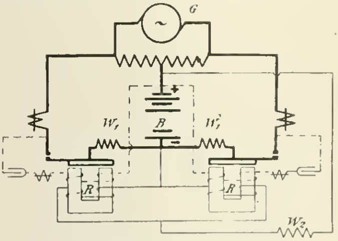


FIG. 3.—DIAGRAM OF RECTIFIER.

Magnetic Oscillations in Alternators.—G. W. Worrall.—A paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. on magnetic oscillations in alternators. The results of his investigations based on experimental tests are as follows: There are two kinds of magnetic oscillation in the main magnetic circuit: (a) A variation in magnitude or "flux pulsation"; (b) a to-and-fro movement of the flux or "flux swing." "Flux pulsation" is a maximum when the ratio of polar arc to toothpick equals a whole number, and is a minimum when the ratio equals a whole number plus one-half. "Flux swing" is a maximum when the ratio of polar arc to tooth pitch equals a whole number plus one-half, and is a minimum when the ratio equals a whole number. The ripples in the crest of the e. m. f. wave are due to the "flux swing" and those in the zero portion of the wave to the "flux pulsation." When the armature carries current the flux entering the teeth is displaced (a) backwards, when the current is in the same direction as the main e. m. f. generated; (b) forward, when the current is in the opposite direction to the main e. m. f. generated. In the discussion which followed some of the speakers showed a disposition to question how far general deductions should be drawn from experimental results on a machine of special design.—Lond. *Elec. Eng.*, Jan. 16 and 23.

Low-Voltage Alternator.—An article describing tests of a low-voltage alternator of British make for a calcium carbide furnace plant. The normal output is 8600 amperes at 50 volts, and the machine should be able to carry an overload of 10 per cent continuously without a rise of temperature sufficient to injure the insulation. The temperature rise of any accessible part of the machine should not exceed 75 per cent of that of the surrounding air during continuous working at normal full load. In the tests which are described the efficiency was found to be 95 per cent.—Lond. *Elec. Rev.*, Jan. 17.

Lamps and Lighting.

Metallic Filament Lamps.—A letter referring to the placing of osram lamps on arc-lamp posts at East Bourne, the osram lamps not to replace the arcs but merely to be used as half-night lamps. In connection with this the following editorial note is given: "Osram lamps alone are being increasingly used in the 100-cp size for street lighting. A notable example is Exeter, where this has been done for nearly two years, and the average life has been found to be about 1200 hours. The 100-cp osram lamp is now made up to 130 volts and consumes 105 watts. A 200-volt, 100-cp lamp will be on the market in a month or two. There is a little difficulty in obtaining quick deliveries of large quantities of 100-cp lamps, but this will disappear as soon as the arrangements for manufacture in this country are completed. We believe the 100-cp lamp is listed at 8s. ($2).—Lond. *Elec. Eng'ing*, Jan. 16. It is stated that the new 16-cp, 100 to 120-volt German tantalum lamp will be sold in England in a month or two, and that 200-volt osram lamps for 100 candle-power will be obtainable in England in a few weeks' time, while 40 and 50 cp osram lamps for from 200 to 250 volts are stated to have also been made. (A complete list of high-voltage metallic filament lamps now on the market in Germany was given in the Digest last week.)—Lond. *Elec. Eng'ing*, Jan. 23.

Amalgam Lamp with a Very Rich Line Spectrum.—L. Arons.—A paper on the use of a lead-bismuth-mercury alloy (of the formula $Hg_2\,Pb\,Bi$) instead of pure mercury in the mercury vapor lamp) in a quartz tube of Heraeus make. The lamp gives a very rich line spectrum showing all three spectra of Pb, Bi and Hg.—*Ann. d. Phys.*, 1907, No. 6, Vol. 23, p. 176.

Power.

Electric Energy for Industrial Purposes.—J. F. C. Snell.—The conclusion of this paper read before the (Brit.) Inst. Elec. Eng. The author first deals with the cost of electrical energy generated by small gas plants, oil engines and steam plants, in order to make a comparison with the cost of public supply. He then gives the actual cost of energy for works of different kinds, such as docks, shipyards, paper mills, jute mills, cotton mills, collieries, steel works, breweries, etc., and points out which cases offer difficult problems for a central power supply. Finally he discusses the chances of existing undertakings in London and the provinces successfully competing with private plants and what steps are necessary in order that these existing undertakings may supply the demand for energy on a sound financial basis. The severest handicap to energy supply from existing London and British provincial stations is, in the majority of cases, their present high capital cost per kilowatt. "In the case of London undertakers it will be difficult to reduce this much below $300 per kilowatt, or, in the case of large provincial stations, $200 per kilowatt, or smaller stations $250, taking into account all existing capital outlay." The present capital expenditure per kilowatt on London municipal systems averages $465 and London company stations $515, while the present expenditure on provincial municipal stations is $354, and provincial companies $450. The author endeavors to show that the motor user is being supplied with energy by many British stations at the expense of their lighting customers, who are paying an unduly high rate for their supply, or in the case of certain London municipal plants at too high a cost of public lighting. This system may do well where there is only a small amount of energy to be given, and where the proportionate revenue is only a small fraction of the gross receipts; "but let there be a big increase in the amount of energy supplied at the same rates and (despite its effect in the general reduction of generating costs) it will be found then that the total receipts are not commensurate with the total costs, and the result will be an unsuccessful undertaking." The author's chief conclusion is that in the case of a large generating station where the capital expenditure is reduced to a minimum and the supply is produced on a sufficiently large scale but within a reasonable distributing radius, a sound scale of charges for energy can be made which can hold its own with any independent local plant, whether using steam, oil or gas.—Lond. *Elec.*, Jan. 17. The same paper is printed with the complete account of the very extended discussion which followed in Lond. *Elec. Eng'ing*, Jan. 16.

Cost of Energy.—F. H. Hirschland.—An article giving estimates of the cost of energy generation by different means in the case of 800-kw stations delivering 6,200,000 kilowatt-hours per year for an electrochemical process, the plant to run 24 hours per day. The author compares the cost of energy from steam, producer gas, natural gas, oil engine plant and buying electricity from a large hydro-electric station. His results are in favor of the latter.—*Electrochem. and Met. Ind.*, February.

Equipment of Railway Warehouse.—H. Henderson.—A fully illustrated paper, read before the Newcastle section of the Brit. Inst. Elec. Eng., on the equipment of the Northeastern Railway Company's new freight warehouse at Newcastle, which utilizes to the full the advantages obtainable, especially in the way of compactness of arrangement, by the use of electrically driven apparatus, and describes some interesting forms of overhead revolving jib, and other cranes, capstans and wagon hoists. —Lond. *Elec. Eng'ing*, Jan. 16.

Coaling Machinery.—F. Collischonn.—An illustrated description of the electric coaling machinery installed at Savona Harbor, which is one of the most important coaling stations in Italy. Two movable elevators and a cable railway are provided. —Lond. *Electrician*, Jan. 17.

Tusciano Generating Station Plant.—J. Spadini.—An illustrated description of this Italian hydro-electric plant which supplies the industrial district in the neighborhood with energy for lamps and motors. There are five 1400-hp turbines driving 3000-volt, three-phase alternators. For transmission the voltage is raised to 30,000.—*La Lumiere Elec.*, Jan. 18.

Producer Gas.—O. Nagel.—An illustrated article pointing out the advantages of producer-gas firing over direct firing with coal.—*Cassier's Mag.*, February.

Traction.

Automobile Motors.—Sieg.—A paper read before the Electrical Society of Cologne. The author first gives some notes on the different requirements of automobiles for luxury purposes and of automobiles for cab service. Motors for automobiles should have as high an efficiency as possible and should be as light as possible. These are, of course, two contradictory requirements. There is a possibility of improving the efficiency by increasing the speed, since the efficiency of the gearing system is not greatly affected by the ratio of gearing. However, the noise of the gearing is thereby increased to an objectionable degree. By using high-speed motors it is possible to get 5.5-hp motors with an efficiency of 90 per cent, while with a 1000-r. p. m. motor an efficiency of 85 per cent, and with 600 to 700 r. p. m. an efficiency of 80 per cent is very good, if the weight is not increased too much. In the Lohner-Porsche system a high weight is admitted, but the motor speed is so low that the motor is direct connected with the axle. There is, therefore, not only no noise from the gearing but also no loss in the same. Therefore, such a motor may have from 3 to 5 per cent lower efficiency than a high-speed motor without causing a greater consumption of watt-hours per car kilometer. The motor may also be somewhat more expensive than the high-speed motor plus gearing since there is no cost of maintenance of the gearing, which latter amounts to about one-fourth cent per kilometer. This system is the more advantageous the more rapidly the automobile is permitted to run. On broad, straight streets and in the country where speeds of from 15 to 18 miles per hour are permissible, the energy consumption of these motors per car kilometer is only very little higher than that of the best high-speed geared motors, namely, "140 to 150 watt-hours per car kilometer." If, however, it becomes necessary to diminish the speed as in crowded streets, or on grades, the energy consumption increases rapidly. The extraordinary reduction of the number of revolutions deprives the motor of a very important property, its overload capacity. This system is, therefore, useful only on automobiles which are intended to run rapidly on straight, level roads. For running on roads which contain grades, high-speed motors are more suitable, while for traveling in a really mountainous country an electric automobile is unsuitable.—*Elek. Zeit.*, Jan. 9.

Electrification of Railways.—G. Kapp.—The first part of the first of a profusely illustrated series of lectures on the electrification of railways. The reliability of electric operation is pointed out, and it is said that if electric traction has a weak part it is certainly not in the train itself, but in the link between the power house and the train, that is in the conductor with its sliding contact; this weakness is not a serious matter. While in most of the third-rail equipment used at present the working face of the conductor is on the top, this has certain disadvantages. Reference is made to Sprague's construction of an "under-running contact shoe." With respect to trolley systems the suspension by catenary is described.—Lond. *Elec. Engineer*, Jan. 24.

Single Phase Traction.—Henry.—The conclusion of his article on the Oerlikon system of single-phase traction. The author describes the motors used and gives diagrams showing the results of tests.—*L'Electricien*, Jan. 25.

Ratio of Gearing.—O. Allen.—A discussion of the influence of the ratio of gearing on consumption of energy on tramways. The author shows how to determine, with the aid of diagrams, that ratio of gearing which gives the best all-round efficiency of motors and gear.—*La Lumiere Electrique*, Jan. 18.

Gasolene-Electric Omnibus.—An illustrated description of a new gasolene-electric omnibus of English design. The electrical equipment is on the Stevens system. A 30-hp engine drives a commutating-pole dynamo, which supplies energy to two motors, one of which drives each back wheel through worm gearing. A controller enables the motors to be connected in series or parallel. No series resistances are used, but the field of the generator can be varied.—Lond. *Electrical Eng'ing*, Jan. 16.

Gasolene-Electric Automobiles.—P. Gasmier.—A general review of the present status of purely electric automobiles and of gasolene-electric automobiles.—*L'Ind. Electrique*, Jan. 10.

Installations, Systems and Appliances.

Protection Against Breakage of Wires.—Barre and Marige. —Two papers read before the International Society of Electricians in Paris. Barre discusses in a long paper the different types of apparatus for protection against the dangerous consequences of the breakage of overhead wires. The paper of the second author deals with the same subject with special reference to trolley wires.—*Bull. Soc. Internat. des Elec.*, December, 1907.

Wiring in South Africa.—An article stating that in many of the towns in South Africa electric energy distribution has become possible only by the extensive use of overhead wires. Of 30 distributing systems all, with two exceptions, employ bare overhead wires, except in the business section of some of the larger towns, where underground mains are used. Some methods of wiring are described.—Lond. *Elec. Review*, Jan. 17.

Electrophysics and Magnetism.

Flames as Rectifiers.—A. Cathiard.—A flame in which no solid conductor is suspended may be utilized for rectifying alternating currents. It is necessary merely to use one electrode having a much smaller area than the other. The larger current then passes from the larger to the smaller electrode. The author uses by preference graphite electrodes in a coal gas flame, the smaller electrode being a pointed pencil 5 millimeters in diameter. An alternating e. m. f. of from 2000 to 10,000 is applied at forty periods per second. The distance between the electrodes may vary from 5 millimeters to 10 centimeters without altering the phenomenon, and the electrodes may be at different levels. The continuous current obtained is feeble, never surpassing 30 milliamperes. But it produces distinct electrodeposition in a voltmeter. When the current is made stronger it becomes alternating. There is then a bright arc within the flame and a transport of solid carbon. Even when the conduction is unipolar, a feeble luminous arc is seen, whose end moves rapidly about on the larger electrode. When the voltage is reduced the current also decreases and finally the rectification is reversed, giving rise to Hanckel's phenomenon. The author has not yet obtained oscillograph curves from the flame current. —*Comptes Rendus*, Jan. 6; Lond. *Elec. Eng'ing*, Jan. 23.

Conduction in Solids.—J. Koenigsberger.—An article on the nature of electric conduction of solids which are not electrolytic conductors, with special reference to the temperature coefficient of the conductivity. The subject is treated from the standpoint of the electron theory and a formula is developed which is believed by the author to be the general resistance law of all solid bodies not partaking of a saline character.—Lond. *Electrician,* Jan. 17.

Electric Charge of Ions.—H. Pellat.—A theoretical note in which on the basis of molecular and ionic hypotheses the author determines the absolute value of the electric charge of a monovalent ion. His result is in good agreement with the former result of J. J. Thomson. From this value the size of the diameter of the atom is found to be 7.8×10^{-9} centimeters.—Lond. *Electrician,* Jan. 17.

Roentgen-Ray Tubes.—J. Trowbridge.—By the application of a longitudinal magnetic field at the anode of a Roentgen-ray tube it is possible to concentrate the cathode rays. A method of doing this is described and illustrated.—*Am. Jour. of Science,* February.

Lightning Flash.—Bermbach.—An abstract of a paper read before the Electrical Society of Cologne. The author discusses the question whether the lightning flash is an oscillating discharge or not. The author sums up the arguments which may be made for and against this assumption.—*Elek. Zeit.,* Jan. 9.

Electrochemistry and Batteries.

Electrometallurgy of Lead.—J. W. Richards.—In a section of his serial on metallurgical calculation dealing with the metallurgy of lead he gives details as to the Salom process of cathodic reduction of galena and of the Betts process of refining lead bullion.—*Electrochem. and Met. Ind.,* February.

Electrochemical Analysis.—A. M. Fairlie and A. J. Bone.—A second article on electrochemical analysis with rotating anodes in the industrial laboratory. The article gives details of the methods of analysis employed by them with great success in commercial copper determinations.—*Electrochem. and Met. Ind.,* February.

Units, Measurements and Instruments.

Treatment of Electric Measuring Instruments.—K. Edgcumbe.—A paper read before the (British) Association of Engineers in charge on "electrical measuring instruments and some of their weaknesses." A mistake is often made from the very outset in selecting the most suitable range when ordering the instrument. It is a great mistake to order a higher range than is absolutely necessary. This is true even for moving-coil instruments, where the scale is perfectly even throughout its range. But this mistake is often more unfortunate with moving-iron instruments, since, owing to the fact that the permeability of iron is small at low inductions, the first tenth of the scale of such an iron instrument is always cramped. For this reason the top reading should be chosen as small as possible, so that the upper part of the scale may be mostly used. The question of range becomes of supreme importance in ampere-hour or watt-hour meters, since with very light loads it is not simply a case of the indication being inaccurate, but the meters will not start at all below a certain minimum, owing to the initial friction which has to be overcome. A point requiring careful consideration when specifying an instrument is the accuracy to be aimed at. One must remember that the accuracy of a test really depends on that of the least exact instrument used. For example, in testing the efficiency of a glow-lamp, it is sheer waste of time to measure the power consumption to 1 per cent when the candle-power cannot be relied upon to within more than 5 per cent. In the case of a cell-testing voltmeter, on the other hand, an inaccuracy of more than 1 per cent would be inadmissible. A mistake often made lies in the type of instrument selected for a particular purpose; for direct-current circuit the moving coil pattern is undoubtedly the one to choose. For alternating current, on the other hand, the moving iron is greatly superior to the hot-wire or induction pattern on the score of both accuracy and durability. The former is always uncertain in its readings owing to the unequal expansion in the various parts, and the latter is seriously affected by frequency, wave form and temperature. The moving-iron pattern, if properly designed, is entirely free from these errors. For ordinary commercial testing of lamps, a satisfactory photometer consists of two cards inclined at an angle, each illuminated by one of the lamps and so placed that one card is seen behind the sharply cut edge of the other. An incandescent lamp whose candle-power at the normal voltage is known, forms the standard, and is set at a given distance on one side of the cards. Another lamp (the candle-power of which is immaterial) is placed on the other side, and is moved to and fro until the two cards appear to be equally illuminated, after which this lamp must not be again moved. The standard lamp is now replaced by the lamp to be tested, which is in its turn moved up to and away from the photometer until a balance of illumination has again been obtained. This is the method in its crudest form; several small refinements and modifications are possible. In order to be able to determine the efficiency of a lamp the consumption must be measured, and for this purpose a deadbeat ammeter or wattmeter provided with a lampholder is the most suitable. The instrument should also be furnished with a fine wire fuse, and even when so protected it is best to short-circuit the ammeter temporarily when the lamp is first put into circuit, in order to prevent any damage in the event of a faulty lamp being put into the holder.—Lond. *Elec. Eng'ing,* Jan. 16.

Portable Measuring Bridge.—D. Bercovitz.—An illustrated description of a portable measuring bridge which may be used with direct current or alternating current and is specially suitable for lightning-rod tests which are generally carried out by people who are not highly skilled. The instrument was designed by Ruppel and the essential feature of it is the oscillating device *A* which by means of mechanical oscillations of a spring transforms direct current into alternating current. A tuned steel spring *A* connects alternately the positive and negative pole of the battery *B* with the bridge, as indicated in Fig. 4. The spring is so tuned that the frequency of the alternating current produced is about 17 periods per second. This frequency is also sufficient for tests of electrolytes. In connection with this bridge it is possible to use instead of the telephone a sensitive damped Deprez galvanometer *G* which is caused to oscillate by means of the alternating current. Not the deflection of the needle but the force of the oscillations is observed, since the method is a zero one. The galvanometer *G* is so tuned that there is almost perfect resonance between the oscillations of its needle and those of the tuned steel spring *A*. The bridge is adjusted until the needle of the galvanometer ceases to oscillate. The resistance desired is then directly read off. It is, of course, possible to use the instrument for direct-current tests. In this case the steel spring *A* is not caused to vibrate, but is brought into continuous contact with either *C* or C_1.—*Elek. Zeit.,* Jan. 9.

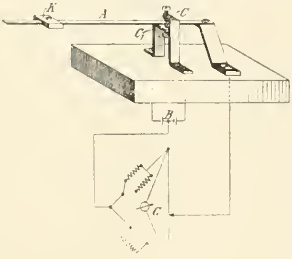


FIG. 1.—PORTABLE MEASURING BRIDGE.

Standard of Radioactivity.—A note on a report recently presented to the (London) Roentgen Society by its standards committee. Constancy and homogeneity, which are conditions essential to a standard of radioactivity, are not obtained from the alpha and beta rays, but from the gamma rays. It is, therefore, recommended that one milligram of pure radium bromide should be regarded as a standard, and that the ionization produced by the gamma rays from that quantity after passing through one centimeter of lead (in order to cut off the inconstant alpha and beta rays) should be taken as the measure of the unit of radioactivity. A fundamental c. g. s. unit of radioactivity is not thought to be feasible at present, but it is suggested that it might ultimately be possible to define the standard in c. g. s. units as that weight of radium which reduces energy at a rate of one erg per second. From some communications received at the meeting it appears that according to Sir William Ramsay the atomic weight of radium is 240 against Mrs. Curie's estimate of 225 or 226. Rutherford suggests in the above definition of the standard a lead-screen thickness of five millimeters instead of one centimeter.—Lond. *Electrician,* Jan. 17.

Telegraphy, Telephony and Signals.

Undamped Oscillations.—P. Barreca.—A paper on Poulsen's method of producing undamped oscillations. The author finds that the results are always better when the copper is cathode rather than anode, whether it is cooled or not. This is against the advice of both Poulsen and Hahnemann. The advantage is in additional stability. In order to obtain a given value of CL it is better to alter L only and leave C untouched. In any case for a given CL a large C is advantageous. For his experiments the author used a hollow upper cathode of copper and a lower anode of carbon kept in rotation by clock work. The copper was used up in three or four hours. The hydrogen was carburretted by bubbling through benzine. The effect of the carburretting is shown by the following figures: With an e. m. f. of 200 volts and a continuous current of 10 or 12 amperes, waves were produced 240 meters in length. "A hot-wire ammeter in the oscillating circuit showed 23 amperes (3.75 effective) with pure hydrogen, and 50 amperes (8.14 effective) in hydrogen bubbled through benzine." The benzine also notably increases the regularity. The ammeter remained, in fact, steady for 15 or 20 minutes at a time, and a vacuum tube on the secondary of a Tesla coil remained alight. The carbon electrode is covered with a spongy growth in the benzine, which must be filed off.—Lond. *Electrician,* Jan. 17.

Wireless Telegraphy.—J. de Beaupre.—An article on the equipment of French battleships on the Mediterranean Sea with wireless telegraph apparatus. Mention is made of the success obtained by the Cruiser Kleber, stationed at Casa Blanca (Morocco), in transmitting wireless telegraph messages to the Eiffel tower in Paris over a straight distance of 1200 miles.—*La Lumière Elec.,* Jan. 18.

Miscellaneous.

Heat Dissipating Varnishes.—A. R. Warnes.—An article on the best heat-dissipating varnishes. Two commercial white varnishes, called *A* and *B,* of this kind are described as follows: *A* is composed of boiled linseed oil, zinc oxide and Russian turpentine. *B* is rather a more complicated mixture, the white base being china clay and lithopone (a mixture of zinc sulphide and barium sulphate), the binding material consisting of blown or oxidized cotton oil and the solvent a mixture of coal tar naphtha and American turpentine. A third black varnish was made of best bitumen combined with oil turpentine and specially refined naphtha constituting the solvent. According to the laws of physics the black varnish should have the best heat-dissipating property. A comparative test between the black varnish and the white varnish *B,* however, showed a very slight superiority of *B* over the black varnish with respect to dissipation of heat. This property alone, however, is not sufficient to determine the superiority, since the white varnish shrinks and becomes brittle while the black varnish does not. Further, the black varnish contains no mineral matter and after stoving is much more homogeneous than the white. For this reason it is a much better insulator.—Lond. *Elec. Review,* Jan. 17.

BOOK REVIEWS.

Annuaire pour l'An 1908. Publié par le Bureau des Longitudes. Paris: Gauthier-Villars. 958 pages. Price, 1.50 francs.

This yearly publication of the Bureau des Longitudes contains 400 pages of astronomical tables and nearly as many of physical and chemical data. These include recent values found for the specific heat of solids, liquids and gases; critical temperatures, viscosity of liquids, elasticity of solids and wave lengths in the solar spectrum. The volume contains six appendices, three of which refer to astronomical work in progress in France and abroad; two are obituary notices of Loewy and Trépied; the last has the names of the "Bureau" members.

La Moderno Teoria dei Fenomeni Fisici. Radioattivita, Ioni, Elettroni. Third edition. By Augusto Righi. Bologna: Nicola Zanichelli. 290 pages; illustrated. Price, 5 lire.

The works of Prof. Augusto Righi are well known for their clearness, directness and simplicity of presentation. This volume is no exception to that rule. The author presents the salient physical and experimental facts recently discovered concerning electrons and radioactivity in a very acceptable form for the reader who has a knowledge of elementary physics, but who has not kept up with the recent rapid progress of science in this important direction. The volume treats of electrolytic ions, of ions in gas, of the nature of cathode rays, radioactivity, and radioactive transformations, concluding with the modern electron theory of the conditions of matter. The book will be valued by all students of physics and particularly by students of electricity. Although we have good books by English speaking writers on this subject, this volume would be welcomed by many if translated from the Italian.

Handbuch der Angewandten Physikalischen Chemie. Part 1. Elektrochemie Wässriger Lösungen. By Dr. Fritz Foerster. Leipzig: Johann Ambrosius Barth. 507 pages. 121 illustrations. Price, 20 marks.

The scope of the work is best given in the words of the preface: "The applications which the electrochemistry of aqueous solutions has found in the laboratory and the works, stand in the foreground. The prevailing theory of electrochemistry need therefore only be outlined. The book will primarily be a text-book, for the use of students and for teaching the technical applications of aqueous electrochemistry. It does not pretend to embrace all the facts of this field; copious references, however, will guide the student to further studies beyond the text. Patent literature has been cited only where its contents contain undoubted contributions to science or technology."

The 500 cleanly printed and attractive pages are a veritable mine of information, compiled, systematized, classified and worked out in detail with characteristic German thoroughness. There is nothing in English half so complete. It is, however, not absolutely free from lack of balance. Chapter 5, on the potential drop of an electrolytic bath, is unsatisfactorily short; on the other hand, Chapter 14, the special electrochemistry of the halogen elements, is unexpectedly complete (100 pages) and well written. The other special subjects handled, usually with commendable completeness, are Faraday's law, resistance of electrolytes, batteries, decomposition of water, electro-osmosis, electrolytic separation of the metals, metal plating, metal refining, electrolytic reduction, electrolytic oxidation. The absence of a systematically arranged chapter on "secondary reactions" would add much to the completeness of the book. The work as a whole is admirably adapted to give electrical engineers and electricians a comprehensive view of the field of electrolysis in aqueous solutions, and its manifold applications

San Francisco 4000-kw Gas-Engine Plant.

Excellent reports are received from the 4000-kw gas-engine-driven Crocker-Wheeler alternators in the Martin Station of the California Gas & Electric Corporation. Parallel operation, which before the installation was made was thought impracticable, has been successfully accomplished. The machines remain in step even against back explosion in the engine cylinder, which is the most severe condition possible. There is one instance recorded when the back explosion was tremendous enough to throw one of the generators out of step, but even in this instance the generator regained its step instantly, and without assistance of the station attendants.

The Single Air-Gap Construction in D'Arsonval Meters.

By Paul MacGahan.

The greater proportion of the designs of direct-current indicating ammeters and voltmeters which have appeared upon the market have embodied the well-known construction first brought out, comprising a U-shaped permanent magnet with a cylindrical soft iron core embraced by soft iron pole-pieces. The arrangement of these pole-pieces is similar to that of a bipolar direct-current generator field circuit, and generally the air-gaps between the core and the pole-pieces are made uniform in length and of very small proportions, barely enough clearance being allowed to permit the moving coil to swing without touching. In many designs, this air-gap is as small as .04 in., the clearance between the coil and the iron being only .01 in.

More recently there has been brought forward a different type of construction based upon the D'Arsonval principle, whose fundamental distinction is that only one air-gap is provided in the magnetic circuit for the coil to swing through. As this has become an accepted type with several manufacturers, a complete description of the principles involved may be of interest.

Fig. 1 clearly illustrates the general features of one of these single-gap types. The permanent magnets *A-A* are provided with soft iron overlapping pole-pieces *B-B* clamped in position to the magnets and separated by a uniform air-gap *C*. The moving coil *D* is wound on a rectangular aluminum shell, and is so pivoted that it encloses the upper pole-piece, the lower portion of the winding being centrally located in the air-gap *C*.

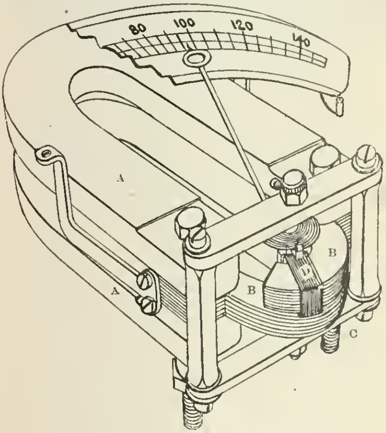


FIG. 1.—MAGNETIC AND ELECTRIC CIRCUITS.

Given a certain minimum clearance in the gaps, it will be evident that the air-gap reluctance of the single-gap magnetic system is half that of the bipolar, or double-gap, system. This advantage fully compensates for the fact that in the single-gap forms the length of active wire in the air-gap is half that in the bipolar type. Therefore, in general it is true that the same amount of steel is required to give the same torque and sensibility with the single air-gap as with the double-gap form. The choice of designs is therefore dependent on several other considerations, such as ease of assembly and of repairs, strength and balance of moving element, simplicity, etc.

The question of actual length of air-gap and clearance is one common to the two forms of construction. The larger the air-gap and the clearance in either form, the more magnet steel is required to secure proper operation. One consideration in designing the original D'Arsonval meters was the fact that magnet steel was comparatively expensive and it was advisable to make the air-gaps as small as possible—barely enough to allow a free swing of the coil under favorable conditions, no iron filings and no dust being present in the air to accumulate in the air-gap and cause friction.

As the art of making magnet steel progressed, however, the fundamental reason for the extremely small air-gap vanished and thus it will be found that the later designers who are responsible for the single air-gap have seen fit to take advantage of the lower cost of steel to increase the clearance by increasing the amount of magnet steel used.

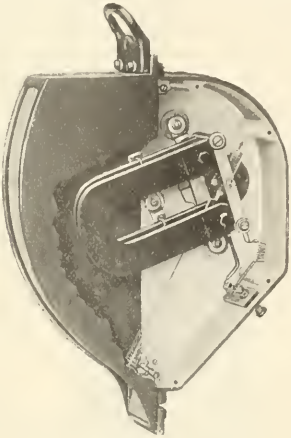


FIG. 2.—VERTICAL EDGEWISE TYPE OF METER.

In the meter shown in Fig. 1 the air-gap is double the width of that in the majority of bipolar meters, and instead of a single permanent magnet, two magnets of the same size are used. To the superficial observer it might appear as though the two magnets were necessitated on account of a lower efficacy of the single-gap meter system, but the fact should be emphasized that in the meter illustrated the very generous clearance in the air-gap accounts for the extra amount of steel used.

The fundamental structural advantages of the single-gap type are:

(1) The complete moving element may be removed from the magnetic structure without disturbing the magnetization. In order to remove the coil of the bipolar type for repairs, it is necessary either to remove the permanent magnet from the pole-pieces or to remove the cylindrical iron core, thus in either case disturbing the magnetic circuit. Permanent magnets are always weakened by opening the magnetic circuit; moreover, they do not recover from a severe magnetic disturbance and settle down to a permanent magnetic value immediately after their magnetic field is violently disturbed. In the case of the single-gap construction, the magnetic circuit may be assembled complete with the pole-pieces before being magnetized. After magnetization and aging, the magnetism may be measured, then the magnets stored away for a sufficient length of time to insure against latent defects, then tested again for magnetic strength; and those not showing a change in strength

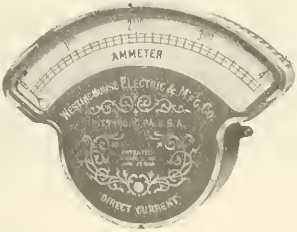


FIG. 3.—ILLUMINATION DIAL TYPE OF METER.

may be assembled into meters. The advantages with regard to permanency of this method are obvious to all who have made a careful study of the subject of permanent magnets. The manufacturing advantages are also obvious.

(2) The coil can balance the weight of the pointer, making possible a very strong pointer and giving a movement of lower weight than if a separate counterbalance is used to compensate for the pointer. The whole moving structure thus becomes rigid, easily handled, and rugged enough to withstand violent short circuits which would quickly destroy the more delicate construction necessary for the centrally pivoted coil of the bipolar type. The use of the coil to counterbalance the pointer is especially valuable in the vertical-edgewise types of cases which require very long, stiff pointers, as illustrated in Fig. 2, and in illuminated-dial meters.

(3) The air-gap being formed by parallel plane surfaces is much easier to clean out and freer from dirt or iron filings than a cylindrical gap. This is important in localities where the air is charged with dust and iron filings. In case the cover is removed for repairs or inspection, these iron filings will inevitably collect on the pole-pieces; moreover, shipment may loosen some stray filings adhering originally to the interior of the instrument, which had escaped the most vigilant shop inspection system. The absolute accuracy of alignment required to secure free operation in a cylindrical air-gap is not necessary in the case of the parallel plane surface pole-pieces. This is of vital importance to an operating company proposing to do its own repair work and recalibration.

Post Brake for Rolling Mill Motor Service.

The latest addition to the Westinghouse Electric & Manufacturing Company's list of apparatus for rolling mills is an improved brake of the solenoid post type designed to meet the severe requirements of motor work in iron and steel mill service. Its principal members are a brake wheel and two friction shoes, which are mounted within a structural frame supported by a steel base. The brake is controlled by a heavy spring and a solenoid which is completely enclosed in a cast-steel frame. The brake is built entirely of cast iron and steel, the former material being used in the wheel and shoes, because of its better wearing qualities and the cheapness with which renewals can be made.

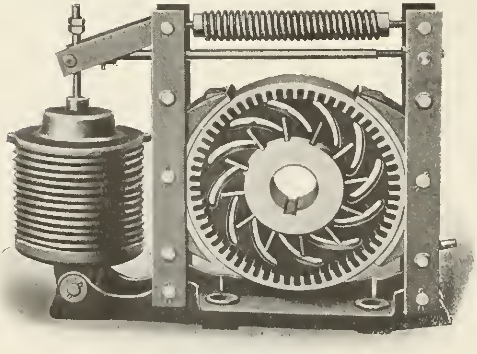


FIG. 1 FRONT VIEW OF BRAKE

The shoes are clamped to the wheel during the braking period by means of the spring, and are released by the solenoid. The full force of the brake is applied at the moment of contact between the shoes and the wheel, and as soon as contact is made the spring ceases to contract. The braking force therefore is never beyond normal value and the stress on the brake parts and motor shaft is much less than is ordinarily the case. To obviate the hammer-blow effect, the plunger has a certain amount of lost motion to permit of over-travel. All parts of the mechanism needing adjustment are easily accessible, and no lubrication of either shoes or wheel is required.

In the design of the brake ample provision has been made to counteract heating tendencies. The rim of the wheel is corrugated on the under side for the double purpose of increasing its strength and giving the maximum radiating surface.

Numerous curved arms permit an expansion of the rim due to heating, without producing undue stresses. On each side of the arms and extending from the hub are vanes, which direct a current of air against the corrugations inside the rim while the wheel is running, thus dissipating the heat and keeping it away from the motor bearing.

The shoes are cast with a solid thick face to permit long wear. On the rear of the shoe is a series of narrow ribs which strengthen it and increase the radiating surface. The shoe is free to turn on a pivot and find a true seat on the wheel, so that the pressure is distributed and unusual wear in any one part of the shoe is prevented.

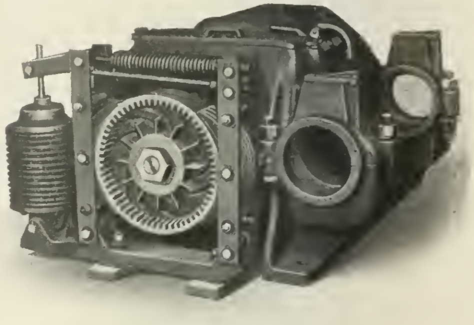


FIG. 2.—BRAKE ATTACHED TO MILL MOTOR

The solenoid frame is pivoted at the base to prevent any tendency to bind as it follows the wear of the shoe. The coil may be either series or shunt wound for a direct-current circuit of 110, 220 or 500 volts. The series winding is preferable to the shunt, due to its quicker action and is considered as standard. The series coils will release the brake at 0.6 of the full load current of the motor, and will hold it open at 0.1 full load current.

The brake is secured to the motor by means of suitable brackets, which may be made integral with the motor frame when so specified. This arrangement is recommended as it precludes the possibility of the brake getting out of alignment.

These brakes are at present made in five sizes for 25, 50, 75, 100 and 150-hp motors, and may be applied to any type of motor used in mill or crane service.

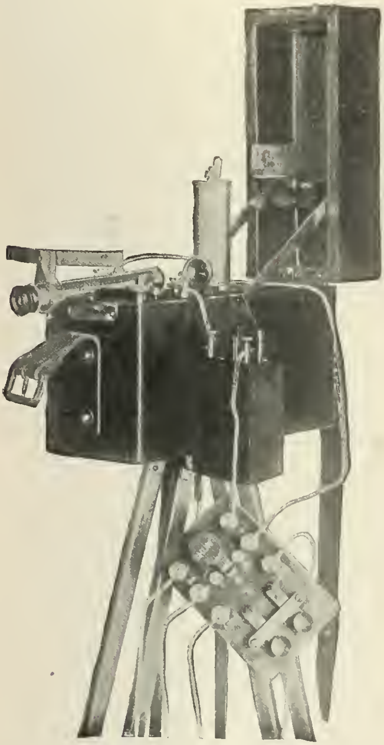
Universal Galvanometer.

All of the advantages of the pivoted form and the added sensibility of a suspended instrument are said to be combined in a universal galvanometer just produced by Queen & Company, Philadelphia. The permanent magnets are made of the finest quality of magnet steel, carefully aged to insure permanency. The moving coil swings in a uniform magnetic field and hence the deflections are proportional to the current. With proper shunts this instrument can be used as an ammeter or a milliammeter, and with a series resistance it can be used as a voltmeter or a milli-voltmeter.

The coils are rectangular in form and swing over a soft iron core having radial faces. The moving system is suspended by phosphor-bronze strips secured to abutments terminating at the ends of two steel rods that also hold the soft iron core over which slides the clamping device for transportation. A $\frac{3}{8}$-in. plain mirror is mounted just above the coil. The upper abutment is provided with two milled heads, one for locking the system and the other for adjustment to zero. The whole is enclosed in a brass tube provided with a ¾-in. circular window. The entire system can be lifted from the tube by the removal of two small screws. The tubes are interchangeable, so that the user can have tubes of different sensibilities.

The containing cases are made of hardwood, well finished and provided with a leather carrying strap. The permanent magnet is securely bolted in the case, thereby insuring extra stability.

A telescope with scale is attached to the magnet, as is also the curved soft iron pole-pieces that form a receptacle for the tube and its system. On either side of the telescope is provided a mill-head screw for leveling the instrument when used as a table galvanometer. There is also provided a brass plate secured to the lid of the instrument, so that it can be used as a wall galvanometer. This instrument has also a brass plate on the bottom with a hole taped to receive the screw from a tripod for street work.

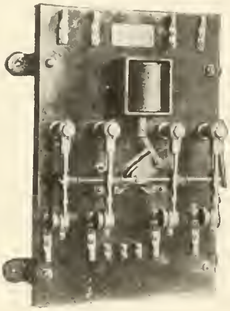


UNIVERSAL GALVANOMETER ARRANGED FOR STREET WORK.

With this instrument there is provided a 100,000-ohm coil wound with a wire having a negligible temperature resistance coefficient mounted in a neat case with suitable terminals. There is also an Ayrton shunt with all necessary binding posts and two battery receiving keys. This instrument fits in the box very compactly, and the entire dimensions over all are 6.5 in. high, 8.5 in. long and 3.5 in. wide, and it weighs 5.5 lbs.

Magnet Switch for Direct- or Alternating-Current Circuits.

The illustration herewith shows a Darrin four-pole magnet switch for alternating-current circuits. The switch is also made with one, two and three poles, the three and four-pole switches being especially designed for alternating-current work, and all are applicable for direct-current circuits. The operating magnet is energized only during the actual movement of the switch to open or close the circuit, the circuit to the magnet being automatically broken when the main circuit is closed or opened, as the case may be. The type of construction shown is also made use of for magnet-reversing switches, used in connection with reversible motors, by the addition of another set of contacts. It is well known that in a plunger magnet on alternating current the pull is greatest at the beginning of the stroke, gradually diminishing as the core approaches the end of its travel. The manufacturer has taken advantage of this by dispensing with any effort on the part of the magnet after the initial flow of electricity. The initial pull of the core sets in motion a toggle mechanism having sufficient momentum to close or open the switch. Contacts are provided for de-energizing the coil after it has been energized, and these connections are made up again by the continued movement of the mechanism, and are thus ready for a throw in the opposite direction when the electricity is supplied through the other contacts. This construction obviates the breaking of the circuit at the controlling point. The latter mechanism has, therefore, only to perform the function of closing the circuit, and, as a result, no provision need be made for taking care of the arc at the controlling point. On narrow adjustments, or in a pressure-regulating system, where a very slight variation of pressure will affect the movement of a Bourdon tube index arm to such a slight extent as to cause a movement of less than 1/32 in., it will readily be seen that no very great current could be taken care of, nor, in fact, in any such delicate controlling device, were it not for the fact that the magnet circuit is broken by the switch itself. In the magnetically controlled electric elevators, moreover, it is desirable to use as little energy on the reversing switch as possible, so as to obviate the heat, to take care of which would otherwise largely increase the cost of construction. The switches are also well adapted for controlling lamp circuits from a distance, and can be operated from any number of buttons in multiple, if desired. Magnetic blow-outs may be made part of the equipment. The switch is manufactured by the Automatic Switch Company, 131 Liberty Street, New York. The contacts are easily renewed, and are designed to withstand heavy arcing. The toggle mechanism holds the contact arms securely in the open or closed position.



MAGNET SWITCH.

H. W. Johns-Manville Company Convention.

In accordance with its usual custom the H. W. Johns-Manville Company held a convention of its branch managers, in New York, from Jan. 29 to Feb. 1. The managers of the various branches of the company throughout the United States were present at the meeting and a general discussion of the business affairs of the company took place. As a fitting windup of the convention a banquet was given to the managers at the Union League Club on Friday evening, Jan. 31. The convention was pronounced a decided success by all present.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—What little change there was in the commercial situation was in the right direction, but trade generally, both retail and wholesale, was rather quiet. Commodity prices as a whole were irregular, and collections showed little improvement. Money was easier and offerings of commercial paper were well taken care of, but dulness in trade and industry limits the output of notes for sale. Reports indicate that shrinkage in January trade amounts to from 30 to 50 per cent as compared with January last year. Building expenditures at leading cities were 39 per cent smaller than a year ago, pig-iron production was 52 per cent less, shoe shipments were 28 per cent smaller, and bank clearings shrunk 29 per cent. Preliminary reports of January railway earnings show a decrease of fully 8 per cent from a year ago. Failures were very numerous, and liabilities, swelled by financial suspensions, were only three times exceeded. The production of pig iron in January was the smallest recorded since that month in 1904, and was a decrease of 15 per cent from December, 55 per cent from October, and 52 per cent from January, 1907. The demand for structural material was fair, but in order to stimulate business in certain lines prices were shaded. The Pennsylvania Railroad Company placed an order during the week for 55,000 tons of steel rails. Copper is lower, the general demand being light, and much resale stock is on the market. The closing quotations are: 13.62½c. for Lake; 13.50c. for electrolytic and 13.25c. for casting. Foreign commerce at the port of New York for the week showed a gain of $6,025,713 in exports and a loss of $8,778,665 in imports, as compared with the corresponding week in 1907. The January reports of business failures to *Bradstreet's* show a total of 1722, with liabilities aggregating $63,416,589. The number is the largest for any month for eleven years past, and was exceeded only seven times in the past fifteen years. The liabilities were only twice exceeded in 1907 and only three times exceeded in the past fifteen years. Compared with 1907, the number of failures in January represent an increase of 55 per cent, and the liabilities were three and one-half times larger. Every important section of the country, excepting the Territories, show a greater number of casualties and heavier liabilities. The number of failures during the week ended Feb. 6 was 272, against 359 in the previous week and 198 in the corresponding week last year.

FRANCO-BELGIAN INDUSTRIAL SYNDICATE FOR JAPAN.—Reference has previously been made to a proposed syndicate of French and Belgian capitalists having for its purpose industrial operations in Japan. According to consular report the organization of the syndicate has recently been completed with the assistance of the Japanese government. The capital is mainly advanced by Banque de Paris, La Banque l'Union Parisienne, La Banque d'Outremer in Brussels and La Compagnie Internationale d'Orient in Brussels. At present there are 15 men from these institutions traveling in Japan and thoroughly examining the economic conditions of the empire, as well as the industries which are already taken over by the syndicate, or the acquisition of which is contemplated. A number of concerns have already been taken over and are being operated by the syndicate, and it has already organized several enterprises, among others the Orient Rubber Company, with a capital of $500,000, equally divided among French, Japanese and British. It is the intention to start a syndicate bank at Tokyo as soon as plans can be completed. This institute will have a capital of $10,000,000 and prominent Japanese financiers will be interested, but aside from them only Frenchmen.

INCREASE IN BUSINESS.—According to the officers in charge of the Westinghouse Machine and Westinghouse Electric and Manufacturing companies under the existing receiverships, the amount of business booked by both concerns for January is three times in excess of December's business. The New York, New Haven & Hartford Railroad has ordered from the Westinghouse Company six more single-phase, electric locomotives, which will be duplicates of the 35 heretofore furnished by that company to the railroad. Inquiries received by the Westinghouse Company indicate that large enterprises which were held up in the fall will shortly be resumed within the next few weeks. Among other orders are the closing of contracts for two 1000-hp turbine engines for the Panhandle Lumber Company, of Spirit Lake, Iowa; a 750-hp turbine engine for the Hard Rubber Company, of College Point, L. I., and a 1000-hp turbine engine for a plant in South Manchester, Conn. The Armstrong Company, which is improving and enlarging its plant in Lancaster, Pa., has placed an order with the Westinghouse Company for nine electric motors, varying from 25 to 100 hp and with a total of 500 hp.

COMPETITOR FOR GENEVA-SENECA COMPANY.—At a recent meeting of the Geneva Board of Public Works, J. H. Bendure, consulting engineer for the Economic Power and Construction Company, announced that his company is preparing to enter the field as a competitor for private lighting, and for city lighting when the present contract with the Geneva Seneca company expires. The company desires to use about 5000 ft. of the present conduit system and would take more, but Mr. Bendure said that the rate of 5 cents per duct foot as rental value was too high. Recently the control of the Steam Heating Company passed to persons in New York and Buffalo, who are planning to engage actively in the heating and lighting business. Plans for a number of places have already been drawn up, it is said, and a large plant has been designed for Buffalo. The Board appointed a committee to confer with the city attorney and learn what powers are granted to the company and what rights are possessed by the city. The matter will be further discussed at the next Board meeting.

ANGLO-JAPANESE ELECTRICAL DEVELOPMENT.—Consul-General Henry B. Miller, of Yokohama, reports that on Dec. 6, 1907, the Japanese government granted a license to the Anglo-Japanese Oi-gawa Hydro-Electric Power Company, which has for its object the supplying of electricity to Shizuoka and other cities on the Tokaido and neighborhood by ultilizing the cataracts of the Oi River. The company intends to develop water-power of about 66,000 horse-power at Tamochimura, about 27,000 more at a point between Ikamamura and Hambaraumechi, and about 8000 horse-power at Uchinakubi, in Yamanashi prefecture, respectively. The first being the largest among the three works, will have to be postponed for some time. The second and third will be started in 1908 at an estimated cost of $5,000,000. The company is backed by a capital of $5,250,000, half of which will be equally subscribed by the British and Japanese promotors. It is further reported that the company will issue $2,500,000 worth of its shares for subscription.

MICHIGAN CITY POWER PLANT.—The Michigan City & Indiana Gas Company, of Michigan City, Ind., has added to its electric power plant two Corliss units, one consisting of an 18 in. and 38 in. x 36 in. heavy-duty cross-compound engine direct-coupled to an alternating-current generator of 500-kw capacity, and the other, of somewhat smaller size, for driving a 300-kw generator of the same type, each delivering three-phase current at 2300 volts. Both engines and generators, as well as the condensing apparatus, are of Allis-Chalmers make.

THE TAYLOR INSTRUMENT COMPANIES, of Rochester, N. Y., have acquired the sole American rights of manufacture and sale from the Cambridge Scientific Instrument Company, Ltd., Cambridge, England, and are now prepared to execute all orders for its product. A plant is being established for the manufacture of all instruments coming within the companies' field, which will be developed as rapidly as possible under charge of Mr. C. E. Foster, who for many years past has been associated with the Cambridge company.

THE WEEK IN COPPER.—During the last week the copper market remained dull and steady, almost without change in prices for copper metal. Shipments to Europe continued during the week, but were less in volume than in December or January. Between Feb. 1 and Feb. 7, 3997 tons were exported to Europe, and as British manufacturers are buying small lots from store, there is a fair volume of metal moving into consumption. Despite the heavy stocks of the metal in the hands of London dealers, they say that there is little possibility of any marked decline in prices. At the close of the week the London market showed weakness and it was thought that some of the dealers, long on the metal and tired of holding, were getting rid of their stocks in store. Such business as was done here during the week has been transacted on a 14c. basis. There continues to be a gap of about ⅜c. between the leading interests and the independents, the former still holding to the price of 14¼. Price changes at New York for the week were:

	Highest.	Lowest.	Close. Feb. 7.	Close Jan. 31.
Copper, lake	13.75	13.62½	13.62½	13.75
Copper, electro	13.62½	13.50	13.50	13.62½
Copper, casting	13.37½	13.37½	13.25	13.37½

The week's metal prices at London were as follows:

	Higbest. £ s. d.	Lowest. £ s. d.	Feb. 7. £ s. d.	Jan. 31 £ s. d.
Copper, spot	62- 0/0	60-15/0	61- 2/6	61- 2/6
Copper, futures	61-12/6	61-10/0	61-10/0	61-15/0

Notwithstanding the apathy of the copper market, copper experts are inclined to view the situation with equanimity, and confidently predict a large volume of business for 1908. They point to the undisputed fact that many jobbers have reduced their stocks to a bed rock basis and will be forced into the market at the first symptoms of a business revival. It is said that the Amalgamated Copper Company is in a much better position than at any time during the last six months. Heavy exports and the curtailment of production have reduced the large surplus on hand last fall to a point to where the resumption of many mines, at present closed, is but a matter of a few months. The Boston and Montana group of mines, the only mines of the Amalgamated group in operation and which can produce copper at a lower price than any of the subsidiary companies, are now in full operation and producing approximately at the rate of 90,000,000 pounds a year. It is expected that the question of resuming full operations in the Butte camp will come up for consideration before long. Considering that nearly a year has elapsed since local consumers have been in the market for any large quantities, it would not be surprising to see a strong buying movement started before spring. Last month the output of the Butte camp was 2,318,475 pounds, which is nearly twice the December production and very little short of September's output. The *Boston News Bureau* figures the production of copper in the United States, Mexico and Canada for the month of January at 65,900,000 pounds, comparing with 84,935,143 pounds in January, 1907, and 97,296,400 pounds in January, 1906. It is estimated that the present supplies of spot copper in the United States do not exceed 30,000,000 pounds, and a buying movement of any strength would exhaust this stock in a few days.

WESTINGHOUSE MACHINE COMPANY BUSINESS.—The business of the Westinghouse Machine Company which last year aggregated $6,000,000, will, it is stated, not fall much, if any, short of that figure this year. The company's shipments from Oct. 23, 1907, to Jan. 31, 1908, aggregated $1,500,000, against $1,700,000 for the same period of last year. The company has sufficient orders on its books to keep the shops employed and maintain the same business ratio of last year for at least six months to come, and inquiries being received give encouragement that the volume of business reported at the end of the next fiscal year will not be less than that for the preceding year.

ALLIS-CHALMERS ORDERS.—Among recent orders received by the Allis-Chalmers Company is the equipment of the cement mills of the Atlantic Portland Cement Company, at Nazareth, Pa., which includes seven large Corliss engines with electric generators, motors, transformers and full complement of auxiliary apparatus. A fifth 1000-kw Reynolds-Corliss engine has been ordered for the Bristol Tramways Company, of Bristol, England, and is now in the erecting shop at Milwaukee.

WESTERN PACIFIC RAILROAD TO USE ELECTRICITY.—Mr. Guy C. Earle, vice-president of the Great Western Power Company of Big Bend on the Feather River, has stated that the Western Pacific Railroad, now being built to San Francisco, will use electricity for motive power.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and heavy in tone throughout the week, with decided weakness at the close. Investment demand slackened, notwithstanding the easy money market, and a certain amount of discouragement was manifested regarding the continued agitation against corporation and stock market interests and the diminished earnings and increased expenditures almost uniformly displayed in the current returns of railroad earnings. The heaviness of Southern Pacific and Union Pacific, due to this cause, had a rather unsettling influence upon the entire list, although there were some other weak stocks. The market was not without its firm spots, however, United States Steel holding well in the face of the general tendency of the list to ease off on the limited selling and the feeble buying support. Electric and traction securities were, in common with the rest of the list, dull and little business was transacted in them. All of these stocks are lower in price, as shown in the accompanying table. On the curb market, stocks were irregular with a tendency to sag and with closing prices at about the lowest. Following are the closing quotations of Feb. 8:

NEW YORK.

	Feb. 3	Feb. 8		Feb. 3	Feb. 8
Allis-Chalmers Co.	6	6	Interborough Met. com.	7¾	7¼
Allis-Chalmers Co. pfd.	18	18	Interborough Met. pfd.	20⅛	19½
Amalgamated Copper	50⅞	48⅛	Mackay Cos.	54	52¾
Am Dist. Tel.	—	39*	Mackays Cos. pfd.	61	61
American Locomotive	37	33¾	Metropolitan St. Ry.	—	20½
Amer. Locomotive pfd.	90	87⅞	N. Y. & N. J. Tel.	100	98½
American Tel. & Cable	—	55	United States Steel com.	28	27¼
American Tel. & Tel.	106	106	United States Steel pfd.	92½	90¼
Brooklyn Rapid Transit.	45½	39¾	Western Union Tel.	54½	53½
General Electric	119	115½	Westinghouse com.	41½	40
Hudson River Tel.	—	—	Westinghouse pfd.	—	70*

BOSTON.

	Feb. 3	Feb. 8		Feb. 3	Feb. 8
American Railways	43	42½	Mass. Elec. Ry. pfd.	47½	—
Cumberland Telephone	108	—	Mexican Telephone	1½	—
Edison Elec. Illum.	209	208	New England Telep.	—	—
General Electric	—	—	Western Tel. & Tel.	6½	—
Mass. Elec. Ry.	11	—	West. Tel. & Tel. pfd.	62½	

PHILADELPHIA.

	Feb. 3	Feb. 8		Feb. 3	Feb. 8
American Railways	43	42¾	Phila. Electric	6	5⅝
Elec. Co. of America	9	8¾	Phila. Rapid Transit	16	15½
Elec. Storage Battery	28	27	Phila. Traction	89	
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Feb. 3	Feb. 8		Feb. 3	Feb. 8
Chicago City Ry.	165	172*	Metropolitan Elec. com.	18	17
Commonwealth-Edison	87	86	National Carbon	55*	—
Chicago Subway	—	16	National Carbon pfd.	101	—
Chicago Tel. Co.	115	115½			

*Asked.

POTOMAC ELECTRIC LIGHT & POWER COMPANY.—The gross revenue of the Potomac Electric Light & Power Company, of Washington, for last year was $1,166,280; operating expenses were $554,393 and interest on funded debt $207,338, leaving a surplus before paying dividends, and not allowing for depreciation, of $406,479. The amount received from private arc and incandescent lighting was $789,724; from public arc lighting $108,418, and from power $216,353. Of the 50,000 shares of stock of the company, 40,000 are owned by the Washington Railway & Electric Company and 9989 by the United States Mortgage & Trust Company.

THE MANUFACTURERS LIGHT & HEAT COMPANY.—At the annual meeting last week of the Manufacturers Light & Heat Company, of Pittsburg, the earnings were reported to show a loss of $172,000, with an increase in expenses of $250,000. The deductions were less than in 1906, with the result that the net income available for dividends amounted to $2,015,914, against $1,870,563 of the previous year. The company paid no dividends last year, and consequently the entire amount is credited to the surplus fund. The old board of directors was re-elected.

AMERICAN TELEPHONE & TELEGRAPH.—The last six months of 1907 showed a marked reduction in new construction on the part of the American Telephone subsidiary companies throughout the country, one reason being the high price of labor and material. On Dec. 31 the system represented a capitalization, deducting depreciation, of $149 per station. In 1907 the average cost of installation for every new station was $170, or $21 higher.

MASSACHUSETTS ELECTRIC.—The gross earnings of the Massachusetts Electric for January showed an increase of about 1½ per cent over the January, 1907, results; the December gross earnings showed a decrease of something less than 1 per cent over the results of the corresponding month last year.

LETTER TO WESTINGHOUSE CREDITORS.—Following the completion of a readjustment plan by the Committee of Creditors of the Westinghouse Electric and Manufacturing Company, a circular letter has been sent to the creditors of the company by the Bankers' Trust Co., recommending the holders of 5 per cent convertible bonds and three-year 6 per cent collateral trust notes to promptly deposit their bonds and notes before March 1 in order that the readjustment plan may become operative. The letter says: "The committee believes that if the conduct of the business can promptly be restored to the stockholders under the direction of a strong board of directors, the company will continue to make substantial earnings. On the other hand, there can be no doubt that a continuation of the receivership for a considerable time and a forced liquidation of the assets would be disastrous to the creditors as well as the stockholders. The business of the company is so complex and its indebtedness so widely scattered that the only effective method of providing for an early termination of the receivership and the protection of the creditors is by the immediate concentration of the indebtedness under the control of a committee with ample power to carry through a plan of readjustment with the minimum of delay, and in the meantime to support the receivers in their efforts to continue the business and maintain the good will of the company." The letter is signed by the Committee of Creditors, consisting of James N. Jarvie, chairman; A. G. Becker, Chicago, Ill.; Richard Delafield, New York, N. Y.; Charles A. Moore, New York, N. Y.; Neal Rantoul, New York, N. Y., and Boston, Mass.; F. H. Skelding, Pittsburg, Pa., and Albert H. Wiggin, New York, N. Y. The request is made that deposits be made with the Bankers' Trust Company, New York, N. Y., or with the First Trust and Savings Bank, Chicago, Ill., or with the First National Bank of Pittsburg, Pittsburg, Pa. The receivers, consisting of T. H. Given, H. S. A. Stewart, C. C. Burlingham and E. M. Herr, have approved the plan and urge the creditors to become parties to the agreement. The Board of Directors of the Westinghouse Company and the president of the company, George Westinghouse, have also approved of the plan for the readjustment of the debt and the agreement, both dated Jan. 20, 1908.

CALIFORNIA LIGHT AND POWER PLANT MERGER.—A deal has been completed whereby the interests and properties of all the gas and electric light and power companies of San Francisco and twenty-five counties of Central California are merged into one corporation. A bond issue of $45,000,000 has been authorized, of which $38,282,000 is to take up the underlying bonds of the component companies. A transfer was made to the California Gas and Electric Corporation of all the property and franchises of the following companies: Oakland Gas, Light and Heat Company, Oakland Equitable Gas Company, Berkeley Electric Lighting Company, Bay Counties Power Company, Valley Counties Power Company, Yuba Electric Power Company, Nevada County Electric Power Company, Butte County Electric Power and Light Company, Standard Electric Company of California, Stockton Water Company, Blue Lakes Water Company, Sacramento Electric, Gas and Railway Company, Central Electric Railway Company, United Gas and Electric Company, San Mateo Power Company and the shares of stock of the South Yuba Water Company. The California Gas and Electric Corporation will convey all of its property to the Pacific Gas and Electric Company, which owns the San Francisco Gas and Electric Company, and the preferred and common stock of the California Gas and Electric Corporation, which latter owns all of the stock and property of the Pacific Gas and Improvement Company, the Independent Gas Company, the Independent Electric Company, and also holds contracts for the purchase of the shares of the Mutual Electric Light and the Central Power and Light Companies.

LONG ACRE FINANCES.—The Long Acre Electric Light and Power Company, of New York City, has appealed to the Public Service Commission for its approval of an issue of $10,000,000 of preferred stock and $50,000,000 in bonds for the purpose of retiring the present issue of bonds and for acquiring property upon which to erect power houses and substations, constructing power houses and substations, and purchasing and laying underground cables. The present capital stock of the company consists of 500 shares of $100 each, all but a few shares being in the name of a trustee. The outstanding indebtedness is $500,000 on bonds issued and sold, and $100,000 upon bonds given as collateral security for the faithful performance of a contract with the American & British Manufacturing Company. The petition states that the company has the right to place wires for electric light, heat and power in the Borough of Bronx under the city franchise. The officers are Mr. Edgar Van Etten, president; Mr. John C. Sheehan, vice-president; Mr. W. W. Waters, secretary and treasurer; Mr. C. B. Corbin, assistant secretary and treasurer. It is reported that the company is controlled by the Manhattan Transit Company, which has a franchise to operate a tunnel beneath the East River to Brooklyn, and representatives of the interests of the New York Central, the General Electric Company and the International Power Company.

WESTERN ELECTRIC ANNUAL REPORT.—At the annual meeting of the Western Electric Company, held in Chicago Feb. 6, President Barton reported that the sales for the fiscal year ending Nov. 30 were $52,724,168, a falling off of $16,521,163, or 23.8 per cent from those of the year ending Nov. 30, 1906. The sales for 1907, however, exceed any previous twelve months in the history of the company, with the single exception of 1906. President Barton stated that the reduction in the volume of business was due chiefly to the decrease of the sales to the Bell Telephone Company, which made very large expenditures for new construction in 1906. The amount of foreign business and business with other than American Bell Telephone subsidiary companies was larger in 1907 than in 1906. The following table gives the sales of the company for the ten years ending Nov. 30, 1907:

YEAR ENDED	AMOUNT.
November 30, 1898	$10,516,016
November 30, 1899	17,850,473
November 30, 1900	24,472,450
November 30, 1901	23,877,188
November 30, 1902	28,626,770
November 30, 1903	30,256,628
November 30, 1904	32,453,980
November 30, 1905	44,145,753
November 30, 1906	69.245,331
November 30, 1907	52,724,168

INDEPENDENT TELEPHONE SECURITIES COMPANY.—The properties of the United States Independent Telephone Company and the Independent Telephone Securities Company were sold Feb. 4 at Rochester on a foreclosure sale. The price paid for the former company was $250,000 and $150,000 for the latter company, the sale being made to a representative of the reorganization committee. The underlying companies of the first-mentioned company are the Rochester Telephone Company, the Stromberg-Carlson Telephone Manufacturing Company, and the New York Independent Telephone Company. The Independent Telephone Securities Company controls a large number of the independent telephone companies in Western New York, including those of Syracuse, Utica and Rome.

SALE OF NORTH AMERICAN BONDS.—Bonds of several of the subsidiary companies of the North American Company will be issued within the next thirty days, if present monetary conditions remain favorable. The advances made by the larger company to the subsidiary companies aggregate several millions, and the North American Company passed its dividend last year in order not to force the dependent companies to issue their bonds on an unfavorable market. The smaller companies are in excellent condition and the sale of the bond issue will enable the North American Company to resume payment of dividends at the former rates. Already small blocks of the bonds have been marketed at 4½ and 5 per cent interest, and the remainder will be offered for sale before the end of the month.

STONE & WEBSTER OPERATIONS.—The report of the Stone & Webster organization for the year ending Dec 31, 1907, shows total earnings of $14,996,712, expenses $9,793,314, and charges $2,317,752, leaving a net balance of $2,885,646, of which $1,304,406 was disbursed in dividends. The liabilities are reported at $44,895,000 in bonds and coupon notes, and $55,974,000 in property and common stock, making a total of $100,869,000. The miles of equivalent electric railway single track operated are 861; the total connected electric lighting load is equivalent to 1,243,300 16-cp lamps, and the total combined power-station capacity 136,534 hp, of which 47,033 hp is generated by water-power.

INCREASE OF CAPITAL.—The California Gas & Electric Corporation, of San Francisco, has filed a certificate of the increase of its capital stock from $15,000,000 to $50,000,000, and an increase of bonded indebtedness from $10,000,000 to $45,000,000.

WHITNEY COMPANY RECEIVERSHIP.—An application for a receivership for the Whitney Company, which has been engaged in a large electrical water-power development on the Gadkin River, N. C., was granted to A. O. Brown & Co. last week. The application was in the nature of a friendly suit and was made in order to bring about a readjustment that would permit the company to issue further securities which would enable it to raise $1,500,000 necessary to complete the construction work. A. O. Brown & Co. have acted as bankers for the company and E. F. Buchanan, of that firm, who is also president of the Whitney Company, said that a plan for readjustment of the finances would be completed within two weeks and that the construction work would proceed without interruption. The Whitney Company was organized by George I. Whitney, of the Pittsburg Stock Exchange firm of Whitney, Stephenson & Co., which failed recently. When Mr. Whitney resigned as president of the company in December, Mr. Buchanan was elected to succeed him. The company is developing a plant of 45,000 hp on the Yadkin River, near Yadkin, N. C., and contemplates developing 50,000 hp later. The T. A. Gillespie Company has the contract for development and the energy generated at the Whitney plant will be furnished to manufacturers in Lexington, Thomasville, Greensboro, High Point, Charlotte and many other towns within the range of distribution. The company has laid out a town of 600 acres near the power house and is offering special inducements to manufacturers. It also owns 10,000 acres of land in Rowan County and will spend large sums in development. The power plant will in part be ready for service by July 11, 1908. The officers of the company are: Edward F. Buchanan, president; A. O. Brown, vice-president; H. L. W. Hyde, secretary; Cornelius O'Connor, treasurer. John L. Henderson is general manager and J. J. Kennedy, chief engineer.

PHILADELPHIA ELECTRIC ASSESSMENT.—At the recent meeting of the directors of the Philadelphia Electric Company an assesment of $3.50 a share on the capital stock was voted. Simultaneously a stock dividend of $1 per share was declared from the surplus, which dividend will amount to $1,000,000 or 10 per cent of the paid-in capitalization. In a statement, President Joseph B. McCall said that this is the first call made upon the stockholders for additional capital during the past four years. In that time there have been large expenditures for permanent improvements and extensions, which have been largely paid for out of the earnings of the property and from loans made from time to time. The money derived from the present call will pay off all floating indebtedness and will leave a considerable balance in the treasury for the company's requirements. Dividends of 5 per cent per annum on $10 a share paid in have been declared during the past four years. In 1903 the dividend was 3.75 per cent on this value. A movement is on foot to contest the action of declaring the assessment headed by Mr. Hubert J. Horan. In an interview Mr. Horan said that while $10 per share had been paid in the stock is now only selling around $6 per share, and predicted that, after the assessment called for has been paid in, this price will drop to $5. He referred to a rumor that the company will purchase the conduit system owned by the Keystone Telephone Company to prevent competition, but that this will not require the $2,500,000 available after payment of the dividend of $1 per share.

KANSAS CITY GOLD NOTES.—Kuhn, Loeb & Company and Blair & Company are offering $4,125,000 Kansas City Railway and Light Company 6 per cent five-year convertible collateral gold notes, series A, due Sept. 1, 1912, interest payable March 1 and Sept. 1. These notes are part of an issue of $5,500,000, secured by pledge with the New York Trust Company, as trustee, of obligations of underlying companies and the company's own securities, having a par value of over $10,000,000, and also of securities of subsidiary companies pledged under the indenture of May 15, 1903, securing the first lien refunding gold bonds, subject to the prior lien of that indenture.

PROSPECTIVE NAVAL PURCHASES.—The Bureau of Supplies and Accounts, U. S. Navy Department, has advertised for two lots of electrical supplies, the bids to be opened Feb. 25 and March 10. The schedules for the earlier date include 42,876 ft. duct, multiple conduit; 28,000 ft. of steel enamel conduit; two 20-hp motors and two 7½-hp motors. The schedules for March 10 relate principally to circuit fittings and to conductors. Of the latter there are specified 60,000 ft. of intercommunicating cable; 80,000 ft. of conductor cable, 155,000 ft. of twin lighting conductor; and 79,000 ft. of single lighting conductor.

NATIONAL BATTERY COMPANY RECEIVERSHIP.—George P. Keating and Edward R. O'Malley have been appointed receivers of the National Battery Company of Buffalo by Judge Hazel as the result of a petition in a suit of equity brought against the company by Emma Coleman, of Somerset, Va. The liabilities of the company, it was alleged, amount to about $120,000, most of which consists of promissory notes which are due. The total assets of the company are said to be about $425,000, but on account of the financial stringency it was impossible to meet demands of creditors. At the New York offices of the company it was said that the receivership would probably bring about a readjustment of the company's finances, and that the company would continue to do business as formerly. The plant is worth $160,000 and there are good accounts due worth $160,000. Material on hand and uncompleted work are estimated to be worth $93,000. The receivers will continue the business and endeavor to put the company on its feet. John R. H. Richmond is president of the company and Ralph Kimberly secretary.

EARNINGS OF OPERATING COMPANIES.—The gross earnings of the Schenectady Railway Company for the year ending Sept. 30, 1907, cover $1,627,157, and the net earnings, $480,033. This company, the control of which is owned by the N. Y. C. & H. R. R. R. and D. & H. R. R., also operates the gas and electric plants of Schenectady. For the year ending Nov. 30, the gross earnings of the Milwaukee Electric Railway & Light Company were $3,998,918, and the net earnings, $1,432,003. The Grand Rapids-Muskegon Power Company had gross earnings of $274,633 for the year ending Dec. 31, 1907, and net earnings of $199,905. For the same period the corresponding figures for the Commonwealth Power Company, of Chicago, were $459,795 and $259,276, and for the Edison Electric Company, of Los Angeles, Cal., $2,206,381 and $1,338,006, respectively.

DIVIDENDS.—Directors of the Niles-Bement-Pond Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 15. They also declared the regular quarterly dividend of 1½ per cent on the common, payable March 20. The quarterly dividend on the common of 1½ per cent, payable June 20, was also declared. Directors of the Pratt & Whitney Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Feb. 15.

SHERWIN-WILLIAMS STOCK INCREASE.—The capital stock of the Sherwin-Williams Company, of Cleveland, Ohio, has been increased from $3,500,000 common to $5,000,000 common and $1,000,000 of 7 per cent cumulative preferred. The business has had a rapid growth for the past several years, and the officers state that additional money is necessary to take care of the expansion in order to obtain the best results.

THE ELECTRIC COMPANY OF AMERICA.—At a recent special meeting of the stockholders of the Electric Company of America, the capital stock of the company was reduced and the directors were authorized to exchange the stock of the Electric Company for bonds of the American Gas & Electric Company. C. Randolph Snowden, son of A. Loudon Snowden, president, was elected a director.

OPERATING COMPANIES' BONDS.—Perry, Coffin & Burr, of Boston, are offering electric lighting and railway bonds as follows: Schenectady Railway Company, 4½ per cent bonds, at 96; Milwaukee Railway & Light Company, 4½ per cent bonds, at 90; Grand Rapids-Muskegon Power Company, 5 per cent bonds, at 92; Commonwealth Power Company, of Chicago, 5 per cent bonds, at 92.

THE OHIO-NEVADA ELECTRIC POWER, WATER & MINING COMPANY, of Marion, Ohio, has completed its organization by the election of Dr. A. Rhu as president and W. M. Jackson as manager. The company is incorporated under the laws of Nevada with a capital stock of $2,000,000, all of which is non-assessable.

DETROIT UNITED RAILWAY.—The stockholders of the Detroit United Railway Company have authorized the sale of $750,000 of the company's first consolidated mortgage 4½ per cent bonds now in the treasury. The proceeds of the sale will be used to meet the cost of improvements.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

HEADLAND, ALA.—The citizens have voted to issue electric light and water works bonds to the amount of $23,500.

MONTEVALLO, ALA.—Bids will be received until Feb. 15 at the office of William Spink, architect, Title Guarantee Building, Birmingham, for the construction of power house and laundry building; also for boiler, machinery and equipment to be installed in the same for the Alabama Girls' Industrial School at Montevallo. A cash deposit of $10 will be required for plans and specifications.

NORTH BIRMINGHAM, ALA.—The City Council is contemplating issuing bonds for improvements to the municipal electric light plant.

VALDEZ, ALASKA.—It is reported that an electric light and power plant will soon be erected in Cordova by the Copper River Electric Telephone & Power Company. The company has filed on several acres on Cordova Bay, and has taken up the water right known as the Humpback Creek. The company proposes to furnish electricity to light the town of Cordova, and will operate a telephone system, etc.

SPRINGDALE, ARK.—The Springdale Electric Light & Power Company will erect an electric light plant here at a cost of $8,000.

CORONA, CAL.—The Board of Supervisors of Riverside County has granted the Corona Gas & Electric Company permission to erect electric transmission lines over certain highways and roads in the county.

DINUBA, CAL.—The San Joaquin Light & Power Company contemplates extending its transmission lines from Dinuba to the Stone Corrall country, a distance of about 21 miles. The sub-station will be located near the Docker Place, about 16 miles from Dinuba. A. G. Wishon is manager of the company.

ELSINORE, CAL.—The City Trustees have decided to call an election to vote on the proposition of issuing $7,000 in bonds to purchase the local electric light plant.

LOS ANGELES, CAL.—A petition has been presented to the City Council by A. D. Houghton asking that a bond election be held for the purpose of voting $1,000,000 for the construction of a municipal railroad between this city and San Pedro, to give employment to a large number of men in Southern California who are out of work.

SANTA MARIA, CAL.—The Pacific Coast Railway, which is owned by the Pacific Coast Company, is building a new electric railway between Santa Maria and Guadalupe, a distance of eight miles.

RIVERSIDE, CAL.—Plans are being made for the installation of cluster lamps on Main Street and the principal side streets. F. A. Worthley is superintendent of the electric light department.

WILLOWS, CAL.—The Northern California Power Company contemplates extending its transmission line to a 400-acre tract of land near Willows to furnish electricity to operate pumps for irrigation purposes. The company is also furnishing estimates for supplying electrical energy to five small tracts to operate pumping plants that are to be installed just north of Willows.

WOODLAND, CAL.—The trustees have passed an ordinance revoking the electric franchise granted to John Reith, Jr.

BRUSH, COL.—The Brush Electric Light, Fuel & Power Company contemplates the construction of an entire new plant, with a rating of 300 kilowatts in two units, direct-connected. George C. Stiles is manager.

TRINIDAD, COL.—The Stonewall Valley Electric Railroad Company has filed a mortgage with the county clerk to the St. Louis Union Trust Company, of St. Louis, Mo., for $500,000, the proceeds to be used to complete the construction of the road.

NEW BRITAIN, CONN.—The Board of Public Works has decided to replace the Welsbach gas lamps with incandescent electric lamps and has authorized a contract to be made with the Connecticut Company for a term of three years with the privilege of extending it to five years. Under the terms of the contract the company agrees to furnish 182 incandescent lamps of 32 candle-power at the rate of $20 per lamp per year, with all-night service.

TORRINGTON, CONN.—A 500-hp turbine generator has been installed in the power house of the Torrington Electric Light Company. Plans are being made to change the system from 133 to 60 cycles.

WILMINGTON, DEL.—No bids were received by the Street and Sewer Department Jan. 28 for lighting the streets of the city by electricity, and only one bid was received for gas lighting. The time for receiving the bids was extended to March 31, and the existing gas and electric contracts were extended from July 1 to Sept. 1. The specifications call for electrical energy for not less than 350 arc lamps and 428 incandescent lamps. The new contract is for a term of five years beginning Sept. 1.

WASHINGTON, D. C.—Bids will be received until April 6 by the Bureau of Engraving and Printing, Treasury Department, Thomas J. Sullivan, director, Washington, D. C., for furnishing electrical supplies during the fiscal year beginning July 1, 1908.

WASHINGTON, D. C.—Bids will be received until Feb. 25 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 765—Two-power factor meters, ammeters, volt and watt meters, automatic starting panels, 100 condenser plates, six starting dynamos. Schedule 769—Sheet brass, 8500 lbs.; sheet copper, seamless drawn copper pipe, 2880 lbs.; metal tubing, 50,000 lbs.; rolled zinc. Puget Sound, Wash.: Schedule 765—Conduits, steel, etc.; 2010 lbs. magnet wire, 3000 ft. cable for interior communications. Schedule 767—Seamless drawn brass pipe and voice tubing. Applications for proposals should designate the schedules desired by number. E. B. Rogers is Paymaster General, U. S. N.

JACKSONVILLE, FLA.—The Board of Bond Trustees has approved the recommendations of Superintendent R. N. Ellis for changes in the machinery in the municipal electric light plant, which recommends that the 350-hp tandem compound engine taken out to make room for the 1500-kw generator be sold, and that bids for the same be invited and the engine be disposed of.

AUGUSTA, GA.—The Atlanta & Carolina Construction Company has been granted a franchise to construct and operate an interurban railway through the streets of the city.

MACON, GA.—The Citizens' Electric Company has applied to the City Council for a franchise to furnish electricity for lamps and motors in the city. In the petition presented to the Council the company agrees to furnish electrical energy for lamps at the rate of 10 cents per kw-hour and for motors at 8 cents per kw-hour. The company made an application for an electric light franchise last October, but for some reason the application was withdrawn.

MACON, GA.—The Bibb Power Company has changed its name to the Central Georgia Power Company and is planning to develop the various water power properties on the Oconee, Ocmulgee and Flint rivers owned by the company. The first plant will be erected on the Ocmulgee River, eight miles from Jackson, which is capable of developing 18,000 hp, the cost of which, including the entire equipment and transmission lines, is estimated at $1,850,000. Lockwood, Greene & Company, of Boston, Mass., have charge of the construction of the plant. The company proposes to furnish electricity in Macon, Griffin, Jackson, Thomaston, Greensboro and other cities for lamps and motors; also to furnish electrical energy to operate the Macon & Albany and Atlanta & Macon Interurban railways. The officers of the company are W. J. Massee, president; J. C. Walker, vice-president; J. T. Moore, treasurer, and Charls F. Howe chief engineer.

BLUE ISLAND, ILL.—Plans are being considered for making extensive improvements to the municipal electric light plant.

CAIRO, ILL.—The capital stock of the Home Telephone Company, of Cairo, has been increased from $5,000 to $100,000.

CARLYLE, ILL.—An election will be held Feb. 26 to vote on the proposition to issue $20,000 in bonds for improving the municipal electric light plant and extending the water mains.

CENTRALIA, ILL.—A company has been incorporated to build an electric railway from Centralia to Sandoval, work on which will begin in the spring. The incorporators are: H. M. Warner, G. L. Pittenger, G. E. Hubbard and E. R. List, of Centralia, and F. F. Reinhardt, of Sandoval.

CHICAGO, ILL.—Bids will be received until Feb. 24 by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for lamp brackets for the U. S. post office, court house, etc., at Chicago, Ill.

NORTH CHICAGO, ILL.—Bids will be received until March 19 by the Bureau of Navigation, Navy Department, Washington, D. C., for power plant equipment for the power house at the naval training station of the Great Lakes at North Chicago, Ill. J. E. Pillsbury is chief of the department.

SPRINGFIELD, ILL.—It is reported that improvements will be made to the municipal electric light plant, the cost of which is estimated at $35,000.

ELNORA, IND.—The local electric light plant was recently destroyed by fire, causing a loss of $17,000.

EVANSVILLE, IND.—The Grand Central Traction Company, through C. M. Shanks, has made application to the City Council for a franchise to build an electric railway through the city. Mr. Shanks states that work will commence on the construction of the road not later than March 31.

MT. VERNON, IND.—R. L. Sullivan, Jr., city clerk, writes that bids will be received until April 1 for lighting the streets of the city for a term of 10 years.

PERRY, IA.—Plans are being made by the Hawkeye Telephone Company for extensive improvements to its system in this place and in the surrounding country.

WARSAW, IND.—The property of the Indianapolis, Huntington, Columbia City & Northwestern Railroad, which has been in the courts for a number of years, was sold at a receiver's sale Feb. 1 to Melvin A. Peoples, of Chicago, Ill., formerly with the St. Joseph Valley Traction Company, of La Grange, Ind., for $6,500. Mr. Peoples states that the road will be built.

FORT DODGE, IA.—The Fort Dodge, Des Moines & Southern Railroad Company contemplates taking over the Crooked Creek Railroad and equipping it to be operated by electricity, and also constructing a railway between Gypsum and Brushy.

LOUISVILLE, KY.—We are informed that the contract for erecting the new power plant for the Kentucky Heating & Lighting Company, of Louisville, has been awarded to F. A. Clegg & Co., of Louisville.

INDEPENDENCE, KAN.—The Independence Electric Company is planning to install additional machinery in its plant.

HAVEN, KAN.—It is reported that arrangements are being made to light the streets by electricity and that a plant will soon be installed for that purpose.

BANGOR, ME.—The citizens are contemplating installing a 350-hp Babcock & Wilcox boiler and a 50-light constant-current transformer in the municipal electric light plant. C. W. Cunningham is chief electrician

BELGRADE LAKES, ME.—The Belgrade Water & Light Company is making arrangements to connect with the plant in Oakland, and the name of the company will be changed to the Oakland & Belgrade Electric Company. The company will operate in both places and will sell electricity for heat, lamps and motors.

LEWISTON, ME.—The Lewiston, Augusta & Waterville Street Railway Company is arranging to erect a transmission line from its plant now under construction on the Sebasticook River in Winslow to Lewiston, a distance of 36 miles. The company has applied for a franchise in the towns of Vassalboro, Sidney, Augusta, Manchester, West Gardiner and Litchfield. The charter of the company gives it the right to sell electricity in any towns where such action will not interfere with previous right granted to other parties. The company has taken a 99-year lease of the property and franchises of the Fort Halifax Power Company, which is building the power plant in Winslow

PORTLAND, ME.—Alfred Black, of Rockland, and associates have bonded land on either side of Back Bay, in Portland, just east of Tukey's Bridge, where it is proposed to erect a tidal power plant capable of developing at least 25,000 hp.

WESTBROOK, ME.—Announcement has been made that the name of the Westbrook Electric Light & Power Company has been changed to the Presumpscot Electric Company. It is said that there has been no change in the ownership or organization of the company. The company will open its new power station, which occupies the site of station No. 1, which will be known as "Saccarappa" station. W. B. Bragdon is manager.

HOLYOKE, MASS.—The Holyoke & Westfield Railway will pass into the control of the New York, New Haven & Hartford Railroad, if the Railroad Commissioners approve of the lease.

HOLYOKE, MASS.—Contracts for the new equipment for the municipal electric light plant have been awarded by W. H. Snow, manager of the Gas & Electric Light Department, as follows: For four 400-hp water-tube boilers to the Babcock & Wilcox Company, of New York, N. Y., for $20,745; four mechanical stokers to the Murphy Iron Works, of Detroit, Mich., for $7,153.

MILLER'S FALLS, MASS.—The municipal electric light plant has been closed down, and energy for operating the local system is supplied by the Franklin Electric Light Company, of Turner's Falls. Formerly the streets were lighted only from dusk until 11:30, now an all-night service, on a moonlight schedule, is furnished at a less cost than the former service.

READING, MASS.—Legislation is being sought to place the Reading municipal electric light in a position to furnish electricity in the towns of Wilmington, North Reading and Lynnfield Centre.

SOUTHVILLE, MASS.—The citizens are considering the question of establishing an electric light system in the town.

SPRINGFIELD, MASS.—The United Electric Company contemplates an expenditure of $50,000 this year for placing its wires in underground conduits in the Forest Park section.

FREDERICK, MD.—Harry D Baumgardner is contemplating installing an electric light plant in the abattoir.

HYATTSVILLE, MD.—It is reported that the Washington Spa Springs & Gretta Electric Railway Company will erect a power house at Beverly B. J. Stephens, of Hyattsville, is president.

LAUREL, MD.—The city is considering the question of issuing $35,000 in bonds for the construction of a municipal electric light plant

DETROIT, MICH.—The stockholders of the Detroit United Railway Company have authorized the sale of $750,000 of the company's bonds now in the treasury, the proceeds to be used to meet the cost of improvements.

COHASSET, MINN.—The Cohasset Hardwood Manufacturing Company has been granted a franchise to erect and operate an electric light plant in this place.

CROOKSTON, MINN.—A number of prominent men in the Red River Valley have formed a company for the purpose of erecting a large dam on the Red River near Halstad, at the junction of the Red River and the Wild Rice River, where it is proposed to erect a large power plant and transmit electricity to Crookston, Fago and Grand Forks.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company has made arrangements with the St. Anthony Falls Water Power Company for a supply of electric energy from the new hydro-electric plant on Hennepin Island. It is stated that the company will take the entire output of the plant after the contracts now outstanding have been satisfied.

MINNEAPOLIS, MINN.—The council committee has decided to add ten blocks to the territory in which all telephone, telegraph and other electric wires must be placed underground. All wires in this territory must be placed underground by July 1, 1909.

ARCADIA, MO.—Louis Miller, of Arcadia, writes that he is considering the installation of an electric light plant in the spring, and proposes to increase the capacity of his ice plant from three to ten tons.

IBERIA, MO.—The citizens of this place have raised $9,000 by subscription for the purpose of constructing an electric light plant, work on which will begin in the spring as soon as the weather will permit.

LEES SUMMIT, MO.—The Home Telephone Company is planning extensions to its system, the cost of which is estimated at $3,000.

KANSAS CITY, MO.—The light committee of the City Council has decided to grant a franchise to W. M. Hall, who is operating a plant in the Hall Building, from which electricity for lamps and steam heat is supplied to four blocks north, south, east and west from Ninth and Walnut streets. He will be given reasonable permits, in return for which he agrees to pay the city 2 per cent annually of the gross receipts

ST. JAMES, MO.—The question of installing an electric light plant in this place is under consideration. Charles Kolen, of St. Clair, is interested in the project.

JOLIET, MONT.—A proposition has been submitted to the town by A. F. McCune to install a water and electric light system, provided a 25-year franchise is granted. A special election will soon be held to vote on the question.

LIVINGSTON, MONT.—The Livingston Water Power Company has applied to the City Council for a franchise to furnish electricity for lamps and motors in the city.

BLAIR, NEB.—The Blair Electric Light & Power Company contemplates installing new machinery in its plant.

PENDER, NEB.—M. M. Neumann has applied for a franchise to construct an electric light plant in the town.

RENO, NEV.—The North Yuba Electric Light & Power Company recently incorporated, proposes to construct and operate a power plant near the North Yuba River and to furnish electrical energy for lamps and motors in different cities and towns in California and Nevada The capital stock of the company is placed at $1,000,000.

OCEAN CITY, N. J.—The City Council has granted a franchise to the Atlantic City & Ocean City Railroad Company to lay its track along Eighth Street to the Boardwalk. This will complete the railway from Atlantic City Boardwalk to the Ocean City Boardwalk.

TRENTON, N. J.—J. Willard Morgan, State Comptroller, writes that the contract for furnishing electricity for lighting the State House was granted to the Public Service Corporation, at the rate of 5¾ cents per kw-hour.

BABYLON, N. Y.—The village trustees have granted a 50-year franchise to the South Shore Traction Company to construct an electric railway within the limits of the village. In return for the franchise the company is to pay the village $200 per annum after 10 years and $300 per annum after 15 years.

GENEVA, N. Y.—J. A. Bendure, consulting engineer for the Economic Power & Construction Company, has made application to the Board of Public Works for two ducts in the entire city conduit system The company recently purchased the plant of the Geneva Steam Heating Company, and proposes to furnish steam heat, and also electricity for private lighting, and to compete for lighting of the city when the present contract with the Geneva-Seneca Company expires.

FRANKLIN, N. Y.—The Delaware & Otsego Light & Power Company is contemplating extending its transmission lines to the neighboring towns to furnish electricity for lamps as soon as its new dam and power house are completed. E. A. Markey is president.

MIDDLETOWN, N. Y.—The switchboard in the central telephone office of the Orange County Telephone Company was destroyed by fire on Feb. 5, leaving the city without telephone service.

NEW YORK, N. Y.—The Long Acre Electric Light & Power Company has applied to the Public Service Commission for permission to issue $10,000,000 in preferred capital stock and $50,000,000 in mortgage bonds, the proceeds to be used to retire $600,000 outstanding indebtedness and to acquire property on which to build power houses and substations, to construct power houses and purchase the necessary equipment and laying underground cables. The company has a small plant at Forty-Seventh Street and Second Avenue. The officers of the company are: Edgar Van Etten, president; John C. Sheehan, vice-president, W. W. Walters, secretary and treasurer, and C. B. Corbin, assistant secretary and assistant treasurer.

ONEIDA, N. Y.—The directors of the Oneida Street Railway Company have decided to make arrangements with the Madison County Gas & Electric Company whereby the latter company is to tap the high-tension feed wires on the West Shore Railroad near Oneida Castle to take sufficient electrical energy to light the city of Oneida. The necessary connections for this purpose will be made in a short time.

ROCHESTER, N. Y.—The properties of the United States Independent Telephone Company were bid in by the reorganization committee of the bondholders at a public foreclosure sale Feb. 4 by Walter P. Duffy, chairman of the committee, for $250,000. The property of the Independent Securities Company, which holds the stock of the Rome, Syracuse, Utica and other independent companies, was sold for $150,000.

SAVONA, N. Y.—The village trustees have granted a franchise to the Citizens' Public Service Company, of Bath, to furnish electricity for lamps in this village.

WATERLOO, N. Y. The Village Board has awarded the contract for lighting the streets of the village to the Geneva-Seneca Electric Company for a term of five years. The contract will take effect May 1, 1908, and provides for 28 arc lamps at $70 each per year, and 113 incandescent lamps at $18 per lamp per year. The company will install new lamps and apparatus, work on which will begin at once and is to be completed not later than May 1.

WEBSTER, N. Y.—The business men of the village are contemplating forming a company to buy the old lighting plant, which was partially destroyed by fire by an explosion Jan. 10, for the purpose of lighting the village.

CLINTON, N. C.—The Clinton Electric Light & Power Company has been reorganized and the capital stock of the company increased. It is proposed to increase the equipment of the power plant. The officers of the company are: A. D. O'Brien, president; D. L. Bonny, vice-president; A. D. McGraham, secretary.

NEWBERN, N. C.—The Fort Wayne Electric Company, of Fort Wayne, Ind., has been awarded the contract for enlarging the municipal electric light plant.

NORTH WILKESBORO, N. C.—The North Wilkesboro Electric Light & Power Company contemplates installing additional machinery in its power house in the near future. L. F. Carleton is manager.

CINCINNATI, OHIO.—The Bell Telephone Company is arranging to absorb the Citizens' Telephone Company, of Batavia, which went into the hands of a receiver a short time ago, with debts aggregating $21,000. The plant of the independent company will be sold at a receiver's sale.

CLAREMONT, OKLA.—George Wytell, of Claremont, and Joseph McDermott, of Virginia, have been granted a franchise to construct and operate a street railway in Claremont.

COLUMBUS, OHIO.—David L. Parsons is preparing plans for an electric light plant to be equipped with engines, boilers, pumps, heaters, dynamos, 100 to 300 kw, three-phase machines, or 100 to 150 kw direct-connected direct, 500-volt machines, transformers, switchboards and appurtenances, apparatus for general machine and repair shop work, etc.

CUYAHOGA FALLS, OHIO.—The City Council is considering the question of increasing the equipment of the municipal electric light plant.

CRESWELL, ORE.—The Lane County Court has granted a 20-year franchise to John Turrell to erect and maintain an electric light plant to furnish electricity to light the town and the surrounding country.

MASSILLON, OHIO.—Bids are being asked by J. C. Haring for the construction of a hospital, the cost of which is estimated at $50,000; a power house and lighting plant will be erected in connection with the hospital.

ROCKY RIVER, OHIO.—The Rocky River Water, Light & Power Company, which now supplies the town with water, is contemplating installing generators in its plant to furnish electricity for lighting the town.

ROSEVILLE, OHIO.—The directors of the Devonshire Brick and Ceramic Company have decided to erect an electric lighting plant in this place, at a cost of $60,000. The town is now considering a proposition to co-operate with the company in the enterprise. W. A. Shoemaker is secretary and manager of the company.

TOLEDO, OHIO.—The City Council has revoked the franchise granted the People's Heat & Power Company last September. Homer T. Yaryan was promoter of the company.

YOUNGSTOWN, OHIO.—It is stated that the Consolidated Gas & Electric Company wants the privilege of submitting a proposition to the city for street lighting before the city takes action on the construction of a municipal electric light plant.

HARWOOD MINES, PA.—Arrangements are being made by the Harwood Power Company to install electrical machinery in its power plant. John F. Wise, Jr., is secretary.

NEW MILFORD, PA.—The New Milford Light & Power Company is contemplating enlarging its water-power plant. S. M. Beecher is president and manager.

PITTSBURG, PA.—The Pittsburg Railways Company has commenced work on the construction of a railway to connect the Washington & Canonsburg Street Railway Company with the Pittsburg system.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company is asking for sealed bids for generating equipment to be installed in power house, complete, including a 500-kw 2300-volt 60-cycle three-phase steam turbine, or engine-driven generating set, jet condenser and cooling tower and a 30-kw steam driven exciter set and switchboard panel; also a 14-mile 23,000-volt three-phase transmission line to be erected on poles already placed; a sub-station equipment, complete; a 10½-mile 0000 direct-current feeder to be erected, the line to be in operation in 112 days. The company is extending its railway 11½ miles from the present terminus at Greencastle to Chambersburg. J. F. Geiser is electrical engineer and superintendent.

YORK, PA.—A company has been formed to construct an electric railway from Shrewsbury to York. The officers of the company are: David C. Gooding, of Loganville, president; Charles Williams, of Paradise, and C. B. Smith, of Shrewsbury, vice-presidents; John H. Keller, of Shrewsbury, secretary, and Jacob L. Myers, of Glen Rock, treasurer.

SPARTANBURG, S. C.—The Spartanburg Railway, Gas & Electric Company is contemplating the construction of a spur from the North Church Street Railway to the base ball park in the rear of Wofford College.

RAPID CITY, S. D.—The Dakota Power Company is making arrangements to develop the water power of Rapid Creek for the purpose of generating electricity to be transmitted to Rapid City and the mining camps in the hills. The company will erect a large power house in the spring about 12 miles from this city. The city recently granted the company a franchise to furnish electrical energy for lamps and motors in the city.

KNOXVILLE, TENN.—W. A. Boyce, of Asheville, N. C., has been in the city in the interest of the French Broad River Power Company, which enterprise he is promoting. He states that the company has secured property and water rights on the French Broad River, near Asbury, N. C., and proposes to erect a dam and hydro-electric plant at Pickle Island for the purpose of generating electricity to be transmitted to Knoxville and possibly near-by towns. The company will apply to the City Council for a franchise at an early date.

SOUTH PITTSBURG, TENN.—Extensive additions and improvements are contemplated by the new South Pittsburg Light & Power Company, including the installation of a three-phase 60-cycle 2300-volt system and extending its transmission lines to Bedford, Copenhagen and Bridgeport. C. A. Sutliff is owner and manager.

AMARILLO, TEX.—The Amarillo Street Railway Company has been granted a franchise to furnish electricity for lamps and motors. The company will install additional machinery in its power house, including a dynamo and engine. H. A. Nobles is president.

MARBLE FALLS, TEX.—The Granite Manufacturing Company, of Dallas, have secured the contract for constructing the dam in connection with the hydro-electric plant to be erected on the Colorado River at Marble Falls. The dam is to be built of marble, about 1100 ft. long and 17 ft. high above the falls. The plant will have a maximum output of 15,000 hp and will furnish electricity for lamps and motors within a radius of 150 miles. John W. Maxcy, of Houston, has charge of the construction of the plant.

ODESSA, TEX.—An electric light and power plant and ice plant will be established in the town in the near future. F. Stephens, of Midland, and D. F. Shaddox, of this city, will install the two plants.

BARNET, VT.—The citizens have subscribed $500 toward replacing the electric light plant, which was destroyed by fire Jan. 16. The plant was owned by Donald Judkins.

BRIDGEWATER, VA.—The North River Electric Company is building a 500-hp hydro-electric plant, and will install three water turbines under 20-ft. head and will also install two 100-kw, three-phase generators. It is expected to have the plant completed in June, when the company will furnish electricity to Mt. Crawford, Bridgewater and Dayton for lamps and motors. The company will furnish a 24-hour service. G. Richard Berlin is president and manager.

HOLLIS, VA.—We are informed that the Hollis Institute contemplates increasing the equipment of the electric power plant and will install a boiler, engine and generator this year. Joseph A. Tume is general manager.

RADFORD, VA.—Bids will be received until March 1 for furnishing the city with electricity for arc and incandescent lamps and motors; bids will also be received for gas lighting. J. C. Bird is clerk of Council.

DEER PARK, WASH.—The Deer Park Light & Water Company has been formed to take over the electric light and water franchises secured by the Standard Lumber Company some time ago.

FORT ORCHARD, WASH.—Application has been made to the County Commissioners by John T. Mitchell for a franchise to erect electric transmission lines on certain roads of the county.

PROSSER, WASH.—E. F. Benson, president of the Prosser Falls Land & Power Company, writes that the company contemplates extensions and improvements to its plant, the cost of which is estimated at $50,000. A. L. Smith, of North Yakima, is engineer.

TACOMA, WASH.—The City Council on Jan. 29 adopted a resolution instructing the Commissioner of Public Works to employ an expert electrician to make a thorough investigation of the municipal electric light system.

TWISP, WASH.—Plans are being made for the installation of an electric light and power plant in this place during the coming summer, a site for which has been secured.

WHITE SALMON, WASH.—Messrs. Myers and Shepler have applied to the City Council for a franchise to operate an electric light system in this city.

BLOOMER, WIS.—The capital stock of the Bloomer Telephone Company has been increased to $30,000.

IONA, WIS.—A telephone company has been formed by Peter Holmquist and others for the purpose of installing a telephone system in Iona, Eagle Valley and other towns.

MILWAUKEE, WIS.—The street lighting committee of the City Council has recommended that an appropriation of $500 be made to secure an estimate of the cost of a municipal lighting plant. The purpose is to let the people know the cost of the plant when they vote on the proposition.

PORT ARTHUR, ONT., CAN.—The Electric Railway, Light and Telephone Commission has authorized Superintendent T. H. McCauley to make arrangements with the Canadian Northern Coal & Ore Dock Company for a supply of energy, temporarily, at the rate of $40 per hp per year. A contract for 150 kilowatts to operate the street railway system will be taken at once for a term of three years.

PUENTE DEL PASO, MEX.—Fernando Iglesias has filed a notice with the federal government that he will install a hydro-electric plant on the El Cliflon River, near this town.

PANAMA.—Bids will be received until March 2 at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing the following articles: Tobin bronze, brass and copper tubing, rivets, wire rope, electric clusters and wire, globes, etc. Blanks and general information relating to circular (Np. 423) may be obtained from this office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and 410 Chamber of Commerce Building, Tacoma, Wash.; also from the U. S. Engineer offices in the following cities: Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala.

MONTREAL, QUE.—The directors of the Montreal Street Railway Company have decided to issue $1,000,000 in capital stock at $125 and to sell $2,000,000 in bonds, the proceeds to be used to take care of the floating indebtedness and to provide for the construction plans of the company.

New Industrial Companies.

THE LAMB ENGINE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000. The directors are Russell B. McCoy and Fred B. King, of Clinton, Ia., and Hugo E. Ritterbusch, of New York, N. Y.

THE FRENCH ELECTRO MANUFACTURING COMPANY, of Trenton, N. J., has filed articles of incorporation, with a capital stock of $25,000, by Theodore G. Kitchin, P. N. Van Vliet and Jonathan Kitchin. The company proposes to manufacture electrical appliances.

THE CLAPP-EASTHAM COMPANY, of Boston, Mass., has filed a certificate of incorporation, with a capital stock of $10,000. The directors are J. Emory Clapp, president; O. K. Luscomb, treasurer, and Melville Eastham. The company proposes to deal in electrical machines, apparatus, etc.

THE MERCER ELECTRICAL MANUFACTURING COMPANY, of Trenton, N. J., has been incorporated, with a capital stock of $25,000, by Theodore Kitchin, P. N. Van Vliet and Jonathan Kitchin. The company proposes to manufacture and deal in electrical machinery, materials, gas fittings and plumbing devices. William R. Sweeney is agent in charge.

Company Elections.

DOUGLAS, ARIZ.—At the annual meeting of the Douglas Street Railway Company the following named officers were elected: James S. Douglas, president; W. H. Brophy, vice-president; S. F. Maguire, secretary; M. J. Cunningham, treasurer.

PETALUMA, CAL.—At the meeting of the Petaluma Power & Water Company the following named officers were elected: A. B. Hill, president; H. T. Fairbanks, vice-president, and Fred Heseker, secretary and superintendent.

TORRINGTON, CONN.—At the annual meeting of the Torrington Electric Light Company the following named officers were elected: George D. Workman, president; Frank M. Travis, vice-president; F. F. Fuessenich, secretary, and Clayton E. Smith, treasurer.

CAIRO, ILL.—At the annual meeting of the Home Telephone Company the following named officers were elected: Andrew Lohr, president; J. S. Aisthorpe, vice-president; S. M. Heller, secretary, and H. R. Aisthorpe, treasurer.

OGUNQUIT, ME.—At a meeting of the Wells Electric Light & Power Company held Jan. 28 the following named officers were elected for the ensuing year: J. W. Gordon, president; J. H. Littlefield, secretary.

GREAT BARRINGTON, MASS.—At the annual meeting of the Great Barrington Electric Light Company the following-named officers were elected: Frank Russell, president; P. A. Russell, treasurer and general manager; Clyde Parrish, superintendent.

DETROIT, MICH.—At the annual meeting of the Detroit United Railway Company, Charles M. Swift, of Detroit, and J. M. Wilson, of Montreal, Que., were elected directors to succeed Messrs. Holt and Wason, the other directors were re-elected. The officers are the same as last year, with the exception that E. W. Moore has been elected second vice-president, and F. W. Brooks, general manager.

SEMINARY, MISS.—At the annual meeting of the People's Telephone Company held recently the following-named officers were elected: O. W. Tucker, president; J. H. Temple, vice-president, and B. F. Bailey, Jr., manager.

NEW MARKET, N. H.—At the annual meeting of the New Market Electric Light, Power & Heat Company the following named officers were elected: Fred B. Philbrick, president; Leonard R. Philbrick, vice-president, and Sarah J. Woodman, treasurer.

NEWARK, N. J.—At the annual meeting of the Newark Telephone Company the following named officers were elected: James B. Curtis, president; A. Norton Taylor, secretary and treasurer.

ONEIDA, N. Y.—At the annual meeting of the Oneida Railway Company the following named officers were elected: Horace E. Andrews, president; John J. Stanley, first vice-president; C. Loomis Allen, second vice-president; Walter N. Kernan, secretary, and Charles B. Rogers, treasurer.

MANSFIELD, OHIO.—At the annual meeting of the Wooster & Mansfield Electric Railway Company the following-named officers were elected: B. L. Chase, president; David Collier, vice-president; D. H. Graven, secretary, and J. C. Chesrown, treasurer.

LA RUE, OHIO.—At the annual meeting of the La Rue Telephone Company the following named officers were elected: J. H. Leonard, president; W. H. Johnston, vice-president; W. F. Kniffin, secretary, treasurer and manager.

ALLENTOWN, PA.—At the annual meeting of the Allentown & Reading Traction Company the following-named officers were elected: H. E. Ahrens, president; Herman P. Roeper, vice-president; S. K. Hoffman, secretary; George B. Schaeffer, treasurer.

GETTYSBURG, PA.—At the annual meeting of the Gettysburg Transit Company and the Keystone Electric Light Company the following-named officers were elected: Thomas Cooper, president; H. C. Case, vice-president; C. T. Leland, secretary and treasurer.

SCRANTON, PA.—At the annual meeting of the Lackawanna & Wyoming Valley Railroad Company the following-named officers were elected: George B. Smith, president; Charles F. Conn, vice-president.

WAVERLY, WASH.—At the annual meeting of the Waverly-Fairfield Telephone Company the following named officers were elected: James Hays, president; A. L. Robinson, secretary, and J. C. Lodge, treasurer.

BLOOMER, WIS.—At the annual meeting of the Bloomer Telephone Company the following named officers were elected: J. A. Morrison, president; Jacob Wirth, vice-president, and J. G. Pruher, secretary and treasurer.

PLEASANT HILL.—At the annual meeting of the Edenvale Telephone Company the following officers were elected for the ensuing year: J. M. Cornelius, president; O. J. Warbinton, vice-president; Robert Baughman, secretary; W. H. Shelby, treasurer.

New Incorporations.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the San Diego-Southern Railway Company. The company is capitalized at $5,000,000 and proposes to construct a railroad from San Diego to Ensenda, Mex.; branch lines are also to be constructed from San Diego to Coronado to La Presa, through the Jamacha Valley to Lakeside. The length of the road is estimated at 150 miles, to be operated by steam, electricity or other lawful power. The directors are John D. Spreckels, A. B. Spreckels, John D. Spreckels, Jr., all of San Francisco; William Clayton and Harry L. Titus, of San Diego.

WILMINGTON, DEL.—The Cuban Telephone & Telegraph Company of New York has filed articles of incorporation with a capital stock of $5,000,000 for the purpose of operating all kinds of wire lines in the West Indies. The directors are: William Lohman, Daniel C. Beerman and William J. Patterson, all of New York, N. Y.

AMERICUS, GA.—It is expected that work will soon commence by the Americus Railway & Light Company on its electric power plant and street railway, for which machinery and electric equipment have already been purchased. Under the terms of the contract with the city the company is to construct five miles of street railway. The company has a contract to furnish electricity for lighting the city for a term of 20 years, and will also furnish electricity to pump the city water supply.

JESUP, GA.—A company has been formed here, under the name of the Goose Creek Railway & Power Company, with a capital stock of $300,000, for the purpose of developing water-power and generating electricity for manufacturing purposes. The promoters of the company are N. W. Whaley, F. E. Breen, S. E. Cohen, J. H. Wilkens, J. F. Breen, W. M. Roberson, J. T. Winn, E. Crumney, D. M. Clark and D. G. Zeigler, architect and engineer. The company will also erect a cotton mill and a cotton seed mill, and also construct and operate an electric railway from Jesup to several surrounding towns. Application will soon be made for a charter, and the privilege of increasing the capital stock of the company to $500,000 is asked.

SPRINGFIELD, ILL.—The Mississippi Valley Interurban Railway Company has been incorporated, with a capital stock of $1,000,000, for the purpose of constructing an interurban railway from Springfield to Quincy, from Mount Sterling to Hillsboro, and from Hillsboro to Murphysboro. The incorporators are James H. Ward, of Butler; George E. Watson, of Hillsboro; H. R. Lakin, of Rochester; John E. Melick and F. A. Melick, of Springfield, Ill.

BILLINGS, MO.—The Billings Light, Power & Water Company has been incorporated, with a capital stock of $135,000, by S. F. Bronson, J. B. Berghaus and others.

TRENTON, N. J.—Plans are being made by the New Jersey & Pennsylvania Traction Company to enlarge its power house at Yardley in the spring. The company has purchased a 1500-hp engine and generators, with the necessary boilers and other apparatus to be installed in the plant.

COEYMANS, N. Y.—The Rural Home Telephone Company has been incorporated, with a capital stock of $1,500, by Jefferson Powell, Amos Briggs, of Alcove; E. S. Palmer, Harry Shear, of Coeymans; Stephen Tompkins, and Aldine Nodine, of Ravena.

LANGSTON, OKLA.—The Langston Rural Telephone Company has been incorporated, with a capital stock of $2,500, by Morris Janos, C. Robinson, R. A. Henderson, John Trotter, of Langston; Henry W. Gaines, James Madden, of Goodnight; C. M. Suttle, of Guthrie, and others.

PORTLAND, ORE.—Articles of incorporation have been filed for the Washington Home Telephone & Telegraph Company. The company is capitalized at $500,000 and the incorporators are: S. V. Davidor, H. J. Meagher, D. J. Eaton and B. C. Clements.

WEST NEWTON, PA.—Articles of incorporation have been filed for the West Newton Light, Heat & Power Company. The company is capitalized at $25,000 and proposes to furnish light, heat and power in the borough of West Newton.

CLARKSVILLE, TEX.—The Texas Union Traction Company has been chartered, with a capital stock of $2,000, by C. P. Moore, John T. Upchurch, of Longfellow, and A. A. St. John, of El Paso. The company proposes to construct an electric railway between the cities of Texarkana and Sherman, a distance of 154 miles; between Paris and Ennis, a distance of 124 miles; between Texarkana and Forth Worth, a distance of 215 miles; between Paris and Cleburne, a distance of 155 miles, and for extensions and spurs leading from the main line to inland towns, estimated distance from 5 to 20 miles.

Legal.

TELEPHONE FRANCHISE GRANTED BY THE CITY OF MILWAUKEE HELD INVALID.—In a proceeding instituted by the state of Wisconsin to oust the Milwaukee Independent Telephone Company from the streets of Milwaukee, it was held that the ordinance of that city, under which the company claimed the right to occupy the streets for the purpose of constructing and maintaining its system, was invalid for the reason that the city had no power to grant telephone franchises in its streets. After the company had made formal application for the privilege of conducting a telephone business in the city of Milwaukee, the city council enacted an ordinance by which the company was authorized to commence the construction of its works. It was provided that the city should have the right to use certain cross-arms and a duct in the company's conduit for its telephone and telegraph wires. The company was required by the ordinance to pay a percentage of its gross earnings to the city and to pay a rebate to its patrons out of the total excess of its net earnings above ten per cent. The ordinance also provided for the purchase of the plant by the city. It was held that the validity of the ordinance depended upon the power of the city to grant such a franchise as the ordinance purported to confer. In the recent case of Wisconsin Telephone Company vs. Milwaukee, 104 N. W. Rep., 1009, the question of the power of the city of Milwaukee to grant rights and privileges and to impose conditions upon telephone companies for the conduct of such a business in the city was considered and it was held to be established under the statutes and decisions that: "No power is conferred upon the defendant (city) to impose any other conditions except such as it may lawfully impose under its power to control and regulate the streets, alleys and public grounds and prevent the encumbering thereof under its general police powers," and that "no power is conferred upon the defendant (city) under its charter or by any law of the state to grant to the plaintiff the privilege of constructing, maintaining or operating its telephone lines upon the streets of the city." The ordinance in question, therefore, was held to be an attempt on the part of the city to grant franchises and privileges which it was beyond the power of the city to give. The rights which the city undertook to grant pertain to a class of powers which are public in their nature, and which do not belong of common right to persons generally. Such powers cannot be exercised except under authority from the state. State vs. Milwaukee Independent Telephone Company, Supreme Court of Wisconsin, 114 N. W. Rep., 108.

Personal.

MR. D. H. PAYNE, formerly of Payne Engine Company, delivered an address Feb. 11 before the Modern Science Club, of Brooklyn, on the subject of engineering.

MR. ARTHUR L. KELLY has been elected president of the Narragansett Electric Lighting Company, of Providence, R. I., to succeed Mr. Marsden J. Perry, who recently resigned.

MR. GALEN STONE, of Hayden, Stone & Company, of Boston, Mass., has been elected a trustee of the Massachusetts Electric Companies, in place of Mr. E. Rollins Morse, resigned.

CAPTAIN GODFREY L. CARDEN, U. S. R. M., sailed for Europe last week, where he will investigate, for report to the Secretary of Commerce and Labor, conditions affecting the exportation of American machinery and particularly machine tools.

MR. LINDON W. BATES has resigned as president and director of the Empire Engineering Corporation. He has been succeeded as president by William Barclay Parsons, who has been a director of the company.

MR. ALBERT B. HERRICK has just finished an extensive investigation in Rochester on the subject of electrolysis, and reported that little damage has been done to pipes and conduits by electric railway ground return current.

MR. S. A. REDDING, formerly electrical engineer of the Georgia Railway & Electric Company, of Atlanta, Ga., has been promoted to the position of general superintendent of the electrical department of the company. In future Mr. Redding will have charge of all the generating stations, sub-stations and wires and conduits.

PROF. B. F. HARDING has been appointed to succeed the late Prof. C. P. Mathews as head of the electrical engineering department of Purdue University. Prof. Harding is a graduate of the Worcester Polytechnic Institute. Upon graduation he became connected with high-speed electric railway work in New England and for a period was a member of the electrical engineering faculty of Cornell. He has recently been in charge of the publication department of the Fort Wayne Electrical Works.

MR. FRANK J. SPRAGUE has prepared, for the annual volume of the Smithsonian Institution, by request, an abridgment of his interesting and valuable paper on "Some Facts and Problems Bearing on Electric Trunk Line Operation." This annual report to Congress embodies a few of the leading papers and articles on scientific and engineering advances made public during the year, constituting an excellent record of progress.

Obituary.

MR. JOHN JOYCE, of Columbus, Ohio, died suddenly Jan. 31 at his home in this city. Mr. Joyce was president of the Green-Joyce Company, vice-president and one of the organizers of the Citizens' Telephone Company. Mr. Joyce was 77 years old and is survived by his widow and five children.

MR. WILLIAM J. SEATON, JR., second vice-president of the C. W. Hunt Company, West New Brighton, N. Y., died at his home at Clifton, Staten Island, on Jan. 18 from typhoid fever at the early age of 36 years. Seventeen years ago Mr. Seaton entered the employ of the C. W. Hunt Company as office boy, but his exceptional abilities soon gained for him the recognition they deserved, and promotion followed as a matter of course, so at the time of his death he was holding office as second vice-president of the company.

Unclassified Items.

SARNIA, ONT., CAN.—A local company is being formed to build an electric railway from here to Arkona, a distance of 35 miles. Electrical energy will be obtained from the Rock Glen Power Company of Arkona.

EDMONTON, ALB., CAN.—The receipts from the municipal lighting plant for 1907 were $86,598 against $64,338 for the previous year.

CALGARY, ALB., CAN.—The province of Alberta is considering the purchase of the Bell system in this province providing it can be bought at a reasonable figure. Failing this the people are in favor of the Government continuing construction and competing with the Bell.

CALGARY, ALB., CAN.—The Provincial Government has not yet decided whether to install an automatic telephone system in this city. Preliminary arrangements are now being made for the Government system to be installed here this year. Address S. Edwards, superintendent of telephone construction, Edmonton, Alb.

VANCOUVER, B. C.—The British Columbia Electric Street Railroad Company, of which R. H. Sperling, of Vancouver, is general superintendent, has planned an extensive construction campaign for 1908. One of the most important of the works to be undertaken by the company during the present year is the railway from New Westminster to Cloverdale, a distance of 63 miles. Construction work will be performed by contract and it is expected that the first section of 12 miles, plans for which are now complete, will be let at an early date. In addition to the electric railway the company proposes to supply electricity for lamps and motors in towns and territory through which the railway will run. Energy at 40,000 volts will be supplied from the company's generating station at Lake Buntzen to sub-stations along the line. The transmission line will be erected on 50-ft. poles. The total length of the transmission line will be 75 miles. It has not yet been decided whether the road will be a single-phase or 500 volt direct current.

WINNIPEG, MAN., CAN.—The civic power committee has decided to reduce the power staff to a minimum, leaving only one electrical engineer and one assistant hydraulic engineer in addition to Cecil P. Smith, the power expert.

WINNIPEG, MAN., CAN.—Instead of building a civic power plant Alderman Adams favors purchasing the plant of the Winnipeg Electric Company on the Winnipeg River.

BELLEVILLE, OHIO.—It is reported that arrangements are being made to rebuild the Valley Farm Creamery and electric lighting plant, which was recently destroyed by fire. E. G. Barber is manager.

OSTRANDER, OHIO.—The citizens of this village are considering the question of establishing an electric light system in the village.

PHILADELPHIA, MISS.—Plans are being made by the Philadelphia Electric Light & Ice Manufacturing Company for the erection of an electric light plant.

CEDARVILLE, OHIO.—A proposition has been submitted to the village council by the Cedarville Electric Light & Power Company to install 20 arc lamps on the streets of the village at the rate of $72 per lamp per year.

WASHINGTON, D. C.—The Isthmian Canal Commission has awarded a contract to the General Electric Company for furnishing the equipment for a power plant to handle the material to be used in the construction of the Gatun locks at a price between $194,000 and $197,000, the exact figures to be fixed by the engineers on the isthmus.

ALBANY, N. Y.—The Albany & Greenbush Bridge Company has awarded the contract for equipping the drawbridge to be operated by electricity to the General Electric Company, of Schenectady. One 50-hp motor, one 20-hp motor and four 1-hp motors are to be installed in addition to four sub-marine cables. Electrical energy for operating system will be supplied by the Albany Electric Illuminating Company, which will be furnished by the Spier Falls plant. Thomas J. Mulcahy is superintendent of the bridge company.

WHITNEY, TEX.—J. N. Collier, manager of the Whitney electric plant, writes that the question of establishing a fan and power circuit is contemplated.

NORTH MILWAUKEE, WIS.—The North Milwaukee Light & Power Company contemplates changing part of its system to alternating current as soon as possible. A 75-kw, three-phase, 60-cycle generator will be installed and an engine of from 75 to 125 horse-power, also feeder panels for alternating-current generator. The company would like to receive prices on Corliss and medium-speed engines, and also on alternating-current motors, 220 volt, three phase. It also plans to do some heating by exhaust steam, and would like to receive information in regard to different systems. The present system is direct-current, 110 volt, and it is planned to change the entire system eventually to alternating current. Theodore Weach is president and general manager.

TUPPER LAKE, N. Y.—Extensive improvements and additions are contemplated for the municipal electric light plant, including the installation of a 175 to 200-kw generator, one 250-hp engine, one 150-hp boiler, transformers and a larger pump. When the new plant is installed the present machinery will be used as an auxiliary plant. James Garrison is manager.

RENO, NEV.—S. H. Wheeler and Charles H. Burke have applied to the City Council for a street railway franchise covering nearly every street in the southeastern section of the city.

ROGERS, ARK.—J. S. McLeod, town recorder, writes that the town does not contemplate a municipal electric light plant. A plant is already established in the town.

CANBY, ORE.—The Mollala Power Company has been incorporated and proposes to take over the plant and business of the Aurora Electric Company, which operates in Aurora and is now supplying electricity in the towns of Aurora, Hubbard, Barlow and Canby. The new company proposes to locate the Aurora plant on the Mollala River, about 3½ miles southeast of Canby, where water rights have been secured.

JEROME, ARIZ.—The Two Republics Company is planning to install an electric plant in the near future.

ST. LOUIS, MO.—At the annual meeting of the Board of Directors of the Wagner Electric Manufacturing Company, recently held in St. Louis, the following officers were chosen for the ensuing year: S. M. Dodd, president; W. A. Layman, vice-president and general manager; Jas. W. Bell, second vice-president; W. S. Thomas, treasurer; Albert Blair, secretary; M. S. Alcorn, assistant secretary. The board of directors consists of S. M. Dodd, Jas. W. Bell, J. C. Van Blarcom, Thos. H. West, James Campbell, Albert Blair and W. A. Layman.

Business Notes.

VOLTAX COMPOUND.—After a series of tests lasting over nine months, Harlin & Hollingsworth, of Wilmington, Del., have placed a large order with the Electric Cable Company, of 17 Battery Place, New York, for its anti-corrosive compound, Voltax.

THE HOLMES FIBRE GRAPHITE MANUFACTURING COMPANY, manufacturers of the Holmes fibre graphite commutator brushes, dynamo brushes, etc., has recovered from the effects of the fire in October at its plant at Germantown, Philadelphia, and is in readiness to attend to all customers with their former promptitude and care.

DOSSERT & COMPANY, 242 West Forty-First Street, New York, have sold a large order of solderless cable taps to W. L. Barstow & Company for use in the installation of the cement plant of the Fordwick Company at Longue Pointe, Montreal. The Shawinigan Water & Power Company will supply energy at an e. m. f. of 44,000 volts.

THE ROBBINS & MYERS COMPANY, whose main office and factory are located at Springfield, Ohio, recently moved its Chicago office from 1321 Fisher Building to 48 West Jackson Boulevard, where it occupies a big storeroom. This new location provides facilities for carrying a large stock and making prompt delivery of its "The Standard" direct and alternating current fans and "The Standard" power motors. Considerable outside territory has been added to the Chicago branch, including Wisconsin, Minnesota, Iowa and northern Illinois. The Chicago branch is managed by Mr. H. A. Porter.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 4, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

877,901. LOCK-OUT DEVICE FOR PARTY-LINE TELEPHONES; William M. Bruce, Jr., Springfield, Ohio. App. filed Feb. 15, 1906. In a common battery party-line telephone system, a relay at each subscriber's station, means for bridging the same across the line, a shunt around said electro-magnet, including the subscriber's talking instruments, a circuit closer in said shunt adapted to be operated by said relay, and a circuit breaker also in said shunt and associated with said relay, so that any jarring of said relay will operate said circuit breaker, substantially as and for the purpose specified.

877,902. TELEPHONE SWITCH; William M. Bruce, Springfield, Ohio. App. filed Feb. 18, 1907. The combination with the contacting devices and the swinging arm of a detachable lever adapted to engage with the projection on said arm, and a spring catch to engage said lever, said spring catch being provided with a circular flange adapted to engage in a circular groove in said lever, substantially as specified.

877,914. TELEGRAPHIC TRANSMITTER; Patrick B. Delany, South Orange, N. J. App. filed March 31, 1906. Automatic telegraph system having a key moved transversely to transmit dots at one position of its throw and dashes at the other position.

877,915. TELEGRAPHIC TRANSMITTER; Patrick B. Delany, South Orange, N. J. App. filed April 26, 1906. A transmitting mechanism for use in connection with the above patent and employing a vibrating balance wheel.

877,919. ELECTRICAL CONTACT DEVICE; Friedrich Fink, Recklinghausen, Germany. App. filed Feb. 25, 1907. Contact device for the electric ignition of blasting charges, mine cartridges and the like. Has a pair of levers fastened to a wooden block and held in a position of rest by means of a spring. The circuit is completed by raising the levers.

877,921. TELEPHONE EXCHANGE SYSTEM; Samuel B. Fowler, La Fayette, Ind. App. filed May 22, 1906. Covers details of exchange circuit for special operation of supervisory relay.

877,953. TROLLEY; Jean E. Saucier, Montreal, Quebec, Canada. App. filed Oct. 6, 1905. In addition to the usual trolley wheel, the harp carries a convex roller mounted on a separate spring impelled arm and designed to prevent shocks to the wire from the trolley wheel.

877,968. COMBINED TELEPHONE DROP AND JACK; Henry C. Thomson, Boston, Mass. App. filed June 7, 1907. The combination of a telephone jack and signal-drop, a grooved and perforated insulating block upon which the same is mounted, a sleeve for the jack-plug inserted in said perforated block, and a transparent guard-plate mounted in the grooved insulating block in said jack in front of, but not touching, said signal-drop, and substantially as described and shown.

878,012. AUTOMATIC ELECTRIC SUPERVISORY AND SIGNALING SYSTEM; James G. Nolen, Chicago, Ill. App. filed Dec. 23, 1902. Signaling system for telephones. See following patent.

878,013. ELECTRIC SIGNALING SYSTEM; James G. Nolen, Chicago, Ill. App. filed March 11, 1904. A signaling system for automatic fire-alarm purposes, and particularly for supervising the valves of an automatic fire-extinguisher system.

878,017. PARTY-LINE TELEPHONE SYSTEM; Arthur F. Poole, Wheeling, W. Va. App. filed Feb. 20, 1905. Covers complete diagram of circuits.

878,018. LOCK-OUT TELEPHONE SYSTEM; Arthur E. Poole, Wheeling, W. Va. App. filed Dec. 30, 1905. Renewed Sept. 27, 1907. Relates to modifications of the above.

878,062. TROLLEY BRUSH; George Heineman, San Francisco, Cal. App. filed Sept. 12, 1907. Overhead trolley brush for electric car system designed to sweep across exposed contact plates arranged above the roadbed and depending at regular intervals from an overhead feed or supply cable.

878,083. VIBRATOR; Walter N. and Frederic W. Nicholls, Toronto, Ontario, Canada. App. filed April 17, 1907. Vibrator for induction coils having a bolt loosely contained in a chamber on the vibrating member to impart a more positive movement thereof by its momentum

878,106. ELECTRICAL SIGNALING APPARATUS; Benjamin F. Wooding, Denver, Col. App. filed Feb. 23, 1906. Signaling apparatus having a contact carried by the train and adapted to engage the conductors of a block system, which conductors may be supported on poles or placed on the ground.

878,112. ELECTROMECHANICAL SWITCHBOARD; E. W. Brackett, Elyria, Ohio. App. filed May 29, 1907. In an electromechanical switchboard signal, an electromagnet having a central core provided with an arc-shaped tongue at one end thereof, a U-shaped return bar secured to the other end of said core and provided with forwardly extending arms, a shaft journaled between said arms, a target secured to said shaft on one side thereof, and an armature having extended ends secured on the opposite side of said shaft and adapted to swing toward the core of the magnet when the latter is energized and to straddle said arc-shaped tongue.

878,125. REEL FOR COIL WINDINGS; Isaac DeKaiser, Wilkinsburg, Pa. App. filed March 3, 1906. An armature winding machine of the type where the coils are formed by threading the wire back and forth in suitable slots in the core.

878,138. ALTERNATING CURRENT SIGNALING APPARATUS FOR ELECTRIC RAILWAYS; John S. Holliday, Wilkinsburg, Pa. App. filed June 3, 1907. Signaling system for electric railways where a single-phase alternating current is used for propulsion. Is designed to avoid the influence of the propulsion current on the signals.

878,139. ALTERNATING-CURRENT SIGNALING APPARATUS FOR ELECTRIC RAILWAYS; John S. Holliday, Wilkinsburg, Pa. App. filed June 28, 1907. Relates to modifications of the above.

878,151. TELEPHONE SYSTEM; Albert L. Parcelle, Boston, Mass. App. filed Sept. 22, 1906. In a telephone system, a local transmitter circuit, comprising branch circuits arranged in multiple, only one having therein a microphone, and each of said circuits having a primary winding with a separate core, and a receiver circuit having a secondary winding common to said primary windings and cores.

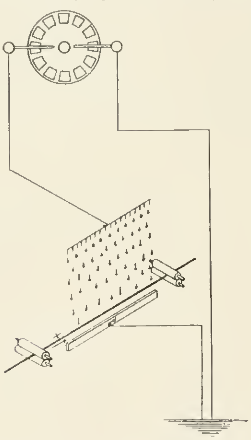
878,165. DYNAMO ELECTRIC MACHINE; E. M. Tingley, Pittsburg, Pa. App. filed April 4, 1906. An armature construction for dynamo electric machines designed to provide an effective support for those portions of a laminated core structure which are adjacent to the core slots containing the windings.

878,167. COMMUTATOR COVER; J. E. Webster, Pittsburg, Pa. App. filed Feb. 6, 1906. Means for providing suitable ventilation of the commutator and designed to prevent chattering when the machine is in use. Has specially constructed latches for the cover.

878,192. TELEPHONE TRANSMITTER; William W. Dean, Elyria, Ohio. App. filed Aug. 9, 1905. In a telephone transmitter, a cup containing granular material, a diaphragm having a stiffening rib or flange, and an electrode carried by said cup and intraperipherally engaged by said flange, said electrode receiving motion transmitted directly from the diaphragm through said flange.

878,212. ELECTRIC FUSE; S. J. Leveen, Rock Island, Ill. App. filed Nov. 3, 1906. Construction of fuse holder or shell designed to be easily and cheaply refilled as often as the fusible element is burned out.

878,247. OVERHEAD ELECTRIC CONTACT; T. W. Small, Cleveland, Ohio. App. filed Dec. 5, 1906. The trolley harp carries on one side a contact stud or boss which engages a depending spring plate from the trolley hanger for direct switch and other purposes.



878,273—Method of Neutralizing Static Electricity.

878,249. ELECTRIC APPARATUS FOR RAILWAY SIGNALING; H. W. Spang, New York, N. Y. App. filed Jan. 12, 1903. Railway signal system employing constant track circuits with galvanic batteries at the forward end and a relay at the near end and which controls a signal circuit.

878,260. ELECTRIC AIR COMPRESSOR; N. M. Watson, Detroit, Mich. App. filed April 23, 1906. Patentee has hollow solenoids, the interior of which are fitted with air cylinders, so that their cores serve the double function of piston and plunger.

878,264. TELEPHONE CENTRAL-OFFICE APPARATUS; Charles S. Winston, Chicago, Ill. App. filed Dec. 21, 1904. The combination with a trunk circuit extending between telephone and switchboard sections, of a cord circuit at the outgoing end of the trunk provided with a bridged clearing-out signal, and means whereby when the connection is taken down at the incoming end of the trunk a current is sent through said clearing-out signal in the cord circuit at the outgoing end of the trunk, substantially as described.

878,265. AUTOMATIC TRUNKING SYSTEM; Charles S. Winston, Chicago, Ill. App. filed Jan. 2, 1907. In a telephone system, the combination with automatic and manual subscribers' lines, of a trunk circuit for connecting such lines for conversation, a plug and a terminal for one end of said trunk line, a seat switch for said plug, and means operated by the actuation of said plug-seat-switch for maintaining a connection with the trunk line for a short duration of time after the plug-seat-switch has been actuated, substantially as described.

878,272. CONDUCTOR FOR DISCHARGING HIGH VOLTAGE ELECTRIC CHARGES; W. H. Chapman, Portland, Maine. App. filed May 18, 1906. A conductor having pointed needles or spikes for discharging electricity in treating paper, yarn, roving and other material in the process of manufacture.

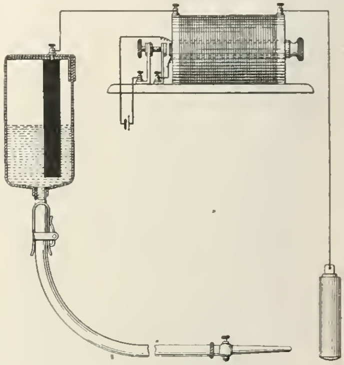
878,273. METHOD OF NEUTRALIZING STATIC ELECTRICITY; W. H. Chapman, Portland, Maine. App. filed May 25, 1906. Process for carrying out the invention of the above patent.

878,302. INSULATOR; H. R. Markel, Dayton, Ohio. App. filed July 10, 1907. An insulator having two porcelain blocks which fit together on a zig-zag line of division and include the conductors there between.

878,361. ELECTROLYTIC IRRIGATOR; P. Del Gaudio, New York, N. Y. App. filed July 8, 1907. A form of syringe in which fluid is made the terminal of an electric circuit.

878,402. MAGNET FOR ALTERNATING CURRENTS; Christian Kramer, Frankfort-on-the-Main, Germany. App. filed March 12, 1906. The combination with a source of single-phase alternating current, of an electro-magnet comprising a core consisting of three parallel pole pieces and a yoke connecting the same, and windings upon said pole pieces, the winding upon one of said pole pieces being connected in series with a motor across said source, the windings upon the other two pole pieces being connected in a series across said source.

878,423. COMBINED GAGE AND CIRCUIT CLOSER; J. P. Raynes, Hyde Park, Mass. App. filed May 21, 1907. Patentee has a shifting contact on the face of his pressure gage which is engaged by an arm moving with the usual pointer.



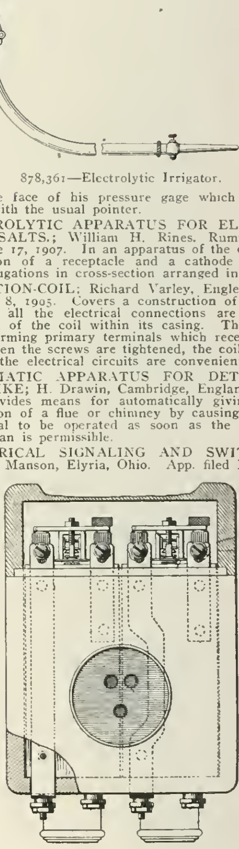
878,361—Electrolytic Irrigator.

878,425. ELECTROLYTIC APPARATUS FOR ELECTROLYSIS OF METALLIC SALTS.; William H. Rines, Rumford Falls, Maine. App. filed June 17, 1907. In an apparatus of the character described, the combination of a receptacle and a cathode plate having deep V-shaped corrugations in cross-section arranged in said receptacle.

878,435. INDUCTION-COIL; Richard Varley, Englewood, N. J. App. filed February 8, 1905. Covers a construction of induction coil and box in which all the electrical connections are completed by the mere insertion of the coil within its casing. The casing has bifurcated strips forming primary terminals which received screws on the coil unit. When the screws are tightened, the coil units are fastened in place, and the electrical circuits are conveniently made.

878,456. AUTOMATIC APPARATUS FOR DETECTING SMOKE AND THE LIKE; H. Drawin, Cambridge, England. App. filed Dec 6, 1907. Provides means for automatically giving warning of the smoky condition of a flue or chimney by causing a bell to be rung or other signal to be operated as soon as the smoke has become more dense than is permissible.

878,465. ELECTRICAL SIGNALING AND SWITCHING APPARATUS; R. H. Manson, Elyria, Ohio. App. filed May 29, 1907. Details of construction of a spring jack for telephone switchboards. The jack is made as a unit and is detachable from the rest of the structure.



878,435—Induction Coil.

878,467. INDUCTION-COIL SYSTEM; I. C. Orswell, Amesbury, Mass. App. filed Jan. 25, 1906. Has means accessible from the exterior of an induction-coil casing for adjusting the vibrator.

878,463. PROCESS OF MANUFACTURING INCANDESCENT BODIES FOR ELECTRIC LAMPS; Alexander Just and Franz Hanaman, Budapest, Austria-Hungary. App. filed Jan. 7, 1907. The method of producing an incandescent body for electric lamps, which consists in subjecting a carbon body coated with tungsten for a certain period to a high temperature under the influence of an electric current in an atmosphere of a neutral gas to cause the carbon core to be dissolved in the metal forming a carbid thereby, and then removing the carbon from the carbid thus produced, substantially as and for the purpose described.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, FEBRUARY 22, 1908. No. 8.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. Harold S. Buttenheim, Secretary.
A. E. Clifford, 2d Vice-President. Curtis E. Whittlesey, Treasurer.
239 West Thirty-ninth Street, New York.
Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office....590 Old Colony Building
Cleveland Office....1015 Schofield Building
Philadelphia Office....Real Estate Trust Building
European Office....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....per year, $3.00
Dominion of Canada....4.50
Other Foreign Countries within the Postal Union....6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, FEBRUARY 22, 1908.

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ALTERNATING-CURRENT GENERATORS AND CONVERTERS.

The three papers read at the recent meeting of the American Institute of Electrical Engineers and printed elsewhere in abstract, dealt with the construction and operation of alternating-current generators and converters. The mere production and operation of a non-synchronous generator cannot be considered novel, because induction motors have been used experimentally as generators for many years. Moreover, the characteristics of this machine have been studied by many investigators, and an outline of certain of its interesting and advantageous features was given in our issue for Jan. 17, 1903. According to the paper by Mr. W. L. Waters, and as restated by those who discussed his paper, the induction generator need not longer be treated as merely a laboratory curiosity, but deserves serious consideration as a reliable and satisfactory machine for certain duties. It seems to possess only one important disadvantage, its inability to produce its own exciting current or to deliver wattless current to the system. Where the equipment necessitates the continuous use of self-starting synchronous motors or converters having a rating largely in excess of the total wattless volt-amperes required by the load on the system and for exciting the generator, the induction generator can be used to advantage.

Mention has already been made in our columns of the vertical-shaft synchronous converter and of the split-pole variable-ratio converter. Although when first put forth some engineers may have considered these machines freaks in their line, yet apparently they have given satisfactory results in actual service. It is claimed for the split-pole converter that in spite of the fact that the counter e.m.f. of the converter may differ considerably in wave-shape from the e.m.f. of the supply system, there are no distortions in the current wave, and the power-factor remains at unity. If such results are actually obtained, then certain universally accepted theories need revision. It will be interesting to examine oscillograms of the current taken by the converter throughout its whole range of transformation when the impressed e.m.f. is sinusoidal. The paper by Mr. J. E. Woodbridge sets forth the advantages of a six-ring over a three-ring synchronous converter. Mr. Ralph D. Mershon, in an article printed in these columns about 12 years ago (June 15, 1895), established these advantages by mathematical demonstration, showing that the armature copper losses are more uniformly distributed in the former machine and that it can be operated at a greater output and higher efficiency than the latter machine. Mr. Woodbridge shows that the complication of three extra slip-rings and connecting circuits are of minor importance with converter rates at more than 500 kilowatts. An interesting feature of Mr. Woodbridge's paper is a discussion of the compounding of converters, which is the most complete treatment that has come to our notice. Although the suggestion to adjust the series reactances in the alternating-current circuits, the series field-turns in the direct-current circuit and the shunt excitation, to produce unity power factor at one-half load, may not be the best for all conditions, yet the method explained in the paper is applicable to any problem, and it will prove useful to all persons concerned with the compounding of synchronous converters.

The Luminous Properties of Conducting Helium

The only primary standards of light we have to-day in physical laboratories are flame standards, in which a certain standard column of incandescent gas is produced by the regulated rate of combination of a definite chemical substance with atmospheric oxygen. It is found to be much easier to regulate the behavior of the chemical, such as oil, pentane, or amyl-acetate, than to regulate the behavior of the atmospheric oxygen, owing to the influence of contained steam or carbonic acid, the temperature and barometric pressure. Hence arise variations and uncertainty. This trouble with flame standards has led physicists to seek for a suitable luminous source of accurate reproducibility. If such a source could be found to be capable of reproduction by specification all over the world, to within, say, one-fifth of one per cent every time, the flame standards would probably die of envy and innocuous desuetude. An article by Mr. P. G. Nutting appears at page 390 this week, on a preliminary search for a helium primary light standard. The article shows that such a standard lamp, if it can be successfully realized, might consist of a glass tube of assigned dimensions and composition containing pure helium gas of definite pressure and carrying an assigned current strength. There are many difficulties in the way of securing such a standard of light. The kind and quality of glass for the tubes, the manipulation for determining the vapor-pressure of the helium, the care exercised in eliminating hydrogen, oxygen and other impurities—all conspire to make the path of the experimenter sufficiently thorny to satisfy the most ardent and pioneering spirit. Considering these difficulties, it is surprising that such good results are found as are reported in the article. There is some hope for the standardized Geissler tube after all. It is curious that although a relatively high efficiency may be looked for from lamps of conducting gas, owing to the selective frequencies of the gaseous atoms, yet in these particular cases the efficiency was rather below that of the standard carbon incandescent lamp. Whereas one watt of radiation in the visible spectrum might be expected to produce, say, a 10-cp point source, each watt in the reported observations produced only about one-quarter of a candle. Of course, if the lamp were otherwise satisfactory as a primary standard, its efficiency would be of no importance.

Lighting and Decoration.

Mr. Hunter's paper, read last week before the Illuminating Engineering Society and abstracted elsewhere, is a very striking illustration of the many-sided aspects of the art of illumination. It is also important as impressing the necessity for study of illuminating technique in attempting interior decoration under modern conditions. The expert on illumination must be a great deal more than a technologist; he must have a clear comprehension of essentials in physics, physiology and æsthetics. The definition of the illuminating engineer as "an electrical engineer with common sense" is both incorrect and slanderous. Most electrical engineers have common sense, but this does not prevent their making serious blunders when brought up against problems requiring special knowledge for their successful solution. Nor is it in the least necessary that the illuminating engineer start as an electrical or gas engineer, since his qualifications in these branches of engineering are of minor importance compared to the rest. Mr. Hunter's paper is particularly useful in pointing out the necessity of taking account of æsthetic and physiological facts in providing for illumination. A great deal has been written by artists on the æsthetics of color, but most of it is mere unconvincing guesswork, chiefly because the writers while familiar with effects have done little or nothing about the physical causes of them, and if possible less about the modifications produced by the use of artificial light.

We must confess to a deal of sympathy with Mr. Hunter's diatribe against color charts. They serve in some purposes a useful purpose, but from Lambert to his latest follower they are of small value save as regards the particular pigments or dyes concerned. The older charts being made from painters' pigments were reliable as regards these, but are useless for modern dyes. On the other hand, charts based on the fairly pure colors obtainable with dyes would be deceptive if applied to pigments of the ordinary sort. Both would disagree with the results from spectral colors. Even the often quoted table by Chevreul of the effects of colored lights on colors must be taken with reservations unless applied to pigment or old vegetable dyes, and somewhat cautiously even then. So far as decoration is concerned, the range of colored lights has been extending of late. The Welsbach, the mercury arc and the yellow flaming arc give on colored surfaces effects that have never been classified and that can be properly reprobated only by trying them. For the decorator the effects of colors on each other have to be taken into account in considering illumination. Two papers may harmonize by gas light, but that is no sign that they will not swear at each other under the glare of an arc, or vice versa. The "electrical engineer with common sense" has no reason to know the laws of simultaneous contrast, but the decorator has, even though his knowledge is generally somewhat empirical, and the illuminating engineer cannot neglect them. This necessity of knowing something more than crude technology is well expressed in the many papers before the I. E. S. on topics touching physiology and the theory of optics as related to practical illumination.

We note that Mr. Hunter falls into the not unnatural error common among artists of thinking that the human eye is subject to great variations in color perception. So of course it is, if one considers the color-blind, who number perhaps five per cent of civilized mankind; but these have for the most part a single kind of error—red-blindness. Aside from the color-blind class, color vision varies comparatively little under normal conditions, and the peculiarities commonly ascribed to such variations are generally due to the effects of contrast and fatigue, which are striking enough, but temporary, and the same for nearly all individuals. To anyone interested in the practical applications of the theory of color we would recommend as a preliminary the perusal of a little book by Sir William Abney entitled "Color Measurement and Mixture." After assimilating this, one is qualified to begin the study of the general literature of the subject which, without such scientific introduction, will be found full of queer and contradictory statements. One useful point which Mr. Hunter brings out strongly is the difference between general illumination and the special illumination needed for working purposes. For the former no "working plane" should be considered, since the whole interior is the thing which must be illuminated. Lighting well adapted to this purpose is generally inefficient for the latter purpose and vice versa. A room in a dwelling needs light for general purposes, a work-shop for special purposes. Neglect of this difference is likely to lead to very inartistic and unsatisfactory results. It is the business of the decorator to go after general effects and he requires especial aptitude and knowledge of color values for success. The lighting of a factory is child's play compared with this color-work. It is a most encouraging sign of the progress of the art of lighting when we find the architect and decorator joining hands with the engineer in an earnest effort to put the work on a thoroughly scientific basis.

Load Factors in Towns with Few Stores.

There are a number of cities in this country which, although of considerable size, have few stores owing to proximity to a large city where people go for shopping. It has sometimes been customary for central-station managers in such places to bewail their fate and say that the electric lighting business is poor because of the absence of stores, which are too commonly supposed to be the cream of the lighting business. A little investigation into the actual conditions in a city of this kind recently revealed the fact that the central-station company had a yearly load factor of 35 per cent, this being the ratio of the average to the peak load of the year. There are plenty of central-station companies operating in large cities which would be delighted to push their load factor up to 30 per cent. In the great majority of cases it is less than 25 per cent. Care should be be taken not to confuse this with the daily or monthly load factor, which may be considerably better than the yearly load factor. The case just mentioned with a 35 per cent load factor for the year indicates the beneficial effect on the ratio of earnings to investment of a central-station company to have a load which consists mainly of motors and residence lighting. Motor load in a manufacturing town runs from 8 to 24 hours, and the load factor of residence lighting by itself is likely to be much better than of commercial lighting by itself. Residence and power lighting loads overlap somewhat during November and December, but not to cause any such enormous peak as occurs when the commercial lighting of stores and offices is added.

New Method for Obtaining the Polar Intensity Curve of a Lamp and for Recording Luminous Intensity.

Now that spherical intensity photometers have become established in use, so that it is possible to take an arc lamp, for example, and measure at one observation the total light flux it emits, or, immediately connected therewith, its mean spherical candle-power, the long and tedious process of measuring the candle-power of the arc zone by zone in elevation becomes unnecessary. The arc may wander along its meandering wayward path over the surfaces of the electrodes like an ant on a mole-hill, the feeding of the electrode may take place according to its own natural law of hunger, but the observation of the mean spherical intensity photometer or lumenmeter tells the whole story as to the total emission of light from moment to moment. In an article recently printed in the *Elektrotechnische Zeitschrift* and abstracted in the Digest, Dr. W. Voege points out that although the convenience of the lumenmeter for measuring total flux is great, a knowledge of the polar distribution of intensity can rarely be dispensed with when comparing different lamps, or when designing a lighting installation. Nevertheless, to have to go over the tedious zonal photometry once more, after the convenience of the lumenmeter, is to exchange ease and comfort for weariness and vexation of spirit. He suggests a plan that appears to have marked advantages for reducing the time and labor in making zonal luminous intensity measurements. Dr. Voege substitutes a little thermopile for the eye of the photometrist, obtains thereby a deflection on a thermo-galvanometer, which is recorded as the thermopile is carried in an altitude circle about the lamp under test, zone by zone.

At first sight, it might seem that a thermopile would not be applicable to replace the eye in a photometric apparatus. Nevertheless, it is easily understood that if a bright body is operating at all points at the same temperature, and rays from all its parts fall on the thermopile, the ratio of incident power in the visible spectrum to the total incident radiant power, will be constant. In other words, if a human eye at a certain angle of elevation from the source observes twice the illumination received at the horizontal plane, then there will be twice the radiant power in all regions of the spectrum, and a thermo-galvanometer should therefore also read double. Moreover, if a plain glass screen be interposed between the lamp and the thermopile, the great bulk of the invisible radiance will be cut off from the pile, and the remainder, reaching the pile, will be mainly luminous radiance. As the illumination changes, judged by an eye moving from zone to zone at constant radius, the thermopile should increase its e. m. f. in the same proportion, even although the red rays may stimulate the pile more than the yellow or blue rays. Of course, if the successive zonal aspects of the luminous source varied in temperature, the ratio of retina-stimulating radiance to total radiance would vary, and the readings of the thermopile would diverge from the corresponding readings taken by the eye in the ordinary photometer.

The article points out that in the case of the incandescent lamp, all parts of the filament are kept at substantially the same temperature, so that the proportionality of stimulus between retina and thermopile will hold. It is stated, moreover, that by experimental observation arc lamps maintain this proportionality sufficiently nearly for practical purposes, especially if they are provided with enclosing glass covers. A milky or semi-transparent cover, acting as a diffuser, naturally tends to maintain the said proportionality at all angles of emission, and thus gives the thermo-galvanometer a good chance to make its readings photometrically. All that is necessary is to move the pile-carrying arm, zone by zone, around the arc lamp in the vertical plane through the center of the same, and read off the galvanometer deflections as soon as they become steady. These deflections, plotted on a polar diagram, will then correspond to luminous intensities to some particular scale of reference. The scale may not be required, if the polar diagram is only to show the relative distribution of intensity. If, however, the scale is required, it is only necessary to observe some particular zonal intensity in the photometer in order to establish the relation. By recording photographically the thermo-galvanometer deflection with respect to time, the degree of constancy in the luminous intensity in any direction can be readily registered.

Electric Service Suspended in Atlanta.

The electric light, telephone, telegraph and street-railway service of Atlanta, Ga., was completely suspended for 36 hours by a heavy ice and sleet storm, beginning Sunday night, Feb. 9. The damage to the telegraph and telephone equipment was so heavy that the municipal authorities ordered the Georgia Railway & Electric Company to shut off all current. Underground lines in the fire district, however, were kept in operation, and by Monday night the arc-lamp service in the business center was resumed. Large forces of men were put at work by the Western Union and Postal Telegraph companies clearing up the wreckage. The stoppage of the Atlanta & Marietta single-phase railway also caused great inconvenience to business men.

N. E. L. A. Exhibitors' Committee Meeting.

A meeting of the National Electric Light Association exhibitors' committee was held in Chicago, Feb. 11, to formulate plans in connection with the exhibition to be held during the National Electric Light Convention at Chicago, May 19 to 22. Six members of the committee were in attendance. Plans were adopted to be submitted for approval to the executive committee of the National Electric Light Association, which is to meet in New York Feb. 20. Those present were Chairman F. H. Gale, General Electric Company; S. E. Doane, National Electric Lamp Association; W. S. Heger, Allis-Chalmers Company; H. M. Post, Western Electric Company; F. M. Holbrook, Crocker-Wheeler Company, and Walter Neumiller, of the New York Edison Company. Mr. Neumiller represented by proxy an absent member of the committee, and by virtue of his connection with the exhibition at last convention was able to give the committee valuable advice. The exhibits are to be in the former dining-room of the Auditorium Hotel.

Marconi Canadian Commercial Service.

The Montreal *Star* states that the service of the Marconi Wireless Telegraph Company has now been extended to include commercial, in addition to newspaper messages. It quotes Mr. J. G. Opp, manager of the Marconi Montreal office, to the effect that it is the intention of the company to extend the service to other commercial centers, and that offices will be opened in other cities of Canada within a short time. A flat rate of 15 cents per word is charged for commercial messages, this rate covering transmission over the land lines from Montreal to Glace Bay, and from Clifden, Ireland, to destination of message. The newspaper reports that a grain merchant sent a message by this medium to London and received a reply in two hours. It is not the present intention of the Canadian-English company to have American business transmitted through the Montreal office, owing, it is stated, to difficulties in land line facilities; but the erection of a station is contemplated in the United States, possibly in the vicinity of New York, for the benefit of the American public.

Electrical Mining Development in Mexico.

The greatest mining districts in Mexico to-day are those in which cheap electric power has been installed. Guanajuato, which is now producing its millions of dollars of ores per annum, was dormant for a century and more because the surface richness of the mines had been exhausted by the Spaniards and the cost of fuel was too great to continue operations. It was well known to the mining men of the early days that rich deposits of ores existed in the Guanajuato mines at greater depths, but it was impracticable to go deeper. In those days no power existed which could keep the lower workings clear of water or hoist the ore to the surface at low expense. The mines had to be abandoned with the wealth within easy reach.

Years and years rolled by and the Guanajuato mines lay idle. The first step in the direction of awakening the dormant industrial life of Guanajuato was taken by a syndicate of Americans. George W. Bryant, of Colorado Springs, Col., and associates organized the Guanajuato Light & Power Company and installed a great hydro-electric plant at El Duro, where a waterfall was utilized to furnish the initial power. Transmission lines were built to Guanajuato, a distance of 110 miles, Irapuato and other points in the states of Guanajuato and Michoacan. Sub-stations were built and the electrical energy was placed at the disposal of the owners of mines and other industrial concerns. It was soon demonstrated that this cheap power meant the reaping of fortunes out of abandoned mines and in opening new properties. American capital began pouring into the district, and it is estimated that more than $40,000,000 gold have been invested by Americans in what is known as the Guanajuato district during the last five years that the electric power and transmission plant has been in operation.

In addition to causing the rejuvenation of the ancient mines which had been idle for so many years, the introduction of electric power made it possible to operate low-grade mines which would not stand the expense of the ordinary fuel being used. It enabled the workings of the old mines to be deepened and as a direct result of this development ore bodies of vast richness have been uncovered in several properties and the output of the camp and district is attracting world-wide attention.

What has been accomplished at Guanajuato is being done also at El Oro and other mining camps of the republic. The Mexican Light & Power Company, which is composed of Canadian capitalists, extended its transmission line to El Oro from its hydro-electric plant, situated at Necaxa, near Mexico City. The mine operators of El Oro were quick to take advantage of the opportunity for cheap power, and many thousand horse-power were contracted for and are being installed at the different mines as rapidly as possible. One of the first of the larger companies operating in the El Oro camp to adopt electricity for its uses was the Compania Minera Las Dos Estrellas. It found that the new power gave the company an enormous saving during the past two years. The company has now taken steps to convert its mine railway from steam to electricity. To accomplish this it is having built a 450-hp motor generator set, comprising alternating-current motor, which will be located centrally with regard to the part of the road to be electrified, this set taking its power from the circuits of the Mexican Light & Power Company. The motor will drive a 300-kw direct-current generator for line supply on the trolley. This company already has in operation six electric locomotives in and about its mines. It is claimed that since the installation of this electric railway system the cost of hauling has been reduced one-half.

In the Cananea copper district, where the mines and smelters of the Greene Consolidated Copper Company are located, has been built one of the most extensive systems of surface electric mining roads in Mexico. The system covers all parts of the mining camp and extends into the mines. At Cananea, however, the cost of electric power is higher than in other parts of Mexico for the reason that steam instead of water power is used to generate the initial energy. The Necaxa plant of the Mexican Light & Power Company is situated at the Necaxa waterfalls.

Steps are now on foot to establish a great hydro-electric plant on the Santiago River, near the city of Guadalajara, for the purpose of affording power for mines and mills in remote districts of the state of Jalisco. The proposed transmission lines will be from 100 miles to 175 miles long.

A number of mines of the Sultepec district, state of Mexico, are now being supplied with power from the Sultepec Light & Power Company. This company recently installed a hydro-electric plant at Temascaltepec and built a 25,000-volt transmission line from there to Sultepec, where a sub-station was built for the purpose of supplying the mines with power. In addition to the mines already being supplied, a number of other properties are being equipped with motors and other machinery preparatory to being operated by the new power.

There are individual electric plants at many of the mines in the principal camps of the states of Chihuahua, Sonora, Sinaloa, Coahuila, Zacatecas and San Luis Potosi, but in most instances these plants are operated by steam. Where steam is used the cost of the power is much greater than where the initial energy is generated by water. For this reason scores of water-power projects are on foot all over Mexico.

An American company will soon begin the installation of a hydro-electric plant on the Conchos River, in the state of Chihuahua, which will generate sufficient energy to supply the mining camps of Parral, Santa Eulalia and other remote places. It is planned by this company to build several hundred miles of transmission lines, the longest of which will be about 150 miles. A similar project of big magnitude is on foot in the states of Oaxaca and Coahuila. The establishment of a dozen of these plants of the size of that at El Duro and the one at Necaxa, if properly distributed throughout the country, will afford sufficient power to operate all of the mines and industries now in existence in Mexico.

Large Texas Hydro-Electric Plant.

A large hydro-electric plant is being installed on the Colorado River at Marble Falls, 40 miles northwest of Austin. There are natural falls in the river at that point and this natural dam of granite is to be raised to a height of 36 ft. by the construction of a cap of reinforced concrete. The material for the construction of this cap has arrived at Marble Falls and the structure will be built as rapidly as possible. The power of these falls will be used to generate electricity which will be transmitted to Austin, San Antonio and many smaller towns throughout the central and southwestern parts of Texas. Large granite quarries are being worked near Marble Falls and the power from the hydro-electric plant will also be used to operate the machinery of these quarries. The large lake, formed by the construction of the cap upon this natural dam, will be made a great pleasure resort.

The concern which is erecting this hydro-electric plant is called the Granite Manufacturing Company. G. W. Voires is manager. It is stated that the company has planned to establish a number of manufacturing plants in the vicinity of the power station. These include cotton, woolen, oil and flour mills. It is stated that the power can be commercially transmitted to San Antonio and Waco and other places, 100 to 125 miles distant, with ease, and that there will be abundant power left to supply the smaller towns and local industrial plants.

Scenic Niagara Falls.

Chairman Burton, of the House Committee on Rivers and Harbors, has been supplied with the following data of suggestions made by Frederick Law Olmsted for the improvement of the scenic conditions about the power plants and lower factory district at Niagara:

First. That the public ownership of the shores of Niagara River, already very large, should be extended to include everything between the head of the rapids and the end of the gorge, this control to extend everywhere far enough back from the brink to permit the maintenance of a permanent belt of forest trees sufficient to screen out from the scenery of the river all the factories, houses, hotels and other structures upon adjacent private lands.

Second. That any future structures needed in the development or utilization of power should be erected out of sight behind the enclosing belt of trees, that the penstocks of any new plant should be carried down through the rock as in the case of the Ontario Power Company, and that no new structures except inconspicuous intakes and outlets should be permitted within the limits of the reservation scenery.

Third. That provision should be made for the removal or the reconstruction in accordance with the requirements just above proposed of all the existing power plants that intrude upon the scenery of Niagara, at the expiration of a term of years sufficiently extended to give a fair opportunity for the plants to earn their cost, a sinking fund being established for cancelling the investment in the plants by means of an annual license fee for the use of the water, regulated according to the number of cubic feet per second allowed in each license.

It is further proposed in the general beautification of Niagara to remove the New York Central railroad tracks back from the edge of the high bank between the upper and lower steel arch bridges, planting a belt of forest trees to skirt the cliff.

The American Civic Association is advocating the extension of the provisions of the Burton bill for 10 years more, but Congressman Porter, of Niagara, will strongly oppose this. He considers that the Burton bill has already injured the interests of Niagara, and it is not proposed to permit it to kill it without a struggle for existence. There is a strong local sentiment that no measure ever struck such a blow at American industry, engineering and progress as the Burton bill.

The Consumption of Line Poles.

The U. S. Department of Agriculture has issued a bulletin giving the results of inquiries to determine the consumption of line poles during 1906. Inquiries were sent to over 6000 operating telephone and telegraph lines, electric light and power systems, trolley and street railway lines and steam railroad companies operating their own telegraph or telephone lines, and it is stated that replies were received from practically all addressed. The following table gives the number and average value per pole of round and sawed poles purchased in 1906:

	Number.	Value.
Cedar	2,174,279	$2.57
Chestnut	988,084	2.66
Pine	177,809	3.86
Cypress	111,657	2.30
Juniper	57,064	2.86
Redwood	24,760	3.56
Oak	9,924	1.41
Fir	9,601	2.25
All other	21,488	1.68
Total	3,574,666	$2.65

The total value of the poles was $9.471,171. As will be seen from the average value per pole at the point of purchase, pine stands highest and oak lowest. Round poles brought an average of $2.63 and sawed poles $4.22 each. Cedar and chestnut are the principal trees cut for round poles, and pine and redwood for sawed poles. Since the sap wood of pine decays rapidly, a sawed pine pole will last longer than a round one.

As to length of poles, the figures for cedar are: 1,305,148, 25 ft. long; 408,139, 30 ft. long; 262,739, 35 ft. long; 133,391, 40 ft. long; 70,452, 45 ft. long. The same order applies to other poles except cypress, in which case the largest number of poles were 30 ft. long. The total number of poles used by telephone and telegraph companies was 2,395,722, the average price per pole being $2.19; by steam railroad companies 254,268, the average price being $2.30; and by street railways, electric light and power companies 924,676 poles, the average price being $3.95. The report states that cedar poles are the most durable: chestnut and cypress come next, but the former is not so straight as cedar and is liable to be knotty. Pine is so much less durable than cedar that it cannot compete as pole wood without preservative treatment. Redwood possesses durability, lightness and softness, but its size necessitates sawing, which adds to the cost.

Poles which have not been treated by preservatives may be expected to give from 10 to 15 years of service, roughly speaking. Creosote is probably more extensively used than any other preservative, though ordinary paint is a common agent. For the butt, tar is often employed and charring by fire is found useful. By the comparatively new open-tank treatment, the preservative is forced into the wood of the butt by a much simpler and more inexpensive method than was formerly employed. The department has printed a circular (Forest Service Circular No. 104) on tank pole treatment.

Electricity in Peru.

Special Agent Charles M. Pepper has made to the Department of Commerce and Labor a report of the present state and future prospects of electrical development in Peru, as follows:

Electrical development in Peru is likely to call for increased purchases of material, notwithstanding the fairly large installations that have been made during the last two years. Hydraulic and electrical engineers the world over are familiar with the power that the Andes waters hold in reserve, but not all of them have kept pace with the recent application of this power and with the prospects for its further utilization. Some of the grander projects will have to wait a further period of industrial growth on the part of the west coast before they can become commercially feasible. Such is the proposed tapping of Lake Titicaca, by means of a tunnel through the crest of the Cordilleras, bringing 500,000 horse-power down to the Pacific. This vast volume of power cannot be utilized profitably for many years, though some day it will be done.

Other large projects, particularly in relation to railway traction, manufacturing and mining, are not so remote. The waters of the Peruvian Andes present ideal conditions for transformation into electrical energy in their freedom from ice, brushwood, leaves, etc., and these advantages are fully recognized in all the plants that are formulated. Peru now imports coal to the value of $1,000,000 annually, and it is estimated that 50 per cent of this amount could be saved in fuel by the use of water through electrical energy. When the Peruvian coal mines are opened up by getting railways to them there will still be economy in water-power.

The Central or Oroya Railway, running from Callao, and piercing the wall of the Andes in the Galera tunnel at an elevation of 15,665 ft., with 4 per cent grades and numerous zigzags and switch-backs, offers the best opportunity for the application of electrical power for traction on a large scale. This railway, the main sections of which were built by Henry Meiggs in the early seventies, is still both in its engineering features and in its scenic grandeur the most remarkable railroad in the world. Naturally its transformation into an electric line appeals to the ambition of electrical engineers, some of whom have made careful studies at their own expense and prepared elaborate plans. The ampleness of the water-power in the heights of the Andes is easily determined, but other questions requiring the judgment of experienced railway men, both in regard to engineering and to the relative economy of steam and electric power in handling traffic, have been carefully tested and with a favorable judgment. Some sections of the line present exceptionally favorable conditions for the economical operation of the road by electricity.

When the group of American capitalists who control the Cerro de Pasco mines offered to lease the Central Railway from the Peruvian Corporation, their plans contemplated the immediate electrification of the system and estimates had been made for that purpose. The offer was not accepted, and the line will continue to be operated by the Peruvian Corporation. I am informed that the project of changing the motive power to electricity has not been rejected nor yet has it been definitely determined. It is under consideration in the expert technical examination of the property that is now being carried on with a view to obtaining the funds for the physical rehabilitation of the system that is necessary in order to provide for the increased traffic. Financial reasons may prevent an early change to electricity, yet it is the opinion of those who have given careful attention to the subject that within a few years the change will be made, and that the economy of electrical power will be demonstrated.

Possibly before the Central Railway is operated by electrical traction the mining industry will undergo a radical modification. Electrical smelting is by many experts thought to be on the eve of introduction. The water-power is as abundant for it as for railway purposes. The Cerro de Pasco Company recently has completed extensive investigations of the power which may be obtained in the regions tributary to its properties, and the results are reported to be satisfactory. Within 36 miles of the smelter an available 15,000 horse-power has been located, while at a distance of 55 miles, and an elevation of 10,000 ft., there is 25,000 horse-power. The transmission is said to present no serious difficulties, and when detailed estimates of cost are completed, it is possible that definite steps will be taken for the installation of a great electrical power plant.

At Rio Blanco, 80 miles from Lima, on the Central Railway, the Boston capitalists who are erecting a big smelting plant, in order to take care of the ore in the neighboring districts, have about 3000 horse-power available, and are installing machinery for utilizing 400 horse-power when the smelter begins operations in April. The most successful mining installation up to the present time is reported to be that of the Inca Company, in the Santo Domingo gold fields of southern Peru. An electric plant of 400 horse-power, which was brought out and set up at some distance from the mine, where there was sufficient water-power, is said to be giving good results in working the ores on a larger and cheaper scale. In the Department of Ancachs, which is the chief mining province of the country, some installations of small electric power plants are in prospect and this is regarded as a promising field. The lack of railway and other means of transportation renders freights expensive, but this is no more burdensome for electrical machinery than for other kinds of mining machinery, and the saving to be effected in working the mines justifies the expense.

The future of the trolley tramways has definite bounds, since Peru has only a small number of cities where street-car systems are required, and most of these are already provided with trolleys or have contracted for them. Lima and Callao made the change from horse cars some years ago, and their local systems and the lines joining them are electric lines. One steam railway between Lima and Callao, which is controlled by the local trust or Associated Electrical Companies, will have its motive power changed from steam to electricity, and be used for freight. The largest extension is of the lines between Lima and the residence suburbs and bathing beaches on the seashore, the most important of which is Chorrillos. A parallel and competing line between Lima and Chorrillos, which depends on steam instead of on water-power for its motive force, was built and is operated with very unsatisfactory results to the stockholders, though recent extensions are said to improve the outlook for reducing the deficit. Ancon, a seaside resort, 30 miles from Lima, which has also the facilities of a commercial port, may have the steam railway replaced by the trolley. In the towns of Trujillo and Chiclayo, in northern Peru, existing electric systems are being extended, while the trolley may also be introduced in Paita and Piura, but for many other towns the single-mule tramway supplies all the necessary facilities for passenger traffic. At Arequipa, in southern Peru, an extension of the use of electric power is under way.

A few municipalities are not yet provided with electric lighting, but most of them have made provision for its introduction. Growth in the use of electric lights for private purposes in Lima and the other large towns is noted, and the companies engaged in supplying them find an increasingly profitable business.

Some of the larger sugar plantations have their own dynamos and small electric plants for lighting and other purposes, but these are not universal and the representatives of the various companies have still an open field. Efforts have been made to secure the introduction of electricity on the larger plantations to replace steam plowing, and convincing arguments have been made of the greater economy, but so far without much success. Even the most progressive of the planters are conservative on this point and stay by the English steam plow, which has been in use for a generation.

The minor applications of electricity, such as to domestic uses in cooking, etc., have been introduced in Lima with passably encouraging results. An electric cooking stove has had some sale at the hands of a persistent dealer. The high price of coal renders its use economical. Telegraphic and telephone apparatus have a good market, since these systems are regularly being extended. The government follows a definite plan in extending the telegraph lines. The local Italian hospital obtains its electrical appliances in the United States.

The leading electrical enterprise in Peru at the present time is that known as the Trust, or the Associated Electrical Companies. This association supplies the power for all but one of the tramway systems of Lima and Callao, the electric lighting, and a variety of industrial purposes. The total available force is to be 17,000 horse-power, consisting of a central installation at Yanacoto of 8000 horse-power, of which 5000 horse-power is in two machines and 3000 horse-power in a third machine to be installed—5000 at Chosica, 800 at Santa Rosa, 400 at Piedra Liza—and 2500 steam power in reserve. The consumption in 1907 was 7400 horse-power for force and 3300 for lighting. The Rimac River and its affluents are the source of these combined installations. Two miles from Chosica, which is 30 miles from Lima, a cement dam, headgates and canal were built to divert the waters of a stream called the Santa Eulalia to the Rimac at a point about two-thirds of a mile higher. At this point a concrete dam and gates are located, which divert the waters of both rivers into a canal a mile and a quarter long. The canal has a grade of 1½ per cent. From the reservoir, two steel pipes of 1½ meters diameter each and 670 meters long, lead to the station. The effective head is 47 meters. Here five double-nozzle, double-wheel Peltons, direct-connected to General Electric revolving field three-phase generators produce 4000 horse-power. The velocity of the water as it strikes the wheel is 1800 meters per minute. From the switchboard the voltage is raised to 35,000 volts, and transmitted to Lima over a double set of transmission lines. At the chief station in Lima this high voltage is reduced to 2300 for distribution.

Just below the bridge at Chosica a third dam has been built, and the river is again taken for the third station at Chacra Sana, farther down the river. At the side of the dam three gates, having their tops level with the crest of the dam, lead the water to the canal. In the dam, just below the entrance gates to the canal, is located an all-steel gate, having its bottom 2 ft. below the canal gate. This is to remove the immense quantities of sand and rocks that the river carries during high water. In three other places along the canal are located settling chambers and waste gates, to remove automatically the sand and gravel. This canal is 3 miles long, 1¼ miles being in earth and the remainder having cement walls and floors. The gradient is 3 ft. per thousand.

From the reservoir a steel pipe line 6 ft. in diameter and 400 meters long carries the water to the station. The effective fall is 79 meters. At this station larger units are located, each of 2500 horse-power, two of which are in operation, the third, of 3000 horse-power, which will be installed, giving a total capacity for the station of 8000 horse-power and 12,000 horse-power for the two hydro-electric stations. These two stations operate in parallel, or in synchronism with the Lima generating stations. The Chacra Sana station is constructed of solid concrete with concrete block trimmings for the doors and windows, and steel roof, entirely fireproof. It is 10 by 48 meters. From the transformer room 50-ft. steel towers carry the transmission lines.

The Lima receiving and generating station has two 750-hp water-wheels that operate under a head of 24 meters. A reservoir and steel pipe line, the same size as the Chosica No. 1 station, has an automatic relief pipe, 70 ft. high and 5 ft. diameter, that takes care of any sudden closing of the turbines, thus relieving the pipe line and wheels of dangerous strains. The steam section consists of seven engines and boilers, with an aggregate capacity of 3000 horse-power.

From the general station at Lima all public and private circuits, power circuits and railroad circuits are controlled by a switchboard with automatic switches. For the public street lighting, 10 circuits supply current to 400 of the latest type inclosed arcs and 1200 series incandescent lamps for the streets of Lima. The private lighting service for Lima, Callao and other towns is all supplied from the principal distributing station at Santa Rosa, Lima. Over 60,000 incandescent lamps are connected.

The Trust or Associated Companies is controlled by Lima capital, but the machinery is from the United States and the installation was made under the direction of American engineers. All the leading electrical companies of the United States have supplied machinery for the various installations in Peru, and their representatives have supervised most of the work. The chief German company, whose head offices are in Berlin, is an active competitor through its local representatives, and it has furnished the installation for the tramway system that does not have water-power, for some municipal lighting and traction plants, and industrial plants including mines, a cartridge factory and elevators. A Belgian company, with headquarters at Liege, maintains a local agency.

The prospective application of electricity on a large scale, such as for the Central Railway and for the Cerro de Pasco mines and smelters, I have described, but there seems to be a more immediate application for light manufacturing. About 2000 horse-power on five power circuits is now furnished by the Trust to the cotton mills, flour mills, biscuit, chocolate and cigar factories of Lima and vicinity. Coal is expensive fuel for the local industries, and it has been demonstrated that with the water-power which is available electric force can be furnished cheaper.

Most of the electric companies have their own agents and representatives in Peru, and no suggestions, therefore, are necessary as to the means for reaching this market. The point on which I would lay stress is that electricity in all its forms will play a continually growing part in the industrial development on which Peru has entered, and the local conditions are such as to assure that the present world-wide monetary stringency will not seriously interrupt this development. Many enterprises are at the stage where they can be carried forward profitably by the utilization of electricity, while to stop means loss. The industrial impulse in Peru is in reality too strong to be checked.

February Meeting of the A. I. E. E.

At the meeting of the American Institute of Electrical Engineers, on Feb. 14, papers discussing alternating-current non-synchronous generators and synchronous converters were presented by Mr. W. L. Waters, Mr. Charles W. Stone and Mr. J. E. Woodbridge. Abstracts of these three papers are given on page 384 of this issue.

In a written communication Mr. C. F. Scott stated that the non-synchronous induction generator discussed by Mr. Waters possesses certain marked advantages in eliminating hunting and minimizing the short-circuit current. He said that both the split-pole method of voltage regulation of synchronous converters, as described by Mr. Stone, and the series-reactance method treated by Mr. Woodbridge involve a variation in the power factors, while when transformer loops, induction-regulators or boosters are used the power-factor may be held at unity.

Mr. P. M. Lincoln showed by means of flux-distribution and counter-voltage curves that a converter constructed with three-part poles requires so much more material than an ordinary converter as to make it an uncommercial machine. However, a converter with two-part poles requires less material than a three-part-pole machine but more than an ordinary converter. Moreover, the efficiency of a split-pole converter is as low and sometimes lower than that of a combined standard converter and separate booster, and it introduces considerable wattless current of high frequency into the system.

Mr. F. J. Clark discussed in detail each advantageous feature claimed by Mr. Waters for the induction generator and pointed out certain disadvantages which preclude its use in large stations where synchronous alternators are now installed. He expressed the opinion that induction generators when used with synchronous converters will prove superior to turbine-driven direct-current generators which have not been very satisfactory. In speaking of the various methods of starting converters, he said that on the Long Island Railway System absolutely no trouble has been experienced with the small induction motors used for bringing the armatures up to speed.

Dr. C. P. Steinmetz remarked that the proper work for the induction generator is in supplying power to synchronous apparatus—motors as well as converters. The one field to which the induction generator is preëminently suited is in the parallel operation of small hydro-electric plants with engine-driven equipments. There should be used a synchronous machine controlled at constant speed by means of a steam engine and an induction generator directly connected to a water-wheel operating without a governor. The latter generator supplies to the system all of the available power from the water, while the other generator supplies the rest. Where numerous small waterfalls are scattered over a large area, many small, direct-connected induction generators could supply power to a common transmission system delivering to synchronous apparatus.

Prof. C. A. Adams showed that the excess in the synchronous motor equipment required when some of the receivers demand lagging wattless current which the induction generators cannot supply, should not be urged against an induction generator when compared with a synchronous generator, because the latter machine must be constructed with increased amount of material when it delivers wattless current.

Mr. J. R. Bibbins called attention to the fact that the modern gas engine gives as good service as the modern reciprocating engine. Even when used with 60-cycle generators spring couplings are not necessary. Thus the demand for special generators for use with gas engines is not so urgent as formerly.

Mr. Philip Torchio said that the New York Edison Company about three years ago placed a contract for an induction generator to be used with a synchronous motor, as an emergency equipment, but the manufacturer failed to deliver the machine on time and standard machines were chosen.

Mr. J. B. Taylor expressed the opinion that there has been no case where the e. m. f. wave-form was responsible for any definite trouble and where it was necessary to take steps to change the wave-shape or to modify the constants of the circuits in any way in order to permit the system to operate.

The Effect of Light on the Eye Discussed at Chicago.

The Chicago Section of the Illuminating Engineering Society met in the breakfast room of the Grand Pacific Hotel Feb. 13 to discuss the effect of artificial light on the eye. The paper by Dr. H. H. Seabrook, read before the New York Section Jan. 9, was first read, after which several prominent Chicago oculists took part in the discussion.

Dr. Edwin J. Gardiner put the kerosene lamp at the head of the list of illuminants used near the work, because of the low candle-power per unit area of flame and the dense opal shades commonly used. The general principles he laid down were that in artificial lighting the light should come from as large surfaces as possible to imitate daylight. He thought some of the indirect lighting of large interiors where the lamps were concealed in coves was excellent. In his opinion the quantity and intensity of the sources of artificial light in a room would have more to do with injuring a very sensitive or slightly inflamed retina than the color of the light. He was asked by Chairman Cravath whether the incandescent lamp provided with a frosted bulb and covered with a dense opal dome shade like the ordinary kerosene reading lamp would not give practically the same results and be just as good for the eyes as a kerosene lamp used under the same conditions. Dr. Gardiner said that it would. He admitted that the bad effect of the incandescent lamp was due to the way it is frequently misused.

Dr. George F. Suker agreed with Dr. Gardiner on all of the points just mentioned. He called special attention to the necessity of looking well to the illumination provided for children both in the schoolroom and the home. In connection with lighting in the home living room, he called attention to the fact that frequently if a table lamp only were provided, the grown people would occupy the best positions, and the children would be allowed to sit around in whatever room was left with an inferior illumination. For this reason he favored providing means whereby a considerable area in the room would be lighted to a high enough intensity for reading in order that the whole family might have ample light. He emphasized the bad effects due to streaks caused by light from incandescent lamps not properly equipped, and also said that it was bad to have dark corners in a room because of the violent change which the eye must make in looking from a lighted area into a dark corner. He spoke of the prevalence of the disease of cataract of the eye in India due to the religious custom of looking at the sun. There is also a disease termed electric cataract resulting from too strong electric light shining in the eyes. Like Dr. Gardiner, he agreed that probably the question of color was not as important in connection with damage done to the eye by artificial light as was the question of the intensity per unit area of the source of light, but unlike Dr. Gardiner he preferred to protect a sensitive, diseased eye by amber glass. Dr. Gardiner for similar purposes uses blue glasses, believing that the important thing is to relieve the eye of the stimulation of the great quantity of yellow rays which are present in most artificial lights rather than to look after the few chemical rays.

Dr. Gardiner gave one very notable instance in his experience which demonstrated the practical effect on the eye of good and effective lighting schemes. The study room in a boys' school at Lima, Ind., several years ago was lighted with unshaded incandescent lamps hung on drop cords. The school was a regular gold mine for the oculist. There was hardly a boy in the school that was not complaining of his eyes. A scheme of indirect illumination was worked out whereby the lamps were concealed and the illumination was received by reflection from the ceiling. The eye trouble completely disappeared, and the school ceased to be a source of profit for the oculist.

Dr. Henry Gradle spoke of experiments carried on in Germany in connection with lighting of school rooms, as a result of which it was concluded that an illumination of 50 meter-candles (about 5 foot-candles) was desirable on the desks. He enunciated very clearly the principles which, as an oculist, he would advise be carried out in artificial illumination. These principles are the same as are generally recognized by the most advanced illuminating engineering practice of to-day. He favored placing light sources high out of the line of ordinary vision, and using diffusing glass between the lamp and the eye. Indirect lighting, or lighting by reflection from the ceiling was also favored.

Dr. Suker told of one notable specific case in his practice where a stenographer, who had been working by a desk lamp placed in front of her, had eye trouble which for a time baffled him. He had asked the usual question as to the kind and position of lamp used, and was told that it was satisfactory. After several months he instructed the patient to have the lamp placed so that the light would come from behind. She was thereafter able to do without glasses, and has had no further trouble, although he had monthly reports made to him as a matter of scientific interest, to determine whether the trouble returned.

Mr. A. D. Curtis asked the oculists present for an opinion as to whether indirect lighting in which lamps are concealed and the illumination received by reflection from large surfaces would be considered by them unquestionably the best method of artificial lighting, provided it were commercially feasible. Drs. Gardiner, Suker and Gradle all agreed unhesitatingly that the indirect lighting system would be the best. Mr. George C Keech said that indirect lighting had been discussed many times in this society, but that the thing which had always stood in its way was its prohibitive expense because of its inefficiency. Chairman Cravath called attention to the fact that some of the rooms lighted indirectly which had received the most criticism, both on the grounds of inefficiency and uncomfortable effect on the eye, were rooms in which the indirect lighting was not skilfully designed. Those attending the convention of the society at Boston last summer had the pleasure of meeting in a room lighted by a reasonably efficient indirect-lighting system, and one which was practically free from the objectionable effects on the eye which had been urged against the indirect lighting in certain rooms in which tests reported to the society had been made.

Varnished Cloth Insulation.

On Feb. 5, the Pittsburg Section of the American Institute of Electrical Engineers held a meeting in the Carnegie Institute Lecture Hall after an informal dinner at the University Club. Several papers dealing with varnished cloth insulation were read and discussed.

Mr. Henry W. Fisher read a paper on varnished cloth insulated cables which was very interesting and instructive, and while most of the processes of manufacture are still secret, Mr. Fisher gave some good data. The samples of cloth are made in thicknesses varying from 5 to 16 mils. The specific gravity of varnished cloth is very close to 1, and while the electrical properties of different makes vary widely, some average tests made on samples of a circular foot in area showed as follows: Insulation resistance, from a few megohms to 955 megohms per mil.; alternating electrostatic capacity, from .11 to .26 microfarad; breakdown e. m. f., from 120 volts to 860 volts. The power factor of varnished cloth is an important consideration. One sample when tested with 20,000 volts for two hours became very hot, while a similar sample of another kind was perfectly cool after a similar test. Mr. Fisher exhibited a number of samples of varnished cloth cables, some lead-covered and others covered with an asbestos braid for switchboard work.

Mr. A. B. Reynders explained the great variety of uses to which varnished cloth is put in modern electrical machinery. As insulation for curved surfaces it stands alone. He also explained the different processes of its manufacture, and said that when finished it would withstand an e. m. f. of from 800 to 1200 volts per mil of thickness. The methods of inspection and testing are arranged to insure that the cloth will withstand bending and creasing without breaking down. The testing surfaces should be flat discs. The cloth should withstand baking at high temperature for a number of hours without being injured. A temperature of 300 deg. Fahr. or over will injure the mechanical strength of the cloth.

Mr. G. A. Jacobs expounded the technical requirements of varnish in varnished cloth. He called attention to the fact that it is impossible to obtain a quick-drying varnish that will remain permanently elastic. A varnish should never lose its life and elasticity when used at temperatures below 180 deg. Fahr. He said that most oxidizing or drying agents continue to dry out the cable after the main process has been completed, and for that reason alone the varnish loses its elasticity with age. Hot air is one of the most reliable oxidizing agents. Varnished cloth should also possess the property of adhering to itself.

Dr. Riddle read a paper for Mr. James Todd, of the Sterling Varnish Company. Mr. Todd believes that the mechanical properties of varnish-insulated cloth are just as important as the electrical properties. A cloth should be given an endurance test as well as a quick-puncture test. Varnished cloth is best when made up of a succession of layers dried one on top of the other. Some kinds of oil tend to rot the cloth. Linseed oil should be purified before being used.

In a general discussion of the subject, Mr. S. P. Grace called attention to a varnished cloth-insulated cable several miles long, used by the Pittsburg Railways Company, for carrying a three-phase energy at 13,000 volts from Brunots Island to Bellevue. This cable is hung aerially, without lead sheathing, and has been working for several years without giving any trouble with the exception of one splice that was improperly made. He considered this an important stride onward in the art of high-tension energy transmission. He also spoke of trying varnished-cloth distributing wires for telephone service.

Mr. Paul Lincoln mentioned the use of varnished cloth-insulated cables as a protection against break-downs caused by electrolysis.

Mr. B. P. Rowe called attention to the advantages of using varnished cloth-insulated cables with asbestos covering for power switchboard work and short duct runs. He called attention to the great permanency of everything about a switchboard except the insulation on cables. He thought this should be made as permanent as the barriers built for protection. He spoke of the advantage of doing away with bells on cables without lead-covering.

Mr. C. E. Skinner thought that an asbestos covering for varnished cloth-insulated cable is advantageous for fireproofing the wires. He also spoke on the subject of the manufacture of varnish, calling attention to the three principal agents for oxidizing linseed oil. These agents consist of heated air, borate of manganese and oxide of lead.

Messrs. R. D. DeWolfe and O. A. Sandborgh gave some data regarding power-factors and the weakness of varnished cloth under high temperature. Some linseed oils under test show a power-factor of 50 per cent, and other oils show as low as 10 per cent.

Mr. R. Wilson spoke highly of varnished cloth-insulated signal cables, which have been in use for a long time, and have proved absolutely unaffected by oil.

The Single-Phase Railway System.

In a paper read before the Philadelphia branch of the American Institute of Electrical Engineers, on Feb. 10, Mr. William McClellan said that among the improvements that will probably be introduced in the present high-voltage trolley circuits are a reduction in the number of insulators at which break-down can occur, and a greater amount of sectionalizing on single-track and double-track roads than has heretofore been considered necessary. For example, there could be used at curves a pull-off combining in one insulator the two that are now employed for pull-off and suspension. The pantagraph trolley mechanism as at present designed is not wholly successful, and important modifications will have to be made. The effective weight of the moving piece in contact with the wire must in some way be lessened. This cannot be done by lessening the actual pressure of the shoe on the trolley wire, but must be accomplished in the design of the shoe, so that its equivalent inertia is greatly reduced.

Little practical difficulty is caused by smoke, provided the insulation of the overhead system is properly designed. Although much study was required before a solution was found for the problem of overcoming the interference of single-phase railway systems with adjacent telegraph, telephone and signal systems, no difficulty is now experienced in avoiding the disturbances.

Viewing the single-phase system from the standpoint of several months of experience, one must conclude that it is destined to be the means by which at least a portion of the transportation work of this country will be accomplished. No man ought to be so foolish as to prophesy that the present overhead structure, or the present type of motor, will be the final type. In fact, it is not known whether an e. m. f. higher or lower than 11,000 volts will be found most acceptable in the future. It is true that if an e. m. f. higher than 2000 volts is to be used, reasons of safety need not deter one from selecting an e. m. f. as high as one pleases. Considering the fact that insulation on a railroad should be almost absolute, it is as easy to insulate for 11,000 volts as it is for 2000. The only feature which will need considerable attention if single-phase lines are extended widely across open country is lightning protection. This has proved the only hard problem in all transmission work heretofore. In connection with transmission lines, it is easy to provide lightning protection for e. m. fs. not over 11,000 volts. The conditions on trolley lines, however, are somewhat different, inasmuch as distances must frequently be cut down to a minimum, and new problems will have to be solved.

The important point for all interested to observe is that single-phase has, and probably always will have, limitations. Each problem must be viewed from the standpoint of its own local position. It is not too much to say, however, that some general conclusions may eventually have to be reached. In view of the fact that in order to obtain the greatest usefulness from all railroads, it is likely that they will have to be laid out for a uniform system. While a high-voltage single-phase or 1200-volt direct-current overhead, or 650-volt third-rail system, may be distinctly unfavorable for certain cases, one of them will have to be chosen to make for standardization.

CURRENT NEWS AND NOTES.

GOVERNMENT COAL SPECIFICATIONS.—The U. S. Geological Survey has issued a bulletin (No. 339) with Mr. J. T. Randall as author relating to the purchase of coal under government and commercial specifications on the basis of its heating value. Methods of sampling and testing are given, together with tables of analyses of coal delivered to the government.

SOUTHERN APPALACHIAN WATER POWERS.—The U. S. Department of Agriculture has issued, in accordance with an act of Congress, a report on the watersheds of the Southern Appalachian Mountains, which includes a section on the water powers of the regions considered. The minimum horse-power is reported at 2,740,700, and the maximum for six months of the year at 4,929,573.

WESTINGHOUSE FOREMEN'S BANQUET OFF.—The Foremen's Association of the Westinghouse Electric & Manufacturing Company, at Pittsburg, will not hold its usual annual banquet on Feb. 27. All arragements had been made, but because of the many men out of work the foremen decided to declare the banquet off and to devote to charity the thousand dollars to have been spent on the dinner.

HIGH-EFFICIENCY LAMPS IN BERLIN.—According to a recent visitor to Berlin, Germany, only flaming arc and high-efficiency incandescent lamps can be there seen in the business portions of the city, and that 90 per cent of the outdoor lighting is now done with flaming-arc lamps. Both tantalum and tungsten lamps are used, but the former are seen usually in old fixtures where the lamp cannot be placed vertically.

TWENTY-FIVE THOUSAND ELECTRIC IRONS FOR CHICAGO.—The *Chicago Examiner*, a paper owned by W. R. Hearst, has made a contract for 25,000 six-lb. General Electric flatirons to be used as premiums with subscriptions to that paper. The contract provides for the immediate delivery of 5000 irons. If these irons are all disposed of among central-station customers in Chicago, they ought to make quite an addition to residence revenue.

N. E. L. A. CONVENTION DISCUSSIONS.—President Dudley Farrand, in the current issue of the *N. E. L. A. Bulletin*, states that numerous requests have been received to hold at conventions simultaneous meetings for the consideration of widely different subjects, and at the coming Chicago convention the experiment will be tried, a second meeting room having been provided. This arrangement will permit of specializing by committees to any degree desired, thus obviating separate organizations in the association, to which principle the present administration is opposed.

SCHENECTADY A. I. E. E. SECTION.—At a meeting of the Schenectady Section of the A. I. E. E., held on Feb. 13, with Mr. S. T. Dodd in the chair, Mr. C. J. Mellin, consulting engineer of the American Locomotive Company, gave a talk on the "Design of Steam Locomotives." There were about 300 present, Mr. S. T. Dodd, acting chairman, opening the meeting with a few general remarks on the subject. Diagrams of construction, curves and photographs of locomotives were shown by means of lantern slides. Mr. Mellin also gave a detailed description of the Walschert valve, illustrated by diagrams. On Feb. 20, Mr. E. J. Berg, of the General Electric Company, will deliver a lecture before the Schenectady Section on "Rotary Converters."

NEW YORK "HOME" SHOW.—The "Home Show" will open at the Grand Central Palace on May 2 and run for a week. As the name indicates, the show will be devoted to the home, and to all things in the constructive, decorative and furnishing lines that pertain to the home. A special effort is being made to obtain the best and latest electrical devices and convenience for exhibition, and the application of electricity as used in a hundred ways in the up-to-date house will be fully demonstrated. An invitation to architects, builders and contractors to attend the show as guests of the management will be extended and special efforts will be made to obtain their cooperation. William Horwood is president of the Home Exhibits Company, which has the exhibition in charge; I. L. Wilfong is vice-president; and G. C. Horwood, secretary.

EFFECT OF FREQUENCY ON FLICKER.—Bulletin 157 of the University of Wisconsin has for its subject a comparison of the effects of frequency on the light of incandescent and of Nernst lamps. The author is Mr. Frederick W. Huels and the paper is preceded with an introduction by Mr. Marshall W. Hanks. The experiments were made with frequencies from 6 to 20 cycles per second, and showed that the incandescent lamp is not suitable for use at such low frequencies. The Nernst lamp, however, was found to be "quite satisfactory at frequencies as low as 15 and 17½, for outdoor illumination at least." Mr. Hanks refers to a previous investigation by Mr. H. Seaman from which it was found that apparent fluttering to the eye of light from the incandescent lamps starts at about 28 cycles, and at 25 cycles is quite apparent. He ascribed the greater steadiness of the light from the Nernst lamp to three causes, namely, the comparatively thick filament; the sensitive balance resistance, and the fact that the greater part of the current flows through the hot center of the glower owing to the negative temperature coefficient of the latter.

RAILWAY ELECTRIFICATION.—In a paper read Feb. 6 before the Royal Automobile Club of England, Mr. Philip Dawson presented the following conclusions to a discussion of the subject of railway electrification: (1) Electrification of the suburban portions of railways dealing with heavy local traffic appears to be essential, both in order to meet the very serious tramway competition, as well as in order to better utilize existing track and terminal facilities, and in order to save the enormous capital expenditure which an enlargement of the number of tracks and terminal facilities (even if, and when possible), would involve. (2) As regards the system to be adopted, it should be such as to easily lend itself to extensions, even to considerable distances, and so as to interfere as little as possible with existing structures and permanent way, and to cause no fresh source of danger and annoyance to railway employees. (3) It is useless to expect satisfactory financial results except when electrification is adopted on such a scale as to make it possible to fully reap its benefits and unless it is so installed and operated as not to be constantly interfered with by existing local steam trains sandwiched in between the electrical ones. (4) It is no use adopting electric traction if rolling stock of such a nature and design is adopted as will neutralize the benefits resulting from electric traction at termini. (5) Economies in working may, and will, no doubt, result if and when the system has been sufficiently developed, but if electrification is only resorted to in order to decrease working expenses, and not in order to increase the earning capacity, then nothing but disappointment must be expected. (6) It is no use electrifying unless frequent as well as rapid service is given.

TELEGRAPH REGULATION.—A bill has been introduced in the New York Legislature compelling telegraph companies to stamp conspicuously on every telegram the hour of filing, as well as the time received.

INTERNATIONAL GAS-POWER REVIEW.—The first number of a monthly journal of this title bears the date of January, the publication office being at Watertown, N. Y. The plan of the publication is that of a monthly index of literature relating to gas power. The United States patents granted monthly in this branch of invention are also recorded.

NEW YORK FIRE ALARM SYSTEM.—The New York Board of Fire Underwriters have begun an investigation of the New York City fire alarm system. About two years ago Mr. Kempster P. Miller conducted an investigation of the system for the Fire Underwriters, the result of which were recommendations that the present system be replaced by a new and more modern one.

SCHENECTADY A. I. E. E. SECTION.—A lecture on the subject of "Gas Power" was delivered before the Schenectady Section of the A. I. E. E. on Feb. 6 by Mr. H. H. Supplee. Mr. J. M. Knox, of the General Electric Company, and recording secretary of the local section, acted as presiding chairman. The lecture was illustrated by an interesting series of lantern slides showing gas-engine installations, both in America and abroad.

MUSICAL COOKERY.—A correspondent of the Chicago *Daily News* who had his interest in electric cooking excited by the exhibit of apparatus at the recent Electrical Show, suggests that an electric piano be attached to the electric stove in order that when certain dishes are in preparation the piano will cheer the cook by playing an appropriate tune. A long list of tunes is given; to accompany the cooking of potatoes, "Melodies of Ireland" is suggested, and for frying sausages, "Broken Links" is offered as appropriate.

CHICAGO ELECTRIC SHOW.—In the notice in our issue of Jan. 25 of the Chicago Electrical Show, it was stated that the attendance was somewhat less than in previous years. We are informed by Mr. Homer E. Niecz, manager of the show, that this statement is incorrect, as not only was the attendance greater than at the previous shows, but the interest shown in the exhibits was even greater than previously, indicating that the show had increased in favor with both the trade and the public rather than the reverse.

IOWA WATER POWERS.—State Railroad Commissioner N. S. Ketchum, of Iowa, advocates the organization of a syndicate with large capital to develop the numerous water powers in the State for the generation of electricity for electric light, railway and power purposes. He states that millions of dollars of water power is now annually wasted which through such a syndicate could be utilized. Among towns, he says, that would thus be benefited by the development of water powers are Keokuk, Fort Dodge, Frazier, Des Moines, Peterson, Ackley, Marshalltown, Waterloo, Boone, Eldora, Steamboat Rock, Webster City, Ottumwa, Oskaloosa, Sigourney and Knoxville.

ST. LOUIS ELECTRICAL SHOW.—The Missouri Independent Telephone Association and Missouri Electric Light & Street Railway Association will meet at St. Louis between April 18 and 25, the dates having been fixed to coincide with those of the St. Louis Electrical Show. The novelties of the recent Chicago Show will be on exhibition, and the Union Electric Light & Power Company proposes to make the finest "Home electrical" exhibit yet attempted. At a meeting held last week at Planters' Hotel, all of the electrical interests of St. Louis were represented and pledged their earnest support to the enterprise.

EDISON MOVING-PICTURE LITIGATION.—It is announced that an arrangement has been made with moving picture manufacturing interests and concerns which rent machines whereby all litigation relating to Edison patents will be withdrawn. The arrangement is in the interest of the Edison Moving Picture Company, and it is stated by the president of one of the large companies entering the combination that $1,000,000 would be a conservative estimate of the annual returns to Mr. Edison on the moving-picture patents now that his rights are conceded. We understand that Mr. Edison's personal benefit from the arrangement will approach $150,000 per annum.

WESTERN SOCIETY OF ENGINEERS.—A meeting of the Electrical Section of the Western Society of Engineers was held at Chicago, Feb. 14, at which Mr. James N. Hatch presented a paper on "The Evolution of the Electric Railway," profusely illustrated with lantern slides. The paper was mainly historical. At the close of the paper Mr. D. W. Roper, chairman, called attention to the interesting fact that the output of power houses supplying electric railways of various kinds is about three times that of power houses supplying central station electric light and power. The Commonwealth Edison Company in Chicago has been supplying power to take care of the growth of several of the principal surface and elevated railway lines for several years past. Its output for electric railway purposes is now about one-half of its total output.

ANOTHER MEXICAN HYDRO-ELECTRIC DEVELOPMENT.—The Kansas City, Mexico & Orient Railroad Company will soon commence work on a large hydro-electric plant on El Fuerte River in the state of Sinaloa, Mexico. A survey for the proposed plant is now being made by Mr. A. M. Nelson, the engineer and superintendent of the railroad in Mexico. It is stated that the initial installation will be for 10,000 horsepower, and it is planned to use the electric power for operating the railroad at one or more places in its course through the Sierra Madres. Power also will be used in the construction of tunnels and other difficult work in building the road through that section. There are several large mining camps within convenient distance to the site, and transmission lines will be built to these and power furnished for running mining machinery.

GRAND HAVEN, MICH., MUNICIPAL PLANT.—The *Tribune*, of Grand Haven, Mich., in a recent issue criticises severely the municipal electric lighting plant of that town, which it states has been misconducted, misdirected and "politicked" to death. For the past two years, it says, the street lights have been comparable to "red-hot irons stuck up in the air," and that in some parts of the town matters have come to such a pass that people have gambled on whether or not they would have lights at a certain hour on a certain night. "At the plant things have been going to smash right along. First one machine would burn out or be wrecked, then another. The tax-paying public has been contributing regularly to repairs and rebills, and it has been like dumping refuse into a quicksand pit."

CENTRAL STATION AGREEMENT WITH WORKMEN.—The Scranton Electric Company has entered into an agreement with its firemen and engineers covering a period of 10 years in the case of firemen and three years in the case of engineers; the agreement with the firemen, however, provides that every three years there may be a discussion looking to an adjustment of the wage scale. The agreement includes a stipulation that there shall be no discrimination between union and non-union men. Bonuses for increased efficiency will be paid on a basis that has been mutually agreed upon. It is also provided that firemen who have been in the employ of the company for a year, and who pass an examination equivalent to that of the Scranton Correspondence Schools, will receive an increase of $5 per month.

TOULOUSE INTERNATIONAL EXPOSITION.—The city of Toulouse, France, has organized an International Industrial Exposition, to open in May of the present year and extend to September. It will then be in direct competition with the International Exposition to be held at Marseilles during the present year.

TOLEDO A. I. E. E. SECTION.—At the February monthly meeting of the Toledo section of the American Institute of Electrical Engineers, Mr. H. W. Fisher, chief engineer of the Standard Underground Cable Company, of Pittsburg, spoke on "Electrical Cables." Mr. C. R. McKay, chairman of the Toledo section, opened an interesting discussion that followed the reading of the paper.

INDUSTRIAL EDUCATION.—The Winona Technical Institute, of Indianapolis, Ind., has strengthened its course for electricians, which has become very popular. The enrollment of the institute has increased rapidly, and numerous gifts in the way of equipment have been made to its several departments. Instruction is now given for electricians, carpenters, painters and house decorators.

MEETINGS OF THE I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society, held on Feb. 13, the secretary announced that at the forthcoming March meeting of the section a paper will be presented by Mr. E. L. Elliott dealing with architectural principles and illuminating practice from the viewpoint of the illuminating engineer. At the April meeting Dr. E. L. Nichols, of Cornell University, will deliver a lecture on daylight and artificial illumination.

MUNICIPAL LIGHTING IN LAFAYETTE, IND.—Mayor Dugan, of Lafayette, Ind., is urging the municipal Council to adopt an ordinance providing for the submission of the question of construction of a municipal lighting plant to a vote of the people. He states that the cost of lighting under present conditions for the next 10 years would amount to $172,950, whereas Prof. Esterline has reported that the cost of erecting a city plant complete would be $49,185, and the cost of operation complete would be $8,507 per year. Figuring upon this report, the Mayor estimates that, including interest, the total cost of the plant and operation for 10 years would be $141,764.

WHO IS THE PROFESSOR?—We clip the following from the New York *Sun:* "'Have you noticed,' asked the professor, 'how often you get a slight shock these days whenever you touch the radiator or the gas jet, or any other body of metal? It was not so when we were young. Thirty years ago such shocks required long and industrious tramping up and down the carpet, and could be produced only by certain people. Now they are almost universal after the slightest movement and are felt by every one. The reason is that we use such enormous quantities of electrical force, all of which is dissipated into our surroundings, that everything in a large city gradually becomes charged with electricity. It is not so in the country. If anyone could devise a means of collecting this wandering electrical energy it would be very valuable.'"

PENNSYLVANIA STATE COLLEGE.—Dean J. P. Jackson, of the School of Engineering, of the State College of Pennsylvania, in conjunction with a number of committees, is considering the question of improvements in the present courses of engineering. Among these is the introduction of more work bearing upon the business principles which enter into the transportation and manufacturing problems of the country, and means for encouraging a greater spirit of original independent investigation and research among the students. Efforts are being made to have leaders in Pennsylvania industries visit the college for the double purpose of securing their suggestions as to improvement of its work, and enlisting their interest in the future graduates.

WIRELESS REGULATION.—President Roosevelt in a message to Congress has urged early legislation for the protection of government messages transmitted by wireless telegraphy. The restrictions suggested for enactment into law are intended to apply in times of peace, as during times of war more radical regulations can be put into effect without legislation by means of executive proclamation as a belligerent right of the President. In a letter from the Secretary of the Navy accompanying the message, it is stated that on frequent occasions important messages from war vessels were interfered with and held up for a considerable time by the working of commercial wireless stations. The department asks that it be made a punishable offense to originate or transmit a false message purporting to be official; to break in and interfere with any wireless station while it is transmitting an official message; to refuse to cease or to fail to cease sending a private wireless message when called upon to do so by an operator having an official message to be sent.

LEAD-COVERED CABLES IN DEEP MINES.—A number of years ago F. N. Bosson, electrical engineer of the Calumet & Hecla Mining Company, at Calumet, Mich., attempted to use lead-covered cables in that mine where, on account of the depth of the working, there are some remarkably long runs. For example, in some places the cable would extend a mile or more down a shaft. It was found that the insulation of this cable always broke down and that the break-down invariably occurred at the lower end. The matter was not thoroughly investigated from a purely scientific standpoint at the time, but different construction was adopted to get rid of the difficulty immediately without delay. The usual construction now is to run conductors in extra heavy iron-pipe conduit. Various theories have been advanced to account for this break-down of insulation, the most feasible being that it is due largely to mechanical causes and that there is a creeping of the copper conductor in the insulation when a conductor is hung at an angle of 39 degrees, as in the Calumet & Hecla mine. On long runs of cable this causes a buckling of the copper conductor at the bottom which in some cases has proved enough to break through the insulation.

PITTSFIELD A. I. E. E. SECTION.—The Pittsfield Section of the American Institute of Electrical Engineers has held seven meetings so far this season. The opening meeting was held on Nov. 2, 1907, at which Mr. D. B. Rushmore gave an interesting address on "Institute Work and Policy." At the second meeting, held on Nov. 14, 1907, Mr. H. H. Barnes, Jr., consulting engineer of the New York office of the General Electric Company, delivered an address on "The Practical Side of the Curtis Steam Turbine." The lecture was illustrated with a number of interesting lantern slides. Mr. E. B. Merriam, of the General Electric Company, Schenectady, N. Y., addressed the third meeting on Dec. 6, 1907. His subject was "Some Notes on High-Power Tests." Mr. C. E. Eveleth, of the General Electric Company, Schenectady, on Dec. 20, gave the fourth lecture, his subject being "The Electrical Equipment of the West Jersey & Sea Shore Railway." The fifth meeting, held Jan. 10, 1908, was addressed by Mr. E. E. F. Creighton, of Schenectady, on "Lightning Phenomena and Protective Devices." The section held its sixth meeting on Jan. 24, 1908. This meeting was a departure from the others, in so far as there was no lecture given, it being an informal smoker, at which answers were given to a number of questions which had been handed in previous to the meeting. The chairman called on various members present to reply to the questions, which covered a wide range of subjects. As an experiment the results were satisfactory, and it is probable that similar meetings will be held in the future. The seventh meeting of the season was held on Feb. 6, 1908. Ninety members were present and listened to a very interesting talk by Mr. E. J. Berg upon the "Phenomena Occurring on High-Voltage Power Transmission Lines." Mr. Berg accompanied his remarks with a number of diagrams and gave actual figures obtained by tests made under operating conditions

Generating Station, Garage and Equipment of the Auto Transit Company of Philadelphia, Pa.

The Auto Transit Company of Philadelphia began operating a line of electric omnibuses over a six-mile route on Broad and Diamond Streets on July 16, 1907. The route on Broad Street extends two miles either side of City Hall, while that on Diamond Street extends two miles west of Broad Street to the entrance of Fairmount Park. The omnibuses thus pass the Pennsylvania Railroad station, the City Hall and the principal theaters, hotels and public buildings. With the exception of the pavement about City Hall Square, asphalt pavement obtains throughout the route. The electric omnibuses serve a densely populated section of the city and provide a direct and necessary means of transportation between sections more easily reached by this means than by trolley cars.

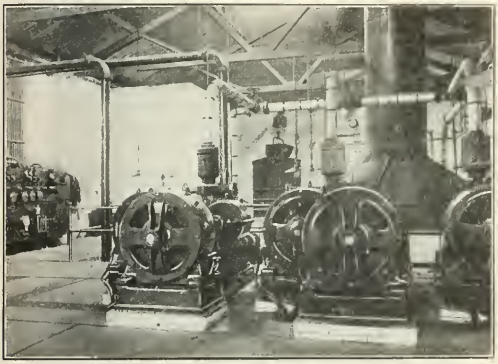


FIG. 1.—GENERATORS AND SWITCHBOARD IN AUTO TRANSIT COMPANY'S CHARGING PLANT.

GENERATING STATION.

The charging station, power plant and offices of the company are located on Thirty-first, Fletcher and Dauphin Streets. The two buildings are divided into a power station, battery department, garage and repair shop. Store rooms and offices are located on the floor above the repair shop at the corner of Dauphin and Thirty-first Streets.

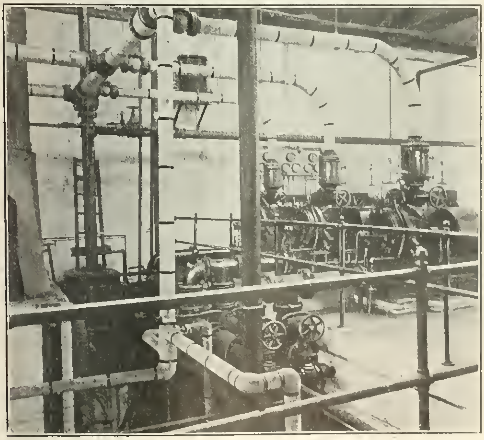


FIG. 2.—VIEW OF POWER PLANT SHOWING COMPACT ARRANGEMENT OF APPARATUS.

The power plant equipment comprises three 150-hp De Laval steam turbines each of which drives a pair of 115-volt, shunt-wound Western Electric generators. The turbines operate condensing on 26-in. vacuum and receive steam from two 175-hp Heine water-tube boilers equipped with grates for burning No. 2 buckwheat coal. Forced draft is supplied by an engine-driven fan. The turbines are guaranteed to show a steam consumption of 30 lbs. per kilowatt-hour output at the switchboard when operating at full load under a steam pressure of 160 lbs. on a 26-in. vacuum. This is a conservative figure, as a test run on 80 per cent load with a vacuum of 25.5 ins., showed a steam consumption a trifle below 28 lbs. The condenser equipment consists of a C. H. Wheeler surface condenser, a "Mullen" patent suction, valveless, vacuum pump, two Wheeler-Pratt cooling towers, one steam turbine-driven circulating pump and one motor-driven circulating pump, the latter being used when one or two engines are running. The feed water for the boilers is passed through a Cochrane feed water heater.

The layout of the power plant is such that the steam connections are made very simple. The boilers are located in a pit 10 ft. below the engine-room floor. The condenser is also installed in this pit and is set at right angles to the turbine beds, making a very short and compact arrangement of condenser piping as well as convenient connections for the feed-water heater. Fuel is stored in bins under the sidewalk and the daily supply of coal is chuted, through a door in the wall, immediately in front of the boilers, where it is convenient for the fireman to handle it. A Sprague, ½-ton, motor-driven hoist, suspended from an I-beam and carrying a ½-yard dumping bucket, is used to lift the ashes to wagons on the street.

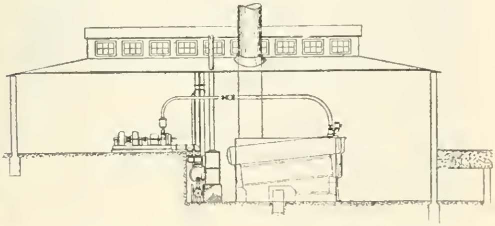


FIG. 3.—SIMPLE ARRANGEMENT OF GENERATING APPARATUS.

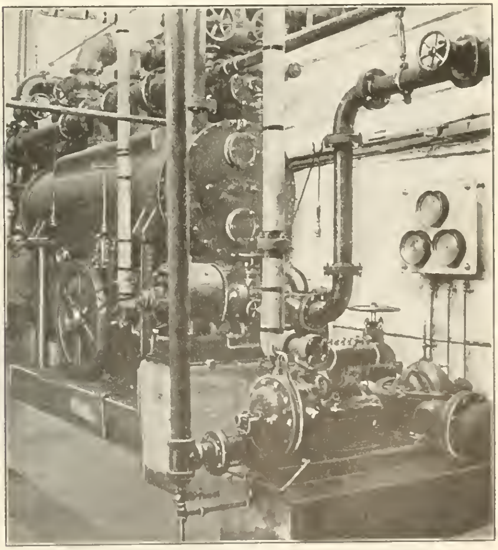


FIG. 4.—CONDENSER EQUIPMENT IN BOILER-ROOM PIT

The switchboard, built by the Walker Electric Company, is arranged for controlling the six generators. Three generator, one feeder and one distributing panel are provided. Three negative busbars connect the negative side of the line with corresponding bars on the distributing board on a gallery in the battery room through 1,000,000 circ. mil cables. A single positive bus leads directly to the terminal lead for each battery.

BATTERY CHARGING ROOM.

The room devoted to charging and repairing batteries is equipped for handling 80 batteries and space is provided for 40 additional batteries. These are placed on timber stands and lead-covered cables are run to each stand. The negative leads are brought from the charging board located on the gallery at one end of the room; while the positive leads are all connected to a common busbar built up of copper strips and mounted on porcelain blocks, the whole being encased in wood boxing. The cables are carried along the floor under the battery stands and are thus out of the way when the batteries are being shifted.

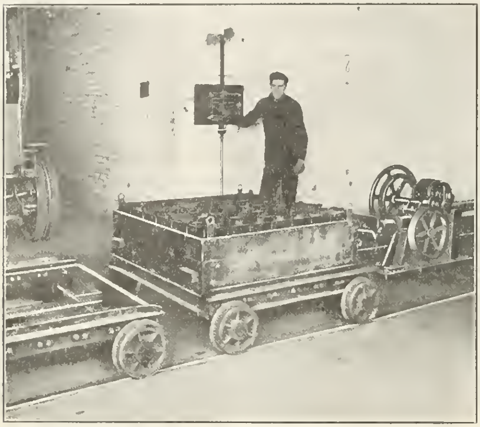


FIG. 5.—METHOD OF INSTALLING FRESH BATTERY IN OMNIBUS.

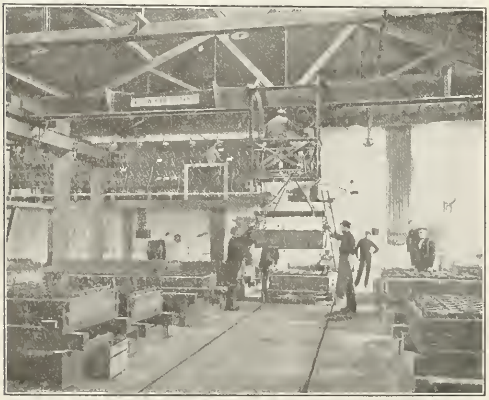


FIG. 6.—BATTERY CHARGING ROOM.

The charging board is made up of 10 slate panels. On each panel is an ammeter and 12 three-point switches, each of which connects with a battery stand on the floor below. The operator is thus enabled to connect the battery to any desired busbar. The ammeter is arranged with a portable shunt which can be inserted in the clips of the switches in place of the switch blades used for closing the circuit so that the charging current of the battery may be observed, after which the shunt is removed and the switch closed, thus permitting one ammeter to serve the 12 switches and reducing the wiring on the board to the limit of simplicity. Three voltmeters are mounted on one end of the switchboard.

Two methods of charging are in use. In the three-voltage scheme the potential on the three busbars is 90 volts, 100 volts and 110 volts respectively. The battery is connected first to the 90-volt bus until the current decreases to a specified value, when the battery is switched on the 100-volt bus. The battery is finally connected to the 110-volt bus, where it remains until it is fully charged. In the second scheme, sufficient batteries are connected to one bus and one turbine is run under that load until the batteries are fully charged. Once started, little attention is necessary and this is the quickest possible way of charging the batteries. In addition the plan has the advantage of keeping the generators fully loaded and is conducive to high efficiency.

FIG. 7.—BATTERY REPAIRING ROOM.

The battery room is well ventilated and has practically no exposed iron work. The battery-room floor is of asphalt. The battery trays are handled by a two-ton electric crane. The charged batteries are placed on trucks or cars which are pushed by hand in front of the battery ram. The latter is operated by a ¼-hp series-wound motor. The field coils of the motor are connected in parallel so as to give the motor sufficient torque. A friction nut is placed in the ram gearing to limit the thrust of the ram and prevent injury to either the ram or the battery. The equipment is capable of handling a battery every two minutes, and cranes, trucks and rams are provided in duplicate to guard against delay in case of breakdown.

FIG. 8.—WASHING AND REASSEMBLING BATTERY.

Distilled water is supplied from the condenser to a cedar tank located over the battery ram and the water is piped to convenient points in the battery room for use in the batteries. The provisions made for washing and repairing the batteries are clearly shown in the engravings. The storage batteries used are manufactured by The Electric Storage Battery Company, of Philadelphia. Each tray contains 42 cells of type 21 MV, connected permanently in series. The rated discharge of the battery is 70 amperes for four hours. The method of handling the omnibuses as they come in is as follows:

The omnibus is run into a driveway until opposite the ram. In front of the ram is a battery truck or car with a fully charged battery. On the other side of the omnibus and directly opposite the ram an empty car is pushed. The battery in the omnibus is disconnected from circuit and an operator closes the switch which sets the ram in operation. In one operation the fully charged battery is pushed into the omnibus and the latter battery in turn pushes the exhausted battery out of the other side of the vehicle onto the car placed there to receive it. The connections to the new battery are quickly made and in less time than it takes to relate it the omnibus continues on another trip. The method of handling the batteries is well shown in Fig. 6. Beyond the door may be seen the battery ram and the distilled-water tank overhead. The car in the foreground contains the tray with the exhausted battery from an omnibus Immediately back of it is an empty car and the crane is shown in the act of lifting a fresh battery to be placed on the empty car and pushed in front of the ram. Other batteries are shown on charge. The engraving shows the charging switchboard with cards in place on switches controlling the circuits of batteries on charge. The switchboard attendant is shown using the ammeter jack.

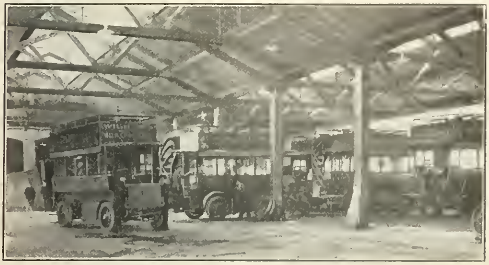


FIG. 9.—CORNER OF GARAGE.

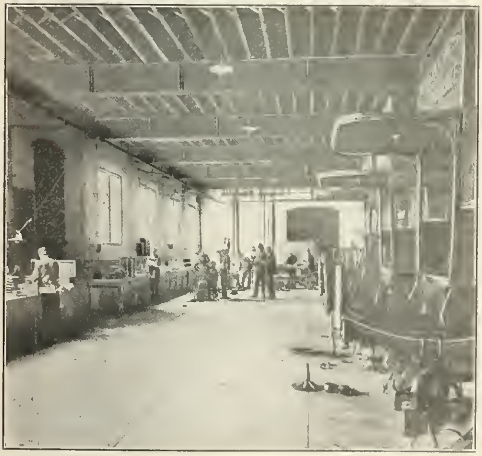


FIG. 10.—VIEW OF AUTOMOBILE REPAIR SHOP.

Fig. 7 gives a view of the battery department and illustrates the method of assembling the batteries and "burning" the lead connections. In the background is shown a motor-driven air compressor used for supplying air for the hydrogen flame used in "burning" the lead. Fig. 8 shows the batteries being washed and reassembled.

OMNIBUS EQUIPMENT

The omnibuses, of which there are 25 in use, are of the double deck, London type, seating 34 passengers—18 on cross seats on top and 16 on side seats inside. The vehicles were built by the Commercial Truck Company of America, a Philadelphia concern, and each wheel is equipped with a series motor of special design rated at 22 amperes, 90 volts and 1600 r. p. m. The motor is connected through a 14 to 1 double reduction gear to an internal gear attached to the hub casting of the wheel. The normal speed of the vehicle, fully loaded, is 12 miles an hour on a level street.

The four motors are controlled by a revolving-cylinder controller having street-railway type of fingers. The combinations made are as follows: First notch, four motors in series without resistance; second notch, two front motors in series and in series with two rear motors in parallel with no resistance; third notch, motors in series parallel; fourth notch, motors in parallel with resistance; fifth notch, motors in parallel with no resistance. A bus under ordinary conditions and when fully loaded can travel 30 to 33 miles on a charge; but the trips are arranged so as to leave a safe margin to guard against the batteries running down while the bus is in regular service. Under the present arrangement the vehicles make two trips on one charge of battery, traveling a distance of 25 miles.

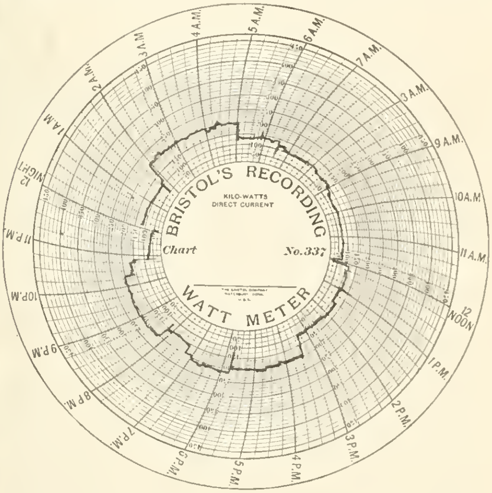


FIG. 11.—WATTMETER CHART SHOWING UNIFORMITY OF LOAD

The vehicles are lighted by four 8-cp lamps and two head and one tail lights of 4 candle-power are used to comply with the requirements of the automobile law. The brakes, which are operated by the foot, consist of hard-wood shoes pressing against a cast-steel surface on the hubs of the rear wheels In addition, the controllers are designed to permit the motors to act as emergency brakes on the first notch with reversed connections in the event of the failure of the foot-brake No circuit-breaker is used in the motor connections, but a cartridge fuse is inserted in each motor circuit. This fuse is large enough to permit sufficient current to pass for ordinary service and yet protect the motor.

The garage is designed to accommodate 50 vehicles The omnibuses, when coming in for battery renewals, pass through the garage and give the attendants an opportunity for making close inspections and quick repairs. After the last trip a fresh battery is installed in the battery compartment under the body of the car, after which the vehicle is returned to the garage where it is washed, inspected and put in first class order before being sent out the next morning. The repair shop is located in the same building with the garage, a room 40 ft. by 128 ft. being provided for that purpose.

The omnibuses operate very closely along street railway lines, the system of accounting being modified somewhat to meet the changed conditions, due to tires, batteries, etc. The vehicles run on a schedule which requires an average speed of eight miles an hour, and cover about 130 miles a day. Three batteries are allotted to each bus, two being on charge to each battery in service. The vehicles weigh 11,400 lb. and the weight of 'bus per passenger is 335 lb. The percentage of live load to weight of 'bus is 47.5. Compared to a Brill semi convertible car, seating 40 passengers, the latter weighs 32,000 lb.; has a weight of car per seated passenger of 800 lb., and the percentage of live load to weight of car is 19.7. The accompanying wattmeter chart shows the fairly uniform load and low peak on the station equipment supplying the energy for charging the batteries. Complete records are kept of the wheels and tires, armatures, batteries, etc., in addition to the engine-room log and daily station report.

The station was designed by the staff of the Commercial Truck Company, the builder of the omnibuses. The officers of the company are Mr. H. S. Kerbaugh, president; Mr. J. M. Hill, vice-president and general manager; Mr. S. H. Carpenter, secretary and treasurer; Mr. F. E. Whitney, assistant general manager.

Alternating-Current Generators and Converters.

At the meeting of the American Institute of Electrical Engineers, held on Feb. 14, three papers were presented dealing with central-station and sub-station machinery. A paper by Mr. W. L. Waters discussed the advantageous features of non-synchronous generators. Some developments in synchronous converters were described in a paper by Mr. Charles W. Stone, while a paper by Mr. J. E. Woodbridge outlined certain features of railway converter design and operation.

NON-SYNCHRONOUS GENERATORS.

A non-synchronous generator is in reality an induction motor driven at a speed greater than synchronism. Since the load on an induction motor depends upon its slip, it reverses its sign and increases in the negative direction when the speed is increased beyond synchronism. The machine is not inherently self-exciting, but must be supplied with lagging wattless magnetizing current from a synchronous generator, synchronous motor, or condensers. When a non-synchronous generator is used with a synchronous motor or converter, the voltage of the circuit is determined by the excitation of the synchronous machine. When the load increases, the additional load comes first on the synchronous machine, energy being supplied from the momentum of its rotating part, and then as the machine decreases its speed somewhat, and thereby decreases the circuit frequency, the load is transferred to the non-synchronous generator, the synchronous machine supplying merely the additional lagging current required when carrying the additional load.

Since a short-circuit on a system supplied with energy from non-synchronous generators causes the voltage to drop to zero, there is no tendency to deliver energy to the short-circuit. Moreover, during normal operation a non-synchronous generator acts as a strong damper to remove all harmonics in the e. m. f. wave-form of the system, so that a non-synchronous generator takes no part in the sudden surge of electricity which occurs during a short-circuit.

An equipment consisting of 1200-kw, six-phase, 140-volt, 30-cycle non-synchronous generator transmitting energy to a 1200-kw synchronous converter has been used successfully during the past three years by a copper smelting and rolling company for obtaining 6000 amperes direct current at an e. m. f. of from 100 to 230 volts. This equipment combines the flexibility of the standard direct-current or alternating-current generator with the overload range of the synchronous converter, and the reliability and robustness of construction of the induction motor.

SYNCHRONOUS CONVERTER DEVELOPMENTS.

In the paper by Mr. Stone it was stated that, although most of the larger systems using synchronous converters operate at 25 cycles, 60 cycle converters, even when used for 600-volt railway work, can be considered thoroughly reliable, machines rated as high as 1500 kilowatts being in successful operation.

A recent improvement in the design of synchronous converters has been in the use of the vertical in place of the horizontal shaft.

The vertical shaft converter occupies less floor space than a horizontal-shaft machine. Moreover, it is possible to walk around the machine and examine and adjust all of the brushes on both the commutator and the collector rings without climbing over a bearing-pedestal or descending into a pit. The shaft, unlike that of the horizontal-machine, is stationary; in fact, it is merely a pedestal supported on and fastened solidly to the foundations.

Among the devices for regulating the e. m. f. delivered by a synchronous converter may be mentioned variable-rated transformers, series inductive reactance, induction regulator in the supply leads, and direct-connected alternating-current booster. The most recent development, which is unlike any other scheme, was first proposed by Mr. J. L. Woodbridge, and improvements have been introduced by Mr. J. L. Burnham. In this method advantage is taken of the fact that the ratio of conversion between the alternating and direct e. m. fs. can be changed by varying the distribution of the magnetism over the field poles. Each pole is divided into two sections, each containing its own winding. The winding on the larger section corresponds to the main shunt winding on an ordinary synchronous converter, while the regulation is obtained by changing the excitation of the smaller, the m. m. f. being in one direction to raise the e. m. f. and in the other to lower it.

DESIGN AND OPERATION OF RAILWAY CONVERTERS.

Mr. Woodbridge stated that there are now in service in this country synchronous converters having an aggregate rating of nearly 1,000,000 kilowatts, about one-third of which is in six phase machines. The advantage of the six-phase over the three phase converter resides in the greater output from the same winding, and a more even distribution of the losses in the coils. A three-phase machine may safely be increased in rating by from 40 to 50 per cent with no increased losses, and with a correspondingly higher efficiency by the addition of three or more collector rings.

The relative disadvantage of the higher number of phases are the increased number of parts of the machine and possibly some little additional complication of the transformer circuits. If the reactive coils or other devices are serially connected in the six-phase circuits, these need be, and commonly are, only three-phase.

About 50 per cent of the railway converters in use in this country are started from rest by the direct application of alternating e. m. f. at reduced value to the collector rings. With an e. m. f. 25 per cent of normal value, the machine at rest will take about twice full-load current; that is, 50 per cent of full-load volt amperes. The machine accelerates to synchronism as an induction motor. In actual service 25-cycle converters rated at less than 500 kilowatts are usually started from mid-taps in the transformer windings and reactances, which consume 15 per cent of the normal voltage when carrying full-load current, are connected in series in the collector-ring circuits. The starting voltage for 25-cycle converters rated at more than 500 kilowatts is usually one-third of normal.

Converter equipments are commonly designed for delivering a constant direct e. m. f. when the resistance loss in the line is 10 per cent. The author stated that in general for such service the total reactance in circuit should be such as to give a 25 per cent inductive voltage at full-load, and the series turns on the field coils should be such that the m. m. f. balances about one-half full-load armature ampere-turns, with the transformer ratios such as to give normal direct e. m. f. with about one-quarter full-load current (lagging) at no-load; the converter field rheostats should be set for normal direct e. m. f. regardless of the power-factor, and the main station e. m. f. should be kept constant at such a value as will give unity power-factor at about one-half load on the converter.

Methods of Testing Igniting Apparatus.--II.

By F. W. Springer.

In a previous article the measurements of resistance and magnetic flux were described in detail, together with the measurement and calculation of the self-induction of coils and armatures. In what follows the various other measurements necessary to the proper testing of ignition apparatus are taken up and the subject concluded.

CAPACITY OF CONDENSERS.

The capacity can be calculated from the dimensions. Thus,

$$C = \frac{KAN}{4\pi d\ 900{,}000} \text{ micro-farads,}$$

in which C is the capacity in micro-farads. K is the dielectric constant (varying from 2 to 2.3 for paraffined paper, about 6 for common window glass, and 6.6 for mica) : A is the area of one side of one sheet of the dielectric which is covered by one side of one condenser plate or sheet of tinfoil; N the number of active sheets of dielectric, and d the thickness of the dielectric, all values being expressed in the c. g. s. system. (In Fig. 1 the condenser has five active sheets of dielectric.)

A condenser consists of 11 sheets of paraffined paper, .0075 cm thick, is covered by tin foil sheets 50 cm long and 7 cm wide. Then,

$$C = \frac{2 \times 7 \times 50 \times 11}{4 \times 3.14 \times .0075 \times 900{,}000} =$$

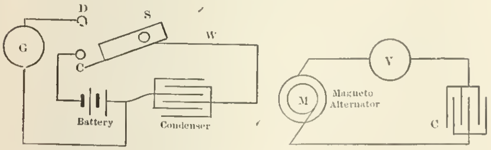
$$C = .09 \text{ micro-farad.}$$

The "free discharge" capacity of a paper condenser will be about 30 per cent less than the above-determined value owing to the dielectric absorption of paper.

Since the "free discharge" capacity of a condenser for an induction coil is its useful working capacity, the wiping contact method should be used in comparing the capacity of a condenser with that of a standard.

The method consists in charging the condenser by making a "wiping" contact with a set of cells and then immediately, by continuing the motion of the switch or key made in charging, discharging the condenser, by a second "wiping" contact, through a ballistic galvanometer. Ordinarily the contact should be made for about .01 second.

The deflection being made while using a standard condenser of known capacity and charged with the same set of cells, the capacities of the two condensers are in the ratio of their respective galvanometer deflections. Referring now to Fig. 1, the switch S or a well-insulated wire, W, is "wiped" not too quickly against the contacts C and D to charge and discharge the condenser, respectively. The discharge, of course, passes through the ballistic galvanometer, G. A standard mica condenser should first be used, then the spark-coil condenser. A 0.1—mf standard condenser gave a deflection of 7.42 cm and a spark-coil condenser 6.35 cm.



FIGS. 1 AND 2.—MEASURING CAPACITY OF CONDENSERS.

The capacity of the latter was,

$$.1 \times \frac{6.35}{7.42} = .086 \text{ micro-farad.}$$

In case a large number of condensers are to be tested for their capacity, as in factory work, the method indicated in Fig. 2 may be used. In Fig. 2 M is a magneto-alternator—such a machine may easily be constructed by putting one slip-ring on a direct-current magneto-generator and grounding the other side of the circuit on the armature shaft. The magneto-alternator should be run at a constant speed. Any source of alternating current, however, such as a lighting circuit, may be used. V is an alternating voltmeter and C is the condenser to be compared. The larger the capacity of C, the greater will be the reading of the voltmeter V. The latter should be calibrated by using at C a standard condenser of adjustable capacity.

NUMBER OF TURNS OF WIRE ON COILS.

The diameter of the wire being measured by means of a micrometer, caliper or wire gage, the resistance being measured, the total length of wire can be found from a copper wire table; knowing the average length of one turn, the number of turns can be calculated.

The flux ϕ and the coefficient of self-induction L being known, the number of turns can be calculated from the equation

$$L = \frac{\phi N}{10^8 I} \text{ in which } L,\ \phi \text{ and } I \text{ are known.}$$

For example, a coil, of which L = .25 henry, had 15,400 lines of force when the current was .8 amp.

$$.25 = \frac{15{,}400\,N}{10^8 \times .8} \quad \text{hence } N = 1300 \text{ turns.}$$

When L_p and N_p of one coil and L_s of the other are known, both coils being on the same core, N_s can be calculated at once.

$$\frac{L_p}{L_s} = \frac{N^2_p}{N^2_s}\ ;\ \frac{.004}{25} = \frac{220^2}{N_s^2} \text{ hence } N_s = 17{,}600 \text{ turns.}$$

If there are two coils, the number of turns of one of which is known, or if it is possible to wind on a temporary coil having a known number of turns, current may be sent through first one coil and then the other, so that the flux is the same in the two cases. The relative number of turns will be inversely proportional to the currents used, thus,

$$\frac{N_1}{N_2} = \frac{I_2}{I_1}, \text{ and } N_2 \text{ may thus be calculated.}$$

BATTERY TEST.

A short-circuit test is the most effective to use to determine the internal resistance and depolarizing qualities of cells. For this purpose one cell, or a number of cells connected in series, should be short-circuited through an ammeter. Thus, if the open circuit e.m.f. of one cell is 1.41 volts, and the short-circuit current 25 amperes, the internal resistance will be $1.41 \div 25 = .056$ ohm.

In case of several cells in series, the short-circuit current will be a little larger than for one cell, owing to the fact that the ammeter resistance will be relatively smaller per cell than with a single cell.

The rate at which the current decreases in value with time is a measure of the depolarizing power of the cells. Moreover, the rate at which the cell voltage returns to its original open-circuit value is a measure of the strength of the depolarizer.

A good method for testing cells is shown in Fig. 3, in which R is any convenient resistor, such as an iron wire, adjusted in resistance to limit the current to a reasonable amount. Suppose, for example, the e. m. f. of five cells on open circuit to be $1.4 \times 5 = 7.0$ volts, and on closing the circuit, $V = 5.5$ volts, when $I = 4.5$ amperes,

$$\text{Then, } R_i = \frac{V_1 - V_2}{I} = \frac{7. - 5.5}{4.5} = .33 \text{ ohm.}$$

$$\frac{.33}{5} = .066 \text{ ohm internal resistance per cell.}$$

The polarization may be measured as above by taking the readings of V_2 and I after a definite time, then calculating the resistance plus the polarization. The difference between this and the true resistance as determined above will be the polarization as expressed in ohms. The polarization may also be expressed in terms of the time taken for the current to fall a certain amount when the cell is discharging at a certain rate. A five ampere discharge rate is approximately correct for comparative polarization tests.

It should be noted, however, that the decrease in current due to polarization is caused first by a counter e. m. f. set up by the products of electrolysis of the discharging current, and also by the reduction of the effective area of the carbon electrode of the cell. The latter is due, in a common dry cell, to the deposit of hydrogen gas which prevents liquid contact with the electrode and thus increases the internal resistance.

Life tests may be conducted by continuously discharging the cell through a resistance and taking readings of the current, and the e. m. f. with closed circuit, and occasionally observing the e. m. f. with open circuit, in order to calculate the internal resistance and to note the polarization, until the cell is exhausted. The average current multiplied by the time of discharge gives the ampere-hour output capacity of the cell. The output capacity will vary greatly with the rate at which the cell is discharged, being larger at the lower discharge rates. The internal resistance and polarization will increase with the time of discharge and the open circuit voltage of the cell will decrease. Sixty ampere-hours is the ordinary output capacity of an ignition battery.

Curves may be plotted with time as the abscissas and e. m. f., current, resistance and polarization, watts, etc., as the ordinates, thus graphically showing the condition of the cell throughout its life.

Service tests of cells are generally made by noting the change in resistance, polarization and e. m. f. of the cells while in actual service. In general, the amount of service of a set of cells can be fairly expressed in terms of the amount of engine fuel consumed.

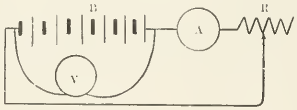


FIG. 3.—BATTERY TEST CONNECTIONS.

GENERATOR TESTS.

The resistance of the armature, brushes and contacts may be measured by the well-known ammeter-voltmeter method.

The commercial efficiency of magneto and other direct-current generators can be most easily determined by the "constant-loss" method as follows:

The resistance of the armature, *Ra*, should be observed at the normal running temperature. The generator should then be run without load at the desired speed and field excitation, the volts and amperes being observed, such e. m. f. being impressed on the armature as will give the desired speed. Suppose the resistance *Ra* to be 2 ohms, the voltage e. m. f. to be 30 volts, speed 2000 r. p. m., and the current 1.2 amperes. Then the efficiency when the current output of the machine as a generator is 3 amperes and the output voltage, *E*, will be,

$$\text{Efficiency} = \frac{E \times 3 - 30 \times 1.2 - 2 \times 3^2}{E \times 3}$$

The output voltage *E* must be measured by trial when the current is 3 amperes, or any other desired value.

A motor to drive the generator can be calibrated by the "constant-loss" method described above.

The speed-voltage characteristic of a generator is determined by measuring the open-circuit voltage of the armature of the machine while running at different speeds. All magneto-generators give an open-circuit voltage which is strictly proportional to the speed.

The current-voltage characteristic may be found by running the armature at the normal, or any desired, speed and measuring simultaneously the voltage and the armature current. An adjustable resistance must be connected in the armature circuit to vary the current. The voltage will usually fall off very rapidly as the armature current is increased, due to the resistance of the armature and to the demagnetizing and distorting action of the armature m. m. f. upon the poles.

The safe current output of the generator may be ascertained by running it at the desired speed, connecting a resistance in the armature circuit so as to limit the current to the desired amount and then noting the rise in the temperature of the machine above that of the surrounding atmosphere. The temperature can be observed by means of an ordinary thermometer laid on the armature poles, etc., and covered with putty. This test will require a run of from two to three hours. The safe current output will decrease greatly with increased speed and field excitation.

COMPARATIVE TESTS OF IGNITION SYSTEMS.

It is very essential in making a comparative test of igniting devices to maintain constant engine conditions. One of the best ways in which to do this is to connect the two sets of coils batteries, etc., to the two ends, respectively, of a double-throw switch, the middle one being connected to the engine. Either igniting set can then be used by quickly throwing the switch, without stopping the engine or changing any of the conditions, and the differences can be noted in the operation of the engine, such as change in speed, power, etc., with different throttle openings, variable back pressure, different amounts and kinds of fuel, different speeds, loads, etc.

Service tests consist in a long time test of an igniter under the varying conditions of service, to determine the reliability, wear, temperature rise, battery demand, etc.

The oscillograph method is excellent for observing the performance of spark coils, etc. In case it is not convenient to make oscillograms while the coils are in service, use may be made of a spark-gap having a greater length than that of the spark plug by an amount depending upon the ratio of the engine compression pressure to the pressure of the atmosphere.

IGNITER LAG, NUMBER OF SPARKS PER SECOND AND SPARK DURATION

The above quantities may be observed by means of the oscillograph or by the falling-plate tuning-fork method. Another method is to lead the spark-current circuit to the rim of a revolving wheel or to the end of a spoke and to note the spacing of the sparks while the wheel is in motion; the duration of the sparks will also be shown by this method. There will, however, be no indication of the igniter lag.

By mounting two spark-gaps upon the same wheel, one a little nearer the axis than the other, a very satisfactory comparison of the sparking characteristics of two coils might be made except in regard to their igniter lags.

The sound of the buzzer may be compared with that of a tuning fork having a known number of vibrations, and the frequency may thus be determined. The frequency will vary between 85 and 250 per second.

THE ENERGY OF THE SPARK.

The spark energy can be roughly determined by inserting paper in the spark-gap and noting the size of the puncture or the readiness with which the paper is inflamed. The most accurate method is one involving the use of the oscillograph for comparing the sparks.

QUANTITY OF ELECTRICITY.

The quantity of electricity per spark can be determined by measuring the average current taken by a jump-spark coil while continually buzzing. This current divided by the number of vibrations per second will give the ampere-seconds, or coulombs used per spark. In the case of a touch-spark coil, or non-vibrating jump-spark coil, the average demand made upon the battery or generator may be measured by an ammeter placed in the battery circuit, and this value divided by the number of sparks per second as determined by the engine speed and number of engine cylinders, will give the coulombs. There is, of course, one spark for every two revolutions in a four-stroke cycle engine.

The quantity of electricity per spark may be determined by measuring the area of an oscillogram of the primary or the secondary current. This is the only method that can be used in case of secondary currents.

ESTIMATION OF CURRENT DEMANDS AT DIFFERENT ENGINE SPEEDS.

If the steady-current demand of a vibrating jump-spark coil and the *arc of contact* in per cent of one engine revolution are known, the average current demand at any speed will be equal to the above per cent multiplied by the steady-demand current. At very high speeds, however, many timers are subjected to a slightly decreasing arc of contact owing to "throwing off" of the contact members of the timer. Moreover, in case the time of contact is so short that the time is equal to that of, for example, 1½ coil vibrations, there will be a decrease in current-demand with increase of engine speed. If the *"duration of the time of contact"* is a constant one at all speeds the average current demand will increase directly as the speed.

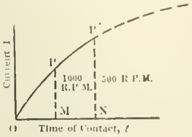


FIG. 4.—CURVE OF CURRENT INCREASE.

With touch-spark coils, the demand will increase as illustrated in Fig. 4, in which it may be supposed that the primary break comes on the straight part, *OP'*, of the current-time curve at all speeds considered, the area *OPM*, divided by the time, being the average current demand at 1000 r. p. m., and *OP'M* at 500.

The area of *OPM* is one-fourth of that of *OP'N*, but there are twice as many sparks at 1000 as at 500 revolutions, hence doubling the speed will decrease the average current demand by one-half when the arc of contact is constant. This also applies to non-vibrating jump-spark coils.

In case the *"duration of the time of contact"* is constant at all speeds the average current demand of vibrating and non-vibrating jump-spark coils and touch-spark coils will increase as the engine speed increases.

MAXIMUM VOLTAGE.

There is only one practical method of measuring the intermittent maximum voltage of a jump-spark coil. (The average value of this voltage as measured by a static voltmeter has little significance.) An adjustable needle-pointed spark-gap should be connected in parallel with the spark-plug gap and the needle-gap should be decreased until the sparks are shunted from the spark plug. The battery circuit should be disconnected during each adjustment. The needle-gap distance corresponds to a definite voltage, as shown in the curve of Fig. 5 For example, .2 in. corresponds to 5000 volts, at atmospheric pressure. The rupturing voltage increases with the atmospheric pressure and with the bluntness of the points.

SPARK PLUGS.

The voltage necessary to break down the insulation of a spark plug may be applied and measured as described above. The spark-plug gap must be lengthened and perhaps insulated with mica in order to conduct the test.

The equivalent jumping voltage of a spark plug may be observed as indicated above.

ENGINE TESTS.

The best way of observing the varying speed of an engine is to drive a direct-current magneto-generator from the engine, and to connect an adjustable voltmeter resistance and voltmeter in series with the magneto. The resistance may be set so that, for example, an indication of 6 or 60 on the voltmeter scale corresponds to a speed of 600 r. p. m. as determined by a speed counter. All other speeds will vary proportionally with the voltmeter readings.

Angular velocity variation will not, as a rule, have any effect upon the ignition. A test for such variation, however, may easily be made by covering the periphery of the flywheel with smoke from a candle and causing a vibrating tuning fork to move across the face of the flywheel so that a wavy line may be traced, by a stylus, in a spiral around the wheel. The tuning fork should be placed in a tangental position to the wheel.

There is no simpler or better method for measuring the steady power output of an engine than that of the common Prony brake. If, however, one is observing slight changes in the operation of the engine in connection with the test of coils, etc., the following is by far the best method. The method consists in belting the engine to a generator of suitable rating, preferably separately excited, and measuring the total armature current, I_a, field exciting current, I_f, speed of the armature, S, and voltage, E, at the brushes of the generator. The latter is preferably measured by placing the voltmeter leads directly upon the commutator opposite the middle points of the brushes.

The horse-power, P, of the engine may be calculated as follows:

$$P = \frac{I_aE + W + I_a^2R_a + \text{belt loss}}{746}$$

in which W is the watts (as measured by an ammeter and a voltmeter) required to run the armature of the dynamo without a belt as a motor at the same speed and with the same field current as when the reading I_a and E in the above equation were taken. W includes all of the constant losses of the dynamo when running either as a generator or as a motor.

$I_a^2R_a$ is the watt loss in the armature, R_a being the resistance of the armature between the voltmeter terminals, measured at the same temperature as that at which the readings for the horse-power were taken. The belt loss is usually very small.

The measurements of the temperature, specific gravity and quantity of the fuel, although simple enough, are quite troublesome. Probably the best way is to observe the temperature by means of an ordinary thermometer inserted in the feeding bottle. The latter consists of a plain glass bottle with straight sides, calibrated in cu. cm. or 1/1000 of pints, out of which the fuel is siphoned to the carburetor. The bottle should be of such a size that a good reading of fuel consumption can be made during a two-minute or a three-minute run.

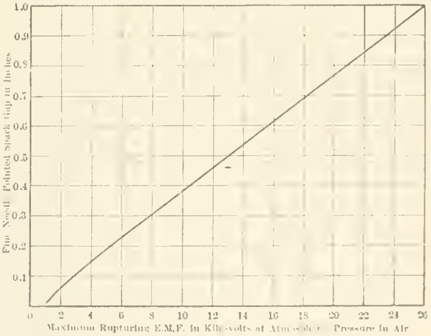


FIG. 5.—SPARK DISTANCES CORRESPONDING TO DIFFERENT VOLTAGES

The specific gravity, the weight and the volume of the fuel can be ascertained at once by weighing a quantity of the fuel in a bottle of known weight, filled to a mark on the neck of the bottle. This result may then be compared with the weight of the bottle filled with water to the same height. A gasoline hydrometer may also be used for determining the specific gravity.

The speed of inflammation of the charge can be measured photographically, or by means of a high-speed pressure indicator, such as the manometer.

The Luminous Properties of Conducting Helium.*

By P. G. Nutting.

A GAS conducting an electric current radiates the energy imparted to it by the current. Neglecting relatively very slight losses, the efficiency of such a gas as a transformer of electrical energy into radiation should approach unity in value. Radiation from a gas should then be expressible in terms of current and other specificable conditions with considerable precision. To express this radiation in terms of light, the spectral distribution of the radiation and the visual sensibility of the observer must be known.

The results here presented relate to the amount of light emitted laterally per unit length by a column of helium gas carrying a known current. The chief object of the investigation was to determine the constancy and reproducibility of such a source of light and the specifications most favorable to constancy and reproducibility.

Conducting helium emits light of a yellowish-white color, which is better for photometric comparisons with a glow lamp than is that from any other of the permanent gases. Next best is perhaps carbon-dioxide. This emits a snow white light, but it decomposes and disappears rapidly even with moderate current densities. Sulphur vapor emits bluish-white light, but its density is difficult to measure and control. Helium has the further great advantage of not disappearing rapidly as other gases do when conducting a heavy current. The life of a tube of helium is at least 50 hours; as compared with half an hour for a similar tube of hydrogen or nitrogen carrying the same current.

Preliminary tests with tubes of various forms led to the adoption of a simple straight form, with disc electrodes. The electrodes are of aluminum 1.5 mm. thick and 25 mm. in diameter, in spherical bulbs 35 mm. in diameter. The bulbs are connected by a straight piece of capillary tubing 50 mm. in length and 2 mm. in internal diameter. Foil 5 mm. wide was wound about each end of the tubing to give the light emitting portion a definite measurable length. Light from the bulbs was screened off from the photometer.

Ordinary methods were used in filling, but extra precautions were taken to free the electrodes from hydrogen. The tubes were cleaned with chromic acid and water, and exhausted with a Geryk oil pump. After from 20 minutes to an hour of steady pumping with heavy current running through the tube, the last trace of hydrogen disappeared. Then helium was admitted, its pressure adjusted to about 5 mm. by means of an oil manometer of special design, and then the tube was sealed off. A mercury pump or McCleod gage cannot be used on account of the contamination of the helium by mercury-vapor.

The tubes were operated at about 5000 volts by alternating current from a transformer, the e. m. f. of which was controlled by using resistance in its primary circuit. The light emitted was compared with that from a calibrated 4-cp incandescent lamp by means of a Lummer-Brodhun photometer of the equality type. The uncertainty in each determination is about 2 per cent, the probable error being less than 1 per cent. In a spectrophotometric comparison, the uncertainty would have been from 10 to 50 per cent on account of the variable width of the lines.

The variation of light with the current in various forms of tube is shown in the accompanying table and curves. The light from the whole capillary tube, when stationary, is given in candles, but the value is uncorrected for mean horizontal equivalent.

The plotted curves indicate the effect of a change in the size of capillary tubing. Tube No. 18, with its small bore, gives a curve much steeper at the start, but early approaching a maximum. Tubes of larger bore give curves of less curvature.

The variation of light with the potential gradient was studied with the purpose of expressing the light emitted in terms of the rate of absorption of energy. Auxiliary potential electrodes of platinum wire were inserted at each end of the capillary portion of the tubes, and potential readings were taken with a multicellular voltmeter. By this means fairly constant potential readings could be obtained. It was found, however, that by playing a flame or blast of cold air upon the capillary tube, a variation of 5 to 10 per cent in the indicated fall of potential could be produced. This variation, however, was not accompanied by a variation in the light emitted, so long as the current was held constant.

TABLE I.—VARIATION OF TOTAL CANDLES WITH CURRENT

Tube No.	Bore mm.	Length mm.	CURRENT IN MILLI-AMPERES							
			10	15	20	25	30	35	40	45
18	1.2	40	0.58	0.94	1.19	1.33	1.39	1.42	..	..
27	1.8	54	0.55	0.86	1.16	1.45	1.71	1.92	2.11	2.30
43	3.12	50	0.29	0.68	0.96	1.23	1.47	1.69	1.89	2.09
39	2.17	49	0.60	0.92	1.23	1.54	1.83	2.06	2.30	2.53

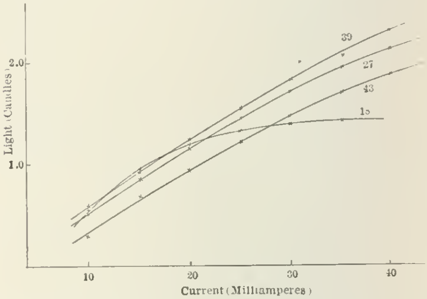


FIG. 1.—VARIATION OF LIGHT WITH CURRENT IN DIFFERENT TUBES.

TABLE II.—VARIATION OF POTENTIAL GRADIENT WITH CURRENT

	Current in Milli-amp.	Light in Candles	Potential Gradient	Watts consumption	Candle per watt	Watts per candle
Tube No. 38 operated at pressure of 4.2mm. of Hg.	10	0.60	274	2.74	0.219	4.57
	15	0.86	256	3.84	0.227	4.40
	20	1.21	245	4.90	0.246	4.07
	25	1.50	237	5.92	0.253	3.96
	30	1.76	233	6.99	0.258	3.88
	35	2.00	231	8.10	0.247	4.05
	40	2.24	230	9.20	0.244	4.11
	45	2.46	229	10.30	0.239	4.19
Tube No. 43 Pressure 5.0mm. of Hg.	10	0.39	233	2.33	0.169	5.92
	15	0.68	211	3.16	0.215	4.65
	20	0.96	198	3.96	0.242	4.14
	25	1.23	190	4.75	0.259	3.88
	30	1.47	185	5.55	0.265	3.78
	35	1.69	180	6.30	0.268	3.74
	40	1.89	176	7.04	0.268	3.74
	45	2.09	173	7.79	0.268	3.74
	50	2.28	170	8.50	0.268	3.74

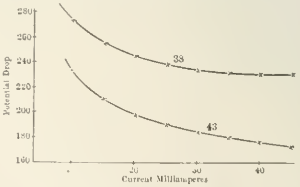


FIG. 2.—VARIATION OF VOLTAGE WITH CURRENT IN DIFFERENT TUBES.

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*Abstract of a paper appearing in the *Bulletin of the Bureau of Standards.*

Some typical results are given in the accompanying tables and curves.

The two curves for fall of potential plotted against current are of the typical form for the anode column of a conducting gas. That for the larger capillary tube is lower and on a larger scale. These curves are of very nearly the same form for all pressures from 2 mm. to 10 mm., but are a few per cent higher, because the higher pressures of the auxiliary electrodes took up the actual potential of the gas. The above data give an indication of the luminous efficiency of such a tube. It passes through a maximum at a current density of about 6 milli-amperes per sq. mm. The low luminous efficiency of helium is due largely to the three infra-red lines at 728, 1117 and 2040 $\mu\mu$, which represents at least 90 per cent of the total radiation without contributing to the light emitted.

The variation of the light emitted with the density of gas was studied by means of tubes of three different diameters filled with helium at pressure ranging from 2 mm. to 10 mm., and carrying currents from 10 to 45 milli-amperes. Gas pressure was measured on a special manometer containing gas-free pump-oil of one-fifteenth the density of mercury. Each tube was first filled with pure gas at the highest pressure, then the pressure was reduced in steps by temporarily connecting with a highly exhausted auxiliary bulb of the proper size.

TABLE III.—VARIATION OF LIGHT WITH GAS PRESSURE AT VARIOUS CURRENTS IN TUBE NO. 38.

Current Milli-amp.	GAS PRESSURE IN mm. OF HG.					
	9.0	7.7	5.8	4.2	2.8	1.9
10	0.38	0.55	0.55	0.55	0.48	0.08
15	0.70	0.87	0.91	0.90	0.83	0.66
20	0.98	1.22	1.24	1.24	1.20	0.91
25	1.25	1.51	1.54	1.54	1.54	1.24
30	1.48	1.79	1.83	1.85	1.86	1.51
35	1.72	1.99	2.10	2.10	2.10	1.71
40	1.96	2.20	2.31	2.35	2.07	...
45	2.11	2.35	2.47	2.56	2.58	....

The complete results with tube No. 38 are reproduced in Fig. 3 with a curve dotted for tube 43 and one for tube 45. The curves for the 2-mm tube are parallel with the pressure axis over a wide range of pressure and current. For the 3-mm tube the curve is higher at lower pressures; for the 1-mm tube it is higher at high pressures.

Both direct and alternating current at high and low frequency and voltages were used with the apparatus unchanged. Direct-current at 1000 volts, obtained from two 500-volt generators in series, could be adjusted at 22.5 milli-amp. and at 23.7 milli-amp. Afterward the more easily adjustable alternating current was brought to these values. (See Table V for results.)

TABLE IV.—VARIATION OF LIGHT WITH GAS PRESSURE AT VARIOUS CURRENTS IN TUBE NO. 43.

Current Milli-amp.	GAS PRESSURE IN mm. OF HG.				
	8.5	6.6	5.0	3.7	2.5
10	0.13	0.26	0.41	0.42	0.33
15	0.34	0.52	0.71	0.74	0.65
20	0.53	0.82	1.01	1.03	0.92
25	0.74	1.09	1.29	1.34	1.20
30	0.92	1.31	1.54	1.58	1.53
35	1.11	1.60	1.77	1.79	...
40	1.31	1.71	1.98	1.99	....
45	1.46	2.01	2.20	2.07	....
50	....	2.12	2.40	2.17	....

The slight differences observed are less than the uncertainty in the light determinations.

The light emitted by a tube varies with its orientation, on account of irregularities in the bore. Heavy walled tubing is worst, deviations of 10 per cent from the mean horizontal being not uncommon. Walls 1 mm thick are sufficiently strong for such tubes, and such thin walled tubes if carefully selected are found to give deviations of only one or two per cent from the mean. Such deviations are of slight consequence when the mean horizontal candle-power is obtained.

The diameter of the bore affects the light emitted per unit length with a given current. Tests indicated that in such a luminous column of gas practically all the radiation comes from within half a millimeter of the surface so that the light emitted varies with the area of the longitudinal section rather than with the volume. The current density varies inversely as the square of the diameter, so that if the light varied directly as the diameter (at constant current density), as above indicated, it should vary approximately inversely as the diameter at constant current. Results are available for four different bores of tubes at 25 milli-amperes of current.

TABLE V.—EFFECT UPON LIGHT EMITTED OF CHANGING THE NATURE OF THE CURRENT.

Nature of Current	LIGHT EMITTED	
	22.5 Milli-amp.	23.7 Milli-amp
Direct, 1000 volts	1.21	1.30
Alt. 60 cycles, 2000 volts	1.22	1.28
Alt. 60 cycles, 5000 volts	1.22	1.29
Alt. 900 cycles, 5000 volts......	1.21	1.29

When properly plotted these four points lie near a smooth curve that is nearly a straight line.

In the light of the above results, the specifications most suitable for constancy and reproducibility in a helium standard of light intensity may be drawn up, namely, a current of 25 milli-amperes, a bore 2 mm. in diameter and a gas pressure of about 5 mm of Hg., which need not be accurately known. Conversely it might be stated that a tube having a capillary of 2-mm bore, filled with pure helium at 5-mm pressure, will emit *N* mean horizontal candles per centimeter of length when carrying a current of 25 milli-amperes. The constant *N* has been shown to be very nearly a linear function of current and bore, and nearly if not quite independent of other small variations. The uncertainty in the value of *N*, aside from the uncertainty in its photometric determination, is very small, probably much less than one per cent in the mean.

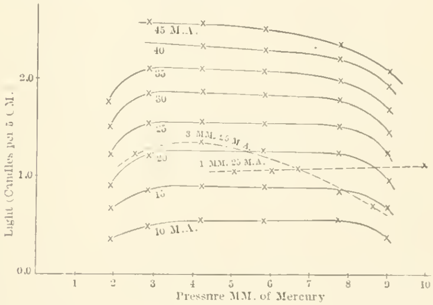


FIG. 3.—VARIATION OF LIGHT WITH GAS PRESSURE AT DIFFERENT CURRENTS.

TABLE VI.—VARIATION OF CANDLE POWER WITH DIAMETER OF BORE.

Diameter of bore, in mm.	1.029	1.949	2.168	3.120
Mean horizontal Cp. per Cm. at 25. Milli-amp...	0.365	0.325	0.311	0.259

To test the reproducibility, a set of six duplicate tubes were made up with a mean internal diameter of 2.168 mm and filled at 5 mm pressure. These gave the following values in mean horizontal candles per cm length at 25 milli-amperes.

The greatest deviation is only about one per cent, the average deviation less than one per cent and the probable error in the mean value less than one-third of one per cent.

The correction for the bore of the tube is 0.009 from the curve of variation of light with bore, so that this set of tubes gives for the value of the constant N, 0.337 candle per centimeter.

Incidentally, many tests for a time effect were made. At the end of a long series of observations with varying current of orientation, tubes would be brought back to the initial current or position and their light values checked with previous ones made half an hour before, and with others made a week or a month previously. In every case values checked up to within the uncertainty of observation. In the few cases where apparent changes were recorded the change was large and due to an obvious change in the tube itself, a crack or the development of hydrogen or a cathode deposit due to excessive current.

TABLE VII.—REPRODUCIBILITY OF HELIUM GAS LAMP AS LIGHT STANDARD.

Tube No.	Candles per cm.	Deviation from mean
37	0.325	−0.003
38	0.329	+0.001
39	0.332	+0.004
40	0.328	+0.000
41	0.326	−0.002
42	0.326	−0.002
	Mean 0.328 ±0.001	0.002 mean deviation

These results are so promising that the helium tube seems to be worthy of consideration as a primary light standard. Its freedom from the troublesome atmospheric corrections to which the Hefner, Carcel and Pentane standards are subject, are very much in its favor. The only quantity to be measured while in operation is the current, and this may easily be determined with the required precision.

The uncertainties in the value of the light constant N are of three classes and these require further investigation before the helium tube may be considered as a competitor of existing standards.

These uncertainties are:

1. Separate determinations by the same observer on the same tube. These are not serious, being of the same order as the uncertainties in ordinary photometric work.

2. Uncertainties due to using different tubes. Reproducibility will require further investigation with tubes made of different kinds of glass and of different diameters. If this uncertainty is no greater than is indicated by the test of the six tubes Nos. 37 to 42 above recorded, it is of little consequence.

3. Uncertainties due to varying the observer on account of color differences. These are perhaps the most serious of all and will require careful investigation by many different observers.

Light and Color in Decoration.

At the meeting of the New York section of the Illuminating Engineering Society, held on Feb. 13, the newly elected chairman, Mr. W. W. Freeman, presiding, Mr. George L. Hunter presented a paper dealing with light and color in decoration, the presentation being accompanied with lantern demonstrations in color. Mr. Hunter stated that he could not understand why so much effort is being exerted to illuminate interiors without wasting light on ceilings, walls or refractors. To illuminate a room is the same thing as to light its walls, ceiling and furniture, and the light thus used is not wasted. It is the reflecting surface or refracting medium that makes the light useful by changing its composition and lessening its intensity. The reflected or refracted light has lost some of its colors, but the colors that remain are those that identify the thing seen and make it visible. Often ignorance of the importance of walls and ceiling in light distribution leads to serious and expensive error. In many of the so-called highly efficient lighting systems the reflectors and refractors of various types have succeeded in taking the light from the ceiling and upper walls that can distribute it effectively, and in concentrating it on the floor where it is objectionable.

A small room of good proportions with light walls and ceiling is beautifully illuminated by two 16-cp lamps suspended from the center of the ceiling about 6.5 ft. from the floor. In large rooms the light of lamps as low as that would strike the eye unpleasantly, especially as their power would of course be greater. Only in rooms with high ceiling where the lamps can be hung high is the use of powerful units permissible. The permissible candle-power of the light source is directly regulated by the height of the ceiling. In a huge auditorium like that of Madison Square Garden, lamps of enormous power can be effectively used. In interiors with low ceiling the units must be kept small.

Another way of preparing light for the eye is to refract it through frosted opal or mosaic glass, or through crystal beads or prisms. This turns the lamp from something to be avoided into something that the eye likes to look at, and at the same time it transforms glare into diffused light. The refractors play the same part as ceiling and walls, and would help to illuminate even a room in black velvet. The use-efficiency of a lamp that distributes light cannot be compared on the basis of photometric tests. The light that counts is the light that is actually employed in the revealing of objects to human vision.

The color of lamp shades and refractors is highly important. Those in golden yellows, ambers and light-browns are safe almost anywhere. In a red room, blue or green shades should never be used, nor red shades in a green room. Rooms finished in dark colors are almost impossible to illuminate brilliantly, and look best when kept comparatively dim. Whether the room be light, or dark, the material of the lamp standards and fixtures should never be dark enough to contrast strongly with the lamps.

The best than can be done in a room with dark walls and ceiling is to use small units generously distributed and enclosed in globes or crystals that are competent to break up the light and distribute it without mural assistance. To direct all the light to the floor—although this does produce high photometric tests in the plane of illumination—is to apply to general illumination principles that are properly applicable to local illumination only. Even in local illumination the light reflected from book or embroidery is much more agreeable if it has been subdued before reaching the object illuminated. The printed page that shines beneath the light reflected down from the white polished surface of a tin desk shade is not lighted efficiently, though invariably lighted too much. A smaller amount of light from an opal globe or frosted bulb is infinitely preferable.

DISCUSSION.

The discussion was opened by Mr. H. F. Huber, who outlined in a convincing manner the difficulty arising from the lack of co-operation between the architect, the decorator and the illuminating engineer, each one attempting to outdo the work of the other and make his own especially conspicuous. Satisfactory results will be obtained only when all persons interested in the illumination work together in harmony to produce the most efficient and pleasing final result, without regard to the credit that each will get for his part in the undertaking.

Dr. H. H. Seabrook discussed the color sensations recorded by the eye and showed why certain combinations are effective and pleasing while others produce the opposite effect. These effects have been investigated mathematically on the wave-frequency basis and some of the most surprising results have thus been thoroughly explained.

Mr. E. Y. Porter stated that the law of inverse squares does not apply the diminution of the sensation of excessive brilliancy as the distance between the eye and the lamp is increased. In fact, throughout a considerable range the eye recognizes the intensity as equally disagreeable independent of the distance.

Dr. Louis Bell said that many of the colors that the eye classifies as pure are in fact made up of several colors, so that the exact effect of illuminating a surface of a certain color with a light of known composition cannot always be predicted. Erratic color combinations are frequently found in decorative materials.

Mr. A. J. Marshall called attention to the present method of transmitting intelligence through printed matter where the words which are to be observed are printed in black (which cannot be seen) on a white background (which alone is visible). He expressed the opinion that except for the seeming novelty of the arrangement better effects upon the eye would be produced by printing the words in white upon a black background.

Conduit Construction.

Mr. Bernard C. Groh, formerly conduit engineer of the American Telephone & Telegraph Company, and now engineer of the American Conduit Company, at Chicago, presented a paper before the Chicago section of the American Institute of Electrical Engineers, Jan. 21, on "Telephone Conduit Construction." In opening he referred to the former opposition of telephone engineers to placing telephone cables underground, which still existed as late as 1895. These objections are of considerable historical interest, as they enable us to form an idea of the great development and change since then when we consider the enormous number of wires in underground telephone cable at present. In a conduit with an interior diameter of 3 or 3¼ ins. a cable containing 300 pairs of No. 19 B. & S. conductors or a cable containing 600 pairs of No. 22 conductors can be placed. One of the larger telephone companies has successfully experimented with a cable containing 900 pairs of No. 25 conductors.

In 1884 the Board of Electrical Control of New York City, realizing the necessity of underground construction to do away with the increasing number of overhead wires, held a conference with the representatives of the principal electrical companies of the country. At this conference over 600 patents and plans relating to the subject of underground electrical construction were examined. Many were discarded, but a number were actually tried. One proposed method experimented with was to surround a collapsible mandrel with concrete, the mandrel being collapsed and withdrawn after the concrete had set, thereby providing a monolithic concrete subway. This method has again been experimented with within the past year by engineers connected with the construction of the tunnels under the North River between New York and New Jersey.

In the tunnels it is very difficult and undesirable to cut out the concrete lining should the conduits upon completion be found imperfect, and extra precautions are taken that the alignment of the concrete conduits shall not be disturbed by the placing of the concrete. In this work a collapsible mandrel 50 ft. long was successfully used. One was placed in each duct before the concreting was begun and then removed to be used over again after the concrete had hardened. One method tried by early experimenters was to place concrete around zinc tubes instead of removable mandrels. This system was unsuccessful on account of the weakness of the zinc tubes, which not only became dented, but corroded and fell in strips into the conduit. A number of other unsuccessful systems were described.

Cement-lined pipe until recently was extensively used for underground work. This consists of a thin sheet-iron tube lined with cement, the tubes being 8 ft. long and the cement lining about ½ in. in thickness. While this type of conduit has been reasonably successful, there is a chemical action between the alkali of the concrete and the lead sheath of the cable which gradually decomposes the lead. The best-known types of conduit extensively used to-day are creosoted wood, single and multiple vitrified clay, fiber and artificial stone. Up to a short time ago creosoted wood duct was made almost exclusively from short leaf yellow and Norway pine. These woods are sufficiently porous to take the oil well. On account of these timbers becoming scarce, experiments have been made with other woods.

Wood duct, after being sawed and bored, is placed in sealed tanks, where the sap and moisture are exhausted. Then a certain amount of dead oil of coal tar is pumped into the tank under pressure. The chief requirements in the dead oil of coal tar are 40 per cent of naphthaline, no acetic acid or acetates and as small a per cent of tar acids as is commercially practicable. The naphthaline is the principal preservative. Acetic acid attacks the lead sheath and in time forms white lead. It is impossible to obtain dead oil of coal tar without some tar acids, but this amount can be as high as 8 per cent without danger to the lead sheath. The usual amount of tar used per cubic foot of timber is 15 lb. on the average, the sap wood taking more and the heart wood less.

Vitrified clay conduit is made of a special kind of clay finely ground and then burned until vitrified. All surfaces are covered with a soft glaze. The most desirable clay for conduit contains alumina, silica, lime and iron. The lime and iron assist in the vitrification. The color of vitrified clay is due to the presence of iron, the red clay showing a higher oxide, and yellow a lower oxide. When both lime and iron are present, the color of the duct is almost black. The conduit, after being formed from the plastic clay, is placed in a drying room for several days until thoroughly seasoned. It is then placed in the kilns and fired. The fires are started gradually and do not reach their maximum heat for about two days. They are kept at this point for approximately two days more, during which time the contents of the kiln are at white heat. Then the heat is reduced and common salt is thrown on the fire, which forms a glaze on the conduit. The kiln is then allowed to cool. In all, the conduit is in the kiln about a week.

Fibre conduit is made up from paper saturated with a preservative compound. There are two types of this conduit on the market. One type is formed directly from paper pulp by special machinery, the pulp being rolled while wet in very thin layers on a mandrel until the desired thickness of wall is obtained. The pipe is then removed from the mandrel and thoroughly dried, after which it is dipped in a compound similar to natural asphalt. After cooling, the ends are provided with the joint desired. In making the other type of fibre conduit, paper is passed through a bath of hot bituminous compound in such a way that it is thoroughly saturated. It is then, while still hot, rolled on mandrels which form it into conduit. When cooled, it is ready for the desired cutting of the joints at the end.

Outside of real estate, a conduit system is conceded to have the longest life of any portion of a telephone plant. In engineering studies, a 50-year life is assumed. It is, therefore, advisable to give much thought to planning the underground portion of the plant. The most economical arrangement of conduit leads will usually be found to be a gridiron with a single base line passing the central office parallel to the longer dimension of the blocks. Irregularities in streets and districts will usually require a departure from the ideal layout. It will usually be found advisable to parallel existing conduit which is too small with one on another street rather than to enlarge the existing run.

Owing to the nature of the work, considerable time is consumed in wheeling and placing the concrete after it has been mixed. Therefore, a cement with a considerable period of time between the mixing of the water and the initial set is desirable. For this reason Portland cement is usually employed in conduit work. In the past it has been the practice to employ a stronger mixture than experience has proven can be justified. It has been found that a mixture of 1—3—6 or 1—4—8 is of sufficient strength for conduit work, and a 1—2—5 is usually recommended for manhole walls and roofs. Sand should be reasonably clean. Few specifications now require "sharp" sand. Gravel is usually treated the same as crushed stone in conduit specifications. It is claimed that gravel concrete will have greater ultimate strength, while crushed stone will show greater strength on short-time tests.

Where considerable digging is anticipated close to a conduit containing important cables, concrete on the sides of the structure is desirable for any conduit except creosoted wood. Fibre and single artificial stone ducts are laid in practically the same encasement of concrete as single or multiple vitrified clay, with the exception that on account of the long lengths in which these materials are supplied, the concrete base is frequently omitted. The circular cross-section of these materials and the fact that they are usually installed with a separation between each conduit results in an inverted concrete tunnel construction with vertical webs, which many engineers consider afford sufficient strength in itself to warrant the omission of the concrete base, thereby effecting a material economy in the cost of the structure. In suburban districts where streets are not congested with underground structures, concrete manholes will usually prove the more economical. In congested districts where the shape of the manhole has to conform to the conditions encountered, thereby prohibiting the use of standard forms, brick manholes will be more desirable. This is especially true where future alterations are likely to be required in a manhole. The conduit should be so graded as to drain into the manholes. It is not necessary to provide a continuous grade from manhole to manhole so that a candle held in the duct of one manhole is visible from the other, as has been specified in a few comparatively old telephone specifications and is to-day specified in government work. The conduit can be crowned at any part of the section between manholes and allowed to drain into the manhole at each end if economy in excavating can be effected by so doing.

Meter-Testing Regulations.

The past few years have witnessed the passage of abundant laws and measures, the appointment of public utilities commissions, etc., for the regulation of public service companies. The rates that electric light companies may charge for electrical energy have been fixed in many states by statute and various rules for the guidance of the customer and lighting company alike have been promulgated. The meters maintained by electric light companies have always been and probably always will be, next to the rates, the center of attack, and for that reason the rules relating to the testing of meters in some of the states and in Canada are given in brief herewith:

In Massachusetts a customer of an electric light company or the company itself may apply to the Board of Gas and Electric Light Commissioners for an examination and test of any meter in use, the board furnishing the applicant with a certificate of the result of the test and the expense attached thereto. If the meter is incorrect, the board may order the company to correct it or substitute a correct meter for it. All fees for examinations and tests are paid by the applicant, and if the examination is made at the request of the customer and the meter is found to register too fast, the electric light company pays the fees to the board, to be repaid by it to the applicant. The meter is deemed to be correct if it does not vary more than 5 per cent from the standard approved by the board. The inspector employed by the board receives a salary, together with necessary traveling and other expenses. The aggregate amount, however, must not exceed $3,000 in any year. Should the amount of compensation and expense exceed the amount of fees received, the excess is assessed and recovered from the electric light companies. The board establishes rules and regulations, fixes standards, prescribes fees, and employs such means and methods in connection with examinations and tests of meters as in its judgment are most practicable, expedient and economical. The fees charged for the testing of various sized meters are given in the accompanying table.

In Wisconsin a commission provides for the examination and testing of any and all appliances used in measuring electricity, and any consumer may have such appliances tested upon payment of the fees fixed by the commission. As in Massachusetts, the fee is paid by the consumer at the time of his request, but it is paid by the electric light company to the commission to be repaid to the consumer if the appliance is found to be defective or incorrect, to the disadvantage of the consumer.

In New York, under the old laws, every meter in New York City was supposed to be tested; but because of the great expense attendant thereto, this was found to be impracticable and meters were tested only upon complaint. In order to secure impartiality, an arrangement was made with Columbia University to take charge of all meter testing. This work was done under the supervision of Professor Sever, and the university was paid $1,500 a year. In order to have a meter tested, the complainant sent $2 to the Department of Water, Gas and Electricity, and if the meter on test was found to be more than 4 per cent fast, the fee was returned to the complainant, but if the meter was found to be slow, the fee was retained by the department. According to C. F. Lacombe, the engineer for the department, 106 meters had been tested during the year, most of which were found to be accurate. Seventy-five per cent of those found to be inaccurate were slow, and of those found to register too fast, the extra registration of the fastest meter tested was found to be 16 per cent.

By the provisions of the Canadian law, a meter must be tested and stamped every five years. The meters to be tested are brought to the government inspection office, and in small towns and villages the test is conducted on the premises of the electric light company. When a customer desires his meter to be tested, he notifies the electric light company to that effect, requesting it to send a qualified person to detach the meter from the mains so that it may be taken to the inspector's office. The inspector files with either the electric light company or the purchaser on payment of the proper fee a certificate stating the result of the inspection, with such other particulars as he may deem right to insert for the information and guidance of the persons concerned. Electrolytic meters at present in use may be continued unless objected to by the purchaser, but all renewals of meters must be made by the substitution of direct reading types. No meter is passed which, when working at its full rating, varies more than 3 per cent from the legal standard unit of electricity, in favor of either the electric light company or the consumer. Whenever a reading of a meter is taken by the electric light company, the company must give a duplicate of such reading to the consumer. In every case the owner must keep the meter in good repair and is responsible for the due inspection thereof. There are numerous penalties in force for persons who knowingly repair, tamper with or alter meters.

RATES FOR TESTING WATT-HOUR METERS.

Meter Rating.			Canada.	
	New York.	Massachusetts.	Lamps.	Motors.
3 amp.	$1.00	$1.50	$0.75	$3.00
5 "	1.00	1.50	.75	3.00
10 "	1.50	1.50	1.25	3.00
15 "	2.00	2.00	1.75	3.00
25 "	2.50	2.50	2.75	3.00
50 "	3.00	3.00	3.50	3.00
75 "	4.50	3.50	5.00	6.00
100 "	5.50	3.50	6.50	6.00
150 "	8.00	4.00	9.00	9.00
200 "	10.50	4.50	11.50	12.00
300 "	15.50	4.50	16.50	18.00
450 "	23.00	5.00	24.00	27.00
600 "	30.50	5.00	31.50	32.00
1200 "	60.50	....	61.50	72.00

New Telephone Patents.

TWO-WIRE CIRCUIT SYSTEMS.

In some systems, instead of the usual single common battery supplying all lines alike, several different batteries are used to supply current for different functions. In one of these the division of current between two batteries is according to calling and called lines; the one being supplied from its battery and the other from a second distinctive battery. Such systems have in some instances been subject to many disagreeable clicks due to the transfer of the lines from battery to battery. To avoid this there has been devised a new arrangement of the circuits whereby this shifting of batteries is overcome. H. M. Post, of Chicago, has obtained a patent for such an arrangement with a three-wire multiple, and W. W. Dean for a two-wire multiple, both patents having been assigned to the Kellogg Switchboard & Supply Company. In both, the live or ungrounded side of each battery is connected into the line signal circuits. The relays of these circuits are then so arranged as to perform different functions, according to whether the line happens to be a calling one or a called one, in each case causing the proper arrangement of circuit to meet the corresponding side of the cord circuit. The changes of circuit are effected without abrupt changes of battery conditions in the talking circuits.

CALLING SWITCH FOR INTER-COMMUNICATING SYSTEM.

Mr. A. K. Andriano, of San Francisco, has invented a selecting switch for use in connection with desk stands, for inter-communicating systems. The idea concerns the use of the home lines of the two stations involved in any connection to pair together as a metallic circuit. The main improvement lies in the restoration of the circuit conditions to normal upon the return of the receiver to the hook without the necessity of restoring the switch. Mr. Adriano's patent is assigned to the Direct-Line General Telephone Company.

LETTER TO THE EDITORS.

Noisy Operation of Dynamos.

To the Editors of Electrical World:

Sirs:—In view of Professor Craighill's article on "Noisy Operation of Dynamos," in the issue of Feb. 1, it may be of interest to readers to know that this same subject has been treated in the *Zeitschrift für Electrotechnik* (Vienna), issue of June 5, 1904, by Mr. J. Fischer-Hinnen, whose formula for quiet operation, transcribed into the designations used by Mr. Craighill, reads:

$$\frac{AB - .7r}{P} = K + 0.5$$

The rounding off of the pole corners is taken care of by the term .7*r*, whereas Professor Craighill writes .81*r*; otherwise the formulas are identical.

This formula has been tested on 25 machines, with the result that the average of 13 noisy machines satisfied the equation

$$\frac{AB - .7r}{P} = K - 1$$

and the average of nine quiet machines the equation:

$$\frac{AB - .7r}{P} = K \pm .5 + .1$$

There are exceptions to this rule, as shown on three machines, which, however, had an unusually great number of armature teeth per pole.

The acoustic experiment to show the connection between speed, number of slots and the pitch of the note emitted by the machine, as described by Professor Craighill, has also been carried out by Mr. Fischer-Hinnen. He observed that a machine of 1070 r. p. m. = 17.8 r. p. s. emitted the note G_2 sharp. This note, lying between G_2 and A_2 corresponds to $\frac{792+880}{2} = 836$ vibrations per second, as derived from the tables given in the articles of both authors. Per armature revolution there are 836:17.8 = 47 vibrations, corresponding to the 47 slots, which the armature had. Another experiment was made on a machine running at 1400 r. p. m. = 23.46 r. p. s., which was found to produce the note A_2 sharp. The corresponding number of vibrations per second is 935, the average of $A_2 = 880$ vibrations and $B_2 - 990$ vibrations per second. Per revolution there are $\frac{935}{23.46} = 40$ vibrations, corresponding to the 40 armature teeth which the machine possessed.

Professor Craighill reports that a 47-slot armature, running at 1125 r. p. m. = 18.75 r. p. s. emitted the note A_2 with 880 vibrations per second. The vibrations per revolution amounts to $\frac{880}{18.75} = 47$. Two other machines he mentioned had a 40-slot armature, revolving at 660 r. p. m. = 11.0 r. p. s. and produced the note A_1 with 440 vibrations per second. The number of vibrations per revolution, therefore, are $\frac{440}{11} = 40$. These results show a remarkable agreement of both authors.

Jamaica Plain, Mass. Fred. E. Meurer

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Heat Conductivity of Iron Stampings.—T. M. Barlow.—An illustrated paper read before the Birmingham section of the (British) Institution of Electrical Engineers. The object was to determine the heat conductivity of assembled insulated iron stampings, first in a direction parallel to the plane of their surfaces, and second in a direction at right angles to their surface through both iron and paper. The coefficient of heat conductivity is defined numerically as the quantity of heat which flows per unit time through unit area of a plate of unit thickness, having unit difference of temperature between its faces. From the measurements of the author the coefficient of heat conductivity for iron laminations in a direction parallel to the surface of one stamping was found to be 0.1405 and in a direction at right angles to this surface 0.00137. From these figures it is possible to calculate the ratio of the sides of two square surfaces in order to dissipate the same amount of heat, one being the edged surface of a packet of stampings and the other being the plane surface of the outside stamping of the packet. This ratio is found to be 10. The results emphasize the importance which should be given in dynamo design to the amount of edged surface of the stampings of a laminated iron core exposed to a cooling medium. The temperature gradient is almost a straight line in a direction with the plane of the stampings. Thus the internal temperature of the core is quickly reduced if the method of cooling employed, either air or oil, is used on this edge surface. On the other hand, if the iron laminated core is only cooled on the plate surface, the temperature will rise, comparatively very rapidly as the core is penetrated across the iron and paper. This rise amounts to as much as 5 degs. C. for a distance of 2 cms. for an induction of 10,000 lines per cm^2 at 50 periods in the iron for which the curves are plotted. The effect of this steep temperature gradient in an iron core thus cooled is the increase of the hysteresis loss in the center portion due to the decrease of the permeability of the iron with the rise of temperature. Also for any iron rectangular laminated core, which is heated internally, the ratio of the linear dimensions of the sides of the core, i. e., edge side to plate side, for the most efficient cooling must equal 1:10. This ratio is somewhat higher than is used at present in common practice, the figure averaging about 1:6 for small armature cores and transformers, and 1:7.5 for large cores. Further, dealing with the question of the ventilation of direct-current armatures, it will be noticed that the ventilating ducts between the packets of iron stampings are not so useful on account of the extra plate surface exposed to the cooling draught induced, but act more as an outlet for the air inside the center space of the armature which has been heated in cooling the inside edge surface and so the internal parts of the core. This also applies to the ducts in large transformer cores cooled by a direct air blast.—Lond. *Elec. Eng'ing*, Jan. 23.

Commutation.—R. Rüdenberg.—The commutation in dynamos depends essentially on three different things: First, the magnetic phenomena at the armature circumference determine the value of the e. m. fs. induced in the short-circuited coils; second, the conditions of electric resistance, etc., determine the variation of the short-circuit current in time; thirdly, the thermic effects of the short-circuit current at the brushes manifest themselves to the outside. While we have not yet any exact knowledge of the heat phenomena at the commutator, there is available a long series of investigations of the magnetic and electric phenomena. In former investigations, however, the treatment of the electric or magnetic phenomena has been restricted to an investigation of the short-circuited coils themselves, although their connection with the non-short-circuited active armature wires is also of great influence on commutation. The author pays special attention to this point in order to lay the foundation for a more complete theory of commutation. For calculating the e. m. f. of self-inductance of the short-circuit currents the primary flux is divided into three fluxes. One encircles the front connections of the armature winding; the second passes through the armature iron and when leaving it passes only through the short-circuit zone; the third one passes through the active wires at the armature circumference. The short-circuit current is considered as the sum of a current which changes in linear relation with the time, and an "additional current" component. All three fluxes mentioned before determine the self-induction of the "additional" short-circuit current, while the linearly varying current component is determined only by the fluxes around the front connections and in the short-circuit zone. It is not necessary that the short-circuit currents pass completely through the commutator brushes, since there is also a branch circuit open through the armature and the external circuit which prevents an excessive increase of current density below the brushes. The self-induction of this armature circuit is of importance for the commutation, and the spark limit is beyond that which is found by the calculations used heretofore. The fundamental formulas of the commutation problem are given.—*Elek. Zeit.*, Jan. 23.

Lamps and Lighting.

Determining the Distribution of Light from a Lamp.—W. Voege.—While the integrating photometer of Matthews or the spherical photometer of Ulbricht permit the determination of the mean spherical candle-power of a lamp by a single measurement, they give no indication of the distribution of light around the lamp, although this is of great importance for illumination purposes. To make photometrical tests under different angles against the horizontal plane is a most tedious and inaccurate method. An attempt to carry a selenium cell around a lamp and measure the change of its resistance was unsuccessful. The author then devised a method which he has found quite suitable for practical use and which is very simple, being based on the use of a thermo-cell. The thermo-cell is mounted on a stand and is gradually carried around the lamp and the deflection of the galvanometer needle is noted. A curve of this kind may be plotted in a few minutes with great exactness. By changing the arm on which the thermo-cell is mounted and by changing the glasses which are placed before the thermo-cell, the same instrument may be used for low-candle-power incandescent lamps as well as for arc lamps. It is of importance that the distance of the thermo-cell from the lamp is not too small in comparison with the dimensions of the lamp. It is of fundamental importance that the thermo-cell measures the total radiation and not the radiation within the visible spectrum. The author, therefore, absorbs the dark heat rays by placing thick, clear glasses before the thermo-cell. The light rays pass through and among those, the red rays will have the greatest effect on the thermo-cell. It would, therefore, be impossible to use a thermo-cell for absolute measurements of candle-power. But if the ratio of radiation within the visible spectrum to total radiation has the same value at every point of the lamp, the energy values measured in this way will be proportional to the energy within the visible spectrum. This is, for instance, the case with electric incandescent lamps in which the whole surface of the filament is on the same status of incandescence. But care must be taken that the distance of the thermo-cell from the lamp is so large that the length of the filament is small compared with this distance. If by means of an optical photometer the candle-power of the lamp is measured in a suitable direction (for instance, the horizontal candle-power), the figures of the energy curve may be easily changed into figures of candle-power. The author states that he has made this method also suitable for arc lamps by placing besides the clear glasses a green glass before the thermo-cell. This absorbs the greatest part of the red light rays. Since the red rays have a small effect on the eye but a great effect on the thermo-cell their absorption diminishes this source of error. The sensitiveness of the thermo-cell remains nevertheless sufficiently large. In his tests of arc lamps he uses a clear glass of 3 mm thickness and a light green glass of 1.5 mm thickness before the thermo-cell. He further places a collecting funnel before the thermo-cell which concentrates the different rays emitted from the lamp under a certain solid angle onto the thermo-cell so that the latter measures a mean value. Numerous experiments have shown that with arc lamps a correct picture of the distribution of light is obtained in this way, especially if the arc lamp is tested with a globe. A simple method of control is to replace the green glass by a red glass. The new curve obtained must then be quite similar to the other one. Fig. 1 gives the results for the tests of a carbon-filament incandescent lamp. The drawn-out curve gives the light distribution around the original lamp with clear globe, while the dotted curve gives the distribution of light, after the upper half of the lamp has been silver-plated. Fig. 2 gives the light distribution of a tantalum lamp; the drawn-out curve referring to a plain, clear globe and the dotted curve to a frosted globe. The difference between both curves is small. It is, however, of importance whether the filament is mounted a little higher or lower within the globe. In this test the filament was a little higher in the frosted globe than in the clear globe. Several curves of arc lamps are also given and a simplification of the method is described in which the deflection of the needle is automatically registered. For this purpose the arm which carries the thermo-cell is provided with a sensitive paper disc within a box. The latter has a single slit through which the light enters. When the arm with the thermo-cell and photographic paper is carried around the lamp, the light distribution curve is automatically

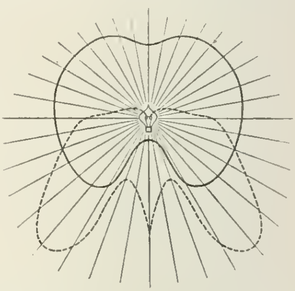


FIG. 1.—DISTRIBUTION OF LIGHT FROM CARBON-FILAMENT LAMP.

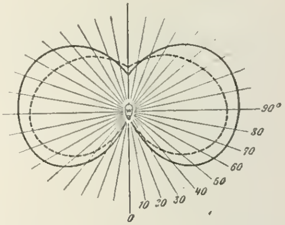


FIG. 2.—DISTRIBUTION OF LIGHT FROM TANTALUM LAMP.

registered on the paper. By an obvious modification of the method it is possible to use it for registering the degree of uniformity of arc lamps. Fig. 3 shows the variation of candle-power obtained with an ordinary direct-current arc lamp of an older type in about 60 minutes. Slow periodic oscillations are due to the unsteadiness of the arc, while the quick changes in the curve are due to the regulation of the lamp.—*Elek. Zeit.*, Jan. 16.

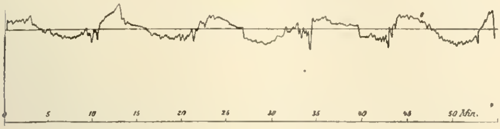


FIG. 3.—VARIATION OF CANDLE-POWER FROM ARC LAMP.

Direct-current Arc Between Metallic Electrodes.—A. Grau and F. Russ.—Guye and Zebrikoff have recently published measurements on the potential difference of a direct-current arc between metallic electrodes as function of current and arc length. Their results show that Mrs. Ayrton's formula for carbon arcs is also applicable to arcs between metallic electrodes, but the arc lamps used by these authors were not more than 4 mm. The present authors have made experiments between cooled copper electrodes in which arcs ten times as long were employed and their results also show that Mrs. Ayrton's formula is applicable.—*Phys. Zeit.*, Feb. 1.

Power.

Swedish Power Station.—Some notes on the way in which the demands in connection with the important electric power station at Trollhätten have grown. During 1906 the Swedish Congress voted a sum of 750,000 kr. (1 crown about = 25 cents) toward it; a specified plan was brought forward toward the end of 1906, and the Congress this year voted further 7,750,000 kr. toward the installation, and now a further sum of 2,800,000 kr. is asked for. The fact is that the 28,500 horse-power upon which the first plan was based, and which, by somewhat heavily taxing the turbines, could be raised to about 34,000 horse-power, will not even suffice for the requirements at the end of the year 1908, when it is expected that the power station will be ready to be taken into use. This will more especially be the case should the State railways, of which there appears to be some likelihood, at that time require power from the station for the electrification of the Gothenburg-Lund section. Under these circumstances, the board thinks it advisable that the question of exploiting the falls to the full extent of their capacity should be placed before the forthcoming Congress, so that no unnecessary or avoidable delay may be caused. The board would prefer that the whole sum of 11,300,000 kr. be voted, so that the station could be at once built for its full capacity of 76,000 electric horse-power. The board has entered upon a preliminary agreement with the city of Gothenburg, which may soon be made final, and which necessitates the construction of lines to Gothenburg and the building of a transformer station there; the demand there may, it is thought, easily reach or surpass 7000 kilowatts. Negotiations are pending with several other towns, including Sköfde, Talköping, Vara and Grästorp, which when completed would likewise necessitate the construction of lines and transformer stations. The State, it is urged, ought to install distribution lines, which it can do more cheaply and quickly than others, and it is considered that the direct profits and the indirect advantages would soon outweigh the risk.—Lond. *Eng'ing*, Jan. 10.

Refuse Destructor and Electricity Works.—An illustrated description of the Fulham station in London, which is one of the most successful existing combinations of a generating station and refuse destructor under municipal control. The original plant erected in 1901 consisted of three 300-kw, two-phase alternators driven by slow-speed steam engines. The extensions installed later show the transition stages from the low-speed to the high-speed reciprocating engine and thence to the steam turbine. The turbine installed is of the vertical Curtis type and drives a 750-kw alternator at 1500 r. p. m. The set has considerable overload capacity and has given as much as 1250 kilowatts for two hours. The destructor is of the Horsfall type and consists of 12 destructor cells of the usual top-feed type with a grade area of "30 feet" each. During the year ended March 31, 1907, the generating works costs of the electricity department averaged 1.6 cents per kw-hour, giving with management and other charges 2.246 cents and with the inclusion of all capital charges 4.516 cents per kilowatt-hour sold. The total kw-hours sold amounted to 2,523,417, and the maximum demand was 1502 kilowatts with a lamp connection of 110,723. There is a power load at Fulham represented by 1167 horse-power of motors. Fulham was the first London district where the price is 2 cents per kw-hour for power was introduced, and now the average price received per kw-hour is, with one exception, the lowest in London.—Lond. *Elec. Eng'ing*, Jan. 23.

Cost of Power.—I. V. Robinson.—A paper read before the Inst. of Eng. and Shipbuilders in Scotland. The author compares the estimated cost of power supply at a high load factor such as is obtained under the conditions of electrochemical work from a water-power plant and from a gas-driven plant. A number of figures are given and from his comparison it appears that the power generated from blast-furnace gases costs about the same as water-power, when the capital cost of the generating station, with or without transmission lines as may be required, is about $90 per horse-power delivered at the consumers' boundary. Investigation shows, however, that the majority of water-power plants are estimated to cost more than this figure.—Lond. *Elec. Eng'ing*, Jan. 23.

Geneva.—R. Weber.—The city of Geneva in Switzerland has already two important hydro-electric stations, which, however, now are no longer sufficient, so that a third water-power station is to be erected utilizing a fall on the Rhone River. The project of the hydraulic development is described and illustrated. —*La Lumière Elec.*, Jan. 25.

Buildings for Power Houses.—H. Boot.—A paper read before the (London) Society of Architects on the design of buildings for power houses, in which the general requirements to which attention should be paid by architects when designing generating station buildings are dealt with.—Lond. *Elec. Eng'ing*, Jan. 23.

Electric Power in Iron Works.—An illustrated description of the electric equipment of a British iron works in which electric motive power is now used throughout, while formerly steam and gas engines were employed. A considerable amount of power is employed for electric welding.—Lond. *Elec. Eng'ing*, Jan. 23.

Gas Engines.—F. W. Burstall.—His long third report to the gas-engine research committee of the (British) Institution of Mechanical Engineers with an account of the discussion which followed.—Lond. *Eng'ing*, Jan. 24.

Traction.

Single-phase Traction Motors.—M. Osnos.—A paper read before the German Association of Elec. Engineers on single-phase commutator motors, with special reference to traction. Tests were made with two 110-hp motors which could be used with either of the six following arrangements: (1) as series motor with a compensation winding connected in series; (2) as series motor with short-circuited compensation winding; (3) as reverse repulsion motor; (4) as ordinary repulsion motor or Atkinson repulsion motor; (5) as compensated series motor; (6) as "double fed motor." As double fed are such single-phase commutator-motors designated in which the axles of the stator and in which the axles of the stator field and rotor field form an angle between 0 and 90 degs. with each other and in which a voltage is impressed on the stator as well as on the rotor. A general equation is given for the volt-amperes consumed per meter-kilogram of starting torque, and it is proven that for all six arrangements the consumption of volt-amperes per meter-kilogram of starting torque is a minimum if the volt-amperes consumed for excitation equal the volt-amperes consumed for the stray flux. With respect to the smallest consumption of volt-amperes per meter-kilogram of starting torque all the above six arrangements with the exception of (4) (ordinary repulsion motor) are practically equivalent. When running, the motors of the arrangements 1 to 3 are about equivalent with respect to the power factor, arrangement 4 is inferior, while arrangements 5 and 6 are about equivalent and both superior to the arrangements 1 to 3. Results of tests are given which confirm the theoretical results and prove that the overload capacity of the arrangement 6 is about 40 per cent greater than that of the compensated series motor (arrangement 5). On mountain roads it is at times advantageous to be able to let series motors or motors with series characteristics run with constant speed. If the difference in level is not very great a uniform and good operation is thus obtained, for the reason that for a single predetermined constant speed sparkless running and a high-power factor and efficiency can be obtained more easily than for varying speed. On the other hand, if the difference in level is great, it is advantageous to run up hill with a series arrangement with varying speed and down hill with constant speed, the motors then returning energy to the net work. In tests of an experimental car on the mountain road from Homburg to Saalburg it was found that when running down hill it was possible to recuperate continuously about 40 kilowatts. When running up hill 12.87 kilowatt-hours were consumed; when running down hill over the same distance 6.97 kilowatt-hours were returned from the motors into the net work, so that the number of kilowatt-hours consumed on the round trip was only 5.90 kilowatt-hours. The energy recuperated when running down hill amounted to about 55 per cent of the energy spent in running up hill.—*Elek. Zeit.*, Jan. 2, 9 and 16.

Watertown.—A. H. Lefevre.—An illustrated article on the equipment of the Black River Traction Company, of Watertown, N. Y. It is probably the only water-power station in the country generating current for a railway without attendance and giving uniform voltage without a governor or any regulating device. This is accomplished by providing each generator with a very strong series field and comparatively weak shunt field. When the turbine is running at its maximum speed of 200 r. p. m. with full gate and no load, the generator, working on shunt field alone, has a voltage of 550. As the load goes on, the speed, and consequently the current in the shunt coils, drops off, but the current in the series coil increases, and the winding of the series coil is so proportioned that the total flux increases with the load, that is, inversely with the speed. In this way the decrease in speed of the armature is compensated for by an increase in the strength of the series field and a practically constant voltage is assured. Another special feature is the use of a vacuum system of ventilation in the cars.—*St. R'y Jour.*, Feb. 8.

Installations, Systems and Appliances.

British Central-Station Statistics.—The annual statistics of British central stations supplying current for light and power but without a tramway load. A vast amount of information on history and equipment of 273 different stations is given in 36 different columns. The number of stations dealt with is practically the same as last year. A point of considerable importance is the great increase shown in the horse-power of the motor connections, indicating that supply engineers and public alike are paying much attention to this branch of electricity supply. Examples are the Glasgow undertaking, where an increase from 11,954 horse-power to 19,805 horse-power is shown, and Coventry, where the increase is from 2346 horse-power to 3881 horse-power. The London undertakings of this class, while showing in most cases increases of a few hundred horse-power in the motors connected, cannot point to any developments such as those indicated above. It would appear that metallic-filament lamps are being adopted to a considerable extent for street-lighting purposes, and this is more likely to become general if it is found that such lamps can without difficulty be burned in series. The majority of the undertakings are now paying considerably more per ton for their coal supply than was the case a year ago, but fortunately the improved load factors due to the additional motor loads should prevent any material increase in the cost per unit.—Supplement to Lond. *Elec.*, Jan. 17.

Small Gas-electric Station in Germany.—The first part of an illustrated description of the electric plant of Steudal in Germany, a city of 25,000 inhabitants, which had already a municipal gas plant. The municipal electric station was installed to cooperate with the gas plant. Illuminating gas from the gas plant is used in gas engines, but as a reserve a small suction-gas plant is being installed. The gas engines can be operated either with illuminating gas or with suction-producer gas. They have a capacity of 80 and 160 horse-power respectively. The dynamos coupled to the gas engines have capacities of 60 to 115 kilowatts respectively and supply a three-wire system at 2 by 220 volts.—*Elek. Anz.*, Jan. 5.

German Station.—O. Ely.—The first part of an illustrated description of the municipal central station of Coburg, a small town in middle Germany. Electric energy is used for light, power and traction. The price per kw-hour is 15 cents for lighting and 6.25 cents for power. Two Dowson gas producers, each of 200 horse-power, supply producer gas to three gas engines coupled with shunt-wound, direct-current dynamos, two of which have a capacity each of 67 kilowatts and the third 100 kilowatts.—*Elek. Zeit.*, Jan. 23.

Wires, Wiring and Conduits.

Enclosed Fuses.—W. Fellenberg.—A long illustrated paper read before the Dresden Electrical Society on a new form of enclosed high-tension fuses made by the Allgem. Elek. Ges. In central stations of a large capacity of 2000 or 3000 kilowatts or more, automatic circuit-breakers are preferable for the protection of all machines. But in smaller stations as well as in the net works of larger stations this new type of enclosed fuses is thought to be useful, especially since they need no attendance. They may also be used in series with automatic circuit-breakers to increase the protection. The fuse wire is best arranged in zig-zag or loop form. Copper is preferable to silver. The shell is made of porcelain. The fuses are made in standard sizes of 110 mm length and may be combined for any desired voltage.—*Elek. Zeit.*, Jan. 16 and 23.

Electrophysics and Magnetism.

Magnetism and Specific Heat.—P. Weiss.—A paper in which the author shows that the discontinuities observed in the magnetization of iron, nickel and magnetite at certain high temperatures are exactly paralleled by similar discontinuities in the specific heat, and gives a qualitative and quantitative explanation of this fact.—*Comptes Rendus*, Dec. 30; Lond. *Elec. Eng'ing*, Jan. 23.

Units, Measurements and Instruments.

Determining the Power Factor.—C. Herz.—The phase difference ϕ ———————— between current and potential difference can be easily found for a three-phase system by means of the formula

$$tang\ \phi = \sqrt{3}\,\frac{W_1 - W_2}{W_1 + W_2}$$

where W_1 and W_2 are the readings of two wattmeters connected in the well-known way. By putting the ratio of W_2 to $W_1 = x$ (smaller than unity) the formula becomes

$$tong\ \phi = \frac{\sqrt{3} - x\sqrt{3}}{1 + x};$$

x may be found directly from the readings of the two wattmeters by means of a slide rule, while the angle of phase difference ϕ is found by a simple graphical method indicated in Fig. 4. If $OP = 1$ and $OQ = \sqrt{3}$, then the equation of the straight line PQ is $y = \sqrt{3} - x\sqrt{3}$. Then QR is also made equal to unity and OH equal to x (found from the two wattmeters), and if $H\ M$ is perpendicular on OP then the angle $M\ R\ P$ is the desired angle of phase difference. A slight modification of the method for practical purposes is also described.—*La Lumière Elec.*, Jan. 25.

Measurement of Radiant Energy.—W. W. Coblentz.—An article in which the author describes the instruments and methods used in radiometry. He discusses in detail four instruments for measuring radiant energy, viz., the radiomicrometer, the linear thermopile, the radiometer and the bolometer with its auxiliary galvanometer. The radiomicrometer is capable of great improvement, by reducing its weight, by lengthening its period and by placing it in a vacuum. On account of para- and diamagnetism the sensitiveness of the radiomicrometer is very limited, perhaps only a fifth of the best bolometers. The Rubens thermopile is as sensitive as the best bolometer, and its heat capacity can be greatly reduced by using thinner (0.06 to 0.08 mm diameter) wires, which are made shorter, thus keeping the resistance low. The thermopile is not so well adapted as is the bolometer for instantaneous registration of radiant energy and it does not admit so great a range in variation of sensibility, but on account of its greater steadiness it commends itself for measuring very weak sources of radiation, e. g., the extreme ultra-violet and infra-red region of the spectrum. The radiometer can be made just as sensitive as the bolometer, but its period will be much longer. This long period is of minor importance so long as we are dealing with a constant source of radiation. A bolometer installation is so distributed that it is difficult to shield from temperature changes. Nevertheless, despite its defects, it is the quickest acting of the four instruments considered and is the best adapted for registering the energy radiated from a rapidly changing source. For precision work it is necessary to keep the bolometer balanced to less than 1 cm deflection. The auxiliary galvanometer is the main source of weakness in measuring radiant energy, and in places subject to great magnetic perturbations a period greater than 5 seconds, single swing, is to be avoided. In measuring intense and weak sources of radiation the thermopile and the bolometer have the same relative accuracy and there is little preference between the two.—*Bull. Bureau of Standards*, Jan. (Vol. IV, No. 3).

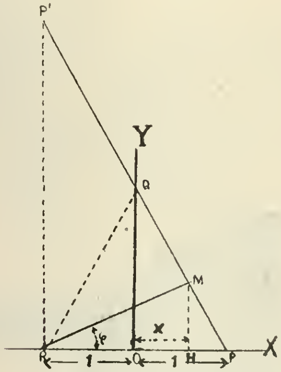


FIG. 4.—DETERMINING THE POWER FACTOR.

Electric Thermometer for Measuring Gas Engine Temperatures.—H. L. Callendar and W. E. Dalby.—A (London) Royal Society paper describing a form of platinum thermometer which measures directly the temperature of the gas in the cylinder of a gas-engine at some one point of the cycle. In order to avoid uncertain corrections, it is necessary in any attempt on this problem to employ wires fine enough to follow the changes of temperature of the gas very closely during suction and compression. If such a wire be employed under working conditions, it must be perfectly screened from the flame during explosion. The arrangement designed by the authors is such as to introduce the thermometer into, and withdraw it from, the cylinder at the proper instants, and to do this without making any change in the usual form and extent of the clearance surface during the time interval comprising the end of compression. The thermometer itself consisted of a loop of platinum wire, 0.001 in. diameter and 1 in. long, and a compensation loop of similar wire was provided to eliminate the end effects arising from conduction to the leads. The current employed in measuring the change of resistance (which was about 1 ohm for 100 deg. C. rise) was about 1/200 ampere. This thermometric arrangement was contained in a small valve inserted through the spindle of the admission valve, which was bored out to receive it. This thermometer valve was introduced into the cylinder by a cam operated by a simple gear. In order to measure the temperature at a definite point of the cycle, a periodic contact-maker was inserted in the testing battery circuit. At first an ordinary wiping contact was employed, but, owing to certain disadvantages, a novel form of periodic contact was designed and made. This consisted of two cams on the same axle and two brushes. The shape of each cam was a flat spiral, which lifted the corresponding springy brush away from the axis as the shaft rotated, and the spirals each terminated with a stop which allowed the brushes to fall suddenly. The steps were staggered in angle so that the brushes fell at different instants. Now one side of the electrical contact was carried by one brush, and the other side of the contact by a projection on the second brush; and thus, by setting the cams initially at the proper angle, any desired period of contact could be brought about at any desired point of the gas-engine cycle.—London *Royal Soc. Procs.*, Dec.; Lond. *Elec. Eng'ing*, Jan. 6.

Testing Meters.—E. Kraus.—A paper read before the Association of Austrian and Hungarian electricity works. According to the Austrian law of 1894, electricity meters must be used in all installations and according to a later law, meters must be recalibrated every five years. It is now intended to make the recalibration somewhat easier for the stations so as to permit them to install calibration bureaus themselves. The present paper contains a description of several new apparatus of the Siemens-Halske Company which have been devised for such purposes and have been gradually modified in the course of years to meet the requirements of practice. The paper is fully illustrated.—*Elek. u. Masch.*, Jan. 26.

Self-Inductance.—L. Cohen.—A mathematical paper in which the author develops a formula for the self-inductance of a solenoid of any number of layers and which will give results accurate to within one-half of 1 per cent even for a short solenoid, where the length is only twice the diameter, the accuracy increasing as the length increases. The author also shows that Maxwell's familiar formula may lead in some cases to considerable errors.—*Bull. Bureau of Standards*, Jan. (Vol. IV, No. 3).

Fault Locating.—T. Vaillant.—A brief article describing in detail how a short circuit between two phases of a three-phase cable was located, giving the measurements made together with the formulas.—*Elek. Anz.*, Jan. 2.

Telegraphy, Telephony and Signals.

Telegraphy and Telephony.—Summary of advances and improvements made in telegraphy and telephony in the last three months of 1907.—*Elek. Anz.*, Jan. 2 and 12.

Miscellaneous.

German Manufacturing Works.—An illustrated description of the Felton & Guilleaume-Lahmeyerwerke in Frankfort. The original founder of this company, Mr. Lahmeyer, died in December, 1907.—Lond. *Eng'ing*, Jan. 24.

German Electrical Imports and Exports.—Tables showing the imports and exports of different kinds of electrical machinery and apparatus to different countries during the month of November, 1907.—*Elek. Anz.*, Jan. 12.

BOOK REVIEWS.

La Ionizzazione e la Convezione Elettrica nei Gas. By Lavoro Amaduzzi. Bologna: Nicola Zanichelli. 368 pages; 88 illustrations. Price, 5 lire.

There are many books devoted to the subject of ionization. Some deal with the subject almost entirely from the standpoint of the mathematician. Others deal with it almost entirely from the standpoint of the descriptive physicist. Consequently, the quantitative facts are ordinarily either presented in difficult and indigestible form, or they are so meagerly presented as hardly to be presented at all. This book is one of the welcome few which occupies a middle ground. It is sufficiently descriptive from the physical standpoint to be interesting reading, and it is also sufficiently mathematical to present the quantitative facts in a manner readily capable of assimilation. For example, the Lorenz theory of the Zeeman effect is usually either inaccessible or inassimilable to most students of technology. It is here developed in a clear and simple manner. The book will be welcomed by technological students interested in the large and rapidly growing subject of ionization.

Deutsches Patentrecht fur Chemiker. By Dr. Julius Ephraim. Halle: Wilhelm Knapp. 608 pages. Price, 18 marks.

Dr. Ephraim, who is a chemist and a patent attorney, gives here a treatise of colossal proportions and immense usefulness. His preface says: "This is the first exposition of patent law with sole reference to a certain technical field. In previous treatises, by eminent jurists, the general patent law was unfolded, but application of the same to concrete technical cases omitted. The present work, the first compilation of German patent law by a patent attorney, takes up the general principles of patent law, but arranges them in the order most applicable to chemical purposes, and for every principle explained gives a typical illustration from chemical technology fitted to elucidate the teaching of the patent law and also to set forth the application of the principle in practice." The result is a work of immense labor and of great usefulness. One can hardly imagine that an electrochemical inventor in Germany could afford to be without the work, its information would be so indispensable to him.

The idea of such a work is first-class, and most commendable. It is fervently to be hoped that similar treatises, based on this as a pattern, may appear in English, giving us in a complete and accessible manner "U. S. Patent Law for Chemists and Electrochemists," "U. S. Patent Law for Electrical Engineers," etc.

Technical Dictionary in Six Languages. Vol. II. *Electrical Engineering*. By Chas. Kinzbrunner: Edited by K. Dienhardt and A. Schlomann. New York: McGraw Publishing Company. 2100 pages; 4000 illustrations. Price, $7 net.

The second volume of this work follows the same excellent arrangement used with the first volume (Machine Elements and Tools), namely, a diagram or sectional illustration showing the thing described, together with a descriptive word or phrase in each of the six languages, English, German, French, Russian, Italian and Spanish. An immense amount of labor has evidently been expended in insuring the completeness of the dictionary and the accuracy of the information contained therein. An indication of the completeness may be obtained from the fact that 1360 pages of the book are devoted to the strictly dictionary feature, each page dealing with about ten different subjects—a feature not found in the usual dictionary is an alphabetically arranged table of contents covering the Russian words and phrases, and a separate table of contents covering the words in all of the other languages. The accuracy of the descriptive matter is attributable to the co-operation of a large staff of contributors to the text and revisers of prominence in the electrical profession in the countries where the six languages are used. The production of such a dictionary is by far a more stupendous task than has ever previously been accomplished by any one man or collection of men, hence the book is in a class by itself. The present volume covers the whole field of electrical engineering, including telegraphy and telephony, except electric traction. It is stated that the latter subject will be dealt with fully in a volume on "Railway Engineering," which is in course of preparation. In the present volume the errors of translation and the important omissions so prominent in the dictionaries heretofore obtainable for use in translating a technical article from one language to another, have been largely eliminated, so that the book can be employed with confidence by anyone engaged in such translation.

Air Break Circuit-Breakers.

In a paper entitled "Air-Break Circuit-Breakers and Their Applications," read before the Electric Club, of Cleveland, Ohio, Mr. C. C. Badeau, after tracing the development of the circuit-breaker and describing its various forms and makes, gave some interesting data on the circuit-breakers made by the Switchboard Equipment Company, of Bethlehem, Pa., of which company he is the chief engineer. A number of these circuit-breakers are illustrated herewith. It will be noticed that the laminated brush is made stationary and that the flexible strip in back serves not only as the rear contact, but as the magnetic coil as well. On small circuit-breakers the contact studs are screwed directly into the brush and the coil, as shown in Fig. 2, but in larger breakers, in order to save joints, this brush and coil are brought directly through the board, as shown in Fig. 3. This circuit-breaker is made in sizes rated at from 5 to 10,000 amperes.

There are two things that all circuit-breakers should do: in the first place, they should carry their full rated load without overheating and, in the second place, they should open on overload without undue injury to the contacts. The author deplores the custom among some consulting engineers of specifying generators and motors on the temperature basis and auxiliary apparatus on the basis of amperes per square inch without reference to the temperature rise. That this method of rating will give varying temperature rises according to the size of apparatus was shown in a curve giving the temperature rises at varying amperes per square inch on bright copper studs of various diameters suspended in still air. This is due to the fact that the ultimate temperature of any piece of electrical apparatus is determined by its resistance and its radiating surface. The Switchboard Equipment Company has appreciated this fact and has not rated its circuit-breakers on the arbitrary, amperes-per-square-inch basis, but has taken the temperature rise as the limiting feature, and the design curve of these breakers takes the form of a straight line on logarithmic cross-section paper. The curve is based on the carrying capacity of round copper studs, and all of the various areas and contact surfaces of the company's breakers are ratios of this carrying capacity. Circuit-breakers designed by this curve have been built in sizes rated at from 10 to 10,000 amperes with a remarkably close adherence to the calculated results, the resulting temperature rise, at full-load, always being less than that indicated by the curve. This is the first attempt, as far as the author knows, to lay out a design curve for any auxiliary apparatus which has as many joints as a circuit-breaker or switch, and the success of the curve is probably due in part to the fact that the copper in the circuit-breaker is so disposed as to give a maximum radiating surface for its area and the factor of safety introduced by this has more than compensated for the inevitable uncertainty introduced by contact resistances.

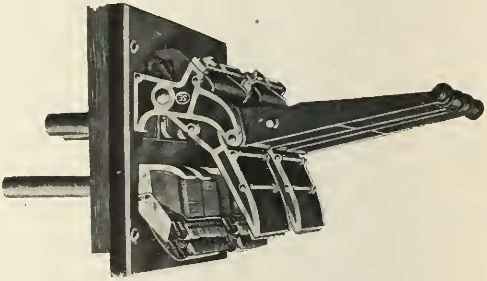


FIG. 1.—10,000 AMPERE, DOUBLE-POLE CIRCUIT-BREAKER.

In order successfully to open the circuit, breakers should be provided with low-resistance secondary contacts which will protect the main contact surface from the burning necessarily caused by the arc and should open the circuit quickly and securely, and with a sufficiently long break to enable the arc to rise. It is also necessary that the circuit-breaker be so constructed as to afford protection to the circuit under any and all conditions of said circuit. For example, assume that a motor is grounded on one side of the circuit-breaker, and the line is grounded on the other side of the circuit-breaker. This produces two paths for the electricity on the grounded side, one path through the circuit-breaker and one path through the grounded side, and if this grounded side happens to be the side in which is connected the coil of a single-coil, double-pole circuit-breaker, it will render this coil inaccurate by the amount of current flowing through the ground. In a double-pole, double-coil circuit-breaker there will always be at least one side of a circuit-breaker which is not grounded.

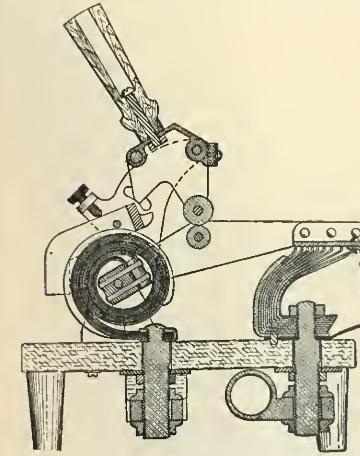


FIG. 2.—CROSS-SECTION OF 600-AMPERE OVERLOAD CIRCUIT-BREAKER.

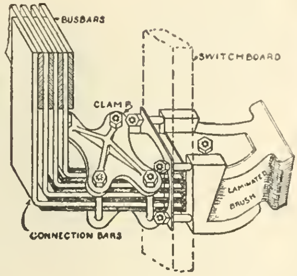


FIG. 3.—BRUSH FOR 300-AMPERE CIRCUIT-BREAKER.

Circuit-breakers are divided into several different types according to their applications. Figs. 1 and 2 show overload circuit-breakers which operate when the current flowing through the heavy series coil reaches a predetermined maximum. The second type, shown in Fig. 4, has a shunt trip attachment. That is, it is provided with a fine wire coil, and when its circuit is closed by means of a push button or other apparatus this coil is energized and the circuit-breaker is opened. This type of breaker is used wherever it is desired to open a circuit from a distant point, and has found its principal application on printing presses, cranes, etc. It is used on cranes to prevent the block from coming in contact with the body of the hoist. When so used, the block is provided with a small contact which closes the circuit when it comes in close proximity to the body of the crane and trips the circuit-breaker.

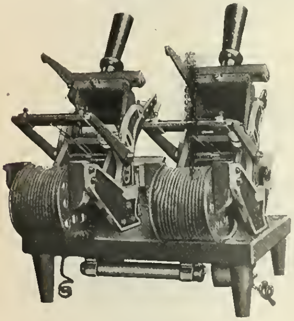


FIG. 5.—300-AMPERE DOUBLE-POLE, OVERLOAD AND NO-VOLTAGE CIRCUIT-BREAKER.

The type shown in Fig. 5 has a no-voltage release, and is one in which the circuit is opened when the current is removed from a fine wire coil instead of when a fine wire coil is energized. This type of breaker is used principally in the protection of motors, as the no-voltage attachment on the breaker is sure to open if for any reason the circuit is interrupted and prevents the sudden rush of current due to the throwing of full-voltage on the armature of a motor at rest.

Fig. 6 shows an underload circuit-breaker which operates when the current has reached a predetermined minimum value. The armature of this breaker normally tends to fall and is restrained by the pull created by the series coil. When the current has fallen to a predetermined point, the weight falls and trips the breaker. It will be noticed that the handle is fastened to an auxiliary piece pivoted to the handle lever. This pivoted piece has an extension bearing against the armature. In closing the breaker this projection pushes the armature against the core pin, while the armature is free to drop a considerable distance before tripping the breaker. This device renders the breaker sure and positive in its action. This type of breaker is used for the protection of storage batteries. When batteries are fully charged their voltage approaches that of the generator, and the passage of current is small. The breaker is so set that it will open when this current is diminished to one tenth of normal current.

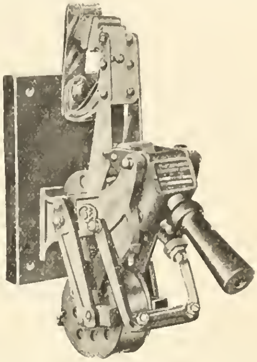


FIG. 4.—100-AMPERE OVERLOAD SHUNT-STRIP CIRCUIT-BREAKER.

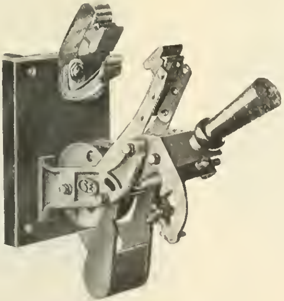


FIG. 6.—100 AMPERE UNDERLOAD CIRCUIT-BREAKER.

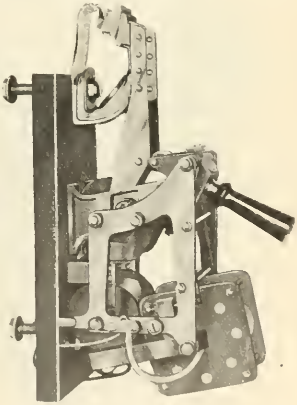


FIG. 7.—700 AMPERE SINGLE POLE OVERLOAD AND REVERSE CURRENT CIRCUIT-BREAKER.

Fig. 7 shows an overload, reverse-current circuit-breaker which operates on an overload, or when the direction of the flow of the current has reversed. In this type of circuit-breaker there is a core which is energized by means of a series coil, the polarity of this core depending on the direction of the flow of current through the series coil. There is also a moving U-shaped armature co-operating with this core, the polarity of this moving U-shaped armature being fixed by means of a potential coil. Inasmuch as the polarity of the current is not reversed when the direction of the current flow is reversed, the potential coil will maintain a constant polarity on the U-shaped portion of the magnetic circuit. When the current is flowing in normal direction, the polarities of the two parts of the magnetic circuit are so fixed that they will oppose each other. When the polarity of one, therefore, is reversed due to the reversal of the flow of energy through the circuit, the two parts of the magnetic circuit will attract each other and cause a movement of the U-shaped portion, which will trip the circuit-breaker.

It will be noticed that if for any reason the potential coil is de-energized, due to failure of potential on the circuit caused by destruction of the coil by lightning or the accidental breaking of any of the connections, the series coil will immediately move the U-shaped portion which completes the magnetic circuit and will trip the circuit-breaker in such an event. The parts are so proportioned that this will happen when from 50 per cent to 75 per cent of full-load current is passing through the circuit-breaker.

Storage Ignition Battery.

The Helios Manufacturing Company, Bridesburg, Philadelphia, Pa., has placed upon the market a type of storage ignition battery which is claimed to possess many advantageous features. The containing case is of very heavy hard rubber, divided by hard rubber partitions into two or three compartments so as to contain either two or three separate elements. Each compartment is provided with a cover, which is sealed into place, and over these individual covers is placed a heavy hard-rubber master cover, which effectually conceals all of the live parts, and entirely prevents the slopping of acid, even under severe service.

STORAGE IGNITION BATTERY.

On the bottom of the containing jars are strips of soft rubber, and a soft-rubber band passes entirely around the lower portion of the case so that shocks from severe road service are absorbed sufficiently to prevent the jars from being broken.

The handle by which the complete battery can be carried is of rubber webbing, and there is absolutely no metal exposed to become corroded, nor is there any wooden case to become saturated with acid, thereby not only destroying its appearance, but causing a leakage of the current from one cell to another. There is no brass used at any point in this battery, nor is there anything that can be deteriorated or acted upon by either acid or fumes. It is stated that the construction of the battery is so simple that in case of damage or deterioration of the elements, they can be replaced by a novice, and all the parts are interchangeable so that repairs can be furnished at any time, if needed.

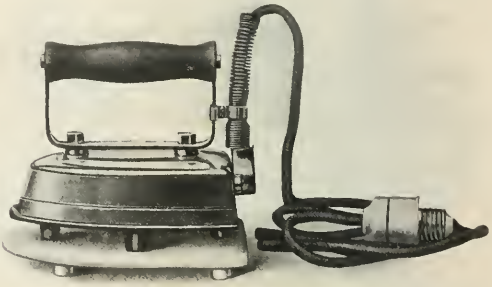
Electric Equipment of a Copper Concentrator.

Sixteen miles east from Salt Lake City there has recently been completed a concentrator plant from which more than 150,000 lb. of copper will be obtained per day. For the operation of the mill there has been installed a 7000-hp station containing three-phase generators driven by reciprocating engines. The generators are wound for 4000 volts; the e. m. f. is transformed to 440 volts for driving induction motors in the mill, and to 40,000 volts for the transmission of energy over a 15-mile line to a small mill at Bingham canon. J. G. White & Company acted as consulting engineers for the plant. The Gates gyratory breakers and mill machinery, and two 1500-hp Reynolds-Corliss engines were built by the Allis-Chalmers Company.

Electrically Heated Sad-Iron.

The electrically heated sad-iron shown in the accompanying illustration is now placed on the market by the Westinghouse Electric & Manufacturing Company. In form the iron differs only from an ordinary utensil in its more symmetrical and attractive appearance, and in being provided with terminals and a flexible cord through which the current is transmitted. Its heating mechanism, which is entirely concealed, keeps the iron at the proper temperature at a minimum consumption of current. It consists of a flat insulated resistance strip clamped by hydraulic pressure between two flat iron plates, forming a solid heating element of high thermal conductivity, and having a large heat-storage capacity.

The design of the element is such that the heat is evenly distributed over the entire bottom of the iron, the edges and point being practically the same temperature as the middle of the bottom. A non-conducting element is used between the top of the iron and the heating unit. This construction results in the top of the iron being cooler than its face. The heating unit is hermetically sealed in its insulation and cannot, therefore, deteriorate any faster than the iron, as it is not subject to the oxidizing effects caused by contact with air.



ELECTRIC SAD-IRON.

The iron is extremely simple and with nothing to get out of order or to require renewal. Irons which have been in use continually for the past six years, without costing a cent for repairs, are in as good condition to-day as ever. In fact, the electrical construction is so simple and durable that there is no reason why it should not last as long as the iron itself.

The terminals are protected by a solid metal guard, and the cord leading from them is securely anchored by a clamp on the handle of the iron. A wire spring which surrounds the cord at this point prevents any sharp bends. A separable plug is provided by which the iron can be connected to any convenient lamp socket without twisting. A small spring attached to the cord takes up all slack, and so keeps it from dragging on the clothes or getting in the way of the operator.

The polishing surface of the iron is of highly polished cast-iron, found by experience to be the most satisfactory surface for the purpose. The upper portions of the iron have a burnished nickel-plate surface. The handle is of ebonized wood, heat-proof and unbreakable. A heat-proof stand, upon which the iron should be set when not in use, is provided with every iron. The irons are made to suit all commercial lighting circuits, and can be used on either alternating or direct current with equally satisfactory results.

Motor-Starting Enclosed Rheostats.

The Ward Leonard Electric Company, Bronxville, N. Y., has placed on the market a line of motor-starting rheostats having both the resistance portion and the face plate entirely enclosed; that is to say, all current-carrying parts are enclosed by casings.

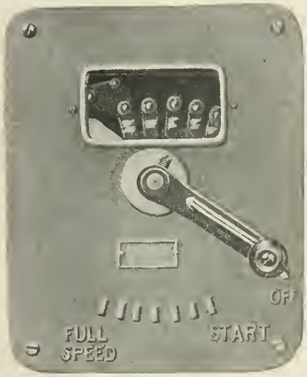


FIG. 1.—FACE OF MOTOR-STARTING RHEOSTAT.

In dusty, dirty places previous practice has been to place the motor-starting rheostat inside of a slate box in order that accumulated dampness or dirt could not affect the parts, thereby causing a short-circuit and presenting a fire hazard. In practice it is found that the door of these enclosing cabinets is usually left partly or entirely open; an accumulation of dirt occurs with its consequent damage. This new line of rheostats possesses the advantage that the enclosing case is always closed. As designed, the controlling lever does not carry current. The lead wires enter through bushings, and a plate of glass is set in the case enclosing the face plate so that the operator can readily see the contacts. All of the Ward Leonard protective features are embodied in these new rheostats.

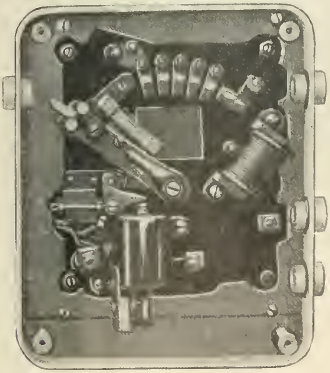


FIG. 2.—VIEW OF MECHANISM.

Electrical Machinery for Gold Assaying.

The Charles J. Bogue Electric Company is shipping to the government mint at San Francisco an electrical machine to be used in determination work in a new chloride-of-gold process. The equipment consists of a motor-generator set with a 2½-hp 30-volt motor and a 200-ampere, 6-volt generator, regulated from one-half to six volts. One of the first of these machines was set up in the mint at Philadelphia about two years ago and has a 1500-ampere, 15-volt generator. During the test, which takes from 10 to 14 days, the motor runs continuously.

Circuit Fittings for Emergency Work.

James S. Stewart, chief electrician of the Madison Square Garden, has designed a line of receptacles, rosettes, sockets, etc., particularly adapted for emergency lighting circuits. Before he became connected with the Madison Square Garden, Mr. Stewart was chief electrician of the Metropolitan Opera House. At the Garden the various shows during the winter follow one another in close succession, with sometimes less than 24 hours intervening, and as often the whole scheme of lighting is entirely changed to meet the requirements of the coming show, the electricians are compelled to work under the highest pressure. Mr. Stewart's inventions contain many time- and labor-saving points, and will be of great value in places like the Garden, where rapid work is necessary. The Atlantic Electric Goods Company will put the line on the market in about two months.

Large Storage-Battery Equipment.

The Electric Storage Battery Company, of Philadelphia, has recently installed in the Edgar Thomson Works, of the Carnegie Steel Company, a storage battery consisting of 125 elements, and having a capacity of 10,000 amperes, with switchboard and two regulating boosters, one of which is a spare unit. This will be used in regulating load fluctuations and can be discharged at a rate of 15,000 amperes in times of emergency.

The chief cause of the fluctuations of load necessitating a battery of such great capacity is the operation of two 750-hp 250-volt electric motors in one of the rail rolling mills. The current taken from these motors often varies from nothing to 15,000 amperes within a period of a few seconds, the result being not only to cause heavy strains on the generating apparatus, but to increase the number of generators necessary over those that would be required were it not for these excessive fluctuations. Although the battery is located near the rail mill, the booster regulating the coil is located between the generator bus and the feeder panels, so that smaller fluctuations of load due to cranes, skip hoists, etc., are also handled by the battery and the load on the generator is kept practically constant. The improvement in the service can be realized by the fact that since the installation of the battery it has been found possible to cut off a 1000-kw generator from the system, which means that the plant is often operated with less than half the generating apparatus than was found necessary before the battery was installed. It also provides the steel company with a generator which can be used as a reserve or to meet the rapidly growing demand on the power station. The above battery has a greater current output than any other individual battery installation in the world. It is the tenth largest battery contracted for by the Electric Storage Battery Company for this class of service.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies are to the effect that buying of spring goods was more active last week, but was dominated by caution and conservatism. In no case, however, was the buying reported equal to that a year ago and in some instances the decreases were very heavy. Reports as to the various industries were conflicting, more business being done in some instances, with numerous resumptions of full time noted. Some finished iron and steel mills resumed, but others were reported slowing down, and the improvement as a whole was slight. Railway earnings continue to decrease and leading railway systems report one-third of their cars idle. Collections are still backward, being especially slow at the south, where much cotton is being held. Business and collections are, however, reported better in the Pacific Northwest. Prices of commodities are lower, especially at the exchanges dealing in farm staples. Wheat fell to the lowest price of the season on smaller export inquiries and statements of large shipments from Argentina. Railway earnings for the first week of February decreased 15.4 per cent as compared with the same period last year, and foreign commerce at the port of New York for the week showed a gain of $4,321,043 in exports and a loss of $6,370,677 in imports from the movement in 1907. Pig iron continues dull but the demand for steel bars was a little improved. New business in steel rails was light, and there was a fair demand for structural material, but prices were cut by independent interests. Wire, wire products and tin plate were the bright spots in the general situation. Operations have been resumed in part in some finishing plants, but the movement in this respect was very slow. *Bradstreet's* reports 326 business failures during the week ending Feb. 13 against 273 in the previous week and 204 in the corresponding week last year.

THE PANIC—RETROSPECT AND PROSPECT.—Commenting on the causes of the recent financial depression and carrying his line of reasoning farther back than most persons, Mr. Arthur Williams, general inspector of the New York Edison Company, believes that the panic was brought about by a series of events, world-wide in their influence and extending over a period of years and which finally compelled a universal readjustment of values. Mr. Williams, who is a close student of economic conditions, believes that under the present situation business stagnation cannot continue for any length of time. He says: "In this country it would be impossible for industrial stagnation to continue long. There is too little margin between the minimum of consumption and the maximum of production. On every hand appear unmistakable evidences of renewed activity in the business world. Building construction, the last to feel the force of the money stringency, will also probably be the last to recover from the effects of the recent crisis. Contracts are usually made well in advance of actual work and many months pass in their fulfilment—stagnation follows after the crisis has been reached and passed in many other industrial directions. While as yet there may be little improvement in building operations, manufacturies, especially of life's necessities, appear commencing to resume on a large scale. The causes for the recent depression lay in the head rather than the body of the nation. We now lack the fundamental causes found in similar periods of history, namely, over-production and short crops. To-day, according to the well informed, we seem to have practically no over-production, and crops were never more abundant. Over the basic conditions which finally resulted in the panic no human agency probable could have had complete control. Personally I am of the opinion that they were the result of an inevitable readjustment of monetary values brought about by a series of events, world-wide in their extent. As time passes much of the original cause of our recent troubles will doubtless be found in the readjustment of interest values. Where money is plentiful and the demand for it limited, interest rates go down; where the reverse is true, and money is hard to get, because of the many opportunities for its safe use, the price that people are willing to pay to use it—interest—goes up. All recall that just previous to 1898 in every direction interest was falling. Great corporations were floating their bonds on a 3½ per cent basis and many of the savings banks reduced the interest to their depositors to the same rate. If I recall rightly, predictions were freely offered that the time was not far distant when this country would be on a 3 per cent basis, and I believe that government bonds were actually sold on a basis of 2 per cent, but, here, other considerations also counted. This period was followed by the Spanish-American war with its accompanying cost, the awakening of many branches of industry in this country, the destruction of great property values and the opening up of the Philippines, Porto Rico and Cuba to the investor who, assured of comparative safety of various enterprises, found a much higher rate of interest for his money than any corresponding industries of this country were then prepared to offer. This was followed by the Boer war, again costing vast sums, attended by the destruction of millions of property and the opening up of new fields for English investments, again paying higher rates of interest. Even greater moment was the Russian-Japanese war, destroying the navy of one country, as well as much property, and costing millions daily. Japanese loans were floated in England and here on more than a 6 per cent basis, and Russia, also in the market for money, was compelled to outbid former rates of interest. The destruction of San Francisco by earthquake and lesser catastrophes have also made large demands for capital; likewise the great undertakings of the railroads, examples being found in the New York Central and the Pennsylvania, and the embarking upon new industries in every direction have added their part in increasing the demand for capital and the prices people are willing to pay for its use. It became necessary that investments in stocks and bonds, of even the highest order, should readjust themselves from a basis of 3, 4 and 5 per cent to, in many instances, more than that which they were previously returning upon their market values. Practically all business is conducted on credit. The supply of gold—the basis of all values—is comparatively limited, and credit based upon confidence takes its place and enables the conduct of the industries of the country on their present enormous scale. Take away this confidence, and chaos inevitably follows. It is now in process of being restored, and when fully restored, probably little in the way of industrial activity will be left to be desired. There is little cause to fear that the time of complete restoration is far removed. There are no serious political issues at stake. We are to be congratulated upon the character of the men prominent in the public life of our country—the best in men is coming to the surface, moral standards are higher than they have ever been and the day of the demagogue and the muck-raker seems to have passed, never to return. All this is due, perhaps more than to any other cause, to the higher average of education of the people, who are not to be long deceived by sophistries or false doctrines. In connection with our depression and financial panic it will be remembered that these have not been confined to this country, but have been of world-wide extent. Readjustments, however, seem to have been largely, if not entirely, completed and before long we will be wondering how it all came about and why, when the opportunity presented itself, we did not invest our money to better advantage. The enterprises of the future will undoubtedly be as large and on an even larger scale than in the past. Universal economic development cannot be halted any more than it is possible to prevent electricity from replacing candle light or steam from replacing mule power."

ARIZONA POWER COMPANY.—The Electric Operating Construction Company, of 49 Wall Street, New York, has completed the financing of the Arizona Power Company, 7500-hp water-power development near Prescott, Ariz. William P. Bonbright & Company, of 24 Broad Street, act as fiscal agents, and Viele, Blackwell & Buck are the consulting engineers. The Electric Operating Construction Company will itself manage the construction, and its chief engineer, R. S. Masson, has located at Prescott to direct the work.

COPPER PRODUCTION IN UTAH AND NEVADA.—The Utah Copper Company, controlled largely by Guggenheim interests, is stated to be now producing at the rate of 3,000,000 pounds of copper a month, and it is reported that production will be increased to 4,000,000 pounds, or at the rate of 48,000,000 pounds a year, by the middle of next summer. It is figured that the mine is producing copper at a cost of less than 9 cents a pound. This low cost of production bears out the optimistic statements made from time to time in connection with the low cost of turning out copper in the Bingham camp. The same conditions apply to the copper properties in the Ely, Nev., camp, where the Guggenheims are the controlling factors of the Cumberland-Ely and Nevada Consolidated companies. The concentrator owned jointly by these companies will begin operations by April next and the smelter will be completed in the following month. It is figured that the Cumberland-Ely can produce copper at a cost of 1½ cents a pound below that of the Utah Copper Co. The plant of the company will be put gradually into commission, so that the Cumberland-Ely can produce at the rate of 2,500,000 pounds of copper a month by Aug. 1, 1908. The railroad has been completed to the veteran mine of the Cumberland property. The Cumberland-Ely will require no more financing, and will start business with a substantial working capital.

NOT A "BOOM" YEAR.—"However much conditions in the business world have improved," said W. S. Doran, of the Alberger Condenser Company, in speaking of the general situation, "we cannot expect the year of 1908 to be a 'boom' year. The outlook is excellent, but the political situation always causes affairs to slow up and we must expect things to remain more or less quiet until the political situation has been straightened out and settled. The depression was rather welcomed by many of us. We were far behind in our orders and were glad of an opportunity to come abreast of our business. Incidentally it gave us an opportunity to do a little necessary house cleaning. Just as the depression is commencing to make itself felt we note the signs of business revival. Daily inquiries have been received in increasing volume and a number of large orders. The big contract must not be looked for until after the elections, when the political atmosphere has cleared. Then we may expect to see times as good or better than we ever have seen them before. But the railroads, which are among the heaviest buyers, have been hard hit by the policy of the present administration. Public confidence in their values has been shaken and as a consequence they have not been able to market their bonds. Without money it is impossible for them to go ahead with projected extensions and improvements."

ALLIS-CHALMERS SALES.—The Allis-Chalmers Company reports that within a week it sold machines for motor drives in capacity ranging from 1 to 200 hp to a score or more manufacturing companies distributed throughout the United States. Among these are the Procter-Gamble Company, Cincinnati; Berwind-White Coal Mining Company, Windber, Pa.; Crane & Company, Chicago; Goldfield (Neb.) Consolidated Mines Company; Diamond Match Company, Barberton, Ohio; Cudahy Brothers, Cudahy, Wis.; Goulds Pump Manufacturing Company, Seneca Falls, N. Y. Among other recent sales of the Allis-Chalmers Company are a 300-kw, direct-connected unit for the shops of the Chicago, St. Paul, Minneapolis & Omaha Railroad at St. Paul, Minn.; a 1200-kw, direct-connected, 550-volt unit to the Mobile Light & Railway Company, Mobile, Ala.; a 100-kw alternator to the Seattle-Tacoma Power Company, which supplements an equipment of three large water-wheel generators installed by the same builders in the hydraulic plant of this company.

GENERAL ELECTRIC LAMP FACTORIES.—The General Electric Company has made formal announcement of the erection of four lamp factories in different parts of the country, reference to which has appeared in these columns. The new factories are situated at East Boston, Mass.; Toledo, Ohio; Fort Wayne, Ind., and Newark, N. J. The factory at Toledo will produce only gem filament lamps; at the Newark factory only tungsten filaments will be made, while the factories at East Boston and Fort Wayne will produce regular carbon filament lamps. A new factory building has also been erected at Harrison, N. J., adjoining the present lamp factory, which is devoted to the production of tungsten lamps. It is stated that the total productive capacity of the General Electric Company lamp factories now aggregates 60,000,000 lamps per year.

SALES OF COPPER MINES.—The Summit group of copper mines has been sold by the Phoenix Securities Company, of New York, to the Stauffer Chemical Company, of San Francisco, which has large mining interests at several points in the state. The Summit group of 30 copper claims lies adjacent to the Mammoth. A great deal of development work has been done and enough copper ore uncovered to warrant either the erection of a smelter or the building of a transportation system for the shipment of the ore to the chemical works. The Stauffer Chemical Company took a bond on the Summit in May. The bond has nine months more to run, but the company was so well pleased with the property that it was willing to pay cash for the mine before the bond expired, a discount being made for the early payment.

WESTINGHOUSE LAMP COMPANY RECEIVERSHIP.—On Feb. 24 the matter of the discharge of the receivers for the Westinghouse Lamp Company will come up in the United States Circuit Court, in Newark. It is stated that 98 per cent in amount of the creditors having claims in excess of $500 have signed an agreement consenting to the extension of the time of payment until Jan. 1, 1909, and to the turning over of all assets and property in the hands of the receivers to the company. The net profit from the business from Oct. 26 to Dec. 31 was $34,129.33. The receivers have on hand $91,620, which will be sufficient, after paying the expenses of the receivership, for the payment of all accounts and notes under $500 with interest, and leave a balance sufficient to continue business safely.

ANOTHER OPTIMIST.—Mr. R. B. Corey, of the R. B. Corey Company, speaking of the outlook in the contracting and engineering supply field, sees a marked improvement in the present conditions and the prospects for the future. "There is a better feeling throughout the business world," he said; "the increase of money in the banks and the consequent easing of the money situation has done as much as anything to restore confidence. Dealers in electrical supplies and electrical contractors are buying more freely than for some time and every indication seems to point to a good business year."

ELECTRICAL MACHINERY FOR CHILI.—Recent shipments to customers in Chili by J. K. Robinson, representing the Westinghouse Electric Company and the Westinghouse Machine Company, in Chili, Bolivia, Peru and Ecuador are as follows: Two 85-kw generators, 30 motors, 2 double-drum electric hoists; to another concern, one 85-kw generator, 15 motors and one double-drum electric hoist; to a third customer, 2 Gould triplex electric pumps for pumping petroleum, operating 1500 pounds to the square inch. The shipments include a Robbins belt conveyor and 20 silent chain drives, using Morse chains.

MEXICAN MINE EQUIPMENT.—The General Electric Company is furnishing the entire electrical equipment for the Tajo Mines, in the Rosario district of Mexico. The order includes a three-phase, 60-cycle, 2300-volt revolving-field generator of 150-kw capacity; nine oil-cooled transformers; three 440-volt induction motors of 15, 35 and 75-hp capacity, with starting compensators; two-circuit feeder panel; complete lightning arrester equipment, and the necessary wire, insulators, etc.

CURTIS BATTERY COMPANY.—The Curtis Battery Company, of Minneapolis, Minn., has been reorganized, and has started work on the manufacture of the Curtis battery, making a specialty of batteries for train lighting. The directors of the company are: W. W. Heffelfinger, E. C. Best, W. W. Leonard, C. W. Hack, C. W. Gardner, of Minneapolis, and A. W. Trenholm and G. Scholle, of St. Paul.

JANUARY BETTER THAN DECEMBER.—"Things are quiet now," said C. H. Florandin, of the C. & C. Electric Company, when asked about the outlook in the electrical field for the coming year, "but business has shown a marked improvement in January as compared with December. If the improvement continues throughout the year in the same ratio there should be no complaints coming from anybody."

THE PENNSYLVANIA ROYAL ARC LAMP COMPANY has been incorporated to market the "Royal" flaming arc lamp, made by the Royal Lamp Company, New York. Mr. James R. Dodworth is president, and Mr. Frank B. Ward, general manager of the company.

WESTINGHOUSE ORDERS.—Orders have been received by the Westinghouse Company for $75,000 worth of electrical machinery for Mexican mining, electric light and traction companies.

THE COPPER SITUATION.—The prediction of 12-cent copper for March seems more than likely to be realized, unless there is some decided improvement in the copper situation. On Monday electrolytic broke through 13c. to 12¾c., making the lowest level reported this year, and within ¾ of a cent of the low level for 1907. London, which has been the key to the situation for the last six months, is reported to be stocked with American copper, and the flattening of the London and Continental markets is thought to have forced foreign holders of the metal to throw their stocks on the market at any price. The demand from abroad has been the sustaining feature of the copper market for a long time, and the growing industrial inactivity on the Continent has had a disastrous effect upon the home market. The shipments to London have, of late, been largely speculative in character, and large quantities of the metal have been stored in British warehouses, awaiting an advance in price. The failure of the American market to improve, and the report that the Amalgamated Company is contemplating resumption in many of its mines, have been bear factors which have forced the London dealers to liquidate rather than carry their stocks longer in the face of a declining market. During the last four months Europe has taken in all about 250,000,000 pounds, and declining exports for February indicate the limit has been reached. It cannot be denied that the developments of the copper situation have proved a disappointment to nearly every one. The January indications of a better market for the metal have not been realized. American consumers are not buying in any considerable quantities, but stick to their policy of purchasing only enough for their immediate needs. It is certain that there will have to be a substantial betterment of the business situation before there will be any chance for improvement in the copper market. Electrical consumption of copper also shows no signs of improvement. The large buyers are inclined to look on the market with suspicion. "During the last six months," said a representative for one of the largest consumers of copper in the electrical line, "there has been more manipulation in the copper market than at any during the last six years. I can see nothing at present that might cause copper to go higher, and I can see many causes that might force prices lower. So I am doing like nearly every one else, keeping away from the market as much as possible." At the Metal Exchange on Monday prices were quoted as follows:

	Monday.		Friday.	
	Bid.	Asked.	Bid.	Asked.
Lake	$12.75	$13.50	$13.12½	$13.37½
Electrolytic	12.62½	12.87½	12.87½	13.12½
Castings	12.50	12.75	12.75	12.87½

London metal prices were as follows:

	Opening to-day. £ s. d.	Closing to-day. £ s. d.	Closing Friday. £ s. d.
Copper, spot	57 12 6	57 12 6	58 10 0
Copper, futures	58 0 0	58 0 0	59 0 0
Copper, best selected	62 10 0	62 10 0	63 0 0

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¾
Lake copper, spot	13⅞	12⅞
Casting copper, spot	13½	12⅝
London, spot	£64 5 0	£57 12 6
London, futures	64 10 0	58 0 0
London, best selected	67 10 0	62 10 0

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and weak early in the week, with apparent renewed liquidation and evidences of aggressiveness by bearish speculative interests. Among the weakest features were the Gould stocks, regarding which unfavorable reports were circulated. Reports of better indications in different lines of trade were passed without much notice on the part of the market, but the accumulation of idle cars, with the decreased traffic and earnings of railroad companies which it indicates, formed the basis for not a little talk about further developments connected with cutting down or passing of dividends. The activity throughout was on a rather moderate scale and was concentrated upon a comparatively few issues. At the close of the week a more bullish spirit was in evidence. Electric stocks were weak and closed with net declines, Western Union being the heaviest loser. This stock closed at 46½, which is a net loss of 7 points for the week. The reason for the weakness in Western Union was due, it was stated, to the unsatisfactory financial condition of the company. For the fiscal year ended June 30, 1907, the company reported a surplus over fixed charges and the 5 per cent dividend of exactly $36,053. The recently published earnings for the first half of the year ended Dec. 31 showed net of $688,507, or $177,618 less than was required to pay interest charges. The deficit on that date amounted to $2,611,668. Instead of its being a question of whether or not the regular dividend would be paid, it is a question of how the interest charges will be met. Last January the company paid its quarterly dividend in stock, but up to that time 5 per cent in cash had been paid regularly since 1887. In 1880 it sold as high as 116½, and during 1892, 1893 and 1901 it touched par. The general drift of prices on the curb market was downward, with a temporary rally toward the close, followed by sagging quotations. Following are the closing quotations of Feb. 17:

NEW YORK.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
Allis-Chalmers Co.	6	6	Interborough Met. com	7¼	7¼
Allis-Chalmers Co. pfd.	18	17	Interborough Met. pfd.	19½	18¼
Amalgamated Copper	48⅛	46¼	Mackay Cos.	52¾	52
Am. Dist. Tel.	39*	39*	Mackay Cos. pfd.	61	58
American Locomotive	33¾	33	Metropolitan St. Ry.	20½	—
Amer. Locomotive pfd.	87⅞	88	N. Y. & N. J. Tel.	98½	90
American Tel. & Cable	55	55	U. S. Steel com	27¼	27⅝
American Tel. & Tel.	106	105	U. S. Steel pfd	90¼	91½
Brooklyn Rapid Tran.	39¾	38¾	Western Union Tel.	53½	46½
General Electric	115½	114	Westinghouse com.	40	40½
Hudson River Tel.	—	—	Westinghouse pfd.	70	70

BOSTON.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
Amer. Tel. & Tel.	105½	—	Mass. Elec. Ry. pfd.	—	42
Cumberland Telephone	—	—	Mexican Telephone	—	—
Edison Elec. Illum.	208	205	New England Telep.	—	110
General Electric	—	114½	Western Tel. & Tel.	—	—
Mass. Elec. Ry.	—	11	West. Tel. & Tel. pfd.	—	—

PHILADELPHIA.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
American Railways	42¾	33	Phila. Electric	5⅝	5⅜
Elec. Co. of America	8¾	8¾	Phila. Rapid Transit	15½	15
Elec. Storage Battery	27	26	Phila. Traction	—	86
Elec. Stor. Battery pfd	—	—			

CHICAGO.

	Feb. 8	Feb. 17		Feb. 8	Feb. 17
Chicago City Ry.	172*	172*	Metropolitan Elec. com	17	14
Commonwealth-Edison	86	84	National Carbon	—	53
Chicago Subway	16	—	National Carbon pfd.	—	100
Chicago Tel. Co.	115½				

*Asked.

NIAGARA ELECTRICAL DEVELOPMENT COMPANY.—According to a telegram to the New York *Tribune*, William McKenzie, president of the Toronto Railway Company, will advance $3,000,000—$2,000,000 of which is to satisfy creditors and $1,000,000 to be used for developments—to save from liquidation the Electrical Development Company at Niagara Falls. It is stated that as a result of this deal, the Canadian Northern Railway, which is to be extended through Western Ontario, will probably be made an electric system; also that an electric railway will be built from Niagara to Toronto, with running arrangements with the New York Central, and that the Electrical Development Company will supply power to the Grand Trunk for some of its lines in the Niagara district.

NEW YORK STATE ELECTRIC LIGHT MERGER.—The Public Service Commission in the Second District of New York State has finally approved the merger by the Utica Gas & Electric Company with the Herkimer Light & Power Company, the Glens Falls Gas & Electric Company, the Consolidated Light & Power Company, of Whitehall, and 51 per cent of the Union Gas, Electric Light & Fuel Company, of Sandy Hill and Fort Edward. There will be a bond issue of $3,000,000 to carry out the merger.

CHICAGO TELEPHONE.—The annual report of the Chicago Telephone Company shows that the stockholders increased 51 per cent in the last year, and that the American Telephone & Telegraph Company still holds 52 per cent of the stock. The gross earnings were $8,718,951, an increase of about $800,000 over the previous year; the expenses were $6,976,868, an increase of about $700,000 over the previous year. The earnings represent 10.3 per cent on the capital stock.

BELL TELEPHONE REPORT.—The American Telephone & Telegraph Company reports a balance over its operations of $16,269,387 for the year ending Dec. 31, 1907, equivalent to 10.01 per cent on the $353,476,600 capital stock. The assets of the company are reported at $396,357,982, the surplus being $30,738,418.

WEST END STREET RAILWAY BONDS.—The West End Street Railway of Boston has sold $7,000,000 4½ per cent, 15-year bonds to a syndicate composed of Parkinson & Burr, Blake Bros. & Company and E. H. Rollins & Sons.

CHICAGO UNION TRACTION RECEIVERS.—Notice has been given that all claims against the Union Traction Railway, of Chicago, must be filed with the receiver by Aug. 1.

PACIFIC LIGHT & POWER COMPANY.—The Pacific Light & Power Company, of Los Angeles, Cal., according to the report recently filed with the city clerk by Charles Foreman, secretary of the corporation, earned $413,142.55 in profits for its stockholders during 1907. The earnings from light in the city are declared to have been $463,882.82, and from power in the city $525,894.40. The total earnings are reported to have been $1,281,055.01, the inference being that the difference of $291,277.79 represents the proceeds of the sale of light and power outside the city, although it is not specifically so stated. The expenditures for supplying light and power in the city were, for operating, $271,938.66; general expenses, $92,720.50; fixed charges, $74,155.25. For supplying light and power outside the city the expenses were: Operating, $30,215.41; general expenses, $10,302.28; fixed charges, $8,239.47. The expenditures during the year at plants used for gas, railway and water service outside the city and the expenditure for interest totaled $380,340.89, making a total expense of $867,912.46. The total current sold inside and outside the city for light and power aggregated $3,081,120. The possessions of the company are stated as follows: Land, $507,763; transmission and distributing systems, $3,991,228.37; horses, wagons and harness, $12,723.70. Replacements are valued at $586,667.81, making the alleged actual cost of properties $7,233,274.51.

WESTERN ELECTRIC BOND ISSUE.—Dispatches from Chicago state that President Barton, of the Western Electric Company, said, when asked what had become of the "proposed bond issue": "We have done nothing about it and are not likely to in the near future. The necessity for a bond issue has largely ceased. Besides, there is no bond market. Our indebtedness is considerable; it is large in the aggregate, but not larger than we can carry comfortably as a floating debt. The tendency of money rates is downward, and our policy is further to reduce our debt. We consider our financial position a favorable one at present. The present volume of orders ahead and for immediate use is small. We do not see anything in the immediate future to lead us to expect any substantial increase. We thought we saw signs of a revival in November and December, and our business did improve somewhat, but during January orders were very light. We are not looking for any early improvement. Our first effort now is to adjust expenses to the volume of business. We had the misfortune of three years' profits compressed into one year. We are paying the penalty for too much success."

MACKAY COMPANIES' REPORT.—The annual report of the Mackay Companies, a holding corporation for the Postal Telegraph & Commercial Cable Companies, as well as the owner in whole or in part of the stock of 102 cable, telephone and telegraph companies of the United States, Canada and Europe, gives the receipts for the year ending Feb. 1 as $3,330,390. The value of the companies' investments is about $92,075,593. The capital outstanding consists of $50,000,000 preferred and $41,380,440 common stock. The companies have been earning during the past quarter more than is necessary for the dividends of preferred and common stocks, notwithstanding the general business depression. Dividends of 4 per cent have been paid on each class of stock. The report states that the Mackay Company continues to be the largest stockholder in the American Telephone & Telegraph Company, and during the year subscribed through the Commercial Cable Company for its proportion of the new stock issued in June, 1907, by the telephone company.

APPLICATION FOR RECEIVER FOR UNITED STATES INDEPENDENT TELEPHONE COMPANY.—An application has been made to adjudge the United States Independent Telephone Company insolvent and place it in the hands of a receiver. The capital stock of the company is $50,000,000, of which $42,576,000 has been issued. At present the company has no president; the first vice-president is John N. Rouher, and the secretary and treasurer, W. Roy McCanne, both of Rochester, N. Y. Adolph Busch, of St. Louis, is stated to be one of the 24 directors. The assets of the company are declared to be large interests in the Rochester Telephone Company, the Stromberg-Carlson Telephone Manufacturing Company, the New York Independent Telephone Company, and the Utah Independent Telephone Company. The application for receivership was made by James M. E. O'Grady, of Rochester, N. Y. Justice Foote, at Rochester, on Monday, granted a motion asking that Henry W. Conklin be appointed receiver for the United States Independent Telephone Company. Ex-Justice Nash, who made the motion, is reported to have appeared as a trustee of the Security Trust Company. Receivership proceedings will also come up this week at Newark, N. J., on motion of the attorney of the United States Independent Bondholders' Protective Association.

HUDSON COMPANY BOND ISSUE.—Through Harvey Fisk & Sons, bankers, the Hudson Companies offer $5,000,000 of an issue of 6 per cent gold notes, with $15,000,000 as the limit of the issue. These notes are issued to complete and equip the system of the Hudson & Manhattan Railroad Company, which owns and will operate the four tunnels under the Hudson River connecting Jersey City and Hoboken with New York City. They are offered at 98½ and interest, yielding more than 6½ per cent per annum, and are secured by the pledge of the Hudson & Manhattan Railroad Company first mortgage 4½ per cent convertible gold bonds, due 1957, at the rate of $1,500 par value of bonds for each $1,000 note outstanding. The first mortgage 4½ per cent bonds are secured by a first lien upon all the property of the Hudson & Manhattan Railroad Company.

DIVIDENDS.—The directors of the Susquehanna Railway, Light & Power Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 2. Directors of the American Railways Company have declared the regular quarterly dividend of 1½ per cent (75 cents per share), payable March 16. The directors of the Susquehanna Railway, Light & Power Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable March 2. The directors of the Kansas City Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable March 2. The directors of the Rochester Railway & Light Company have declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable March 2.

WESTINGHOUSE PLAN PROGRESSING.—As a result of the letter sent out by the Westinghouse Reorganization Committee to the creditors of the company, urging them to deposit their claims with the committee, it is announced that deposits are being made in a highly satisfactory manner, and it seems more than likely that the agreement and plan for the readjustment of debt will be successfully carried out. The depositories are the Bankers' Trust Company, New York, N. Y.; the First National Trust & Savings Bank, Chicago, Ill., and the First National Bank of Pittsburg, Pa. On March 1 the committee will meet to determine whether or not the plan may be put into operation.

THE DOSSERT SOLDERLESS CONNECTOR COMPANY.—The annual report of Dossert & Company for 1907 showed an increase in gross business of 27.5 per cent notwithstanding a falling off in the last quarter owing to the slowing down of construction work. It is stated that there has been a marked increase of orders, however, since the first of the year, the figures for January showing a large increase over the same month last year.

ROCKY MOUNTAIN BELL TELEPHONE.—President Lane, of the Rocky Mountain Bell Telephone Company, states that the reason for passing the quarterly dividend of the company is the serious manner in which its business has been affected by the closing down of coal and copper mines and smelters and the unsettled condition of labor, particularly in Montana. He is unable to say when dividends will be resumed.

MEXICAN LIGHT & POWER COMPANY.—The report of this company, which controls the hydro-electric plants on the Nexcaca and Tenango rivers, shows earnings from all properties in 1907 of $4,930,370 and net earnings of $1,490,114. The net earnings showed an increase of $415,000 over 1906. The property and franchise concessions are valued at $26,825,000 and the total assets at $30,888,000.

ELECTRIC STORAGE BATTERY.—In connection with the annual meeting of the Electric Storage Battery Company, on March 18, it has been reported that the par value of the stock will then be reduced from $100 to $50 per share. We are informed through an official source that there is no truth in this report.

PRESIDENT BARTON NOT TO RESIGN.—It is reported that President Barton of the Western Electric Company will not resign as rumored. To relieve him of much of the great amount of work he has been doing, the report says, he will shift some of his duties to younger men.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

CENTERVILLE, ALA.—The Centerville Power Company is considering the question of erecting a dam across the Cahaba River.

GUNTERSVILLE, ALA.—A company is being organized to establish an electric light plant in this place. V. V. Moore is interested in the project.

HUNTSVILLE, ALA.—The City Council is agitating the question of erecting a municipal electric light plant. The present contract with the Huntsville Railway, Light & Power Company expires at the end of this year, and as the Council has the power to make an issue of bonds for the purpose of establishing a municipal plant there is some discussion on the subject.

PRESCOTT, ARIZ.—Arrangements have been completed by the Electric Operating Construction Company, of New York, N. Y., for the financing of the Arizona Power Company, which proposes to erect a 7500-hp hydro-electric plant near Prescott. The Electric Operating Construction Company will take charge of the construction of the plant, and R. S. Masson, its chief engineer, has located at Prescott to direct the work. Viele, Blackwell & Buck, 49 Wall Street, New York, N. Y., are the consulting engineers.

COTTON PLANT, ARK.—The question of establishing an electric lighting plant in this town is under consideration. E. P. Ford, of St. Louis, Mo., is interested in the enterprise.

LESLIE, ARK.—The Williams Cooperage Company is making extensions to its electric light system.

LOS ANGELES, CAL.—Bids will be received by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., until March 17, for the installation of a conduit and electric wiring system for the U. S. court house and postoffice building at Los Angeles.

NEWMAN, CAL.—The Newman Light & Power Company contemplates erecting about 16 miles of new transmission lines. J. McDonald is president.

REDDING, CAL.—The Board of Trustees has awarded the contract for city lighting for the ensuing year to the Northern California Power Company for $208.05 per month. The contract calls for 33 arc lamps on the streets, a number of lamps for alleys and the lamps in the city hall. The new contract takes effect within 60 days.

REDLANDS, CAL.—The Southwestern Home Telephone Company has taken over the plant of the Pacific Telephone & Telegraph Company in this city.

SACRAMENTO, CAL.—The City Trustees have accepted the offer of the Sacramento Electric, Gas & Railway Company to furnish arc lamps for lighting the streets of the city at the rate of $6.30 per lamp per month for the ensuing year. The street lighting system now consists of 550 arc lamps. The city has been contemplating establishing a municipal electric light plant, and recently appointed Prof. C. L. Cory, of San Francisco, to investigate the cost of installing a plant. According to the report submitted by Prof. Cory to the Trustees, on a basis of 600 lamps, it would cost the city for the construction and operation of its own plant at the rate of $6.70 per lamp per month at the least. The cost of installing a plant to supply electricity for 600 arc lamps is estimated at $237,000, and for installing an incandescent system for lighting the city hall, library and other public buildings is estimated at about $18,000, making the total cost of the plant about $250,000. Under the circumstances the Trustees do not think it advisable to install a municipal plant at this time. The city has been paying at the rate of $7 per lamp per month. The new contract takes effect from Feb. 1.

DENVER, COL.—The Denver Gas & Electric Company is contemplating making improvements and extensions to its plant, the cost of which is estimated at $50,000. F. W. Frueaff is vice-president of the company.

HARTFORD, CONN.—The State Railroad Commissioners have issued an order giving the Shore Line Electric Company power to condemn certain pieces of land in the towns of Essex and Old Saybrook for the right of way for an electric railway.

SCOTLAND, CONN.—Bids will be received until March 2 by the Uncas Power Company, Norwich, Conn., for the completion of the power house above the foundations now in place, also for building a reinforced concrete dam on earth bottom about 200 feet in length and for a 25-foot head, located on the Shetucket River at Scotland, Conn., on the New York, New Haven & Hartford Railroad, including also certain embankments and other accessories.

JACKSONVILLE, FLA.—Sealed proposals will be received by the trustees for the Water Works and Improvement Bonds of the city of Jacksonville until March 4, for one Hamilton Corliss tandem compound engine, one General Electric 250-kw, 2300-volt, belted monocyclic generator with exciter. The machinery is now in use, but will be ready for delivery about April 1. For further information apply to R. N. Ellis, superintendent.

ATLANTA, GA.—The officials of the Southern Bell Telephone Company estimate the damage to its lines by the recent storm from $110,000 to $137,000, the loss in Atlanta is estimated from $10,000 to $12,000 and from $100,000 to $125,000 on the long-distance lines.

MACON, GA.—The Macon Railway & Light Company has purchased a 2,000-hp steam turbine from the Westinghouse Electric & Manufacturing Company for $58,000. The company has also reduced the price of electricity from 15 cents to 12 cents per kw-hour.

MACON, GA.—It is reported that the Macon Railway & Light Company has awarded contracts for new power house equipment, consisting of a new turbine and generator, at a cost of $53,000. The new machines will develop 2500 horse-power and will be installed this spring. W. J. Massee is president.

MACON, GA.—The Macon Railway & Light Company has reduced the price of electricity for lamps from 15 cents to 12 cents per kw-hour, with an additional 10 per cent reduction on all bills paid before the tenth of each month. The new schedule took effect Feb. 1.

MILLEDGEVILLE, GA.—Plans are being made by the Oconee Milling Company for the development of about 800 horse-power on the Oconee River.

QUITMAN, GA.—The City Council has granted a franchise to the Thomasville and Valdosta Electric Street Railway & Power Company to construct an electric railway on the principal streets of the city. The railway will also connect Quitman with Valdosta, Thomasville and Blue Springs.

SANDERSVILLE, GA.—The city has recently purchased a 150-kw Westinghouse generator, and a 225-hp tandem compound Skinner engine for the municipal electric light and water works plant. Arthur Pew, Temple Court, Atlanta, Ga., is engineer.

WEISER, IDAHO.—O. F. Markhus, general manager of the Oxbow power project, it is said, will present a proposition to the City Council to buy or lease the municipal electric light plant or to furnish electrical energy from his plant to operate the city system. Mr. Markhus expects to have his plant ready for operation by July 1.

CANTON, ILL.—Orders have been placed by the Illinois Central Electric Railway Company with the Ohio Brass Company, of Mansfield, Ohio, for six miles of overhead equipment, and with the Danville Car Company for two cars. The company also contemplates extending its railway to Norris, a distance of five miles, in the near future.

CARTERVILLE, ILL.—The local electric light plant owned by A. C. Hope & Sons was recently destroyed by fire.

CHICAGO, ILL.—The Commonwealth-Edison Company is contemplating the construction of a three-story power house at 2438 Twenty-fifth Street, at a cost of $100,000.

CHICAGO, ILL.—The City Council has decided to extend the street lighting system and will install 5500 additional street lamps. Electrical energy for supplying the additional lamps will be secured from the Sanitary District of Chicago.

CHICAGO, ILL.—The Drainage Board of the Sanitary District of Chicago has entered into a contract to supply the Winthrop Asphalt Shingle Company, the Shaving & Sawdust Company and the McDonnell & Brennan Company with electrical energy for lamps and motors for a term of five years, at the rate of 2½ to 9 cents per kw-hour.

QUINCY, ILL.—Negotiations have been consummated by the directors of the St. Louis, Terre Haute & Quincy Traction Company for the purchase of two short interurban lines running from Roodhouse to Virden, and from Virden to Taylorville. The company has secured the right of way for three-quarters of the distance, 142 miles, between Quincy and Taylorville. It is said that construction work will commence in the spring

BLOOMINGTON, IND.—The Citizens' Telephone Company, recently incorporated, is in the market for material, equipment and expert labor for the construction of a new telephone exchange and system. William H. Adams is president.

BROWNSTON, IND.—A new dynamo and pump have recently been installed in the municipal electric light and water plant. D. B. Vance is manager.

FORT BRANCH, IND.—The citizens are considering the question of purchasing the plant of the Fort Branch Electric Light & Power Company to be operated as a municipal electric light plant.

FRANKFORT, IND.—A company has been organized to promote the building of a new electric railway from Kokomo through Frankfort to Terre Houte. The officers of the company are: Dr. Oliver Gard, of Frankfort, president; J. C. DeWeese, of Kokomo, first vice-president; D. W. Bolden, of Indianapolis, secretary, and E. B. Swift, of Kokomo, treasurer. The capital stock of the company will be placed at $3,000,000.

INDIANAPOLIS, IND.—The State Board of Agriculture is advertising for bids for the construction and equipment of an independent electric light plant on the State Fair grounds. The cost of the plant is estimated at $28,000. Rubush & Hunter, Fitzgerald Building, are the architects.

LAFAYETTE, IND.—The City Council has passed an ordinance providing for the submission to the voters of a proposition to erect a municipal light plant advocated by Mayor Durgan.

SPRING LAKE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has installed at its power house in Spring Lake a new generator, direct-connected to a 2250-hp steam turbine.

WARSAW, IND.—The Commercial Club has passed resolutions in favor of municipal ownership and requested the City Council to purchase the Winona Water & Light Company's plant while the opportunity is offered.

COUNCIL BLUFFS, IA.—Announcement has been made by the Omaha & Council Bluffs Street Railway Company that the extension from Council Bluffs to the State School for the Deaf will be constructed in the near future.

DES MOINES, IA.—The Des Moines City Railway Company contemplates enlarging its power house and adding 1500 horse-power, making the maximum output of the station 6500 horse-power. The improvements will probably be made this spring.

LAKE CITY, IA.—A plan is being considered for the construction of an interurban railway from Lake City to Jefferson, and thence to Perry, where connections will be made with the Des Moines Interurban Railway Company. The railway will be about 44 miles in length, and it is stated that the officials of the Des Moines Interurban Railway have offered to furnish electrical energy to operate the road. The leading men of the three above named cities are interested in the project and have raised sufficient funds to make a preliminary survey of the road.

HERINGTON, KAN.—Bids will be received by C. H. Randall, chairman Water and Light Commission, until Feb. 24, for the construction of an electric light plant and water-works system as follows: Construction of power house; installing tubular boilers, feed water heater and boiler feed pump; one 500-gallon, compound, non-condensing pump; one 750-gallon fire pump; one 150-kw, 2300-volt, 60-cycle generator; two constant-current transformers; 45 alternating-current lamps; one three-panel switchboard; one four-valve engine; also furnishing and erecting water tower, 120 ft. in height, with 70,000 gallon water tank; constructing reservoir, three 8-in. wells with necessary piping, and one 10x12x10 air compressor; also furnishing and laying water pipe, etc. Plans and specifications are on file at the office of the Water and Light Commissioners, and may also be seen at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo.

OPOLIS, KAN.—The question of establishing an electric light plant in this town is under consideration.

SALINA, KAN.—The Salina Street & Interurban Railroad has been sold to Robert A. Handy, of Denver, Col. It is said that steps will be taken to improve the road and increase the number of cars.

WICHITA, KAN.—We are informed that the Wichita Railroad & Light Company contemplates placing contracts during the next 10 weeks for the construction of three miles of track.

BOWLING GREEN, KY.—The Bowling Green Railway Company is constructing a new power station and announcement has been made that the company will erect a car house near the new power plant. The company is also planning to purchase two new cars. H. D. Fitch is manager.

LOUISVILLE, KY.—The Louisville Lighting Company is contemplating extensive improvements to its plant, the cost of which is estimated at $1,500,000. F. M. Sackett is president.

MURRAY, KY.—The proposition to issue $10,000 in bonds for construction of an electric light plant and water works system was defeated at an election held Feb. 12.

LAKE PROVIDENCE, LA.—E. J. Berry, manager of the municipal electric light plant, writes that a 75-hp boiler will soon be installed in the plant.

LEWISTON, ME.—The Lewiston, Augusta & Waterville Street Railway Company proposes to erect two sub-stations to be located at Monmouth and Vassalboro. The contract for electrical equipment has been awarded to the General Electric Company, of Schenectady, N. Y.

LUBEC, ME.—The plant of the Lubec Electric Light Company was sold at auction Feb. 3, in default of the payment of taxes, the purchaser being C. L. Pike. The owners of the plant, it is understood, have a year to redeem the property.

SHARPSBURG, MD.—The Burgess and Commissioners of Sharpsburg have awarded a franchise to John C. Livers to operate an electric light plant to furnish electricity for lighting the streets and for commercial purposes. The contract calls for 55 arc lamps. Electrical energy for operating the system will be furnished from the power plant on the Potomac River at Shepherdstown.

BERLIN, MASS.—A movement has been started toward having the streets of the town lighted by electricity. The Board of Selectmen is making inquiries as to the cost of securing electricity from the plants in Clinton, Hudson and Marlboro. Arthur Hastings, one of the members of the board, favors the establishment of a municipal plant.

BOSTON, MASS.—The State Board of Gas and Electric Light Commissioners has approved of an issue of 2000 shares of capital stock by the Charlestown Gas & Electric Company, to be offered to the stockholders at $100 per share. The proceeds of 1680 shares are to be applied to the payment of an equal amount of promissory notes outstanding Dec. 31, 1907, and the proceeds of 320 shares to the payment of the cost of additions to plant subsequent to that date.

CLINTON, MASS.—The reduction promised several months ago by the Clinton Gas Company went into effect Feb. 1. The rate is on a sliding scale, offering discounts to those paying their bills before the 10th of each month, a reduction of from 10 to 50 per cent, according to the amount of electricity used, making the net rates from 18 cents to 10 cents per kw-hour.

FRANKLIN, MASS.—The Board of Selectmen has entered into a contract with the Union Electric Light Company for lighting the streets of the town for a term of three years, with the privilege of extending it to five years. The street lighting system consists of 43 arc lamps and 55 incandescent lamps of 32 cp, to be operated by one of three following schedules, to be chosen by the Selectmen: Schdule 1 calls for service until 1 a. m. on a moonlight schedule, total number hours of service not to exceed 1800, at a cost of $4,000 per year and $75 per year for each additional arc lamp and $15 per year for each additional incandescent lamp. Schedule 2 calls for service every night until 1 a. m. week days and until midnight Sunday, the total number of hours not to exceed 2200, at a cost of $4,320 per year and $80 for each additional arc lamp and $16 for each additional incandescent lamp. Schedule 3 calls for all-night and every night service for $5,620 per year and $100 per year for additional arc lamps and $24 per year for additional incandescent lamps. The company also agrees to erect a transmission line from the Woonsocket power station and furnish a 24-hour service, and also agrees at that time to reduce the price of electricity for commercial lighting. The town has the right to cancel the contract if the company fails to live up to the terms.

ORANGE, MASS.—Arrangements are being made by the Rodney Hunt Machine Company for building a concrete dam at the Partridgeville mill privilege recently purchased by the company. The dam when completed will furnish power to generate electricity for the operation and lighting of the plant of the Rodney Hunt Machine Company and to other concerns.

SCITUATE, MASS.—The citizens are making an effort to have the streets of the town lighted by electricity, and a petition is being circulated asking the Cohasset Electric Light Company to furnish electrical energy for the purpose.

HOUGHTON, MICH.—Application has been made to the City Council by the South Range Street Railway Company for a franchise to construct and operate a street railway in the city. The company proposes to construct an electric railway from Houghton to South Range. James T. Healy is interested in the enterprise.

DULUTH, MINN.—H. J. Rich, of this city, has secured the contract for installing engines, generators and ventilating system in the addition to the Board of Trade Building, to cost about $7,000.

ST. PAUL, MINN.—Notice has been filed with the city clerk by the Minneapolis Rapid Transit Company of its proposed extensions of track in the city during the coming year, aggregating several miles.

COLLINS, MISS.—The City Council has decided to issue $4,000 in bonds, the proceeds to be used to improve the water and light plants.

LONG BEACH, MISS.—The Town Council has voted to have Jeff Davis Avenue lighted with electricity from the beach to the Louisville & Nashville Railway tracks.

WAYNESBORO, MISS.—The citizens have voted to issue $12,000 in bonds for the construction of an electric light plant.

ST. JAMES, MO.—An election will be held Feb. 25 to vote on the proposition submitted by Chris. Koeln, of St. Louis, for the operation of an electric light plant.

HARLOWTON, MONT.—The Harlowton Light & Water Company, recently incorporated, contemplates the construction of a water and light system at a cost of about $30,000. L. D. Glenn is secretary of the company.

NORTH PLATTE, NEB.—We are informed that the North Platte Electric Light & Power Company contemplates making improvements to its plant, the cost of which is estimated at $15,000. L. W. Walker is treasurer and manager.

PAWNEE CITY, NEB.—The Pawnee City Telephone Company contemplates the construction of a new central station in the near future plans for which have been received. The cost of the building is estimated at from $3,500 to $4,000.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company has decided to commence work on the construction of the new long-distance toll lines into Omaha as soon as the weather will permit, and will also establish exchanges in Alvo and Murdock.

STANTON, NEB.—M. M. Neumann is said to have petitioned for a franchise to establish an electric lighting plant here

MANHATTAN, NEV.—The Nevada-California Power Company contemplates extending its transmission lines from Tonopah to Manhattan during the coming summer. The company will also extend its lines up the valley to Round Mountain.

RENO, NEV.—A petition has been presented to the City Council by S. H. Wheeler and Charles H Burk asking for a franchise for a street railway on most of the streets in the southeastern section of the city

CONCORD, N H.—The Concord Electric Company is contemplating the construction of a steam plant to be used as an auxiliary to the Sewall's Falls power plant. It is expected to have the plant installed and ready for operation by next fall.

ASBURY PARK, N. J.—The Atlantic Coast Electric Railway Company is installing three 500-kw Westinghouse Parsons turbo-generators in its power station.

ASBURY PARK, N. J.—The New Jersey Consolidated Water & Light Company, of Deal, is contemplating making a bid for lighting the streets of Asbury Park and has asked the City Council to defer making a contract for street lighting pending a proposition which the company would make to install an underground system and ornamental poles in the city, at a rate much less than is paid under the existing contract with the Atlantic Coast Electric Light Company.

ATLANTIC, N. J.—Bids will be received by the city clerk until Feb. 24 for furnishing lighting standards as follows: Sixty-five corner lighting standards, type "A"; 13 corner lighting standards, type "B," and 200 intermediate lighting standards. Blue prints of the standards will be exhibited at the office of the city engineer, Bartlett Building, Atlantic City, and at the office of Carrère & Hastings, 225 Fifth Avenue, New York, N. Y., architects, where blank forms of proposal, contract and specifications can be obtained. J. W. Hackney is engineer.

COLUMBUS, N. J.—The citizens of this town are agitating the question of having the town incorporated into a borough for the purpose of securing better street lighting service and other improvements.

LOCKPORT, N. Y.—The Common Council has awarded the contract for furnishing electrical energy to the new pumping station of the Lockport water works system at North Tonawanda to the Tonawanda Light & Power Company. The contract is for a term of five years and the cost is estimated at about $6,000 a year.

NIAGARA FALLS, N. Y.—Representative Alexander has introduced a bill in the House of Representatives to grant the Lower River Power & Water Supply Company permission to divert 40,000 cubic feet of water per second for power development. The Ontario Power Company interests hold the State right under which the company was created.

LA GRANGE, N. C.—The officials of the town are considering the question of granting a 10-year franchise to the Joyner Mill Company to furnish electricity for lamps in the town.

SALISBURY, N. C.—A movement is on foot to have the Southern Power Company extend its transmission lines from Charlotte to Salisbury at an early date. The plan is to co-operate with the Salisbury-Spencer Railway Company in the distribution of electricity for lamps and motors in the two towns. If the Southern Power Company extends its lines to Salisbury the local company will install new and improved machinery in its power plant.

SALISBURY, N. C.—Col. John S. Henderson, the recently appointed receiver for the Whitney Company, near Salisbury, N. C., is making active preparations to continue the work of completing the $5,000,000 hydro-electric development on the Yadkin River. At present 500 men are engaged on the work and the receiver believes that power will be available July 1. T. J. Jerome, of Salisbury, and D. W. Noell, of New York, N. Y., have been named as attorneys for the receivers. The T. A. Gillespie Company is the contractor, while the defendant company is represented by Burton Craige, of Salisbury.

THOMASVILLE, N. C.—The new electric light plant of the Thomasville Light & Power Company is nearly completed and will be placed in operation about March 1.

WASHINGTON, N. C.—It is proposed to make a canvass of the town offering a 24-hour service for lamps and motor, and if a sufficient demand exists the municipal electric light plant will be made adequate to meet the increased demand.

RAPID CITY, N. D.—The Rapid City Electric & Gas Light Company will establish a day circuit about March 15. A. Emerick is manager

CAMDEN, OHIO.—Charles S. Houston has purchased the plant of the Camden Electric Light Company and will at once apply to the Village Council for a franchise and a contract for the street lighting.

ROCKFORD, OHIO.—A special meeting of the stockholders of the Cleveland & Buffalo Transit Company will be held March 14 to vote on the proposition of increasing the capital stock from $1,000,000 to $1,500,000.

AFTON, OKLA.—The city will hold an election to vote on the proposition of issuing bonds for the construction of an electric light plant.

CUSTER CITY, OKLA.—The Custer City Commercial Club is considering the question of establishing an electric light plant in the city.

MUSKOGEE, OKLA.—We are informed that contracts will be placed by the Muskogee Electric Traction Company for the construction of 2½ miles of track in the near future.

SAPULPA, OKLA.—The Sapulpa Lighting & Power Company is contemplating the installation of a 100-kw generator and a 150-hp gas engine. E. C. Reynolds is president and general manager.

HEPPNER, ORE.—The City Council is contemplating changing the street lighting system, and will replace the present arc lamps with incandescent lamps of 25 and 16 candle-power.

WALLOWA, ORE.—The City Council has granted a franchise to the Wallowa Mercantile Company to construct and operate an electric light and power plant in Wallowa.

BEAVER FALLS, PA.—Arrangements have been made for the construction of the Pittsburg, Lisbon & Western Railroad from Darlington to Morado Park above Beaver Falls. It is proposed to equip the railroad to be operated by electricity for the entire distance between Lisbon and the Beaver Valley. It is said that a survey has been made and a portion of the right of way secured, and that active work on the construction of the road will commence in the spring.

HARRISBURG, PA.—The Central Pennsylvania Traction Company has applied to the City Council for a franchise to extend its lines on certain streets in East and West Harrisburg.

NEWTOWN, PA.—The plant and holdings of the Newtown Electric Light & Power Company have been purchased by the Bucks County Electric Railway Company. Extensive improvements will be made at once to the power house.

SHAMOKIN, PA.—The Borough Council has adopted an ordinance authorizing the chief burgess and secretary to enter into a contract to provide for lighting the streets and public places of the borough with arc and incandescent electric lamps. John Drumbeiser is chief burgess.

TYRONE, PA.—The new plant of the Home Electric Light & Heating Company is rapidly nearing completion. The equipment of the plant will consist of two 500-kw, three-phase, 2300-volt Curtis steam turbines; two 300-kw rotary converters to furnish electrical energy for the electric railway, and also a storage battery for the same purpose. The boiler room is equipped with a battery of 1000-hp Stirling boilers; space is reserved for additional boiler equipment of 1500 hp, and foundations have been placed in the generating room for a 1000-kw generator. The electrical equipment was furnished by the General Electric Company, of Schenectady, N. Y. The cost of the plant is estimated at $200,000 and will be ready for operation in April.

WILMINGTON, PA.—The officials of the Westminster College, located at Wilmington, have organized a company for the purpose of constructing an electric railway between New Castle and New Wilmington, a distance of 10 miles.

PAWTUCKET, R. I.—Frank Harrop, superintendent of street lights, in his annual report submitted to the Board of Aldermen, recommends that an incandescent lighting system be installed on the outskirts of the city, and also recommends an all-night service in the city instead of until 1 a. m. as at present.

CHATTANOOGA, TENN.—The Chattanooga-Tennessee River Power Company is reported to have made arrangements with the Wilson & Baillie Manufacturing Company, of New York, N. Y., for completing the construction of its plant at Hales Bar, 12 miles below Chattanooga. Legal complications interfered with the completion of the previous contract. This plant will insure permanent improvement for navigation on the Tennessee River and provide a hydro-electric development with ultimate output of 56,000 horse-power. A dam 1200 ft. long, 50 to 60 ft. high above rock bottom of the river, of masonry and concrete construction. The power house will be 60 x 320 ft., and the equipment will consist of 14 units of 4000 horse-power each, 10 of which will be installed before the end of 1909. Electricity will be transmitted at 60,000 volts to a substation near Chattanooga, where it will be transformed and distributed for lamps and motors. The company will erect a double transmission line, each to have three copper cables supported on steel towers. The construction also includes a 300-ft. lock, 60 ft. wide. The plans were prepared by the U. S. army engineers and engineers of the company and approved by the chief engineers of the army. John Bogart, 16 Exchange Place, New York, N. Y., is engineer for the company.

MEMPHIS, TENN.—There is now pending before the Council a proposition from the Consolidated Gas & Electric Company to furnish the city with arc lamps at the rate of $75 per year, in case the city agrees to use 1000 lamps. The city has now in use 750 lamps, for which it is paying at the rate of $85 per year.

BASTROP, TEX.—The plant and holdings of the Bastrop Water & Light Company have been sold to Robert Bayne, of Fort Worth, subject to the ratification of the stockholders.

CLARENDON, TEX.—The Clarendon Water, Light & Power Company is contemplating improvements to its plant, the cost of which is estimated at $10,000. T. S. Kemp is local manager.

FALFURIAS, TEX.—The Falfurias Telephone Company has increased its capital stock from $5,000 to $7,500.

FORT WORTH, TEX.—The City Council is considering the question of enlarging the municipal electric light plant so as to furnish electrical energy for 900 additional arc lamps. New machinery will be installed, the cost of which is estimated at $50,000. Samuel Davidson is city commissioner.

SAN ANTONIO, TEX.—The San Antonio Traction Company will purchase 10 semi-convertible cars with General Electric equipment, and will also build an addition to its repair shop and install additional machinery. T. C. Brown is superintendent.

OGDEN, UTAH.—Plans have been completed by the Utah Light & Railway Company for the construction of a large power plant at Devil's Gate, in Weber Canyon. The cost of the plant is estimated at $350,000 and will furnish electrical energy to operate the street railway systems in Ogden and Salt Lake City. Work on the construction of the plant will begin this spring.

ASHLAND, VA.—The Virginia Light & Power Company is making arrangements to construct an electric light system, and has contracted to furnish 300 lamps in the business section of the city.

CHRISTIANSBURG, VA.—It is reported that the Montgomery Electrical Company will absorb and operate the Grayson Electric Corporation and municipal lighting system of Christiansburg and Cambria. The general offices of the company are at Christiansburg, and the officers are J. L. Vaughn, president; E. S Hagan, vice-president, and A. A. Phlegar, Jr., secretary and treasurer.

DILLWYN, VA.—It is reported that an electric light plant will be erected in this town at an early date. The proposed plant will furnish electricity for lighting the towns of Dillwyn, Arvonia, Bremo and New Canton.

EMPORIA, VA.—The Emporia Light & Power Corporation contemplates rebuilding its entire system in the spring. E. C. Goodwin is secretary and treasurer.

NATIONAL SOLDIERS' HOME, VA.—Bids will be received until Mar. 2 by John T. Hume, treasurer National Home for Disabled Volunteer Soldiers, National Soldiers' Home, for furnishing material and installing complete two electric motors, one in the main laundry and the other in the bakery.

NORTON, VA.—An election will be held to vote on the proposition to issue $20,000 in bonds for the construction of an electric light plant.

RICHMOND, VA.—The City Council has adopted a resolution appropriating $6,500 for plans and specifications for installing a municipal electric light plant at the old pump house.

ROANOKE, VA.—The Roanoke Railway & Electric Company has sold its property on Earnest Avenue, on which its power station and car barns are located, to the Norfolk & Western Railway Company. The Railway & Electric Company is to remove the buildings and their contents from the property sold, but retains possession for 18 months, during which time the company will build a new car barn on Walnut Street.

VIRGINIA BEACH, VA.—Plans are being considered for the construction of an electric light plant at Virginia Beach to furnish electricity for lamps in the hotels and cottages within the corporation limits. A petition will be presented to the Town Council for a franchise at its next meeting.

CENTRALIA, WASH.—The Centralia Electric Railway & Irrigation Company has applied to the City Council for a franchise to construct a street railway over several streets of the city.

TACOMA, WASH.—Frank L. Davis, city engineer, has submitted to the City Council an estimate of first cost, together with operating expenses and efficiency of a steam power plant to be used for generating electricity for auxiliary lighting purposes. For a 5000-hp plant with a 50 per cent load factor he estimates the cost at $500,000, and the cost of operating the plant, including fixed charges, coal, depreciation, interest, etc., at $285,813 per year, making the cost of the electrical energy to the city 1.31 cents per kw-hour, as against 1.25 cents now paid by the city to the Seattle-Tacoma Power Company, under a five-year contract for 5000 horse-power. For a 5000-hp plant with a 30 per cent load factor the cost of the plant is estimated the same, but the cost for operating, fixed charges, etc., is placed at $198,686, making the price of electricity 1.51 cents per kw-hour. The cost of a 2000-hp plant with a 50 per cent load factor is placed at $275,000, and the fixed charges are placed at approximately $122,374, making the cost of production 1.4 cents per kw-hour. For a 2000-hp plant with a 30 per cent load factor with fixed charges at approximately $88,027, the price for electricity would be 1.68 cents per kw-hour. Both the city engineer and the Commissioner of Public Works favor a water-power plant.

WALLA WALLA, WASH.—Application will be made to the County Commissioners by the Washington & Oregon Traction Company for a franchise to construct an electric railway into the Blue Mountains, and also to tap much of the rich farm lands of this section. The company was recently granted a franchise by the City Council of Walla Walla.

EAU CLAIRE, WIS.—The bids which were submitted to the City Council Jan. 15, for lighting the streets of the city by either gas or electricity for a term of five or ten years, were returned unopened. The City Council is now asking for bids for street lighting with gas or electricity for a term of five years. William Danforth is city engineer.

IOLA, WIS.—E. R. Cushman is reported to be interested in a proposition to establish an electric light and power plant in this town.

LOYAL, WIS.—The citizens have voted to issue $17,000 in bonds for electric light and water works.

MADISON, WIS.—The contract for the dynamos and other electrical equipment for the heating and lighting plant for the new State Capitol has been awarded by the Capitol Commission to the Northern Electric Company, of Madison, for about $42,000, and the contract for boilers to the Babcock & Wilcox Boiler Company, for $14,000.

PORTAGE, WIS.—The State Railroad Commission has issued an order granting the Portage Electric Light Company authority to readjust and increase its rates for electricity. The order may be modified after the property has been valued by the commission.

CHAFFEY, ONT., CAN.—The Muskoka Telephone Company has received a franchise to operate a telephone system here and will extend its line from Rosseau, Yearley and Sprucedale.

EDMONTON, ALB., CAN.—Owing to the delay in installing the telephone system the City Commissioners have cancelled the contract awarded to the Lorimer Automatic Telephone Company, of Toronto, and the company has started suit. The Stowger Company, of Chicago, offers to install a system by April 1, and will pay a forfeit of $25,000 if the system is not installed by that date.

LONDON, ONT., CAN.—A. E. Welch, of this city, has been awarded a contract for the construction of 35 miles of the proposed electric railway to connect this city with Stratford, Ont. Several branch lines are planned.

NEW LISKEARD, ONT., CAN.—The Nipissing Central Electric Railway Company will let a contract early in May for the construction of a section of the railway between New Liskeard and Cobalt. Address F. H. Latchford, New Liskeard.

PORT ARTHUR, ONT, CAN.—Cecil B. Smith has completed the survey of the Dog Lake Falls for the proposed power development for this town. The transmission line will be 23½ miles in length. Address Mayor Carrick.

TORONTO, ONT., CAN.—Alexander Dow, of Detroit, Mich., has placed an outside value of $4,000,000 on the plant of the Toronto Electric Light Company which the city proposes to purchase.

CRESTON, B. C.—Plans are being considered for developing the water power of the Goat River Canyon, three and one-half miles from Creston. A company is being formed to carry out the project.

VANCOUVER, B. C., CAN.—The British Canadian Wood, Pulp & Paper Company has received a grant of water rights on Rainy River, opposite Gambier Island, and will at once proceed with the installation of a plant to develop 5000 hp. Address W. H. R. Collister, 313 Cordova Street, Vancouver, B. C.

YARMOUTH, N. S., CAN.—The Yarmouth Amalgamated Telephone Company is applying to the provincial government to increase its capital from $25,000 to $50,000 for the purpose of making extensions.

OROGRANDE, N. M.—It is reported that the Wachusetts Mining Company of Massachusetts, which is working the Harvey group, will soon install a power plant.

CHIHUAHUA, MEX.—Surveys are being made in connection with the construction of a hydro-electric plant to furnish electrical energy to operate the El Salto mill at the Ocampo mines. It is said that the plant will be installed at once and will also furnish electricity for the Matulera and other mines.

GUADALAJARA, MEX.—Luis H. R. von Ruecau, of Mexico City, is planning the construction of an electric railway from Cuale to the Pacific port of Las Penas. He has a concession for taking water from the Ameca and Mascota rivers, and proposes to generate electricity to operate the proposed railway and for mining purposes.

New Industrial Companies.

THE AMERICAN SIGNAL LIGHT & APPLIANCE COMPANY, of San Antonio, Tex., has been incorporated, with a capital stock of $25,000, by F. Wessel, D. F. Youngblood and others.

THE DAMM ELECTRICAL COMPANY, of New York, has filed articles of incorporation, with a capital stock of $10,000. The directors are Albert Damm, Max Sommer and Charles W. Reed, of New York.

THE ELECTRIC CONSTRUCTION & SUPPLY COMPANY, of Muncie, Ind., has been incorporated for the purpose of doing a general business in electrical work and will carry a large supply of electrical goods. C. C. Radabaugh, who was with the General Electric Company for 30 years, is at the head of the company.

THE IMPERIAL ELECTRIC COMPANY, of Akron, Ohio, has been incorporated, with a capital stock of $180,000, by E. E. Andrews, R. E. Inskeep, William Weaver, W. C. Hall and A. C. Linzee. The company proposes to purchase the plant and equipment of the Akron Electrical Company, located in South Akron, and is practically a reorganization of the old company.

THE NATIONAL COMPANY, of South Bend, Ind., has been incorporated for the purpose of carrying on a general contracting business, making a specialty of constructing and equipping electric light plants, water works, heating systems and a general engineering business. The company will also manufacture contractors' tools suitable for all kinds of construction work. J. F. Cole, R. W. Miller and G. A. Harrop are the directors.

THE WESTERN GAS ENGINE COMPANY, of Los Angeles, Cal., has increased its capital stock by $40,000. This increase in the capital brings the total amount now paid in up to $131,000, the authorized issue being $150,000. The engines manufactured by the company use the native cheap distillate and the company is about to bring out a simple apparatus which manufactures any kind of crude oil into a fixed gas, being taken direct into the engine, and producing, according to the builders, an economy far superior to anything possible with steam or distillate. The works of the company are located at 908 to 932 North Main Street. W. H. Frost is president.

Company Elections.

BIRMINGHAM, ALA.—At the annual meeting of the Birmingham Railway, Light & Power Company the following-named officers were elected: A. H. Ford, president and general manager; Lee C. Bradley, vice-president; J. P. Ross, secretary; E. M. Cory, treasurer, and E. C. Jolly, assistant treasurer.

PETALUMA, CAL.—At the annual meeting of the Petaluma & Santa Rosa Railway Company the following named officers were elected: W. A.

Cottell, president; J. A. McNeal, vice-president; Thomas Archer, secretary and treasurer. An assessment of $10 per share was levied in December to wipe out a floating debt of $75,000 and to purchase additional equipment.

SAN FRANCISCO, CAL.—At the annual meeting of the Presidio & Ferries Railroad Company the following named officers were named: George C. Newhall, president; H. M. A. Miller, vice-president; J. P. Laighton, secretary, and William J. Dutton, treasurer.

MACON, GA.—At the annual meeting of the Macon Railway & Light Company the following-named officers were elected: W. J. Massee, president; Jacob S. Collins and M. Felton Hatcher, vice-presidents; J. E. Jaudon, secretary and treasurer, and J. S. McFarland, general superintendent.

ALTON, ILL.—At the annual meeting of the Alton Gas & Electric Company the following-named officers were elected: O. S. Stowell, president and treasurer; L. C. Haynes, vice-president; T. W. Gregory, secretary and assistant treasurer.

ALTON, ILL.—At the annual meeting of the Alton, Granite & St. Louis Traction Company the following-named officers were elected: L. C. Haynes, president; F. E. Allen, vice-president; T. W. Gregory, secretary and assistant treasurer, and C. A. Caldwell, treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the Citizens' Electric Light & Power Company the following-named officers were chosen for the ensuing year: L. C. Haynes, president; H. D. Sexton, first vice-president; M. S. Hopkins, second vice-president; T. W. Gregory, secretary and treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the East St. Louis & Suburban Railway Company the following-named officers were elected: C. M. Clark, president; L. C. Haynes, first vice-president; M. S. Hopkins, second vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant secretary and assistant treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the St. Louis & Belleville Electric Railway Company the following-named officers were elected: L. C. Haynes, president; M. W. Schaeffer, vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant treasurer and assistant secretary.

EVANSVILLE, IND.—At the annual meeting of the Evansville & Southern Indiana Traction Company James Murdock was re-elected president, and Charles Murdock, secretary and treasurer.

DES MOINES, IA.—At the annual meeting of the Southern Iowa Telephone Company the following named officers were elected: D. N. Smith, president; L. M. Grimes, secretary, and E. A. Nye, treasurer.

LOUISVILLE, KY.—At the annual meeting of the Indianapolis & Louisville Traction Company the following-named officers were elected: J. M. Andrew, president; James C. Chaplin, first vice-president; W. L. Lyons, secretary and treasurer, and Alexander C. Thompson, assistant secretary and assistant treasurer.

LOUISVILLE, KY.—At the annual meeting of the Cumberland Telephone & Telegraph Company the following named officers were elected: James E. Caldwell, president; W. W. Berry, William Letterer and A. G. Sharp, vice-presidents; J. W. Hunter, Jr., secretary; T. D. Webb, treasurer, and Leland Hume, general manager.

DOVER, ME.—At the annual meeting of the Dover & Foxcroft Light & Power Company the following named officers were elected: C. C. Hall, president; E. A. Thompson, treasurer, and E. W. Crocker, clerk and superintendent.

PORTLAND, ME.—Articles of incorporation have been filed for the Hancock & Lake Linden Traction & Power Company, with a capital stock of $800,000. The incorporators are James E. Manter, Clarence E. Eaton, Charles D. Fullerton and Millard W. Baldwin, of Portland.

WELLS, ME.—At the first meeting of the Wells Electric Light & Power Company the following named officers were elected: J. W. Gordon, president, and J. H. Littlefield, secretary. The company hopes to be able to supply electricity for lamps this season.

ANNAPOLIS, MD.—A bill has been introduced in the House of Delegates incorporating the Baltimore & Pennsylvania Railway & Power Company. The company proposes to generate electricity to be used for street, commercial and residence lighting in any part of Baltimore and Carroll counties or in Pennsylvania; also to build and operate a railroad from Reisterstown through Hampstead and Manchester and thence to the Pennsylvania state line and in the state of Pennsylvania, to be operated by steam or electricity. The company is capitalized at $250,000 and the incorporators are: William Massenheimer, Charles J. Wells, Jesse A. Davis, Henry M. Foster and C. Dickerson Day.

ESCANABA, MICH.—At the annual meeting of the Escanaba Electric Street Railway Company the following named officers were elected: John K. Stack, president; O. B. Fuller, vice-president; I. C. Jennings, secretary and general counsel, and John J. Cleary, treasurer.

NEW RICHLAND, MINN.—At the annual meeting of the New Richland Telephone Company the following-named officers were elected: E. J. Batchelder, president; M. A. Hodgkins, vice-president and manager, and H. E. Johnson, secretary and treasurer.

ARCADIA, MO.—At the annual meeting of the Arcadia Mutual Telephone Company the following officers were chosen for the following year: G. W. Dick, president; A. L. Anderson, secretary, and E. E. Bish, treasurer.

ST. LOUIS, MO.—At the annual meeting of the Laclede Gas Light Company John I. Beggs was re-elected president; August Gehner, vice-president to succeed Breckenridge Jones, and P. E. Bisland, of New York, N. Y., also vice-president. The other officers are as follows: C. L. Holman, secretary; W. S. Dodd, treasurer; W. F. Kroyer, of New York, N. Y., assistant secretary and E. B. Pray, of New York, N. Y., assistant treasurer.

PLATTSMOUTH, NEB.—At the annual meeting of the Plattsmouth Telephone Company the following named officers were elected: T. E. Parmelee, president; C. C. Parmelee, vice-president; T. H. Pollock, secretary and general manager, and J. N. Wise, treasurer.

NEW YORK, N. Y.—At the annual meeting of the United Electric & Power Company, Henry J. Hemmon, Cortland Betts and Arthur H. Elliott were elected to the board of directors, succeeding Osborne W. Bright, H. E. Gawtry and William Bunker. The other directors were re-elected.

ROCHESTER, N. Y.—At the annual meeting of the Rochester, Charlotte & Manitou Railroad Company the following named officers were elected: Michael Doyle, president; Herman Behn, vice-president; J. M. McGrath, secretary and treasurer, and R. S. Nagle, auditor.

ROCHESTER, N. Y.—At a meeting of the reorganization committee of the Home Telephone Company, held Feb. 5, the following named officers were elected: E. B. Odell, president; H. F. Miller, vice-president; Charles H. Poole, secretary and manager, and W. I. Taber, treasurer.

CLEVELAND, OHIO.—At the annual meeting of the Forest City Railway Company the following named officers were chosen for the ensuing year: M. A. Fanning, president; C. H. Miller, vice-president; Fred C. Alber, secretary and treasurer.

COLUMBUS, OHIO.—At the annual meeting of the Columbus Telephone Company the following-named officers were elected: Henry A. Lanman, president; Frank A. Davis, vice-president and counsel; Edwin R. Sharp, secretary and treasurer, and Gansey R. Johnson, general manager.

DEWEYVILLE, OHIO.—The directors of the Mutual Telephone Company at the annual meeting of the company elected the following-named officers: Scott Weisley, president; Frank Ritter, vice-president; Charles Ewing, secretary, and William Compton, treasurer.

FINDLAY, OHIO.—At the annual meeting of the Home Telephone Company the following named officers were elected for the ensuing year: E. C. Taylor, president; C. Y. McVey, vice-president; J. W. Vernor, secretary and manager, and H. B. Taylor, treasurer.

MARION, OHIO.—At the annual meeting of the Marion County Telephone Company the following named officers were elected: George W. King, president; S. E. Barlow, vice-president; D. M. Odaffer, secretary and general manager, and Oswald Wollenweber, treasurer.

ASTORIA, ORE.—At the annual meeting of the Astoria Electric Company the present officers were re-elected. D. I. McGee, of New York, N. Y., was elected manager of the company.

PITTSBURG, PA.—At the annual meeting of the Pittsburg & Allegheny Telephone Company the following-named officers were elected: J. G. Splane, president; John S. Weller, vice-president and general manager; Thomas G. Davis, secretary and assistant treasurer, and Robert C. Hall, treasurer.

SPARTANBURG, S. C.—The Greenville & Spartanburg Electric Railway Company has been chartered with a capital stock of $100,000 by O. K. Mauldin, H. H. Prince, A. A. Gates and C. C. Good. The company proposes to construct an electric railway from Greenville to Spartanburg.

DALLAS, TEX.—At the annual meeting of the Dallas Interurban Electric Railway Company the following named officers were elected: Henry Dorsey, president; I. J. Willingham, vice-president; S. A. Stemmons, secretary, and W. W. Caruth, treasurer.

SPOTSYLVANIA, VA.—At the annual meeting of the Spotsylvania Telephone Company the following named officers were elected for the ensuing year: George W. Perry, president; Norman L. Mills, vice-president; William B. Warren, secretary and treasurer, Manlins F. Waite, business manager.

POULSBO, WASH.—The Poulsbo Rural Telephone Company has been incorporated with a capital stock of $10,000 by John Stoseth, Paul Paulson, George C. Telen, Henry Nordahl, Nels Sonju, C. A. Johnson and John Ryen.

WAUSAU, WIS.—At the annual meeting of the Wausau Telephone Company the following officers were elected: Nathan Heinemann, president; E. B. Thayer, vice-president; James Montgomery, secretary, and W. W. Thayer, treasurer.

New Incorporations.

FOLEY, ALA.—The South Baldwin Telephone Company has been incorporated with a capital stock of $2,500 by C. L. Howe, E. A. Bemis, F. L. Babcock, of Magnolia Springs; J. V. Erksine and Frank Fesler, of Foley.

LITTLE ROCK, ARK.—A charter has been granted to the Paris, Subiaco Traction Company, with a capital stock of $60,000, for the purpose of constructing an electric railway from Paris to a point near Subiaco, a distance of five miles. The incorporators are: D. J. Young, Conrad Elsken, G. G. Danridge and Charles J. Jewett.

SAN FRANCISCO, CAL.—The Pacific Shipsmithing & Electric Company has been incorporated with a capital stock of $25,000 by F. A. Schaumleffel, C. O. Lundholm and L. P. Dunkley. H. C. Scharetzer, attorney.

SANTA ROSA, CAL.—The Magnolia Telephone Company has been incorporated with a capital stock of $10,000 with the following directors: D. M. Winans, president; T. C. King, secretary; G. B. Robinson, Jas. W. George and Diedrich Rangers.

LYNN CENTER, ILL.—The Lynn Center Telephone Company has been incorporated, with a capital stock of $2,500, by F. E. Peterson, A. Lundquist and F. L. Johnson.

GASTON, IND.—The Gaston Home Telephone Company, has filed articles of incorporation capitalized at $10,000. Charles W. Recor, Allen Oxley and Jas. M. Love are the directors.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indianapolis & South Bend Traction Company, with a capital stock of $10,000. The company proposes to construct and operate street and interurban railways. The directors are: Robert H. Keller, John Keller and Edward M. Bowman.

SEYMOUR, IND.—Articles of incorporation have been filed with the Secretary of State for the Seymour Mutual Telephone Company, with a capital stock of $30,000, by John A. Ross, William F. Bush, Fred Able, Leroy Miller, Fred H. Hickman and others.

SULLIVAN, IND.—The Marion Trust Company, of Indianapolis, has been appointed receiver of the Sullivan Electric Light Company. The company recently expended a large amount of money in remodeling and re-equipping the plant, which is the cause of its present embarrassment.

ELLSWORTH, ME.—The North Penobscot Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are E. H. Moore and others.

BOSTON, MASS.—A certificate of incorporation has been filed with the Secretary of State for the Connecticut River Transmission Company, with a capital stock of $10,000. The company proposes to generate and transmit electricity for heat and motors. The officers of the company are C. Arthur Fiske, president; William W. Brooks, treasurer, and Stanley R. Miller, a director.

COLRAIN, MASS.—The Colrain Electric Light Company has been organized, with the following officers: J. W. Cram, president; R. C. Hillman, secretary, and H. A. Smith, treasurer.

PALMYRA, MO.—The Palmyra Telephone Company has been incorporated, with a capital stock of $6,000, by Lewis Frazer, John A. Miller, George W. Pine, L. C. Henderson and others.

FAISON, N. C.—The Faison-Clinton Telephone Company has been incorporated, with a capital stock of $3,000, by H. C. Precise, J. M. Faison, M. M. Williams and others.

STATESVILLE, N. C.—The Amity Telephone Company has been incorporated, with a capital stock of $1,115, by J. S. Goodman, of Amity, and others.

ALDEN, OKLA.—The Alden Telephone Company has been incorporated with a capital stock of $10,000 by H. S. Sturgis, S. W. Carpenter, of Alden; Fred Brasted, of Oklahoma City, and others.

CASHION, OKLA.—The Silver Ridge Telephone Company has been incorporated by H. C. Marman, Orch Bryan and M. Winters.

GRACEMONT, OKLA.—The Gracemont & Binger Rural Telephone Company has been incorporated, with a capital stock of $2,000, by J. Knedson, R. H. Hering, Charles Vandeventer and W. H. Darwold, all of Gracemont.

VENUS, TEX.—The Venus Telephone Company has been incorporated with a capital stock of $3,000 to build a telephone system.

COURTLAND, VA.—Articles of incorporation have been filed for the Courtland & Burdette Telephone Company, with a capital stock of $500 to $2,000. The incorporators are R. Whitfield, president; G. W. Wade, vice-president; J. P. Johnson, secretary and treasurer; T. H. Birdsong, W. T. McLemore, Algar Woolfolk, all of Courtland.

LOUISA, VA.—The Citizens' Mutual Telephone Company has been incorporated with a capital stock of $5,000. The officers of the company are B. C. Goodwin, of Buckner, president; J. H. Parrish, of Bumpass, vice-president, and C. B. Meredith, of Willowbrook, secretary and treasurer.

POUND, VA.—The Lower Pound Telephone Company has been organized, with a capital stock of $2,000, by J. Greer, R. Lee Greer and others.

WHITTLES DEPOT, VA.—The Climax Telephone Company has been incorporated, with the following officers: George W. Anderson, president, W. S. Anderson, vice-president; John C. Shelhouse, secretary, and James B. Shelbouse, treasurer.

NORTH YAKIMA, WASH.—The Natchez Light & Water Company has been incorporated with a capital stock of $10,000 by James Barnes, J. E. Boyle and F. A. Luce. The company proposes to furnish water and light in the city of Natchez.

NORTH YAKIMA, WASH.—The Yakima Inter-Valley Electric Railway Company has filed articles of incorporation with a capital stock of $1,000,000, for the purpose of building and operating electric railways throughout the valleys of Yakima County. The first line from Granger to North Yakima, 34 miles in length, will be completed this year. The incorporators are H. H. Lombard, A. B. Wilcox, J. H. Thomas, C. H. Furman, Hector P. Eaton and C. E. Page.

RIVERSIDE, WASH.—The Okanogan County Telephone Company has been organized to construct and operate a telephone system [illegible] the towns of Riverside, Omak and Okanogan. The officers are: H. M. Fryer, president; J. Z. English, vice-president; Arthur Lund, secretary and treasurer, and A. M. Storch, superintendent of construction.

PINEVILLE, W. VA.—The Pineville Water & Light Company has been incorporated, with a capital stock of $10,000, by R. A. Kellers and others.

WHEELING, W. VA.—The Mozart Improvement Company has been incorporated, with a capital stock of $100,000, to construct and operate an electric power plant at Mozart Terrace. The plant will furnish electricity for lamps and motors and will be operated by gas engines. H. L. Hesse is secretary and treasurer.

MILWAUKEE, WIS.—Articles of incorporation have been filed with the Secretary of State for the Independent Telephone Company, of Milwaukee, with a capital stock of $10,000 The incorporators are H. D. Critchfield, R. W. Dunlap and J. C. Harper, of Madison.

TWO RIVERS, WIS.—The Two Rivers Telephone Company has been incorporated with a capital stock of $15,000 by M. F. Kirst and others.

WINDSOR, N. B., CAN.—The Farmers' Telephone Company has been incorporated with a capital of $5,000. The directors are: H. A. Smith, E. W. Spinner, G. O. Britton, F. W. Smith, all of Windsor.

Legal.

TELEPHONE COMPANY BOUND TO EXERCISE ONLY REASONABLE CARE IN KEEPING LINES IN WORKING ORDER.—Under a contract with the defendant telephone company, the plaintiffs advanced the necessary funds to build and equip an extension of the company's lines running to the town in which the plaintiffs lived. The company agreed to see that the work was properly done, and to maintain telephone service during the life of the contract, and the plaintiffs agreed on their part to see that the company would have a certain number of subscribers. After the erection of the line, the plaintiffs brought an action against the company to recover the money they had advanced, on the ground that the company had failed properly to maintain the telephone line, and had permitted the line and the boxes to be out of repair to such an extent as to destroy the value of the telephones. It was held that the evidence introduced was not sufficient to warrant a verdict in favor of the plaintiffs. It showed substantially that there was little or no trouble until after bad weather came in winter, and that the trouble then was incidental to the fact that it was a new line, a part of which ran through lands where the poles settled and the wires interfered. While there was delay in some cases in remedying defects, it was due to the situation of things, and there was nothing to indicate fraud or bad faith. The company was bound to the plaintiffs to use ordinary care to keep and maintain its telephones and lines in order, and, if it failed to exercise such care, it could be held by them for the damages they thereby sustained. But a subscriber to a telephone must know that it is liable to get out of order and that a line running through the country must in winter be expected sometimes to get down. The company is bound to use ordinary care in constructing and maintaining its line, but it is not responsible for those interruptions which may not be prevented by ordinary care. Eastern Kentucky Telephone & Telegraph Co. v. Hardwick, Court of Appeals of Kentucky, 106 N. W. Rep. 307.

RIGHT OF PERSON TO REMOVE POLE FROM PRIVATE ALLEY ABUTTING ON HIS PROPERTY.—A telephone company, having asked permission from the owner of a lot to erect a telephone pole in a private alley at the rear of the lot, and having been refused such permission, proceeded to place the pole in position without authority at a time when the owner of the lot was away from home. The top of the pole, [illegible] erected, and the cross arms, projected over the lot and when the owner returned and saw the pole in position he notified the company that if the pole was not promptly removed he would take steps to compel removal. The company made no reply to his letter but permitted the pole to remain in the alley, though it was straightened so that it did not project over the lot. The owner then cut the pole down and was sued by the telephone company for damages sustained by reason of the act. The decision was in favor of the defendant lot owner under the well-known rule that the planting of telephone or telegraph poles along a public highway, or railroad right of way for other than railroad use, in the country where the title of the abutting owner runs to the center of the road subject to the right of way, is an appropriation of private property, and is unlawful unless the right to do so has been acquired by contract or condemnation. The same principle applies with equal force to the planting of poles [illegible] a city on a private alley, such as the one in this case, where the title of the abutting owner extends to the center of the alley, although a different principle would control the erection of poles on the public streets of the city whose beds are owned by the municipality. The rule is the same whether the title of the abutting owner be a leasehold or a fee. It was held that the pole constituted a nuisance, which the lot owner had a right to abate. The company was armed with the power of condemnation of an easement for the erection of the pole, and if under those circumstances it proceeded forcibly and in entire disregard of the owner's rights to erect it so as to injure and annoy him it could not expect the law to be too strictly applied to him in its favor, when he, without any breach of the peace, cut the pole down. Maryland Telephone & Telegraph Co. vs. Ruth, 68 Atl. 358.

NO LIABILITY ATTACHES TO TELEPHONE COMPANY BECAUSE HORSE IS STRUCK BY LIGHTNING IN VICINITY OF ITS LINES.—The owner of a horse brought an action against a telephone company to recover damages for the death of the animal based on the following facts: The horse, having been turned into a pasture, through which ran the company's line consisting of three wires, was not seen again until found dead beneath the telephone wires, where it had been struck down by lightning. The wires were about eighteen inches apart and the middle one was about a foot lower in its construction than the other two. The horse was about six feet tall and at the place where he lay the middle wire was about six inches higher than his head, when standing. The examination of the horse after the storm, considered in the light of the height of the wire above him, disclosed rather positively that the wire did not come in contact with him. Neither were the wires crossed or together. There was not shown any structural or inherent quality or defect of the line or wire, or that it was out of repair or maintenance at the time. The lightning in its course shattered the cross-arm separating the wires from contact on a pole distant therefrom, and cut a swath of grass underneath 3 ft. wide beneath the wires, extending from a point 30 steps from the horse on the ground sloping north toward the horse and beyond him 12 or 15 ft. Two wires of a barbed-wire fence on the south side of the pasture had been broken from several posts and rolled up. The question to be determined, said the Court, is this: "Was the horse killed by electricity which came from the wires, or directly by a bolt of lightning from the clouds? If the same bolt of lightning struck both the telephone line and the horse, but if the wire did not control the path of the bolt from the clouds to the earth so as to be the proximate cause of the bolt's striking the horse, the appellant as a matter of law would not be liable. It is not sufficient that the wire was a possible consequence of conducting the lightning to the horse. The proof in the record, properly construed, as a matter of law, would not warrant the finding by a jury that the wire or telephone line was the efficient cause of the bolt of lightning's striking the horse, or leaping to the horse's body from the telephone wire suspended out of his reach." Southwestern Telephone & Telegraph Co. v. Morris, Court of Civil Appeals of Texas, 106 S. W. Rep. 426.

Personal.

MR. C. HOLDEN has been appointed superintendent of the municipal electric light plant at Moosejaw, Sask.

MR. A. E. GURNEE has been appointed treasurer of the New York & New Jersey Telephone Company, to succeed Mr. H. S. Snow, resigned.

MR. WILLIAM K. HOWARD has been elected superintendent of the municipal electric light plant at Fredericksburg, Va., to succeed Mr. E. M. Green, resigned.

MR. P. E. HALL, JR., of Everett, Wash., has been appointed general manager of the Montesano Light & Water Company, of Montesano, Wash. Mr. W. E. Meyer will be retained as local manager of the plant.

MR. THOMAS A. EDISON was the guest at a dinner given in Newark, N. J., last week in honor of his 61st birthday. His hosts were the heads of the various departments in his West Orange laboratory.

MR. S. W. HUFF, general manager of the Virginia Passenger & Power Company, has been elected president of the Coney Island & Brooklyn Railroad Company, of Brooklyn, N. Y., to succeed Mr. John L. Heins, who recently resigned.

MR. ROBERT McF. DOBLE, consulting and supervising engineer making a specialty of hydro-electric power development and transmission, formerly of San Francisco, has removed his office from Colorado Springs to Majestic Buildings, Denver, Col.

MR. ARTHUR H. ALLEN, formerly with the Westinghouse Electric & Manufacturing Company, has been appointed district agent for the Triumph Electric Company, of Cincinnati. Mr. Allen will have his office at 1019 Land Title Building, Philadelphia.

MR. C. H. DAVIS, formerly manager of the Chicago office of the Nernst Lamp Company, on March 1 will take charge of the electric railway details department of the Westinghouse Electric & Manufacturing Company at the East Pittsburg Works.

PROF. ROLAND CARLBERLA, of Columbia University, presented a paper entitled "Manufacture of Ferro-Chrome in the Electric Furnace" at a meeting of the New York Section of the Society of Chemical Industry, held in the Chemists' Club, Feb. 21.

MR. W. E. GILMORE, of Orange, N. J., who for many years has been actively and prominently identified with Edison manufacturing interests there, has been admitted as a special partner into the Consolidated Exchange firm of G. Edward Graff, of New York City, having offices both uptown and downtown.

MR. JOHN FRITZ, of Bethlehem, the veteran iron master, has been elected a member of the board of trustees of Lehigh University and has accepted the position. His universally recognized high standing among the engineers of the country makes this addition to the board of trustees of this leading technical institution eminently fitting.

MR. A. G. WESSLING, who has been with the Bullock works of the Allis-Chalmers Company as a designing engineer for many years past, resigned recently for a year of travel and study abroad in Great Britain and on the Continent. He sailed last week from New York on the *Cedric*. Mr. Wessling is a graduate of Cornell University.

MR. PETER COOPER HEWITT has entered the competition for the supply of a war balloon to the U. S. Army, and has offered a bond of $20,000 for a balloon, to be finished in 200 days. Mr. Hewitt recently announced that he, in connection with Mr. Miller Rees Hutchinson, was experimenting on a balloon which would make 60 miles an hour.

MR. HENRY DOCKER JACKSON is tkaing a vacation in Bermuda, having finished an important piece of work for the city of Brockton. He has formed an association with Mr. Harold Y. Currey, of Chicago, and is making plans for an association on the Pacific Coast as well. Hereafter he will extend his field, to include Mexico, the United States and Canada.

PROF. D. C. JACKSON, head of the department of electrical engineering, Massachusetts Institute of Technology, has been retained by the Massachusetts Highway Commission, and will make a preliminary report regarding the telephone situation in the State, with special reference to the practicability of a reduction in rates and a higher efficiency of service.

MR. H. C. KAERSCHNER has been appointed superintendent of motive power of the Hudson Valley Railway Company, of Glens Falls, N. Y., to succeed Jesse D. Abell, resigned. Mr. Kaerschner's appointment took effect on Feb. 1, but until March 1 he will have charge of the power plants and electrical appliances of the Hudson Valley Railway. After that date he will assume charge of the rolling stock.

MR. EDGAR B. GREENE, who for several years has been most successfully identified with the management of the lighting system at Altoona, Pa., will celebrate, with Mrs. Greene, on Feb. 20, the 25th anniversary of their marriage. They are in receipt of congratulations from a host of friends, particularly those in the National Electric Light Association and the Association of Edison Illuminating Companies.

MR. S. W. HOUGH has resigned as general manager of the Virginia Passenger & Power Company, of Richmond, Va., and will succeed Mr. John L. Heins as president of the Coney Island & Brooklyn R. R. Company. Mr. Hough was at one time assistant superintendent of the Baxter Electric Motor Company, of Baltimore. Since that time he has been connected with street railway work in Raleigh, N. C., Baltimore, San Francisco, Philadelphia, and Richmond, Va.

DR. A. PIRELLI, of the firm of Pirelli & Co., the great Milan firm making insulated wires and cables, automobile tires, etc., is again in this country and will stay a few weeks. The Pirelli tires are used on the Zust car from Italy, which started from New York on Feb. 12 via Alaska to Paris, as they were also on the car of Prince Borghese, which made the famous trip from Pekin to Paris. Dr. Pirelli takes great interest in this department, but devotes his attention largely to the electrical side of the industry.

MR. WYNN MEREDITH has become a partner in the firm of Sanderson & Porter, of 52 William Street, New York, N. Y., and will have charge of the Western office, which they have opened in the Union Trust Building, San Francisco, Cal. Mr. Meredith was actively connected with the engineering and operation of the electrical plant of the World's Fair at Chicago, Ill., in 1893, and the California Fair in 1894, subsequently becoming associated with Messrs. Hasson & Hunt, and later a member of the firm of Hunt, Dillman, Meredith & Allen, of San Francisco, Cal.

MR. A. H. ACKERMANN, formerly in charge of the meter and test departments of the New York Edison Company, and who joined the staff of the Electric Storage Battery Company as engineer of the New York office about two years ago, has recently resigned from the latter company to accept an offer from the Studebaker Brothers Company of New York to become their sales engineer. Mr. Ackermann will devote himself to the electric vehicle department, both of commercial and pleasure type. He will cover the entire eastern territory, though his headquarters will be in New York City.

Obituary.

MR. WALTER I. BARNES, assistant general manager of the Narragansett Electric Lighting Company, died last week at his home in Manton, R. I., after an illness covering a period of two years, during the final nine months of which he was confined to his house. Mr. Barnes entered the employ of the Narragansett Electric Lighting Company in 1891 as a salesman and worked up to the position of general superintendent, which he occupied from July, 1895, until his appointment as assistant general manager, which occurred just prior to the beginning of his illness. He was born Dec. 20, 1859, and after a common school education graduated from the commercial school of Bryant & Stratton.

PROF. W. F. C. HASSON, at one time a considerable factor in the electrical engineering field, died at Annapolis, Md., Friday, Feb. 14. Prof. Hasson upon graduation from Woodward College, Cincinnati, as gold medalist in 1876, entered the Naval Academy as cadet-engineer and was graduated therefrom third in his class, four years later. After a cruise on the Asiatic Station he served several years as professor of mechanical engineering at the University of Nebraska. Upon returning from a cruise around the world following this duty he was stationed at San Francisco and resigned from the naval service in 1893. In that year he took a prominent part in the proceedings of the international electrical congress of Chicago, particularly in the discussion of high-tension transmission problems of the day. In the early part of 1894 he organized and conducted, as chief electrician, the electrical department of the Midwinter fair, which achieved a notable success as an electrical show. Shortly after he entered into partnership with Mr. A. M. Hunt, also formerly of the navy, and the firm of Hasson & Hunt carried through some of the most important transmission and railway work of the period on the Slope. Owing to ill health Mr. Hasson retired from the firm about ten years ago, and after a residence of several years in Hawaii, accepted an appointment in the department of mathematics at the U. S. Naval Academy. Prof. Hasson was a man of lovable disposition and brilliant intellect, whose withdrawl from active work in the electrical engineering field was a distinct loss to the profession and the industry.

Unclassified Items.

DES MOINES, IA.—At the annual meeting of the Des Moines City Railway Company the following named officers were elected: George B. Hippe, president; Harry H. Polk, vice-president; H. T. Guernsey, secretary; G. B. Hippee, treasurer, and A. G. Maish, general manager.

HARTFORD, CONN.—At the annual meeting of the Hartford Electric Light Company the following named officers were elected: A. C. Dunham, president; S. G. Dunham, vice-president; Curtis C. Cook. secretary and assistant treasurer, and D. N. Barney, treasurer.

PROVIDENCE, R. I.—At the annual meeting of the Providence Telephone Company the following named officers were elected for the ensuing year: Dexter B. Potter, president; Fenner H. Peckham, vice-president; Charles T. Howard, secretary and treasurer, and Joseph F. Beck, general manager.

MONROE CITY, MO.—The plant of the Ralls County Electric Light & Power Company has been sold by R. F. Roy, trustee, to P. W. McGown. who will make improvements to the same.

BLOOMFIELD, MO.—The Bloomfield electric light plant has been purchased by Rudolph Houck and A. D. Wilcox. A company will be incorporated to operate the plant.

MARYVILLE, MO.—Considerable new machinery is being installed in the electric light plant here with a view to increasing the service.

JOHNSON CITY, TENN.—The Watauga Electric Company is installing a 400-kw dynamo which will nearly double the output of the plant. The company furnishes electrical energy for the city lighting system and also to the Johnson City Traction Company.

PEARSALL, TEX.—The Orella Telephone Company has been incorporated with a capital stock of $50,000 by Jesse H. Jones, E. C. Lamb and D. E. Garrett.

ADRIAN, MICH.—At the annual meeting of the Citizens' Light & Power Company the following named officers were elected for the ensuing year: J. H. Fee, president; G. A. Wilcox, vice-president; Henry A. Wing, secretary; C. E. Baldwin, treasurer, and H. A. Fee, general manager.

HARMONY, N. C.—The Harmony Telephone Company has been incorporated with a capital stock of $5,000 for the purpose of erecting and operating a telephone system between this city and Statesville and other points in Iredell, Davie, Alexander and Yadkin Counties.

BRAWLEY, CAL.—The injunction issued against the Holton Power Company restraining them from wasting water into the Salton Sink became effective Feb. 12, and caused the shutting down of its plant at Holtville, with the result that all the towns in the Imperial Valley are without electrical service. It is expected that the service will be restored within a few days, as the company's auxiliary plant is nearly completed.

RENO, NEV.—The machinery for the new substation of the Reno Power, Light & Water Company, is now being installed in the old power house. The equipment of the station consists of two large transformers and a 375-kw generator. As soon as the plant is completed the high-tension wires of the company will be removed from the streets, and the two substations in the city will be abolished. The cost of the improvements is placed at $25,000.

WASHBURN, WIS.—The city has purchased the outside equipment of the Washburn Electric Light & Power Company. F. W. Downs is superintendent of the municipal plant.

WEAVERVILLE, CAL.—Arrangements are being made to install electrical equipment at the Brown Bear Mine at Deadwood.

CALISTOGA, CAL.—An attachment has been placed on the entire plant of the Calistoga Electric Light & Power Company in this place, and the power house and machinery now under construction and installation at Barrow. The attachment is the outcome of two suits filed in the superior court Feb. 9 by H. H. Brown, president of the Bank of Calistoga to recover moneys due. The plant has been placed in the hands of Lee Hopper, of Calistoga, who will act as keeper.

BETHEL, VT.—The Bethel Printing Company has installed a 2-hp motor to operate its printing presses by electricity. Energy for operating the motor will be furnished by the Bethel Electric Light & Power Company. Several other industries using a small amount of power are contemplating installing electrical service.

MR. S. P. GRACE, chief engineer of the Bell Telephone Company, of Pittsburg, has been elected a director of the Engineers' Society of Western Pennsylvania. This society now numbers nearly a thousand members and has become an important factor in the industrial development of Pittsburg.

MR. GEORGE E. BRUEN has been appointed engineer for the Underwriters' Laboratories, Inc., which have been moved from 29 West Thirty-ninth Street to the twelfth floor of the building at 135 William Street, where the offices of the National Board of Fire Underwriters are also located. Mr. Bruen is employed in an engineering capacity by the National Board and will take up the laboratory work in connection with his other duties, and have charge of the business of that corporation in and around New York City.

Business Notes.

THE DALE ELECTRIC COMPANY, New York, is about to put on the market a new Universal Portable, designed especially for use on roll-top desks and stenographers' desks. By means of swivel joints the light may be adjusted to any position desired.

THE F. BISSELL COMPANY, Toledo, Ohio, announces that for 1908 it will have an unusually large stock of cedar poles. Besides a large supply of both larger and smaller sizes which it is now cutting in Idaho and Michigan, there is a supply already at its yards sufficient to take care of any immediate demand.

THE AMERICAN ENGINE COMPANY reports that the increased business consequent upon the manufacture of its new engine, the "Angle-compound," has necessitated a large addition to its plant at Bound Brook, N. J., where even in these troublous financial times they have for some weeks been running both day and night shifts.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., suffered the loss by fire of one of its rope shops on Feb. 5. The shop destroyed, compared with the other shops, was of minor importance. Owing to the fact that business in general has been somewhat depressed and that at this season of the year the demand for wire rope is always less than during the spring and summer months, the facilities of the rope shops have not been overtaxed, and the productive capacity of the remaining shops will enable the company to continue prompt shipments of wire rope to its customers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEB. 11, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

878,496. SYSTEM FOR CONTROLLING THE MOTION OF ELECTRICALLY-OPERATED ELEVATORS BY MEANS OF A SWITCH; William Baxter, Jr., Jersey City, N. J. App. filed May 21, 1902. A system for controlling the motion of electrically-operated elevators by means of a switch located within the car. Covers complete electrical and mechanical features.

878,498. SWINGING ELECTRIC BRACKET; J. F. Brown, Toledo, Ohio. App. filed July 8, 1907. A sliding contact for completing the circuit connections in an electric wall fixture, so that the circuit wires will not be bent and broken.

878,520. MEANS FOR TYING WIRES TO INSULATORS, ETC.; L. W. Gerdon,, Meadville, Pa. App. filed Oct. 14, 1907. Patentee makes use of a tie for binding the line wire to the insulator and consisting of two members, each of which completely encircles the insulator, and intersecting at the point where the line wire is tangent to the insulator.

878,551. PROTECTING HOOD FOR SPARK PLUGS; D. B. Mills, East Orange, N. J. App. filed Feb. 2, 1906. A protector for electric terminals, particularly for the central terminal of spark plugs. Is designed to prevent the formation of a conducting film of moisture.

878,586. PUSH BUTTON SWITCH; H. C. Williamson, New York, N. Y. App. filed May 17, 1906. A two-button snap switch, having a depressible latch, which is engaged by a cam to release the switch element.

878,591. SWITCH DEVICE; Karl Abel, et al., Vienna, Austria-Hungary. App. filed Jan. 25, 1907. A switch device with four crosswise connected fixed contact pieces, which can be connected to alter the direction of the current.

878,629. ELECTRIC MERCURY MOTOR METER; Jacob H. Hodde, Springfield, Ill. App. filed March 16, 1907. Has a body of mercury and a spindle rotating therein, and a washer loosely surrounding said spindle at the point where the spindle enters the body of the mercury.

878,633. KEY SOCKET; H. Hubbell, Bridgeport, Conn. App. filed March 5, 1907. A single pole key socket designed to be very cheaply constructed.

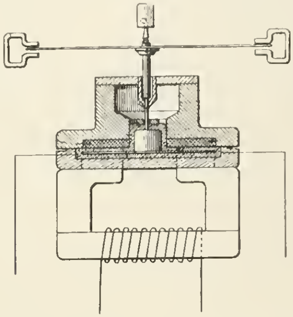
878,634. SOCKET SHELL CAP FASTENING; H. Hubbell, Bridgeport, Conn. App. filed Sept. 5, 1907. Means for attaching the caps to electric socket shells, so that the cap is rigidly secured to the shell and readily detachable therefrom when required.

878,646. HIGH-POTENTIAL INSULATOR; Fred M. Locke, Victor, N. Y. App. filed April 18, 1904. A wire insulator, comprising concentric rings, having their ends spaced apart and terminating in different transverse planes.

878,653. TROLLEY PULLEY; E. J. Matthews, et al. In place of the usual trolley harp, patentee has a wheel with radially extending spokes which maintain a device in position over the trolley wire, but permit the latter to travel over the tops of specially constructed hangers.

878,656. TROLLEY WHEEL; J. T. Mishler, Johnstown, Pa. App. filed Aug. 10, 1907. The trolley wheel has spiral grooves communicating with the central grooves so as to insure the replacement of the wire.

878,661. SYSTEM OF ELECTRICAL DISTRIBUTION; R. S. McLeod. App. filed July 11, 1904. Dynamo electric machine for regulating the charge and discharge of storage batteries. Comprises a reversible booster connected in series with the battery across the mains.



878,629.—Electric Mercury Motor Meter.

878,679. SUPPORT FOR INSULATORS; W. N. Smith, Yonkers, N. Y. App. filed April 28, 1906. Patentee has cast-iron insulator support clamped to the cross-arm of the pole by a U-shaped staple with threaded ends.

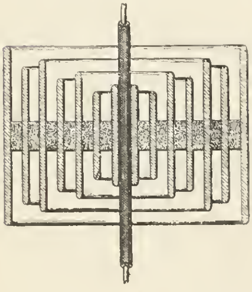
878,688. ELECTRIC HEATED HAND MOLDER FOR FILLING SHOES; A. Thoma, Cambridge, Mass. App. filed June 11, 1907. A small tool having a flat blade with a resistance element assembled against the rear face thereof so as to warm the same.

878,708. HEATED STEERING WHEEL; C. Berg, New York, N. Y. App. filed March 25, 1907. Patentee provides a hollow steering wheel for an automobile, and embodies a resistance element therein to warm the same.

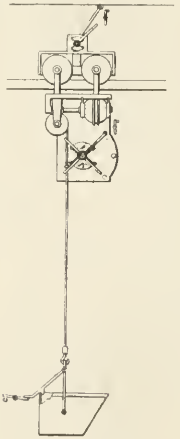
878,710. ELECTRICAL VAPOR APPARATUS; H. L. Campbell, et al., Nashville, Tenn. App. filed Feb. 18, 1907. Has a vessel in which is formed an electric arc and through which air under pressure is forced.

878,756. CONTROLLER; W. J. Warder, Jr., Chicago, Ill. App. filed May 13, 1907. A form of starting or speed controlling rheostat for electric motors having a ratchet mechanism, by which it is impossible to turn on the controller too rapidly.

878,779. PARTY-LINE TELEPHONE SYSTEM; Wm. W. Dean, Chicago, Ill. App. filed Jan. 22, 1904. In a party line telephone system, the combination with a telephone line, of a plurality of substations located on the line, a harmonic device at each substation adapted to respond to current of predetermined frequencies, a bell also at each substation, a shunt circuit of the bell adapted to be continuously broken during the actuation of the device, and a source of current at the central office for each substation adapted to impress current upon the line of the proper frequencies to operate said harmonic devices, substantially as described.



878,646 High Potential Insulator



878,787.—Telpher

878,791. SUPERVISORY APPARATUS; K. Friedlaender, Berlin, Germany. App. filed Jan 31, 1900. Signal system for night illumination of factories and warehouses where the lights glow faintly at all times, but are lighted brilliantly during the passage of the watchman in his patrol.

,797. TELPHER; H. M. Harding, et al., New York, N. Y. App. filed April 13, 1905. A complete electric telpher system having means by which the operation of both the hoisting and the telpher motors are controlled entirely automatically. The arrangement is such that the bucket is hoisted, dumped, returned and again lowered automatically after once being started into operation.

878,816. SLEEVE FOR JOINING WIRE ENDS; F. W. Maxstadt, Los Angeles, Cal. App. filed Nov. 7, 1904. A sheet metal sleeve shaped like figure 8 in section and spirally twisted to enclose the circuit wires to be connected.

878,830. SECURING DEVICE FOR TROLLEYS; E. D. Trickey, Blanchester, Ohio. App. filed April 17, 1907. Patentee has a pair of spring-impelled arms projecting upward from the trolley harp and adapted to close over the wire.

878,855. SYSTEM FOR CONTROLLING THE OPERATION OF ELECTRIC MOTORS; T. E. Barnum, Milwaukee, Wis. App. filed July 10, 1905. A system of contactors for electric motors, by which they are controlled from a distant point by the actuation of push-button contacts in the pilot circuit.

878,870. INSULATOR SUPPORT; T. J. Creaghead, Covington, Ky. App. filed May 19, 1902. Patentee has a cast-iron support for an insulator of X shaped transverse section with a stud bolt for connecting it to the pole arm.

878,877. ELECTRIC CLOCK; N. Friedman, New York, N. Y. App. filed Nov 2, 1906. A self-winding clock having a motor with a shaft having a pinion, the shaft being larger than the pinion, to prevent backward rotation of the shaft by power applied to the pinion.

878,894. SIGNAL SYSTEM FOR ELECTRIC RAILWAYS; C. F. Pike, Philadelphia, Pa. App. filed Oct. 19, 1901. Details of circuits of a block signal system, making use of special equipment throughout and having certain functions affected by the movement of the controllers on the cars.

878,919. ELECTRIC HEATER; W. R. Whitehorne, Brooklyn, N. Y. App. filed April 22, 1907. Electric heating means for dye vats designed to obviate the possibility of any electrolytic action which might affect the liquor or compounds in the vat.

878,923. SINGLE-PHASE MOTOR; James J. Wood, Fort Wayne, Ind. App. filed April 26, 1906. In a single-phase motor, a rotor winding provided with both commutator and collector rings, connections for supplying current from an external source to said commutator and collector rings alternatively, and a stator winding short-circuited upon itself on a definite line.

879,963. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Feb. 3, 1906. Arrangement for telegraphy over lines of comparatively large capacity.

878,949. ELECTRIC WIRE INSULATOR; J. H. Hanson, Chicago, Ill. App. filed Jan. 12, 1907. A rectangular porcelain insulator having undercut transverse passages to receive the circuit wires so as to automatically lock them in place.

878,952. ELECTRICALLY HEATED SOLDERING AND BRANDING IRON; H. Hertzberg, et al., New York, N. Y. App. filed April 5, 1907. A soldering iron having a rectangular metallic chamber in which is received a spirally wound resistance element.

878,961. CONTROLLER FOR ELECTRIC MOTORS; P. N. Jones, Pittsburg, Pa. App. filed Aug. 12, 1907. Controllers for electric motors having two or more controllers with suitable mechanism, whereby the controllers can be simultaneously operated to regulate and reverse the current to the motors.

879,033. INSULATOR FOR ELECTRIC WIRES; J. Caldwell, Philadelphia, Pa. App. filed Aug. 7, 1907. A cylindrical insulator having deeply cut grooves on planes to produce a triangular transverse section of the insulator therebetween.

879,034. TROLLEY POLE CONTROLLER; J. J. Coit, Venice, Cal. App. filed Oct. 20, 1906. The trolley harp is pivoted to the upper end of the pole, and a small piston is effective to keep the wheel pressed upward against the wire. Additional pneumatic mechanism operates to retrieve the pole or control it in other ways.

879,035. CABLE-TERMINAL; Frank B. Cook, Chicago, Ill. App. filed May 28, 1906. A cable terminal, comprising a sheet metal distributing plate, sheet metal channel portions secured to the said plate in a vertical position, sheet metal rings mounted to the said channel portions between same, and protective apparatus suitably mounted around the said sheet metal rings.

879,046. ELECTRICALLY HEATED SAD IRON; H. Hertzberg, et al. New York, N. Y. App. filed April 5, 1907. Patentee has a flat iron with a hollow interior, in which is received a spirally wound resistance element which is clamped tightly in place by wedge blocks.

879,061. RECTIFIER FOR ALTERNATING CURRENTS. George W. Pierce, Cambridge, Mass. App. filed Jan. 11, 1907. In an electrical apparatus, a rectifier for alternating currents, consisting of carborundum.

879,062. RECTIFIER AND DETECTOR; George W. Pierce, Cambridge, Mass. App. filed April 5, 1907. A rectifier for oscillatory currents, consisting of a conductive oxid of titanium.

879,073. TELEPHONE AND STATION APPARATUS; Nuchim L. Weingott, Warsaw, Russia. App. filed Dec. 30, 1907. The combination with a telephone and a key connected thereto and carrying the conductor terminals of said telephone, of station contact apparatus comprising movable contact parts, said last-named contact parts being connected to the wires of the telephone system.

879,083. ELECTRIC-INCANDESCENT-LAMP LUMINANT AND THE PROCESS OF MANUFACTURING IT; Francis M. F. Cazin, Hoboken, N. J. App. filed Nov. 30, 1903. In an electric incandescent lamp a filament-shaped luminant, which consists of a primary core-fillet, plated electrolytically with metal-alloy.

879,084. MANUFACTURING OF FILAMENTS IN ELECTRIC INCANDESCENT LAMPS, PROCESS AND PRODUCT; Francis M. F. Cazin, Hoboken, N. J. App. filed May 31, 1904. A glower filament in an electric incandescent lamp, which glower-filament consists of a metallized carbon-fillet, the metallization of which fillet consists of electrolytic alloy-deposits in concentrical layers, the inner layer consisting of metals of the ruthenium-osmium class and being on its contact with the carbon inter-impregnated therewith, and the outer layer of which consists of rare metals, the surface of which is covered with oxids.

879,085. FILAMENT IN ELECTRIC INCANDESCENT LAMPS AND ITS MANUFACTURE; Francis M. F. Cazin, Hoboken, N. J. App. filed June 2, 1904. A filament in an electric incandescent lamp, which consists of a central core and of adhesive concentrical layers thereon, the layers consisting of electrolytical deposits, and the ends of which filament increase in thickness towards the terminals.

879,068. INSULATOR FOR HIGH-TENSION CURRENTS; L. Steinberger, New York, N. Y. App. filed Aug. 12, 1907. Patentee has an insulator with a ribbed top surface over which is placed a laterally projecting cover so as to shed water from the ribs.

879,117. RECTIFIER AND DETECTOR; George W. Pierce, Cambridge, Mass. App. filed April 5, 1907. A reflector for oscillatory currents, consisting of a compound of silver and tellurium.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN

VOL. LI. NEW YORK, SATURDAY, FEBRUARY 29, 1908. No. 9.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. HAROLD S. BUTTENHEIM, Secretary.
A. E. CLIFFORD, 2d Vice-President. CURTIS E. WHITTLESEY, Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE..................1015 Schofield Building
PHILADELPHIA OFFICE...............Real Estate Trust Building
EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.......................per year, $3.00
Dominion of Canada.......................................4.50
Other Foreign Countries within the Postal Union..........6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, FEBRUARY 29, 1908.

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THE PRICE OF COPPER.

During 1907 the copper exported from this country reached the value of over $100,000,000, and this occurred in spite of a sharp fall in price. The export price for copper in December, 1907, was 13.3 cents per pound, whereas in 1906 it was no less than 24.4. Hence, the total value of the copper exported in December, 1907, no less than 82,000,000 pounds, was only three and a half million dollars in excess of less than half that quantity, or 34,000,000, sent abroad in the corresponding month of 1906. These are certainly notable and extreme fluctuations, emphasizing the fact once more that export values must be read in the light of the quantities sent out. It will, of course, be interesting to see how far such low figures as those of present quotations can go in stimulating foreign demand. The electrical market for copper, whether abroad or at home, waits, of course, upon the conditions of trade; and while copper may stiffen in value, no great hardening of prices can be expected until the great electrical industries are again humming with full activity. We trust and expect that will come soon, but meantime the price of copper looks inviting.

THE INFLUENCE OF VOLTAGE-VARIATIONS ON THE CANDLE POWER OF INCANDESCENT LAMPS.

It has long been known that the mean horizontal candle power of an incandescent lamp, when plotted on logarithm paper as ordinates against terminal volts as abscissas, gave a substantially straight-line graph, the inclination of the straight line varying with different types of filament. This means that the candle-power of a lamp varies substantially as a certain power of the voltage at its terminals. An article on this subject, abstracted in the Digest, has recently appeared in the *Elektrotechnische Zeitschrift* from Mr. F. Hirschauer. The article analyzes certain tests on incandescent lamps with filaments of carbon, tantalum, osmium and tungsten in addition to the Nernst lamp. The results showed that the candles varied as the tenth power of the voltage in the Nernst lamp, as the 6.3 power in the carbon, 4.3 in the tantalum and as the fourth power in osram and in tungsten lamps. Consequently, for each 1 per cent variation of voltage near the normal, the candles would change 10 per cent with the Nernst, 6.3 per cent with carbon, 4.3 per cent with tantalum and 4 per cent with osram and tungsten lamps. The same kind of inquiry in America with the lamps we have in the market here, have shown that for 1 per cent of terminal voltage variation near the normal we get a variation in candle-power of 5.5 per cent with carbon, 5 per cent with graphitized carbon, and about 4 per cent with tantalum and tungsten.

The general conclusion to be drawn from the observations reported in the paper is that the more recent metallic filaments are not only more efficient than carbon filaments in transforming electric energy into light, but they are also more stable in luminous intensity considering accidental changes in voltage between the distributing mains. The reason for the greater sensibility of carbon-filament lamps to voltage variation seems to be at least mainly due to the fact that whereas carbon filaments either fall in resistance or only rise very slightly as the voltage is increased near the normal, the resistance of metallic filaments tends to rise distinctly—about 0.6 per cent for 1 per cent increase in voltage. In other words, if the resistance behavior of all incandescent filaments in regard to terminal voltage were the same, we might expect the rate of increase of candles per volt to be nearly the same for all filaments. The rate of diminution in the resistance of Nernst filaments with respect to voltage is greater than that of carbon, and metal filaments have the opposite tendency. If a filament were found which increased 5 per cent in resistance for 1 per cent increase in voltage, it should give constant candle-power.

Westinghouse.

It is a matter of profound pleasure to all interested in the welfare of the electrical industries to note how rapidly the Westinghouse situation is righting itself. As one looks back. the vista to last October shortens up, and it is seen how superficial, in a sense, the embarrassment of the moment was seriously as its pinch was felt temporarily. We are now glad to note that the receivership of the Westinghouse Lamp Company has been terminated this week, and the property turned back to the officers and stockholders. At this rate, very few traces are left of the troubles of four months ago, and the recovery has been more quickly effected than seemed possible even to the most sanguine observer. Courage and tenacity under adverse circumstances have brought this about, and no one is more heartily to be congratulated than Mr. George Westinghouse himself, who has relaxed neither nerve nor endeavor in confronting problems before which men of lesser calibre would have succumbed. The Westinghouse industries and their spirit of advance and progress have been among the foremost factors in the modern American industrial triumph, and they cannot be spared from the resources of the country In whatever field they operate, and such fields are chiefly electrical, they are getting into shape to share brilliantly in the renaissance of prosperity now not very far away.

Effect of Early Rising.

Sumptuary legislation will go a long way, and of late has made some rather spectacular outbursts, but we doubt whether any of it of recent date is quite so interesting to central station managers and others engaged in electrical development as a bill introduced in the British Parliament "to promote the earlier use of daylight in certain months of the year." History records the standing still of the sun to accommodate a certain warrior who needed an extra hour or so to get all his killing done, but usually mankind has tried to adjust its work and play to the hours of sunshine. This new piece of legislation appears to be both humanitarian and utilitarian in its object. It embodies a definite scheme, that of advancing the clock 20 minutes on each of the four Sundays of April. The author of the bill asserts that the saving in daylight during the six summer months subject to the action of the measure would be just about 700 hours. By going to work earlier, the artisan would acquire command of long afternoons for recreation or study and moreover "in artificial light alone the scheme would save $10,000,000 yearly" in England.

Visionary and amusing as such a scheme is, there lie elements of common sense back of it, and we are all of us too apt to assume that the present régime of late going to bed and late rising will always prevail. Should we revert gradually to the healthier régime of our forefathers, largely that of the farm where it still prevails in spite of cheap kerosene, that will have been attained by the slow process of custom and fashion at which this English bill aims. We can also imagine a time coming when with the coal of the world near exhaustion such a bill, or one even more stringently Rooseveltian in its definition of crime against society, may forbid any kind of liberal use of light after dark or after dawn. In those days the lighting companies will only be happy that have cultivated a day load of power business. But, seriously, such times of depression as we have lately gone through, tending to cut down consumption of electrical energy at night, show how insensibly and automatically people become economical of light without being forced into it by direct arbitrary legislation

Is the Arc Doomed?

The coming of the present high-efficiency incandescent lamps raises very forcefully the inevitable question regarding the status of the arc lamp in the future. The matter is a very serious one because of the large investment in arc equipment now carried by the central stations and the certainty of its loss in large part if the arc is generally abandoned. Of one thing there is reasonable certainty—that the so-called commercial arc service, using 75 volts or so at the lamp out of 110 to 120 at service wires, is already on the down grade of obsolescence. However good as an illuminant the arc may be, the waste of energy is so prodigious as to cut down the practical efficiency woefully. If one takes the other horn of the dilemma and uses alternating arcs, he is little better off since the arc itself is at a disadvantage. No one but an American would seriously consider throwing away one-third of his energy at the start in order to save a relatively small amount of labor. as is evidenced by the small progress made by the enclosed arc abroad. That the saving in labor is relatively small in many instances there is good reason to believe, although in operation on a large scale the cost of energy comes down enough to show a saving as over the Continental practice of burning two or sometimes three open arcs in series.

We are aware that some of our readers will hold up their hands in horror at this mention of open arcs, but unless all the signs of the times are wrong, the enclosed arc in anything like its present form cannot survive the attack of the modern incandescent, though it will have a moderate respite so long as its rivals are held up to present prices. The solemn truth to tell, the cost of trimming open arcs was much exaggerated during the exploitation period of the enclosed arcs. Perusal of the discussions at the conventions of the N. E. L. A. will show that in the hands of skilfully managed companies open arcs were often trimmed at a very modest figure annually, in some cases little above $5 and often below $10. Of course, the old open arc has nearly disappeared, but the new arcs, which alone are fitted to cope with the tungsten and similar lamps, are practically in the open class. The flaming arcs of the kind now common have the same short life of carbons, but improvements are being rapidly made and if the price of the electrodes falls to a reasonable figure, as it soon must, the labor and cost of trimming will not be so serious an item as it now seems. The new arcs of the magnetite class or so-called "luminous" arcs have much longer life of the electrodes, but need considerable care as yet to keep the globes in condition.

The new arcs materially change the situation. Basing comparisons on mean spherical candle-power, they are about three times as efficient as the tungsten lamp. When a tremendous flood of light is needed they are there with the goods. It seems improbable that they will not be materially improved over their present form in various ways, leaving them in still better condition for competition. It looks therefore as if so far as economy is concerned the new arcs have a bigger advantage over the new incandescents than did the old arcs over the old incandescents. In fact, one could in the matter of illumination come pretty near to beating out the commercial enclosed arc with carbon filaments. The arc when properly screened had much the advantage in color, however. At present the tungsten lamp has made a great improvement in color value, but is still behind the best arc illumination. The new titanium arc is admirable in color, and even the yellow flaming arc is less objectionable than the violet enclosed arcs at small current. It is very gratifying that with the improvements in the incandescents, the arcs have moved forward at an even pace. For there is a genuine use for big units of light, a use that will expand as the general plane of lighting is raised. Most streets are to-day only half lighted and the tendency should steadily be toward a considerably larger volume of light, so to speak To give this with economy in fixtures and with enhancement of the general effect of brilliancy, powerful units are needed, which cannot yet be furnished with incandescent lamps. But this much is certain, that the whole matter of street lighting has been opened wide for reconsideration. Save for the enclosed arc, changes have heretofore been few, while to-day with scant warning one is confronted with half a dozen startling possibilities which demand immediate consideration.

Standard Performances of Electrical Machinery.

A valuable paper has recently been presented before the Institution of Electrical Engineers, in London, by Dr. R Goldschmidt (abstracted in the Digest), on standard performances of electrical machinery, the keynote of which is the torque of such machines. The matter is somewhat disguised and befogged in the treatment, because the standard of reference in the paper is the kilowatts per thousand revolutions per minute and this is called "power"; whereas it is not actually power but power divided by angular velocity, and, therefore, equal to a torque. The unit of torque thus selected is 9.55 megadyne-decimeters in the metric system, or 7.04 lb.-feet in the British system, or the torque which a weight of 7.04 lb. avoirdupois at the latitude of London establishes about a shaft axis when acting over a pulley of one foot radius. This torque develops a power of one kilowatt per 1000 r.p.m. It is easily shown by the relations of the C. G. S. system of units that in any direct-current machine the product of total useful megamaxwells, to as well as from the armature from all poles, times the number of thousands of armature wires, times the average amperes flowing in each wire will be six times the torque generated when measured in the above unit. If the machine is a generator, the torque developed must therefore be the product of kilo-ampere-wires and total flux in megamaxwells, divided by six, when expressed in the unit selected by the paper. In other words, if kilo-ampere-wires are written AW, and megamaxwells flux by F, then $AWF \times 0.167$ is the torque of the generator expressed in units of 7.04 lb.-feet. In the case of any direct-current motor, the torque developed will correspond precisely with this formula; but the usefully available torque or delivered torque, will be less, since the total mechanical and magnetic friction torques within the motor must first be deducted. In the paper, the numerical constant for direct-current machines is given as 0.165, which agrees with the above theory within 1 per cent.

In the case of a single-phase synchronous machine, the same law of torque applies at any particular instant, but the resultant average torque developed is the arithmetical mean; whereas the current is expressed in terms of its square-root of mean square. For sinusoidal currents, at unity power factor, we should, therefore, have $AWF \times 0.15$ as the torque in units of the paper, and with a power factor of less than unity a correspondingly smaller numerical constant. The constant given in the paper is 0.145 for single-phasers. The advantage of the particular unit of torque given in the paper is that it is obtained directly by dividing the power of the machine in kilowatts by its angular velocity in kilo-revolutions per minute the speediest computation that our sexagesimal time units will probably admit of. If we consider the torque of different successive sizes of any type of machine, we may divide the triple product AWF into two terms, namely, the ampere-wires AW and the flux F. There is no necessary ratio between these two terms, so far as the formula expresses the relation. As the machines get larger, we might conceivably have the ampere-wires constant and the total flux in megamaxwells increasing in direct proportion to the torque developed; or we might go to the other extreme, and suppose that as the torque developed in successive machines increased, the flux might be the same but the ampere-wires of the armature advance progressively.

In either of the above extreme cases, the ratio of ampere-wires to total interlinked flux would vary in successively larger machines. The middle position of constant ratio between ampere-wires and total interlinked flux would require that each of these similarly increased in successive sizes of machine This would require either or both to increase as the square root of the torque developed. The curve of either ampere-wires, or of total flux, plotted as ordinates against machine torque would be a parabola, having its axis on the axis of abscissas. The paper indicates in a very interesting way, taking presumably the analysis of many actual machines into account, that this is substantially the fact, the curves given being nearly parabolic. It was pointed out in the discussion to the paper that there was by no means always in practice a constant ratio between ampere-wires and total megamaxwells. Nevertheless, the paper is a useful contribution to our knowledge of dynamo analysis in bringing out the fact that as the torque increases in successively larger dynamos, the increase occurs uniformly, or nearly so, both in ampere-wires and in flux. It would be interesting to have the corresponding analysis made out for American machines. A large number of curves accompany the paper. Two only of the figures are reproduced in our digest. One of these gives the parabolic relations already referred to and the other gives the efficiencies of transformers with different frequencies. The limit indicated of 97 per cent at 50 cycles per second is distinctly less than is obtained in large sizes in America, where 98.7 per cent has been reached at rated load.

N. E. L. A. Chicago Convention.

A meeting of the executive committee of the National Electric Light Association was held at the office of the association, 29 West Thirty-ninth Street, on Thursday, Feb. 20, at which the details of the Chicago convention, May 19 to 22, were taken up and discussed. The following members of the committee were present: Mr. Dudley Farrand, president; Mr. W. C. L. Eglin, first vice-president; Messrs. Arthur Williams, Charles L. Edgar, Charles R. Huntley, Louis A. Ferguson, Frank M. Tait, A. J. DeCamp and W. W. Freeman, secretary. Messrs. Frank H. Gale and Walter Neumuller presented the plans of the exhibition committee, which were approved. A number of important matters bearing upon the work of the association were considered, and much satisfaction was expressed regarding progress made in various ways since the last meeting.

The decorations in booths in the exhibition hall will be designed and furnished by D. H. Burnham & Co., the well-known firm of Chicago architects, which had charge of the recent Chicago Electrical Show. Already many applications for exhibition space have been received by the committee. This year it is decided to allow the manufacturers to have charge of the exhibition rather than the central-station men. Further details will be announced later. Mr. Frank H. Gale, of the General Electric Company, is the chairman of the committee; Mr. H. M. Post, of the Western Electric Company, is treasurer, and Mr. Walter Neumuller, of the New York Edison Company, is secretary.

Opening of the Hudson River Tunnel.

The first of the Hudson & Manhattan Railroad Company's tunnels under the Hudson River was formally opened to the public on Feb. 25. The part of the route now opened consists of a twin-tube tunnel extending from Hoboken, N. J., to Sixth Avenue and Nineteenth Street, New York, a distance of nearly three miles. This section of the tunnel system is generally designated as the Morton Street or uptown tubes.

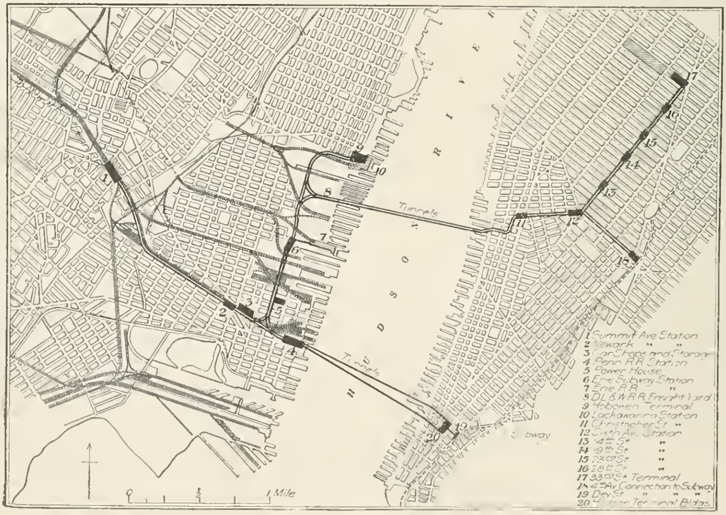


FIG. 1.—MAP OF ROUTE OF COMPLETED TUNNEL SYSTEM.

Passenger stations in Manhattan will be located as follows: Christopher and Greenwich Streets, where connection will be made with the Ninth Avenue elevated line; Christopher Street and Sixth Avenue, where connection will be made with the Sixth Avenue elevated, and in Sixth Avenue, at Fourteenth, Nineteenth, Twenty-third, Twenty-eighth and Thirty-third Streets. For the present trains will run only to Nineteenth Street and Sixth Avenue. At the Hoboken terminal connection is made with the Delaware, Lackawanna & Western Railroad, where passengers may descend directly to the tunnel cars without leaving the station.

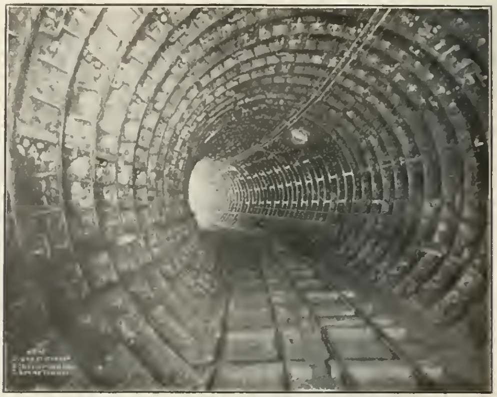


FIG. 2.—INTERIOR OF TUNNEL, SHOWING STEEL RINGS BEFORE BEING COVERED WITH CONCRETE.

Eight-car trains, electrically propelled, are used in the tunnel The cars are made entirely of steel, and are constructed upon a plan differing materially from any others now used in the Metropolitan district. They have large, sliding side doors in the middle as well as at either end, and the platforms are so arranged at the terminal stations that passengers enter and leave the cars at the same time. The doors are operated by compressed air and no signal bells are used. When the last door in the train is securely closed, the motorman receives an electric flash signal and starts the train. The automatic adjustment is such that the signal to start cannot be given so long as any door in the train remains open for even the fraction of an inch

The ventilation of the tubes is automatic, as each train acts as a piston, forcing out the air ahead of it and drawing in a fresh supply from the surface as it proceeds.

The tunnels are made of steel rings which were bolted together and set in place as the boring shield, working in compressed air opened the way for them In most places the steel rings are covered with a coating of concrete, so that the interior of the tunnel is smooth. The interior diameter of each tube is 15 ft 3 in. The two tubes are entirely separate from each other, and are about 30 ft. apart for the greater part of the distance under the river.

There are four sections to the tunnel system. Section one, the part just described, is known as the north tunnel. Section two is the south tunnel, which is nearly completed: it extends from Cortlandt and Fulton Streets New York, to Jersey City. The third section is a transverse tunnel running along the New Jersey shore of the Hudson one and a fourth miles, connecting the terminal in Jersey City with that in Hoboken. The fourth section is a branch line running from Jersey City to Newark.

A 22-story structure, known as the Hudson Terminal Building, has been placed over the New York terminal of section two. From the train platform, which is two stories below the street level, one may proceed by underground and under-river routes to any part of Greater New York.

A sectional elevation of the tunnel is shown in Fig. 3, which indicates the arrangement of the third-rail and feeders. The third-rail construction is similar to that employed in the East River Tunnel of the Interborough Rapid Transit Company. This construction was designed by Mr. Hugh Hazelton, electrical engineer of the Hudson Companies, in conjunction with Mr. L. B. Stillwell, consulting engineer for both companies.

The engineering features of the present tunnel system were worked out by Mr. Chas. M. Jacobs, deputy chief engineer. The system is in reality an extension of a brick tunnel constructed for 1200-ft. under the Hudson in 1879 by Mr. D. C. Haskins, and pushed forward for 1800 additional feet 10 years later by Pearson & Son. The work has been completed by the Hudson Companies for the Hudson & Manhattan Railway Company, of which Mr. Wm. G. McAdoo is president. It is stated that the cost of the system when fully completed will be about $70,000,000.

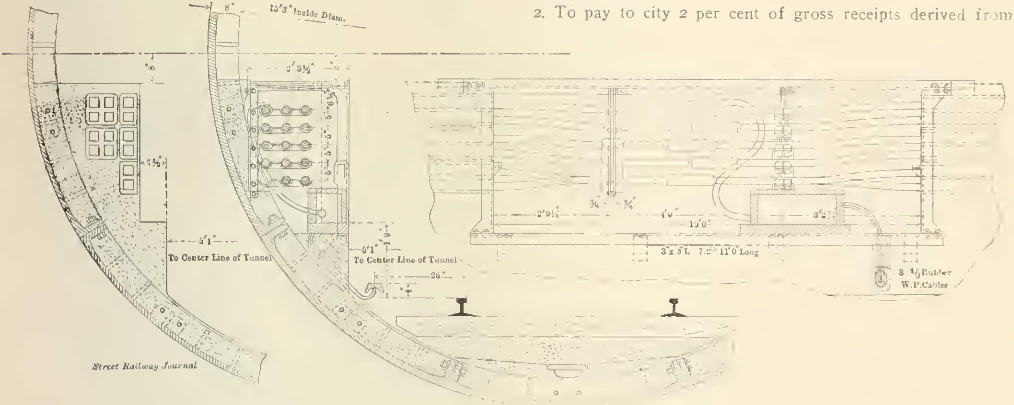


FIG. 3.—SECTION OF TUNNEL, SHOWING ARRANGEMENT OF THIRD-RAIL AND FEEDERS

New York City Independent Telephone Movement.

At a public hearing last week before a special committee of the Board of Estimate on telephone franchise applications, counsel for the New York Electric Lines Company made an appeal to obtain the co-operation of the city in the company's efforts to install its lines in the conduits of the Empire Subway Company. Mr. J. Aspinall Hodge, representing the New York Electric Lines Company, said that the company had contracts with 107,000 persons who would use its service if it should be installed. He asserted that the company had a franchise which had been granted by the city in 1883 and that the Court of Appeals when asked to decide the point whether or not the company had a right to build its own conduits, had handed down a decision saying that the company had a right to use the conduits of the Empire Subway Company. Mr. Hodge criticised the Empire Company, saying that it was impossible to find out from it which of its ducts were available, and charged that many ducts were filled with dead wires so that the claim could be made that they were in use.

Mr. D. A. Reynolds, president of the Electric Lines Company, said that a rate as low as $30 a year will be made for a private line or limited business service, with a rate from 2 cents to 5 cents for excess messages. For an unlimited service the rate will be from $1 to $5 a month. He said that with present suburban and allied lines the company could, at the start, put its subscribers in the city in touch with 2,000,000 outside subscribers. For a permit to operate for 25 years, Mr. Reynolds said, the Bell Company offered the city approximately $7,250,000 and the Atlantic Company $9,000,000. In a letter to the city, a summary of which is given below, the inducements of the New York Electric Lines Company are enumerated as follows:

1. On recognition of the company's right and co-operation by the city, the company promises to pay to the city in accordance with the franchise wherever it may be necessary to disturb the pavements, within 10 days after the taking up of such pavements, the maximum sum which may be required of grautees for laying electrical conduits under streets of said city by any existing ordinance.

2. To pay to city 2 per cent of gross receipts derived from rental of wires, estimated to exceed 500,000 telephones annually up to the completion of the system of 600,000 telephones.

3. To duplicate present "Bell" system with strictly modern equipment and furnish city with first-class telephone service at one-half present rates; or if the city elects, the company will install without charge, maintain at actual cost, whatever equipment the city may desire, and furnish flat rate of 2 cents per message for all local calls.

4. To establish, maintain and operate without cost to the city under the direction of the fire department, an auxiliary fire alarm system adapted for installation in factories, stores and dwellings, to be operated in conjunction with the company's lines and supplied to customers at actual rental, not to exceed $10 a year.

5. To establish, maintain and operate without cost to the city under police regulations, a police-call system connecting each police station with the exchange in its respective precinct, thereby placing every telephone user in the system within three seconds of the nearest police station.

The committee before which the hearing was held will report later.

Cazin Metallic-Filament Lamps.

Three patents were granted Feb. 11 to F. M. F. Cazin relating to the manufacture of his system of metallic-filament lamps. In one patent the claims are on a filament with a primary core coated with an electrolytically deposited layer of metal alloys, the layers decreasing in affinity for oxygen from the core to the surface, which latter consists of a rare metal oxidized on its exposed side. The core may consist of carbon or other practically fusible material, which is coated electrolytically with a metal like the natural alloy osmiridium. The outer layer may be of a metal having little affinity for oxygen, such as uranium. In the claims of the second patent, it is stated that the layer in contact with the carbon is "partly inter-impregnated with the carbon" and that on the surface is coated with an oxide, all the metals having a high point of fusion, and the inner ones having more affinity for oxygen than the outer ones. The metals in contact with the carbon may be of the ruthenium-osmium class, and the outer one of the rare metal class, coated on the exposed surface with its oxide. The third patent relates to a filament which increases in thickness toward the terminals in order that these may not become unduly heated under current.

High-Efficiency Lighting in Berlin.

By L. J. Auerbacher.

Practically all the commercial arc lighting in Berlin is accomplished by the flaming arc. They are very liberally used, some store fronts of moderate size having as many as 15 to 20 lamps, hung about 5 ft. apart. The large department stores also use the flaming arc for show-window illumination. The lamps are installed over the windows, and a heavy opal glass between the lamp and forming the ceiling of the window serves to screen and diffuse the light.

The lighting company only furnishes current and wire up to the service switch, and do not furnish or trim lamps of any description. There are a number of companies, however, which make a business of trimming and cleaning flaming arcs. As there are many blocks having 50 lamps or more, the business is said to be profitable. With rare exceptions, the lamps burn steady and give good service.

There are a few open arcs still used, but no enclosed arcs used. A new line of arc lamps called "Economy" lamps are now being installed. They operate singly on 115 volts, and are made in 4, 6, 8 and 10 ampere sizes. They burn 30 to 50 hours and give a brilliant white light. The economy is about that of an open arc.

The incandescent lighting is practically all high-efficiency. Here and there a few carbon-filament lamps are still in service. Whenever the fixtures or conditions are such that the lamp can hang in a downward position, the "Osram" or tungsten lamp is used. If lamps are required to be hung at an angle the tantalum lamp is used. Some fixtures have both types, the tantalum on angular arms and the tungsten on the vertical arms. Fixtures are now designed to have the lamps hang downward. I noticed this particularly in a new theater and in the newest department store, where only high-efficiency lamps are used.

The cost of current for lighting is 10 cents per kilowatt-hour. The company furnishes no lamp renewals. The conditions noted in Berlin are typical of all German cities at the present time. Everywhere the high-efficiency lamp, arc and incandescent, appears to have passed into regular use.

Large Colorado Water-Power Development.

Surveys have been recently completed and rights obtained from the United States government and state of Colorado for an important water-power and irrigation project upon the Cache LaPoudre River, in Laramie County, Colorado, north of Denver.

The Cache LaPoudre River is the largest river on the eastern slope of the Rocky Mountains within the state, having a very large and important drainage area, and within a distance of 30 miles has a fall of nearly one-half mile. From the lower power house site to the headwaters of the upper reservoir the total head is 2420 ft.

Three immense reservoir sites have been determined upon. The first is located above a narrow canyon, where a dam will be constructed having a height of 200 ft, a length on top of 180 ft. and a length at the bottom of 27 ft. This reservoir will hold 1,153,630,559 cu. ft. of water.

A second reservoir and dam, just above the first reservoir, is also projected, having a capacity of 4,955,278,148 cu. ft., and a third dam and reservoir, 20 miles farther up-stream, the dam having a height of 230 ft., will impound 5,103,141,958 cu. ft. of water.

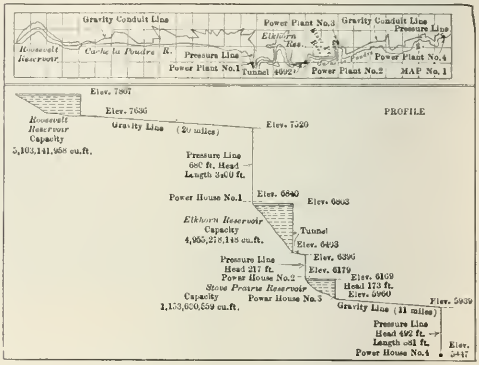


FIG. 1.—PROFILE MAP OF WATER-POWER DEVELOPMENT.

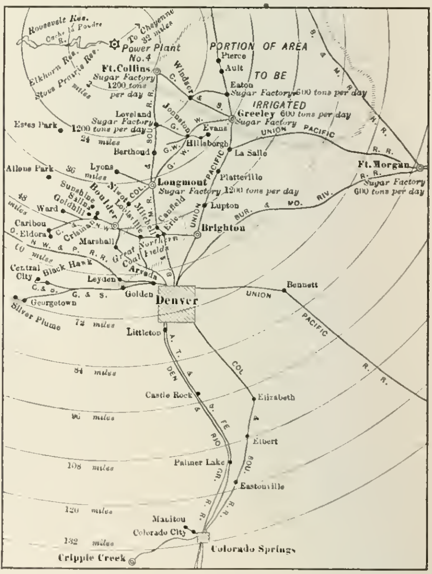


FIG. 2.—MAP OF WATER-TOWER AND IRRIGATION DEVELOPMENT.

The power to be developed from these various reservoirs it is expected will be utilized in part by the Denver City Tramway Company in the operation of its city and interurban lines, and also to pump water for irrigating a large territory of undeveloped lands in northern and eastern Colorado. Hundreds of thousands of acres of the richest land in the state, now arid, has an underflow of water at a depth of from 15 ft. to 40 ft. which may be pumped to the surface, thus making the land fertile. This land is now used principally for grazing purposes and has little value, but with water available for irrigacion it will be very fertile and well adapted for raising sugar beets and other profitable crops. The sugar-beet crop of Colorado during the past year was valued at $17,000,000. An acre of irrigated Colorado land will produce 30,000 lbs. of sugar beets, which in turn yields 6000 lbs. of refined sugar at the wholesale price of 4 cents a pound, making $240 per acre. This land, after water is secured.

readily brings from $200 to $300 per acre, and pays a good interest on a much larger valuation. There is a rapid development in the power requirements of not only the tramway lines, for which some 70 miles of new construction is now projected, but in all branches of a great many varied industries throughout this section of the state.

The ultimate development of power in the Cache LaPoudre River will furnish upward of 100,000 horse-power, which is considerably larger than any water-power development yet planned in the state. This project is to be carried forward and completed by an organization of very strong Colorado interests.

"Loaded" Telephone Cables in Germany.

The following table gives a list of the telephone cable lines loaded with Pupin inductance coils which have been installed by the Siemens-Halske Company, of Berlin:

Cable.	Year of installation.	Length of cable in kilometers.	Copper diameter in mm.	Number of double wires.	Distance between successive inductance coil boxes in km.
Berlin-Potsdam	1902	32.5	1.0	28	1.3
Merida-Progreso (Mexico)	1904	40.	0.8	14	1.4
Düsseldorf-Elberfeld	1904	32.	1.5 and 2.0	28 56	1.3
Schoeneberg-Ragow	1905	28.	0.7	3.5 7	1.4
Berlin-Spandau	1906	18.	0.8	56 112	1.75
Berlin-Potsdam	1906	40.	0.9	100	1.4
Friedrichshafen - Romershorn (submarine cable in Bodensee)	1906	12.			
Berlin-Wannsee	1907	25.	0.8	250	1.5
Berlin-Köpenick	in course of erection	17.	0.8	56	1.6
Duisburg-Mülheim-Oberhausen	in course of erection	27.	1.5 2.0	56	1.5

The above cables are stated to have been in uninterrupted service since their installation. With the exception of the Mexican cable, all of them are in Germany. The submarine Bodensee cable and the difficulties in laying it have been referred to in the Digest. The aggregate length of the above 10 cables is 271.5 kilometers or 168.6 miles. For lexicographers it may be of interest to know that at one place a cable loaded with Pupin inductance coils is called a "pupinized" cable.

Public Service Dinner of the A. I. E. E.

The public service dinner of the American Institute of Electrical Engineers, held at the Waldorf-Astoria, New York City, Feb. 19, was successful from many points of view Through the co-operation of the Commonwealth Edison Company (Chicago, Ill.), the Edison Illuminating Company of Boston, the Edison Electric Illuminating Company of Brooklyn, the Philadelphia Electric Company and the New York Edison Company, who contributed the decorations of the dining-room, and Sibley & Pitman, who furnished art-glass fixtures, the illumination of the banquet hall was in tasteful accord with the engineering idea of the proper appearance of a room for such an occasion. Miniature lamps, the circuits to which were concealed beneath the carpet, were sprinkled among the green leaves of the flowers and plants forming the live decorations of each table. The official seal of the institute, with its blue background and outlined in golden yellow lamps, with white lamps for the letters, occupied a commanding position over the speakers' table. The souvenirs included miniature lamps arranged as stickpins and plaster casts of the institute seal. Regret was expressed on all sides at the inability of two of the announced speakers, Mr. Theodore P. Shonts and Dr. C. P. Steinmetz, to attend the dinner, owing to illness.

President H. G. Scott, of the institute, who acted as toastmaster, read a telegram of cordial greetings from Governor Hughes, and announced that arrangements are under way for a political economy meeting of the institute in the near future.

The first speaker was Mr. Walter C. Kerr, of Westinghouse, Church, Kerr & Company, who responded to the toast "The Ethics of Public Service." Mr. Kerr said that the public server must be compelled to serve well. "The strongest impelling force is the hope of gain. Fortunately, bad service never pays in the long run and good service stands a fair chance of profit. The spirit of service is unselfishly doing something that does some one else good. It always pays, and when this spirit is sufficiently cultivated, then those who wish to yield public service will be given full, fair and right opportunities to do it."

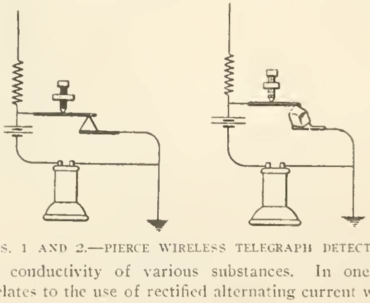
Mr. Frank W. Stevens, chairman of the Second District Commission, of New York, spoke on the subject of "State Control of the Public Service Corporations, Past and Present." He treated the subject historically, and limited his remarks to conditions in New York state. The first law relating to railroads was passed in the year 1826. Although it was recognized from the outset that steam transportation must be under the control of the state, the legislation previous to 1846 was tentative in nature. In this year the constitution of the state provided that the chartering of all such corporations as railroads must be done by general law. In 1883 a railroad commission was appointed for serving in an advisory capacity. Beginning with July 1, 1907, the Public Service Commission, with law-making power, has been in control. The commission is not designed to manage the business of corporations, but to stop abuses, and to secure equal rights to all mankind under its supervision.

Mr. Chas. R. Huntley, of the Buffalo General Electric Company, had as his subject "The Electric Lighting Companies and the Public." He said that the public, not knowing the essential details of the production of electrical energy, may have come to look askance at public service companies, while the companies, in turn, may have been more reticent to discuss the details in the face of malicious criticism. The purpose of the Public Service Commission is to protect the people from any injustice on the part of the companies, and the companies from any injustice on the part of the people. When the parties concerned mutually understand the full facts most of the troubles that now harass the electric companies will be at an end. Mr. Huntley said he had since 1895 favored the idea of such commissions, but for a long while stood almost alone in this respect among central-station men.

Mr. T. Commerford Martin responded to the toast "The Technical Press and the Public." He stated that the one aim of the technical journal is to cultivate the truth, and to give the facts, and it serves the interests of both its readers and the public by telling its readers how to improve its service to the public. It is a great misfortune that the technical press cannot reach a larger proportion of the general public in order to correct the injury done by the daily "yellow press" to the public utility corporations, and more particularly to the technical staffs which serve them. The public is already becoming weary of the insult that has been heaped upon the electrical developments of the last 25 years. A turning point has been reached, and under the new régime with public service commissions the public utility companies will receive a more cordial treatment.

Alternating-Current Rectifiers.

Three patents granted Feb. 11 to Mr. G. W. Pierce described rectifiers for alternating current which make use of the asymmetrical conductivity of various substances. In one patent which relates to the use of rectified alternating current with uni-



Figs. 1 and 2.—Pierce Wireless Telegraph Detector.

directional ammeters, the inventor states his preference for carborundum as the asymmetrical conductor. In a second patent which relates more particularly to detectors for use in wireless telegraphy, the substance employed as an asymmetrical conductor is the oxide of titanium. The crystal is cut out on a plane substantially at right-angles to its axis, and one of the electrodes is engaged with a point or corner of the crystal so that a small area of contact is secured. It is stated that when the substance is placed as shown in Fig. 1 it is highly sensitive as a detector of electromagnetic waves. In Fig. 2 a similar arrangement is indicated where telluride of silver is used as the asymmetrical conductor. The use of the latter substance for this purpose is covered by the third patent issued to Mr. Pierce.

CURRENT NEWS AND NOTES.

INCANDESCENT LIGHTING.—Mr. John W. Lieb, Jr., associate general manager of the New York Edison Company, will discuss this subject on March 6, at 8:15 p. m., before the Electrical Engineering Society of Columbia University, in Room 301 of the Engineering Building of the University.

PURDUE EXCURSION.—About 250 students of the civil, electrical and mechanical engineering department of Purdue University will make an inspection trip to Chicago and other cities where industrial and electrical plants will be thrown open for their inspection and study. The trip will be made about the first week in April.

FOREST PRESERVATION.—A special meeting of the American Institute of Electrical Engineers will be held in the auditorium of the Engineers' Building, Thursday evening, March 5, 1908, at 8 o'clock, when Mr. Gifford Pinchot, Forester of the United States Department of Agriculture, will deliver an illustrated lecture on forest preservation. This lecture will be open to the public, and tickets will not be required.

STEAM IN THE STEAM TURBINE.—The March meeting of the American Society of Mechanical Engineers will be held on Tuesday evening, March 10, at 8:15 o'clock in the Engineering Societies Building. The meeting will be addressed by Dr. Charles P. Steinmetz, member A. S. M. E.; past president A. I. E. E. and professor of electrical engineering Union University, the subject being "The Steam Path of the Steam Turbine."

LONDON ELECTRICAL SUPPLY.—The total electrical energy supplied in London during the past year was 213,174,379 kw-hours. Of this amount the municipal authorities supplied 28,281,320 kw-hours for power and heating; 42,934,965 kw-hours for private lighting, and 16,578,716 kw-hours for public lighting. The private companies supplied 38,006,198 kw-hours for power and heating, 82,995,205 kw-hours for private lighting, and 4,377,875 kw-hours for public lighting.

NEW YORK CITY DEBT.—At the present moment, when there is still so much clamor for municipal plants of one kind and the other, New York City is issuing long-time bonds to meet current running expenses. Such a policy of financial suicide could not endure very long and it is not surprising therefore that the State Legislature is proposing the appointment of a committee to investigate the subject of the city debt, the present limit of which it has been proposed to sweep aside so that the city can plunge deeper. The obligations of the city are selling to-day on about a 6 per cent basis, and stand no higher than those of first-class public utility corporations.

ELECTRIC SUPPLY IN LONDON.—The English Board of Trade has issued a report on the use of electrical engineering in the London metropolitan area, in 1907. The municipal authorities supplied 28,281,320 units for power and heating, 42,934,965 units for private lighting, and 16,578,716 for public lighting, the cost per unit, respectively, being 1.301d., 3.677d. and 1.850d., a total of 87,795,001 units supplied at an average cost of 2.563d. The companies were responsible for the supply of 38,006,198 units for power and heating, 82,995,205 • for private lighting and 4,377,875 for public lighting, charging for such supply 1.45d., 3.833d. and 1.62d. per unit, respectively, altogether 125,379,278 units supplied at an average cost of 3.034d. per unit. From these figures it appears that London's total supply of electricity was 213,174,279 units, costing 2.839d per unit.

BRANLY WIRELESS TORPEDOES.—M. Branly, to whose invention of the coherer wireless telegraph owes its origin, has taken up the subject of the wireless control of torpedoes. While experimental torpedoes have been made for wireless control, they have been impracticable owing to being subject to interference from sources of Hertzian waves other than that of the controlling station. M. Branly has obviated this fault by the invention of a system whereby the torpedo apparatus is only influenced by Hertzian waves emitted by the transmitting apparatus with which it is in special connection. He has not, he says, invented the control of mechanism at a distance, as this has been done by others. "There is, however, one new object which my apparatus attains. It removes this control from other influences. The advantage is that freedom is obtained from accidental or voluntary perturbations which might have been produced by others. That is all."

WIRE INSPECTION.—The Underwriters' Laboratories, Chicago, announces that after extended conferences with the representatives of manufacturers of rubber-covered wires and cords, and following notices sent all manufacturers utilizing the services of the Wire Inspection Bureau, affiliation with that bureau has been withdrawn, and its reports will not be accepted after Saturday, Feb. 29. Stamps or labels issued by the Wire Inspection Bureau and attached to rubber covered wires, or cords after Saturday, Feb. 29, should therefore not be recognized as having been affixed under the supervision of the Laboratories, representing insurance interests. The announcement further states that during the progress of negotiations resulting in the action reported above, inspection departments, users and manufacturers have requested the inauguration of a system of testing, inspecting and labeling insulated wires and cords at factories which would receive the endorsement of the Laboratories, and the conduct of such a service, along the lines established by the Laboratories for a number of other industries, is under consideration.

ELECTRICITY AND LIFE.—Last week, according to Marconi wireless advices to the *New York Times*, Dr. Louise B. Robinovitch, of New York, presented a remarkable paper before the French Biological Society on a new method of resuscitating animals apparently dead from electrical shock. Miss Robinovitch, whose methods of electrical anæsthesia have already attained wide attention in France, after a long series of experiments on rabbits, dogs and other animals, has reached the conclusion that the cases are rare where the victims cannot be recalled to life. Her method differs from that of Dr. Leduc and other French experts in that she places the cathode, or negative pole, near the spinal column, and the anode over the kidneys, and gives the patient a series of rhythmic electrical impulses, thus restoring respiration and the cardiac reaction, and the animals which to all intents and purposes were perfectly dead come to life. When treated thus resuscitation is said to be very rapid. The same treatment has been successfully applied where the subject has been suffering from a syncope produced by chloroform. A friend of Dr. Robinovitch states that she would shortly make application to competent authorities in New York for permission to apply her system of resuscitation to the next murderer put to death by electricity.

ELECTRICITY AND MULES.—The Comstock Lode has adopted electricity for haulage, and among the mules displaced are said to be 12 which have been underground for 30 years, not having seen the light of day during that period.

TWENTY-MILLION-DOLLAR SAN FRANCISCO TERMINAL.—Plans have been prepared for a $20,000,000 union transportation terminal for San Francisco, to be used by electric traction surface and subway lines, as well as steam lines for freight and passengers.

MR. THOMAS A. EDISON, on Sunday, Feb. 23, underwent an operation at the Manhattan Eye, Ear and Throat Hospital, New York, owing to the development of an acute abscess in the left middle ear. The operation was successful and the patient will only be detained at the hospital for a few days.

"BLACK HAND" USES THE TELEPHONE.—The Italian criminals who have been practising the Neapolitan and Sicilian system of blackmail in this country are having recourse to the telephone in their operations. In a recent case in New York City, the arrest of a blackmailer was followed by telephonic messages to the family of one victimized threatening to kidnap the children, burn the house and kill the husband.

EIGHT-HOUR TELEGRAPHERS.—Acting under the advice of their general attorneys, the railroads of Texas have agreed to ignore the new State eight-hour-day law affecting the employment of telegraph operators. An operator has complained to the State's attorney and a fight in court over the new law is to be precipitated.

THE SUBWAY CAR.—With this title a pamphlet has been issued containing a part of the report by Mr. B. J. Arnold upon the New York City subway, made to the Public Service Commission. Included is an analysis of the various types of cars adapted to subway work, accompanied by drawings of the cars. The conclusion of Mr. Arnold is that the present car, when provided with additional side doors located near each end, or four in all, will best meet the conditions of the present subway and will permit a marked increase in the capacity and comfort of travel. The report, which is dated Feb. 18, supplements a preliminary report by Mr. Arnold dated Nov. 26.

TELEPHONIC AMENITIES.—The Nebraska Telephone Company, of Omaha, has granted to its new rival, the Independent Telephone Company, the right of connecting up with its fire alarm system. General Manager Belt, of the first-mentioned company, said that while it had a contract with the city for supplying this service and could, if so desired, stand on its lawful rights and withhold the service from competitors and their patrons, it felt that there were larger interests to be served and safeguarded than those of any corporation; and that his company had always operated on the principle that a public corporation is a public servant and that the best service to the greatest number of people was a motto that ought to commend it to the people at large.

ILLUMINATING ENGINEERING IN SALOONS.—At Dubuque, Ia., a clever piece of illuminating engineering has been done by some saloon keepers to nullify the practical effect of a recent law requiring that saloons have no screen or partition of any kind between the bar and the front window. The plan is to place several arc lamps near the front of the saloon with reflectors which throw the light forward toward the window. The result is that anyone looking into the saloon is partially blinded by the glare of these lamps, and as the bar is in shadow as compared with the front end of the saloon, it is difficult to see who is in the saloon. It remains to be seen whether Iowa lawmakers will recognize and prohibit this method of producing the practical effects of a screen without having a material partition of any kind.

LONG ISLAND RAILROAD ELECTRIC LINES.—Plans have been made for the equipment of the lines of the North Shore Division and between Jamaica and Long Island City. The equipment has been purchased for the Northern Division of the road east of Whitestone Junction, and work will be finished the present year. The Jamaica station will be the terminal for steam trains from the central and southern sections of the Island, and passengers will change here to electric trains operating through Long Island City to the Pennsylvania station in New York and also to Flatbush trains for transfer to the Battery tunnel line. Lines now equipped for electric service include the main branch from Flatbush Avenue to Belmont Park, with a loop from Ozone Park to Rockaway, Valley Stream and Jamaica. The plans of the Long Island Railroad also contemplate the electric equipment of all lines in Queens County. The total immediate expenditure involved is $12,000,000, and it is expected that all work laid out will be completed within three years.

THE PASSING OF THE STEAM LOCOMOTIVE.—Mr Wilson E. Symons presented a paper on "The Passing of the Steam Locomotive" before the Western Society of Engineers Feb. 19. He took the position that although electric locomotives would be used in the future in densely-populated districts, the extension of railways into districts now sparsely populated would call for a steadily-increasing number of steam locomotives. The increase in population which is sure to take place in the United States would call for a great increase in the number of both steam and electric locomotives, an increase in the number of tracks on trunk lines and the canalizing of our principal waterways to take care of the traffic. Mr. Peter Junkersfeld, chairman of the meeting, called attention to the interesting fact that all the passenger trains now operated within the city limits of Chicago could be moved by a power station of 50,000-kw capacity. It would call for only part of the capacity of the largest electric power station now in Chicago—that of the Commonwealth Edison Company at Fisk Street. He thought there must certainly be some economical advantage in such a method of operation.

TORONTO SECTION A. I. E. E.—After a luncheon at the St. Charles, at which some 25 members of the section and their friends were present, the Toronto section of the American Institute of Electrical Engineers held its regular February meeting at the rooms of the Engineers' Club, 96 King Street West, in conjunction with the club, many of whose members were present. Over 50 attended. After the formal business of the evening, the chief item of which was the presentation and carrying of a motion requesting the board of directors to take up the matter of the subdivision of the associate group of the membership, the technical subject for the evening was taken up. This involved a paper presented by Mr. Walter S. Moody, of the Schenectady section, who treated very thoroughly the subject in hand, namely, "Feeder Regulators." Mr. Moody, the well-known designing engineer with the General Electric Company, took up the history of the attempt to regulate the voltage of feeders in distributing and transmitting systems. He indicated the lines of development of this apparatus from the earlier resistance methods of control in the case of direct-current circuits to the most recent automatic induction type of alternating-current regulator. He then discussed at considerable length the latter type of regulator, showing its field of operation, its mechanical characteristics, and indicating some of the successful installations with records of their performance. The address was very fully illustrated by means of lantern slides, and at its close a number of inquiries were made of Mr. Moody concerning the features which he had touched upon and a considerable discussion followed.

EIFFEL TOWER WIRELESS APPARATUS BURNED.—Ten thousand dollars' worth of wireless telegraph apparatus, part of the equipment on the Eiffel Tower, Paris, was destroyed by fire Feb. 18.

CHICAGO ELECTRIC RAILWAY CONSOLIDATION.—It is reported that a movement is on foot to merge into a single system under practically one management all electric railways entering Chicago. The plan includes the construction of a subway to the shopping district.

WIRELESS TELEGRAPHY IN GERMANY.—A bill now receiving the consideration of the Reichstag at Berlin provides that wireless telegraph stations on board ships and on shore may be erected and operated only with the sanction of the imperial government.

INLAND WATERWAYS CONFERENCE.—President Roosevelt has invited the presidents of the American Institute of Electrical Engineers and other professional bodies to be present in May at the conference in Washington of State governors on the subject of inland waterways.

ELECTRIC IRONS AT GRINNELL, IOWA.—The Grinnell Electric & Heating Company now has 312 electric irons in service among its customers. Grinnell has a population of about 5000. The irons have been sold to customers at the rate of about 100 for each summer season since they began to be introduced.

TOLSTOI'S GIFT TO EDISON.—Count Leo Tolstoi will send to Mr. T. A. Edison a phonograph cylinder bearing several interpretations of Gospel texts, spoken in English. Some time ago Mr. Edison sent the great Russian author a phonograph, together with a letter expressing his high regard for him, and requesting a phonographic record of his voice.

CONSTITUTIONALITY OF THE NEW YORK PUBLIC SERVICE COMMISSIONS.—A decision last week by the New York State Court of Appeals in a case upon an appeal from the old State Commission of Gas and Electricity indicates that the same court will uphold the constitutionality of the act authorizing the present public service commissions should an action on that subject come up before it.

OHIO RATE REGULATION.—A bill has been introduced in the Ohio Legislature to give city councils power to regulate the prices of electric light and gas. A bill which proposed to place the regulation of telephone rates in the hands of city councils has been indefinitely postponed in committee. Independent telephone companies, it is said, favored the state plan through representatives who appeared before the committee.

CONTROL OF WIRELESS.—In the House of Representatives at Washington, on Feb. 21, Mr. Sheppard, of Texas, introduced a bill making it a punishable offense to originate or transmit a false wireless message purporting to be official; to break in and interfere with any wireless station while it is transmitting an official message; to refuse to cease or fail to cease sending a private wireless message when called upon to do so by an operator having an official message to be sent.

NEW SOUTH WALES TROLLEY PLANT.—A correspondent of Sydney, New South Wales, has sent us further particulars relating to the new plant of the New South Wales Government Electrical Tramways. The direct-current portion of the power station consists of four 850-kw, 550-volt General Electric direct-current generators, driven by Allis-Chalmers horizontal engines; the alternating-current portion of the station consists of three 1500-kw, 6600-volt, 25-cycle General Electric three-phase generators driven by Allis-Chalmers cross-compound engines. A 1750-kw Parsons turbine unit has also been installed and orders have been placed for two Parsons 5000-kw turbine units.

A PROGRESSIVE NEW JERSEY CENTRAL STATION.—In three years the Lambertville (N. J.) Heat, Light & Power Company has increased the number of its customers to 208 from 85. In that time the plant has been rebuilt, a 24-hour circuit installed and lines extended to New Hope to furnish electrical service for the streets and the residents of that town. Notwithstanding the expense entailed in renovating the plant, dividend payments began last year. The general manager is Mr. H. M. Morehead, who deserves in no small degree the credit for transforming a dilapidated plant into a paying proposition.

OHIO MUNICIPAL OPERATION.—The Ohio House of Representatives has passed the Shuler bill, which gives cities the right to operate electric light and natural gas plants and sell the product for private use. A proposed amendment providing that municipal plants should not fix their charges at a figure less than cost failed of adoption. This was supported by the private lighting interests, as they feel that cities should not have the right to operate plants at public expense for the benefit of those who purchase the current or gas. The bill, it was claimed, would enable cities to drive lighting and power plants out of business at any time and substitute the public service. The Senate may take up some of these matters.

NEW YORK OVERHEAD WIRES.—The New York Central Railroad Company has denied the jurisdiction of the Commission of Water Supply, Gas and Electricity of New York City with relation to the transmission of electricity for all purposes within the limits of the city of New York, or to the construction of electrical mains, conduits, conductors, subways and the erection of poles for the transmission of electricity. This position was taken by the railroad officials in relation to an order for the railroad company to remove its overhead transmission poles and conductors on its right of way along the Harlem River to the city line. It was also held in the reply that the Public Service Commission has no power in the matter at issue.

WHITE MOUNTAIN WATER POWER.—The U. S. Department of Agriculture in a recent report gives a statement of the water-power from the watersheds forming the White Mountain region of New England. It has been estimated that the capital invested in the manufacturing enterprises utilizing the power of streams originating in these watersheds amounts to $250,000,000. The water-power at present supplied by the Connecticut River and its tributaries amounts to 140,000 horsepower, and all of the power available has not yet been developed. The amount of power in the Saco River is stated to be very large, but its value is not given. No less than 180,000 horse-power is stated to be used along the course of the Androscoggin River.

BOVEY GOES TO ENGLAND.—It is understood that Prof. Henry T. Bovey, dean of the faculty of applied science at McGill University, is to retire, having been appointed to the rectorship of the Imperial College of Science and Technology, an institution which has been some time in formation in London, and which will affiliate and direct the several technical institutes of that city, besides building and equipping new college headquarters at South Kensington, as a training place for the whole empire in post-graduate work. Dean Bovey will not teach, although eminently successful in that direction, but will be given a great opportunity to display his ability, already well tested as an administrator. McGill and technical education in Canada owe a great deal to him, and he will be sorely missed by a host of friends and admirers in the Dominion and the United States.

Combined Central-Station and Water-Pumping Plant.

At Pine Bluff, Ark., a city of about 20,000 inhabitants, a new central station will shortly be completed for the Equitable Securities Company, under the design and direction of Ford, Bacon & Davis, consulting engineers, of New York. Combined with this central station will be the pumping equipment of the city water works. The plans for the plant illustrate a progressive scheme of development, as is shown in the accompanying drawing, Fig. 2, which is a general floor plan of the power house as it will be when completed. The equipment shown in dotted outline represents future alternators, and the present installation is shown in solid lines.

The power house is a brick-and-steel structure designed for an ultimate length of about 243 ft., and a maximum width of about 116 ft. It is located at the intersection of Plum Street and Fourth Avenue, about 75 ft. east of the city's water reservoir; from this reservoir water will be obtained for boiler feed and condensing purposes, as well as for drinking and commercial service. The present length of the power house is about 110 ft., the width being the same as in the final completed structure. The plans provide for an ultimate installation of six batteries of boilers, aggregating 6000 horse-power, the boilers being set two in a battery. The present installation will consist of two batteries of 300-hp boilers, aggregating 1200 horse-power, the future boilers to be of the same rating. The plant is designed with all boiler fronts in a single row, allowance for the space requirements of the larger boilers being made by building the blow-off trench at the rear with an offset of 2 ft. The first installation of boilers will be handled by a sheet-iron stack 80 in. inside diameter by 125 ft. high, located in the center of the boiler room between the two 600-hp batteries. The boiler room extends at present to a length of about 91 ft., its width being 48.5 ft. inside.

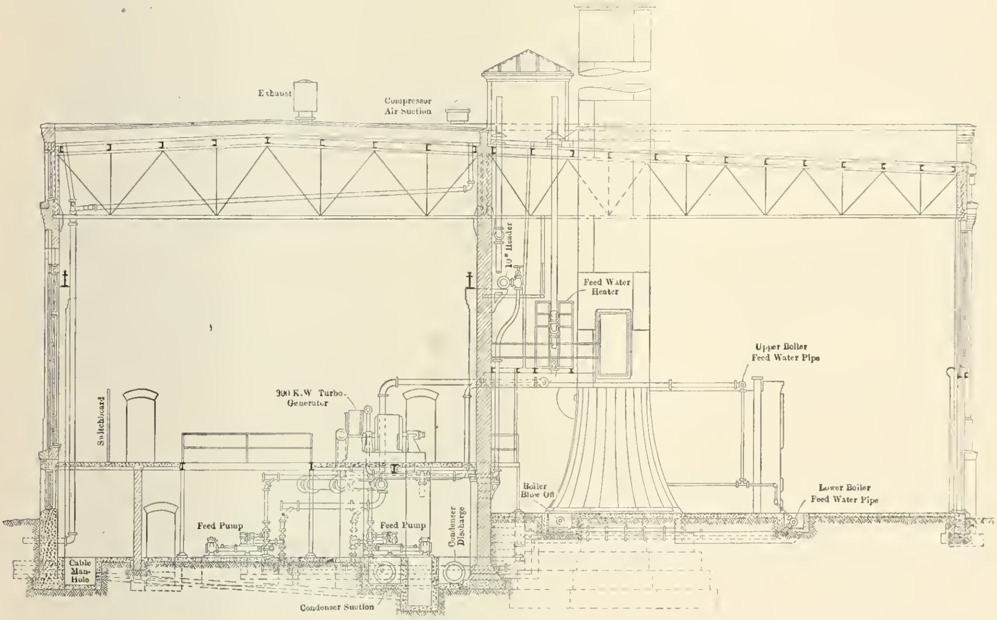


Fig. 1.—Cross-Section Through Generator Room.

The stack is mounted on a concrete foundation built in five octagonal courses. Each course is 2 ft. high, the top course being 15 ft. in width, and the bottom course 21 ft. in width. The length of each face of the top course is 6.5 ft., each of the bottom faces being 9 ft. long. The sheets of the stack vary in width from 62 in. to 70 in., the thickness being from 3/16 in to ⅜ in. A clean-out door, 30 in. wide and 6 ft. high, is constructed at the bottom of the stack. The opening from the breeching on each side is 6 ft. 6 in. high by 38 in. wide, the bottom being 14 ft. 6 in. above the floor line.

Each boiler at present installed is a Babcock & Wilcox unit of water-tube type, with 140 4-in. tubes, three 54-in. steam drums, a 2½-in. blow-off valve, and hand-fired grate 8 ft. 6 in. long by 7 ft. wide. The space occupied per battery is 21 ft. 10 in. by 21 ft. 7½ in. The furnace for each boiler discharges into a breeching connecting each battery directly with the stack. Each uptake is 102 in. long by 33 in. wide. The breeching is 38 in. wide throughout, but the height inside varies from 35 in. at the further furnace on each side to 6 ft. 6 in. at the stack.

Space is provided behind the first stack for two Webster 1200-hp open heaters, one of which will suffice for the first installation. The heater is provided with an 8-in. exhaust-steam inlet, with a grate-valve attachment, a 2-in. cold-water inlet, a 3½-in. overflow outlet, and a 5-in. outlet to the feed pumps, with 2-in. drain pipe. The heaters, which are guaranteed to raise the temperature of the feed water from 40 deg. to 210 deg. Fahr., will be located on a platform 15 ft. 5 in. above the floor line, as illustrated in Fig. 2. This platform is tied to the roof truss of the boiler room by angle-irons and is supported upon steel columns. In the plans space is provided in the boiler room for two additional stacks, 110 in. in diameter and 175 ft. high; one stack will be placed between each pair of 1200-hp boiler batteries. The blow-off tank for the present, and also for the completed installation, is located in a pit behind the boilers. It is 3 ft. in diameter and 5 ft. long, and is served by a 4-in. line which collects the blow-off steam from all of the boilers as it passes through the blow-off trench. A 6-in. vent is joined to the blow-off tank.

A general cross-section of the plant is shown in Fig. 2. The boiler room is separated from the machinery section by a 24-in. fire wall. At present the electric generating equipment occupies a room 44 ft. x 45 ft., and the water-works pumping apparatus occupies a separate space 60 ft. long and 64 ft. wide. The present generator room contains two 300-kw horizontal Curtis turbines driving General Electric alternators, a six panel switchboard 13 ft. long and an engine-driven exciter set. Each generator is a 2300-volt, four-pole, revolving-field machine built with two bearings, and designed to deliver three-phase, 60-cycle current, the speed being 1800 r. p. m. Each turbine is supplied with steam through a 4-in. pipe and exhausts through a 20-in. outlet. The height of each turbo-generator is 7 ft. 6 in., its extreme length 10 ft., and width 6 ft. 3 in. The turbines are placed 12 ft. apart on centers. Space is available for three additional units of higher rating in the completed room, as shown in Fig. 2, and also for two motor-driven exciter sets and three rotary converters or motor-generator sets.

The reservoir for the water supply is capable of holding 3,000,000 gal. It is built of reinforced concrete, 240 ft. long by 154 ft. wide, with a maximum depth of 15 ft. 6 in. Two deep wells, which have been driven on the reservoir site, are operated by air-lift pumps. To supply the necessary pneumatic pressure, two Laidlaw-Dunn-Gordon cross-compound Corliss two-stage compressors have been installed at the power plant. The high-pressure steam cylinders of these compressors are 17 in. in diameter, and the low-pressures 32 in.; the air cylinders are 30 in. and 18 in. in diameter, and the common stroke is 36 in. Each compressor is equipped with a fly-wheel 14 in. in diameter, having an 8-in. face, a 12-in. suction pipe, 6-in. discharge pipe, 6-in. steam supply, and 12-in. exhaust outlet. Water is drawn from the reservoir through a 30-in. suction pipe. Space is provided in the pump room for two compressors of similar design, as the plant is enlarged.

Opposite the compressors are the Worthington triple-expansion pumps which force the water through the city mains and services. The high, intermediate and low-pressure cylinders are respectively 10 in., 16 in. and 25 in. in diameter; the water cylinders are 17 in. in diameter, and the common stroke is 24 in. Each pump has an 18-in. suction and 16-in. water delivery pipe, a 2½-in. steam line and a 7-in. exhaust line. The floor space per pump is 23 ft. 1 in. x 6 ft. 9 in., and the height above the floor, 11 ft. Four more similar service pumps can be installed in the extended pump room. The boiler feed-pumps are of the Blake duplex type, 7½ in. x 5 in. x 10 in.

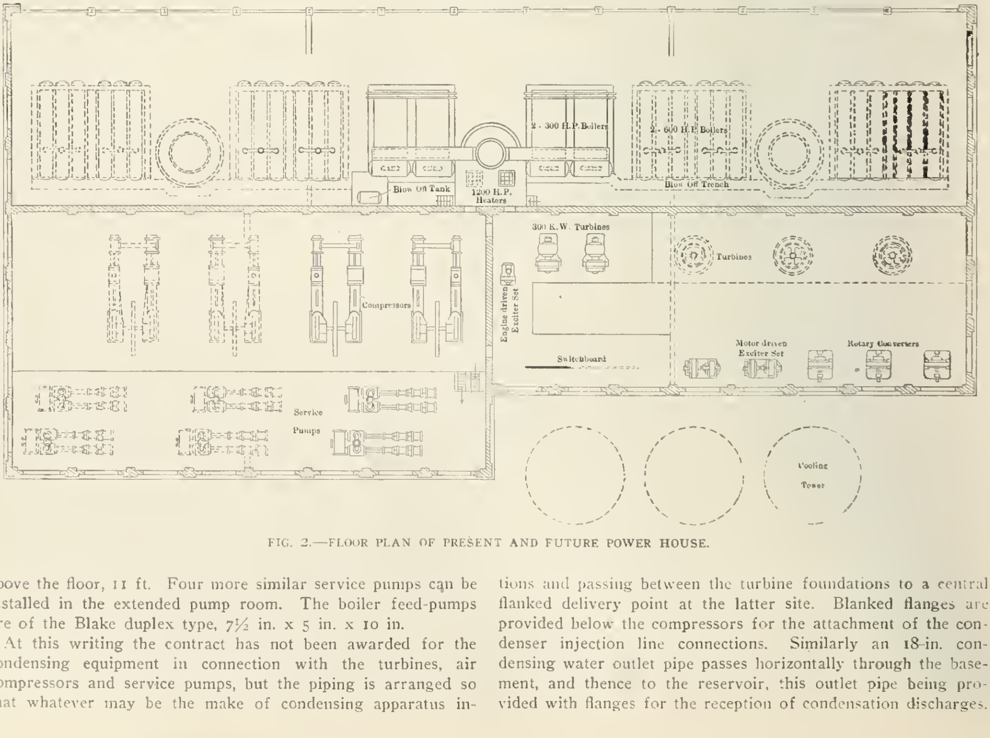


FIG. 2.—FLOOR PLAN OF PRESENT AND FUTURE POWER HOUSE.

At this writing the contract has not been awarded for the condensing equipment in connection with the turbines, air compressors and service pumps, but the piping is arranged so that whatever may be the make of condensing apparatus installed, the suction and discharge piping arrangements will be satisfactory. The 30-in. suction main from the reservoir is provided with bell-and-spigot lateral pipes for the future service pumps, with a special three-way flanged lateral pipe for connection with the existing service pumps, and compressors. Provision will be made for the supply of injection water from this main to jet condensers which will probably be installed in the basement beneath the steam turbines. Provision will be made to operate the apparatus non-condensing, if desired.

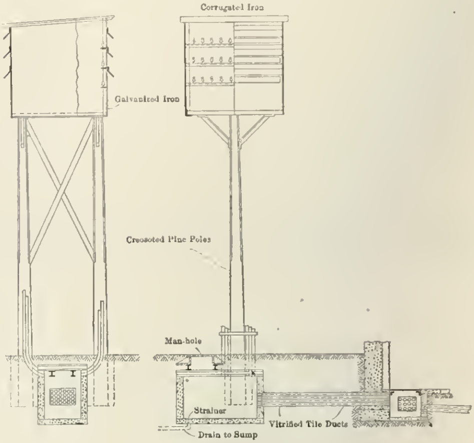


FIG. 3.—DISTRIBUTING POLE BOX.

The condenser suction header is mainly an 18-in. line, which runs from the flanged three-way lateral mentioned above through the basement, cutting through the compressor foundations and passing between the turbine foundations to a central flanked delivery point at the latter site. Blanked flanges are provided below the compressors for the attachment of the condenser injection line connections. Similarly an 18-in. condensing water outlet pipe passes horizontally through the basement, and thence to the reservoir, this outlet pipe being provided with flanges for the reception of condensation discharges.

It is probable that at some time in the future a cooling-tower installation will be made at the plant, and the piping plans provide for discharge and suction connections with any future cooling-tower system.

The live-steam piping is simple in arrangement. Each boiler supplies steam to a 10-in. wrought-iron header running horizontally through the boiler room about 24 ft. above the floor The steam-delivery outlets are 6 in. in diameter, each being controlled by a valve at the boiler and just before they join the header. From the main header two 4-in. steam lines drop down to the turbine-room floor level, pass beneath it and rise to feed the turbines. A 4-in. pipe or auxiliary header supplies steam to the boiler feed-pumps, sump pumps, etc. Each air compressor is supplied with steam through a separate 6-in. pipe line from the main header, and the service pumps receive steam through separate 3-in. pipes. Special care was taken to avoid crippling any piece of machinery by the failure of any other machine or any supply line. The auxiliary exhaust steam is passed through the feed-water heater in the usual way. A double feed line conveys water to the boilers from the feed pumps, the pump mains being cross-connected and provided with valves to give the maximum flexibility.

Two sets of 2300-volt, three-phase busbars are provided, and any generator or feeder can be thrown at will upon either set. Automatic tripping devices are provided on the oil-switch relays. There are three feeder panels, one station and two turbine panels. An oil-switch is included in each main generator circuit, and selector knife switches effect the transfer from bus to bus. The busbars, selector switches, oil switches and auxiliary transformers are located in the basement. The switchboard proper is placed 5 ft. 2 in. from the wall. The cables are carried beneath the floor in vitrified tile ducts. Fig. 3 illustrates the cable ducts and distributing pole details. The cables from the turbo-alternators pass to a 5 ft. x 3 ft. pit below the switchboard in 4-in. pipe conduits. A cable trench with floor outlets extends beneath the switchboard from the pit, and the outgoing lines leave the station by conduits that are branched into 2½-in. pipes outside the building, the latter being carried up two 32-ft. creosoted pine poles to a corrugated iron cable terminal box, 10 ft. square and 10 ft. high, located at the tops of the poles. Inside this box cross-pieces are set horizontally, with insulators 12 in. apart on centers, and louvers beneath which the feeder lines are run horizontally to their various distribution points.

A Transmission Line Considered as a Mechanical Structure.

By W. T. Ryan.

Although the line is the weakest portion of almost every energy transmission system, it usually receives less attention from the designer of the system than any other part. Considered as a conductor the question of proper proportioning of the line and its bearing on the general efficiency of the plant of which it is a part, generally receives very careful consideration. The electrical difficulties which may appear on the line and the consideration of the line as a mechanical structure are usually treated as of secondary importance.

The purpose of this article is to present the equations, which are made use of in the mechanical design of the line, in such a form that with certain data and a reasonable allowance for practical considerations one can at once find the deflection to be allowed in the wires, diameter of pole, bending moment of the force to be counteracted by guying at curves, and finally the variation in heights of poles on grades in order that the tension on the poles produced by the wires may remain in equilibrium.

When a wire is suspended freely between supports it takes a curve known in mechanics as a catenary.

The exact solution of the properties of this curve is very tedious, but for small deflections such as are encountered in transmission wires, use may be made of the parabola, which approaches very closely to the catenary and is a very simple curve to compute.

The relation between the length l, the deflection d, and the tension T on a wire at A or B (Fig. 1), as a factor of its weight is expressed by the formula,

$$T = \frac{l^2 w}{8d} \qquad (1)$$

l = length of span in feet.
d = deflection in feet.
w = weight of wire (+ insulation and an assumed coating of ice) in pounds per foot.
T = tension on wire in pounds.

Transposing equation (1)

$$d = \frac{l^2 w}{8T} \qquad (2)$$

The tension on the wire at the ends of the span AB would be increased by an amount equal to wl due to the weight of the wire. This quantity is such a small portion of the total tension that it may be neglected without introducing any appreciable error

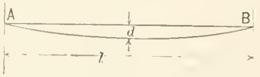


FIG. 1.—DEFLECTION OF WIRE BETWEEN POLES ON LEVEL.

When in use wire is subject to serious mechanical stresses due not only to its weight plus its additional coating of ice, but also to variations in tension caused by change of temperature and wind pressure. The difficulty due to temperature effects is taken care of by using as the deflection d in equation (2) the minimum deflection, or, in other words, the deflection to be allowed in the coldest weather. The length of the wire L for a span of length l and a deflection d is obtained from the formula,

$$L = l + \frac{8d^2}{3l} \qquad (3)$$

Knowing the length of the wire L' for the minimum temperature, its length L'' at any desired temperature can be determined by the formula,

$$L'' = L'\,(1 + B\,(t - t')\,) \qquad (4)$$

B = temperature coefficient of linear expansion.
t = temperature at which it is desired to determine the deflection d.
t' = minimum temperature to which the line is exposed.

It is to be remarked at this point that instead of using the coefficient of linear expansion given in the usual text-books in physics and mechanics (.0000095 per deg. F. for copper) from one-third to one-half of this value is here used, depending principally upon the degree of hardness of the material of the wire. Some of the wire manufacturers have made experimental determinations of this coefficient by suspending a wire between supports whose distance apart was known and observing the sag at a number of different temperatures. The value of the linear temperature-expansion coefficient of copper thus obtained was only from one-third to one-half the usual value. If B is taken as .0000047 for copper wires one will be on the safe side and still have a fairly accurate solution. The deflection d_t at the temperature t will then be given by the formula,

$$d_t = \sqrt{\frac{3l(L' - l)}{8}} \qquad (5)$$

The wind pressure will be considered as acting at right angles to the direction of the wire, since the maximum tension is produced by a wind which is at right angles to the direction of the line. The pressure P per lineal foot on a wire is given by the formula,

$$P = .05\, p\, D_w$$

P = pressure in lbs. per lineal foot.
D_w = diameter of wire in inches.
p = normal pressure of the wind in lbs. per sq. ft.

p is usually taken at about 30 for its maximum value in the open. This corresponds to a wind velocity of 90 miles per hour. Where the force of the wind is broken by buildings, trees, etc., 20 would be a better value. By substituting in the above formula, the effect of the pressure in pounds per lineal foot of the wire is given at once. This pressure combines with the weight of the wire at right angles, hence the resultant stress per foot, which will be designated as W, is,

$$W = \sqrt{w^2 + P^2} \tag{7}$$

w = weight per foot of wire + insulation + ice.
P = stress in pounds per foot due to wind.

The minimum deflection in feet is now given by the formula,

$$d = \frac{l^2 w}{8T} \tag{8}$$

The stresses sustained by a pole may be classified under three heads, as follows: (1) Weight of wire (+ insulation + ice). (2) That produced by tension in the wires (varies with configuration of the line both as regards direction and elevation). (3) Wind (upon wires, poles, cross-arms, etc.).

Stress (1) is a compressive force, (2) and (3) produce flexing strains. The weight of the wire, ice, etc., produces on the poles simply a compressive force which can be neglected, inasmuch as poles which are strong enough to withstand the bending stresses to which they are subjected are not perceptibly affected by this slight compression.

The pole is treated as though it were a beam rigidly fixed at one and loaded at the other end. The resisting moment M is

$$M = \frac{SI}{C} \tag{9}$$

S = stress in section.
I = moment of inertia of section.
C = distance from center to fiber under maximum stress.

The moment of the force applied to the top of the pole is $W'h$ where W' is the total tension in the wires (in pounds) and h is the height of the pole (in inches).

For a circular pole section having a diameter D (in inches), $I = \pi D^4 \div 64$ and $C = D \div 2$. Substituting these values in equation (9),

$$W'h = \frac{SI}{C} = \frac{S\pi D^4 \div 64}{D \div 2} \tag{10}$$

Substituting for S, $\frac{T_m}{n}$ where T_m = tensile strength (in pounds per square inch) of the material in the pole and n = factor of safety,

$$W'h = \frac{T_m \pi D^3}{32n}$$

$$D = \sqrt{\frac{32W'hn}{\pi T_m}} \tag{11}$$

Now, from equation (1)

$$T = \frac{l^2 w}{8d} = wl\left(\frac{1}{8}\frac{l}{d}\right) \tag{12}$$

or, in other words, $T = K$ (weight of wire + insulation and ice), where K is a constant and equal to one-eighth the span divided by the deflection at the center.

$$Pt = 05\ pDwlN + \frac{.05pD''h'}{2} \tag{13}$$

Pt = total stress in pounds due to wind.
p = maximum pressure due to wind in pounds per square foot, say, 30.
Dw = diameter of ice-laden wire in inches.
l = length of span, in feet.
N = number of wires.
D'' = average diameter of pole, in inches.
h' = height of pole above ground, in feet.

The stress due to wind pressure on the pole acts along the whole length of pole, hence it has the same effect as though one-half of its force were concentrated at the top. (The slight stress produced by the wind striking against the cross-arms and insulators is neglected.)

$$W' = \sqrt{(NT)^2 + Pt^2} \tag{14}$$

The bending moment due to an angle in the line, which is to be counteracted by guying is $2W' \cos\frac{\alpha}{2}$, where W' is the stress as determined above, and α is the angle made between the wires at the turn.

The diameter of the pole obtained by the above formula is, of course, the maximum diameter, or the diameter of the pole just above the ground. In order to determine how this diameter should compare with the diameter at any other point, consider again that the pole is a beam rigidly fixed at one end and loaded at the other. If the pole has a round cross-section and tapers toward the top, it is a truncated cone and should have a parabolic section in order that the least material should be used for the maximum strength. If the pole is round a section of it would then be a cubic parabola, and the diameter at the ground should be 3/2 the diameter at the top.

In the above the poles have been assumed to be of equal length, a constant distance apart, and on level ground. When the tops of the poles are no longer in line, and are different distances apart, unbalanced stresses will be encountered unless special precautions are observed in the erection.

Consider first the case where the pole line is level, with the poles set at unequal distances. Since the tension produced in the poles by the wires varies with the sag in the wires, it is at once obvious that the tension can be kept in equilibrium in unequal spans by varying the deflection of the wires in the spans of unequal length.

Where the pole tops are no longer level it is to be observed that since the wire in any span is everywhere in equilibrium as regards tension in the wire, it may be tied to a pole at any point intermediate between its ends without disturbing its equilibrium in any way. It should also be borne in mind that it is a change in grade and not the grade itself that is of chief importance.

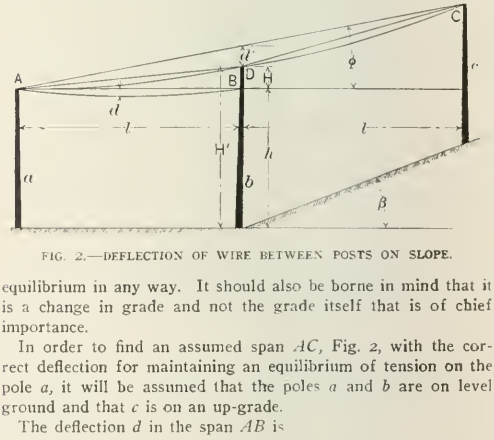


FIG. 2.—DEFLECTION OF WIRE BETWEEN POSTS ON SLOPE.

In order to find an assumed span AC, Fig. 2, with the correct deflection for maintaining an equilibrium of tension on the pole a, it will be assumed that the poles a and b are on level ground and that c is on an up-grade.

The deflection d in the span AB is

$$d = \frac{l^2 W}{8T} \tag{15}$$

The deflection d' in the assumed span d' is $\frac{(AC)^2 W}{8T}$. Since the spans are assumed to be of equal length an appreciable error will not be introduced by substituting $2l$ for AC. The equation for d' then becomes $d' = \frac{(2l)^2 W}{8T}$ (16)

If the pole b be made of such a length that the span AC will be anchored to it at a point D which lies upon its natural curve between A and C, the equilibrium of the tension in the wire will not be disturbed.

From the figure it is seen that.

$$H = l \sin\phi - d' \text{ (very closely)} \tag{17}$$

but from equations (15) and (16)

$$d' = 4d$$

and,

$$\sin\phi = 1/2 \sin\beta$$

hence,

$$H = \tfrac{1}{2}\, l \sin\beta - 4d \qquad (18)$$

Therefore, the height of the pole *b*, which is designated as *H′* is

$$H' = h + \tfrac{1}{2}\, l \sin\beta - 4d \qquad (19)$$

where

h = normal height of poles.
l = length of span.
d = normal deflection allowed.
β = angle of change in grade.

If the spans are of unequal length the solution will be the same except that the deflection in the assumed span *AC* will be more or less than four times the normal deflection *d;* and more or less than ½ *l sin β* will be added to *h* according as the span *BC* is more or less than the normal length. A general statement of equation (19) would be as follows:

$$H' = h + kl \sin\beta - k'd \qquad (20)$$

where,

$$k' = \left[\frac{\text{length of assumed span } (AC)}{\text{length of normal span } (AB)}\right]^2$$

$$k = \frac{\text{length of normal span } (AB)}{\text{length of assumed span } (AC)}$$

The above method of obtaining the values of *k′* and *k* is limited to cases where the length of the assumed span (*AC*) does not vary widely from twice the length of the normal span (*BC*). This does not limit the practical application of the formula very much.

As an example of the above, suppose that 30-ft. poles are being placed along level ground and up a 10 per cent grade. The "angle of the grade" is the angle made by a line, drawn between the bottoms of two adjacent poles at the point where they enter the ground, with the horizontal, irrespective of the configuration of the ground between the poles. Let the poles be 100 ft. apart and the normal sag 1 ft. According to equation (20),

$$H' = h + \tfrac{1}{2}\, l \sin\beta - 4d$$
$$H' = 30 + 50 \sin 10^\circ - 4$$
$$H' = 30 + 8.65 - 4$$
$$H' = 34.65 \text{ ft.}$$

What would be actually done in practice would be to divide the extra 4.65 ft. by two and add one-half of it, or 2.30 ft., to the last pole on the level ground, thus making it 32.30 ft. high and cutting 2.3 ft. off of the first pole on the grade, thus making it 27.7 ft. high. If the change in slope should be so abrupt as to necessitate the use of an unusually long or short pole, the length should be made more nearly normal by making the length of the assumed span (*AC*) less than twice the normal span (*AB*). It is evident that, knowing the deflection in the wires, the length of span and the normal height of pole, a table of values can very easily be computed showing the value of *H′* for the various changes in grade liable to be encountered in the erection of the line.

APPLICATION OF THE FORMULAS.

Find the sag in the wires at the lowest temperature, say, — 10° F., the sag in the summer time, say, a temperature of 70° F., and the diameter of poles for a transmission system which is to consist of six No. 1 wires on cedar poles whose cross-arms are 32 ft. above the ground, allowing for a ⅛-in. coating of ice and a wind pressure of 30 lbs. per sq. ft. There are to be 60 poles per mile. If a 120 deg. turn is made in the line, what is the moment of the force to be counteracted by guying? If there is a 7 deg. variation in slope, how high should be the pole next to the slope, and the first one on the slope, in order to keep the tension in the wires in equilibrium?

$$\frac{T_m}{n} = 1125 \text{ (factor of safety of three used)}$$

$$l = \frac{5280}{60} = 88 \text{ ft.}$$

The weight of insulated No. 1 wire per foot is .322, the diameter = approximately 3 in. The weight of a ⅛-in. coating of ice per foot would be .072 lb.

$$w = .322 + .072 = .394.$$
$$P = (.05)\,(30)\,(.55) = .825 \text{ lbs.}$$
$$W = \sqrt{(.394)^2 + (.825)^2} = .913 \text{ lbs.}$$

The minimum deflection *d* or the sag at — 10° Fahr. would be

$$d = \frac{(88)^2\,(.913)}{(8)\,(1125)} = .78 \text{ feet, say 9 inches.}$$

The length of wire in a span with this sag would be

$$L = 88 + \frac{(8)\,(.75)^2}{(3)\,(88)} = 88.017 \text{ feet.}$$

The length of wire in the span at 80° Fahr. is

$$L' = 88.017\,(1 + (.000004)\,(80)) = 88.047$$

The deflection at a temperature of 70° Fahr. would then be

$$d_t = \sqrt{\frac{(3)\,(88)\,(88.047 - 88)}{8}}$$
$$d_t = 1.2 \text{ feet, say 14 inches.}$$

The diameter of pole is estimated as follows:

$$T = \frac{l^2 w}{8d} = \frac{(88)^2\,(.394)}{(8)\,(.75)} = 490 \text{ lbs.}$$
$$NT = (6)\,(490) = 2940 \text{ lbs.}$$
$$P_t = .05\,pD_w lN + \frac{.05\,pD\ h}{2}$$

At this point it is necessary to assume a value of *D″*, which is to be corrected for by resolving in case *D′* varies very much from the value chosen. Let *D″* be taken as 12.5, which would correspond to a pole with a 15-inch base and a 10-inch top.

$$Pt = (.05)\,(30)\,(.55)\,(88)\,(6) + \frac{(.05)\,(30)\,(12.5)\,(32)}{2}$$
$$Pt = 735 \text{ lbs.}$$
$$W = \sqrt{(2940)^2 + (735)^2} = 3175 \text{ lbs.})$$

The diameter of the pole at the point where it enters the ground would be

$$D = \sqrt[3]{\frac{(32)\,(3175)\,(32)\,(12)\,(3)}{\pi 11000}}$$
$$D = 13.7, \text{ say 14, inches.}$$

The moment of the force to be counteracted by guying if a turn of 120° were made would be

$$(2)\;(3175)\;(\cos 60^\circ) = 3175 \text{ lbs.}$$

For a change in slope of 7 degrees:

$$H' = 32 + (\tfrac{1}{2})\,(88)\,(\sin 7^\circ) - (4)\,(.75)$$
$$H' = 32 + (5.35 - 3.00) = 32 + 2.35$$

Hence, the last pole before reaching the change in slope should be made 33.17 feet high, and the first on the grade 30.83 feet high, in order to keep the tension in the wires in equilibrium.

Why Wooden Poles Break Above Ground.

By Clinton B. Smith.

It is a matter of observation that most tall wooden poles of, say, 40 ft. and over in length, when blown over by storm, will break a considerable distance above ground.

This fact would lead one to think that the weakest section is not at the ground level, but at some higher point on the pole. The following investigation shows that a pole of uniform taper and free from knots and other local weaknesses is weakest at a definite distance from the top, this distance being independent of the pole length.

This distance is $x = d \div 2t$ in which all distances are in inches, and in which d = diameter of pole top; t = taper of pole, or increase in diameter in inches per inch of length; F = horizontal stress due to wires on cross-arm.

The pole is weakest where the fiber stress is greatest. Therefore, in order to find the weakest point, it is necessary merely to locate maximum fiber stress for any value of *F*.

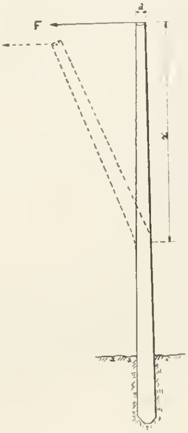
At any section along the pole at a distance *x* from the top,

$$Fx = \frac{If}{c}$$
$$= .098\,d\cdot t \text{ (for round section)}$$

where $I =$ mom. of inertia of section.
$f =$ stress in outer fiber.
$d_x =$ diam. of pole at distance x from top.
but $d_x = d + tx$.
Therefore

$$f = \frac{F}{.098}\ \frac{x}{(d+tx)^3}$$

It will be observed upon differentiating that f reaches its maximum value when $x = d \div 2t$. This is the critical value of x corresponding to the maximum value of f, the fiber stress; the pole, if free from local weaknesses, will break at this distance from the top.



BREAKING OF POLES ABOVE GROUND.

Taking the case of an Idaho cedar pole having a top diameter of 8 in. and an average taper of .01 in. per inch.

$$d = 8$$
$$t = .01;$$

whence,

$$x = d \div 2t = 400 \text{ in.}$$

Hence the pole will break 33 ft. 4 in. from top, no matter how long the pole may be, provided the pole has at least this length above ground. A pole shorter than this length above ground will break at the ground.

Turbine Economies.

By J. R. Bibbins.

In your issue of Jan. 11, Mr. W. L. R. Emmet has presented a very striking comparison of Curtis and Parsons turbine efficiency. It is rather surprising, however, that he has allowed himself to fall into technical errors which are clearly manifest upon even the most cursory analysis. Presumably these errors are chargeable to a too hasty examination of the subject; but as the casual reader is certain to be misled, I feel it my duty to present the problem in a more accurate form. And I rather think that Mr. Emmet himself, upon reviewing the facts of the case, will not be able to extract much comfort from his own argument.

With most evident inconsistency he has drawn certain relative comparisons between turbine performances under different conditions, ostensibly upon the basis of "published data," but actually upon entirely unpublished data of the Curtis turbine. And finally he begs the question altogether by arguments for higher vacuum unsupported in actual practice.

Now, this discussion has nothing whatever to do with the ultimate value of extreme vacuum. That is a question by itself and will be determined upon its merits. If higher vacuum is a good investment, we may expect to see future power plants designed on that basis. The question of an extra inch of vacuum, however, will never be the deciding factor as to *type* of turbine; for, so far as the turbine itself is concerned, the advantage of high vacuum over low vacuum will, regardless of type, be unquestioned. The important point is, however, that these extreme vacua are not at present usually obtained. I do not believe we should find one per cent of the condensing stations of this country carrying 29 in. of vacuum *the year around*. Most engineers would to-day regard 28 in. as rather high, and less than that is more common. The turbine user is concerned only in the commercial aspect of this question. He is, therefore, interested only in ***results***—not those which he might get under conditions which he does not or cannot afford, but those obtained under the conditions which really exist.

The general question, then, is one of relative inherent economy of two prominent types of steam turbines, as evidenced by recorded performance, while the immediate discussion bears upon a comparison of two recent tests of these two types under different conditions of operation; and I had previously attempted to show that the Curtis turbine results, under conditions obtaining in the Chicago Edison tests, were inferior to the Parsons when equated with those prevailing during the New York Edison tests.

At the outset, I cannot permit, without the fundamental data, the introduction of another series of economy curves, *CC* (Jan. 11, page 102), purporting to represent Curtis turbine performance under two different operating conditions—the one corresponding to the moderate conditions of the New York Edison Parsons test, and the other to the high conditions of some unpublished tests on the Chicago Edison turbine. Under both conditions, the Parsons turbine is depicted as hopelessly inferior to the Curtis, and moreover, the accuracy of both the Parsons tests brought into the comparison (one made by Mr. H. G. Stott at the Interboro plant, and the other by Mr. J. P. Sparrow at No. 2 Waterside station) are directly brought into question by Mr. Emmet in his misunderstanding of results—a fact requiring no further comment. He has thus—perhaps unconsciously—diverted attention from the one point at issue, stated above, viz., the direct comparison of the ***original*** Chicago Edison with the New York Edison tests under the ***reasonable*** operating conditions of the ***latter*** plant.

Now it is evidently a hopeless task to discuss effectively a comparison of this kind if additional complications, extraneous in character, are to be continually introduced. If such complete tests had been made at Chicago by independent parties, under all conditions of load, pressure, vacuum and superheat, that results could be taken for comparison "without appreciable correction," as he claims, would it not facilitate matters (permission assumed) to place on public record the original results obtained directly under such conditions, particularly under moderate vacua and superheat, such as obtained during the New York Edison tests? Unauthenticated and irrational curves, such as have been presented, will manifestly not suffice for the purpose.

In order, therefore, to confine the issue to *existing published data*, as Mr. Emmet desires, I shall consider only the points noted in order below, and each as briefly as possible for the benefit of those who have not the time nor patience to follow the more detailed analysis appended. I desire to point out here, however, that *upon this analysis alone* rests the merits of this comparison, and the specific errors involved should be pointed out in any rejoinder.

(1) *Parsons Tests Improperly Presented.*—The original curves *BB*, replotted as lines II and III, sheet B, purporting to represent Parsons economies for both high and moderate operating conditions, are so greatly mislocated as to lead directly to an absurdity. Compare them with the original test, line I, and also with the true water lines IV and V.[1] I feel safe in saying that no characteristic yet exhibited by the steam turbine would result in such a sudden departure of the water

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[1] To facilitate the examination of the results presented, I have first used the total steam, or water-consumption line, instead of the water-rate curve, which is infinitely more valuable in turbine work for revealing irrational results.

line to a decided curve tangent at about 5000-kw load as Mr. Emmet's deductions indicate. This will be apparent from the fact that curve II crosses the original water line at 4500 kw. Can we bring ourselves to believe that any turbine would have the same steam consumption at 150 lb., 2.2 per cent moisture and 28 in. as at 177 lb., 96 deg. and 27.31 in. vacuum? The difference in water, due to this difference in conditions, should be roughly 16.7 per cent decrease for pressure and superheat and 3.7 per cent increase for vacuum, leaving a net decrease of 13 per cent, as shown by the true curves, IV and V. Again, following the same reasoning for curve III, which also tends to intersect the original tests at a load of 3500 kw, the absurdity is likewise apparent, for this intersection would indicate that an increase of 27 lb. and 100 deg. superheat is exactly offset by 1 in. in vacuum. Imagining an immediate line for 28.5 in. vacuum, it is hard to believe that at 4000-kw load, the probable intersection, an increase of 27 lb. and 100 deg. superheat results in no improvement in economy. From the irrational nature of these curves, only one inference seems possible

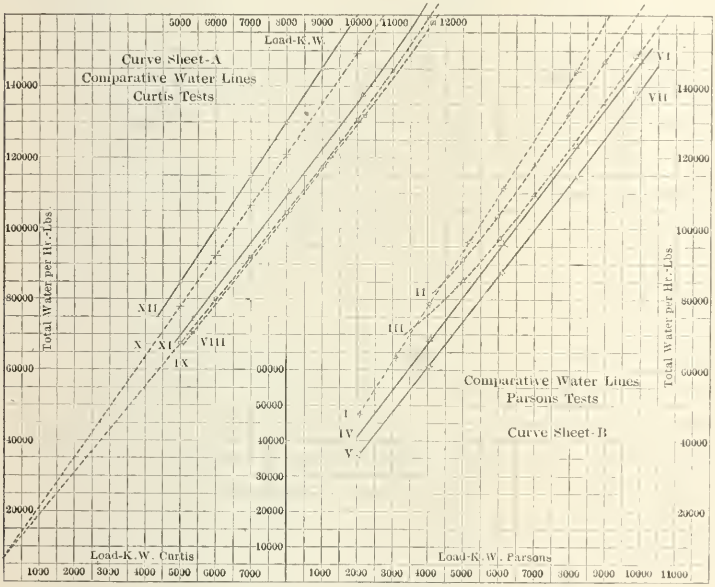

FIG. I.—CURVE SHEETS A AND B—COMPARATIVE WATER RATES.

Curve I.—Original tests, 5500-kw Parsons turbo-generator, Manhattan station, by Mr. H. G. Stott. Approximate conditions, 150 lb., 2.7 per cent moisture, and 28 in.
Curve II.—The same, as corrected by Mr. Emmet, to conditions of New York Edison Parsons test. 177 lb., 96 deg. and 27.3 in.
Curve III.—The same, as corrected by Mr. Emmet, to Chicago Edison conditions, 180 lb., 125 deg. and 29 in.
Curve IV.—The same, properly corrected to conditions of New York Edison Parsons test.
Curve V.—The same, properly corrected to Chicago Edison conditions.
Curve VI.—Actual test of 7500-kw Parsons turbine, New York Edison, Waterside station, uncorrected. Conditions, 177 lb., 96 deg. and 27.31 in.
Curve VII.—The same, properly corrected to Chicago Edison conditions.
Curve VIII.—Original tests, 8000-9000-kw Chicago Edison Curtis turbo-generator, Fisk Street station. Approximate conditions, 190 lb., 150 deg. and 29.5 in.
Curve IX.—Unpublished tests of Chicago turbine reported by Mr. Emmet, for conditions, 180 lb., 125 deg. and 29 in.
Curve X.—The same, for conditions of New York Edison test.
Curve XI.—Original Chicago Edison Curtis tests corrected to 180 lb., 125 deg. and 29 in.
Curve XII.—The same, properly corrected to Chicago Edison conditions, 180 lb., 125 deg. and 29 in

Lines IV and V, however, representing true Parsons results, are quite rational. For these, correction factors sanctioned by test and usage, as outlined under "Technical Analysis," were used. (See Appendix.)

(2) *Non-agreement of Parsons Tests.*—Mr. Emmet's figures indicate some 8 per cent difference in the results of the New York Edison and the Interborough Parsons tests, but with the proper location of his curves *BB*, the wide discrepancy disappears; likewise his inference of gross error in one or both of the tests. Point VI shows this New York Edison test plotted from original data uncorrected and directly comparable with line IV deduced from the Interborough test. Point VII shows these same tests reduced to Chicago conditions and directly comparable with the corresponding Interborough line V. These Parsons tests then show a difference in economy so small as to be quite negligible. Certainly 2 or 3 per cent variation between two different machines operated in different plants and under widely differing conditions of load cannot be called excessive.

(3) *Curtis Results Irrational.*—Coming now to the new data introduced from unpublished tests of the Chicago turbine, I find that both the original curves *CC, replotted* as lines IX and X for moderate and for extreme operating conditions, are entirely inconsistent; neither do they agree in any respect with the original Chicago tests now on record. I will content myself, therefore, in simply pointing out the inconsistency of these special tests, basing final calculations on the original tests and using correction factors advocated by Curtis turbine engineers, as already on record before various scientific societies. (See methods of correction, Appendix.)

First, note the extremely small difference between curves VIII and IX, both stated to be uncorrected tests. Analyzing this difference, we are confronted by the conclusion that the Chicago machine at full load showed a negative rate of improvement between 29 and 29.5 in. vacuum, of less than 0.1 lb. per kw-hour per inch of vacuum (see Appendix), roughly, 1/10 of that claimed for these Curtis turbines, and this a negative, not a positive, improvement.

Second, note the wide divergence of curves IX and X, which tend to *intersect* at about no-load. Can we avoid *this* inference that at no-load the Chicago machine required the *same* amount of steam at 96 deg. and 27.31 in. as for 125 deg. and 29 in.; or even neglecting the 29 deg. increase in superheat, is the increased vacuum of no value? This extra 1.7 in. vacuum should result in a practically *constant* decrement of water per hour at all loads, amounting to nearly 12 per cent of the full-load consumption. Compare the Parsons water lines, IV and V, for the same conditions. Their rational character is shown by the fact that they are nearly parallel through the entire range of load—the slight divergence being due to the increased superheat.

In spite of unanimous statements to the contrary by Mr. Emmet and his associates, the data he presents thus indicate that *the value of extra vacuum progressively decreases to zero at no-load.* This is so absurd upon the face of it that in addition to other disagreements pointed out above, it has influenced me in not considering further the tests represented by the original curves *CC* (Jan. 11, page 102). These inconsistencies must involve error in one or three sources: (a) The original Chicago tests; (b) the basis of correction; (c) the subsequent tests. No data are at hand for analyzing the last. No glaring irrationality attaches itself to the first test. We are, therefore, face to face with the proper method of correction.

The Curtis results, properly corrected, are, however, consistent, as shown by lines XI and XII. Here again the slight divergence is due to the increase in superheat, as in the case of Parsons lines IV and V.

(4) *True Relative Economy.*—Coming finally to the principal point at issue, curve sheets C and D indicate the true relative[1] economy of these two machines to be as follows: Parsons, 15.08 lb. per kw-hour; Curtis, 16.05 lb. per kw-hour—a difference of 6½ per cent—both under New York Edison conditions—177 lb., 96 deg. and 27.3 in., 9865 kw-load.

I now recall my former statement and find that it is borne out in fact, as well as in principle, viz., that under test, the New York Edison Parsons machine shows the superior relative economy; this, and no more, was stated in the original report of the New York Edison tests. (*Proc.*, Am. St. & Int. Ry. Eng. Assoc., October, 1907.) And further, the Interborough tests indicate a superior economy, not only at this, but at all loads. On the other hand, from the relative location of the 29-in. vacuum curve, it appears that the Curtis turbine is slightly better than the Interborough tests indicate this particular machine would be at the same vacuum. The Interborough turbine, however, was built for 27.5 in. vacuum. Had it been designed for 29 in., the improvement with the higher vacuum would undoubtedly have been greater. And, from its good performance under its designed vacuum, I should anticipate better economies at 29.5 in. than these Chicago Curtis tests show. This, however, is a question irrelevant to the discussion.

For the actual performance of a Parsons machine designed for and tested under favorable conditions, I may refer to the Parsons tests at Carville station, Newcastle, at 5164-kw load, 200 lb. pressure, 120 deg. superheat and 29 in. vacuum—13.19 lb. per kw-hour, intrinsically a better result than obtained at Chicago, as the water rate was but 0.29 lb. higher with 0.5 in. lower vacuum.

(5) *Thermal Efficiency from Actual Tests.*—If it still be held that all corrections for operating conditions are misleading and inadmissible, there remains one basic relation upon which heat-engine efficiencies can be correlated, viz., kinetic efficiency or thermal efficiency ration; i. e., the ratio of the actual water-rate to the ideal water-rate of the Rankine-Clausius cycle, for the conditions involved. It is, therefore, pertinent to the subject in hand to present these officiencies based upon *uncorrected* test data. This basis of comparison is quite definite, with one exception—the specific heat of superheated steam—and in the following comparison a variable value around 0.56 has been used in accordance with the more recent expositions of the subject by Professors Thomas, Knoblauch and Jacob.

1. The Curtis machine at 10,186 kw, 176 lb., 147 deg. and 29.47 in. gave a water rate of 12.0 lb. per kw-hour. This is equivalent to a kinetic efficiency, or ratio of ideal to actual, of 62.1 per cent.

2. The New York Edison Parsons turbine at 9865 kw (six-hour constant-load test), 177 lb., 96 deg. and 27.31 in., gave a water-rate of 14.98 lb. per kw-hour. This is equivalent to a kinetic efficiency of 67.3 per cent—5 per cent higher efficiency than the Curtis with its desired high vacuum. Again, therefore, I repeat my statement as to the efficiency record now being held by the New York Edison machine in American turbine practice, as based upon *actual* tests.

Reviewing the letter in general, our critic would accord the poor, old-fashioned Parsons turbine a humble place, indeed, in relative ability to transform steam into kilowatts, yet he actually expresses the belief that he has done it "more than justice" in his deductions. But we cannot allow him to find refuge in the ethereal joys of 29.5 in. vacuum either as a standard operating condition or a basis for commercial testing. In fact, he himself admits as much in the statement that at Chicago the vacuum only "sometimes" reaches 29.5 in. This, to be sure, is fair condenser performance with 32 deg. water, but hardly to be considered as a normal operating condition in present turbine practice. Notwithstanding, we are treated to a delectable series of tests under these particular conditions as a characteristic measure of Curtis turbine efficiency. Does it seem reasonable that if other builders seek to meet the *prevailing* commercial demand for a more reasonable vacuum, they should be compelled to relinquish the very considerable advantage which the high-vacuum advocate claims as his special perquisite? Such is the argument in this, as well as previous comparisons by the same author, particularly with reciprocating engines (*Proceedings*, N. E. L. A., 1907). Such eagerness for the last fraction, as is here displayed, almost suggests the *inherent necessity therefor*, of which other builders are inferred to be in blissful ignorance. "Where high vacuum can be secured it is folly to use low vacuum." But bear in mind that a higher rate of improvement from better operating conditions carries with it the converse proposition that the internal losses are greater when the vacuum and superheat drops. It seems to me that if your correspondent cannot "hitch his wagon to a star" in fact, as well as fancy, he is treading on dangerous ground.

It is claimed by the high-vacuum advocates that any amount of investment in a high-vacuum plant will be well repaid from an ultimate commercial standpoint. Is this true? Has anyone ever endeavored to determine the average effective vacuum for the year around, even on tide-water? For water temperatures around the freezing point, the high-vacuum is, of course, admitted, but how about warm weather? Note the following table:

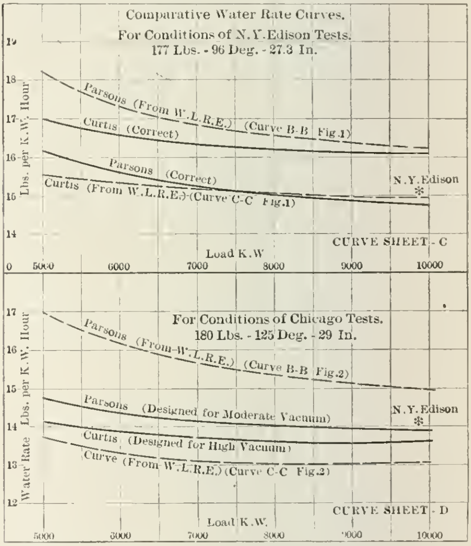

FIG. 2.—CURVE SHEETS C AND D—COMPARATIVE WATER RATES.

POSSIBLE VACUUM—WATER TEMPERATURES.

Temperature cooling water.	Theoretical possible vacuum.	Perfect condenser, no temp. dif.	Actual condenser. 15° dif.	Actual condenser. 15° dif.
Ratio water to steam.	Infinite.	60 to 1.	60 to 1.	100 to 1.
32	29.83	29.67	29.43	29.54
60	29.5	29.12	28.56	28.82
70	29.3	28.77	27.72	28.38
75	29.1	28.51	27.37	28.11

With 70 deg. water, a perfect condenser can give a maximum vacuum of only 29.3 in. And as modern surface condenser equipments seldom discharge less than 15 deg. below steam temperature, the maximum vacuum possible at this temperature and a reasonable water ratio of 60 to 1 is 27.7 in. With 60 deg. water, we may maintain 28.6 in., and with 75 deg. water only 27.4 in.

Now, 29-in. vacuum is by no means unusual in winter on lake or tide water, and is certainly not confined to the Chicago Edison station; but it is hardly logical from any standpoint to construe the geographic as a strictly technical advantage in comparisons of tests. The question that usually confronts the manufacturer is not the design of a machine to meet conditions only occasionally arising, but rather to meet the average operating condition that will obtain in the actual plant.

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[1] This comparison is based entirely upon results obtained during the middle six hours out of the continuous eight-hour test at the New York Edison plant, permissible owing to fall in load and high-condenser leakage, and the fact that this machine had been under full load for only 10 minutes prior to the beginning of the eight-hour test

To conclude, I cannot help but feel that this entire subject of the effect of operating conditions on turbine economy, and the commercial considerations arising therefrom, is at present in an exceedingly muddled state. There is nothing mysterious about the subject which the turbine builder must guard as an invaluable secret. In fact, it is quite as definite as, for instance, the correction for temperature rise in generators, at different initial air temperatures, or the corrections for different initial temperatures of measurement.

It seems to me it lies within Mr. Emmet's power to establish very effectively his position in this entire matter. He and others who have published results on the Curtis turbine have quite uniformly adhered to conditions of high vacuum and superheat only, and have, therefore, made it necessary to introduce corrections for purposes of comparison with other units. In view of the present discussion, he might give us the original results obtained from a Curtis turbine of about the same size, working under approximately the same conditions—in fact, standing alongside of the New York Edison Parsons turbine, whose economy I have discussed above.

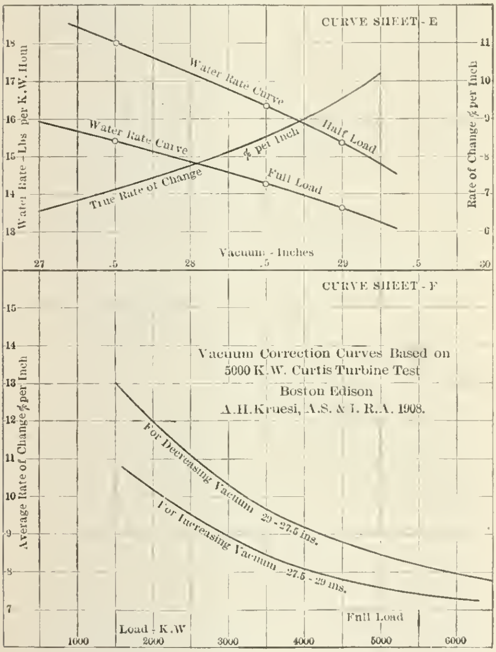

FIG. 3.—CURVE SHEETS E AND F—VACUUM CORRECTION CURVES.

APPENDIX.—TECHNICAL ANALYSIS.

The technical analysis involves two important points—analysis of total water lines and correction factors used. Let us discard for the moment water curves and examine the results by means of the total water or steam consumption line—a valuable turbine characteristic. Experience has shown this to conform faithfully to a straight line, as in the Willans law, regardless of the method of governing[1] employed; i. e., within almost the entire range of load controlled by primary admission of steam. This is true of the Curtis, as well as the Parsons type, and it has been illustrated so often in turbine literature that no further proof is necessary. On the other hand, the water line of a cut-off engine shows a radical curvature approximating the Willans law only in the neighborhood of best economy. We also know that the effect of a change in vacuum is to displace the total water line practically *parallel* to itself, while with superheat, the displacement is *divergent* about an origin usually representing zero steam consumption. This is quite reasonable, for we know that while an increase in both vacuum and superheat adds a definite and constant percentage of energy to each pound of steam, their effectiveness in reducing internal fluid friction are quite different in kind. Vacuum operates progressively from exhaust to admission; superheat the reverse. With higher vacua, the mean effective density (if I may use the term) is little affected at heavy loads; with superheat, at light loads. Upon these premises, it follows that the *rate* of change in economy due to superheat will be approximately constant at all loads; for vacuum, variable, decreasing with increasing load. Such a vacuum relation may be found in tests of 5000-kw Boston Edison turbine (Kruesi, *Proc.*, Am. St. & Int. Ry. Eng. Assoc., 1907, Fig. I). Curve sheet *E* represents the fall in *water-rate* with increasing vacuum at full-load and half-load, respectively. Both curve downward more rapidly on the higher vacua, indicating a greater proportion of gain in this vicinity. This is borne out by the curve showing "True Rate of Change." Around 27 in., the change in economy per inch is 6.6 per cent; 28 in., 7.8 per cent, and 29 in. 9.5 per cent, corresponding to 1.3 lb. per kw-hour per inch. At half-load the change is even more pronounced on high vacuum.

Now the *rate of change* (slope of curve) is quite a different matter from improvement in water-rate between two definite limits, i. e., the average. And, furthermore, much depends upon which way the change is made. Thus, for a total range from 29.0 in. to 27.5 in., the average *increase* in rate is (at full-load) 1.17 lb. per kw-hour per inch, or 8.5 per cent per inch: while from 27.5 in. to 29 in. the average *decrease* in rate is but 7.6 per cent. Carrying this analysis one step farther, Sheet F shows this rate of change for various loads under these two conditions—increasing and decreasing vacuum. For example, 1 in. *decrease* below 29 in. results in an increase in water-rate of 11.1 per cent per inch at half-load, as compared with 8.5 per cent at full-load.

These last curves may now be used as a basis for calculations for the Curtis turbine under discussion. That they seem reasonable is evident from Mr. Emmet's statement (*Proc.* N. E. L. A., 1907), "the available energy with 29 in. is 10 per cent higher than that with 28 in. vacuum, * * * and between 28 in. and 28.5 in. the gain is very nearly proportionate to theory." Likewise, Mr. Kruesi (*Proc.* Am. St. & Int. Ry. Eng. Assoc., 1907) says, "raising the vacuum from 28 in. to 28.5 in. makes 5 per cent more energy available, and of this the turbine realizes an improvement of from 0.5 lb. to 0.6 lb. per kw-hour at rated load," equivalent to a rate of 1 lb. to 1.2 lb. per kw-hour per inch of vacuum (we have already used 1.17 lb.). Therefore, as the rate is still higher from 29 in. to 29.5 in., I am at least conservative in taking curve sheet *E* as a basis for correcting the Chicago Edison tests.

For the Parsons turbine, the rate is known to be much smaller, and as the Interborough tests are on record, I need not elaborate here. Suffice it to say that I have used a similar factor variable with load and vacuum. As the difference in water due to 1 in. vacuum—about 4500 lb. per hour—holds constant practically within the limits of primary admissions of steam, other loads, including the New York Edison tests, may be found by exterpolation. Thus, at 7500 kilowatts, the average rate of change per inch around 28 in. is 3.42 per cent: at 5000-kw load, 5.1 per cent. In the detailed calculations, due allowance has, of course, been made for increasing and decreasing vacuum, as above outlined in case of Curtis curves.

Both types of turbines seem to benefit about equally from superheat around 100 deg., so that we may assume an equal rate of change—1 per cent per 12.5 deg. (For the total change of 100 deg., however, the Parsons usually benefits 10 per cent.) Likewise, an equal gain for pressure and quality for the former, 1 per cent per 10 lb. change around 175 lb. is assumed—a little less for wide ranges; for the latter, a correction double the percentage of moisture content—this to take account of the well-known effect of moisture in increasing internal friction, a factor with which the reciprocating engine does not have to contend.

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[1] Incidentally, the Willans law is supposed to apply only to the principle of pure throttle governing. Hence, it is quite reasonable that the Parsons type should show this characteristic; also the Rateau. That the Curtis likewise conforms, indicates how closely the multiple nozzle system of governing approximates that of pure throttling.

To illustrate the method of applying these various factors, take, for example, the derivation of line *IV* from the original test line *I*:

Test: 8174-kw, 149 lb., 27.78 in., 2.7 per cent moisture. Correct to 8174-kw, 177 lb., 27.31 in., 96 deg. superheat.

Pressure: 26 lb. low; correction for this range, say, 2 per cent to be conservative, factor $= \frac{1}{1.02}$.

Moisture: 2.7 per cent; correction to dry steam for this range, say, 5 per cent, factor $= \frac{1}{1.05}$.

Superheat: 96 deg. low, correction for the range, 9.72 per cent, factor $= \frac{1 - .0972}{1.00} = 0.903$.

Vacuum: 0.48 in. high, correction for the range, 1.488 per cent, or 3.1 per cent per inch, factor = 1.01488.

Original steam consumption: 144,210 lb. per hour, then,

$$144210 \times \overset{\text{(Sup)}}{.903} \times \overset{\text{(Pres)}}{\frac{1}{1.02}} \times \overset{\text{(Moist)}}{\frac{1}{1.05}} \times \overset{\text{(Vac)}}{1.01488} = 123200 \text{ lb. per hour.}$$

$$\text{Corrected water rate: } \frac{123200}{8174} = 15.07 \text{ lb. per kw-hour.}$$

Note here that some of the factors are inverted, depending, of course, on which way a correction is made from a given standard. Thus, using 150 lb. as a basis (100 per cent), the pressure factor would be 0.98; with 175 lb. (100 per cent), it is the reciprocal of 1.02, meaning that at 175 lb. the water consumption is $\frac{1}{1.02}$ or 0.98 + of that of 149 lb. For small changes, the difference is inappreciable, but for large, especially in vacuum, it is material, as already pointed out in curve sheet *D*. This method has been followed in all of the curves involved, for which the factors are given in the appended table

Finally, one example of the converse synthetic method, as applied to Mr. Emmet's water-lines IX and X leads to the following illogical results already noted above:

Test: 8070 kw, 197 lb., 29.55 in., 116 deg., 13. lb. per kw-hour. Corrected to 180 lb., 29.0 in., 125 deg. Difference, 17 lb. low, 0.055 in. high, 9 deg. low.

$$13.0 \times \overset{\text{(Pres)}}{\frac{1.0}{1 - 0.17}} \times \overset{\text{(Supht)}}{\frac{-1 - .10}{1 - 0.928}} = 13.12 \text{ lb. per kw-hour for 29.55 in.}$$

Water-rate from line IX, 13.07 lb. per kw-hour for 29.0 in.

Negative improvement due to 0.55 in. vacuum = 0.05 lb. per kw-hour.

Note here that the only conclusion permissible from line IX is that ½ in. *extra* vacuum above 29 in. actually *increases* the water-rate instead of decreasing it, as it should. This shows conclusively that in line IX, as derived from original curve *CC*, sufficient allowance has not been made for operating conditions. This same method of analysis applied to other points in line IX shows a *positive* improvement with vacuum, as it should, but at an entirely too low rate—less than 0.1 lb. per kw-hour, whereas the rate of improvement claimed is from 1 lb to 1¼ lb. per kw-hour.

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Spectrophotometer.

Mr. R. A. Houstoun in the *Philosophical Magazine* for February describes an attachment which may be fitted to any spectrometer or spectroscope converting it into a spectrophotometer, and which may be removed at once when the ordinary use of the instrument is desired. A method for applying the instrument to the measurement of absorption in the ultraviolet is also described.

Central-Station Heating Load.

Mr. Errett L. Callahan briefly presented the advantages of electric heating load, and suggested some methods of securing it, in a paper before the Northwestern Electrical Association convention at Milwaukee, Jan. 15. He knew of no easier way companies could secure the desired result of getting more revenue with existing investment than by pushing the use of heating devices. Many of these are simple enough to be used in nearly every room in the house by any one, and may be connected to the usual receptacles provided. The central station can supply 75 per cent of the load demand at the present time without giving a thought to providing increased transformer, meter or plant capacity. If a central station does not operate a day circuit, he suggests that they follow the example set by several managers last spring, and for a trial start a day circuit to operate all day on Tuesdays, ironing day. A small motor load would then spring up and the plant would soon be forced to operate every day in the week. As to soliciting business, he suggested that personal solicitation, although the most expensive advertising, is by far the most productive. He thought if the expenses for maintaining a new-business department were divided as follows, the highest efficiency would be obtained: One-half for salary of solicitors and demonstrators; one-fourth for maintenance of exhibit and demonstration room; one-fourth for direct by-mail and newspaper advertising. The trouble with some solicitors is that they do not follow up their first efforts to get business, and hence lose what little advantage they may have gained. He was sure that it was a mistake for public service corporations to neglect to at least provide an attractive display of current-consuming devices, even though it might not be elaborate. Ill-kept and dirty show windows, with the exhibit material always in the same location and consisting of the same devices that passers-by have seen for weeks and months, detracts rather than attracts. He then gave the results of cooking by electricity in his own home, in which for a period of a year the watt-hours per person per meal averaged 264.

In the discussion Mr. J. R. Cravath was called on to give his experience with electric cooking in the home. He said that an experience of several months had convinced him that Mr. Callahan's figures of 300 watt-hours per person per meal is a safe one to assume. He had recently made an experiment for the benefit of central station companies to determine the probable consumption of electrical energy per month, using only the flatiron and the chafing dish on the dining-room table, all other cooking being done by gas. He did this because he believed the chafing dish and flatiron to be the two devices which central stations could successfully push with hope of increasing revenue. A trial of a month and a half showed that the consumption of the chafing dish and flatiron ran about 20 kw-hours per month. A chafing dish was used a great deal in his family, especially for breakfast. He believed that next after the flatiron, the merit of which was already well established, the chafing dish was the thing which central stations could best afford to spend money in pushing, because when customers properly understood its use, they can apply it to so many dishes. He thought that central-station managers sometimes thought lightly of the possibilities of electric cooking because of the fact that at prevalent electric rates we cannot anywhere near compete with gas in point of economy. However, if we go a little further back, we must consider the fact that at prevalent gas rates we cannot anywhere compete with cheap soft coal. The fact of the matter is that there is room for all the easy methods of cooking, and we should not condemn any method simply because it cannot compete in point of economy alone. In a town where there is no gas, there is no competition from anything which is nearly as cheap and convenient as electricity. The only real competitors in such towns are hard coal or gasoline. Gasoline is dangerous and hard coal is a nuisance. An average family can do all the cooking electrically on a 5-cent per kw-hour rate cheaper than it can run a hard coal range.

Mr. Korst, of Janesville, Wis., said that his company had flatirons with about half of its residence customers. It got a very good revenue from that source, especially during the summer months. He finds, however, that when the bills creep up in the winter time people are apt to use their old irons heated on the coal ranges which are in use in the winter months anyway. In the summer, many customers' bills would fall below the $1 minimum. The flatiron will bring this a little above $1, which will give the company more revenue and the customer will feel better satisfied because he will feel that he is not required to pay for something he did not get. The flatiron also acts as a good solicitor to secure the wiring of new houses. Ladies become much attached to these flatirons and do a great deal of talking about them among their neighbors. This makes neighbors easier to approach on the subject of wiring their houses.

Mr. E. F. Strong, of Chaska, Minn., reported starting a day service last May. He had not received a single flatiron back from customers where placed on trial. Mr. R. N. Kimball, of Kenosha, had first attempted to introduce irons by having a demonstrator in the office, but did not get much business that way. The demonstrator was then sent out to solicit the different houses, and the results were very much better. Fully 75 per cent of the irons sent out on trial were kept and not returned to the office.

In answer to an inquiry by Mr. Kemper, Mr. Callahan said that his maximum demand for home cooking is about 2.8 kilowatts. Mr. Cravath said that his maximum demand was about 3 kilowatts. His figures included ironing, and Mr. Callahan's did not. Mr. Kemper said that if the maximum demand was 2.8 kilowatts and the total consumption for the year 803 kw-hours, as Mr. Callahan stated, that would give a use of less than 300 hours a year for the maximum demand, or less than one hour a day. He thought 5 cents a rather low rate to give to business used less than an hour a day. His company was putting out flatirons and they very seldom were on at the peak, but the cooking comes more or less on the peak.

Mr. Cravath explained that the amount that comes on the peak depends entirely on whether it is a large city where the principal meal is at night or whether it is in a small town where the principal meal is in the middle of the day. With the majority of central-stations the cooking peak would be in the middle of the day. The real question in which central-station men are interested is whether much extra money must be invested to carry this heating load over and above that which would have to be put in to carry the lighting load. In an analysis of this question which he had made, it was found that the maximum station demand per customer would be, with a large number of customers, not over 1.2 kilowatts for the cooking load. The fixed charges per customer should, therefore, be based on the 1.2-kw demand instead of 3-kw. Mr. John S. Allen said he had been successful in selling a lot of appliances in his town, but that he could not give any general rules for procedure except that in towns of 5000 inhabitants or less personal solicitation is the only successful way of getting these customers.

Mr. Callahan in closing the discussion said that his company (General Electric) had started out a corps of demonstrators with heating apparatus for central stations about two years ago. Conditions, however, were changing and some of these demonstrators had been trained as solicitors, a number having become very expert. He believed this the proper plan for putting out flatirons as well as other devices, although, of course, percolators and chafing dishes could not be left at houses on trial unless three or four were set aside for that purpose and new ones sent when the purchase was made. This year he was trying to secure young men from college during the summer months. Last year the basis upon which these solicitors were sent out to central stations was that the central station paid 25 cents an iron, plus the solicitor's railroad fare and board. Manufacturers guaranteed the salary. He agreed with Mr. Allen that in a small town the placing of irons was very different from in a large city. Personal solicitation pays best in small cities, while in large cities it does not work at all. The Commonwealth Edison Company, of Chicago, started out a lot of demonstrators and solicitors and spent a lot of money in this way. These would find no one at home or could not get into the house. The company then adopted the plan of sending out follow-up letters and sold 1500 irons in that way at small expense.

New Telephone Patents.

PARTY-LINE SYSTEM.

A party-line system of what might be called the sectional line variety has been patented by N. E. Nostrom, of Chicago. With this system each station has associated with it one section of the line, viz., that section between it and the station next nearer the central office. The first station carries the central-office apparatus at the inner end of its section. Means are provided at all stations whereby any may signal the operator with the line in its normal disconnected condition. The operator responding is enabled to talk to the caller over a grounded circuit and thereby learns his location and the desired station. These stations are then selected.

A make-and-break device with the number of impulses controlled is set in operation to select the desired station. The operator first inserts contact plugs into apertures bearing the station designation, and the arm is then started over the dial. As the arm moves, it causes current impulses over the line. These affect building-up magnets at the stations. The first impulse connects the second section to the first, the second, the third to second, and so on. Now, wherever a contact plug is passed, a secondary grounded circuit is closed simultaneously with the building-up circuit, with the result that the connecting magnet at the corresponding station cuts in the station telephone apparatus. Thus, when the line is built up, the stations corresponding to the contact plugs are connected to the line, the number so connected depending entirely upon the number of contact plugs in the dial. When conversation is complete, the operator can clear out the line by ringing over it. An alternating-current relay at each station responds and restores the station relays to normal.

LETTER TO THE EDITORS.

Hunting of Alternators.

To the Editors of Electrical World:

Sirs:—Referring to your criticism in the issue of the Electrical World of Feb. 15 of the writer's letter concerning your editorial on "Hunting of Alternators" in the issue of Jan. 25, it is quite evident that we are not discussing this subject from the same standpoint.

It seems to the writer that your remarks all refer to the period of oscillation of the engine as one unit and of the generator as another unit, whereas the writer refers to the unit oscillation of the generator and engine combined, which may be observed on the wattmeters of two direct-connected generators when operating in parallel. Successful operation depends directly upon its frequency and amplitude.

The writer believes that this unit oscillation was first observed by Mr. H. H. Barnes, Jr., about seven years ago (see "Notes on Fly-wheels," *Proceedings* American Institute of Electrical Engineers, Vol. 23, 1904), the writer being the first to record and measure the same, in the form of variation in angular velocity of the rim of a fly-wheel, and prove conclusively, he thinks, that a generator may increase the variation in angular velocity of a unit if not properly designed for connection to its prime mover. (See *Electrical World and Engineer*, Sept. 13, 1902, and April 18, 1903.)

The writer notes that you are unable to follow his outline of the difference between the period of oscillation of a synchronous motor and a synchronous generator, which is obvious from the above; but it will be observed that if two direct-connected units, which possess certain characteristics that will allow them to operate successfully in multiple, are paralleled either with or without load, the unit oscillation may be observed on the wattmeters to be, say, 40 oscillations per minute, with the unit running at 90 r.p.m. If the steam is shut off from one engine and it is allowed to operate as a synchronous motor, the number of oscillations will immediately change to 90 per min., corresponding to the speed of the generating unit. This unit oscillation exists whenever two or more alternators are operated in parallel, whether driven with an engine, water wheel, turbine or any other prime mover.

Newark, N. J. P. C. Oscanyan.

[The fact that the interchange current between two synchronous machines has a frequency of 40 cycles per minute when they are operated in parallel as generators, while the fluctuations in the current taken by one machine when driven as a motor from the other as a generator has a frequency of 90 cycles per minute (the speed being 90 r.p.m.), furnishes no proof of Mr. Oscanyan's original statement that the natural period of oscillation of a synchronous motor always corresponds to the revolutions of the prime mover. When the fluctuations in the current to a motor are observed to correspond to the fluctuations in the torque on the shaft of the prime mover, one has evidence merely that the relative speed of the motor is somewhat more regular than that of the generator, and no indication whatsoever is obtained of the natural period of oscillation of the motor; the latter period depends solely upon its electric circuits and the total mass of its rotating parts, which is also true of the generator unit.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Standard Performances of Electric Machinery.—R. Goldschmidt.—A paper illustrated by diagrams in which the author endeavors to provide in a convenient form data of what may be regarded as the standard performance of electric machinery. Continuous-current machines, rotary converters, alternators, induction motors and single-phase commutator motors are dealt with, and numerous curves of efficiencies and other properties of such machines over a large range of sizes are given. In all electric motors and dynamos the kilowatts reduced to 1,000 revolutions per minute equal a "constant" multiplied by ampere-wires multiplied by flux. With direct-current machines, polyphase alternators and polyphase induction motors, the "constant" averages 0.165×10^{-9}. With single-phase machines it averages 0.145×10^{-9}. By "ampere-wires" is understood the total number of conductors which are cut by a plane in the middle of the armature at right angles to the shaft, multiplied by the number of amperes per conductor. With induction motors the ampere-wires are those of the rotor only. The flux is the sum of all fluxes entering the armature from all poles together. It is naturally possible to obtain a certain value of power with an infinite number of combinations of ampere-wires and fluxes. In actual practice the value for the two will be of the same order if the current is expressed in kiloamperes as the unit, and the flux in megalines. Fig. 1 shows $F \times A W$ for different kilowatts at 1000 revolutions for machines having no commutating poles. In most cases these fluxes are identical with the most economical flux, especially for moderate speeds. With commutating poles the flux may be 25 per cent or even 35 per cent less. A great many other curves are given concerning losses, efficiency, etc. The transformer efficiency curves are reproduced in Fig. 2. An account of the discussion which followed the paper is also given.—Lond. *Elec. Eng'ing*, Jan. 30.

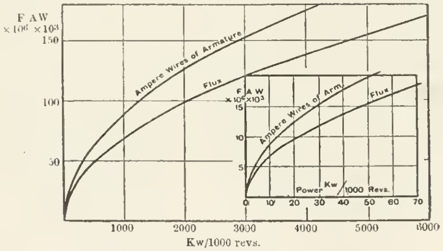


FIG. 1.—STANDARD PERFORMANCE OF ELECTRIC MACHINERY.

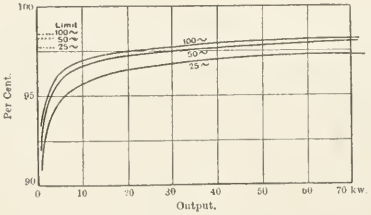


FIG. 2.—TRANSFORMER EFFICIENCY CURVES.

Air-Gap Correction Coefficient.—P. H. Powell.—A note on some experiments on the air-gap correction coefficient. In an earlier paper open slots were dealt with, whereas the present investigation was devoted to partially-closed slots. The experiments were conducted on the stream-line method, and a number of photographs of the stream-lines obtained with sectional models of teeth of various proportions were taken, from the measurements of which the corresponding values of the required coefficient were deduced from 28 different cases given, values varying from 1.062 to 1.320. The chief factors determining the coefficient are the length of air-gap and the width of slot opening. The rounding of the corners is unimportant, as is also the width of iron in the lip of the slot, provided this width is above a certain limit. The ratio of the width of slot to width of tooth is of some importance. From a few typical examples of the stream-line photographs it was found that only a very small proportion of the lines manage to keep in the slot; this is very marked in comparison with some of the diagrams in the previous paper for open slots. As might be expected, the disturbing effect of the presence of the teeth on the distribution along the pole-face and in the pole shoe becomes more and more marked as the gap decreases.—Lond. *Elec. Eng'ing*, Jan. 30. A longer abstract, with illustrations, in Lond. *Elec.*, Jan. 31.

New Winding for Polyphase Generators.—F. Punga.—The author describes a winding which is stated to be very suitable for polyphase generators and which is claimed to have considerable advantages in comparison with ordinary polyphase windings, especially for a large number of poles and a high voltage at the terminals, without any detrimental effect on the wave form of the electromotive force. The number of slots is approximately one per pole per phase, but the chief feature of the new winding consists in the fact that while the stator is uniformly slotted a few slots are not provided with windings. For instance, for an eight-pole, three-phase generator there are provided 27 slots, which are symmetrically distributed around the circumference, but slots numbered 4, 13 and 22 are unused, while windings are placed in the others in the normal way as

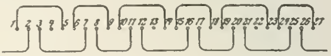


FIG. 3.—POLYPHASE GENERATOR WINDING.

indicated in Fig. 3. The author endeavors to show that such a winding is a perfect three-phase winding and that it has very considerable advantages over an ordinary three-phase winding. —*Elek. Zeit.*, Feb. 6.

Cascade Converter.—A. Bloch.—An illustrated article in which the author describes in a simple way without much mathematics the operation of the Bragstad-LaCour cascade converter, and discusses its advantages.—*Elek. u. Masch.*, Feb. 2.

Direct-Current Turbo-Dynamos.—R. Pohl.—The first part of a paper illustrated by diagrams on the development of direct-current turbo-dynamos. The paper appears to be essentially the same as the English paper recently published by the same author.—*Elek. Zeit.*, Feb. 6.

Direct-Current Turbo-Generators.—R. Pohl.—An account of the discussion of his recent paper before the Leeds section of the (British) Inst. Elec. Eng. Various means of minimizing commutation troubles were discussed. Agreement was expressed with the author as to the impracticability of homopolar designs.—Lond. *Elec. Eng'ing*, Jan. 30.

The Curve Form of the Currents in Three-phase Motors.—K. Simons and K. Vollmer.—With the aid of an oscillograph it is possible to investigate phenomena in electric machines which are hardly accessible to mathematical analysis. The authors have determined with the oscillograph the wave forms of the electromotive force and current in three-phase motors with open slots as well as with closed slots. The form of the curves is discussed and on the basis of these results the different methods for separately determining the various losses in three-phase motors are critically discussed.—*Elek. Zeit.*, Jan. 30.

Effect of Voltage Variation on Incandescent Lamps.—F. Hirschauer.—The relation between voltage and candle-power of an incandescent lamp may be given by the empirical formula $h = Ce^n$ where h is the candle-power in hefner candles, e the voltage, C a constant for a certain lamp and n a constant for lamps of the same type. Measurements have given the following values for C and n:

Carbon filament lamp	C = 3.7×10^{-12}	n = 6.3
Nernst lamp	7.1×10^{-20}	10.
Tantalum lamp	2.8×10^{-8}	4.3
Osmium lamp	7.5×10^{-6}	4.2
Osram lamp	3.4×10^{-7}	4.0
Just tungsten lamp	2.34×10^{-7}	4.0

This formula appears to give the relation between candle power and voltage quite exactly. While the constant C is of less interest, the figure n is of great importance for the behavior of the lamps at varying voltage. If the voltage varies between two limits which are $p/2$ per cent above and $p/2$ per cent below normal voltage respectively, then the absolute variation of the candle-power between its two extreme values is $1/100\, n\, p\, C\, e^{-n}$ or the candle-power variation in per cents is np. This is diagramatically shown in Fig. 4. The formula shows that the candle-power variation in per cent for a given lamp and for a given percentage p of voltage variation is constant and independent of the voltage at which the lamp is used; it depends only on the figure n. For a total voltage variation of 5 per cent the candle-power variation is 50 per cent for the Nernst lamp, 31.5 per cent for the carbon lamp, 21.5 per cent for the tantalum lamp, 21 per cent for the osmium lamp, 20 per cent for the osram lamp, 20 per cent for the tungsten lamp. The diagram enables one to find at once the voltage variation which may be permitted with an allowed candle-power variation. For instance, if a candle-power variation of 12 per cent is allowed, as is often the case with carbon-filament lamps, the points at which the dotted line in the diagram cuts the different lamp curves gives directly the permissible voltage variation. It is 1.2 per cent for the Nernst lamp, 1.9 per cent for the carbon lamp, 8.2 per cent for the tantalum lamp, 2.85 per cent for the osmium lamp, 3.0 per cent for the osram lamp and 3.0 per cent for the tungsten lamp. While on account of the smaller consumption of electric power per candle the electric conductors leading to metallic-filament lamps can be made thinner, the above figures show that their size may be still further reduced on account of the smaller sensitiveness of metallic-filament lamps toward voltage variation.—*Elek. Zeit.*, Jan. 30.

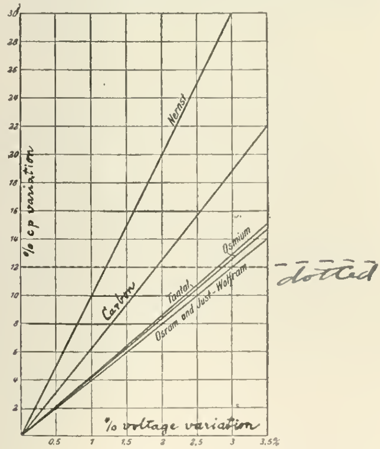


FIG. 4.—EFFECT OF VOLTAGE VARIATION ON INCANDESCENT LAMPS.

Power.

Gas Engines.—F. W. Burstall.—His third report to the Gas Engine Research Committee of the (Brit.) Inst. Mech. Eng. The author describes experiments on a gas engine using very high compressions. The thermal efficiency was found to increase up to 43 per cent as the compression rose, but subsequently to fall off. It was also found that for a given compression a certain mean pressure exists giving the highest efficiency.—Lond. *Elec.*, Jan. 31.

Cost of Power.—An account of a discussion at the Glasgow section of J. F. C. Snell's recent (Brit.) Inst. paper on the cost of electric energy for industrial purposes. Several of the speakers took exception to Snell's paper.—Lond. *Elec. Eng'ing* Jan. 30.

Traction.

Single-Phase Railways.—M. N. Blakemore.—A table giving statistics on single-phase electric railways installed in this country during the past three years. The total number of roads in operation and in course of construction is 28, of which 19 were built by the Westinghouse Company and 9 by the General Electric Company. The total mileage is 966.3, which is simply the length of road, and does not take into account the fact that some roads may have two, three or four tracks electrified. Of this total mileage, roads with 691.8 miles are in electric operation and roads with 274.5 miles under construction. The total number of motor-cars is 240. The total number of locomotives is 57, the total horse-power of motors employed is 137,400. The longest single-phase road is that of the Indianapolis & Cincinnati Traction Company (116 miles), but the Spokane & Inland Railway Company (115 miles) is a close second. The line voltage is 1200 on one road, 2200 on two roads, 3300 on 10 roads, 6600 on 11 roads and 11,000 on four roads. The frequency is 25 with two exceptions: The Visalia Electric Railway Company uses a frequency of 15 and the Shawinigan Railway Company 30 15. On 13 roads both single phase and direct-current systems are used. All of the roads are operated from a single catenary trolley with the exception of the New Haven road, which uses the double catenary line construction. The pantagraph trolley is almost exclusively used in this country, although a sliding bow trolley, somewhat similar to that so common abroad, has been tried, but is not so successful as the pantagraph type of trolley. This is due to the fact that the sliding bow trolley does not respond so readily to the varying heights of wire as does the pantagraph trolley. —*Elec. Jour.*, February.

Storage Battery Traction.—K. Fuerst.—The storage battery cars installed on the Palatian railways having given good results the Prussian railways also equipped some cars with storage batteries in the Mainz district. These cars have been in use for about a year, and have proven satisfactory. Their construction and the charging plant at the station in Mainz are fully described, and the results obtained with this method of traction are given. It is found that on the basis of a yearly run of 34,000 kilometers per motor-car the cost per car-kilometer is approximately 9.73 cents.—*Elec. Zeit.*, Jan. 30, Feb. 6.

Conduit System.—F. R. Roose.—A paper read before the (British) Junior Institution of Engineers on the conduit system employed on the London County Council tramways, discussing the difference between early and present construction. —Lond. *Elec. Rev.*, Feb. 7.

Overhead Conductors.—An illustrated description of a new method of P. J. Pringle of supporting overhead conductors which is in use on recent extensions of the Derby municipal tramways. The writer first refers to former failures to develop an ear which does not interrupt the smooth passage of the trolley wheel, and states that it is possible to construct a soldered ear which will be satisfactory and that by soldering only the semi-circumference a non-fouling ear can be attached with an ample margin of tenacity to round wire of the smallest section in use. The method of suspension is then discussed, and it is claimed that in former methods a considerable sag has been created between supports and that the suspension has always been relatively inflexible. "Hitherto the almost rigid bracket-arm, or bow-string, or tight span wire has confined the trolley wire at the point of suspension both horizontally and vertically. The wire has been unable to cushion the blow of the trolley-wheel by rising to its pressure, and the wheel has struck it hard at the trailing end of the ear. It has been unable to transmit past its supports more than a small portion of the vibration set up by the trolley pole and wheel. Take now, a trolley wire anchored on both sides of a bracket-arm, and unscrew the hanger from the central ear. The wire floats, and is no longer cramped for movement in any direction. The supporting forces are now approximately tangential to the wire, and it is free. That, in effect, is Pringle's tangential suspension."—Lond. *Elec. Rev.*, Jan. 24.

Electric Train Performance.—W. S. Valentine.—An article pointing out the advantages of graphical methods in solving problems of electric train performance. The author describes a method in which by the use of a celluloid templet the amount of work entailed in the usual methods practiced by engineers is greatly reduced.—*Elec. Jour.*, February.

Gear Ratios.—Translations of two German articles, one by P. Gesing on the choice of railway motors as influenced by gear ratio, and the other by W. Bethge on the effect of gear ratio on energy consumption.—Lond. *Elec.*, Jan. 31.

Railway Location.—H. E. Wagner.—The author describes methods of locating a railway and the design of curve-turnouts, frogs and cross-overs.—*Elec. Jour.*, February.

Electric Traction on Railways.—P. Dawson.—A continuation of his very long illustrated serial. In the present installment the author passes on to the consideration of direct-current, three-phase and single-phase motors for railways and their characteristics.—Lond. *Elec.*, Jan. 31.

Electrification of Railways.—G. Kapp.—An abstract of his second lecture before the Royal Institution. He considers briefly the chief characteristics of the forms of the direct-current, three-phase and single-phase systems now in use.—Lond. *Elec. Eng'ing*, Jan. 30; a longer abstract, with illustrations, in Lond. *Elec.*, Jan. 31.

Electrophysics and Magnetism.

Influence of Temperature on Minimum Potential of Spark Discharges.—P. Pringheim.—An account of an experimental investigation. The minimum potential of the negative point discharge when not illuminated is not an absolutely constant quantity, especially when the point is quite new. But after some time it assumes a value which is not only maintained for a very long time, but also, when changed by any influence such as heating or radium rays, always returns on restoring the original conditions. This permanent value applies especially to pressures below 500 mm. When the pressure is constant, and the point is heated above a red heat, the negative minimum potential is distinctly lowered down to a point which is not affected by further heating. This value is also restored on restoring its conditions. Some observations were also made concerning the manner in which the negative point discharge disappears. The minimum potential of the positive point discharge is, as a rule, very constant. The effect of heating under constant pressure is insignificant and there is no marked diminution above heating at a red heat.—Lond. *Elec.*, Jan. 31.

Small Particles on a Nernst Filament.—C. E. Mendenhall and L. R. Ingersoll.—In the course of a determination of high-temperament melting points the authors have noted several curious phenomena attending the heating of minute particles of various metals placed on the surface of a Nernst filament. The first phenomena are associated with an undercooling of molten globules. If a small particle of, say, platinum be placed on the glower, melted into a globule about 1/10 mm or 1/20 mm in diameter, and then allowed to cool either slowly or rapidly, it will not solidify at the melting temperature, but will remain very evidently fluid until a temperature is reached from 50 deg. to 300 deg. lower than the melting-point, when solidification will suddenly occur, accompanied by a quick "flash" or brightening of the drop. Upon reheating there is no flash and the drop melts at its proper melting temperature. The same general effect is observed with gold, palladium, platinum, silicon, rhodium and iridium. The authors conclude that the phenomena is simple one of exaggerated undercooling made possible by the very small mass of metal which assumes an approximately spherical shape. The flashing is not a direct luminescent phenomenon, but is due to the sudden increase in temperature resulting from the liberation of the latent heat of fusion. Quite distinct from these cases of undercooling are a number of cases of motion of various metals on the surface of the glower parallel to the current flow. The most striking of these is observed when a small particle of cobalt, say, is placed on the surface of a glower carrying a direct current. When the temperature is raised to about 1200 deg. C. it will commence a slow and regular end-over-end rolling motion along the glower, which changes in direction when the current is reversed, and which is not affected by holding the glower vertical, or, indeed by turning it completely upside down. While this phenomena has not been completely explained it appears that the forces involved are localized at the point of contact of the particle and glower.—*Phil. Mag.*, February.

Positive Electrons in the Sodium Atom.—R. W. Wood.—An article giving the results of experiments which show that some of the absorption lines rotate the plane of polarization in the positive direction while the others rotate it negatively. If the positive rotation at the *D* lines of sodium can be used as an argument that they are due to negatively charged electrons, it appears to the author that the two types of rotation in the channeled spectrum is an evidence that there are both positive and negative electrons in the atom. The experimental results, however, prove merely that some of the absorption lines give a rotation opposite to that given by the *D* lines.—*Phil. Mag.*, February.

Roentgen Rays.—C. G. Barkla.—A note on Roentgen rays and scattered Roentgen rays. The author's results afford strong confirmation of the electromagnetic pulse theory of Roentgen rays and of the theories of scattering and of polarization based on this. The scattering of "soft" Roentgen rays by substances of low atomic weight is almost perfect, while the radiation is very far from a purely scattered radiation when more penetrating rays are used. There is a small proportion of scattered rays in other secondary radiations.—*Phil. Mag.*, February.

Determining Stream Lines and Equipotentials.—L. F. Richardson.—Maxwell has already referred to tentative methods of altering known solutions of the well-known Laplacian differential equation by drawing diagrams on paper and selecting the least improbable. The present author points out that this free-hand graphic way of determining stream lines and equipotentials can do far more than merely alter known results, and that it may be so far from tentative as to yield a result within 10 per cent of the correct value.—*Phil. Mag.*, February.

Magnetic Rotatory Dispersion.—R. W. Wood.—A paper on anomalous magnetic rotatory dispersion of neodymium.—*Phil. Mag.*, February.

Electrochemistry and Batteries.

Calcium Cyanamide.—J. B. C. Kershaw.—An illustrated article giving a review of the electric furnace industry of calcium cyanamide.—Lond. *Elec.*, Jan. 24.

Units, Measurements and Instruments.

Regulating Resistor.—C. Fredenhagen.—An illustrated description of a portable regulating resistor for laboratory use. It consists of 21 single ristors in series having a total resistance of 85.25 ohms, these being divided into five groups. By means of six levers sliding over contacts it is possible to regulate the resistance from 85.25 ohms down to 0.01 ohm in stages of 0.01 ohm.—Lond. *Elec.*, Jan. 24.

Self-Inductance.—E. B. Rosa.—An article on the calculation of the self-inductance of a coil of any length wound with any number of layers of wire. The method consists of several successive steps. First the self-inductance of the coil is calculated on the supposition that the depth of the winding is reduced to zero. Then a correction is applied to take account of the actual depth of the winding and finally another correction is made which takes into consideration the shape of the section of the wire, the thickness of the insulation, the number of turns of wire in the coil and the shape of the section of the coil.—*Bull. Bureau of Standards*, Jan. (Vol. IV, No. 3).

Telegraphy, Telephony and Signals.

"Loaded" Telephone Cables in Germany.—The following table gives a review of the cable lines equipped with Pupin inductance coils which have been installed by the Siemens-Halske Company of Berlin:

Cable.	Year of installation.	Length of cable in kilometers.	Copper diameter in mm.	Number of double wires.	Distance between successive inductance coils in km.
Berlin-Potsdam	1902	32.5	1.0	28	1.3
Merida-Progreso (Mexico)	1904	40.	0.8	14	1.4
Düsseldorf-Elberfeld	1904	32.	1.5 and 2.0	28 56	1.3
Schoeneberg-Ragow	1905	28.	0.7	3.5 7	1.4
Berlin-Spandau	1906	18.	0.8	56 112	1.75
Berlin-Potsdam	1906	40.	0.9	100	1.4
Friedrichshafen - Romeishorn (submarine cable in Bodensee)	1906	12.			
Berlin-Wannsee	1907	25.	0.8	250	1.5
Berlin-Köpenick	in course of erection	17.	0.8	56	1.6
Duisburg-Mülheim-Oberhausen	in course of erection	27.	1.5 2.0	56	1.5

The above cables are stated to have been in uninterrupted service since their installation. With the exception of the Mexican cable, all of them are in Germany. The sumarine Bodensee cable and the difficulties in laying it have been noticed repeatedly in the Digest. The aggregate length of the above 10 cables is 271.5 kilometers, or 168.6 miles. For lexicographers it may be of interest to note that at one place the "loading" of a cable with Pupin inductance coils is called "pupinizing" the cable.—Circular 11 of Siemens & Halske Company of Nov. 21, 1907

Pupin System of Telephone Lines.—M. Klein.—A communication in which the writer points out that the damping coefficient alone does not determine the quality of telephonic transmission. It is not true that the increase of self-induction always means an improvement of telephonic transmission. The reason is that while the increase of self-induction decreases the damping coefficient it also decreases the current at the transmitting end. The author claims that in the case of the submarine Bodensee cable the transmission can hardly have been improved by the use of Pupin inductance coils if the theory is correct. The current at the receiving end of the Pupin cable is a function of the frequency, although the damping coefficient is independent of the frequency. The distortion of speech is changed, but is reduced quantitatively only to a small extent. A formula is given to show that for any cable which is to be equipped with Pupin coils, there is a certain limit of total cable length below which the use of coils is not useful but detrimental. In the case of the Bodensee cable this minimum length is from 12 to 15 kilometers, while in reality the cable is 12 kilometers long. The damping coefficient determines to what distance speech can be transmitted, but does not determine the quality of telephonic transmission over distances which are much shorter than the maximum possible distance. The writer believes that in the formula $al < 2$ the figure 2 is somewhat too low for determining the distance l of transmission (a being the damping coefficient). The German postal department (which controls the telephone lines) uses cables with air-insulated double conductors of 0.8 mm wires. With such cables it is possible to speak over a distance of 50 kilometers, and over a distance of 40 kilometers the transmission is still good. This gives $a = 0.09$ and $al < 3.6$.—*Elek. Zeit.*, Feb. 6.

Continuous Oscillations.—O. M. Corbino.—A description of a method of producing continuous undamped electric oscillations, different from that of Poulson's arc method. It consists in coupling a series dynamo with a shunt motor, and does not require a condenser. The principle underlying the system is put as follows: "A shunt motor, having field magnets and armatures of laminated iron, when subjected to a sinusoidal e.m.f. at the terminals, behave as an inductive resistance, whose inductance may have a negative value. Hence such an apparatus is equivalent to an inductance connected in series with a capacity. For a certain value of the speed, the inductance and the capacity are independent of the frequency." At this speed, therefore, the impressed e.m.f. need no longer be sinusoidal. A dynamo is equivalent to an inductance and a negative resistance as far as the period of the entire system is concerned. The author gives formulas expressing the inductance, capacity and resistance of the whole combination and shows that the damping is, under suitable conditions, automatically compensated.—*L'Elettricista*, December, abstrated in Lond. *Elec. Eng'ing*, Jan. 30.

BOOK REVIEW.

Projektierung von Elektrizitätswerken. By Fritz Hoppe. Hannover: Max Jaenecke. 204 pages; 43 illustrations. Price, 3.8 marks.

It is not to be expected that an analysis of the cost of installations in one country can be applied without modification to installations in another country where conditions of labor, cost of material, etc., are greatly different. However, the fundamental laws of Nature are equally applicable in all countries. The information which the present volume gives relative to the performance of various types of prime movers, generating units and distributing circuits would prove of value to the American engineer, while the tabulations of the cost of operation and the income to be expected would be of no particular value to him except for purpose of comparing them with similar tabulations for this country. For the German engineer, the book contains a large amount of data which he can use to considerable advantage.

Luminous-Arc Lamp for Constant-Potential Circuits.

The luminous metallic arc lamp is now recognized as a highly efficient and excellent all-around street illuminant for commercial use. This system of street lighting, having passed the experimental stage, is now in quite general use. For low voltage, direct-current, constant-potential circuits, however, there has been but little use made of the luminous-arc lamp

The General Electric Company recently placed on the market a luminous-arc lamp for operation on direct-current circuits at an e. m. f. of from 100 to 125 volts. The general form of this lamp can be seen by referring to Fig. 1. The casing is of solid copper with a black oxidized finish, and it is of sufficient thickness to form a durable housing for the lamp mechanism, as well as a substantial support for the outer globe.

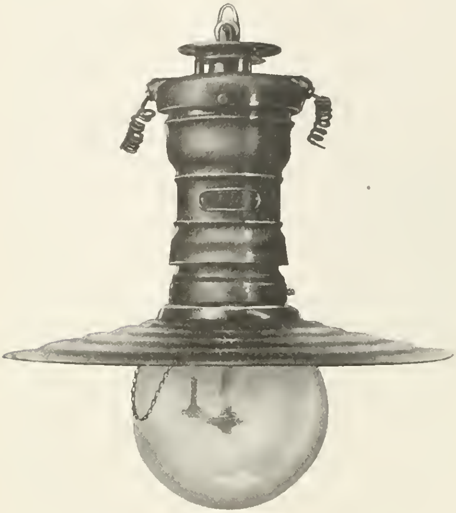


FIG. 1.—LUMINOUS ARC LAMP

Fig. 2 is an interior view, showing the mechanical construction of the lamp. The main frame consists of a 1.5-in. iron pipe connecting the top and bottom castings. This construction is rigid and at the same time it provides a suitable center draught or chimney for disposal of the arc fumes. At the top the chimney is protected from rain and snow in such a manner as not to interfere in any way with the natural and uniform draught required for the proper action of the arc.

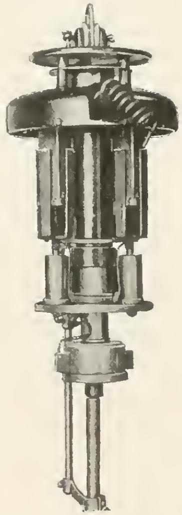


FIG. 2. LAMP MECHANISM.

The upper or positive electrode consists of a drop forging of copper. With a large volume of copper and a large radiating surface, it is possible to keep this electrode at a low temperature. This condition, together with the peculiar characteristics of the luminous arc, prevents a rapid wearing away of the copper. The copper electrode in a 4-amp. lamp will require renewal after about 1800 hours of operation; or with an average burning of 5 hours per day it will last about one year.

The lower electrode, which is responsible for the flaming characteristic of this lamp, is an iron tube about .75 in. in diameter filled with a magnetite composition. The life of the lower electrode is about 150 hours.

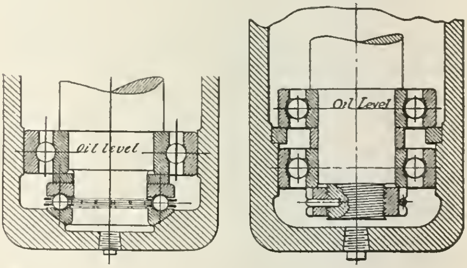
There are two single magnets, with two plungers mechanically connected. The action is positive and at the same time remarkably sensitive, responding quickly to any variations of the e. m. f. or the current, and thus a close regulation of the arc is maintained.

Photometric measurements show that a 4 amp. magnetite-arc lamp gives more light than a 5-amp. direct-current enclosed arc, or a 7.5-amp. alternating-current enclosed arc lamp. The characteristic light distribution of the luminous arc, with its maximum intensity near the horizontal, is well known. This natural distribution can be changed to meet other street lighting requirements by the use of correctly designed concentric wave reflectors.

In general, the lamp needs little attention; less, in fact, than the enclosed lamp, as there are no enclosing globes and gas caps to require careful handling, cleaning and renewing. The luminous-arc lamp is specially recommended for the lighting of foundries, machine shops, train sheds, freight houses, drill halls and riding academies.

Ball Bearings for Vertical Shaft Lower End Journals.

The Hess-Bright Manufacturing Company, of Philadelphia, Pa., has among the many ball bearings manufactured by it some for vertical-shaft lower-end journals which take the radial and thrust load on the collar and radial bearings. One race has a close sliding fit in its seat and the other has a light driving fit. As a rule it is more convenient to have the outer race free. The speeds that are practicable with collar bearings rarely exceed 1500 r.p.m. and the carrying capacities for thrust of the collar ball bearings increase with decrease of speed. The arrangement shown in Fig. 1 takes the radial and thrust load on separate bearings. The washer between the two bearings prevents contact between the rotating plate of the collar bearing and the stationary outer race of the radial bearing, but when the collar bearing is not large enough to cause such contact, the washer may be omitted. The action of the spherical seat in compensating for deflections of the shaft and housing and inaccuracies of alignment is best when the center of the spherical seat lies as nearly as possible under the center of the radial bearing. The arrangement shown in Fig. 2 takes radial and thrust loads on separate radial bearings. In this arrangement the upper radial bearing is free circumferentially and so receives only thrust. The lower radial bearing as mounted is not subject to thrust, so that its full capacity may be applied to carrying radial load.

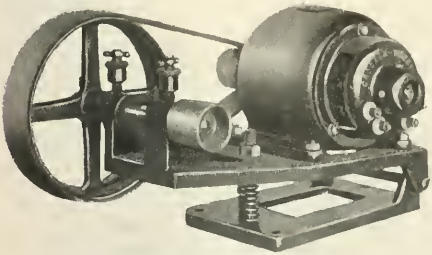


FIGS. 1 AND 2.—BALL BEARINGS FOR RADIAL AND THRUST LOADS

Countershaft Belt-Tightener for Electric Motor.

A simple device for tightening the driving belt of an electric motor, which has been developed by the Crocker-Wheeler Company, is shown in the accompanying illustration. It consists of a countershaft and a simple and effectual belt tightener. Though designed for linotype machines, it can be used to advantage with any machinery requiring low-speed drive.

The motor and countershaft are mounted on a cast-iron base, which is pivoted at one end to a sub-base, the tension in the belt being produced by means of an adjustable nut at the other end. A spring is provided to support the movable base in case the belt breaks. The belt between the motor and the countershaft is tightened in the usual way, by shifting the motor on the movable base with the aid of an adjusting screw.


MOTOR WITH SPRING BASE COUNTERSHAFT.

It will be readily seen that the device is much more effective than a simple idler. Not only does it maintain the tension on the belt, but by the use of the countershaft a great difference between sizes of driving and driven pulleys is avoided, and the belt, therefore, makes contact with a greater arc of the driving pulley, with a consequent absence of slip.

Electrically-Heated Glue Pots.

The Westinghouse Electric & Manufacturing Company has brought out a line of improved, electrically-heated glue pots that illustrate the application of electricity in the simplest and most convenient form. The pots are made in two-quart and four-quart sizes, in both portable and bench types.

The pots themselves are made of seamless drawn copper with brass bail and wiper rod. The water bath is made of seamless copper, and the heating element, which is wrapped around the lower portion, is enclosed in a water-tight tin envelope. The water bath is provided with a patent circulating device, which gives it the maximum heating efficiency. This device consists of a hollow ring, the lower end of which is closed by a diaphragm having a central opening. This confines the heating action to the thin film of water outside of the device, and sets up a rapid circulation in the water, which brings the glue up to the working temperature in a short time.

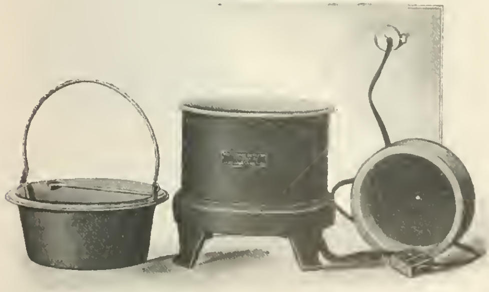


FIG. 1.—PARTS OF GLUE POT.

To promote economical heating, the pots are provided with heat-regulating switches, by means of which the glue can rapidly be brought to the desired temperature, and then maintained at that temperature at a lower value of current.

Fig. 1 shows the parts of the four-quart portable pot, including the water-circulating device. Fig. 2 illustrates the bench pot with the cover in place, and the unobstructed working surface on the bench. The glue pot and water-bath are hung underneath the table when not required, and when the pot is in use the cover may be likewise hung on the hook.

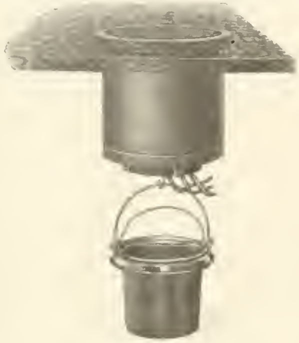
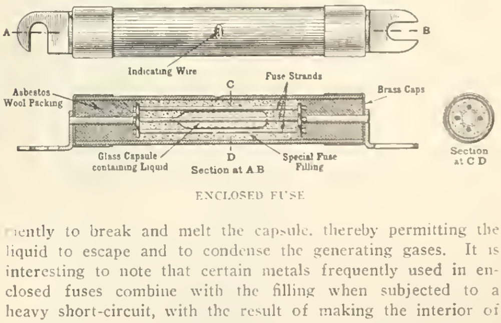


FIG. 2.—BENCH GLUE POT.

Electrically-heated, dry glue pots are made for those industries where the water-bath glue pot is undesirable.

New Type of Enclosed Fuse.

As is well known, it is not an uncommon occurrence for an ordinary type of enclosed fuse to explode violently when subjected to a heavy short-circuit. This is due to the abnormally high temperature and high pressure produced within the fiber tube containing the filling by the sudden volatilization of the fuse metal, and if cooling is not rapidly effected, the enclosing tube cannot resist the heat and strain. Mr. E. B. Schattner, of the Electrical Apparatus Company, Caxton Building, London, S. W., England, has brought out a type of fuse in which the cooling of the arc is said to be effectively carried out under short-circuit conditions. The fuse resembles the ordinary cartridge fuse and is known as the "Koolark." Its make-up is clearly shown in the accompanying engraving. In addition to the usual filling surrounding the fusible strip, there is a glass capsule containing a special liquid. Under ordinary conditions the arc is damped by the filling in the usual way, but under a heavy short-circuit the pressure and temperature increase sufficiently to break and melt the capsule, thereby permitting the liquid to escape and to condense the generating gases. It is interesting to note that certain metals frequently used in enclosed fuses combine with the filling when subjected to a heavy short-circuit, with the result of making the interior of the fuse a solid conductor of a type similar to that used in producing the light in the Nernst lamp, so that a short-circuit



ENCLOSED FUSE

may oftentimes be re established. With the type of fuse illustrated, this silicating of the filling is said to be impossible under the most severe short-circuit. Tests made at the Deptford generating station of the London Electric Supply Corporation are said to have given excellent results. A series of short-circuits was made across a 500-kw, 550-volt generating set with various sizes of special "Koolark" fuses, the only other apparatus in circuit being a switch and a circuit-breaker set at 3500 amperes. The fuse in each case is said to have acted instantaneously without an appreciable noise and without tripping the circuit-breaker. The results were attributed to the cooling fluid set free at the time of the short-circuit, together with the special filling used. The fuse is manufactured in standard sizes for standard voltages and for any required current-carrying capacity.

Polarity Flush Receptacles and Wall Plugs.

A new line of 20-ampere flush receptacles and wall plugs is being placed on the market by Harvey Hubbell, Inc., Bridgeport, Conn., illustrations of which appear herewith. The devices embody the essential features of the 3-ampere plugs made by the same company, including the convenient interchangeable cap, but the porcelain parts and contacts are larger and stronger, in order to insure perfect safety for use on 250-volt circuits. While designed primarily for use with motors and the larger types of heating and cooking apparatus, their utility extends to any application where their features are desirable. The contact-post being set at right angles, they can enter a receptacle but one way, and reversal of polarity is thus rendered impossible. This feature is of especial value in connection with use on electrical indicators and experimental apparatus. The flush receptacles fit standard switch pockets. To prevent marring, the plate may be readily removed when a wall is being redecorated. The concealed cleat and molding wall plugs are especially convenient for use in connection with electrically driven machinery and tools. A snug-fitting metal casing covers the interchangeable cap, thus protecting the inner parts and making the whole practically indestructible.

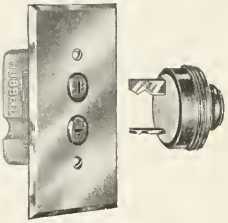


FIG. 1.—FLUSH RECEPTACLE.

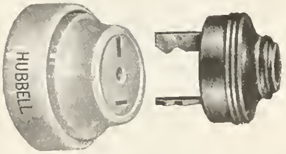


FIG. 2.—WALL PLUG.

Remarkable Performance of an Induction Motor.

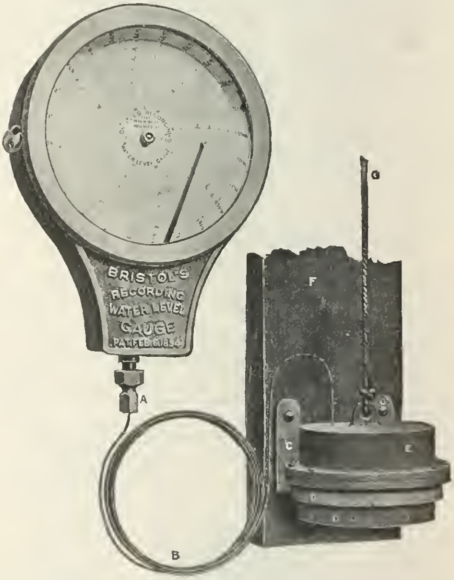
The general sturdiness and endurance of the induction motor under adverse conditions is proverbial, and the following incident illustrates the reason for their universal popularity.

A 5-hp, 440-volt, squirrel-cage General Electric induction motor was belt-connected to a centrifugal pump in the quarry of the G. H. Perry Company, Sioux Falls, S. D., the capacity of the pump being 158 gal. per minute when lifting about 45 ft. The motor was operated continuously during the rainy season, and was often allowed to run without attention during the night.

One Sunday morning an operator noticed that the quarry pit was full of water, the motor being partly submerged. The necessity of clearing the pit of water being evident, the current was turned on. To the surprise of all, the motor came up to speed and carried the load until the pit was clear, apparently none the worse for its prolonged bath. On examining the motor the next day, that portion of the paper pulley which had been under water was found to be softened and considerably warped out of shape. The motor gave excellent service until two months later, at which time it was completely destroyed in a fire which consumed several of the company's buildings. The simplicity, and consequent ruggedness of the induction motor was aptly expressed by the practical observer who said that it was a piece of shafting revolving between two hangers.

Recording Water-Level Gage.

In the gage illustrated herewith use is made of air pressure for transmitting the motion to the recording device, and it is claimed that thereby many mechanical difficulties found in practice have been overcome. There is located at the lowest point to which the water will fall a double bell casting between the halves of which there is placed a diaphragm of thin sheet rubber so that the water pressure below compresses the air above; the pressure of the air is transmitted to the recording device through a flexible copper tube.



RECORDING WATER LEVEL GAGE

It is seen, therefore, that all moving parts have been eliminated except the rubber diaphragm, which is permanently located below the freezing point in the water. The recording portion may be located at any convenient distance from the water and can be equipped with either daily or weekly charts of almost any range.

These recorders have also been developed for registering the depth of oil in fuel-oil or storage tanks. When adapted as an oil-level gage a different form of casting is employed. In this the dividing rubber diaphragm is not used, thus eliminating the only element that would depreciate. The gages are made by the Bristol Company, 114 Liberty Street, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE. Unsettled weather conditions during the last week were reflected by the general trade. Blocked railway traffic reduced the movement of grain to market to the smallest total in 22 months, and industrial operations were temporarily hindered. But the fall of rain and snow furnished a good covering for winter wheat and had an excellent effect upon the coal, rubber and similar lines of trade. The jobbing trade continues good, but country merchants are not buying more goods than they are sure they can sell. In the industrial world the shut-downs just about balance resumptions. Chicago reports that saving deposits have decreased about 8 per cent since last autumn, and talk of railroad wage reductions is general. The bank clearings show a heavy decrease from a year ago, but money is easy and collections are somewhat improved. The January exports, increased by heavy exports of wheat, wheat flour, cotton and oils, totaled but a fraction of 1 per cent behind the record month of last December. Imports were the smallest recorded in two and a half years, being 32 per cent smaller than the imports of January, 1907. The excess of exports over imports for January was the largest ever reported for any month. The total exports for the three months ending with January were valued at $617,806,048, a gain of 10 per cent over the same period during the preceding year, and compares with a total of imports of $288,889,604, an excess of exports of $328,916,444. A year ago the excess of exports over imports was but $81,659,569. Pig iron markets continue weak, and it is stated that independent interests in Pittsburg have reduced prices on steel billets from $28 to $26.75. In steel rails the demand is still light. The demand for structural material is fair. Wire and wire products continue in good demand. The leading interest, it is said, is operating to about 50 per cent of its capacity. Business continues fair in the electrical field. Large contracts are rare, but an increasing volume of inquiries promises increased activity in the near future. *Bradstreet's* reports 326 failures for the week ending Feb. 20, against 326 for the preceding week and against 177 for the corresponding week in 1907.

REORGANIZATION OF DEARBORN DRUG & CHEMICAL WORKS.—Robt. F. Carr and several of his associates in the Dearborn Drug & Chemical Works have purchased the holdings of the estate of the late Wm. H. Edgar, who died two years ago, and at a recent meeting of the stockholders, followed by a meeting of the directors of the company, the following officers were elected: Robt. F. Carr, president and general manager; Wm. B. McVicker, vice-president and eastern manager; Grant W. Spear and George R. Carr, vice-presidents; J. D. Purcell, assistant general manager; W. A. Converse, assistant secretary and chemical director; R. R. Browning, assistant treasurer; A. E. Carpenter, superintendent. Mr. C. M. Eddy's holdings were also taken over, he desiring to devote all of his time to his personal business interests. Robt. F. Carr became connected with the Dearborn Company following his graduation, in chemistry, from the University of Illinois, in 1893; for the past ten years he has been vice-president and general manager of the company. Mr. Wm. B. McVicker has been connected with the company for 13 years, having during most of that time been at the head of the Eastern Department; and for several years he has been second vice-president and eastern manager, at the general eastern offices in New York. Mr. G. W. Spear, who is a graduate in mechanical engineering, University of Illinois, entered the business in 1895. He has been one of the vice-presidents of the company for five years, in charge of the branch offices in the central district of the United States, having his headquarters in Chicago. Mr. George R. Carr has been connected with the company since he graduated from the University of Illinois, in chemistry, in 1901. He has occupied the position of assistant general manager of the company for the past four years, devoting his time largely to the railroad department of the business. Mr. W. A. Converse, who was elected to the position of assistant secretary, in addition to the office of chemical director, which he has previously held, has been in charge of the laboratories for the past 12 years. Mr. Converse has been secretary of the Chicago Section of the American Chemical Society for a long period. Mr. J. D. Purcell, the new assistant general manager, has represented the company in the railroad department for five years. R. R. Browning, assistant treasurer, has held a similar position for some years, having been with the company since 1896. Mr. A. E. Carpenter, superintendent, has had charge of the manufacturing department for many years, and is the oldest employee in the service of the Dearborn Company.

HIGHER PRICES FOR COPPER.—Senator William A. Clark sees no likelihood of any further marked decline in the price of copper, but believes that the price of the metal will be advanced before summer to a figure considerably above present prices. Speaking for him, a representative said: "The only conditions that would bring about a decline in the price of copper metal would be an increase in production with a simultaneous decrease in the demand. But while the mines are still producing at about the rate of production established last October, the consumption has increased, and the inquiries coming in seem to indicate a good business within the next few months. The copper market, like all markets, is obedient to the economic laws of demand and supply. When the enormous demand of 1906-1907 gave an opportunity to raise the price of the metal, every one got greedy and wanted to push prices higher and still higher. As a result, the metal reached a point where manufacturers would no longer buy copper in large quantities, and, naturally, the prices had to tumble. But the curtailment of the last few months has put the copper market in an excellent position. The unwieldly surpluses have been reduced by exports, to other shipments abroad, and the increase in orders and inquiries indicate a good spring business; that is, if the administration will leave the railroads alone and give them a chance to go ahead with their extensions and improvements."

AGENTS FOR UTAH COPPER COMPANY.—The Utah Copper Company has completed arrangements with the United Metals Selling Company whereby the latter will act as selling agent for the entire output of the copper company. Previously the Metal Selling Company had been acting as agents for the Utah Copper Company, but there was no contract between the two. The Utah Company, which has only recently entered the field as a large producer, claims that it will become one of the great copper factors of the globe. Its production in 1904 and 1905 was respectively 3,898,490 and 5,473,469 fine copper, and a rate of production is claimed of more than 50,000,000 lb. per annum before the close of the present year. Wall Street looks upon the transaction as additional evidence of the closer relations which now exist between the Amalgamated Copper interests and the Guggenheims. It is said that the contract will run for three years.

NAVY ELECTRICAL SUPPLY PROPOSALS.—The U. S. Navy Department asks proposals for furnishing a schedule of electrical supplies, the bids for which will be opened March 10. The schedule includes about 1300 electric bells and 15,000 feet of bell wire, large quantities of cable for interior communication, twin and single conductors and steel enameled conduits. Two hundred and thirty seven thousand feet of the latter are required, and several hundred thousand feet of cable and conductors.

RIO DE JANEIRO ELECTRICAL SUPPLY HOUSE.—Mr. John B. Orr has opened in Rio de Janeiro a new four-story electrical supply house for the importation and exploitation of North American manufactures, and desires to receive from manufacturers of material, tools or apparatus used in or applying to any branch of the trade their catalogues with prices and export discounts. Mr. Orr has been engaged for 10 years in importing American goods into Brazil.

THE CHICAGO CITY RAILWAY has placed an order for 8000 tons of steel rails with the Lorain Steel Company, which involves an outlay of about $300,000. This duplicates a similar order of last year. Purchases of ties, paving materials, etc., will bring the total cost of road-bed improvements to $500,000.

THE COPPER MARKET.—The sudden decline in copper metal, followed by a recovery equally as sudden, was succeeded by another dip during the last week. The movements of the market have been not inaptly compared by a writer on copper to the fluctuations of an alternating current. Heavy selling by London longs, brought the price of lake copper down to 12¼ cents, which was ⅛ of a cent above the 12⅛ of last October, the lowest point touched by the metal since 1903. The announcement that the United Metals Selling Company had disposed of between 35,000,000 and 40,000,000 lb. at 13 cents or better, was received with incredulity. Even the low price induced but little buying, although it was conceded that the metal was cheap at that price. The absence of a speculative element, the poor outlook for money and the knowledge of available heavy supplies, kept the large consumers from breaking away from their policy of buying from hand to mouth; but under more favorable financial conditions it is more than likely that large contracts would have been placed. The statement of the available foreign visible supply, which has increased 1575 tons in the last two weeks, was a further deterrent to active buying here. The visible supply as compared with the supply at the same time in previous years is as follows:

Feb. 15, 1908	22,175 tons.
Feb. 1, 1907	13,991 tons.
Feb. 1, 1906	10,951 tons.
Feb. 1, 1905	15,733 tons.
Feb. 1, 1904	14,233 tons.

Covering by bear interest abroad together with the support given by the home market steadied the prices and brought about a slight rise toward the end of the week, but little confidence is felt in the situation, as it is believed that the London interests are still heavily long and are waiting only for a better market to throw over the larger part of their holdings. The total of the exports from Atlantic ports since the first of February is 17,245 tons, which is about 3000 tons below the exports for January for the same period. The present home consumption is estimated at about 10,000 tons a month, while the production and imports amount at least to 35,000 tons monthly. The week closed with the market steady around 13 cents, but with little prospect of any large contracts. Prices on the Metal Exchange on Monday closed as follows:

	Monday.	Friday.
Lake copper	..@13¼	13@..
Electrolytic copper	13@13⅛	13@..
Castings copper	—@13	12.75@13

London metal prices:

	Opening Monday. £ s. d.	Closing Monday. £ s. d.	Closing Friday. £ s. d.
Copper, spot	58 0 0	57 17 6	58 7 6
Copper, futures	58 7 6	58 5 0	58 12 6
Copper, best selected	62 0 0	62 0 0	62 0 0

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 12 6
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0 0

There seems to be no foundation for the report that the Amalgamated properties in Montana will resume operations by May 1. If such resumption is contemplated by the heads of the company in the East, it is not known in Butte; but it is likely that there would be as little intimation of the order to open the mines as there was to the closing order, which came when no one in the camp knew that there was any disturbance in industrial conditions. The copper world for some time has been watching with interest the mining developments in Utah and Nevada. From the porphyries of the Utah Copper and the Boston Consolidated in Utah and the Nevada Consolidated and the Cumberland-Ely in Nevada, there is promised a copper production of 125,000,000 lb. in 1909, and that before the close of the present year it is more than likely the production will total 75,000,000 lb. The Utah Copper Company claims to have already demonstrated that it can produce 3,000,000 lb. of copper a month and can produce it at 8 cents. This is the figure claimed for the Nevada Consolidated while the Cumberland-Ely it is claimed will produce copper at a price not exceeding 7 cents a pound. If these claims can be demonstrated the ultimate effect upon the copper stocks of the high-priced mines and the price of copper metal will be far-reaching.

LIGHTING DISCOUNTS.—In a recent editorial on the trend and results of investigations in the municipal lighting field, the *Progressive Age* makes the following caustic remarks as to electric lighting business methods: "Electricity supply companies are by no means in as good condition to stand investigation as gas companies. Their methods are more wasteful and founded less on safe business policy. They get the business, whether profitable or not, and give away much that should be paid for. They generally have a scale of prices resembling a mathematical puzzle. They mostly run along the ragged edge between profit and loss and through the displacement of machinery rendered necessary by new apparatus of much higher efficiency are frequently compelled to increase their investment. When electric properties begin to be investigated, generally with the same acrimony gas companies have experienced, they will no doubt be found less able to withstand the searching investigation. The question of charging system alone would condemn their methods; discount upon discount are so frequent that the actual value of current becomes simply a hazy impression which, carried a step further, would remind us of a story told of Mark Twain. That distinguished author and publisher entered a book store in which he was financially interested and purchased a book, asking for the usual trade discounts, publishers' discount, stockholders' discount, authors' discount, Mark Twain discount, etc., all of which were granted; the clerk figured out the discounts and informed the humorist that the company owed him 85 cents. The application is not at all far-fetched when the business of some electric companies is considered."

FURNACE PLANT EQUIPMENT.—The new Madeline blast furnace at Indiana Harbor has a fine power equipment furnished by the Allis-Chalmers Company, of Milwaukee. The boiler plant, situated directly back of the furnace, comprises eight 500-hp Sterling boilers, each with individual stacks. There are two pairs of Allis-Chalmers vertical long crosshead furnace blowing engines installed, designed to operate either singly or in compound condensing pairs. The steam may pass through a reducing valve when the low-pressure side is run singly. The power plant is further equipped with three Allis-Chalmers cross-compound Corliss engines, each direct connected to a 550-kw direct-current generator of the same build. The engines are uniform in type, having cylinders 20 in. and 42 in. x 42 in. stroke. Electrical energy is transmitted from the power house to a distributing station at the steel mills, a distance of about 1200 ft., by conducting cables supported on steel towers, to the property line of the blast furnace plant and from this point by underground conduit beneath the intervening tracks. In addition to the engines already enumerated there is installed in this plant an Allis-Chalmers horizontal cross-compound Reynolds Corliss pumping engine used for hydraulic transmission in the mills, operating lifts, stands and other handling apparatus. The water end of this unit has a capacity of 800 gal. of water per minute against a working pressure of 500 lb. per sq. in., under severe continuous service. In addition to numerous motors the plant includes electrical hoists and motor-driven trucks to handle ore. Mr. Arthur G. McKee, engineer, of Cleveland, designed and superintended the erection of the plant.

NEW ALLIS-CHALMERS PLANTS.—The Wolf Mill & Elevator Company, whose plant at Ellinwood, Kan., is being equipped with Allis-Chalmers flour mill machinery on the well-known "Universal Bolter" system, has purchased from the same builders power equipment driven by belting from a 12 and 24 x 36-in. cross-compound Reynolds-Corliss engine. Steam at 150 lb. pressure will be supplied from a Chandler & Taylor tubular boiler operated in connection with an open Stilwell heater and duplex hot water boiler feed pump. Stein-Hirsh & Company, operating a starch and gum factory at the corner of Ashland Avenue and Thirtieth Street, Chicago, is preparing to install an electric generator of 250 kilowatt capacity, direct-connected to a horizontal Reynolds-Corliss engine, the complete unit to be built by Allis-Chalmers Company. Three-phase 60-cycle current, generated at a pressure of 240 volts, will be distributed over the building for power and lighting. With this alternator there will be installed a 15-kw belted exciter of the same make. Adams & Schwab are consulting engineers, and Nimmons & Fellow, architects of the building.

NEW QUARTERS FOR GENERAL ELECTRIC COMPANY.—By the first of April the General Electric Company expects to be installed in its new quarters in the Hudson Terminal Building at Dey and Fulton Streets, New York. The offices of the company will occupy the whole of the seventeenth floor, with approximately 24,000 sq. ft. of floor space. The Edison Building at 44 Broad Street, which at present is occupied in part by the General Electric Company, was built in 1891 by the Edison General Electric Company and sold by the General Electric Company several years ago. The Hudson Terminal Building, when completed, will be the largest office building in the world.

THE ROBINS NEW CONVEYOR COMPANY, which has been recently incorporated, will be operated under the management of Thomas Robins, who founded the Robins Conveying Belt Company in 1896, and was president of that concern until March, 1907, when its management passed into other hands. The position of chief engineer in the new company is filled by Mr. C. Kemble Baldwin, who has served in the Robins Conveying Belt Company in the same capacity for the last seven years. The offices of the company are at 38 Wall Street, New York, and 1240 Old Colony Building, Chicago.

Financial Intelligence.

THE WEEK IN WALL STREET.—Reflecting the uncertainty for the immediate future felt on all sides, the stock market last week continued dull and unsettled, seemingly incapable of being much affected either by good or bad news. During the early part of the week a feeling of pessimism prevailed, which was partly dissipated when it was found that the market had been more or less sold out or oversold, and prices did not go lower, even under the sudden dip in the Gould stocks, a decline which has not been satisfactorily explained as yet. The letter addressed by President Roosevelt to the Interstate Commerce Commission, calling for the investigation of railroads which propose to reduce wages of employees, produced a distinctly bearish feeling toward railroad stocks, but the Chicago court decision, which temporarily, at least, gave the victory to Harriman in the Fish-Harriman controversy, was followed on Thursday by considerable covering and a sharp advance in Union Pacific and other issues of that group. The Interborough-Metropolitan issues were a weak spot in the market, there being apparent liquidation in the 4½ per cent bonds, carrying them down to the level of last autumn. Decline in the prices of copper metal, together with denials of stories of large sales to foreign interests, created bearishness toward Amalgamated. The week closed with the market firm and indicating a tendency to advance. Closing quotations of Feb. 24 were as follows:

NEW YORK.

	Feb. 17	Feb. 21		Feb. 17	Feb. 21
Allis-Chalmers Co......	6	5¾	Interborough Met. com.	7¼	6¾
Allis-Chalmers Co. pfd.	17	17	Interborough Met. pfd.	18¼	17¾
Amalgamated Copper...	46¼	47⅞	Mackay Cos.	52	53
Am. Dist. Tel.........	39*	39*	Mackay Cos. pfd......	58	60
American Locomotive...	33	32¾	Metropolitan St. Ry...	—	15
Amer. Locomotive pfd..	88	89½	N. Y. & N. J. Tel.....	90	80
American Tel. & Cable.	55	44	U. S. Steel com.......	27⅝	28¾
American Tel. & Tel...	105	106	U. S. Steel pfd.......	91½	92¼
Brooklyn Rapid Transit.	38¾	40½	Western Union Tel....	46½	46¼
General Electric	114	115	Westingbouse com......	40½	39
Hudson River Tel.....	—	—	Westinghouse pfd......	70	—

BOSTON.

	Feb. 17	Feb. 21		Feb. 17	Feb. 21
Amer. Tel. & Tel......	—	106¼	Mass. Elec. Ry. pfd....	42	41
Cumberland Telephone.	—	—	Mexican Telephone.....	—	—
Edison Elec. Illum....	205	—	New England Telep...	110	107½
General Electric	114½	—	Western Tel. & Tel....	—	6
Mass. Elec. Ry........	11	10½	West. Tel. & Tel. pfd...	—	.50

PHILADELPHIA.

	Feb. 17	Feb. 21		Feb. 17	Feb. 21
American Railways....	33	42	Phila. Electric	5⅜	5⅝
Elec. Co. of America..	8¼	8¼	Phila. Rapid Transit...	15	15
Elec. Storage Battery..	26	26	Phila. Traction	86	87
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Feb. 17	Feb. 21		Feb. 17	Feb. 21
Chicago City Ry....	172*	172½*	Metropolitan Elec. com.	14	18*
Commonwealth-Edison ..	84	85¼	National Carbon	53	50
Chicago Subway.......	—	16	National Carbon pfd...	100	102
Chicago Tel. Co.......	—	110			

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*Asked.

BELL TELEPHONE COMPANY OF PENNSYLVANIA.—The first report of the Bell Telephone Company of Pennsylvania shows a net gain of 7.14 per cent in stations, $925,931 increase in gross earnings, and $469,096 increase in expenses over the operations of the component companies for the previous year. The Bell Telephone Company of Pennsylvania was formed the latter part of 1907 to take over the Bell Telephone Company of Philadelphia, the Pennsylvania Telephone Company and the Delaware & Atlantic Telegraph & Telephone Company. The total number of stations operated at the end of the year were 225,405, of which 102,023 were in Philadelphia and 123,382 elsewhere. A dividend of 6 per cent was declared, and a balance of $500,333 carried to surplus. The capital stock of the company is $31,148,250, the bonded indebtedness $500,000. Since its organization, the company has taken over the Chesapeake & Potomac Telegraph Company by an exchange of capital stock on the basis of $100 for $150. This latter company operates 4296 stations in Washington, 3670 in Baltimore, and 592 elsewhere.

LAMP RECEIVERSHIP ENDED.—Application was made at Trenton, N. J., on Feb. 24, in the United States Circuit Court for an order terminating the receivership of the Westinghouse Lamp Company. The court approved the reports and accounts of the receivers and directed them to turn over to the company all the assets and property upon the company indemnifying the receivers against all claims arising out of any contracts entered into or approved by them. The court approved the settlements made by the company with its creditors, and it developed in the hearing that the liabilities of the company would be in the neighborhood of $300,000 and the assets about $2,300,000. The company has been four months in the receivers' hands. All of the capital stock of the company is owned by the Westinghouse Electric Manufacturing Company, of Pittsburg.

CANADIAN NIAGARA POWER.—It is stated from Canada that the Electrical Development Company, of Toronto, has passed into the control of Mr. William Mackenzie, the well-known traction magnate. The statement is made that he has taken hold to save it from liquidation, the hydro-electric policy of the Whitney Government having stampeded the British financiers. Be that as it may, the situation as it affects power for Toronto has changed, and there is an idea expressed by the local newspapers that Mr. Mackenzie may be able to come to an arrangement with Toronto that will render it unnecessary to duplicate a transmission line from the Falls or a distribution system in that city. This would probably affect seriously the government electrical scheme and policy.

UNITED POWER & TRANSPORTATION CO.'S ANNUAL REPORT.—At the annual meeting of the United Power & Transportation Co., of Philadelphia, the report for the year ending Dec. 31, 1907, showed an income from securities and loans of $840,119 against $824,021 for 1906. The expenditures for taxes, interest, etc., were $364,110, against $364,020 for 1906, leaving a surplus of $476,009, and a total surplus applicable to dividends of $743,098. The surplus for the year is equal to 13.24 per cent on the outstanding $3,593,750 capital stock. The retiring board of directors were re-elected.

PHILADELPHIA ELECTRIC STOCK.—The Philadelphia Electric Company notified the Stock Exchange that the dividends due to stockholders of record would not be paid until the first assessment is due, March 2. In consequence, the stock listing committee ruled that all transactions in the stock until that date should carry the dividend, the seller giving a due bill therefor. The stock will be quoted dividend on, and deliveries must be accompanied with a receipt for the dividend as per a form prescribed by the company.

CLEVELAND ILLUMINATING BONDS.—The Cleveland Electric Illuminating Company has sold to Spencer Trask & Company, of New York, $500,000 of its first and general 6 per cent gold bonds. This is part of an issue of $2,500,000 dated Jan. 1, 1908, and due May 1, 1913. It is said that perhaps half a million more of the bonds will be sold before the end of the year. The proceeds will be used to retire floating debt and pay for improvements which the company is making.

WESTINGHOUSE PROFITS.—It is noted that the net earnings of 41 per cent on the combined preferred and common stocks of the Union Switch & Signal Company, one of the oldest of the Westinghouse concerns, show it to be the greatest relative earner in the lot. Both the preferred and common stocks have been paying 12 per cent dividends. From 1904 to 1907 its net earnings increased from 14.4 per cent of the gross sales to 20.4 per cent.

TWIN CITY RAPID TRANSIT BONDS.—Wm. A. Reed & Company, of New York, have purchased $1,000,000 of the joint, 5 per cent, consolidated bonds of the Minneapolis Street Railway Company and the St. Paul City Railway Company, due 1928. It is stated that the proceeds are to cover improvements made on the roadbed, additions to the generating plant, etc.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

CENTERVILLE, ALA.—The Cahaba Power Company is planning to develop five water-power properties ranging from 400 to 1500 horse-power on the Cahaba River. The first plant will be built at Centerville, where about 7000 horse-power will be developed. The officers of the company are: H. E. Reynolds, president; W. L. Pratt, vice-president, and J. P. Kennedy, secretary and treasurer.

BISBEE, ARIZ.—The International Gas & Light Company has been purchased by the Bisbee Light & Power Company. A company has been organized under the laws of Arizona, which will be under the management of Edward M. Dean & Company, Grand Rapids, Mich.

HOPE, ARK.—The city has decided to increase the output of the water and light plant, and will construct a power house and install an engine and dynamo.

LITTLE ROCK, ARK.—The directors of the Little Rock Railway Electric Company have decided to extend the West Fifth Street line to the new state capitol building and to double track the entire Highland Park line.

MALMO, ARK.—The City Council has appointed a committee of three to make investigations in regard to installing an electric light plant and water works system. The committee is to make a report at the next meeting of the Council.

MARIANNA, ARK.—The local electric light plant has been purchased by Marshall Hewitt, who will operate the same.

AZUSA, CAL.—Owing to the rapid increase in the business of the Home Telephone Company in the Upper San Gabriel Valley, the company has decided to install an auxiliary station in Azusa to facilitate the work of the central exchange at Covina.

OROVILLE, CAL.—Plans are being made by the Northern California Power Company for the construction of two large power plants on Fall River in the Mooretown district. For one plant 2000 inches of water are available with a fall of 1,000 feet, and for the other a fall of 500 feet with 1500 inches of water.

SAN DIEGO, CAL.—Plans are being made to utilize the tides of False Bay to generate electricity. E. F. Schaniel and A. N. Jones have been granted by the County Commissioner the privilege of installing a tide motor at the outlet of the bay. It is proposed to furnish electricity in San Diego for lamps and motors.

SAN FRANCISCO, CAL.—Plans are being made for placing cluster lamps on ornamental poles on Main Street and the principal streets crossing that thoroughfare. The superintendent of the lighting department has been instructed to furnish estimates of the cost of the work.

WHITTIER, CAL.—The citizens of this city are considering the question of establishing a municipal electric light plant, and a committee has been appointed consisting of N. T. Edwards, chairman, C. F. Klingberg and H. E. Humphrey to formulate plans for the same.

DENVER, COL.—Plans have been filed in the office of the state engineer by D. A. Lord and M. C. Smith, New York capitalists, for the construction of a reservoir on Blue River, 15 miles above Kremmling, to cost about $750,000. The proposed dam will be 325 ft. high and 1700 ft. wide. The dam will furnish power to reclaim about 15,000 acres of valley land, and also to generate electricity which will be transmitted to cities, towns and mining camps within a radius of 100 miles.

WASHINGTON, D. C.—The Commissioners of the District of Columbia have approved a bill authorizing an extension of the Capital Railway line from the present terminus at Fifth and Nicholas Avenue, Congress Heights, to Shepherd's Landing.

ST. AUGUSTINE, FLA.—Mayor Masters has entered into a contract with the St. Johns Light & Power Company for lighting the streets of the city, from Jan. 15 to Oct. 1, 1908. The company is to furnish energy for 95 arc lamps and 65 incandescent lamps on a moonlight schedule at a total cost of $541.66 per month.

NEWNAN, GA.—The new municipal electric light plant was placed in operation Feb. 6. The output of the new plant is double that of the old plant. The equipment consists of two boilers with a total rating of 450 hp, a 350-hp Harrisburg engine and a 350-kw Crocker-Wheeler alternator. A 120-hp motor has been installed, which will be used to pump the city water supply from the reservoir, one and one-half miles distant.

STITES, IDAHO.—The citizens of this place are considering a proposition submitted by Benjamin Schultz, of Nezperce, to install an electric light plant and flouring mill in this town.

CARTHAGE, ILL.—Bids will be received until March 3 by J. W. Westfall, county clerk, for the electric lighting fixtures for the new court house. Joseph E. Mills, Washington Arcade, Detroit, Mich., is the architect.

CHICAGO, ILL.—The South Chicago Street Railway Company is installing an additional 400-hp Stirling water tube boiler in its South Chicago power house and is also erecting a smokestack.

CHICAGO, ILL.—The Commonwealth Edison Company is making arrangements to begin the construction of another generating plant which it is building on the south branch of the Chicago River. The contract for the construction of the building has been awarded to the Wells Brothers Company. The cost of the building and equipment is estimated at $750,000.

EL PASO, ILL.—The Grand Telephone Company has increased its capital stock from $11,000 to $18,000.

PEORIA, ILL.—The Peoria Railway Company has decided to place its wires underground in certain districts of the city, and to replace the wooden poles with concrete poles.

PEORIA, ILL.—Plans are now being made by the officials of the McKinley system for the construction of an interurban line between Peoria and Streator, which when finished will be the connecting link of a cross-country electric railway between Chicago and St. Louis, Mo.

BLOOMINGTON, IND.—The City Council has granted a 20-year franchise to the Citizens' Home Telephone Company, which was recently incorporated. The franchise provides for the annual payment to the city of $200 and furnishing free telephone service to the city departments. A contract for the construction and equipment of a plant will be let as soon as possible.

CRAWFORDSVILLE, IND.—The City Council has decided to improve the service of the municipal electric plant. It is proposed to secure the services of an electrical engineer to investigate the plant and ascertain what improvements are necessary and the cost of the same.

DUNKIRK, IND.—The order to sell the municipal light plant has been rescinded, the sentiment against such sale being too pronounced for the Council to proceed further. Extensive improvements will be made to the plant.

EVANSVILLE, IND.—C. M. Schank, general attorney of the Grand Central Traction Company, has filed an application for a franchise to operate its road in this city. Mr. Schank states that the company now owns 90 per cent of the right of way between Indianapolis and Evansville.

GOSHEN, IND.—The Winona Traction Company is preparing to extend its line north on Ninth Street to the factory district.

SULLIVAN, IND.—The Sullivan Electric Company has been placed under control of a receiver by Judge Henderson, on petition of William F. Poole, of Indianapolis, who holds claims calling for $4,000. The Marion Trust Company is named as receiver. W. A. Young, representing the trust company, states that no change in the local management is contemplated. The company recently expended a large amount of money in remodeling its plant, and hence the present embarrassment.

VINCENNES, IND.—The Vincennes Window Glass Company has renewed operation after a period of idleness. The factory will now, for the first time, be operated by electricity, natural gas being used for steam generation.

WHITE CLOUD, IND.—The Board of County Commissioners has granted to Julius Rothrock, of White Cloud, authority to erect transmission lines over the highways of the county for the transmission of electricity. Power for operating the system will be derived from the falls of the Blue River at the White Cloud Mills.

INDEPENDENCE, KAN.—The Independence Electric Light Company contemplates erecting 10 miles of pole line throughout the city and installing another 500-hp gas engine this fall. W. R. Murrow is secretary and manager.

IOLA, KAN.—Plans and specifications are being prepared by John Stanton, state architect, for the new power plant to be built at the State University, at a cost of $50,000. The mechanical laboratories of the engineering school will be housed in this building.

KANSAS CITY, KAN.—The merchants on Minnesota Avenue, who have applied to the City Council for a franchise to construct and maintain an independent electric light plant for the purpose of illuminating the business thoroughfares of the city, are contemplating making a general application and entering the field in opposition to other companies.

COLUMBIA, KY.—The local electric light plant, owned by W. R. Heyers & Son, has been purchased by Ray Conover. It is said that the new owner intends to enlarge and improve the plant and service.

COVINGTON, KY.—The officials of the Covington, Newport & Cincinnati Traction Company have made final arrangements for the construction of a new street car line between Covington and Newport, the cost of which is estimated at $30,000.

LEXINGTON, KY.—The Board of Aldermen has voted to authorize the Mayor to make a contract with the Lexington Railway Company for lighting the city for the year 1908.

LECOMPTE, LA.—Bids will be received at the office of J. R. Moore, mayor, until April 7 for the construction of an electric light plant. Plans and specifications are on file at the Mayor's office; at the office of A. B. Wood, 5026 Prytania Street, New Orleans, consulting engineer, and C. Scott Yeager, Alexandria, architect.

BANGOR, ME.—Acting under permission from Judge Putnam, of the United States Circuit Court, the receivers of the Bodwell Water Power Company are again furnishing the Eastern Manufacturing Company with electrical energy for operating its paper mill, under temporary arrangements.

OAKLAND, ME.—Fred Patterson, of Belgrade, has submitted a proposition to the Village Trustees to furnish electricity for lighting the town. He wishes to place a contract with the village to furnish 150 hp to be generated either by steam or water power. It is said that he will locate a plant at the upper dam.

BALTIMORE, MD.—Instructions have been given by the superintendent of lamps and lighting to the Consolidated Gas, Electric Light & Power Company for the installation of 120 additional arc lamps, 100 of which are to be erected in the business section of the city. For each arc lamp the city pays $67.49 per year, but where connection has to be made underground the city receives compensation for the use of its conduits amounting to about $10 a year on each lamp, which reduces the price to about $58 per year. All arc lamps in the business section of the city will be served with underground connections.

BOSTON, MASS.—The Finance Commission has appointed a subcommittee of its members to investigate and report upon the city's street lighting contract. The present contract with the Edison Illuminating Company for street lighting expires in February, 1909. Under it the city is paying $118 per lamp per year.

CHARLESTOWN, MASS.—It is reported that W. C. Myers is interested in the establishment of an electric light plant.

DANVERS, MASS.—In the report submitted by the special committee, recently appointed to investigate the condition of the municipal electric light plant, the committee endorses the plant, and recommends an appropriation of $23,500 for improvements and additions to the plant and service as follows: The installation of a compound condensing Corliss type engine, direct connected to a 300-kw, two-phase, 60-cycle, alternating-current generator; a motor-driven exciter and controlling switchboard; to concentrate the arc lamps in the central part of the town, and to place incandescent lamps in the outlying districts. It is proposed to sell the present three-phase generator. A proposition has been made as an amendment to consider changing the steam plant to a gas generating system, which was accepted by the committee.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company has announced a reduction in the rate for electricity to go into effect March 1, by which the majority of customers will make a saving of about 30 per cent. The present rate is 15 cents per kilowatt hour for all energy used. Under the new schedule the price will be 15 cents for the first 30 kw-hours and 8 cents for all used in excess each month.

PITTSFIELD, MASS.—The City Council contemplates asking the Stanley-G. I. Electric Manufacturing Company to bid on the city street lighting contract, which will be renewed in May.

SPRINGFIELD, MASS.—The New England Telephone & Telegraph Company contemplates the construction of a new exchange building to be erected at the corner of Stearns Park Avenue and Washington Street. H. S. Hyde is vice-president of the company.

TAUNTON, MASS.—The Board of Aldermen has adopted a resolution authorizing the manager of the municipal electric light plant to substitute incandescent electric lamps for the gas and naphtha lamps now in use.

MARQUETTE, MICH.—The Board of Light and Power Commissioners has decided to build a substation on Bluff Street, in accordance with the recommendation of C. W. Humphrey, of Chicago, Ill. The cost of the building, including machinery, is estimated at $12,000.

BAUDETTE, MINN.—It is reported that the Village Council is receiving bids for an electric light plant, to be installed at the pumping station.

ERSKINE, MINN.—The question of installing an electric light plant in this town is being considered. It will be operated as a private enterprise.

ST. PAUL, MINN.—The Twin City Rapid Transit Company has made arrangements to issue $1,000,000 in bonds, the proceeds to be used for improvements and for the construction of a new power house.

ST. PAUL, MINN.—W. C. Webber, president and general manager of the St. Paul, Minneapolis & Seattle Electric Railroad Company will soon begin construction of its road. The Co-operative Construction Company, of St. Paul, has been awarded the contract for the construction work. The company proposes to build a double-track, third-rail, electric railroad from St. Paul and Minneapolis to St. Cloud, thence to Fergus Falls, and from there to Fargo, N. D., with spur or branches running from the main line to adjacent towns or cities. It will also operate local traction lines in cities where feasible. The officers of the company are: William C. Webber, president and general manager; James W. Mossop, vice-president and general superintendent; David Phillips, secretary; S. A. Phillips treasurer, and Walter Townsend, chief engineer.

STEWARTVILLE, MINN.—The Stewartville Electric Light Company contemplates installing a new ideal engine and a 60-hp boiler in its plant. F. E. Alexander is secretary and treasurer.

OXFORD, MISS.—R. S. Adams, Mayor, writes that it is proposed to construct an electric light plant in Oxford, the cost of which is estimated at about $15,000.

FARMINGTON, MO.—S. L. Asbury, city clerk, writes that the city will construct a municipal electric light plant to cost about $25,000. Thomas B. Carter is engineer.

WEBB CITY, MO.—The City Council has granted C. U. Porter an extension of six months' time, during which he is to commence work on the proposed light and power plant in this city, for which a franchise was granted last summer.

HELENA, MONT.—It is reported that New York capitalists, who have built two dams near here, will construct another dam across the Missouri River. The new dam will develop 50,000 hp and cost approximately $2,000,000. The power will be utilized in the Butte-Helena mining district, and in pumping water to reclaim about 30,000 acres of land in the valley below Helena. M. H. Gerry is general manager of the company.

BLAIR, NEB.—The Blair Electric Light & Power Company will change its system to 60 cycles and install a three-phase, 60-cycle alternator, also a new engine and boiler. E. V. Capps is president and manager.

LONG PINE, NEB.—The Town Board has granted a franchise to I. Hewitt, of Neligh, to furnish electricity for lamps and motors in Long Pine and vicinity.

GARDNERVILLE, NEV.—A corps of surveyors in the employ of Carson and Gardnerville capitalists are surveying on the Carson River for an electrical power site. A large plant will be built to supply electricity to the towns of Carson, Gardnerville, Reno and Dayton, in opposition to the Truckee River General Electric Company.

KEENE, N. H.—John P. Rust has installed an electric power plant at his Water Street mills to furnish electricity to operate the mills.

CAMDEN, N. J.—The Public Service Corporation of New Jersey has submitted a proposition to the lighting committee of the City Council offering to enter into a contract for a period of five years, to date from July 1, 1909, to furnish energy for street lighting at the rate of $80 per arc lamp per year for 600 lamps or under. The city is at present paying $109.50 per lamp.

MORRISTOWN, N. J.—The Public Service Corporation has announced that it has secured additional land adjoining its present power station here and will erect an addition to its building and install new machinery.

MORRISTOWN, N. J.—The new plant of the Morris & Somerset Electric Company was started Feb. 10 and is now furnishing electricity for lighting the streets of the towns. Fifty-nine arc lamps are used in the center of the town; other streets are illuminated by incandescent lamps. The plant to date has cost $128,000. The new company furnishes energy for arc lamps at $85 per lamp year, and at $18 each for incandescent lamps. Peter V. Stryker is manager and treasurer.

SOCORRO, NEW MEXICO.—A movement is on foot to establish an electric light and power plant in Socorro and it is expected that the plant will be in operation in a short time.

ARCADE, N. Y.—The citizens of this village are contemplating the question of lighting the streets of the village with electricity. A committee has been appointed to ascertain the cost of constructing a plant to be operated by water or steam.

BATH, N. Y.—E. J. G. Tower, president of the Citizens' Electric Service Company, of Bath, writes that plans have been prepared to build an electric light plant in Bath to furnish electricity in Bath, Avoca, Savona and Kanona, covering a distance of 14 miles along the Cohocton Valley. The equipment of the plant will include two 200-hp producer gas engines direct connected to three-phase, 60-cycle alternators; a motor generator exciter set and a direct-connected, gas-engine exciter set. Substations will be erected in Avoca, Savona and Kanona. A day power service will be established and electrical energy furnished for motors at the rate of 3 cents per kw-hour. The price for electricity for lamps will range from 12 to 8 cents per kw-hour. The matter is now before the Public Service Commission of the Second District.

COEYMANS, N. Y.—The Town Board has petitioned the Public Service Commissioner at Albany for permission to allow the Atlantic Light & Power Company to do business in the town of Coeymans.

GOUVERNEUR, N. Y.—The Central New York Telephone & Telegraph Company is making arrangements to make improvements and extensions in its local plant and will install the common battery system.

LOWVILLE, N. Y.—The Black River Telephone Company, of Lowville, is planning to repurchase control of the property, which was transferred to the Independent Securities Company about three years ago. The capital stock of the company is $50,000, and the amount held by the Securities Company is $34,000.

NEW YORK, N. Y.—The Comptroller has been authorized to issue $15,000 in special revenue bonds for the purpose of rewiring and improving the lighting system of the City Hall.

BLUFFTON, OHIO.—William Plattner, manager of the municipal electric light plant, writes that the city is contemplating the reconstruction of its pole lines, etc.

CARTHAGE, OHIO.—The City Council is considering the question of erecting a new electric light plant. President G. A. Bauer, of the Board of Trustees of the old plant, has agreed to furnish arc lamps at $70 per lamp per year, and the Cincinnati Gas & Electric Company has submitted a proposition to furnish arc lamps at $60 per lamp per year.

MIDDLETOWN, OHIO.—Plans have been completed by the Middletown Telephone Company for the construction of a new telephone exchange in this city at a cost of $10,000. The contract for the construction of the building has been awarded to Bender Brothers.

MONTPELIER, OHIO.—A special election will be held March 16 to vote on the proposition of issuing bonds for repairing and enlarging the municipal electric light and water works plant.

NELSONVILLE, OHIO.—We are informed that the Nelsonville, Athens & Glouster Traction Company is planning to begin construction work in the spring. The company proposes to build an electric railway from Nelsonville to Athens, and from Chauncey to Nelsonville. The company has secured franchises in all the towns along the route, and also of the County Commissioners of Rocking and Athens Counties for rights over the county roads. The officers of the company are: L. F. Carpenter, president; C. W. Juniper, secretary, and Charles Tutt, general manager.

WARREN, OHIO.—The City Council is considering the question of constructing an electric light plant and waterworks system.

CLINTON, OKLA.—It is reported that an electric light plant will be installed in the town by parties who were recently granted a franchise.

CANBY, ORE.—A new power plant is to be erected by the Molallo Power Company on the Molallo River, about three miles from Canby. It is proposed to move the plant now located at Aurora and operated by steam to the new site and run it by water-power. The new plant will supply electricity to New Era, Canby, Macksburg, Barlow, Aurora and Hubbard. F. P. Hurst, of Aurora, is interested in the enterprise.

NORTH BEND, ORE.—It is reported that L. J. Simpson and Seymour Bell, of the Coos Bay Gas & Electric Company, will soon commence work on the construction of an electric plant at Porter to supply electricity in both Marshfield and North Bend for lamps and motors. The present plants in both towns will be held as emergency stations.

PORTLAND, ORE.—The Oregon Electric Railway Company is planning to place contracts during the next three months for construction of a substation and a branch line 21 miles in length from the main line to Hillsboro.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will extend its line to the site of the Swift packing plant as soon as the plants are well under way. It is also stated that the railway company will be prepared to supply Swift & Company with electric power for operating its plant if they should desire it. The line will either be extended from the present Vancouver line or a direct line will be built.

PORTLAND, ORE.—The officials of the Mount Hood Power Company have notified Mayor Lane that the company will be prepared to furnish electricity for street lamps in the city by Jan. 1, 1909, and asks for an opportunity to put in a bid for the city lighting contract.

PRINEVILLE, ORE.—Arrangements have been made by H. V. Gates, of Hillboro, manager of the Prineville Light & Water Company, with the Reschutes Irrigation & Power Company to install a 2000-hp electric generating plant at Lava Falls, six miles south of Bend. Work on the construction of the plant is to begin within two months.

GREENVILLE, PA.—Franchises have been asked of the council of Greenville and Sharon by capitalists interested in the proposed electric railway, which is to connect Greenville, Mercer, and Sharon. The Greenville line is to be built first, to be followed by the Sharon-Mercer line.

JOHNSTOWN, PA.—Arrangements are being made to reorganize the Dale Light, Heat & Power Company, and it is expected that some changes will be made in the management of the plant. New equipment will be purchased and other steps taken to insure satisfactory service. George E. Daniels is at present president and manager of the company.

MORGANZA, PA.—Bids will be received until March 3 by the Board of Managers of the Pennsylvania Reform School for installing an electric light plant in the present power house. Proposals will be received on two steam engines, each direct connected to a generator. The engines are to be 125 hp each and the generators 75 kw each.

PEN ARGYLE, PA.—A proposition is being considered to have the Northampton Traction Company build a branch to extend from Ackermanville to Pen Argyle, a distance of four miles.

PENNSBURG, PA.—The Pennsburg Electric Light Company has decided to accept the proposition of the Columbia Silk Company, in East Greenville, to supply electricity for lighting the company's mill, provided the Columbia company erects the wires through East Greenville.

RIVER POINT, R. I.—An electric light plant is to be installed in the Valley Queen Mill, at River Point to furnish electricity for lighting the mill. It is expected that electricity will soon replace the oil lamps now in use in the Royal and other Valley mills owned by B. B. & R. Knight.

HILL CITY, S. D.—The Hill City Electric Power & Mining Company has decided to install an electric light and power plant.

KNOXVILLE, TENN.—The Knoxville Power Company has filed an application for an amendment to its charter, increasing its capital stock from $100,000 to $150,000. John Bogart, New York, N. Y., is chief engineer of the company.

BROWNSVILLE, TEX.—The plant and holdings of the Matamoras & Santa Cruz Street Railway Company have been purchased by Henry E. Scott, Samuel Fordyce and other stockholders of the Union Trust Company, of St. Louis, Mo. The purchase includes all the holdings of the ferry company and tracks at Santa Cruz. It is understood that the present mule car line is to be operated by electricity. The same parties also own the Rio Grande railroad running from Brownsville to Point Isabel, which it is said will later be converted into an electric railway.

NAVOSTA, TEX.—Plans are being considered for the construction of a new electric light plant in this city.

SAN ANGELO, TEX.—Col. J. H. Ransome is making arrangements to begin work on the construction of the power house of the proposed street car system.

RICHMOND, VA.—The Virginia Passenger & Power Company is now installing a new system of street lamps. The company was recently granted a contract for lighting the streets of the city for a term of five years at $54 per lamp per year.

RICHMOND, VA.—The joint committee on water and electricity has appointed a special committee to secure plans and specifications for a new lighting plant at the old pump house. The committee consists of Aldermen Mann, Satterfield and Dabney and Councilmen Mills and E. D. Richardson and City Engineer Bolling. The sum of $6,000 has been appropriated for this purpose.

ROANOKE, VA.—The Roanoke Railway & Electric Company has been granted franchises by the city to extend its Belmont line in the southeast section of the city; also for an extension of the Franklin Road line, and for a new line into the southwest section of the city. It is planned to do the work during the coming summer.

SUTTON, W. VA.—The Sutton Electric Light, Power & Water Company has been awarded a contract by the Council to furnish the town with electricity and water for a term of 25 years. By the terms of the contract the company is to furnish the first 12 lamps for $75 each per year; $60 each for the next 10 lamps, and $50 per lamp for all in excess of 22 lamps. The contract gives the town the privilege of purchasing the entire plant at the expiration of 25 years.

ARCADIA, WASH.—It is stated that as soon as spring opens active work will begin on the development of the Arcadia power plants of the Arcadia Company. Valuable water power rights have been secured by the company on Trout Creek, the Little Spokane and other streams in the vicinity of Horseshoe Lake. It is said that the company will furnish electricity for lamps to several of the towns near Spokane in the vicinity of Deer Park.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company will soon commence work on the construction of a new line to be built from the present terminus of the Dock Street line to the western boundary of Eureka addition, a distance of about two miles.

NORTH YAKIMA, WASH.—The Yakima Valley Transportation Company is making arrangements to extend its lines to the Fair Grounds.

SEATTLE, WASH.—F. X. Waldron & Company, of this city, are promoting an electric railway to run from Seattle to Tacoma by way of Vashon Island. The cost is estimated at $350,000.

SEATTLE, WASH.—The Seattle Electric Company will expend about $1,500,000 in improvements, extensions and new equipments at its power plant at Georgetown.

SPOKANE, WASH.—The New World Reduction & Power Company is engaged in the construction of a 300-ton smelter in Park County, Mont., and is also installing a 15,000-hp electrical plant. J. R. Brown, of Spokane, is president of the company.

VANCOUVER, WASH.—The Home Telephone Company is making plans to erect an exchange building in this city at a cost of about $15,000.

WENATCHEE, WASH.—The Wenatchee Canal Company has decided to replace the overhanging flumes with tunnels and ditches in the rock; 2 miles of tunneling and filling of gulches will also be necessary. A water-power plant is to be constructed at the head of the canal and hydraulic pumps will be installed in the gulches.

HUNTINGTON, W. VA.—A franchise has been granted to H. H. Hughes to furnish electricity for commercial lighting for a term of 50 years.

JUNEAU, WIS.—The Dodge County Commissioners have decided to install a heating and electric plant at the County Insane Asylum.

LOYAL, WIS.—J. M. Philpott, village clerk, writes that the citizens have voted to issue $17,000 in bonds for an electric light plant and waterworks system. W. G. Kirchoffer, Vrooman Building, Madison, is the engineer.

SHEBOYGAN FALLS, WIS.—Bids will be received by the president and Village Trustees until March 16 for establishing and maintaining an electric light plant for a term of 25 years.

WAUSAU, WIS.—The Wausau Street Railway Company has purchased the water power of Little Bull Falls at Mosine, and proposes to improve the plant as soon as possible and develop between 4000 and 5000 horse-power. The company will furnish electrical energy for motors to manufacturing concerns.

VIOLA, WIS.—Plans are being made by E. R. Cushman for the construction of an electric light and power plant, the cost of which is estimated at from $15,000 to $20,000.

KEMMERER, WYO.—The Kemmerer-Big Piney Telephone Company contemplates many improvements and extensions to its system in the spring and is now advertising for about 3000 poles to be delivered along the line.

CHEYENNE, WYO.—C. T. Johnston, state engineer, has denied the application of the Big Horn Power Company for permission to erect a 60-ft power dam in the south end of the canon of the Big Horn River, as it would interfere with the railway rights-of-way through the canon. It is said that a permit would be granted for the erection of a 35-ft. dam, and it is expected that the Big Horn Power Company will erect a dam on the modified scale.

HAMILTON, ONT.—The special committee appointed to deal with the power question has decided to recommend the Council to employ an expert to draw up plans and specifications for the proposed street lighting plant.

PETERBOROUGH, ONT.—The Northumberland Power Company has applied to the Dominion Government for a lease of the Upper Healy Falls, where the company proposes to develop water-power.

LADYSMITH, B. C., CAN.—The Citizens' League has started an agitation for an electric lighting system here. The Council will take the matter up at the next meeting.

NELSON, B. C., CAN.—Cecil P. Smith, of Toronto, Ont., has been retained by this city to supervise the construction of the proposed power plant.

MONTREAL, QUE., CAN.—Application has been made to the Quebec Legislature by the Saraguay Electric Light & Water Company for incorporation and power to take over the Saraguay Electric Light & Power Company and to carry on a general business as an electric light company.

ABERDEEN, SASK., CAN.—The Aberdeen & Rural Telephone Company has been formed to take over the local telephone system. A new switchboard will be installed at once. C. J. Crawford is manager, and W. Jinnite secretary-treasurer.

SELKIRK, MAN., CAN.—The Winnipeg Electric Company has offered to supply this town with electricity for lamps at the rate of 10 cents per kw-hour with discounts of 10 per cent up, according to the amount used. Wilford Phillips is general superintendent, Winnipeg, Man.

CHIHUAHUA, MEX.—The Kansas City, Mexico & Orient Railroad Company has acquired what is known as the O'Gorman concession and plans to construct a large hydro-electric plant to develop from 5000 to 6000 hp. The plant will furnish electricity to operate the railroad through the most difficult part of the Sierra Madre, and will also furnish electrical energy to the mines in that region.

HERMOSILLO, MEX.—W. T. Christman, superintendent of the local electric light plant, owned by Ramon Carrol, of Mexico City, writes that a Reliance engine manufactured by the Allis-Chalmers Company, of Milwaukee, Wis., will soon be installed in the plant. He also states that it will soon be in the market of a belt-driven, 120-kw, 2200-volt, 133-cycle generator, complete with exciters, switchboard, panels, etc. Bids are also being received for 80 enclosed, alternating-current arc lamps to take the place of the open arc lamps now in use; also two 50-lamp transformers, with regulators, switches, panels, etc., complete.

TEXMELUCAN, MEX.—The Empresa de fuerza y lux de Chautla has under construction two new power stations, and also has a water power of 1500 hp undeveloped, which will probably be utilized in the near future. Harold J. Rossi is general manager.

New Industrial Companies.

THE KENT TELEPHONE, SEAL & LOCK COMPANY, of Kent. Ohio, has been incorporated with a capital stock of $10,000 by F. J. Page and others.

THE PONTIAC EXPLORATION COMPANY, of Monteral, Que., Can., has been organized for the purpose of building telephone lines, etc. Address H. L. Dinning, Lachine, Que.

THE ENGINEERING & MAINTENANCE COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $25,000, by R. E. Martinez, E. J. Hampton and W. J. White, to engage in engineering and electrical business in San Francisco.

THE ELECTRICAL MUSIC TRANSMITTING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000. The incorporators are: Mark Elsner, Isaac W. Goodhue, of New York; Jacob O. Goldstein, of Brooklyn.

THE CURRENT SAVING ELECTRIC LAMP COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000. The incorporators are Robert S. Kennedy, of New York; Daniel W. Moor, of Richmond Hill; Harry D. Hooge, of Ocean Grove, N. J.

THE THURSTON ROWE COMPANY, of Boothbay Harbor, Me., has been incorporated with a capital stock of $10,000 for the purpose of dealing in machinery, electrical supplies, hardware, etc. The officers of the company are: H. T. Thurston, president; S. E. Rowe, treasurer.

THE TESLA NITRATES COMPANY has been organized at Portland, Me., for the purpose of producing nitrogen compounds and other chemical substances by electricity. The company is capitalized at $500,000 and the officers are: James E. Mantor, of Portland, president; Clarence E. Eaton, of Portland, treasurer.

Company Elections.

LITTLE ROCK, ARK.—At the annual meeting of the Little Rock Electric Company the following named officers were elected: W. E. Hemingway, president; Oscar Davis, vice-president; George D. Rose, secretary, and D. A. Hegarty, treasurer and general manager.

REDLANDS, CAL.—At the annual meeting of the Southwestern Home Telephone Company the following named officers were elected: K. C. Wells, president; A. Gregory, vice-president; C. H. Breckinridge, secretary. The company has purchased the lines and business of the Pacific States Telephone Company in this territory, and is planning many extensions in various directions.

BLOOMINGTON, ILL.—At the annual meeting of the Kinloch Telephone Company the following named officers were elected: John T. Lilliard, president; C. Marquand Forster, vice-president; Hart F. Farwell, secretary and manager, and August Gehner, treasurer; Marion B. Farwell, assistant treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the East St. Louis Railway Company officers were elected as follows: C. M. Clark, president; L. C. Haynes, vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant secretary and treasurer.

EAST ST. LOUIS, ILL.—At the annual meeting of the St. Louis & East St. Louis Electric Railway Company the following-named officers were elected: L. C. Haynes, president; J. C. Van Ripper, vice-president; G. L. Estabrook, secretary and treasurer, and T. W. Gregory, assistant secretary and treasurer.

LIBERTY CENTER, IND.—At the annual meeting of the Liberty Center Telephone Company the following named officers were elected: Perry Mounsey, president; L. A. Minnear, secretary, and William Arnold, treasurer.

COUNCIL BLUFFS, IA.—At the annual meeting of the Interstate Telephone Company, the following named officers were elected: W. A. Smith, president: H. M. Silsby, secretary and treasurer; F. M. Terry, S. A. Spooner, John Young, W. A. Smith and J. S. Dewell, directors. The company has purchased the Missouri Valley exchange, which gives it a system of about 800 rural and town telephones in the eastern part of this county.

LOUISVILLE, KY.—At the annual meeting of the Home Telephone Company the following named officers were elected: C. C. Bickel, president; Helm Bruce, vice-president; George M. Boone, secretary and treasurer.

JACKSON, MICH.—At the annual meeting of the Citizens Telephone Company the following named officers were elected: J. C. Richardson, president; E. W. Barber, vice-president; E. B. Fisher, secretary and manager, and C. E. Tarte, general manager.

ST. LOUIS, MO.—At the annual meeting of the Kinloch Long-Distance Telephone Company the following named officers were elected for the ensuing year: William D. Orthwein, president; C. Marquand Foster, first vice-president; August Gehner, second vice-president; H. Linten Reher, secretary and general manager; H. G. Fadeley, treasurer; William H. Bassett, assistant secretary, and James Harrison, chief engineer.

LAMBERTVILLE, N. J.—At the annual meeting of the Lambertville Heat, Light & Power Company officers were elected as follows: H. C. Case, president; S. C. Case, vice-president and secretary; M. N. Willits, Jr., treasurer, and H. M. Moorhead, general manager.

COLUMBUS, OHIO.—At the annual meeting of the Columbus Citizens' Telephone Company the following named officers were elected. Henry A. Lanman, president; Frank A. Davis, vice-president and counsel; Edwin R. Sharp, secretary and treasurer, and Gansey R. Johnston, general manager.

TOLEDO, OHIO.—At the annual meeting of the Toledo Home Telephone Company the following named officers were elected: James S. Brailey, Jr., president; R. E. Hamblin, vice-president; Thomas H. Walbridge, treasurer.

PATASKALA, OHIO.—At the annual meeting of the Pataskala Farmers' Telephone Company the following directors were elected: D. S. Snider, William McCormack, J. O. Pryor, C. N. Alward, John M. Beem, E. D. Moore, Jr., and Henry Brooke.

BELLOWS FALLS, VT.—At the annual meeting of the Fall Mountain Electric Light & Power Company the following-named officers were elected: James H. Williams, president; L. J. Royce, vice-president and general manager; R. L. Russell, treasurer, and E. L. Rantoul, assistant treasurer.

GRANTSBURG, WIS.—At the annual meeting of the Farmers' Independent Telephone Company the following-named officers were elected: Robert C. Anderson, president; A. Cassel, vice-president; F. R. Huth, secretary, and Emil Swenson, treasurer.

OSSEO, WIS.—At the annual meeting of the Beef River Valley Telephone Company the following named officers were elected: John Ring, president; Albert H. Larson, vice-president; Paul Kay, secretary, and A. A. Myhre, treasurer.

SPOONER, WIS.—At the annual meeting of the Spooner-Evergreen Valley Telephone Company the following-named officers were elected. Peter Brown, president; Levi Ailport, vice-president; George W. Harmon, secretary, and J. D. Thomas, treasurer.

LARAMIE, WYO.—At the annual meeting of the Little Laramie Telephone Company the following named officers were elected: John Reid, president; O. Wallis, vice-president; John W. Ernest, secretary; J. H. Farr, treasurer, and Samuel Coen, manager.

SELKIRK, ONT., CAN.—At the annual meeting of the Erie Telephone Company, the following directors were elected: S. W. Winger, Springvale, Ont.; W. Nablo, Kohler, Ont.; F. Hoover, Selkirk, Ont.; Chas. Reichfield, Fisherville, Ont.; W. J. Quinsey, Cayuga, Ont.; W. H. Davidson, Nanticoke, Ont.; A. E. Hoover, Selkirk, M. F. Derby, Selkirk Ont.

New Incorporations.

EUREKA, CAL.—Articles of incorporation have been filed for the Humboldt Water & Light Company, with a capital stock of $750,000, by H. C. Seward, B. F. Fink, E. G. Pluke, J. N. Lentell, all of Eureka, and N. H. Falk, of Arcata. The company proposes to build and operate water works systems, electric and gas plants, etc.

OAKLAND, CAL.—Articles of incorporation have been filed for the San Francisco & Bay Counties Railway Company. The company is capitalized at $250,000 and the incorporators are: F. M. Smith, F. C. Havens, E. A. Heron, George E. Pratt and Dennis Searles. The company proposes to construct and operate an electric railway between Oakland and San José.

SAN DIEGO, CAL.—The Del Mar Water, Light & Power Company has filed articles of incorporation. The San Luis Rey power and Warner's ranch will probably be developed. Among the directors are C. A. Canfield, of Los Angeles, and Ed. Fletcher, of San Diego.

CANTON, ILL.—The Illinois Heating, Light & Power Company has been incorporated with a capital stock of $25,000 by J. D. Robertson and others.

EVANSVILLE, IND.—The Evansville, Mount Carmel & Olney Interurban Company has been incorporated for the purpose of building an electric railway from Evansville to Olneyville, Ill. The directors are: Aden Knopp, of Olney, Ill., president; G. W. Courter, of Mount Carmel, secretary; C. J. Seibert, E. O. Lockyear, Jacob Laubscher, of Evansville; E. B. Bixley, Thomas Newell, of Cynthiana; J. O. Smith, J. F. Seibert, of Lancaster; Aden Knopp, J. F. Hyatt, F. N. Boyer, of Onley.

AINSWORTH, IA.—The Ainsworth Telephone Company has filed articles of incorporation with a capital stock of $10,000.

RANDALIA, IA.—Articles of incorporation have been filed for the Fayette County Mutual Telephone Company with a capital stock of $10,000.

GLASGOW, KY.—Articles of incorporation have been filed for the Union Telephone Company with a capital stock of $1,500 by W. E. Taylor, W. G. Tooms, and Charles W. Noran.

LA CENTER, KY.—A new telephone company has been organized in this city to compete with the Cumberland Telephone Company. The company is capitalized at $25,000 and the officers are: T. M. Baker, president; W. H. Viets, vice-president, and Samuel McGee, secretary and treasurer.

HARLOWTOWN, MONT.—Articles of incorporation have been filed for the Harlowtown Light & Power Company, with a capital stock of $30,000 by Benjamin Urner and others.

CAMBRIDGE, NEB.—The Cambridge-Holbrook Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are: Elmer Amon, Philo Hilton, and others.

EDDYVILLE, NEB.—Articles of incorporation have been filed for the Eddyville Southern Telephone Company with a capital stock of $1,600 by T. F. O'Mara, Robert Wiley, John O'Neal and others.

HILDRETH, NEB.—The Farmers & Merchants Telephone Company has been chartered with a capital stock of $5,000 by Fred Stoker, Willis Neff, W. S. Moor, and others.

WESTFIELD, N. J.—The American Light, Heat & Power Company has filed articles of incorporation with the Secretary of State, with a capital stock of $250,000. The incorporators are G. L. Delatour, G. R. Shepard and Alfred Worsnop.

HARTWICK, N. Y.—Articles of incorporation have been filed for the Susquehanna River Power Company with the Secretary of State. The company is capitalized at $200,000, and the incorporators are Charles A. Greene, Jesse Myers and Thomas Achenbach, of New York.

LEETONIA, OHIO.—The People's Electric Light & Power Company, of this place, has been incorporated with a capital stock of $15,000 by Albert E. Green, A. J. Thompson, J. M. Garfield, E. J. Blandon and F. H. Ginn.

FAIRVIEW, PA.—The Fairview Telephone Company has been incorporated, with a capital stock of $10,000.

RINGTOWN, PA.—The Farmers' Independent Telephone & Telegraph Company has been incorporated with a capital stock of $5,000 to operate a telephone system in Columbia and Schuylkill counties.

SALEM, S. D.—Articles of incorporation have been filed for the Star Telephone Company with a capital stock of $1,500.

SUMMIT, S. D.—The Summit Rural Telephone Company has filed articles of incorporation with a capital stock of $25,000.

ALTAMONT, TENN.—The Citizens' Telephone Company has been incorporated by J. N. Hobbs, R. F. Hobbs, J. R. McCarver and others.

ALONZO, TENN.—The Alonzo Telephone Company has been organized with the following officers: L. R. Bonner, president; George Gauvy, vice-president; A. R. Bonner secretary, and Flora Bickers, treasurer.

CELINA, TENN.—The People's Co-operative Telephone & Switchboard Company has been incorporated by J. T. McColgan, E. S. Dalton, P. M. Moore and others.

DALLAS, TEX.—The North Electric Company has been incorporated with a capital stock of $10,000 by A. A. Mans, L. J. Weaver and George C. Steele.

SEATTLE, WASH.—Articles of incorporation have been filed for the Entait Power Company with the Secretary of State by A. B. Gray, M. D. Marsh and J. H. Allen. The object of the company is to develop the water power of the Entait River. The capital stock of the company is placed at $200,000.

STAR PRAIRIE, WIS.—The Cedar Lake Rural Telephone Company has been incorporated, with a capital stock of $5,000, by Charles A. Pilgrim, A. L. McDonald and A. Sabin.

MILESTONE, SASK., CAN.—The Milestone Farmers' Mutual Telephone Company, No. 3, has been organized here and will build about 30 miles of telephone line to the southwest of here. G. A. Sylte, of Milestone, is secretary.

PERIBONCA, QUE., CAN.—The Broet-Couston Telephone Company has been incorporated. The provisional directors are: T. L. A. Broet, Peribonca, Que.; E. Morel, L. d'Apchier, of Pierrelatte, Que.; B. A. Scott, P. Corriveau, G. F. Gibson, of Quebec.

Personal.

MR. FRANK McMASTERS, for many years with the Ft. Wayne Electric Company, has recently associated himself with the Northern Electrical Company.

MR. FREDERICK S. MINOT, president of the Goodyear Rubber Insulating Company, is on a visit to Havana, Cuba, in connection with the contest there for the Havana telephone franchise.

MR. LYMAN C. REED has accepted the position of manager of the Electric Manufacturing Company, of New Orleans, La., recently organized for the manufacture of a high-grade line of panel and switchboards, steel boxes, etc.

MR. WILLIAM J. SMITH, of Providence, R. I., who has had charge of the Long Island Sound stations of the Massie Wireless Telegraph Company, has been appointed manager of the Pacific Coast Division, vice Mr. A. A. Isbell, who resigned on Feb. 1.

MR. IVAN RICE, treasurer of The Switchboard Equipment Company, Bethlehem, Pa., has just returned from an extended trip through the West and the Pacific Coast, and reports that he has found the conditions there a contrast to those in the East, as prosperity prevails everywhere along the Coast.

MR. E. C. DEAL, of Hackensack, N. J., who has been in charge of the Bergen County division of the Public Service Corporation for several years, has been transferred to Elizabeth. He will have general supervision of the central division, which comprises all of Union, Middlesex and Somerest counties.

MR. R. D. TOMLINSON.—The Lowell Association of the national order of Stationary Engineers recently held a well attended meeting, when the members were entertained with an illustrated lecture by R. D. Tomlinson, of the Allis-Chalmers works, of Milwaukee. He spoke on general power station work and dealt in an interesting way with his subject. There were present guests from Haverhill, Lawrence, Nashua and Pepperell and Pawtucket, R. I.

MR. ALPHONS WESTEE has been appointed treasurer of the several Edison companies with headquarters in Orange, N. J., to fill the vacancy recently caused by the death, by suicide, of Mr. John F. Randolph. Mr. Westee, who was born in Brooklyn in 1865, entered Mr. Edison's employ as an office boy, and has been auditor of the Edison companies for about 14 years. Mr. Westee will continue to act as secretary and auditor in addition to his new duties.

MR. WM. P. BEAR, now with Kohler Brothers, of Chicago, will go to Duluth about March 1, to assume the position of general manager of the Duluth branch of the Northern Electrical Company. He has been in the electrical business since boyhood, serving in various capacities with W. T. Osborne & Company, of Kansas City, Chicago Edison Company, Illinois Steel Company, Fort Wayne Electric Company, and in his last position with Kohler Brothers. Mr. Bear is a graduate of Armour Institute, having worked his way through that institution and receiving two scholarships in recognition of high standing in all his work. With Kohler Brothers, where he has been for the past three years, he has full charge of all switchboard work for the firm, doing the engineering and directing all switchboard installations, as well as handling the commercial end of the switchboard department.

PROF. C. FRANCIS HARDING, recently appointed head of the electrical engineering department of Purdue University, and director of the electrical laboratory, will take up these duties early in March. Prof. Harding was graduated with the degree of B. S. in Electrical Engineering from Worcester Polytechnic Institute, where he specialized in high-tension transmission work. After spending some time in the testing department of the General Electric Company, at Schenectady, he was for two years electrical engineer of a high-tension interurban electric railway system in New England, and later was for one year electrical engineer for the D. & W. Fuse Company, of Providence, R. I. After serving as manager of the publication department, Fort Wayne Electric Works, he occupied the position of assistant professor of electrical engineering at Cornell University, which position he resigned to become assistant electrical engineer with the Stone & Webster Engineering Corporation. At present he is with the engineering department of the Boston Edison Company.

Trade Publications.

GAS ENGINES.—Brochure No. 55 of the Weber Gas Engine Company, Kansas City, Mo., is devoted to vertical gas engines and suction gas producer plants.

RECORDING ELECTRICAL INSTRUMENTS.—Bulletin No. 24 of Wm. H. Bristol, 45 Vesey Street, New York, gives a well-illustrated description of recording milli-voltmeters and shunt ammeters.

GATE VALVES for pressures of 150 lb. or 250 lb. per sq. in. are described in detail in a pamphlet recently issued by Jenkins Bros., 71 John Street, New York, as a supplement to their general catalogue.

WEBER GAS ENGINE COMPANY, Kansas City, has issued a brochure on governors that govern, devoted to the proposition that a gas engine can operate an electric generator and ensure steady lights.

ELECTRIC LOCOMOTIVES FOR MINE AND METALLURGICAL WORK.—A reprint issued by the Allgemeine Elektricitaets-Gesellschaft of Mr. A Soeder's paper, with the above title, read before the Mining Engineers' Society of Upper Silesia.

ELECTRICITY AND PRINTING SHOPS.—An admirably illustrated pamphlet, issued by the Allgemeine Elektricitaets-Gesellschaft, describing many applications of its motors to printing presses, from the small job press to the ponderous Webb presses.

INSULATORS.—Insulator Catalogue No. 1 of the Ohio Brass Company describes a great variety of porcelain insulators, for all voltages. A very complete line for low-tension work includes telephone insulators and electric light and railway feeder insulators.

TRANSFORMERS.—Folder No. 4011 of the Allis-Chalmers Company, Milwaukee, Wis., deals with transformers for lighting service. These transformers, which are designed for operation at a primary e. m. f. of 1050 or 2100 volts, are made in 16 sizes, ranging from 6 k-va to 50 k-va.

ELECTRICAL MEASURING INSTRUMENTS.—The Robert Instrument Company, 56 Shelby St., Detroit, Mich., have issued a catalogue dealing with pocket volt-ammeters, ammeters, voltmeters, miniature and standard size switchboard ammeters and voltmeters, electroplaters' voltmeters and spark-coil current indicators.

SECOND-HAND MACHINERY.—Mr. J. Warren Archer, of 114 Liberty Street, New York, has issued a circular list of electrical and steam machinery. The list includes railway units, rotary converters, transformers, controllers, switchboards, instruments, arc dynamos, direct-current and alternating-current generators and motors, Corliss and automatic steam engines.

FUSE HOLDERS.—The Trumbull Cheer magazinette for February gives illustrations and descriptions of fuse holders made by the Trumbull Electric Manufacturing Company, Plainville, Conn. A large part of the publication is filled with gossip which makes interesting reading. Among the pointed paragraphs is one stating that "Advertising is like a bent pin in the seat of a sleepy man's chair."

PUSH-BUTTON AND LEVER-CONTROLLED ELECTRIC ELEVATORS.—The Allgemeine Elektricitaets-Gesellschaft of Berlin has just issued a well-illustrated pamphlet on its push-button and lever-controlled electric elevators for direct-current and alternating-current circuits. The various parts of the controller mechanism are shown, as well as complete diagrams of electrical connections.

AMERICAN FLAMING ARC LAMP.—The American Flaming Arc Lamp Company, Boston, Mass., has issued a pamphlet descriptive of its new type of flaming arc lamp, known as the Baker-Bartlett system, Mr. J. Gardner Bartlett being president of the company and Mr. Malcolm H. Baker the engineer. The lamp is described and illustrated in full detail, and the concluding pages contain instructions for insulation and operation.

ARC LAMPS.—The Allgemeine Elektricitaets-Gesellschaft has undertaken to rebuild its arc-lamp housings so as to conform to esthetic tastes. Prof. P. Behrens has been engaged for the purpose of designing these housings, and the first lamp after his design is shown in a four-page pamphlet. The lamp is shown in colors and its simple and graceful lines give it a dignity that cannot be approached by the tawdry affairs one so often sees.

ELECTRIC WASH DAY is the title of a neat and interesting pamphlet issued by the "1900" Washer Company, of Binghamton, N. Y. It is devoted to their electric washers and wringers, which are both driven by electric motor and have been designed for such method of operation. A large number of these are already connected to electric light circuits throughout the country, both direct and alternating. Both appliances embody a number of good points quite aside from their electrical operation.

STATISTICAL TABLES.—Spencer Trask & Co., investment bankers, William and Pine Streets, New York City, have issued the 1908 edition of their booklet entitled "Statistical Tables." The current edition comprises 84 pages of information relating to American railroad and industrial companies, together with details covering practically all of the securities dealt in upon the New York Stock Exchange. Information is given upon the bonds of street railway, gas, electric light and industrial companies.

PORTABLE AND PRECISION METERS.—Circular No. 1104, of the Westinghouse Electric & Manufacturing Company, covers the entire line of portable meters manufactured by the company. Technical description of the principles upon which these meters operate will be found of much interest to users of portable ammeters, voltmeters, wattmeters and watt-hour meters, and the diagrams of connections illustrating the various methods of testing single-phase and polyphase circuits will prove useful to those called upon to make such measurements.

ELECTRICITY IN PAPER MAKING.—This is a pamphlet, commendable for the beauty of its execution, describing the Allgemeine Elektricitaets-Gesellschaft's systems of motor control in connection with motors driving paper-making machinery. The speed of a paper-making machine must be capable of variation over a considerable range and the variation must be made in small increments. Two control systems are described; in one a booster is used to increase or decrease the potential of the driving motor circuit; the other is that devised by Mr. Ward Leonard. Electric circuit connections for both systems are given.

COMPOUND ENGINES.—Bulletin No. 1512, of the Allis-Chalmers Company, has for its subject compound Reynolds-Corliss engines. Information on the building of compound engines is included from the first one, known as the famous "Centennial" engine, to those recognized today as embodying in their design and construction the very highest development of the engine builder's art. To determine whether it is better to use a compound engine requires careful consideration of the commercial and engineering conditions in each particular case, and to know how to meet these conditions is described in this bulletin.

TELEPHONE APPARATUS.—The Western Electric Company, of Chicago and New York, has just issued a very complete and informational catalogue devoted entirely to its telephonic apparatus. It is a quarto of 170 pages and contains only apparatus in common, general use, it being stated that material for which there is very little demand, or which is furnished only with complex exchange equipments, is omitted. It includes complete telephone sets, switchboards, batteries, insulators, induction coils, jacks, plugs and keys, protectors, bells, switches and supplies generally. All are shown in profusion and in detail, and there is a large amount of descriptive text, as well as list prices in every instance. This catalogue is one of the first actual evidences of the new trade policy of the Western Electric Company in selling its Bell apparatus to all comers.

POLYPHASE INDUCTION MOTORS.—The many advantages of alternating current as a source of power in the operation of manufacturing plants are now being fully recognized. Allis-Chalmers Company will send to any one interested a copy of its bulletin No. 1040, entitled "Polyphase Induction Motors." The induction motor is very simple in construction and, without moving contacts of any kind, insuring absolute freedom from sparking, flashing or burning, which is essential in plants where combustible material is at hand. The voltage in the rotating part is so low that insulation breakdowns do not occur. Allis-Chalmers Company manufactures induction motors of two types. One has a rotor with "squirrel cage" winding and is suitable for all classes of constant speed service. The other type is provided with a wound rotor adapted to the insertion of resistance at starting or for obtaining variable speed.

CARBON BREAK CIRCUIT BREAKERS.—An important feature of all electrical installations is the circuit breaker. In Bulletin No. 455 the General Electric Company, Schenectady, N. Y., describes a number of its well-known lines. Type C, Form G circuit breakers are designed for a small, reliable, automatic, protective device for direct and alternating current systems at a moderate price. Type C, Form P are particularly adapted for use on railway and power systems which are frequently subjected to severe short circuits and heavy overload. They are made up to 12,000 ampere capacity. Type C, Form K, especially designed for heavy service, are particularly well suited for railway work. They are made in capacities up to 10,000 amperes. The bulletin also contains descriptions of auxiliary switches, automatic tripping devices, etc., to be used with the circuit breakers, and gives complete data as to capacities, prices and dimensions of the devices shown. The bulletin contains thirty-six pages and is conveniently arranged for reference.

BOILER SCALE.—"What Scale Does to Boilers and What Is Gained by Keeping It Out of Them" is the title of a pamphlet published by the Harrison Safety Boiler Works, Seventeenth Street and Allegheny Avenue, Philadelphia, Pa. It is sent free on request. The unexpected demand for copies of this treatise has made necessary a second edition, which is now being distributed. The information here presented will be of interest and value to anyone concerned in the design, management or operation of steam boiler plants. The data have been gathered from the reports of the boiler inspection and insurance companies, the recent experiments of Prof. Schmidt at the University of Illinois, the results reported by railroads and power plants and from various authorities and seem to show that by reason of scale the average boiler plant wastes from 5 to 15 per cent of all the coal consumed, while the loss from boiler cleaning and repairs, loss of service and shortened life is even greater. This book will be sent by the publishers upon request.

MILL MOTORS.—Mill type motors manufactured by the General Electric Company, Schenectady, N. Y., to meet the demand of the constantly increasing business done for electrically driven rolling mills, etc., are described in Bulletin No. 4562, recently issued by the company. These motors are manufactured for direct and alternating current and are designated MD and MI motors, respectively. They are built in sizes from 30 to 150 hp, and the direct current motors, while generally rated at 220 volts, can be supplied for 500 volts, with a slight variation from standard speed. The alternating-current motors are wound for either 220 or 440 volts, 25 cycles, three-phase. The illustrations in the bulletin show the particularly heavy construction, and dimension diagrams.

with other data, are given in the text. The motors are totally inclosed, dustproof and are intended for use on heavy and intermittent loads. Mechanically and electrically strong, they are suitable for operating rolling mills, hoists, turntables, conveying machinery, etc.

DIRECT-CURRENT FANS are discussed in an artistic catalogue recently issued by the Peerless Electric Company, Warren, Ohio. Desk, bracket oscillating, ceiling, column and ventilating fans are listed and described.

INDUSTRIAL RAILWAYS.—Booklet No. 075, of the C. W. Hunt Company, 45 Broadway, New York, is a well-illustrated pocket-size publication, containing 64 pages devoted to industrial railways. In the Hunt system the flanges of the wheels are placed on the outside, and the outer rail around each curve is built so that the wheel will run on the flange instead of the tread. All curves are built for a common radius of 12 ft., around which the cars will travel as easily as on a tangent.

FIXTURES.—R. Williamson & Company, manufacturers of electric and combination fixtures, Chicago, have just issued a supplement to their well-known catalogue No. 12, which has been a standard fixture reference catalogue in the hands of central stations and electrical supply dealers the country over for a number of years. This supplement brings the catalogue up to date by showing square, mission and colonial styles designed since it was published. It contains 67 pages of handsomely engraved plates, showing modern fixture designs. One commendable feature of the catalogue is that all the fixture illustrations are made to one-quarter scale. Another commendable feature of design shown in this supplement is the tendency to place lamp sockets pendant and abandon the old-fashioned designs with sockets at an angle, which were usually bad, both from an illuminating and a mechanical standpoint. The catalogue also includes full-sized illustrations and prices of solid brass chain kept in stock for the manufacture of designs to order.

BOILER FEED WATER.—"Where water and fuel are scarce or dear" is the title of an interesting circular treating of the heating and purifying of boiler feed water in mining and smelting plants. The pamphlet is published by the Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa., and shows that by means of a Cochrane heater, about 6½ lbs. of water may be heated from 60 to 210° F. by 1-lb. of exhaust steam, and further than the 1-lb. of steam will be condensed and added to the boiler feed as pure distilled water, thereby saving 16 per cent of the coal bill as well as a nearly equal proportion of raw water. Further, heating the water throws out of solution the bi-carbonate of lime and magnesia, which, along with mud, sand and other impurities, are precipitated in the heater instead of being carried over into the boiler. It is pointed out that as the heater does part of the work of the boilers, six boilers and a Cochrane heater can make more steam, while requiring less fuel, less labor and less water, than seven without one. This pamphlet will be of interest to all who own or operate boiler plants.

CALIFORNIA HYDRO-ELECTRIC PLANT.—Allis-Chalmers Company's Bulletin No. 2027, entitled "The Hydro-electric Plant at Trinity River, California," contains some information on an interesting power transmission system. This plant is one of those which have been constructed with an eye to the future rather than the present needs of the communities they serve. It is located in the central part of Trinity County, California, two miles below the town of Junction City, where Cañon Creek, from which the water used for power is obtained, flows into the Trinity River, having a drainage area of 52 square miles. The dam, which is small, serves merely for diverting the water. Alternating sections of ditch and open flumes, with a total length of 5250 feet and a tunnel 1821 feet long are comprised in the system. An effective head of 600 feet, or working pressure of 260 lbs. per square inch, is obtained from two penstocks, each 1165 feet long. This power house is equipped with Allis-Chalmers electrical machinery, consisting of two three-phase, 25-cycle generators; each 750-kw, 500 r. p. m., 2200-volt, seven step-up transformers and auxiliary apparatus. The description of the entire plant is quite complete and will be found of interest.

GENERAL ELECTRIC RAILWAY CONTROLLERS.—The use of higher operating voltages for electric railway systems has imposed more exacting operating conditions on the controller equipments of electric cars. The General Electric Company, Schenectady, N. Y., has designed a new line of cylinder controllers with improved magnetic blowouts, which can be used on systems on which the voltage peaks reach 750 volts. At present three controllers, known as the K-34, K-35 and K-36, are being built and are described in Bulletin No. 4557, recently issued. The K-34 controller is suitable for use with either two 150-hp or four 75-hp motors, the K-35 with either two 100-hp or four 50-hp, and the K-36 with two motors only, each of 60 hp or less. The K-34 and K-35 controllers are provided with bridge connections and maintain full current through all motors during the transition period from series to parallel, giving a smooth acceleration and reducing the strain on motors and gearing. A powerful magnetic field is produced by means of individual blowout coils and arc chutes, which insures the extinction of the arc under all operating conditions and reduces the burning and repairs to a minimum. The bulletin gives the details of construction and dimensions of the different controllers.

ELECTRIC DRIVE IN CEMENT PLANTS.—The manufacture of Portland cement has several features which differentiate it commercially from almost any industry and which make it a particularly suitable field for the introduction of the electric motor. The General Electric Company, Schenectady, N. Y., in Bulletin No. 4555 describes the application of electricity to cement plants and gives a large amount of information regarding the different processes and the apparatus used. A cement plant is kept in practically continuous production, and the shutting down of any one machine must not affect the operation of the others. The direction and distance of the power transmission should not interfere with the most efficient layout, which should be determined solely by the relative location of the quarries, the storage bins, the best available place for the machinery and the space available for future growth. It is necessary to start the machines under overload and provide for short overloads during operation, so that the driving power must give the best efficiency at normal loads, with a large margin of overload capacity. To the above is added the most severe service conditions, on account of the unskilled labor employed and the character of the material manufactured. The bulletin points out the reasons why the General Electric equipment will successfully meet the requirements. A list of cement plants using General Electric apparatus gives a number of the equipments already installed.

DIRECT-CURRENT MOTOR STARTING.—Reliable and efficient starting devices are necessary for the satisfactory operation of all motor installations. In Bulletin No. 4559, the General Electric Company, Schenectady, N. Y., describes motor starting rheostats and panels for direct current. The rheostats contain an improved enclosed type resistance unit consisting of a low temperature coefficient resistance wire wound on a strong tube that is not brittle. The unit is treated with a special compound, which forms a coating both inside and out, making a strong and solid construction, and it is thoroughly baked before being placed in the rheostat. Rheostats with no-voltage release and those with both no-voltage and overload release are illustrated and described, as well as rheostats for starting reversible shunt or compound wound constant speed motors. In order to facilitate the installation of motor starting devices, the General Electric Company has perfected a line of motor starting panels, in which there is no multiplicity of the terminals to give trouble from bad or incorrect connections; space, labor and time are saved; maintenance is reduced and satisfactory operation, immediate and permanent, is obtained. The bulletin shows a variety of these panels in which different types of starting rheostats are used, the rheostat being combined with a line switch and fuses or with a double-pole circuit breaker. Dimension diagrams for the different capacities of rheostats and panels are included.

Unclassified Items.

BALTIMORE, MD.—At the annual meeting of the Maryland Telephone Company the following-named officers were elected: F. H. Bethell, president; C. E. Bryan, vice-president and general manager, and A. P. Crenshaw, secretary and treasurer. The company was recently taken over by the Chesapeake & Potomac Telephone Company, but will continue to operate separately for the present.

DANVILLE, ARK.—The question of establishing an electric light plant here is under consideration. A. Pace is interested in the enterprise.

WOLVERINE, MICH.—B. F. Stiffer, of Birmingham, who holds the electric lighting franchise, is making arrangements to begin operations at once.

GALT, ONT.—The City Council has decided to ask the Hydro-Electric Power Commission for a contract for 600 horse-power, the price not to exceed $22 per horse-power per year. The Council contemplates purchasing the distributing system of the local lighting company.

WALLACE, IDAHO.—The Interstate Telephone Company contemplates establishing an exchange in this city at a cost of about $30,000. The company will also erect three copper circuits between Spokane and Wallace.

ALLENTOWN, PA.—The Consolidated Telephone Companies of Pennsylvania has filed a notice with the Secretary of State of an increase of its indebtedness to the extent of $2,292,900.

GREEN JUNCTION, IOWA.—The Greene County Telephone Company is contemplating rebuilding its telephone exchange.

FORT WORTH, TEX.—Bids will be received until April 7 by J. J. Nunnally, city auditor, for a 650-kw, three-phase, 60-cycle, 2300-volt. alternating current generator with exciter; ten 100-light transformers; switchboard for 20 circuits of 50 arc lamps each; panels, exciter and generator panel, each panel to be equipped with ammeter, voltmeter, switch and fuses; generator to be direct connected to compound condensing Corliss engine. Alternate proposal will be received for 325-kw generator, exciter, engine, transformers and switchboards for ten circuits. Bids must include cost of foundation, delivery and erection of machinery on same. Bids will also be received at the same time for 1200-cp, 6.6 ampere, alternating-current series arc lamps, complete with inner and outer globes for street lighting. Bids may be submitted on lots of 250, 500 and 750 lamps.

SAN ANTONIO, TEX.—The City Council is considering an ordinance requiring all telegraph and telephone wires to be placed underground in the business section of the city.

DECORAH, IOWA.—The Upper Iowa Power Company is contemplating the erection of a new dam, power house and transmission lines to increase the output of its hydro-electric plant. W. H. Burtis is president and manager.

PELLSTON, MICH.—Plans are being prepared by the Pellston Electric Company for the construction of another dam and power house and about 20 miles of transmission lines. F. E. Hatch is manager.

MR. N. C. WATTS, general manager of the Staunton Mutual Telephone Company, of Staunton, Va., has been elected president of the Virginia & Tennessee Telephone Company, of Roanoke, Va.

Business Notes.

THE EASTERN ELECTRICAL ENGINEERING COMPANY, of Milford, N. H., has opened a branch in Bangor, Maine, in charge of W. E. Billings, treasurer and general manager of the company.

THE INTERNATIONAL STEAM PUMP COMPANY has moved its offices from 114 Liberty Street to 115 Broadway. The repair shops of Henry R. Worthington, the Geo. F. Blake Manufacturing Company, Knowles Steam Pump Works, the Laidlaw-Dunn-Gordon Company, the Slayton Air Compressor Works, the Snow Steam Pump Works, Holly Manufacturing Company and the Deane Steam Pump Company will be located at 44 Trinity Place, New York City.

DOSSERT & COMPANY are making further large shipments of their solderless two-way connectors to be used in the wiring of the eighty-five steel passenger cars now being completed by the Pressed Steel Car Company at McKees Rocks, Pa., for the Pennsylvania Railroad. These cars will run on the main line between New York and Chicago. They will be electrically lighted and no solder will be used in the splicing. The Dossert joints are installed in junction boxes underneath the car floors where the No. 4-0 feeder cables are connected.

MR. H. F. COPELAND, for twelve years manager of the electrical department of James S. Barron & Company, has established offices at 203 West Broadway, New York, as agent for a number of specialties for telephone and telegraph construction and maintenance. He will also manufacture and market the H-P rustless cable hanger. Among the specialties that will be handled are "Glitterine," two-hole telegraph blocks, wood battens, wood wiring cleats, ebonite and specialties in wood and in sheet metal for telephone and telegraph construction and maintenance. He will also handle various other devices.

LARGE ELECTRICAL MACHINES.—Several months ago steps were taken to stock and equip two of the great machine shop units at the West Allis Works, of Allis-Chalmers Company, known as shops 5 and 6, for the building of large electrical machines, particularly those intended for direct connection to the various forms of prime movers which constitute a large part of the product of the company. Heretofore the large electric generators for driving by gas engine, steam turbine, water wheel or Corliss engine have been built exclusively at the company's works in Cincinnati, Ohio. The construction of a part of these large machines in Milwaukee gives much needed room for the manufacture of motors, transformers and small generators at Cincinnati and does away with the former necessity of shipping heavy engine shafts to the electrical works to be fitted and keyed to the rotors of engine type generators. On the other hand, the West Allis Works are better equipped, through large experience in the building of big equipments, to handle the heavy parts. To indicate the type of work which has already been turned out at West Allis, shipment was recently made of two 2000-kw, 660-volt, 25-cycle, 3-phase alternators which were sent to the Homestead Works of the Carnegie Steel Company. These alternators are for direct connection to 42 x 54-in. Allis-Chalmers twin tandem gas engines, also products of the West Allis Works. A third alternator was recently shipped to the central furnaces of the American Steel & Wire Company. This machine was a 1000-kw, 13,200-volt, 25-cycle, 3-phase unit, designed for direct connection to a 34 x 42-in. Allis-Chalmers gas engine. These three generators were the first to be completed and shipped from the new shops, and others, including a 6500-kw unit, will follow in rapid succession during the next few weeks.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 18, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

879,138. RAILWAY SIGNALING DEVICE; Frederick Bauer, New York, N. Y. App. filed Oct. 18, 1907. Railway signaling device adapted to indicate the presence of a train at track sections adjacent to a crossing so as to prevent a collision thereat.

879,158. TRANSFORMER; Charles LeG. Fortescue, Wilkinsburg, Pa. App. filed June 8, 1907. Provides means whereby a large variety of voltages may be obtained from a transformer by employing a comparatively small number of leads and without appreciable unbalancing of the magnetic circuits.

879,168. ELECTRIC RAILWAY SIGNAL; Frederic M. Hill and William C. Davis, Columbus, Ohio. App. filed April 6, 1907. Has a pivoted indicating device with a rotatable disk and a hook member engaged by a magnet trip to turn said disk and raise the semaphore signal.

879,180. ARC LAMP; Oskar Konitzer, Munich, Germany. App. filed Jan. 19, 1906. Patentee has a carbon rod with a longitudinal duct or cavity eccentric therein so as to provide a very thin web or wall at one point. This wall is engaged by a stop of the type ordinarily used in flaming arcs.

879,234. ELECTRIC CIRCUIT CONTROLLER; Christian Aalborg, Wilkinsburg, Pa. App. filed April 4, 1906. Circuit controllers for effecting suitable circuit connections for starting and stopping electric motors of the induction type. Makes use of depressible plungers in an oil bath.

879,245. CONTACT FINGER; William Cooper, Pittsburg, Pa. App. filed May 21, 1906. A spring contact finger for controllers comprising a V-shaped resilient member, one leg of which has a hook at its end to engage the other leg, the other leg carrying a contact block.

879,246. COMMUTATOR FOR ELECTRIC APPARATUS; Frederick W. Cox, Wilkinsburg, Pa. App. filed April 4, 1906. A means for clamping the commutator segments securely in place, comprising undercut collars engaging the segments at the ends and middle portions thereof.

879,252. MULTIPLE RATIO TRANSFORMER; Charles LeG. Fortescue, Wilkinsburg, Pa. App. filed June 8, 1907. Electrical transformer in which the winding is arranged to secure a large number of ratios between the voltages of the primary and secondary windings so that the adjustment of the voltage ratio may be effective without unbalancing the magnetic circuits, or materially affecting the inductance and the power factor of the transformer.

879,257. TROLLEY CATCHER AND RETRIEVER; Franklin J. Gustine, New Orleans, La. App. filed July 5, 1906. Provides means whereby the trolley pole is automatically tripped at a certain position in its upward movement so as to fall by gravity below its normal position of use.

879,267. CONTROLLING MEANS FOR PNEUMATICALLY OPERATED DEVICES; Ray P. Jackson, Wilkinsburg, Pa. App. filed March 3, 1906. Construction of overhead collector or shoe of the double-jointed arm type, having pneumatic retrieving and controlling apparatus.

879,274. FRICTION COUPLING OR CLUTCH; Christian Kramer, Frankfort-on-the-Main, Germany. App. filed Jan. 25, 1907. Magnetic friction clutch having a non-metallic body loosely mounted between the driving and driven members and establishing a friction connection therebetween, but preventing their engagement by residual magnetism.

879,285. AUTOMATIC MULTIPLE FUSE BLOCK; William C. Mayo and John Houlehan, El Paso, Tex. App. filed May 2, 1907. Means for inserting fuses in a circuit after any one is blown. Includes a step-by-step ratchet operated mechanism.

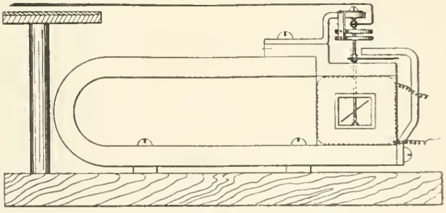
879,300. TELEGRAPH SWITCHBOARD; Albert T. Newman, Greeley, Kan. App. filed March 6, 1907. Switchboard adapted for use by telegraph operators, in which one man frequently has a number of instruments to look after. Has a pivot arm movable over a circular series of contacts for the different instruments.

879,307. SYSTEM OF ELECTRICAL DISTRIBUTION; Roderick M. Palmer, Cambridge, Mass. App. filed March 17, 1906. Has means whereby a plurality of translating devices may be individually or conjointly operated by a current of relatively high voltage, and the circuit of the said devices individually controlled so that one of the translating devices may be operated or a plurality may be simultaneously operated as desired.

879,357. TELEGRAPHIC TRANSMITTER; Clarence Brain, Parsons, Kan. App. filed May 15, 1907. Telegraphic transmitter of the automatic type in which the depression of keys operates mechanism or devices for transmitting Morse signals.

879,361. BATTERY PLATE; William M. Brodie, West Orange, N. J. App. filed Feb. 15, 1905. As a new article of manufacture, a strongly coherent, pressed copper oxid plate having corrugations formed therein of such depth as to materially increase the superficial area thereof, substantially as set forth.

879,385. ELECTRICAL MEASURING INSTRUMENT; Adrian H. Hoyt, Penacook, N. H. App. filed July 9, 1904. Has a pivoted inclined element, means for polarizing said element, mechanical means tending to hold said element in a fixed position, a coil for causing deflection of said element, and a pointer for indicating the amount of deflection.



879,385.—Electrical Measuring Instrument.

879,387. AMMUNITION HOIST CONTROL; John D. Ihlder, New York, N. Y. App. filed Aug. 30, 1907. Ammunition hoist provided with means whereby it may be stopped at different positions corresponding to different elevations of the gun.

879,397. AIR BRAKE, LIGHTING AND SIGNALING SYSTEM FOR RAILWAY TRAINS; William C. Mayo and John Houlehan, El Paso, Tex. App. filed Jan. 31, 1907. Relates to improvements in the electric control of the braking mechanism of railway trains and the lighting of said trains and also the signaling between the train crew and the engineer.

879,400. WIRELESS TELEGRAPHY; George W. Pierce, Cambridge, Mass. App. filed March 16, 1906. Apparatus at the receiving station of a wireless telegraph system designed to be readily tuned or brought into resonance with electromagnetic waves of widely varying length and in which variable resonance may be attained.

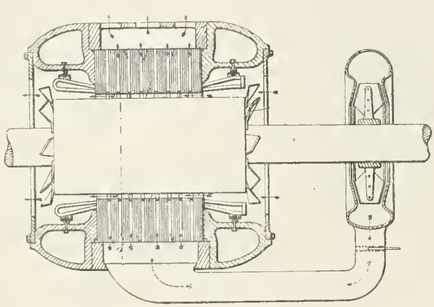
879,411. SELF-WINDING CLOCK; Henry S. Prentiss, Elizabeth, N. J. App. filed Sept. 14, 1906. Self-winding clock of the type having a weighted arm which is intermittently raised by an electromagnet and which impels the clock train through a ratchet wheel.

879,425. ELECTRIC GENERATOR FOR TELEPHONE LINES; Henry Tideman, Menominee, Mich. App. filed Jan. 16, 1905. In a commutator for magneto electric generators, two semi-circular segments of which the joint periphery forms a circle about a shaft, two conducting circular segments having a reduced diameter through half of the circumference, and an insulating circular segment of similarly reduced diameter through the half circumference, embraced between said two conducting circular segments, substantially as described.

879,438. TELEPHONY; Morgan Brooks, Urbana, Ill. App. filed May 31, 1906. In a substation telephone set, the combination of line conductors, a transmitter, a receiver and induction coils, said receiver being connected with a plurality of said induction coils and said line conductors being connected with but one of said induction coils, substantially as described.

879,452. PROCESS OF MAKING MOLTEN PEROXIDS; Hans Foersterling, et al., Perth Amboy, N. J. App. filed March 6, 1907. A process of making molten alkaline oxids which consists in bringing the metal to be oxidized into reaction with an oxidizing agent at such a temperature that the resulting oxid is instantly molten.

879,454. TELEPHONE EXCHANGE APPARATUS; William A. Fricke, Chicago, Ill. App. filed March 8, 1907 A telephone exchange system including a plurality of telephone lines extending from substations to an exchange, line and cut-off relay circuits, condensers for separating said circuits, and connecting means at the exchange permanently associated with said condensers and adapted to connect said condensers in talking sides of the telephone line and between the relays in said circuits.



879,564 —Turbo-Alternator.

9,494. TRAIN PROTECTION FOR RAILWAYS; Benton C. Rowell, Chicago, Ill. App. filed Feb. 13, 1899. Relates to signal and train stop system for railway crossings designed to make it impossible for two cars to collide at said crossing.

879,498. ELECTRICAL WATER HEATER; Milton H. Shoenberg, San Francisco, Cal. App. filed June 5, 1907. Has a dome-shaped chamber in which the water circulates and which contains a plurality of spirally hung resistance elements which the current traverses in a multiple circuit.

879,522. LIGHTNING ARRESTER; George W. Clark, Grand Rapids, Mich. App. filed April 26, 1907. Patentee has a pair of carbon blocks separated by minute gap and a magnet with depending poles arranged to blow out any arc which may be formed.

879,532. SPACE TELEGRAPHY; Lee DeForest, New York, N. Y. App. filed Jan. 29, 1907. Oscillation detector comprising an evacuated vessel having two electrodes enclosed therein, and means for heating one of said electrodes. A plate of platinum is interposed between the electrodes.

879,548. SIGNALING APPARATUS; Jewet G. Homet, Scranton, Pa. App. filed Oct. 8, 1907. Patentee provides a plurality of depending arms in the path of the car which are engaged in a predetermined order so as to light certain lamps in a definite sequence, the character of which gives predetermined warnings.

879,555. INCANDESCENT LAMP CONTROL; Roy E. Kimball, Fruitvale, Cal. App. filed March 30, 1906. Provides means by which an incandescent lamp may be lighted or extinguished by a distant switch independently of the local switch and regardless of the position thereof.

879,564. TURBO-ALTERNATOR; Charles E. Lord, Norwood, Ohio. App. filed June 7, 1905. The stationary field frame has passages therethrough which co-operate with ventilating passages in the armature so as to provide a continuous ventilating current.

879,568. BURGLAR ALARM; James E. Murray, Washington, Pa. App. filed Feb. 1, 1907. Circuit closing device making use of a rod which is supported transversely of the window so as to be raised, and open or close a circuit when the window is disturbed.

879,582. TROLLEY RETRIEVER; Richard Phillips, Washington, D. C. App. filed June 8, 1906. Trolley harp carries wing-shaped pivoted arms which have gear connections with the trolley pole so as to be raised or lowered automatically.

879,586. CABLE HANGER; DeElbert A. Reynolds, New York, N. Y. App. filed Sept. 7, 1906. Patentee surrounds the usual connection wires of a messenger cable with sheet metal parts which prevent injury to the cable suspended.

579,593. TROLLEY WHEEL; Jacob M. Siegrist, Oswego, N. Y. App. filed Sept. 4, 1907. Trolley wheel of the type having spirally arranged grooves adjacent to the main groove of the wheel so as to guide the conductor thereon. Has special supporting means by which the wheel is removable, and lubricating features.

879,596. RECLAIMING TIN-SCRAP; Elmer A. Sperry, Brooklyn, N. Y. App. filed Oct. 8, 1906, The method of reclaiming tin-scrap, which consists in concentrating the tin values, removing the black scrap therefrom, submerging the tin concentrate in an anhydrous liquid and treating the same with chlorin.

879,612. ALKALINE STORAGE BATTERY; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed June 29, 1904. In a storage battery, the combination with suitable active materials, of a practically non-foaming alkaline electrolyte obtained by filtration of an alkaline solution through a filtering medium of very fine porosity, substantially as set forth.

879,632. CIGAR LIGHTER; Augustus C. Gruhlke, Waterloo, Ind. App. filed June 13, 1906. Cigar lighter of the type which employs a volatile fluid and is electrically ignited when it is desired to use them. Has a contact which is passed across the plate adjacent to the wick when desired.

879,633. PROCESS OF TREATING METALLIC ORES OR MATTES; Emil Gunther, et al., Eisleben, Germany. App. filed June 18, 1907. Subjects copper and nickel containing concentrated regulus to electrolytic action, as anode in bath of chlorid of copper.

879,636. TROLLEY WHEEL; Edward J. Harrison, South Bend, Ind. App. filed July 18, 1907. The trolley wheel is made with hollow spokes which communicate with an oil cup within the wheel so as to lubricate the peripheral groove where it engages the conductor.

879,643. TELEPHONE CIRCUIT; Charles M. Jacobs, et al., Reading, England. App. filed Oct. 12, 1906. In a system for eliminating or reducing the influence of disturbing currents on telephone circuits, the combination of a telephone transformer and a phonoporically wound receiver, the latter being connected across the terminals of the secondary winding of the transformer, the said secondary winding being directly in the line.

879,648. MEANS FOR AUTOMATICALLY CLOSING ELECTRIC CIRCUITS; Fayette W. Keeler, Temple, Tex. App. filed Aug. 18, 1906. A signal system designed to permit a train despatcher to communicate with all the operators at once in a division, as well as selectively ring alarm bells at particular stations.

879,650. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isido Kitsee, Philadelphia, Pa. App. filed May 14, 1906. Provides means whereby telegraph instruments may be protected from the inductive influence of neighboring wires.

879,651. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isido Kitsee, Philadelphia, Pa. App. filed Jan. 26, 1907. Means for eliminating or counteracting the inducing effect of wires carrying current for light or power or wires useful for electric transmission of intelligence.

879,683. PROTECTOR FOR THIRD RAILS; Frank D. Sharp, Altoona. Pa. App. filed Jan. 19, 1907. The third rail is beld in inverted relation between insulating blocks inserted in spaced cast-iron supports on the exterior of which are bolted a protecting cover of wooden boards.

879,697. ELECTRIC CLOCK-WINDING MECHANISM; Adolf Trilke, Eimsbuttel, near Hamburg, Germany. App. filed Dec. 21, 1905. Electric winding device for combined clock and wheel trains designed to enable the winding of the clock trains, one of which may he the going train and the other the striking train, and each operated by a weighted lever.

879,711. TELEGRAPHIC TRANSMITTER; Clyde William, Porter B. Mitchell and Sharpe Hathaway, Barton, Ohio. App. filed May 6, 1907. Provides means whereby a succession of Morse signals may be automatically sent so as to relieve the operator of as much unnecessary physical work as possible.

879,723. ATTACHMENT PLUG; Reuben B. Benjamin, Chicago, Ill. App. filed Jan. 29, 1904. A lock or stop for retaining a plug attachment in position in the socket and in firm electrical contact therewith to prevent the plug from becoming partially detached with the consequent arcing between the contacts.

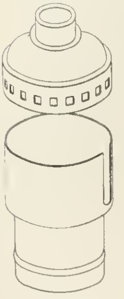
879,724. ELECTRIC LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Feb. 29, 1904. Provides means whereby the usual cap having an opening therethrough for the leading-in wires and an insulating bushing in said opening is entirely done away with.

879,725. ATTACHMENT PLUG; Reuben B. Benjamin, Chicago, Ill. App. filed March 25, 1907. Attachment plug having a base with a plug movable relatively thereto, and an outer contact member carried by the base and adapted to be expanded by the movement of said plug relatively to said base.

879,729. TROLLEY POLE HEAD; George G. Buchanan, Dubois, Pa. App. filed April 21, 1906. The trolley harp is pivoted on a vertical axis so as to swing laterally at the upper extremity of the trolley pole. Spring abutments are provided to limit the lateral movement.

879,760. SWITCH PLUG; Henry C. Froelich, Chicago, Ill. App. filed Aug. 12, 1903. Plug adapted to be inserted into sockets of the ordinary screw-threaded type without necessitating the usual turning manipulation. The plug is adapted to be slipped in and out in the manner of a telephone jack plug.

879,765. SUPPORT FOR ELECTRIC SERVICE WIRES AND CABLES; Edward H. Greenleaf and Theodore A. Dissel, Newburgh, N. Y. App. filed July 23, 1907. A wire hanger of special construction having a portion to engage the messenger wire and a depending hook to engage the main conductor. Has supplemental hooks to carry additional service wires.



879,819.—Electric Lamp Socket.

879,773. EXTENSION PLUG FOR ELECTRIC LIGHTS; Bryson D. Horton, Detroit, Mich. App. filed Oct. 2, 1903. Extension couplings for conductors of electric currents. Designed to be inserted and removed without the usual twisting movement.

879,777. ELECTROMEDICAL APPLIANCE; Samuel H. Lackland, St. Louis, Mo. App. filed April 22, 1907. Has a belt with electrodes in circuit with a small dry battery which is adapted to be worn or carried by the patient.

879,789. REGULATING MAGNET CONTROLLER FOR ELECTRIC ELEVATORS; Henry P. McColl, Hawthorn, Victoria, Australia. App. filed May 29, 1906. A regulating magnet controller comprising a rheostat actuated by solenoids having windings with opposite influences, said windings being controlled by the car switch so that acceleration of the motor may be sustained at any speed by the operation of said switch.

879,819. ELECTRIC LAMP SOCKET; Gilbert W. Goodridge, Bridgeport, Conn. App. filed July 18, 1907. An electric lamp socket having the end of the shell provided with projections and having a cap flange provided with a greater number of symmetrically arranged openings with which the projections of the shell can engage.

879,824. LIGHTING ATTACHMENT FOR GAS AND ACETYLENE BURNERS; Clifford J. Larkin, Everett, Mass. App. filed Aug. 10, 1907. Lighting attachment adapted to be readily applied to the barrel of any burner connected with any usual supply of illuminating gas or acetylene.

879,830. ATTACHMENT PLUG; David L. Webb, New York, N. Y. App. filed April 16, 1903. An attachment plug adapted to he inserted and removed in a threaded socket without any necessity of turning or twisting the same.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, MARCH 7, 1908. No. 10.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. HAROLD S. BUTTENHEIM, Secretary.
A. E. CLIFFORD, 2d Vice-President. CURTIS E. WHITTLESEY, Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Schofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....................per year, $3.00
Dominion of Canada....................4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, on average of 18,294 copies per week. Of this issue 25,000 copies are printed.*

NEW YORK, SATURDAY, MARCH 7, 1908.

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ELECTRIC POWER LOAD.

The contents of this issue are largely devoted to power application from central-station circuits—a subject which is rapidly becoming of such vital importance to central-station managers as to demand their best thought and most energetic action. It is true that the value of a motor load to a central station has always been recognized, but the tendency in the past has been to regard it so far secondary to the lighting load as only to call for odds and ends of attention, if any at all. These remarks do not apply, of course, to the case of most of our large city plants, as the economic study by these of every branch of electrical supply early led to an appreciation of the necessity of a day load in order to make operation profitable. What can, however, be done in smaller cities and towns by persistent effort is illustrated by the examples of Fitchburg, Mass., and Marion, Ind. In the first mentioned place, of which the central-station plant and its business methods are the subject of the two articles printed elsewhere in this issue, almost 60 different applications of electric power have been made, and this in a community of less than 50,000 inhabitants; and in Marion, a relatively small town, every industry is dependent upon the electric motor, which evidence of modernity is one of the points dwelt upon in the publicity campaign carried on by the city to swell its manufacturing industries.

As pointed out by Mr. Kimball in his account of building up the Fitchburg power load, success in this line cannot be expected to attend immediately upon effort put forth. Among the reasons for this are the vague ideas users have as to the amount of power actually expended in the operations of their plant, and the equally vague ideas as to the actual cost to them of steam power. If a small manufacturer has a steam plant rated at, say, 10 horse-power, he assumes that he is using just about that amount of power during the entire working period; and as this class has rarely any system for keeping account of power costs, their rough-and-ready estimates of these neglect important items, such as the large ones of steam plant depreciation, repairs and interest on investment, and many smaller ones that are not obtrusively evident. It is not an easy task to disabuse the minds of the average proprietor on these points and bring him around in favor of electric power by argument alone; for such argument to be effective implied the preliminary instruction of the subject in steam costs and the mysteries of kilowatts, average demand and other matters of a kind with which his mind has not been accustomed to deal. The most successful plan appears to be the installation of motors on trial, and getting on the ground immediately after a break down with a neighborly offer to install immediately an electric motor to keep the plant going. With a motor once installed, and with a power rate that is reasonable, there is little probability of a return to the former power, and the effect on further business of each new motor placed will be of a geometric order.

The field for household applications of electric power has as yet been practically untouched, and is most promising. For example, the electric fan has become as much a summer necessity for the office as ice water, and the time is not distant when this will also be the case in the household. There is here no inertia to use to be overcome; for if once installed, a suggestion from the head of the family to cut it out will be apt to bring the ready reply that economy in this respect might first be applied at the office desk. Central-station preparations for the coming summer season should include a large stock of electric fans for placing out on trial, the term of which should be made somewhat indefinite in order that a final answer as to purchase may be called for at a time when the temperature will have some influence on the decision. The great success in putting out flat-irons on trial should be duplicated by similar electric-fan campaigns. Other most promising motor applications is to the washing machine, which is important on account of possible indirect effect with respect to further uses of electricity. The great domestic issue now confronting the American people is the servant question, and in this electricity can be made to figure as a considerable ameliorating factor on account of the many household conveniences it has to offer. We venture to say that in many communities the introduction and successful use of several electric washers would quickly place this application on a good footing, and that in time servants would give the preference to the household which in this manner has mitigated her hardest task. The relatively small use of electricity in the household aside from lighting, has been due more to inertia on the part of central stations than chargeable to the general public. The social history of the past half century has shown that there is scarcely any limit to the desire of modern people for conveniences that make life easier. At present, the dweller of the tenement house enjoys sanitary conveniences that were a luxury to the wealthy less than a generation ago; and the general introduction of the bath-tub was a matter of less ease than should be the passing into general use of most of the numerous electrical household appliances described in other pages of this issue.

Electrical Manufacturing Costs.

It is understood that the General Electric Company's production of apparatus for the year ended Jan. 31 reached the splendid total of $70,000,000, as compared with $60,000,000 in the previous year. While the report will not be due until May, these figures may be accepted as approximately correct. It is estimated, however, that the amount available for dividends was $9,800,000, as compared with $10,232,839 in 1903 on a gross of $36,685,000, or about one-half the product value. In other words, in spite of the tremendous advance in the value of the product, the per cent of profit to gross has fallen off in the period 1903-8 from 28 to 14 per cent.

This is an extremely interesting result, and raises many conjectures, but we think it is susceptible of various explanations that are generally of an encouraging nature. First of all, it seems part of a general or universal tendency observable throughout the field of industry, and to be noticeable almost invariably as periods of great prosperity climax. Expenses mount up rapidly in such times, but prices do not rise with them, or do it more slowly as the element of competition comes in and other checks are automatically imposed. In some instances prices of goods have advanced sharply, but for the period named it is probably true that electrical prices have relatively and actually declined. This would be due to the fact, as a broad proposition, that the size of the unit has gone up, bringing with it an actual smaller return on the piece, or on the horse-power or kilowatt capacity.

But electrical manufacturing has had to endure during the past five years a scarcity of labor which was increasingly inefficient as it was better paid, if one is to believe the statements made. It was frequently impossible to get the skilled labor needed, and even whole classes were taken out of college at the moment of graduation. Now there are more normal conditions, and the showing will probably be better. The most obvious point is that the cost of one item of raw material, copper, had gone up enormously, and even taking it for granted that electrical manufacturers did not at any time pay the utmost high price, they certainly had to pay a good deal more than now, when open quotations of copper are around 13 cents. This reduction of copper cost will necessarily show in the value of output, and it would seem likely to have a decided influence in bringing the per cent of profit on gross back to the old basis, or near it. There are involved also other questions and considerations, such as the effect of patents on protecting large profits of manufacture. Possibly this element did not enter any more in 1903 than it does in 1908, but it is a reasonable assumption based on facts that profits are usually high where the patents are strong and enforced; it being the wise object of the patent system to encourage the investment of capital in new inventions. Electrical inventions were never so free as they are to-day from controlling patents.

Tests of Desk Fans.

Everyone is familiar with the modern electric desk-fan. It comes into evidence when the thermometer climbs each year into the middle of that part of the scale lying between the marks "temperate" and "blood heat." Long before our office thermometers have reached the mark of intemperate blood heat (98.6 deg. Fahr. or 37 deg. C.) the office fans are at full speed The fan load on a summer day in a large city like New York is a very respectable aggregate for the central stations, and helps to level the load diagram and increase the load factor. During the summer, the swish of every desk fan is a sigh of care lifted from the station manager's heart. The comparative tests of seven different fans, which form the subject of an article appearing in this number, are specially welcome in view of the meagre existing data in this branch of design. All of the fans tested—and probably the samples represent the great bulk of the articles furnished on the market—had a total fan diameter of from 11.5 in. to 12.4 in., or so nearly alike in this respect that they would have to be set side by side to make the difference in diameter clearly distinguishable. Moreover, all fans seem to be divided into four blades. Comparing the direct with the alternating-current fans, we observe from the tables in the article that the mean direct running current is 0.42 ampere, and the mean alternating running current is 0.73 ampere, or about 75 per cent more; but the mean direct-current watts are 46.7 and the mean alternating-current watts 50.6, or about 8 per cent more. In regard to power consumption, the two types are therefore on the average not far apart, although the differences in power consumption among different alternating-current makes are much larger than among the different direct-current makes. Moreover, just as in larger motors, the alternating-current fans take on the average a much larger starting current, namely, 1.75 amperes, as against 0.71 ampere for the direct-current starting average.

It is not clear from the article what "net watts" may mean; but assuming that they mean the power delivered in each case to the blades at full speed, it appears that the mean motor efficiency of the direct-current machines was 43.4 per cent and of the alternating-current machines 29 per cent. In this comparison lies the weakest part of the latter fan, because it is not so much the waste of a watt or two more in the motor that is objectionable, but rather the warmth thereby given to the air that is blown into one's face. Like the hand-fans of Cleopatra's attendants, before the days of the electric fan, they glow the faces they do wave; or, according to Shakespeare, "what they undid, did." It is certainly undesirable to cool a man by blowing warmed air into his face. The article indicates that the average temperature elevation of the direct-current motor frames was 5.5 deg. C., and that of the alternating-current motor frames 11.3 deg. C., or nearly twice as much. Of course, it is easier to criticise than to correct, because the iron losses tend to be greater in the alternating-current motors. Some compensation for the greater warmth of the alternating-current motors is, however, found in the fact that with the exception of the series type, they have no commutators to get into possible trouble, and to that extent are preferable to direct-current motors.

A fan enjoys the property of increasing in resisting torque as the square of the velocity, up to the particular velocity at which it begins markedly to slip through the air or to churn air without displacing it. Assuming that we work below this velocity, a given amount of power put into the blades is exchanged into motion of translation, and into motion of twisting or eddies in the air. The former is the useful motion in fan-moved air. It is theoretically possible either to move a larger volume of air at a smaller average velocity, or a smaller volume of air at a larger average velocity. Neglecting eddy-current motion, a certain quantity of power in watts at the blades exchanges for a definite total quantity of $mv^2/2$ or kinetic energy in air. As a rule, people prefer a fan that gives a fairly large m or mass of air in motion, and a more moderate average velocity v. This means a fan that will distribute air generously in different directions or spread the motion out fanwise, rather than one which sends a concentrated small jet along the axis at a high velocity. Of course, a self-centered man, who thinks only of his own desk, may prefer a thin jet of air at high velocity; but a friendly spirited altruistic person, especially if he catches cold easily, likes to see the beam of air distributed impartially upon the just and unjust, with a large and generous m but correspondingly diminished v^2. The velocity diagrams accompanying the paper are an interesting innovation, and ought to be developed further for different speeds of each fan. It would be convenient to have a polar velocity-curve supplied with each fan by the maker, like the polar candle-power curve of a lamp reflector.

Local Conditions and Business-Getting.

How far do local conditions commonly influence the obtaining of new business by central station companies? We have been treated to a variety of answers to this question during the past two years. It is, of course, common for the central station manager who has not been making the most of his field to hide behind the local-condition excuse and maintain that his town is different from many others. In fact, this was invariably the argument which was brought up for many years to block attempts at progress in central station commercial development. There are those who maintain that there is no radical difference between American communities in the possibilities which they offer for central station revenue, and that the differences of local conditions talked of are largely imaginary, or that the little differences offset each other in different communities. It must be confessed that the supporters of this doctrine have a long record of successful demonstration back of them to prove that in a large number of cities and towns there is no great difference in the possibilities. On the other hand, there are every now and then examples which may or may not be the exceptions which prove the rule, but which certainly seem to show that there are some nuts which are very hard to crack.

We have known of cases where central station solicitors and new-business men after a brilliant record in one community have failed dismally in another. It is true that a solicitor with a successful record in one community, upon being transplanted to another community as a prize business-getter, may have such inflated ideas of his personal importance as to prevent him from making another record. This does not account for all of these cases, however. There is undoubtedly considerable difference in the rapidity with which different communities will take up innovations, and in the freedom with which they will spend money. As a general thing, the community which will take up new things most rapidly is the one which will drop them the soonest. It may take many times the work in solicitation to introduce new electric appliances into a frugal, saving community of retired farmers than in a mining town, where money flows freely. Once introduced, however, these appliances are likely to remain in use, and there will be no great slump in earnings when hard times strike the place, as there would be in the mining community. We think it must be recognized that there is considerable difference in communities as regards central station growth, although this difference is nowhere near as marked as some conservatives would have us believe, and we have yet to hear of the town which has not yielded increased central station revenue under the right kind of effort.

Motors for Domestic Water Pumping.

The electric motor is assuming an important place in making up for the shortcomings or absence of water-works supply in numerous places. In some large cities the water service is so inadequate and poorly planned that insufficient pressure is a chronic condition, and all large flat and apartment buildings have to depend on their own pumps for the supply of the upper floors. This makes good business for the central-station company, even though it may be a reflection on the municipally-operated water works. Nothing is so well adapted to domestic pumping service of this kind as the electric motor with automatic starting and stopping apparatus. It can be used either with or without a roof storage tank. In small towns where there is no water-works system there is always the opportunity to install small electric pumps for the hotels, business houses and larger residences. In this way the absence of the possibility of a city pumping load for the central station is partly made up for by the small individual pump installations.

ELECTRIC DEEP-WELL PUMPING.

The question of the best method of adapting electric motors to deep-well pumping comes up frequently in cases where the electrical operation of small waterworks systems is under consideration. As an assistance to the central station manager in considering the efficiency and desirability of the various methods of deep-well pumping, the abstract of the paper by Mr. Charles B. Burdick before the Western Society of Engineers, which appears elsewhere in this issue, will be found of value. The depth of the water below the surface necessarily has much to do with the plan to be adopted. Probably the most efficient deep-well pumping by electrical means at the present day is by vertical-shaft centrifugal pumps sunk in the well to below water level, as indicated in the paper referred to. Such an arrangement, however, is the most expensive to install of the three methods available. The air lift has never had any great claims for economy made for it, but it certainly eliminates much of the uncertainty of service and expense of repairs to apparatus which operates deep in a well, because all of the moving machinery is entirely outside of the well. Assuming that a central station company is able to do all of its pumping from a well at times when it has ample engine and generator capacity, the question of the inefficiency of the air lift in a small central station need not cause much concern. If the air compressor is operated either by a belt from an engine used to drive a generator, or by a motor from the generator, it will usually cause a surprisingly small incease in the coal consumption. The reason for this is that many of the fixed losses in the engine and boiler plant are so large on light loads that a small addition to the load does not make a proportionate increase in the coal bill. As to deep-well plunger pumps, there is very little to be said in their favor, from the standpoint of a central station company about to pump water from a deep well electrically. To begin with, the question of properly counterbalancing them is serious. If this is not taken care of thoroughly the variations in load on the motor at different parts of the stroke will cause voltage variations on the small central station, and these variations may become of such a frequency as to be very annoying. Add to this the prospect of troubles in hauling up and repairing the deep-well plunger, and the choice seems to simmer down to air lift versus vertical-shaft centrifugal pump. If there is much water to be pumped and the reaming out of the well can be done at a reasonable cost the centrifugal pump is to be chosen on account of its economy. In a small plant, where it is desirable to keep the investment down, the air compressor, which can so easily be adapted either to motor or engine drive, has strong claims for recognition.

MOTORS AND DEFECTIVE HEATING SYSTEMS.

An interesting article by Mr. George H. Jones, elsewhere in this issue, calls attention to the new and extensive field for small electric motors in overcoming the defects in steam-heating systems in large buildings where low-pressure steam-heating plants are in use. The attention of central-station men has already been called to the important part which the small fan motor may take in improving and curing the defects of hot-air furnace-heating systems. It is also well known to the profit of central-station companies, motor manufacturers and pump manufacturers that the electric motor has an important part to play in making up for the shortcomings of city water supply in flats and apartment buildings where electrically driven pumps must be used to insure satisfactory water pressure. It now appears that the "motor cure" can be taken to advantage by steam-heating plants, the motor in this case being used to run a small pump to return water of condensation to the boilers and to insure drainage of the condensed water from the steam-piping system of the building. The owner of an apartment building in which there is trouble from the collection of condensed water in the pipes seems to have heretofore been between the two horns of a dilemma. If the boiler pressure were raised, coal bills were likely to go up in proportion, bcause of unnecessary radiation losses at various points.

If, on the other hand, a steam pump were put in to aid in draining pipes and returning condensed water to the boilers, the boiler pressure would have to be run up considerably above that needed for heating the building in order to operate the steam pump. Besides that, the pump itself under such conditions, exhausting into the atmosphere, is a very wasteful piece of machinery. A small electric motor and centrifugal pump, according to the practical experience cited in Mr. Jones' article, is a much more economical proposition for the building owner than either the steam pump or increase in steam pressure without the pump. With the motor-driven pump, low steam pressures can be carried and the electrical energy required by the pump is a very small item. It is likely that investigation would reveal thousands of steam-heated buildings which might be more satisfactorily heated by looking after the return of condensed water to the boilers and drainage of the pipes. In the case of a small low-pressure plant, this can best be accomplished by the electric motor.

THE ST. LOUIS RATE SYSTEM.

The rate system recently adopted by the central-station company at St. Louis, details of which are given elsewhere in this issue, differs sufficiently from other typical systems of rates in extensive use in the United States to entitle it to special mention in a class by itself. The fundamental principle underlying the St. Louis system is that a customer shall be given a lower rate the higher the minimum guarantee he is willing to make per month per lamp connected. Besides this, the rate is graded according to the amount of a customer's connected load, thus recognizing the principle that it is in some respects cheaper to serve one large customer than several small ones. These two principles, that of the minimum guarantee and the amount of connected load, govern the customer's base rate, and upon this basic rate further discounts are given according to the number of hours' use per month of the connected load and also according to the amount of the customer's bill. The discounts allowed for energy consumed in excess of a certain number of hours' use per month of the connected load is not, however, as large as is customary in rate systems where this principle is recognized. In fact, it would be out of the question under the St. Louis system to make that discount charge in view of all the other discounts to which the customer may be entitled. The most unusual and striking thing about the system is the grading of the basic rate according to the minimum guarantee which the customer is willing to make per month per lamp or per horse-power connected. The idea is a striking one in several respects. The customer has an inducement at the outset to make his minimum monthly guarantee as high as his business will stand in order to get the benefit of the lower kw-hour rate which the high guarantee carries with it. There is, of course, for every customer a balancing point, where the minimum guarantee will equal the bill rendered for energy consumed, and it is about this point that the intelligent customer will attempt to fix his guarantee. The same principle has been applied extensively in measured-service telephone rates. One of its principal practical advantages seems to be that it overcomes the customer's objections to paying high minimum bills. The customer has laid before him a rate schedule whereby he can select his rate per kw-hour by guaranteeing a greater or less minimum bill. It aids in making clear to him the justice of high minimum bills for customers having small kw-hour consumption. It also tends to induce customers who have established a certain minimum bill to consume energy fully up to the minimum, as there is no incentive to economize if the energy consumption is to fall below the minimum.

Right to Regulate Rates.

Note has been made of the unanimous decision of the New York Court of Appeals in the case of the Saratoga Gas Company, holding that as a successor to the former commission, the Public Service Commission has the constitutional right to regulate prices. The old Gas Commission is held to have had such a right, and the new commissions inherit it. There seems to be, however, some misunderstanding as to the real nature of the decision even in that respect. It was held that a maximum rate might be fixed by a body enjoying the delegated legislative powers, but it was likewise held by the court as unconstitutional that the lighting companies should not enjoy or possess the right and opportunity to secure an increase in any rate that the conditions proved to be unreasonable. The lower courts had held that in such respect the companies had no status. The highest court has reversed this as unconstitutional, in denying to the companies equal protection under the law. In other words, a Public Service Commission does not exist merely to cut down prices in the interest of the consumer, but must accord to a company equally the right to apply for a change in its favor. This is only fair, but even some of the members of these commissions seem to have assumed or taken it for granted that their sole mission and object in life was to act on applications against the companies and even to work up complaints against them. It has been our view, and the court now declares that to be the true constitutional fact, that such commissions must not be partisans or prejudiced, but have been created to protect the corporations equally with the consumer, who naturally wants to get a commodity as cheaply as he can. That is human nature, but is not always human equity or divine law.

Electric Power for Vacuum Cleaning.

Vacuum-cleaning apparatus for household use, which has been rapidly on the increase during the past two years, is of interest to central-station men as offering additional opportunities for day load. One can now find on the market apparatus all the way from a light, portable apparatus weighing only 70 lb., using a ⅙-hp motor and costing about $125, up to large stationary plants employing motors from 5 horse-power up, and costing many hundreds of dollars. The machines range all the way from those producing a very small vacuum and moving a considerable volume of air up to others maintaining 15-in. vacuum, which will pull the dust clear through an ordinary rug. The noisy portable gasoline engine-driven automobile or wagon outfit which goes from house to house in our large cities has already become a familiar sight. In large hotels stationary motor-driven outfits have become common. It is to the more extensive use of the smaller apparatus, however, that the central-station man must look for the most important revenue. The smaller machines are rather new on the market as yet, and it is difficult to predict how extensively they will be used. It is not unreasonable to suppose that if once a rug is thoroughly cleaned it can be kept clean thereafter by frequent applications of light suction, and for miscellaneous dusting low vacuum is well suited. There thus should be a good field for the small, portable apparatus which can be used in every house where electric service is available. It is also possible that where individual householders do not feel like purchasing an apparatus, a house-to-house business in a neighborhood might be done by one man with a very small capital at prices which would make regular patronage of such a service attractive. The fixed charges on some of the larger gasoline-driven wagon outfits are high because of their great first cost, and the operating cost is also high because of the number of men required to go with them. If house-to-house work with small outfits is ever successful, it must necessarily be on the basis of more frequent visits and at moderate cost. When vacuum cleaning comes to be the common method in residences and high-class offices, there will be a notable increase in central-station revenue.

It would seem that among the most promising fields for electrically-operated vacuum cleaning systems is that of apartment and flat buildings. The piping of such a building in a manner to have a tap for every apartment is not relatively a very important item of expense, since a few risers can take care of a large number of apartments. In such a case, one good outfit can take care of the cleaning of a large number of families, and the wiring can easily be so arranged that the motor can be started by a switch in any one of the apartments, the current used by the motor being registered by a meter for that apartment. Such an arrangement should prove a very popular feature in any apartment building, since the question of cleaning of rugs and curtains becomes more serious the more congested the city and the larger the buildings.

Patent Office Scandal.

On Thursday, Feb. 27, an indictment was filed in the Supreme Court of the District of Columbia, against Examiner Ned. W. Barton, of the U. S. Patent Office, John A. Heany, of York, Pa., and the patent attorney of the latter, Henry E. Everding, of Philadelphia, in which it is charged that they "unlawfully and wilfully and with intent to steal and destroy the same, did take and carry away from the said Patent Office" certain specifications and an amendment thereto, and a letter relating thereto, the date of the offence being Sept. 2, 1907. The specifications were filed with, and formed part of, an application, No. 241,782, filed Jan. 19, 1905; the amendment was filed on July 27, 1907; the letter, which was addressed to John A. Heany and signed by W. A. Cowles, acting examiner of the patent office, and bore the stamp of Commissioner F. I. Allen, was dated March 28, 1905. Those charged with the crime were arrested and held on $10,000 bail, which was furnished.

The patent involved is apparently one bearing date of issue of Dec. 3, 1907, and relating to tungsten-filaments and electrodes for incandescent lamps. According to the newspaper accounts, applications from a large number of electrical concerns have been in interference with the Heany application upon which the patent is based, and the changes alleged were made to secure a patent that would be superior to any granted on these applications. The evidence presented to the Secretary of the Interior is stated to have been obtained by detectives in the employ of one of the large electrical manufacturing companies.

In a statement relating to the case, Patent Commissioner E. B. Moore said that early in February evidence was laid before the Secretary of the Interior, tending to show that fraudulent acts had been committed in the prosecution and procurement of a patent. The secretary at once brought the matter to the attention of the Commissioner of Patents, who immediately appointed a committee of investigation. This committee found in substance that by the connivance of an employee of the Patent Office, matter that was not in the application for a certain patent at date of filing was unlawfully introduced subsequently during its prosecution, thereby laying a foundation for claims to an invention not disclosed in the application when it was filed. The effect of such an act is to establish a false date of invention much earlier than the true date and thus enable the patentee to dominate and control all inventions falling within the scope of the claims of his patent that were made after the filing date of the application for that patent, even though in fact they may have been made earlier than the invention covered by his claims.

The specific charge, Commissioner Moore said, is that of destroying public records. It is alleged that Barton, by reason of his position, had access to office records, and was enabled, at a very recent date, to substitute for papers filed more than two years previously, certain other papers and give them the same date as if they had been filed originally. The invention described in the substitute papers is thought to be very valuable, and a great advantage would attend it if a date of invention sufficiently early to antedate the prior inventions of others could be secured. To be successful in this plan it was necessary to destroy original records of the office, and file substitutes therefor, and by changing the dates of receiving stamps make it appear that such substitute papers were, in fact, actually filed upon the fictitious dates stamped on the papers.

Commissioner Moore added that notwithstanding the vast moneyed interests involved in patents and the consequent many opportunities for corruption arising therefrom and from the necessity of relying upon the integrity of each individual examiner, owing to the technical and judicial character of the work of the patent office, no examiner has ever been shown false hitherto to the trust imposed upon him in all the 118 years of existence of the United States patent system.

Several patents have been granted to Mr. Heany on metallic-lamp filaments. The latest of these is dated Dec. 3, 1907, an account of which appeared in these columns shortly after its issue. The application for this patent, No. 241,782, was filed Jan. 19, 1905. On an application, No. 239,769, filed Dec. 29, 1904, by the same inventor, a patent was issued Dec. 25, 1906, and on Jan. 29, 1907, a patent was issued to him on application No. 238,769. Accounts of these patents also appeared in our columns. In the specifications of the patent of Dec. 3 a number of other applications on file relating to tungsten-filaments are referred to.

No statement from any of the parties involved in this regrettable scandal has been obtainable; and in view of the previous good standing of those indicted, there should be a suspension of judgment until their side of the case is presented.

"Breakdown" Service in New York.

"Breakdown Service" was the issue discussed last Wednesday before Public Service Commissioner Maltbie at the first hearing in the investigation of electric light companies in New York. Mr. Arthur Williams, general inspector of the New York Edison Company, after giving a definition of "breakdown service" stated under what conditions the Edison Company had been giving such service to consumers in New York. On the books of the company were 123 private plants, Mr. Williams said, which were supplied with this service during the year ending December 31, 1907, using a total of 3,504,961 kw-hours. During 1907 no new contracts were made for such service, except at the request of the Public Service Commission. Mr. Williams testified that the Edison Company had ceased giving this class of service about two years ago, because at that time the increase in the demand for "breakdown service" became so great that the company felt that to comply with all requests would seriously affect the general system. The matter of giving "breakdown service" had never been formulated as a policy of the company, and it was feared that the taking over of large plants of 1000 or 2000 horse-power would seriously interfere with the operation of the entire system. Additional reasons were the large maintenance cost and impracticability from an engineering standpoint, of providing feeders, mains, meters and service, all of which must be installed up to 100 per cent of "breakdown" contracts, for private plants. The 123 consumers who were already on the books of the company were supplied at the best rate of the company for that class of service.

Referring to a recent letter of the Edison Company to the Commission, offering to furnish "breakdown service" to all applicants on a minimum charge of $30 a year per kilowatt of installation, Mr. Williams said that this price was estimated on the basis of the average return which the company was getting from its service to all its customers. He gave $300 to $400 as a fair average cost of installing a distributing and generating system per kw-capacity.

Mr. John W. Lieb, Jr., third vice-president of the Edison Company, said he felt that the "breakdown service" charge, in view of the fixed and stand-by expenses incurred by the company, was a fair and equitable rate, both from the company's standpoint and the standpoint of the consumer. He testified that the ordinary consumer required about 30 to 35 per cent of his connected capacity, but that the company found it necessary to be prepared to supply between 60 and 75 per cent of the installation capacity of a consumer who was using the "breakdown service." "On certain occasions," said Mr. Lieb, "when we felt that the public in general would suffer, we have not allowed anything to stand in the way of making prompt and immediate connections with a company which requested a 'breakdown' connection."

Mr. W. W. Freeman, vice-president of the Edison Electric Illuminating Company of Brooklyn, testified that his company had never refused to give "breakdown service," subject to certain restrictions and conditions. The charge made by the Brooklyn Company for this class of service was the same as that made to other consumers, except with a minimum rate of $1 per year for each 16-cp lamp, which equals $20 a year per kilowatt. Each month the consumer received his bill, and if, at the end of the year the amount of the aggregate bills was less than the minimum charge, the consumer was required to pay the difference. The $20 rate had been established in the early history of the company, and had been fixed in accordance with the custom of other companies. The matter of computing the cost of "breakdown" installation, Mr. Freeman said, had never been investigated until recently, by the Brooklyn Edison Company, but in the last two weeks the question has been taken up, and it was found that, according to averages, each kilowatt of such connected installation cost the Brooklyn company $21.50 per annum to carry; so that any sum received less than this amount from the consumer would not carry the actual fixed charges. The demand on the system, Mr. Freeman testified, was for the last year close to 50 per cent of the total connected installation.

None of the other companies which appeared before the Commission had been furnishing the "breakdown service" to consumers, and after the various representatives had testified to this effect, the hearing was adjourned until Monday, March 2.

Commissioner Maltbie on the date set for the second sitting of the commission adjourned the hearing until Thursday, March 6, when "breakdown service" will come up for further consideration. Only the Brooklyn Edison Illuminating Company, the United Electric Company and the New York Edison Company will be required to appear before the commissioner on that date.

Signals and Automatic Train Stops in the Hudson Tunnels.

An excellent example of the latest practice in block-signaling, interlocking and automatic train stopping is afforded in the equipment of the recently opened tunnels of the Hudson & Manhattan Railroad under the Hudson River.

The installation comprises a complete automatic block-signal and automatic train-stopping system, covering all of the tracks between Nineteenth Street, New York, and Hoboken, N. J. Between Hoboken and Greenwich Avenue—the river section of the tunnels—signals are placed on an average of 367 ft. apart. The minimum distance where speed is low is 115 ft., and the maximum is 1620 ft. On steam railroads, block-signal sections average 2640 ft., or two signals per mile; on the express tracks of the New York Subway the distance is 800 ft., or nearly seven signals per mile. In the Hudson tunnels the signal distance is only 367 ft.—or more than fourteen signals per mile.

The signals give three indications: "proceed," indicated by green light; "proceed with caution," yellow light; "stop," red light. As the consequences of a train passing a signal in the "stop" position may be disastrous, a device for automatically stopping such train is used at each signal. This consists of two movable short arms or trips placed alongside each rail. When the signal is in the "stop" position these arms are raised to engage with the trigger of a valve in the air-brake pipe of the train, releasing the air and setting the brakes. Each car is equipped with two of these valves—one on each end and on opposite sides of the car. When the signal moves again to the "proceed" position, the electric motor moves these train-stop arms out of "stop" position, thus permitting the train to pass without setting the brakes, the arms being returned to stop position by gravity after the train has entered the block. This automatic method of train control is in successful use on the Boston Elevated Railroad and on the New York Subway express tracks. On these lines, however, only one automatic stop is used to protect a train. In the Hudson tunnels, two stops are used, thus insuring a greater measure of protection.

An important feature of the system is that both rails of each track are used for the train propulsion current and also for the signal current. This arrangement permits of broken rail protection—that is, a broken track rail will interrupt the circuit and so cause the display of a "stop" or red signal, and the operation of the automatic stop if the "stop" signal be displayed.

All of the switches are under the control of the interlocking devices, consisting of seven plants—one at the Hoboken Terminal (the largest), two at Caisson No. 1, two at Caisson No. 2, one at Greenwich Avenue, and one at Nineteenth Street. The interlocking is by the All-Electric system—the switches being operated by electric motors at each switch. The signals are of the same type as used in the block system, and are controlled from the machines, the levers of which are so interlocked that it is possible to make only such movements as have been previously arranged for; conflicting movements are in this manner absolutely guarded against.

An interesting and novel feature of this plant is the illuminated track diagram. This is a diagram or chart of each track layout painted on glass and placed in front of each machine for the information of the operator. Each line of track has a row of small electric lamps placed back of the glass; these lamps are controlled from the different track sections; when the tracks are unoccupied the lamps show a bright green light; as soon as a train enters the limits of the interlocking, the light controlled by the track on which the train is running is extinguished, so that movement of a train along the track can be followed by observing the corresponding movement of the dark space along the track on the diagram. Without this method of indicating train movements it would be difficult for the operator to follow closely the train movements, on account of his limited field of vision, due to the construction of the tunnels.

The signal system was furnished by the General Railway Signal Company, of Rochester, New York and Chicago. The automatic stopping system was furnished by the Kinsman Block System Company, of New York.

President Roosevelt on Monopoly of Water Powers.

In a message sent to Congress Feb. 26 by President Roosevelt, transmitting a preliminary report of the Inland Waterways Commission, that part of the report dealing with water powers is commented on at some length. At present, President Roosevelt says, "among the monopolies there is no other which threatens or has ever threatened such intolerable interference with the daily life of the people as the consolidation of companies controlling water power. I call your special attention to the attempt of the power corporations, through bills introduced in the present session, to escape from the possibility of government regulation in the interests of the people. These bills are intended to enable the corporations to take possession in perpetuity of national forest lands for the purposes of their business, where and as they please, wholly without compensation to the public. Yet the effect of granting such privileges, taken together with rights already acquired under State laws, would be to give away properties of enormous value. Through lack of foresight we have formed the habit of granting without compensation extremely valuable rights amounting to monopolies on navigable streams and on the public domain The repurchase at great expense of water rights thus carelessly given away without return has already begun in the East, and before long will be necessary in the West also. No rights involving water power should be granted to any corporations in perpetuity, but only for a length of time sufficient to allow them to conduct their business profitably. A reasonable charge should of course be made for valuable rights and privileges which they obtain from the national government. The values for which this charge is made will ultimately, through the natural growth and orderly development of our population and industries, reach enormous amounts. A fair share of the increase should be safeguarded for the benefit of the people, from whose labor it springs. The proceeds thus secured, after the cost of administration and improvement has been met, should naturally be devoted to the development of our inland waterways. . . . Running water is a most valuable natural asset of the people, and there is urgent need for conserving it for navigation, for power, for irrigation and for domestic and municipal supply."

Minnesota Central-Station Men Organize.

Managers of 25 central station companies and municipal electric-light plants met at Hotel Nicollet, Minneapolis, Feb. 28 and 29, 1908, and organized the Minnesota Electrical Association. The first to move in the matter of organizing a Minnesota association of this kind were Mr. E. E. Rines, a consulting engineer and salesman, of Minneapolis, and Mr. A. H. Lane, of the Glencoe, Minn., central-station company. These issued the call and made the preliminary arrangements for the meeting. At the first session, Mr. A. H. Lane, of Glencoe, was elected temporary chairman, and Mr. Thomas Pitts, of Hutchinson, temporary secretary. Mr. Lane gave an address outlining the benefits of forming a central-station men's association. He was followed by Mr. Rines, who stated some of the work he thought should be attempted by the association. There was then a general discussion of the question whether the membership should be confined to companies or extended to municipal plants. It was finally decided to take in both companies and municipal plant men, as a number of superintendents of municipal plants were present, and it was felt that it would be beneficial for all to meet together.

A committee to draft a constitution and by-laws was appointed to report next day. This consisted of Messrs. R. E. Brown, of Mankato; W. R. Putnam, of Red Wing; Ludwig Kemper, of Albert Lea; A. J. Wagner, of New Ulm, and Leonard Peterson, of Thief River Falls. A committee to nominate officers was also appointed, consisting of Messrs. E. F. Strong, of Chaska; A. L. Westphal, of Staples; B. W. Copperthwait, of Fairbault; Emil Eveldson, of Litchfield, and A. V. Schroeder, of Winona.

The constitution, as adopted next day, provides that the membership shall be vested in central-station companies and in superintendents of municipally owned plants in Minnesota. The annual dues, which include the initiation fee, are $5. The annual convention is to be held the third week in March, the place to be fixed by the executive committee. Electrical manufacturers, dealers and consulting engineers are eligible to associate membership at $5 per year.

Various matters were discussed in an informal way, among other things the desirability of having electric-light companies regulated by a state commission as in Massachusetts, New York and Wisconsin, with competent experts to deal with central-station matters instead of uninformed and frequently dishonest city councils. It seemed to be the consensus of opinion of both municipal and corporation plant managers that regulation by a good commission was very desirable and that since such a commission was likely to be adopted in Minnesota before many years, it was to be welcomed.

A part of one session was given to the explanation of recent new developments by various manufacturers and jobbers. Friday evening the convention was entertained by a dinner at Hotel Nicollet, after which there was a theater party. This was tendered by the following Minneapolis manufacturers, jobbers and supply men: Northern Electrical Company, Minneapolis Steel & Machinery Company, Electrical Machinery Company, Minneapolis Electric Motor Company, R. M. Laird, Hollis Electric Company, Columbia Incandescent Lamp Company, Bryan-Marsh Company, G. J. Caldwell & Company, Walter Geisse, Twin City Electric Company, General Electric Company, Electrical Engineering Company, St. Paul Electric Company, and H. L. Upton.

When the convention adjourned, Saturday noon, it was taken to St. Paul on a special car by the Northwestern Electrical Equipment Company and entertained at luncheon at Hotel Ryan, which was followed by a matinée theater party.

The officers elected are: Mr. W. R. Putnam, of Red Wing, president; Mr. A. H. Lane, of Glencoe, first vice-president; Mr. Leonard Peterson, of Thief River Falls, second vice-president; Mr. Ludwig Kemper, of Albert Lea, secretary and treasurer. Messrs. R. E. Brown, of Mankato; Adolphus G. Wagner, of New Ulm, and T. C. Gordon, of Little Falls, together with the president and secretary, form the executive committee. The officers are a well-chosen body of the active central-station men of the state. Considering the small number of central stations in Minnesota, an attendance of 25 at a preliminary meeting of this kind is remarkably large, and the Minnesota Electrical Association starts in with prospects for a vigorous and useful career.

Electric Lighting in Cities and Villages of 3000 Inhabitants and Under.

At the recent convention of the Northwestern Electrical Association, Mr. Irving P. Lord, the general manager of the Waupaca Electric Light & Railway Company, of Waupaca, Wis., presented a paper with the above title, in which he said that during the past 10 years the number of commercial electric light plants has increased in a wonderful degree, and that this progress seems unabated. There are many small villages of less than a thousand inhabitants that are now lighted by electricity, whereas a few years ago such was not the case. Recent inventions and electrical machinery development have made it possible to invest as meager a sum as $5,000 in an electric-light plant in some small village, and obtain satisfactory returns. This is especially true where water power is available, or where the steam power of some manufacturing plant can be utilized. The demand for electricity keeps pace with general progress, and as rapidly as its production can be made to result in dividends on the required investment, so certain will new plants be built. This condition is to be desired by electrical manufacturers and supply houses for obvious reasons, and it should be their pleasure to encourage it.

Mr. Lord, having been actively interested for some years in the electric lighting business in a small city, and having observed an increase of income from $6,000 the eighth year to more than double that amount the sixteenth year, with no material increase in population, is convinced that there are possibilities in the electric lighting field, even in places having a population of 3000 and under. In these small plants the owner is manager, bookkeeper, collector, auditor, solicitor and purchasing agent. He employs a practical, competent electrician, who, with such help as is necessary, sees that the station is properly kept, and the general line work and inside wiring satisfactorily done. If the owner is ordinarily capable and keeps abreast of the times by regularly reading the electrical journals and attending his state association meetings, he will soon acquire such a knowledge of the business as is necessary to have in order to make it a success.

Another source from which the owner can get much practical knowledge is from the traveling salesmen who will frequently honor him with a call. They come in contact with many different propositions in their travels, and have perplexing questions presented to them almost daily, and it is no wonder they are often able to make suggestions that are valuable to the owner of a small plant, especially if he is new to the business. The acquaintance and friendship of the traveling salesman representing reputable houses should, therefore, be cultivated.

A small owner should acquire the soliciting habit. Assuming that his plant is in good physical condition he must then get the business. A reasonable rate for energy should be established, and as to what is a reasonable rate, local conditions will largely govern. It should be remembered that it is always easier to reduce rates than to advance them. The acquaintance and friendship of the merchants, manufacturers and others who might need considerable energy should be sought. Pleasant argument with these men when they are not busy is productive of good results. Technical terms should be avoided when talking with them, and if energy is sold at 10 cents per kw-hour, they should be told that a 16-cp lamp will consume approximately six-tenths of a cent's worth of electricity in an hour of time, and an 8-cp lamp a little more than half as much. Prospective customers can better understand such statements. One should not dispute the statement, if made, that kerosene or gasoline is cheaper than electricity; but should convince the person making it that neither is as good, convenient or healthy. It has been Mr. Lord's experience that of those who have been induced to try electricity only a very small number will ever cease to use it.

Dwelling-house lighting is profitable and the use of heating devices should be encouraged. Flat-irons when installed at cost will almost sell themselves after a 30 days' trial. They are usually consuming energy when the load is the lightest, and the income they produce is practically clear gain.

Street lighting in small cities and villages is usually a perplexing feature of the electric-light business. The aldermen or board of trustees are seldom composed of the best business talent of the place. They have their own personal interests at stake more than those of the muncipality they are supposed to serve. They think it quite the proper thing to be against the electric light company and they base their prospects of a re-election upon the vigor with which they have opposed the company and its business. Petty jealousies and personalities enter into their deliberations when they act upon an application of some citizen for a new street lamp, and it is often the case that no lamp is installed no matter how badly it is needed.

It is unwise to get into altercations with the aldermen or trustees. They should be treated with common business courtesy and all semblance of interest as to whether they put in new street lamps or not should be avoided. In due time they will find out that it is the public and not the electric light company that is seeking the new street lamps and the installation will soon be ordered.

One thing that is sadly lacking in the operation of small electric lighting plants is system. The business seems to be run too much on the country-store plan, which is really no plan at all. Very imperfect accounts are kept and the operation, construction and maintenance accounts are kept and the operation, construction and maintenance accounts are all so jumbled together that an expert accountant would have hard work untangling them. Many small owners have carried on their business for years without any definite knowledge at the end of the year as to just what the financial condition of the plant is. It is not necessary to have such a detailed system as many of the larger companies have, but it is absolutely necessary to have some system. Almost any practical bookkeeper can devise a system that will furnish the desired information at all times. A separate account should be kept with each customer, showing what his monthly bill is for energy, supplies or labor. It is a source of satisfaction for the owner to compare these monthly accounts with those of previous years, and by showing a prospective customer just what it has cost Mr. Blank to light his store during the year, another customer may possibly be obtained.

In concluding, Mr. Lord impressed upon those to whom his paper is especially addressed the necessity of trying to keep up to date in their business. He suggested that there was no better way of doing this than by mingling with others similarly engaged, exchanging ideas, comparing notes, making inspections of other plants, regularly attending the annual meetings of the state association and coming in contact with those who knew more than he did, listening to the papers and discussions there presented and visiting the exhibits and demonstrations provided by manufacturers and supply men. The small investment necessary to do this will be found to be one of the very best investments of the year.

New York Electrical Society.

Five hundred of the members and friends of the New York Electrical Society were present at the 274th meeting of the society in the Engineering Societies' Building on Feb. 28, when a most entertaining lecture was given by Mr. Augustus Post, the well-known aeronaut, on "Navigating the Air." Mr. Post treated his subject under two heads: apparatus lighter than air, and apparatus heavier than air. The former class was subdivided into balloons or gas bags, both free and captive, without motor, and envelopes or gas bags with motor. The heavier than-air class was subdivided into aeroplanes, including kites, and gliding machines without and with motive power, and machines of the helicopter and ornithopter types. The helicopters are direct lift machines using propellers or other devices for pulling them into the air and supporting them there while other propellers or kindred devices cause them to move forward, or the machine itself is so tilted that the supporting propellers are pulling at an angle in the direction in which progress is desired. Ornithopters are bird-like, flapping wing machines, a form of progression which as hitherto developed is difficult and inefficient.

A practical illustration of an ascension was given by the inflation of a model balloon, perfect in every detail, loaned by Mr. Albert C Tridca, director of the International School of Aeronautics, which was made to ascend in the lecture hall. The incident was made more interesting by the unfurling of the Stars and Stripes as the balloon left its moorings, to the distant strains of the "Red, White and Blue."

The latest signal development in ballooning, the international Gordon Bennett races at St. Louis, were described, and many striking episodes of the races were illustrated on the screen in a series of moving pictures, showing the inflation of the enormous bags under the direction of a special detachment of the U. S. Signal Corps, the start, the ascension, and the shrinking of the receding balloon to a mere speck in the sky

A series of interesting slides was shown by Mr. Wilbur R Kimball and a large number of pictures were loaned for the occasion by the Aero Club and by Mr. W. J Hammer.

Argument on Light and Power Rates at Minneapolis.

On Feb. 25 the Minneapolis General Electric Company and the committee of the Minneapolis City Council came to an agreement on electric light and power rates, which will probably mean the early drafting and acceptance of an ordinance giving the company a 30-years' franchise and fixing the rates for electric light and power for the first year of the franchise The matter has been in controversy over a year, and has brought out interesting points and helped to establish valuable precedents.

The City Council first passed an ordinance requiring a uniform rate of 8 cents per kw-hour, with discounts purely according to quantity. The company refused to recognize this ordinance on the ground that it was unjust, inequitable and confiscatory. It offered instead, as it had in the past, rates based on the number of hours' use per month of the connected load. The rates now agreed upon by the company and Council committee are based on the sound principles of rate-making for which the company has contended, although the company yielded to the committee's ideas on some points The point of notable interest to electric-light companies in this controversy is that a company has been able to convince a council committee and citizens of the fairness of a rate based on load factor, and of the unfairness of a uniform rate per kw-hour for all classes of business. This was done largely by expert testimony and investigation. Extended mention of this case has already been made in these columns, and more will be said in a later issue.

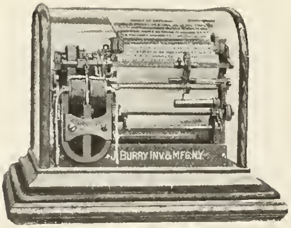
The accepted residence lighting rate is 9 cents per kw-hour for the first 52 hours' use per month, of 40 per cent of the connected load, and 6.66 cents for all over that. Commercial lighting is at the same rate, except that the maximum demand as measured by maximum-demand meters is substituted for 40 per cent of the connected load. Minimum bills are $1 per month per lighting customer. Retail power is to pay 7.5 cents per kw-hour for the first 52 hours per month of the customer's maximum demand, and 2.5 cents for all over that. The minimum bill is $1 per month per horse power connected. The chief difference between these and the old rates of the company is that the maximum rate has been reduced on lighting from 12.6 cents for 52 hours' use of 60 per cent of the connected lamps to 9 cents for 40 per cent; and the minimum bill on power reduced from $2 to $1 per horse-power. Free incandescent lamp renewals and free arc-lamp maintenance have been abolished under the new rates. Quantity discounts from 5 to 25 per cent are to be allowed on sums from $50 to $250 per month.

It was agreed by the experts that the maximum rates are below the profitable point as regards many small customers, and they were accepted as the equivalent of a franchise tax levied on the company in the interests of small consumers.

Printing Telegraph at U. S. Capitol.

A printing telegraph service, to report instantaneously in distant committee rooms and offices the proceedings on the floors of the Senate and House of Representatives, has been installed at the Capitol at Washington, and is now in operation on a demonstration basis. The system used is the Burry "page-printing telegraph," which prints the message, not like a "stock ticker" on a narrow tape, but line after line on a paper ribbon about 5½ in. wide.

The present installation consists of a single transmitting station in the basement of the House of Representatives end of the Capitol, and of a receiving instrument, which is placed in the distant southeast corner of the new House of Representatives Office Building, adjoining the Capitol. As the latter building is several minutes' brisk walk from the House, even when one uses the new subway that connects these buildings, this installation gives a good demonstration of the value of the service in disseminating information as to what is going on in either chamber of the national legislature, for the convenience of Senators and Representatives in the committee rooms or in their private offices. An advantageous feature of the plan is that it provides a record of the proceedings, so that a congressman arriving late at the Capitol can tell at a glance what has occurred.



RECEIVING INSTRUMENT.

The system is operated over a two-wire metallic circuit, the current being supplied from the 115-volt electric-light circuit of the building, the voltage being cut down by resistances. Although for the present only two stations are working, it is said that any reasonable number of receiving stations may be operated from one transmitter; and should the system be adopted by the government, it is proposed to have two transmitting stations—for reporting the proceedings of the Senate and the House, respectively—and a number of receivers located at the most effective points throughout the Capitol and the two new office buildings. The speed, for a heavily loaded line, is said to be 30 words per minute.

The transmission of official business was begun upon the convening of the House, Feb. 20, under arrangement with the House Journal Clerk.* The following are the principal features of the system:

The type wheel has 36 characters, but is controlled by an escapement-wheel having only half that number of teeth. This design means increased speed, since the type-wheel has to rotate through half the arc, on the average, that it would otherwise have to traverse. To print a given character, the received electric impulses actuate a polarized relay controlling the escapement-wheel thereby rotating the type-wheel into a position, with reference to the platen, midway between two characters of which one is to be printed. The selecting impulse from the sending keyboard then shifts the type-wheel forward or backward, by means of an aligning star-wheel on the same shaft as the escapement- and type-wheel, through one-seventy-second of a revolution, thereby presenting the right character to the platen for the printing stroke.

The receiving instrument is also equipped with a "momentum-wheel" spring winding device, consisting of a heavy brass wheel having teeth milled on its edge. These teeth are engaged by a "pumping ratchet" by which every mechanical impulse given by the functioning of the "power magnet" of the instrument, due to the received electric impulses, drives the wheel ahead. The teeth are also engaged by a detent, which prevents backward rotation of the wheel. The latter, thus continually urged ahead by the operation of the instrument mechanism, maintains the tension in a spiral spring which is threaded on the shaft of the wheel and which serves as a source of power for releasing the type-wheel escapement and shifting the paper. This device advantageously replaces the weight wound over a drum that is often used in apparatus of this kind as the source of power for operating the mechanism. An ingenious friction contact between the momentum-wheel shaft and the spring, obtained by winding the latter on a taper arbor, serves to prevent "over winding."

Kelvin and Submarine Telegraphy.

Prof. W. E. Ayrton, who was a student under Sir William Thomson, at Glasgow, contributes a lengthy and highly appreciative letter to the engineering supplement of London *Times*, with the title "Kelvin in the Sixties." From this we print below the portion which treats more particularly with Kelvin's connection with the development of the submarine telegraph:

During the sixties the world was very much interested in the possibilities of an Atlantic cable. In 1857 cable had broken while being laid; the 1858 one had failed after one short month of existence; the 1865 cable snapped after 1186 miles had been laid, and, although nine days were spent in trying to pick it up, and, although it was grappled many times, the rope broke; and this cable, like its predecessors, had to be abandoned. A few yards of this 1865 cable that had been picked up lay on the floor of the Glasgow laboratory and was often pointed to by Thomson as being what had given them heart and kept off despair. Then a prize of over three-quarters of a million sterling was offered to the Telegraph Construction & Maintenance Company if they could complete the 1865 cable and lay an 1866 one. And they won it.

While it was remaining doubtful whether the two sides of the Atlantic would ever be coupled electrically, Thomson's secretary used not unfrequently to be sent to the Glasgow rail station a few minutes before the mail train started with this urgent message from Thomson: "I have gone to White's to hurry on an instrument. The London mail train must on no account start to-night until I come." And such was the national importance of the problem, and such the honor in which Thomson was held, that the station-master obeyed.

Many have used Thomson's reflecting galvanometer and have regarded it merely as an extremely sensitive galvanometer without knowing how it came into existence. It was devised by Thomson to enable him to utilize his mathematical solution of signaling through a long submarine cable, and was regarded of such national importance that a private Act of Parliament was sanctioned by the Privy Council to extend the normal life of 14 years for the patent of this cable "speaking instrument," as it was originally called. The invention of this instrument marks the theoretical solution of a most important problem, which

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*"The Burry Page-Printing Telegraph." *Scientific American*, p. 181, March 23, 1901.

solution Thomson found great difficulty in getting the electricians of that day to accept.

As early as 1855—before any long submarine cable had been constructed—Thomson published in the *Proceedings* of the Royal Society the theory of the propagation of signals through a cable based on a correspondence which he had had with the late Sir Gabriel Stokes, and he showed that the book "Fourier de la Chaleur"—that "mathematical poem," as he used to call it—contained, in Fourier's mathematical equations of the flow of heat, the entire mathematical solution of the propagation of electric waves through a cable. From "Fourier's series" he deduced that, whereas on a short overhead telegraph line the signal reaches its full strength at the distant end practically as soon as the signaler at the near end of the line begins to send it, with a submarine cable it is retarded, spreads out, and blurs the next signal. There is a past history effect as in politics and in many natural phenomena. The passing of an Act of Parliament cannot suddenly change a people; indeed, it is well known that the actual effect of an Act of Parliament promoted by well-wishers is often gradually found to be most harmful, and has to be repealed or curbed in its action.

Herbert Spencer in his "Sociology" strongly advocated legislators to study the science of politics. Thomson would perhaps have said "Study Fourier's mathematical poem."

If it were attempted to send a series of electrical signals through an Atlantic cable with the *same* apparatus and at the *same* speed as messages are sent between London and Brighton, the signaler at the far end would not have the slightest knowledge that the signaler at this end was trying to send a message, whatever were the strength of the current sent into the cable. To work a long submarine cable, either time must be allowed for each signal to grow at the distant end, or, as this would make the sending of the message very slow, the receiving instrument and the signaler receiving the message must, like a clever doctor diagnosing a disease, be able to interpret mere indications. Sending the letter "e," for example, produces at the other end of a long cable a totally different result, depending on what has preceded it. In no case, at a speed of, say, 30 words a minute with a 3000-mile cable, will it be more than a suggestion, even at the beginning of a word; but in the syllables "toe" the "e" is as indistinct as the hurriedly written scrawl that you are very glad to get some one else to read for you.

Thomson wanted a receiving instrument which, unlike the ordinary telegraph instruments used in postoffices and railway stations, could render the interpretation of such suggestions possible in the hands of an expert signaler, and he devised the mirror galvanometer speaking instrument to obtain this result.

Another most important fact that his theoretical investigation brought out was that no increase of battery power could counteract the retardation in the signals produced by any impurity existing in the copper conductor of a cable, and hence that every yard of copper wire used in the thousands of miles of a long cable must be electrically tested before being used.

But all this appeared to the electricians as arising from the ignorance of an inexperienced young man who had never erected a mile of telegraph line in his life, and would not have been given a job in any telegraph office. And so when signals through the 1858 Atlantic cable became weak, and a message from the President to our Queen took 30 hours in transmission, although containing only 150 words and which would need only three or four minutes to transmit through any one of the good Atlantic cables of to-day, the only remedy of those who looked down on the theories of the young Glasgow professor was to use Whitehouse's "thunder pump," a magneto-electric machine which produced a sudden large e. m. f. when the armature of the permanent magnet was jerked off the poles of the magnet. But these shocks only sent sparks through the gutta-percha insulating coating and hurried the poor cable to its doom, so that even the three words per minute which would have been the utmost limit of speed possible had this cable been entirely uninjured, were replaced by absolute silence.

But Thomson energetically struggled on and pursuing (as he told me afterward) a "Parnell-Biggar policy" at the board meetings of the Atlantic Cable Company, obstructed all business until the directors promised to have all the copper wire tested for resistance before being made into cable; and thanks to Thomson for his theory of signaling, to that engineer of energy and surprising resource, even when quite a lad, Sir Charles Bright, to Captain Anderson, of the *Great Eastern*, and to all those who have followed in the history of submarine cable development the London Stock Exchange is by cable to-day within 30 seconds of Wall Street.

Thomson's work in connection with submarine telegraphy has been epoch-making. But 33 years ago it was associated with what I felt was a national loss. I give in an extract from a long letter which he wrote to me in Japan, December, 1874: "My dear Ayrton—You will be very sorry to learn of the terrible loss which has befallen us in the loss of *La Plata*, cable ship, with my nephew, David King, on board. * * *" David King and I had worked together for Thomson. I had seen them much in company with one another. In appearance, independence of thought, and in many ways there was great resemblance between them, so that I used to hope that a corner of the mantle of William Thomson might rest on David King.

Thomson has been called an engineer. In creative power, yes—a great engineer. But not in the forties, nay, even in the sixties, could a university student either at London, Glasgow or Cambridge learn what to-day is called even a college engineer. Thomson had never learned to make a working drawing, he designed in metal. We students could not help him with the T-square and drawing board as we might have done had we received the college engineering training of to-day. He thought of a new instrument, a new method of accomplishing some result flashed on him, and he sketched in his pocketbook a rough indication of what he wanted constructed; I took the idea, or what I understood of it, in my head to Messrs. White, so it was not to be wondered at that alteration after alteration was necessary before the thing that was in Thomson's mind's-eye became realized in metal.

CURRENT NEWS AND NOTES.

OMAHA ELECTRICAL SHOW.—An electrical show will be held at the Auditorium, Omaha, Neb., from April 13 to April 18.

OHIO INDEPENDENT TELEPHONE ASSOCIATION.—The annual convention of the Ohio Independent Telephone Association will be held at Hotel Hartman, Columbus, Ohio, Thursday, March 19.

NO GIFTS FROM CHICAGO PUBLIC-UTILITY COMPANIES.—Comptroller Wilson, of Chicago, has ruled that no telephone, traction, electric light or other public utility corporation can make contributions to hospitals or other charities.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION.—The annual meeting of the Missouri Independent Telephone Association will be held in Kansas City, Mo., Wednesday and Thursday, May 6 and 7. One of the features of the meeting will be a session for the discussion of farm mutual telephone service. The association has now nine district organizations, at all of which meetings will be held in advance of the annual general meeting. Mr. G. W. Schweer, of Windsor, is secretary of the association.

GOVERNMENT TELEPHONE IN BRITISH NORTHWEST.—At a meeting of the Canadian Bell Telephone Company, held at Montreal Feb. 27, it was announced that in all probability the company will sell out its business to the Provinces of Saskatchewan and Alberta. It is stated that while the company did not desire to sell, it was thought best to do so rather than incur the risks of competition with government lines in these provinces. The telephone system in Manitoba is already under government ownership.

NEEDHAM (MASS.) MUNICIPAL PLANT SOLD.—The town of Needham, Mass., has sold its municipal electric-lighting plant to the Boston Edison Illuminating Company and has closed a long-term contract with that company for street lighting.

ELECTRICAL INSPECTION IN CINCINNATI.—An ordiance has been enacted by the City Council providing for an inspection department for gas and electric meters. An inspector is to be appointed by the Board of Public Service at a salary of $2,000 per year.

CENTRAL STATION DINNER.—The Rockford, Ill., Edison Company gave on Feb. 20 a dinner to the "allied electrical interests of Rockford." According to the handsome menu of the occasion, a similar dinner will be given annually, the purpose being to "Boost for a brighter, bigger, busier Rockford."

ARC WIRELESS SYSTEM.—The German Patent Office, in a case of interference between Ruhmer and Poulsen, has awarded priority to the former for a device which has been used in the Poulsen system for interrupting the arc used in the production of Hertzian waves in wireless telegraphy and telephony.

NEBRASKA ELECTRICAL ASSOCIATION.—The annual meeting of the Nebraska Electrical Association will be held in Omaha during the week of the Omaha Electrical Show, May 4 to 9. Mr. William Bradford, of Lincoln, is secretary of the association, and Mr. L. E. Watson, of Beatrice, chairman of the program committee.

ILLUMINATING ENGINEERING SOCIETY.—At a meeting of the New York Section of the Illuminating Engineering Society, to be held in the United Engineering Societies Building, Thursday evening, March 12, at 8.15 o'clock, Mr. E. L. Elliott will present a paper on the "Relation of Illuminating Engineering to Architecture from the Engineer's Standpoint."

M. A. C. ENGINEERING SOCIETY.—The students in the electrical, civil and mechanical engineering courses of the Michigan Agricultural College, East Lansing, Mich., have organized an engineering society, and weekly meetings will be held for the presentation and discussion of papers. As far as possible, the papers will be obtained from members of the faculty and graduates engaged in engineering work.

BIDWELL IN COURT.—Benson Bidwell and his son, Charles F. Bidwell, were summoned in two court proceedings at Chicago on Feb. 18, one under a charge of operating a confidence game and obtaining money under false pretences in connection with the Bidwell Electric Company, and the other in an action for bankruptcy. It was stated at the time that another charge would be brought against the Bidwells for using the mails to defraud. Last week one of the cases came up in a Chicago court, but was adjourned by the judge owing to the evident illness of Benson Bidwell upon his appearance in court. W. H. Davidson, formerly export manager of the Bidwell Electric Company, stated that the Bidwells kept their "cold" motor, when exhibited, covered with ice by pumping carbonic acid gas through pipes which were cast in the outer framework of the machinery. According to the Chicago *Record-Herald*, Charles F. Bidwell, the son of Benson Bidwell, admitted that his father is a brother of the late Austin Bidwell, of the Bank of England notoriety.

NEW YORK STEINWAY TUNNEL.—The Interborough Rapid Transit Company has offered to sell to New York City the Steinway Tunnel under the East River for cost, which is stated to be $7,239,476. The tunnel is now completed, but the company has not received permission from the city for its operation. Accompanying this offer is a suggestion that if the city purchases the tunnel a contract be entered into with the New York & Queens County Electric Railway to operate the tunnel for a period of 25 years, a single fare of five cents to be charged between the New York terminal and any point on the line of the Queens County Electric Railway.

UNDERWRITERS AND WIRE COMPANIES CONFER—Following the announcement made last week that the Underwriters' Laboratories, Chicago, had withdrawn its affiliation with the Wire Inspection Bureau and that the Underwriters would refuse to accept the reports of that Bureau after Feb. 29, extended conferences were held in New York during the latter part of last week between a committee representing the Underwriters and a committee representing the wire companies. Until the committees have reported back to their respective organizations the results of their conferences will not be disclosed, but it is stated that a basis for the readjustment of the differences between the two bodies may be reached and the former relations of the Underwriters with the Wire Inspection Bureau resumed.

TRIBUTE TO THE LATE GEN. EUGENE GRIFFIN.—At the annual reunion of the First Volunteer Regiment of Engineers, of which the late Gen. Eugene Griffin was colonel during the Spanish War, Major Louis Duncan offered the following tribute to the memory of his former commander: "We knew the strength of his patriotism and his feeling of stern devotion to duty, and we knew the delicacy and tenderness of his friendship. In him was no small or ignoble thought. Whether we who are here believe in any creed, or whether our souls are shrouded in the gloom of disbelief, this we know: that somewhere in the illimitable confines of space we shall meet him again. God judges His people outside of creeds or beliefs. Eugene Griffin was a good man, and no harm can happen to a good man, whether he be alive or dead."

MARSEILLES ELECTRICAL EXPOSITION.—The American honorary committee for this French exposition, to be held this summer, has just been announced and includes in the electrical field Messrs. H. G. Stott, B. J. Arnold, C. F. Brush, J. J. Carty, M. Coster, F. B. Crocker, Lee de Forest, Carl Hering, P. C. Hewitt, Samuel Insall, H. Ward Leonard, J. W. Lieb, Jr., C. O. Mailloux, T. C. Martin, R. W. Pope, H. N. Potter, C. P. Steinmetz, L. B. Stillwell, Frank J. Sprague, Elihu Thomson, W. H. Tolman, S. S. Wheeler, and W. J. Wilgus. American exhibits now have until June 1 to get in place at the exposition, which opens April 19, and the classification has been slightly amended and enlarged. The electrical congress in connection with the exposition will be held Sept. 14 to 21. The program will be announced shortly, and will emphasize power transmission and distribution. Mr. Paul Dieny is the commissioner for the United States, Park Row Building, from whom data, rules and regulations can be obtained.

PUBLIC HEARING ON ACCOUNTING.—Commissioner Maltbie, of the Public Service Commission, announces that a public hearing will be held early in March on the subject of electric light accounting. For some time past the accounting committee of the Empire State Gas & Electric Association has been holding conferences with similar committees of the National Electric Light Association, the American Gas Institute, the Street Railway Association and the statisticians of the Public Service Commissions of both the first and second districts. A classification has been prepared by the committee which in many respects has met with the approval of the statisticians of the commission. Several important points, however, are still under discussion before the final adoption of a classification by the commission, which shall be used by all the companies of the state. Under the law the Public Service Commission has the power to decide upon a uniform system of accounting which shall be used by all the gas and electric companies.

Motor Equipment of the Bethlehem Steel Company's Rail and Structural Mills.

THE most severe and trying duty for electric motors is that of driving the reversing tables, transfer tables, screw-downs and other heavy machinery in steel and rolling mills. The frequent starting and stopping, heavy overloads and sudden reversals, subject the motor to strains that are not met with in any other class of service. Some idea of the unusual character of the load can be obtained by reference to the accompanying curves, in which the peaks are caused by sudden reversal.

Railway service was for a long time considered very severe for motors. Yet even in electric railway service the starting and stopping of motors are infrequent compared with the starting and stopping of motors in rolling mill service. Reversal of rotation is seldom necessary, and overloads are the exception rather than the rule. Perhaps in rough handling and exposure of motors to dirt alone can railway service be compared in severity to rolling mill service.

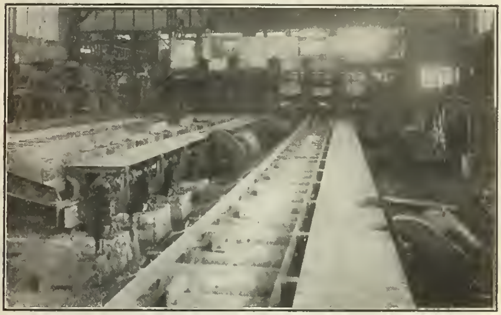


FIG. 1.—MOTORS OPERATING RAIL-MILL REVERSING TABLES

Because the series railway motor was the most rugged type on the market, it was natural that this type of machine should have been used when a motor was required for rolling mill work. Owing to the greater severity of work, however, added to inadaptability of various points of the design, railway motors never proved entirely satisfactory.

One of the shortcomings of railway motors for rolling mill service was that they were designed for 550 volts. Their commutators were therefore too small to take care of the increased current for 230 volts satisfactorily, and for this reason were a source of trouble. In addition to very poor commutation on 230 volts, rolling mill engineers urged the following objections to railway motors for this work: The shocks to which they were subjected in railway work are taken up by springs, and the shafts are therefore not heavy enough when the motors are without this protection. The frames in motors of considerable size are not split. Moreover, the frame is so compact that the parts are not accessible and no room is available for shunt or compound field winding. Further, they are designed for grease lubrication only; they cannot be securely bolted to foundations, owing to the absence of proper feet; and they have other objectionable features. It was therefore seen that in order to make a satisfactory motor for rolling mill work it would be necessary to design one specially for that work, regardless of previous types.

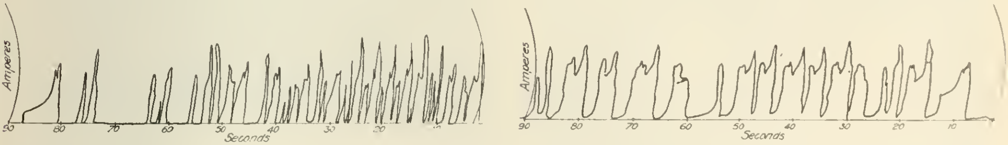


FIG. 2.—CURVES SHOWING CURRENT TAKEN BY ROLLING-MILL MOTORS.

The Saucon plant of the Bethlehem Steel Company at South Bethlehem, Pa., is equipped with motors of the rolling-mill type. The plant is one of the most thoroughly equipped in the country, and is probably the first designed and constructed with a view to using electrical drive wherever possible. While motors have been used in steel mills for light machinery, it is only recently that they have been employed to drive the tables, screw-downs and do heavy work. Notwithstanding that the older types of motors were not rugged enough for the work, the advantages of electric drive were so obvious that it is but natural that a new type of motor especially suited for this very important class of work should be forthcoming.

The motors in use at South Bethlehem are of the Crocker Wheeler make, and were designed after consultation with leading mill engineers to meet the following electrical requirements: The motor must be designed primarily for 230 volts. Commutation must be such that sudden reversals and sudden and extreme overloads will not injure the commutator or produce undue heating. The insulation must be of such character that it will not deteriorate with heat. Shunt field winding must be provided in nearly all cases in addition to the series field winding to prevent racing. Finally, the motor must have tremendous starting torque.

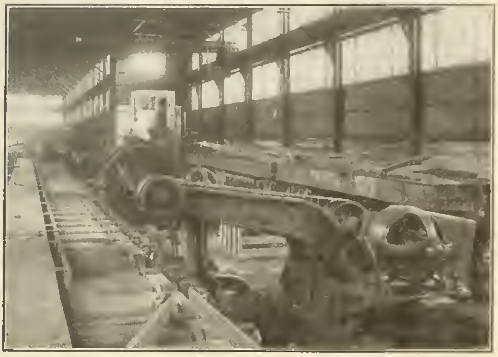


FIG. 3.—MOTOR-DRIVEN HOT SAWS

The mechanical requirements were as follows: The frame must be of such design that it can be securely bolted down. The shaft must be of very large diameter, as all the extreme jars and shocks must be taken up in the bearings and not by springs. The frame must be split and readily separable, so that the armature can be instantly removed and replaced in case of injury to the shaft or windings. The armature must be of comparatively small diameter to avoid danger from high speeds and to minimize the inertia and facilitate sudden starting, stopping and reversal. The armature winding must be retained by means that will not give way under extreme heat. The shaft must be readily replaced. The journal boxes must prevent the escape of oil and the admission of dust. Means for lubrication must be provided. All parts must be readily accessible without disassembling the motor. In general, every part must be extremely strong and durable, fastened in such a way that no amount of vibration will loosen or dislodge it, yet readily replaceable at will. Parts must be interchangeable.

Outside of driving the rolls themselves, for which duty a special arrangement of motors and circuits is necessary, the hardest duty in rolling mill service is that on the motors driving the reversing tables of the blooming and shaping mills. Here the motor is called upon to reverse the ingot as many as 10 or even 12 times in a minute with practically no rest between reversals and very short rest between heats. This is well shown in curve, Fig. 2. Next in severity probably comes the duty on the screw-down of rolls. This is a duty for which railway motors were never used. Transfer tables, loaders, shears and shear tables, saw tables, small tools and other machinery each have load characteristics putting peculiar strains on the motor.

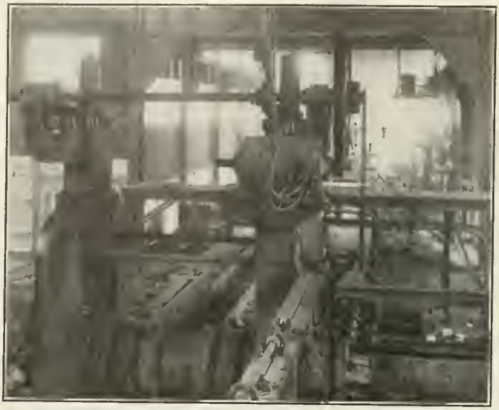


FIG. 4.—MOTOR OPERATING SCREW-DOWN OF BLOOMING MILL.

A view of the rail mill of the Bethlehem Steel Company is shown in Fig. 1. In this mill the billets are deposited on a motor-operated table which delivers them to electrically-driven reversing tables. On the latter tables the billets go through five passes and are then delivered to another motor-driven table, from which they pass to still another table. They pass thence to the reversing tables of the intermediate stand, and after going through seven passes, are transferred to the reversing tables of the finishing rolls. The view shows the arrangement of four of the motors.

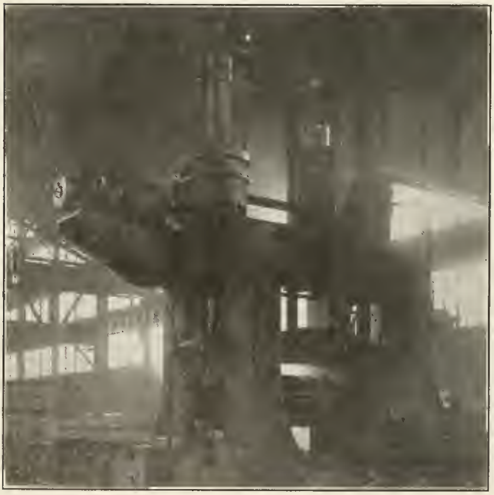


FIG. 5.—MOTOR EQUIPPED WITH MAGNETIC BRAKE ON SCREW-DOWN OF 40-IN. BLOOMING MILL.

The rails are carried on motor-driven tables to the hot saws, where they are cut into standard lengths. Fig. 3 shows a number of these saws, each of which is driven by a 45-hp, open-type motor. One of the rolling-mill motors is also shown in Fig. 3, operating the transfer table. When structural shapes are being rolled, a motor-driven, sliding-frame, hot saw is used instead of the drop type saw shown. After being cut into proper lengths, the rails are transferred to a hot-bed table driven by two motors. The pull-on and rake-off are each operated by

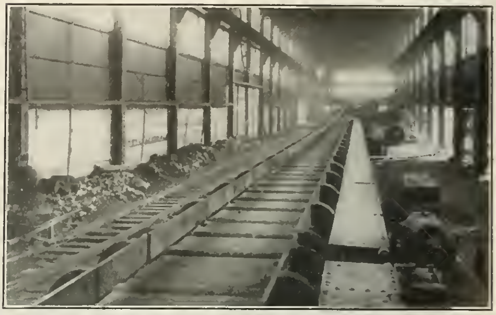


FIG. 6.—MOTOR-DRIVEN TRANSFER TABLES IN GREY MILL.

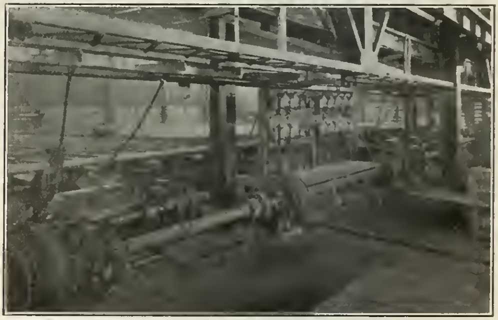


FIG. 7.—PULL-ON, RAKE-OFF AND TRANSFER TABLES OF HOT BEDS.

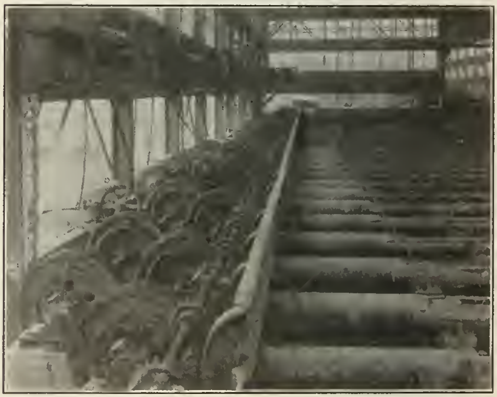


FIG. 8.—MOTORS DRIVING PULL-ON, RAKE-OFF AND TRANSFER TABLES OF GREY MILL HOT BEDS.

seven motors, and the delivery table of the hot beds is driven by two motors.

The screw-down mechanism on the blooming intermediate and finishing mills is also operated by motors. A 75-hp motor is provided for the screw-downs of the 40-in. blooming mill, and Fig. 4 shows the motor-operated screw-down on a 46-in. blooming mill of the Grey structural plant. In the latter mill the various units are arranged in line, and not side by side, as in the rail mill. The intermediate and finishing mills are provided with two motors for the screw-downs, and the reversing and transfer tables are electrically operated. The hot saw is driven by a 225-hp motor. A view in the Grey mill (Fig. 6) shows three 50-hp motors driving transfer tables.

The arrangement of the hot-bed motors is shown in Fig. 8, which illustrates the pull-on, rake-off and table motors in the Grey mill. The motors are controlled by the magnetic controllers of the Electric Controller & Supply Company. About 20 of the motors for the 28-in. structural mill are equipped with induction couplings of the Wheeling Mold & Foundry Company. There are 120 motors in use having an aggregate rating of 6000 horse-power.

Single-Phase Railway in Virginia.

The single-phase equipment of the Richmond & Chesapeake Bay Railway, which was outlined in our issue for June 16, 1906, is now in successful operation. The road extends from Richmond to Ashland, a distance of 14.8 miles. Energy for operating the cars is obtained from special generating apparatus installed in the Twelfth Street station of the Virginia Passenger & Power Company, where two 750-kw, 25-cycle generators are directly connected to hydraulic turbines; one of these generators is arranged also to be driven by a 60-cycle, three-phase motor, and the other by a direct-current motor. The energy is transmitted from this station for about 1.6 miles through lead-covered cables to the Richmond terminal at 6600 volts, which is the same e.m.f as used on the trolley. The trolley wire is of No. 4 copper, suspended from a 3/8-in. steel messenger cable.

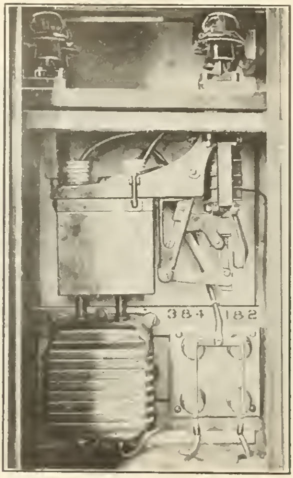


FIG. 2.—PARTIAL VIEW OF APPARATUS IN HIGH-TENSION CABINET ON CAR.

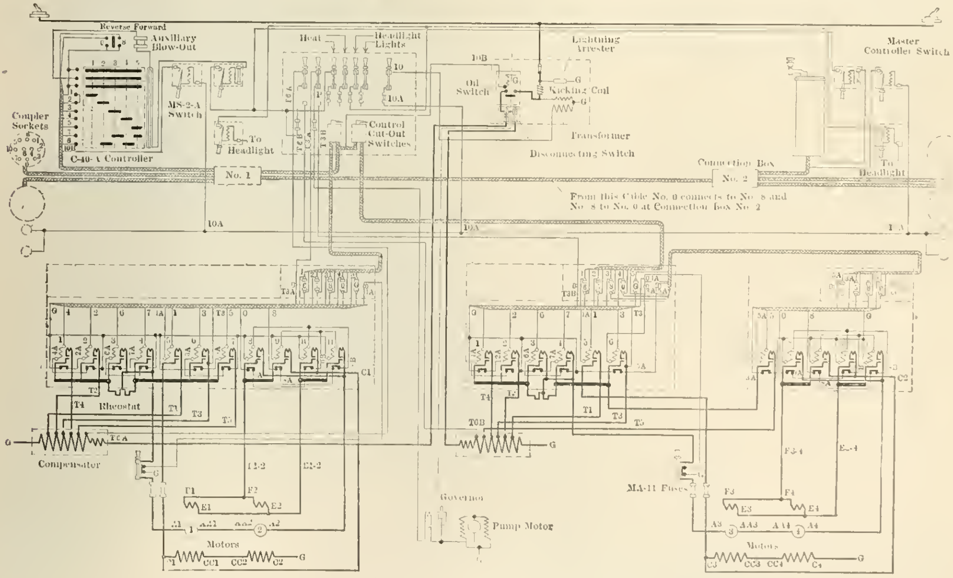


FIG. 1.—MOTOR AND CONTROLLER CIRCUIT FOR SINGLE-PHASE CAR EQUIPMENT.

At present the rolling stock consists of four motor cars. The electrical equipment of each car consists of four 125-hp General Electric series-repulsion 603-A single-phase motors, similar to those in use on the Washington, Baltimore & Annapolis, as noted in our issue for Feb. 15, 1908. The multiple-unit type of control is employed. There are two oil-cooled auto-transformers (sometimes called "compensators") on each car, each transformer being provided with taps to give 600, 450, 400, 340, 280 and 113 volts. The apparatus is arranged and installed in such a manner that each pair of motors and its auto-transformer, together with the respective contactors, etc., form an equipment which is practically independent of the other two motors and auto-transformers, etc. This arrangement has the great advantage that, should a motor or pair of motors, or an auto-transformer, or, in fact, any piece of apparatus constituting part of the equipment become damaged or defective by an accident or from any other cause, the car can be operated as a two-motor equipment by simply throwing one blade of the double-knife disconnecting switch. A diagram giving the wiring connections for this is shown in Fig. 1. A dotted line has been drawn through this diagram to show that as far as the motor control is concerned there is a complete and independent two-motor equipment on either side of this central line; the above remarks do not apply to the auxiliaries, such as heating and lighting, etc. Double-throw switches are provided for transferring the auxiliary circuits from one compensator to the other.

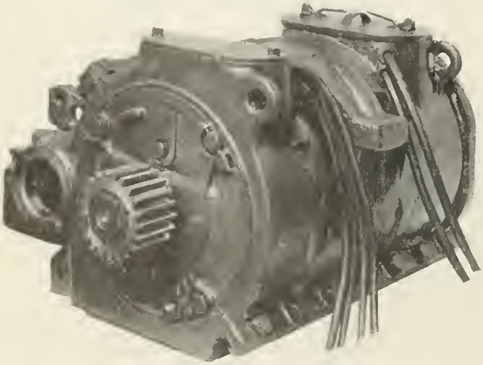


FIG. 3.—EXTERNAL VIEW OF SINGLE-PHASE MOTOR.

It is stated that excellent commutation has been obtained with the motors. Under actual running conditions after the commutators have been in use for some months it is found that they are polished to a chocolate color, and show no signs of pitting from sparking, and service operation indicates a brush life of from 15,000 to 20,000 miles.

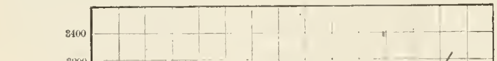


FIG. 4.—PERFORMANCE CURVES OF SINGLE-PHASE MOTORS.

The operation of these motors is well illustrated by a run that was made for the purpose of taking a large party of people from Richmond to Lake Side. On this occasion there were not sufficient electric cars available, so one car equipped with four of these motors was coupled up as a locomotive to a train of five Norfolk & Western standard railway passenger coaches, carrying 300 passengers, and the four motors hauled this load with perfect ease. To test their ability still further, two motors were cut out and the remaining two motors started this same train on a 1 per cent grade. This performance speaks more than could a column of figures for the capability of this new type of motor.

The characteristic curve given in Fig. 2 will show the efficiency, speed and tractive effort at various values of current, while Fig. 3 is an external view of the motor.

Each car is furnished with two pantograph trolleys constructed with steel pans, which material has been found to give much greater satisfaction than either copper or aluminum. The pans are grooved for the reception of a lubricant. The life of these pans will be a matter of considerable interest, but actual figures cannot be obtained until the road has been in operation longer.

Several unique features have been introduced into a substation located at Ashland which supplies energy for lighting the town from the high-tension single-phase trolley. The wiring diagram of Fig. 4 shows how the result was accomplished. It will be seen that the 6600-volt trolley is tapped to feed the high-tension buses from which leads are taken to the high-tension side of the transformers. These transformers reduce the potential from 6600 to 440 volts; leads are taken from the low-tension transformer terminals and pass through a phase-splitting device, which consists of a reactance and resistance, before being connected to a single-phase induction motor. This induction motor forms one unit of a motor-generator set, the other machine mounted on the same base being a single-phase generator. The single-phase generator supplies energy to a 2300-volt bus, from which the feeders to the lighting system are tapped.

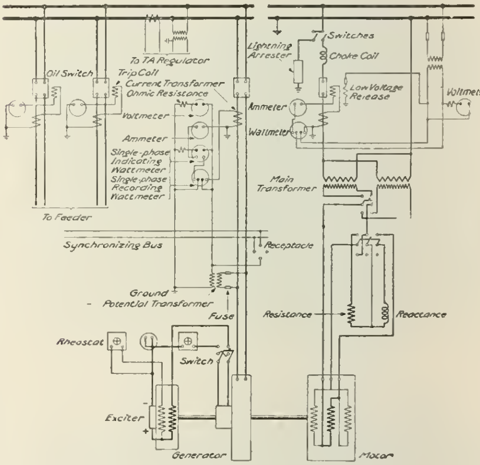


FIG. 5.—CONTROL CIRCUITS OF SINGLE-PHASE MOTOR-GENERATOR SET IN SUBSTATION.

The important feature of this substation is the voltage regulation. This is accomplished by the use of a Tirrill regulator in the Twelfth Street generating station and another at the Ashland substation. The results have been satisfactory and this speaks well for the capabilities of the Tirrill regulator In all probability it is the first time that an attempt has been made to feed a lighting system from a high-tension single-phase trolley subjected to severe fluctuations of load.

Mr. L. B. Stillwell acted as consulting engineer for the railway company. The electrical equipment of the generating station, cars and substation was supplied by the General Electric Company.

Comparative Tests of Different Types of Electric Fans.

By Arthur C. Scott.

In view of the fact that the literature concerning the various types of electric fans upon the market at present contains very little definite information concerning points other than the power required to operate them, it appeared desirable to the writer to make comparative tests which would show other characteristics of such fans under operating conditions.

Six manufacturers of well-known types of fan motors were accordingly requested to send desk fans to the electrical laboratory of the University of Texas for comparative tests. Each of the companies generously responded to the request by donating a 12-in. fan. Two fans were obtained from one of the companies, one being for direct current and the other for alternating current, so that the data recorded below relate to seven different fans; three of these were built to operate with direct current and four with alternating current.

TABLE I.—Types of Fans Tested.

Fan	Type	E. M. F.	Speeds
A	D. C. series	110	3
B	D. C. series	115	3
C	D. C. series	115	3
D	A. C. split-phase	104	2
E	A. C. shaded-pole	110–115	5
F	A. C. series	110–120	3
G	A. C. split-phase	100–110	2

TABLE II.—Tests of Fans Under Normal Condition.

Fan	Speed	Current	Watts input	Net watts	Power factor	Volume of air del. cu. ft. per min.	Cu. ft. of air per min. per watt	Cu. ft. of air per min. per net watt	Temp. rise of frame	Starting current amperes.
A	1900	.405	44.8	23.11	.....	1215	27.2	52.6	2.6°	.780
B	1520	.431	47.7	16.1	.....	1053	22.1	65.5	8.6°	.595
C	1685	.430	47.7	21.0	.....	1155	24.2	55.0	5.4°	.750
D	1660	.60	36.	11.4	.545	878	24.4	77.0	11.4° C	3.50
E	1460	.97	67.	10.4	.628	837	12.5	80.5	5.4°	1.34
F	1290	.74	58.	23.7	.720	537	9.3	22.7	20.2°	1.00
G	1555	.62	41.5	15.73	.601	997	24 0	62.4	8.0°	1.15

Table I gives an outline description of the seven fans, which for convenience are designated by letters.

The fans were supplied by the manufacturers with the understanding that the tests would be made at 110 volts, and that a frequency of 60 cycles per second would be used with the alternating-current motors. The results of tests under the specified conditions, with the motor circuits adjusted for maximum speed, are shown in Table II.

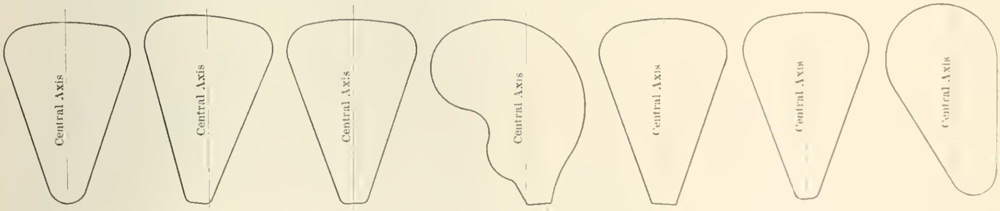


FIG. 2.—BLADES FOR FANS A, B, C, D, E AND F.

VOLUME OF AIR.

The determination of the volume of air delivered by a fan motor was found to be much more difficult than at first supposed. Moreover, no reliable formulas have been developed for calculating the power required for moving certain amounts of air. Several attempts to determine the volume of air experimentally by various arrangements proved unsatisfactory. An arrangement which gave excellent results is indicated in Fig. 1. Across a cylinder 8¾ in. in length and 14¼ in. in internal diameter there were placed two strings precisely at right angles to each other. By means of knots on the strings the cross-section of the cylinder was divided into three imaginary concentric areas covering .041, .354 and .712 sq. ft., respectively. The diameter of the imaginary center circle and also the distance from the inner circle to the next circle and from this circle to the inner edge of the cylinder were about the same as the diameter of the anemometer used for measuring the velocity of the air.

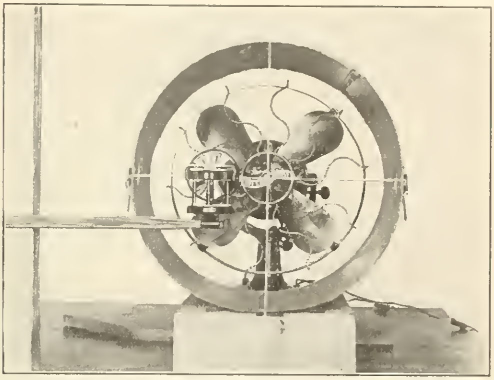


FIG. 1.—ARRANGEMENT OF APPARATUS FOR DETERMINING VOLUME OF AIR.

The fan was placed at the back of the cylinder, as shown in Fig. 1, so that its center should be precisely opposite the intersection of the two strings. Great care was also observed to have the plane of the fan blades perfectly parallel with the plane of the intersecting strings, and to have the fan so placed with respect to the cylinder that no reverse currents of air existed, all of the air which was taken in by the fan being delivered at the front of the cylinder.

With this arrangement it was found that the power input to the fan was perfectly normal, but that a great variation in velocity occurred over the delivery area.

In order to obtain as close an average as possible of the velocities for use in calculating the volume of air blown, four points were selected in each of the two outer rings for placing the anemometer, these points being so marked that the instrument should be placed precisely in the same position for repeated records.

In Table II the value for the volume of air in each case represents the corrected average of the averages of five readings for each point in each ring and five readings at the center. It was found that in each case the velocity was greater in the medium size circle than in the outer circle or at the center. In order to arrive at a close value for the total volume blown, therefore, it was necessary to determine the area of each circle separately, as noted above, and multiply by the average velocity obtained for that circle, and subsequently add the volumes so determined to obtain the final volume.

The volume thus determined for the several fans should be practically correct for each, as all necessary precautions were taken to have similar conditions for the different fans of which determinations were made, and of the several methods tried this one alone appeared to be satisfactory.

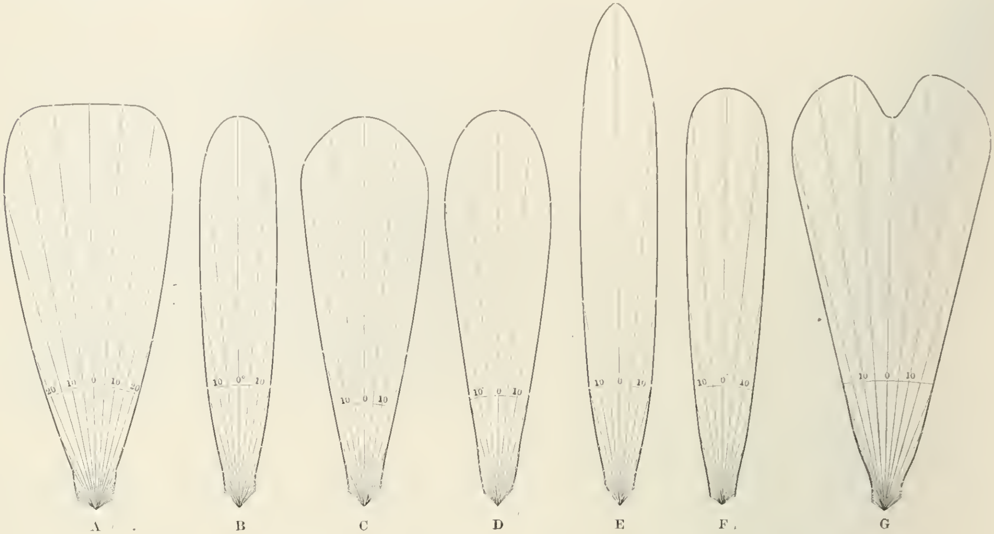


FIG. 3.—DISTRIBUTION OF AIR FROM FANS A, B, C, D, E, F AND G.

THE COMPARATIVE EFFICIENCY OF THE DIFFERENT SHAPES OF FAN BLADES.

In order to arrive at a conclusion concerning the effect which the shape of the blades produced upon the volume of air delivered, the blade-wheel of each of the several fans was fitted accurately to the shaft of one of the motors (A), which was operated at 1600 r. p. m., which speed was only a little above the average of the normal speeds of all of the motors. The results are given in Table III, the same apparatus as shown in Fig. 1 being used for measuring the velocities. For all of the readings taken on the anemometer in use with the cylinder the instrument had a small support, which was maintained in a certain position at the side, as indicated, so that no reflex currents of air could be produced to affect the register of the anemometer, because of the original current striking the observer or any objct in front of the fan.

TABLE III.—TEST OF FAN BLADES AT 1600 R.P.M.

Fan	Watts input	Net watts	Cu. ft. of air displaced per min.	Cu. ft. of air per net watt min.
A	30.0	14.14	1025	72.4
B	41.7	20.44	1119	54.7
C	39.4	18.94	1101	58.2
D	22.2	10.00	853	85.3
E	25.2	11.45	903	78.9
F	27.9	13.34	697	52.2
G	30.6	14.74	1024	69.5

TABLE IV.—MECHANICAL DATA OF FAN BLADES.

Fan	A	B	C	D	E	F	G
Length of each blade, in.	5.19	5.40	5.35	5.6	5.38	5.40	5.70
Total diameter of fan, in.	11.53	12.00	12.	12.4	12.	11.87	12.25
Total area of four blades, sq. in.	50.18	51.36	51.12	59.78	51.16	50.70	50.56
Radius of curvature, in.	15.25	6.98	6.6	12.5	19.8	8.1	7.1
Angle α	17° 50′	17° 10′	16° 0′	13° 50′	14° 30′	14° 30′	15° 50′

Information concerning the shape and size of the various fan blades is given in Fig. 2 and in Table IV. In this table the angle α represents the maximum angular displacement of the edges of the fan blades from a plane parallel to and touching the front edges of the blades. The length of the blade was taken as the maximum distance from one end to the other of one blade, while the diameter of the fan represents twice this distance plus the diameter of the hub to which the blades are fastened.

The central axis line shown represents the line of maximum concavity for the blades. The radius of curvature was calculated from accurate measurements made of the concavity of a blade at its maximum point, and the measurements at the same time of the length of the arc subtending a chord passing through that point.

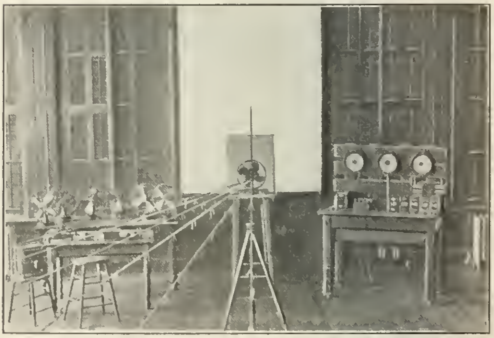


FIG. 4.—ARRANGEMENT OF APPARATUS FOR DETERMINING THE VELOCITY AND DISTRIBUTION.

Reference to Tables III and IV shows that the shape of the blades is of considerable importance in connection with the volume of air delivered per net watt. It appears that the range for the fans tested extends from about 52 to 85 cubic feet of air per net watt.

DISTRIBUTION OF AIR.

Fig. 3 shows the shape of the envelope of the moving air from each fan. Each curve is plotted through points which represent distances from the fan where the velocity was zero for five-degree angles, from zero on the center line to 60 degrees, which was the limiting angle where movement of the anemometer occurred for any one fan. The distance at zero angle in the several curves of Fig. 3 are as follows: A, 29 ft.; B, 28 ft.; C, 28 ft.; D, 28.5 ft.; E, 35 ft.; F, 30 ft., and G, 28 ft. These values were obtained with each motor driving its own fan under the electrical conditions indicated in Table II. The arrangement of the apparatus for the determination of distribution of air from each fan is indicated in Fig. 4. The fan and measuring instruments were placed near one end of an empty room about 40 ft. long and 30 ft. wide. In front of the fan guard and close to it a small steel rod was supported rigidly in a vertical position. To this rod were fastened small strings, which radiated outward from the center by five-degree intervals up to 60 degrees in one quadrant. Great care was exercised to be certain that the strings were stretched precisely five degrees apart, and at such a level that the center of the fan blades of the anemometer which was used for indicating the velocity of the air should be precisely in line with the center of the fan. Precautions were also taken to be certain that each and every fan tested should have its top and bottom edges of the fan blades precisely plumb and in line with each other, and also that the plane of the fan blades was absolutely at right angles to the center line extending outward from the center of the fan.

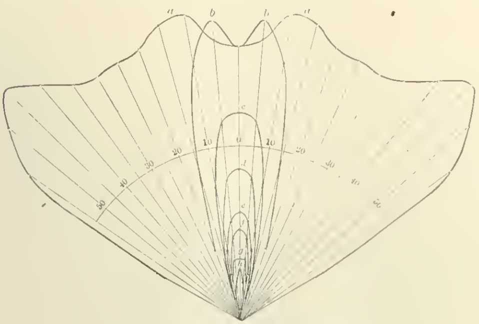


FIG. 5.—VELOCITY OF AIR FROM FAN A.

In plotting the curves, it was assumed that the velocity and distribution in the second quadrant were similar to those in the first quadrant, because no difference in data would have been obtained by taking readings in the second quadrant over those obtained for the first. This assumption is considered to be justifiable because every possible precaution was taken in regard to the correct position of the fan with respect to the network of lines, and also to be sure that the anemometer was placed in the same position for each successive reading at any given point.

VELOCITY OF AIR.

By the use of knotted strings the anemometer was placed in various selected positions at chosen distances from the fan and at certain defined angles. Thus the velocity was measured at 6 in. from the fan, and at regular intervals of 2 ft. thereafter up to a distance of 10 ft. 6 in., after which the intervals taken were 4 ft. each. In Figs. 5, 6 and 7, which show the velocities from fans A, D and F, respectively, curve *a* represents the velocity 6 in. from the fan, curve *b* the velocity 2 ft. 6 in., curve *f* shows the velocity 10 ft. 6 in. from the fan, etc. The velocity in ft. per min. at the center 6 in. from the fan (curve *a*) for fan A is 1195, for fan D it is 930, for fan F it is 879.

In taking readings of the velocity the anemometer was always so placed that its center should be precisely over the center of the knot on the string, and a plane, passed vertically through the instrument, parallel to the string, would pass through the center of the string. Moreover, the instrument was always at the same level since it was supported upon a tripod, with the feet so fastened together as to be always of the same height, and to keep the table of the tripod upon which the anemometer was placed always level. The string at all points where measurements were taken was immediately above the center of the table of the tripod and immediately beneath the center of the anemometer, as indicated in Fig. 4.

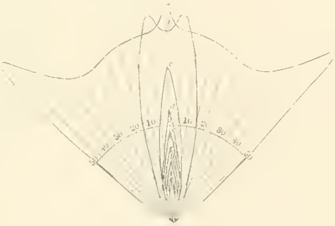


FIG. 6. VELOCITY OF AIR FROM FAN D.

The velocity curves shown in Figs. 5, 6 and 7 for the different fans indicate the rapid decrease in velocity as the distance from the fan increases, and also the decrease in magnitude of the angle in which the air is blown; and, further, a quite remarkable variation in the form of the surface of revolution produced at 6 in. away from the fan blades, the cross-section of which is shown by the curves.

VARIATION OF VOLUME OF AIR WITH SPEED.

By referring to Tables II and III it is possible to consider the relation of the volume of air blown by any certain fan, because the results recorded in Table II were obtained when each fan was operated at its normal speed, while Table III shows the results as to the volume delivered when the blades of each of the fans were run at a definite speed of 1600 r. p. m. The result seems to show that the volume of air delivered per minute by any particular fan varies directly with the speed.

It will be observed from Table II that the starting current for fan D is much larger than that for any other; its running current, however, is lower than that of any other alternating-current fan. The temperature rise was highest on the F fan; it should also be stated that this fan was more noisy in its operation than any of the others. It will be noted that cubic feet of air delivered per minute per net watt by the E fan was greater than that of any other fan, although the value for the cubic feet per gross watt is nearly the lowest in the list. This result is explainable by the fact that the stray power losses are greater in that fan than in either of the others. The value for the cubic feet per gross watt for the D and G fans is almost double that for the E fan. The D and E fans are provided with field windings distributed in slots—which construction gives minimum magnetic leakage—and a special contact device is connected with the rotor in such a way as to cut the auxiliary starting coils out of circuit when the rotor has reached a certain speed.

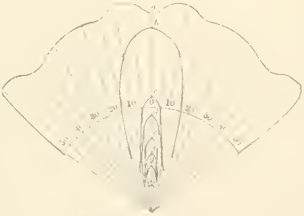


FIG. 7.—VELOCITY OF AIR FROM FAN F.

The writer is indebted to Mr. B. E. Kenyon and Mr. J. A. Correll for assistance in conducting the tests described above.

Direct-Current Motors, Their Action and Control—V.

By F. B. Crocker and M. Arendt.

In the previous article it was shown that changes in speed are likely to occur with load changes. It can readily be shown that at every load change there will be an excessive change in speed. Study the lines in Fig. 1, from which can be read the speed at one-quarter, one-half, three-quarters or any other fraction of rated torque with any position of the controller arm. For instance, the motor is operating at rated torque and with 3 ohms of resistance in circuit (*i. e.*, speed 412) when the load is suddenly reduced to one-half rated torque; from Fig. 1 we see that the speed changes to 635 r. p. m. Using some other methods of speed regulation, to be considered later, the speed variations with changes in load are only very small, from 2 to 4 per cent at a maximum, whereas, by the armature rheostatic method, changes in speed occurring with considerable load variations are so great as to endanger the tool and the work.

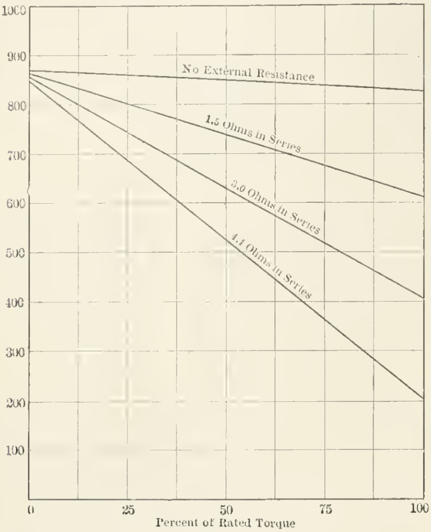


Fig. 1.—Speed Curves of 10-hp Motor, with Different Values of Box Resistance.

That the error introduced by assuming the stray power losses as constant at all speed is small is shown in the following:

Consider, for example, the one-quarter speed condition for which the error due to neglect of the change of stray power losses due to speed change would be a maximum. With speed at one-quarter rated value, and at the rated torque, the motor output would be equal to 1887.0 watts. The various resistance losses would be the same as at rated load, or 675.0 watts. The total stray power loss is made up of eddy current, hysteresis, friction and windage losses, the first of which varies as the square of the speed, while the others vary directly as the speed. In motors of about 10 horse-power capacity the various losses are approximately in the following proportion:

Eddy current loss, one-quarter of total stray power loss.

Hysteresis loss, one-quarter of total stray power loss.

Friction and windage, one-half of total stray power loss.

The eddy current loss at normal speed is $\frac{526}{4}$, and at one-quarter speed is $\frac{526}{4 \times 4^2} = 8.2$. The hysteresis loss at normal speed is $\frac{526}{4}$, and at one-quarter speed is $\frac{526}{4 \times 4} = 32.8$. The friction and windage loss at normal speed is $\frac{526}{2}$ and at one-quarter speed is $\frac{526}{2 \times 4} = 65.6$.

Adding these values, the corrected stray power losses for one-quarter speed are 107 watts. The total motor losses at this speed are, therefore, $675 + 107 = 782$ watts. The motor input is 8740 watts; motor loss, 782 watts, and motor output is 1887 watts; hence, the loss in the rheostat is $8740 - (1887 = + 782) = 6070$ watts; thus $R_x = \frac{6070}{37^2} = 4.45$ ohms, or only .05 more than that obtained by calculation with stray power losses assumed constant. Accordingly the error introduced by this assumption may be assumed as negligible.

2. *Speed Control by Brush Shifting.*

Speed variation by means of brush shifting is not desirable, as it increases armature reaction and tends to produce sparking. The proper position for the brushes is practically fixed by the design of the machine and any other setting is not conducive to good operation. Curves are given in Fig. 2 showing how the speed can be controlled by brush shifting within the sparking limits, this range being small. It is interesting to note in connection with Fig. 2 that armature reaction in a motor due to a considerable negative lead of the brushes can be made to maintain a constant or rising speed. This is not a feasible method, however, because in the operation of direct-current motors it is practically necessary to set the brushes in the position of *minimum sparking*, since sparking is the most troublesome feature of these machines.

3. *Speed Control by Variation of Field Flux—Rheostatic Method.*

The equation $e = \frac{\phi n N 2p}{60 \times 10^8 \times b}$ shows that if e is kept constant, and ϕ varied, the speed n varies inversely as the flux ϕ. This relation, therefore, indicates a method of speed variation.

In the case of ordinary shunt motors, the range of speed variation by means of field weakening is small. For instance, take the 10-hp motor previously considered and weaken its field to produce 30 per cent increase in speed. Since the flux must be varied inversely as the speed, it must be weakened in the proportion 130:100 or 100:76.9, that is 23.1 per cent, while to produce this change the field ampere-turns must be reduced by about 50 per cent. At rated torque with this reduced field strength the armature current must be increased 30 per cent, and the ratio between back ampere-turns and field armature-turns instead of having its normal value of .10 is raised to $\frac{.13}{.5} = .26$, because as the former is 30 per cent greater and the latter is reduced to one half. This ratio is excessive. Similarly the corresponding increase in cross ampere-turns acting collectively with the increased back ampere-turns causes excessive sparking, showing that a 30 per cent increase of speed with an ordinary standard shunt motor cannot be obtained without very objectionable or even prohibitive sparking.

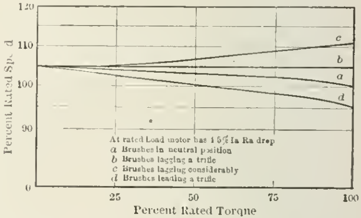


Fig. 2.—Relation Between Brush Position and Speed.

It can also be shown that the increased armature current to maintain constant torque augments the $I^2_a R_a$ loss, which in the 10-hp motor armature rises from $37^2 \times .28$ to $48^2 \times .28$, or an increase of 234 watts, producing too much heat for the armature insulation to stand for any length of time.

All adjustable speed motors of the flux variation type are *not constant torque machines, but constant horse-power or output motors; i. e.*, the torque falls as the speed increases in inverse ratio, or $T \times$ r. p. m. $=$ a constant. In fact, unless the ratio of back ampere-turns to field ampere-turns is less than 10 per cent at minimum speed, an increase in speed of even 30 per cent with constant output is not possible, as shown above.

It is evident that a shunt motor to have any considerable range of speed variation (*i. e.*, increase of more than 20 or 30 per cent) by field weakening requires special design, because the normal field must be more powerful with respect to the armature than in the case of standard single-speed motors. Some special motors of this kind allow of speed variations of four to one, with constant horse-power output, but not at rated torque. These increased speed ranges are obtained as follows:

(*a*) *Magnetic Circuit of Very Soft Steel.* The magnetic properties in this case are such that even with high flux densities the bend of the curve is not reached, so that the change in field ampere-turns to produce a large change in flux is not excessive; *i. e.*, the rate of change of flux and m. m. f. are almost in direct proportion. With these machines the field frame is also large, the total flux being very great, while the armature winding consists of fewer turns per section and a larger number of sections, so that the self-induction per section is low. Thus, under normal or even exceptional conditions the ratio of field to back ampere-turns is kept within 10 per cent. However, a machine having a field of sufficient strength to prevent sparking at high speeds must have a frame considerably larger than necessary for a single-speed machine of equal power and the commutator must have a greater number of bars. In general, when considering this type of variable-speed motors, it can be stated that the percentage of speed increase of which a normally loaded motor is capable by means of field weakening (rheostatic control) is a measure of its overload capacity with full field strength. In other words, *a given range of speed variation demands a motor having a certain increased capacity.* The following practical examples illustrate this point:

Relative Sizes of Frames, 1 to 2-Speed Ratio:

3-hp. frame for a 2-hp motor.
15-hp frame for a 10-hp motor.

Relative Sizes of Frames, 1 to 3-Speed Ratio:

3-hp frame for a 1½-hp motor.
10-hp frame for a 5-hp motor.
20-hp frame for a 10-hp motor.

(b) *When the magnetic circuit* has been designed so that the *flux density is always great at the pole tips,* the field distortion due to armature reaction is lessened and a normal flux is maintained in the commutation zone, giving sparkless operation within reasonable speed and load limits.

(c) *A commutation field* may be maintained by a compensating winding, which prevents field distortion (Thomson-Ryan method, etc.), or by auxiliary poles placed directly over the zone of commutation, the strength of the auxiliary poles increasing in direct proportion to armature load though armature reaction is not eliminated. The object of this auxiliary field is to provide a flux for reversal, which increases in proportion to the motor load and reverses when motor rotation is reversed; thus sparkless operation with weak fields may be obtained.

Electrical Exhibit in a Providence Department Store.

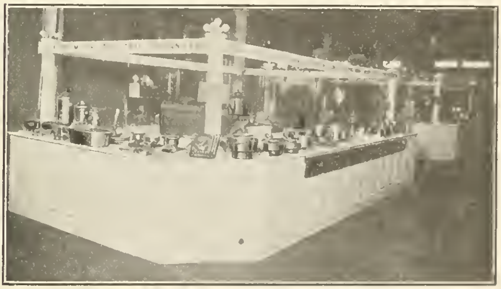
In the largest and most prominent department store of Providence, R. I., that of The Shepard Company, on Westminster Street, an electrical exhibit was given in connection with an annual food fair. The fair lasted four weeks and has just been brought to a successful termination. The electrical display was made by the Narragansett Electric Lighting Company and its merit was best attested by the crowds which surrounded the two sections of the booth.

Each section of the booth was open at the ends nearest each other with a passageway of six feet between. On each corner of each section were wooden columns with clusters of six 4-cp lamps on each. Between the sections, an arbor of apple blossoms was draped, completely hiding the wiring of the decorative outfits which were intertwined throughout. The effect of this arbor was very pleasing.

No attempt was made to give any extensive cooking demonstrations; but one of the two salesmen who were in attendance demonstrated the coffee percolator, bread toaster and corn popper. Electric heating and other special devices have undoubtedly been shown in all of the food fairs held recently, so it will be of little interest to describe the usual run of flat-irons, curling-iron heaters, chafing dishes, etc., that are usually shown at these exhibitions. Three of such fairs have been held in Providence, so that it was necessary to exhibit new devices to gain the interest of the public. With this end in view new devices only were featured, even though some were of very little, if any, revenue making value. By this means a great many people were attracted, giving the demonstrators an opportunity to offer the more popular devices.

Among the devices new to the consumers was an open fire place cleverly arranged with broken colored glass on top and two lamps and a heating unit hidden underneath. A huge electric stove with a tea-kettle holding seven and one-half gallons was mounted in the center of one of the booths and was kept constantly heated. In front of this was displayed another stove with a tea-kettle holding one pint. An electric hair dryer was prominently displayed and an electric radiator and foot-warmer were within easy reach of visitors who could feel the heat given off by both.

The industrial utensils were represented by electric glue pots, one of which was partly filled with glue and often operated, soldering coppers, sealing wax pots and melters, lead pots containing molten metal, hat conformers, tailor's goose and puff-irons, cork branders, immersion coils, wood bender, sterilizers, water heaters and urns.



ELECTRICAL EXHIBIT IN A PROVIDENCE DEPARTMENT STORE.

The new devices in the domestic section were a shaving mug, bread toaster and corn popper as exponents of electric heating; a washing machine and ice-cream freezer, both in operation, as exponents of motor-driven devices for domestic use. A competent operator was furnished by the store management at its expense to demonstrate the sewing-machine motor in exchange for the possibilities of making sales for the department store's make of sewing machines. Different makes of vibrators, small motors, etc., including a bottle-washer, were shown A feature of the exhibit was a large "light"-frosted wedding cake, 28 in. high, lighted by miniature red and frosted lamps.

While the department store management advertised the exhibit, it had nothing to do with it, the Narragansett Electric Lighting Company having rented the space. The company sent out invitations to its customers and prospective customers, and the energy consumed by the devices was taken from its mains The commercial department of the company is under the direction of Mr. E. R. Davenport and it is interesting to note that there has been no curtailment of any character made in the new business department owing to business depression. As near as can be estimated from actual conditions of operation, the income from energy consumed by heating devices last year amounted to about $15,000.

Testing Electric Meters at Their Place of Installation—I.

By Joseph B. Baker.

METER INSPECTOR'S EQUIPMENT.

For testing, repairing and calibrating service meters on the consumers' premises, the following apparatus, tools and materials may be carried:

APPARATUS.

- Voltmeter and ammeter, or wattmeter.
- Slide rule.
- Stop watch.
- Artificial load.
- Storage battery, or low-potential transformer.
- Test lamp, with special lead, for testing armatures.
- Portable torque balance.

TOOLS.

- Small soldering iron.
- Small gasoline torch or alcohol lamp.
- Screwdrivers, large and small.
- Pliers, long-nose and side-cutting.
- Tweezers.
- Fine files.
- Monkey wrench.
- Special wrenches, including a spring wrench for handling pivots.
- Electric pocket lamp.
- Needles, for testing jewels.
- Small level (pocket size, of brass), or small brass weight.
- Old meter shaft, for holding pivots for examination.
- Pieces of soft wood to use as cleaning implements.
- Meter repair kit.
- Sealing tool (Fig. 1), with a supply of lead seals.
- Magnifying glass (preferably a watchmaker's glass).
- Camel's hair and bristle brushes, including one "tooth brush."
- Small hard rubber air syringe.

SUPPLIES.

- Resistance cards.
- Dial hands.
- Commutator brushes.
- Prepared wire solder, with rosin flux.
- Fuse plugs, wire and links, assorted sizes.
- Cotton waste.
- Crocus sticks and cloth.
- Heavy insulated wire, for test connections.
- Connectors.
- Webbing for cleaning commutators (corset strings, shoe strings, or ¼-inch cotton tape free from lint).
- Watch oil.
- Benzine.
- Jewels and pivots.
- Wing-nuts.
- Assortment of the screws and washers used in various types of meters.
- Black and white "friction" tape.
- Insulations for resistance card and other internal meter connections.
- Meter-cover window glasses and putty.
- Special flexible cord for instrument connections.

MISCELLANEOUS.

- Adjustable shunt field coils, to equip old-style commutator meters.
- Meter magnets of standard strength.
- "Creep retarders"—ordinary wire paper clips answer well.

It may not be necessary to include all of the articles given in the above list; the outfit may be simplified to suit individual requirements. On the other hand, there have doubtless been omitted some special articles, in each section of the list, that have been adopted by individual meter men for general testing or in connection with the testing of certain meters. A number of the tools listed individually are included in the pocket kit of meter adjustment tools, a list of which is given below

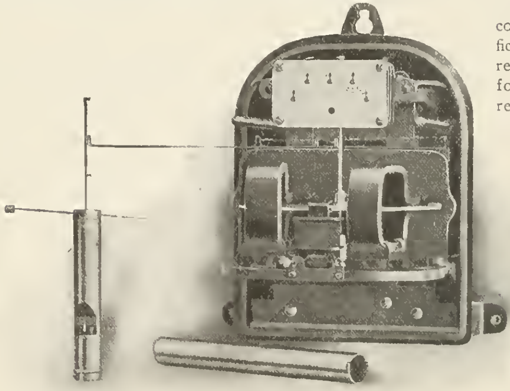


FIG. 2.—PORTABLE TORQUE BALANCE IN USE WITH WATT-HOUR METER.

Apart from the ordinary electrician's tools, such as pliers and screwdrivers, the apparatus, tools and materials given in the list are furnished by the central station company, and should be kept in first-class shape. The entire kit may be charged out to the tester or inspector for the particular work in hand instead of being left permanently in his possession. Under these conditions there is no excuse for poor or unfit tools in the testing outfit, and a good moral effect is exerted on the company's customers, who will, naturally, place more confidence in the test when they observe that the inspectors' outfits are in first-class condition.

Following is a detailed discussion of a number of the items:

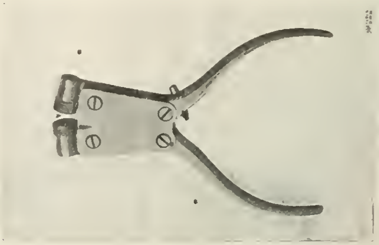


FIG. 1.—SEALING TOOL.

In some instances, an indicating wattmeter may be carried instead of the voltmeter and ammeter, and is to be preferred for testing alternating-current meters. This type of instrument is not reliable for testing direct-current meters on consumers' premises, however, owing to the influence of stray magnetic fields, which cause inaccurate indications. Many companies are now using milli-voltmeters with separate shunts, instead of self-contained ammeters, ironclad, to afford protection from stray fields, with 1.5, 15 and 150 ampere scales; voltmeters, also ironclad, with 150 and 300 volt scales; and similar instruments of larger rating for testing larger sizes of consumers' meters.

In carrying instruments from place to place, care should be taken to avoid rough handling and jarring of the instruments. In riding in street cars, for example, the instruments should not be placed on the floor, where they would be subjected to jarring, and also to possible disturbance to their calibration by stray magnetic fields from the car motors.

The stop watch carried for testing meters should be of good quality; the ordinary cheap stop-watch is not adapted to stand up under the work.

The artificial load may consist of a lamp bank, a resistance-coil rheostat, or a water rheostat. The two first-mentioned artificial loads are most commonly used in testing both direct-current and alternating-current meters, and may be uncalibrated for use with the ammeter, or in calibrated form as "standard resistances." For the testing of meters of small and medium rating, a simple and compact form of lamp bank, which may easily be carried in the tool bag, may be made by wiring four incandescent lamp key sockets together. By using lamps of various candle-powers, carried separately in the tool bag, a load varying from one 4-cp lamp up to four 50-cp lamps may be put on the meter. Another convenient form of lamp

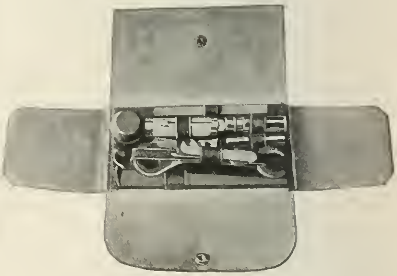


FIG. 3.—METER REPAIR KIT IN POCKET CASE.

bank consists of a group of 20 16-cp or 32-cp lamps, mounted in an open wooden frame with the lamps inside so as to protect them from being broken in carrying. The lamps may be placed in key sockets, to facilitate adjusting the load through a fairly wide range, and may be wired up on a three-wire plan.

The storage battery may be a single cell of the Edison nickel-steel type. A compact cell of this type, weighing less than 15 lb. and capable of delivering nearly 150 amperes, is very handy for testing direct-current meters on artificial load without disturbing the consumer's supply.

The low-potential transformer may be used to advantage in testing alternating-current meters on artificial load without disturbing the consumer's supply.

Fig. 2 shows a portable torque balance made by the General Electric Company for measuring the torque of any motor meter. The device consists of a light moving system suspended in highly polished bearings, and connected by a lever to the meter shaft so that the torque of the latter is balanced against a standard weight. The weight may be 1 gram or ¼ gram, and any one of three lengths of balance arm and shaft lever may be employed. The condition of balance is noted on an index contained within the 7¼ in. x ¾ in. tubular case of the device; the final balance being obtained by varying the load on the meter. The torque, in millimeter-grams, is found by a simple formula involving the balance weight and the length of the lever.

A "jeweler's iron" is large enough for all soldering that may be necessary in connection with the inspection of a meter on the customer's premises.

An "ever-ready" lamp answers well for many purposes. For examining small parts of the meter, however—such as register wheels or worm, or jewels and pivots—a diffused light is better than a concentrated one, since the contrasting effect of the latter is very misleading.

A small level is often used for leveling the meter in installing, and for ascertaining whether the meter is level preliminary to a test for calibration. A better way to level the meter, however, is to load the disk (or "cup") with a small brass weight, such as is furnished by some meter manufacturers for the purpose; a ½-in. length of ¾-in. brass rod answers well, or a silver half dollar will do if there is room to use it. Place the weight on the front or back edge of the meter disk—whichever is more convenient—and note whether it causes the disk to rotate one way or the other. If it turns the disk to either side, raise that side of the meter enough to level it from left to right. Then place the weight on the edge of the disk at the right or left, i. e., at a point 90 deg. away from the former position, noting whether it turns the disk either way, and leveling accordingly, from front to back, without changing the right-to-left leveling. This method is much more accurate than by the use of a small level, and is very sensitive, so that it may be necessary to relevel from right to left, and then from front to back, to obtain a perfect leveling of the meter.

As cleaning implements, one or two orange-wood manicure sticks, sharpened to a point at one end and to a chisel edge at the other, and a few large-size, good-quality toothpicks, answer well.

A neat pocket kit, sold by the General Electric Company (Fig. 3), consists of articles contained in a small leather case, as follows: Folding screwdriver, with ⅛ in., 3/16 in., ¼ in. and 5/16 in. tips; double-end wrench, ¾ in. and 11/16 in., for new and old-style jewels; double-end wrench, ⅜ in. and 3/16 in., for top bearing nut and brush nut; pivot wrench; combined needle for testing jewels, and brush twister for setting and straightening brushes; spirit level; magnet cleaner, for removing dirt between disk and poles of magnets; brush cleaner: piece of ¼-in. cotton tape, for cleaning commutator; piece of ¼-in. crocus cloth, for cleaning commutator, and bottle of porpoise oil.

The air syringe should always be used instead of blowing with the breath, which is liable to precipitate moisture and thereby cause rusting or tarnishing.

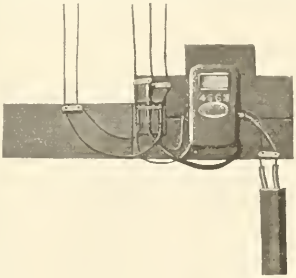
In all soldering about a meter, rosin only should be used as a soldering flux, since the use of any other flux may cause the liberation of acid fumes which would attack the commutator or other parts of the meter.

Insulations consisting of ordinary soft rubber tubing of small bore, cut off in lengths and slipped over resistance card leads or other wires in a meter, while often used, are not to be recommended, as the sulphur in the rubber is liable to attack the meter contacts, more especially the commutator and brushes of a commutator meter, tarnishing them and introducing high resistance. Tubing made of so-called "medicinal rubber" is said to be free from these objections, however, and is used by some meter manufacturers.

For making test connections, ordinary lamp cord is employed by some companies, using several strands taped together and soldered into common terminals at the ends, to give sufficient carrying capacity. Other companies use regular generator brush-holder leads of low resistance with heavy braided, rubber-covered insulation, finding these leads superior to the lamp cord on account of their greater flexibility, more durable insulation and more complete freedom from breaking and "sticking through" of the strands.

A Method of Stopping Energy Stealing.

The accompanying photograph was taken by the meter department of a prominent Southern central station in connection with theft of energy in a job printing-office. It was the practice of the owner of the establishment to hook a homemade lighting circuit across the incoming service switch of a 10-ampere-meter, three-wire power line, on the street side of the meter after the meter-reader had been around, and to take the lines away a few days before the meter reader's time to come again occurred. It happened that one of the company's inspectors visited the place unexpectedly, and arrangements were at once made to obtain the photograph as evidence, in the presence of the city electrician as a witness. The owner was confronted with the photograph, which was taken in his absence, and the company proposes to stop future depredations of this character by making an example of each offender against whom photographic evidence can be obtained.



METHOD USED FOR TAKING UNMETERED ENERGY.

Fuses in Outdoor Lightning-Arrester Circuits.

It is the practice of the Union Electric Light & Power Company, of St. Louis, to place in series with its lightning arresters out on the line a No. 19 copper-wire fuse inside of a glass tube, as shown in Fig. 1. This No. 19 wire is spliced into the No. 6 wire leading to the arrester and over it is slipped a glass tube, held in place with tape wrapped around the wire and the

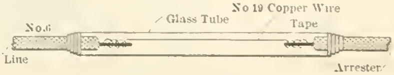


FIG. 1.—FUSE FOR OUTDOOR CIRCUITS.

ends of the tube. The General Electric lightning arrester is used, the iron box being lined with asbestos stuck in with shellac in the company's shops, before the arrester is put up.

Where there is a change from underground to overhead construction, a choke coil is inserted between the cable and the lightning arrester tap, this choke coil being very simply constructed by giving the conductor 12 to 14 turns around itself, as shown in Fig. 2.

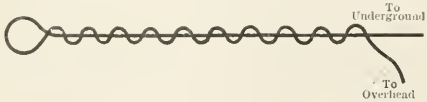


FIG. 2. CHOKE COIL USED BETWEEN CABLE AND ARRESTER.

Data on Elevator Service from Dayton, Ohio.

By the courtesy of Mr. F. M. Tait, general manager of the Dayton Lighting Company, of Dayton, Ohio, we are enabled to present data on 38 elevators, representing 437 rated horse-power in the city of Dayton. In the issue of Feb. 1 some information was given on the policy of New England companies as regards elevator load. The figures in the accompanying table were taken direct from customers' accounts of the Dayton Lighting Company, and show conditions of load and demand from elevators as they exist in the down-town district of a town of 90,000 inhabitants. From these 38 elevators, representing 437 horse-power, the total revenue for six months was $3,308.42. The average receipts per month per elevator were $14.51. The average horse-power per elevator was 11.5. The receipts per horse-power per month were $1.26. The average net rate per kw-hour was $.042. For the six months the total kw-hour consumption was 78,656. The load factor (that is, the ratio of the average load to the connected elevator horse-power) was 5.5 per cent.

DATA ON ELEVATOR INSTALLATIONS AT DAYTON.

Size of motor H.P.	MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		Total am't. for 6 months
	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H.	Am't.	Kw-H	Am't.	
.5	62	$3.89	59	$3.70	71	$4.45	48	$3.01	75	$4.71	72	$4.52	$24.28
.5	90	5.65	103	6.22	82	5.14	85	5.33	85	5.33	89	5.78	33.45
.5	58	3.63	64	4.01	77	4.83	64	4.01	62	3.89	64	4.01	24.38
.5	60	3.77	81	5.08	74	4.64	61	3.82	70	4.39	94	5.89	27.59
.5	57	3.58	40	2.51	36	2.26	44	2.76	40	2.51	34	2.14	15.76
.5	86	5.39	90	5.65	72	4.52	73	4.57	68	4.26	88	5.71	30.10
.5	44	2.90	45	2.25	31	1.55	53	2.65	51	2.55	58	2.90	14.80
.5	4	2.14	4	2.14	..	......	46	2.88	36	2.26	12	2.14	11.56
.5	45	2.83	64	4.01	85	5.33	72	4.52	79	4.95	78	4.89	26.53
.7	6	3.00	6	3.00	11	3.00	5	3.00	5	3.00	3	3.00	18.00
.7	54	3.41	36	3.00	35	3.00	34	3.00	40	3.00	64	4.01	19.42
.7	169	10.20	162	9.77	97	6.08	64	4.01	61	3.82	94	5.90	39.78
7.5	35	2.20	37	3.21	40	3.21	34	3.21	40	3.21	46	3.21	18.25
7.5	16	3.21	19	2.14	17	3.21	17	3.21	16	3.21	17	2.14	17.12
7.5	26	2.14	37	3.21	33	2.14	40	3.21	31	3.21	39	3.21	17.12
8.	56	3.51	61	3.82	61	3.82	....	.....	.. ..	......	....	......	11.15
8.	143	8.63	136	8.20	93	5.83	105	6.33	90	5.65	105	6.33	40.97
8.	29	3.42	38	3.42	32	3.42	38	3.42	30	3.42	39	3.42	20.52
10.	464	27.11	387	22.61	435	25.42	359	20.97	358	20.91	409	23.90	140.92
10.	171	10.31	184	11.10	148	8.86	161	9.71	235	14.18	274	16.53	70.69
10.	111	6.69	148	8.83	142	8.56	147	8.88	214	12.51	281	16.95	62.42
10.	360	21.04	208	12.54	141	8.51	292	17.06	452	26.41	384	22.43	107.99
10.	44	1.67	584	22.19	1365	51.87	1440	54.72	1583	60.15	1861	70.71	261.31
10.	....	....	16	1.00	75	4.71	92	5.73	67	4.28	80	5.02	20.74
10.	191	11.52	230	13.87	234	14.11	89	4.58	201	12.03	202	12.18	68.29
10.	1071	40.69	657	24.96	340	12.92	1216	46.20	1650	62.70	1520	57.76	245.23
10.	52	4.28	49	4.28	57	4.28	63	4.28	76	4.76	82	5.14	27.02
10.	229	13.82	231	13.93	234	14.11	200	12.07	261	15.75	318	18.68	88.36
10.	53	4.28	50	4.28	32	4.28	33	4.28	45	4.28	47	4.48	25.68
11.	171	10.31	158	9.53	131	7.90	....	......	287	16.77	223	13.46	57.97
12.	554	32.37	447	26.12	340	19.87	264	15.93	264	15.93	....	......	110.22
15.	190	11.46	144	8.69	82	6.42	66	6.42	111	6.69	104	6.27	45.95
15.	355	20.74	407	23.78	423	24.71	336	19.63	336	19.63	471	27.52	136.01
15.	10	.63	315	18.41	306	17.87	289	16.83	286	16.71	343	20.04	90.49
15.	659	38.50	707	41.31	834	44.37	143	8.63	1429	73.31	915	48.68	254.80
15.	53	6.42	57	6.42	40	6.42	41	6.42	46	6.42	52	6.42	38.52
18.	176	10.62	198	11.95	165	9.95	52	7.70	248	14.96	147	8.87	64.05
27.5	4114	113.12	7832	215.38	6047	166.29	6191	170.25	5854	160.98	5635	154.96	980.98

In order to give an idea of the exceedingly variable and intermittent character of the elevator load in a city the size of Dayton, the accompanying table showing the kw-hour consumption and amount received from each elevator by months for a period of six months is given. It will be seen that most of the elevators are of what would be considered small horse-power capacity in a large city. The amount received per elevator in some cases varies considerably from month to month. There is also a decided difference between customers, as would be expected. The income per horse-power is considerably below the readiness-to-serve charges commonly made for ordinary stationary motors in cities where a readiness-to-serve rate is in vogue. However, the diversity factor of an elevator motor load is very low. In other words, the ratio of the maximum aggregate demand at any moment to the rated horse-power of the elevators connected is low. It is not, therefore, usually considered equitable to charge elevator motors as high a readiness-to-serve rate as motors which run continuously for an hour or more at a time. In a large city, the elevator income and load are, of course, a much more important part of the whole than in small cities. In a city like Chicago, as shown by Mr. L. A. Ferguson in a paper which he presented to the A. I. E. E. in 1907, the electrical energy taken by elevators may amount to as much as 12.5 per cent of the total output of the central-station company.

Electric Pumping from Deep Wells.

A paper by Charles B. Burdick presented before the Western Society of Engineers, which, together with the discussion thereon, appears in a recent *Journal* of that society, is of considerable interest to central station companies considering city contracts for pumping from deep wells.

The reciprocating deep-well pump, with the pump cylinders deep in the well, is first briefly discussed. He states that where the quantity of water is small and the lift moderate this machine operates with good results; but where considerable water is handled, especially at high lifts, it has proved both costly of operation and maintenance. With the single-acting plunger the water column must be started and stopped once in each revolution and twice with the double-acting plunger. This operation, especially at high piston speed, is both extravagant of power and hard on machinery. This difficulty has been partially overcome by the use of the differential plunger. He gives tests on three Johnson deep-well pumps which had efficiencies ranging from 72 to 67 per cent, which he thinks probably represents the best that can be hoped for by reciprocating machinery under lifts of from 274 to 252 ft.

The air-lift pump, which consists simply of a jet of compressed air from a small pipe discharged into a pipe of larger diameter sunk below water level, is discussed at length. With an air lift the depth to which the air pipe is submerged and the consequent pressure of the air undoubtedly has an important bearing on efficiency. It is usual to express this submergence as the ratio of the total height of the mixed air and water column to the height of the column which is submerged in the water of the well; the total height of the mixed column being measured from the point of air application to the point of delivery of the air and water mixture. Experiment and experience seem to show that the best results are obtained under a submersion of about 66 per cent, and that with lifts of 50 ft. or less the efficiency is reduced to about one-half when the submersion is reduced to 33 per cent. The most favorable air pressure is one slightly in excess of the pressure caused by the head of water due to submergence, and the air pipes and passages should be so proportioned as to permit the passage of the proper quantity of air without seriously reducing its pressure.

Tests on the efficiency of air-lifts are quoted from various sources, ranging all the way from 53 to 17 per cent, considering only the efficiency of the air-lift and taking no account of the efficiency of the compressor. It seems to be the general impression, and this is borne out by such tests as have been made public, that the efficiency of the air-lift as a pump, not considering the compressor, ranges between 25 and 40 per cent under favorable conditions and for medium lifts. As to compressor efficiencies the author thinks it probable after considering various figures that no injustice will be done by assigning an efficiency of 60 to 75 per cent for such steam-driven compressors as can properly be placed in the ordinary water-works installation. He takes up the vertical-shaft high-speed centrifugal pump sunk deep in the well casing, and refers to the installation at La Grange, Ill., which was described in the Electrical World, first issue of February, 1907. To accommodate this centrifugal pump the wells were reamed out to a diameter of 16 in. to a depth of 120 ft., and a three-stage Byron-Jackson pump sunk in the opening thus secured.

In the discussion Mr. O. C. Spurling made some interesting comparisons between the La Grange centrifugal pumps and a double-acting steam-driven deep-well pump at the Hawthorne plant of the Western Electric Company. The average results obtained from a continuous run of 168 hours showed that 226 gal. per minute were pumped against a head of 80 ft., with a consumption of 12.5 lb. of steam per minute. The consumption of steam per hydraulic hp-hour was 164.3 lb., and as the steam delivered to the pump costs 35 cents per thousand pounds, the cost per hydraulic hp-hour is 5.75 cents, and for pumping 1000 gal., 1.93 cents. Assuming that the efficiency of the centrifugal motor-driven vertical-shaft pumps at La Grange is 50 per cent and the motor efficiency 85 per cent, a motor would take 1.75 kw-hours per hydraulic hp-hour. [The overall guaranteed motor and pump efficiency was 55 per cent, which was exceeded in tests made since this discussion took place.—Editors.] Assuming that the pumps were supplied with energy at 2 cents per kw-hour, the cost per hydraulic hp-hour would be 3.5 cents, and the cost of pumping 1000 gal. would be 1.18 cents. He also considered some wells cited by the author using compressed air, where 450 gal. per minute were pumped against 63-ft. head, with 67-lb. air pressure, the air consumption being 2.3 cu. ft. of free air per minute. Assuming a cost of 7 cents per 1000 cu. ft. of free air compressed to 75 lb. pressure (the Western Electric Company's cost for air compressed to 75 lb. is 8 cents per 1000 cu. ft. of free air), the cost per hydraulic hp-hour is found to be 12.5 cents, and the cost of pumping 1000 gal. 3.3 cents, as against 1.93 cents for the motor-driven centrifugal pump. Mr. H. Gansslen cited a case which he had investigated where with a lift of 110 ft. estimates showed that it would take as much steam to lift 250 gal. per minute with an air-lift as it took with a deep-well pump.

Prof. D. W. Mead, the well-known authority on waterworks engineering, said that the deep-well centrifugal pump described in the paper seemed to be one of the most satisfactory solutions for deep-well work where the quantity of water to be pumped amounts to 250 to 1000 gal. per minute. Where smaller quantities are to be pumped other types of machinery can perhaps be used to greater advantage. The wear was very small on deep-well centrifugal pumps, which was a point very strongly in favor of that class of machinery. Both Messrs. J. L. Hecht and Perry H. Hedrick agreed that the best results were obtained with an air-lift when the water flows from the well in a steady stream mixed with the air. The formation of piston-like layers of air and water was not indicative of the best results and would occur when the submergence is insufficient or when the submergence is proper and the air supply either too large or too small. With the correct submergence and with the proper amount of air supply at a proper pressure and admitted under proper control, the flow of water from the well was practically a continuous stream.

Electric Service of the Fitchburg Gas & Electric Company.

By William H. Stuart.

Fitchburg, Mass., is a manufacturing city with a population of about 35,000, and the center of population of 110,000 people in a radius of 12 miles, connected by railroad, trolley or macadam highway, and in some cases by all three. Its manufactures are of a very diversified character, there being in Fitchburg no less than 50 industries each producing a separate and distinct product on a large scale. The most important are saw works, the largest in the world; next in order are works for the manufacture of engines, paper, shoes and ginghams. The manufactured products amount to $16,000,000 annually. One feature of Fitchburg's industries is that they are owned locally.

The first electric light station was established in Fitchburg in 1883 by the Wachusett Electric Light Company. The plant and office were located in a small brick building on Water Street, opposite Crocker Street. In 1889 the Wachusett Company was purchased by the Fitchburg Gas Company and the electric station removed in that year to a new station built near the gas works. In 1902 the business had outgrown this station and a new and up-to-date plant was built and equipped with three generating units with a capacity of 3,000 horse-power. The first electric motor used in Fitchburg was installed by the Sentinel Printing Company, in June, 1892; it was a 15-hp motor and replaced a steam engine used for operating the printing presses.*

The present plant is located in South Fitchburg and comprises three brick and two wooden buildings. In one of the former is located the station proper, the others containing storeroom, coal space, stables and repair rooms.

The generating equipment consists of five Stirling boilers of 258 horse-power each, and three McIntosh & Seymour engines of 600, 900 and 1500 horse-power respectively, direct-connected to three General Electric three-phase generators of 400, 600 and 1000-kw capacity. The current is generated at 2200 volts, which is transformed for power to three-phase, 550 volts, and for incandescent lighting to single-phase, 110 and 220 volts.

The excellent arrangement of the apparatus in the station and the cleanliness of the surroundings have made the plant one of Fitchburg's industrial show places. The main engine and dynamo room is on the first story of the largest station building and is reached from the street by an iron stairway. On one side of the room is located the switchboard, which has three generating panels, four line panels, one station and one exciter and regulating panel, making nine in all. The board is of dark slate with a base finished with dark yellowish tiles, and the instruments are nickel plated. The three generating units are railed off, and all pipe connections are painted white. The floor of the room is covered with heavy cork, varnished. Passageways have a covering of rubber runners. The illumination of the station at night is from lighting units suspended from ornamental arms.

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*An account in detail of the motor service of the Fitchburg plant, by Mr. A. H. Kimball, the superintendent, is given elsewhere in this issue.

The ashes are used for filling. The coal is brought in on a railroad spur and dumped in a pile as needed. An industrial railway runs from the coal heap to the boilers.

The street mains are run overhead on poles with the exception of those on Main Street. The company realizing that in the future the city government might make a request that the mains in this street be placed under ground, voluntarily constructed a subway two miles long. Transformers are used individually, and are mostly on the rear of buildings, as the majority of connections are made from the rear rather than the front. The poles of the company are numbered by means of a small steel plate, bearing the name of the company and the number of the pole nailed to the pole about 9 ft. from the ground. A station employee in an auto runabout covered the territory thoroughly and rapidly. The primary circuits, arc and incandescent, are tested out four times each day.

The meter department is in a comfortable and thoroughly equipped room where all meters are tested when received from the manufacturers and given a number and placed in stock. On complaints of high bills and a request that meters be examined and tested, a portable testing set is used and the meter tested in circuit in the consumer's presence. All meters are tested, cleaned and regulated once a year. The meter department is operated by two men. The meters are read every month by readers sent from the office. For reading, there are meter indexes on cards which contain name of customer, address, meter number, constant, date set and ledger information. The gas and electric meters are read by the same set of men, for which service there are eight men.

The force required to operate the station is composed of a chief engineer, three engineers, three oilers, three firemen, two coal handlers, one foreman and four linemen. The company for two years has had two small auto runabouts which are used both night and day and have become indispensable.

The lighting load is composed of commercial incandescent and arc and street arc and incandescent lighting. The city contract for street lighting calls for 322 arcs of 2000 candlepower at $100 per year, and 83 incandescent lamps of 32 candlepower at $30 per year, lighted all night. The commercial consumers use about 110 arc lamps and the number of incandescent lamps of 16-cp equivalent is about 16,000. The total number of kw-hours generated during the year ending June 30, 1906, was 2,835,687, of which amount 631,200 kw-hours were for street lighting, the balance being used for power and for commercial lighting. During the year ending June 30, 1907, the total output was 3,240,618 kw-hours, of which 1,358,918 kw-hours were in lighting load.

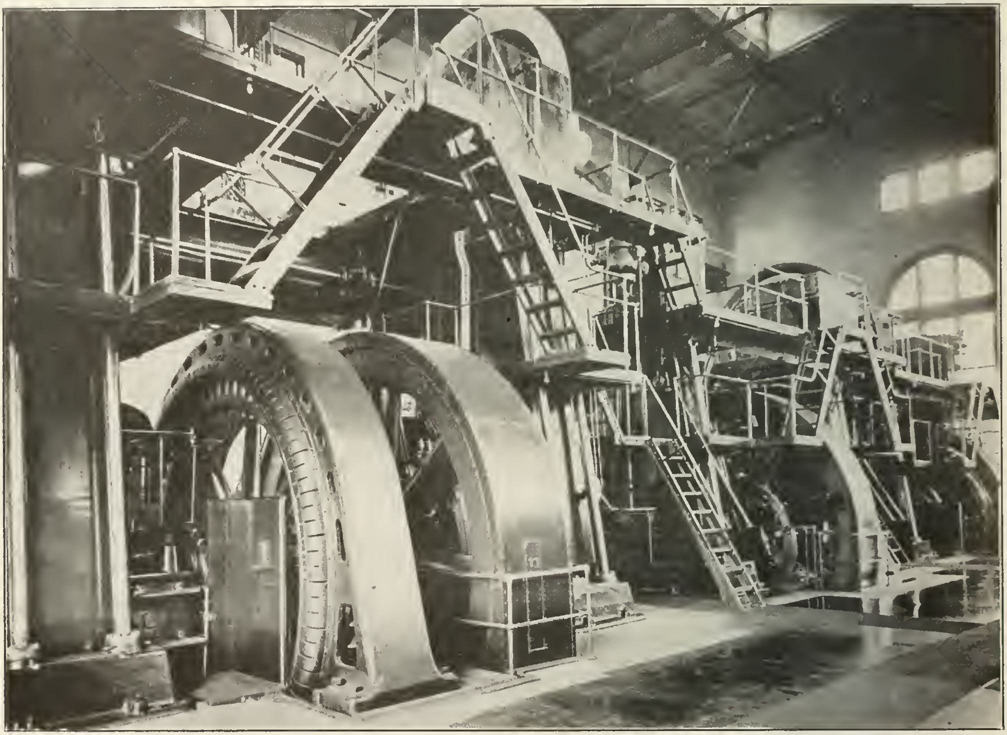


FIG. 1.—VIEW OF INTERIOR OF STATION OF FITCHBURG GAS & ELECTRIC COMPANY.

An interesting and comprehensive account of the power business in Fitchburg, the methods used and the results obtained, is given in an article entitled "Electric Power Business in New England" in the November issue of this journal, where it is pointed out that applications of electric power have been made to about 60 separate uses.

The office of the company is located on Main Street, where it occupies the ground floor of a modern building and has two large show windows. Overhead across the entire front of the building is a large sign reading, "Fitchburg Gas and Electric Company," and just below this is another sign of smaller dimensions reading "Electric Power." The signs are operated by a flasher, and at night show up very nicely. The show windows are well lighted and contain exhibits of various electric and gas fixtures and appliances. The electrical exhibit at present is one composed of small motors showing their adaptability for general use. The office contains an elaborate show room. A large wall showcase with sliding glass doors contains every conceivable heating and cooking appliance. Next to this is a well-arranged space on the wall which is used for exhibiting various styles of lamps and shades. There is also a space allotted for wall lamps and fancy small brackets and arms containing one or more lamps. On the opposite side of the room there are motors of various sizes arranged on a platform raised from the floor. In the basement various rooms have been portioned off and are used as meter rooms, stock and storerooms for arc lamps, motors, wire, fixtures, etc.

The company wires and sets up motors ready to run for a consumer, and if after a fair trial the motor is not wanted the only charge to the consumer is for current consumed. It furnishes arc lamps and keeps them trimmed and in good repair, but does not furnish free incandescent lamp renewals. Outside wiring necessary to connect a service is at the expense of the customer and is charged as service connection. Meters are set and removed without charge.

In the daily papers advertising cuts and descriptive matter is used. Descriptive circulars and follow-up letters are used in advertising campaigns and have brought results. An illustrated descriptive pamphlet entitled "Facts Regarding Electric Power in Fitchburg" has been used to good advantage. A neat little folder of buff color, closed with a red seal and with the wording, "A Few Points for Careful Housewives" on the outside, contains a package of sewing needles, representing the physical points, and opposite are points about electric flat-irons. All of the advertising matter is arranged in attractive and catchy forms.

All current is sold by meter. The rates for incandescent and arc lights are as follows:

Basic rate, 20 cents per kw-hour, subject to the following discount for bills paid on or before the 20th of the month on which such bills are rendered:

Kilowatts metered.	Discount, per cent.	Net rate per kw-hour.
Less than 25 kw-hours per month	5	$0.19
25 to 50 kw-hours per month	10	.18
50 to 100 kw-hours per month	15	.17
100 to 150 kw-hours per month	20	.16
150 to 200 kw-hours per month	25	.15
200 to 250 kw-hours per month	30	.14
250 to 325 kw-hours per month	35	.13
325 to 400 kw-hours per month	40	.12
400 to 500 kw-hours per month	45	.11
500 kw-hours and over per month	50	.10

The minimum monthly charge is $1 for each meter set. The minimum monthly charge for arc lamps is according to the length of contract as follows:

One year or more	$2 per lamp per month
Six months or more	$3 per lamp per month
Three months or more	$5 per lamp per month

The rates for power are as follows:

	Cents per kw-hour.
Less than 100 kw-hours per month	10
100 to 200 kw-hours per month	9
200 to 300 kw-hours per month	8.5
300 tc 400 kw-hours per month	8
400 to 500 kw-hours per month	7.5
500 to 600 kw-hours per month	7
600 to 800 kw-hours per month	6.5
800 to 1000 kw-hours per month	6
1000 to 1200 kw-hours per month	5.5
1200 to 1400 kw-hours per month	5
1400 to 1600 kw-hours per month	4.7
1600 to 1800 kw-hours per month	4.4
1800 to 2000 kw-hours per month	4.2
2000 to 2200 kw-hours per month	4
2200 to 2400 kw-hours per month	3.8
2400 to 2800 kw-hours per month	3.6
2800 to 3200 kw-hours per month	3.4
3200 to 3600 kw-hours per month	3.3
3600 to 4000 kw-hours per month	3.2
4000 to 5000 kw-hours per month	3.1
5000 kw-hours and over per month	3

The minimum monthly rates for the motors range as follows: $1 for ¼ hp, $3 for 1 hp, $8 for 5 hp, $15 for 10 hp, $20 for 15 hp, $22.50 for 20 hp and $1 per hp for 25 hp or over. A discount of 10 per cent is allowed on all bills paid on or before the 20th of the month.

The officials of the company are: President, Mr. Herbert I. Wallace; treasurer and manager, Mr. H. F. Coggshall; superintendent, Mr. A. H. Kimball; chief engineer and electrician, Mr. H. L. Battles.

Electric Power, Its Progress and Possibilities.

By A. H. Kimball.

In the early days 15 or 20 years ago, central stations outside of the larger cities did not run through the daytime and their hours of starting and stopping varied according to the time of the year and weather conditions. In summer, the station started about 6 p. m. and was shut down the next morning after the street lights went off at from 4 to 5 a. m. As the days began to shorten, however, the running hours of the station began to lengthen, till the schedule had changed the starting time to about 3 p. m. and the shutting-down time to about 8 a. m. the next morning. It was a purely lighting load, with the load factor exceedingly low and the prices for lighting correspondingly high, and these conditions would to a great extent exist to-day if it had not been for the introduction of electric power.

With the advent of the electric motor as a commercial piece of apparatus it was necessary to run the station all day in order to obtain electric-power business. It was a losing game for the station to begin with, and in the case of the Fitchburg, Mass., station, where we started with a 15-hp motor in 1892, it was years before our electric-power income was enough to cover the station labor.

The year 1900 saw 110 hp in motors connected to our system, which was then 500 volts direct current, and we began to realize what might be done with electric power if we only had a modern station with capacity to handle electrically the numerous steam-operated plants in this city. After careful investigation we decided to build such a plant, and ground was broken early in 1902, with the result that on July 1, 1903, we started a new and modern station with three-phase, 2300 volt, 60-cycle generators having a capacity of 1000 kw. About July 1, 1907, we doubled this capacity, and have to-day a 2000-kw station, comprising units of 400, 600 and 1000 kw.

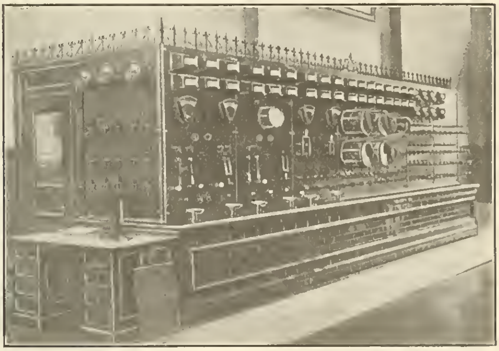


FIG. 2.—SWITCHBOARD IN STATION OF FITCHBURG GAS & ELECTRIC COMPANY.

Electric power has made this possible, has given continuous electric service of all kinds to the customer, has largely influenced the reduction in the cost of electric lighting, and is and will be the salvation of many of the electric-lighting plants of to-day.

At the time of starting our new station we had 246 hp in direct-current motors connected to our system, which we rapidly changed to three-phase, 550 volts. This amount of electric-power business had been acquired in 11 years, a pretty poor showing when we look back on the record from to-day. We realized, however, that this slow growth was due to several causes:

First, the electric-power business was new and undeveloped, and the price of motors and the rates for current were high. Second, data regarding practical operation were lacking, and our arguments to prospective customers carried little weight for want of conclusive facts.

I therefore determined to obtain all possible data on this subject, both as to station output and the operation of the customers' motors, and make use of the information in getting new business. A list of the power customers was first made and the necessary data compiled under the following headings.

The accompanying table gives under these headings a partial list of our power customers, giving the data for six months ending July 1, 1907.

From these data can readily be obtained, if desired, the amount paid by the customer for six months and the rate paid per horse-power used. The data under these last headings we do not carry out in printed form when soliciting power business, as it would not be advisable to make a public exhibition of the amounts paid by our individual customers.

The data are based on six months' operation, 25 working days to the month, and 10 hours per day, which in our particular case is a very close average. This gives us practically all of the customer's working conditions, except his variable load indications from minimum to maximum, which could only be accurately obtained by a three-phase, curve-drawing wattmeter or by taking readings at short intervals from an indicating or recording wattmeter.

As our power business increased these data became very valuable in showing the amount of power actually used by different classes of work and manufacturing industries. A study of the data will be exceedingly interesting to solicitors for electric power as showing what results prospective customers engaged in similar classes of work may reasonably expect. They show conclusively that the total horse-power in motors which the customer has installed has comparatively little bearing on the size of his electric-power bills.

There are two particularly strong points that should be borne in mind when soliciting electric-power business, namely, the possibility of greatly reducing the power actually required to do the work, by eliminating friction due to shafting, connections, etc., and by an intelligent installation of electric motors; and, second, the saving a customer can make with a metered rate where the character of his work is intermittent.

Take, for example, customer No. 3 with 25 hp in motors, with an average use of 20.84 hp, or 80 per cent, of his power installation. This customer has two motors, one of 15 and one of 10 hp, belted to two lines of shafting, from which all his machines are belted. We made a test of this installation recently, the friction load being taken one Saturday afternoon after the shop had shut down and a reading of the customer's recording wattmeter also taken. An accurate record of his running time for the next week was kept, and his meter again read. After deducting the known power used in friction for that time, it was found that out of the total kw-hours used for the week only 24 per cent were used for the actual work and 76 per cent lost in friction.

Compare this with customer No. 7 with 28½ hp in motors, with an average using of 12.50 hp, or 44 per cent, of his power installation. This customer has two 10- and one 7½-hp motors belted to shafting, and a 1-hp motor belted direct to an individual machine. This is a new and modern shop, recently built without engine house, boiler house, or power chimney, and was designed to operate by electric power. On account of the large number of tools and machines to be operated (most of them small and some 60 in number), it was not deemed advisable to attempt to run them with individual motors. The shafting was of the best, and was installed with a view of eliminating all possible friction. A test of this installation on a week's run showed the kw-hours consumed in friction to be 55 per cent of the total kw-hours used.

Now compare these two customers with customer No. 35, with 95 hp in motors, with an average using of 20.76 hp, or 25 per cent of his power installed. This customer has the advantage of No. 7 in having fewer and larger machines to operate, and was induced to adopt a complete system of individual drive, and practically cut out every foot of shafting except a few counters. His installation comprises some 30 motors, averaging from ½ to 10 hp, with a switch at every machine. He has no friction loss except what is in the motors themselves and the machines they operate, and his operating efficiency is the highest obtainable. His average motor installation cost was considerably in excess of the other two, but was offset to a certain extent by their investment in shafting. The efficiency in operation of No. 35 has been sufficient to pay the whole installation cost in a comparatively short time.

The data from other customers are all interesting as showing the continuous or intermittent character of their work. Take No. 9 running a cash system. This is practically a continuous load, and used 84 per cent of the power installed. No. 11 is used for sawing wood, which is very intermittent work, and used only 10 per cent of the power installed.

The table gives practical ilustration of the actual running conditions as they exist in different classes of work, and will very materially assist in convincing a prospective customer that electric power is efficient and cheap (if the rates are right).

One day last summer a man telephoned us that his engine had broken down and asked how quickly we could furnish him with electric power. We carry in stock for immediate delivery motors in all sizes up to 50 hp, and as he claimed 50 hp was necessary for his needs, we had him connected and running the next afternoon with a 50-hp motor belted to his main shaft. He was a man we had approached several times to introduce electric power, but without success, and here was an excellent opportunity to demonstrate what we could do. In two successive days we made eight tests to determine the power he was using, with the following results:

THREE-PHASE POWER RECORD.

January 1, 1907, to July 1, 1907.

	Name of Customer.	Hp installed in motors.	Kw-hours used in six mos.	Rate per yr. per hp installed.	Average hp used	Ratio of hp used to bp installed, per cent.
1	Machine shop...	12½	6,401	$50.83	5.69	46
2	Printery	3	763	41.22	.678	46
3	Machine shop...	25	23,450	53.59	20.844	80
4	Roast'g and grinding coffee.....	5	1,193	37.46	1.05	21
5	Grain elevator...	80	32,180	22.63	28.6	36
6	Sawing wood....	3	358	22.08	.318	10
7	Machine shop...	28½	14,070	33.58	12.507	44
8	Woodworking ...	2	90	22.00	.08	4
9	Cash system.....	1	944	152.78	.839	84
10	Printery	5	1.299	43.15	1.155	23
11	Sawing and splitting wood.....	5	567	20.29	.504	10
12	Printery	2	454	42.38	.404	20
13	Making shoes....	3	278	19.68	2.47	8
14	Making yarn....	75	13,070	12.19	11.618	16
15	Foundry	86	18,790	13.28	16.702	19
16	Sawing wood....	5	376	18.25	.334	7
17	Foundry	30	13,040	30.38	11.588	39
18	Foundry	9	4,230	55.00	3.76	42
19	Machine shop....	10	4,159	48.66	3.697	37
20	Confectionery . .	2	166	24.30	.147	7
21	Machine shop....	5	1,284	39.87	1.141	23
22	Creamery	3	151	18.00	.134	4
23	Printery	10	763	16.80	.678	7
24	Charging batteries	5	1.961	57.01	1.743	38
25	Making yarn....	90	81,830	40.69	72.738	80
26	Foundry	9½	5,018	58.27	4.46	47
27	Gingham mfg....	305	219.736	25.94	195.32	75
28	Gingham mfg....	150	85,460	20.51	75.964	51
29	Gingham mfg....	260	195,100	27.01	173.422	67
30	Ice cream.......	2	215	26.37	.191	10
31	Optician	1	98	32.40	.0871	8
32	Blacksmith shop..	1	35	32.40	.031	3
33	Printery	15	5,982	41.61	5.316	35
34	Saw mfg.......	164½	56,080	16.76	49.848	30
35	Machine shop....	95	23,360	14.02	20.764	25
36	Machine shop....	3	258	18.30	.229	8
37	Sawing and splitting wood.....	5	871	27.87	.774	15
38	Sawing and splitting wood.....	5	336	17.28	.298	6
39	Sausage mfg....	3	1,445	73.72	1.284	43
40	Sawing wood....	5	126.	6.48	.11	2
41	Printery	3	565	36.13	.502	17
42	Lumber yard....	47½	13.680	19.72	12.16	26
43	Grinding coffee..	½	91	43.20	.088	18
44	Roast'g and grinding coffee.....	5	330	17.28	.293	6
45	Waste compress'g	9½	958	16.93	.851	9
46	Elevator	25	6.150	23.20	5.467	22
47	Elevator	10	1.065	10.02	.947	9
48	Machine shop....	2	154	21.60	.137	[illegible]

On the first day four tests showed: 34.1, 31.8, 34.5 and 30.5 hp; and on the second day, 32.2, 31.4, 30.5 and 32 hp, or an average of 32.12 hp being used. We also installed a recording wattmeter, which registered in two days of 10 hours, 470 kw-hours, showing an average of 31.3 hp, compared with 32.12 hp obtained by the indicated readings, a very close comparative record.

On each day between the hours of 12 and 1, when the work had stopped, we took indications to determine the friction load, which we found practically the same on three tests and amounted to 23.4 hp. This showed that only 7.9 hp was required to do the actual work and that 73 per cent of the total power required was consumed by friction. Our demonstration convinced the customer beyond a doubt that we could, with a number of motors properly located, furnish him with electric power for less money than he could operate by steam.

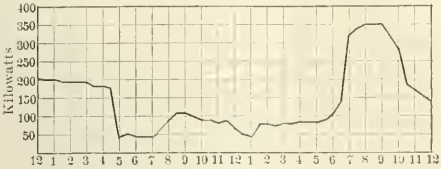


FIG. 1.—OUTPUT AUG. 29, 1903.

I cite this case as an example of the possibility of a practical demonstration of this kind to show the customer on his own premises what can actually be done with electric power. We have made a number of demonstrations of this kind with the most satisfactory results.

July 1, 1903, was the beginning of our fiscal year, and also the date of starting our new station, and we determined to keep some accurate records of our station operation. Our electric-power business at that time amounted to 20 per cent of our total output. Our load factor for the previous year was unknown, and also most of the essential data relating to economic operation.

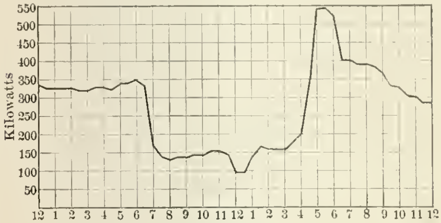


FIG. 2.—OUTPUT DEC. 16, 1904.

Curve sheets 1, 2, 3, 4 and 5 indicate the total output from the station on those days for both lighting and power, and the growth shown is nearly all due to electric-power business. This had a peak load of 95 kw, with an output of 600 kw-hours on Aug. 29, 1903, and a peak load of 800 kw, with an output of 9000 kw-hours for July 31, 1907, which was 80 per cent of the total station output for that day.

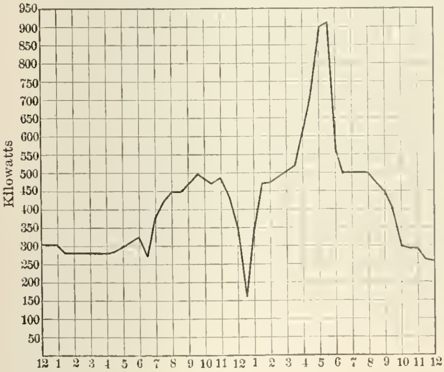


FIG. 3.—OUTPUT NOV. 28, 1905.

Our station load factor for the year ending July 1, 1904, was 15.9 per cent, and for the year ending July 1, 1907, 34.3 per cent, which increase was due almost wholly to electric power.

The first running year of our new station, which ended July 1, 1904, showed an average station motor-load equal to 21 per cent of the total horse-power in motors installed. This showed at once the intermittent character of the load at that time, which condition was gradually changed by the addition of cotton mills and other consumers requiring more continuous power and has brought the electric-power load factor for the last year up to 38 per cent.

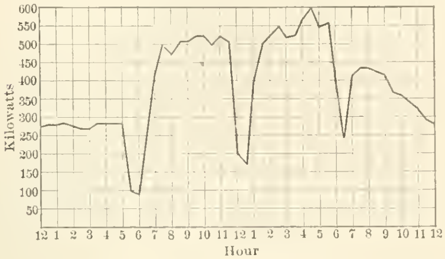


FIG. 4.—OUTPUT MARCH 28, 1906.

Some fears have been expressed, and with good reason, that the acquirement of a power business would bring on a peak load in the winter months that would overload the station lighting apparatus when the lighting and power loads overlapped each other. Our peak load in 1904 was 263 per cent higher than our average day load. In 1905 it was 103 per cent, in 1906 it was 75 per cent, and in 1907 50 per cent, and only 22 per cent higher than our highest day load.

If electric-power business is to be had it is worth going after, and it will pay to enlarge a plant in order to handle it. If it can be obtained in large quantities it will soon outrival the lighting business and make necessary a station capacity that will set at rest all fears of a peak load.

With a largely increased output from a station, the cost to manufacture a kw-hour would be reduced. This saving not only applies to new business, but to old business as well, and makes possible reductions in rates, which are very acceptable to customers and tend to stimulate and increase the business in all its branches.

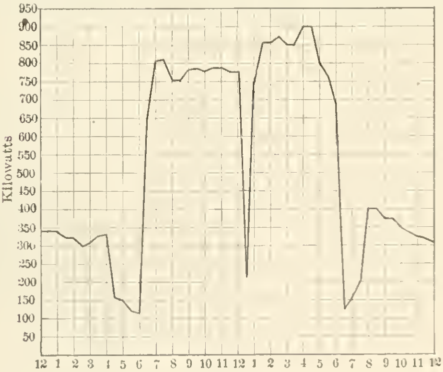


FIG. 5.—OUTPUT JULY 31, 1907.

Electric power is far from being fully developed, but it is growing fast, and its economics are being better understood. There is no question in my mind but that electric power can be produced from a central station in large quantities and be distributed to customers, both large and small, for a lower price than they can make it individually.

Electrical Equipment of an Iron Foundry.

The electrical equipment of a successful iron foundry furnishes one more example of the range of adaptability of electric power. Nineteen motors, with an aggregate rating of 200 horse-power, are used in the Providence foundry department of the General Fire Extinguisher Company, and the motors vary in size from 2 horse-power, which is the rating of a motor on a single rattler, to 40 horse-power, the rating of a motor driving a Roots blower. The foundry in question was not originally laid out for electric drive, so that a more economical arrangement could have doubtless obtained had electricity been used at the start.

Considering the installation with relation to the logical development of the product, the sand-mixer is the first machine to call for attention. The sand for the cores is received in the basement, where it is conducted by a chute to the sand-mixer. This machine is belted through a short countershaft to a 5-hp motor, and a test made on this mixer shortly after its installation showed a consumption of about 3.34 horse-power with the mixer fully loaded. The sand, after passing through the mixer, is discharged into a receptacle whence it is taken by a bucket conveyor to the core-making room on the second floor. The motor on the sand conveyor is rated at 3 horse-power, and is shunt wound. Under normal conditions of operation the power required ranges from 0.8 to 1.25 horse-power, depending on the speed with which sand is fed into the buckets.

An Ingersoll-Sergeant compressor furnishes air for 45 molding machines, two shakers and five hoists. This compressor also supplies air for cleaning the motors; a small pipe being run to each motor, where a cock is provided for the attachment of a flexible tube with nozzle. The compressor is driven by a 30-hp Westinghouse shunt-wound motor through a silent chain drive. A recent test on this machine showed an input of 29 horse-power.

The foundry is equipped with two cupolas, 70 in. and 76 in. outside diameter, respectively. The blast for the cupolas is supplied by a No. 6 Roots blower and a No. 5 Baker blower. The larger cupola and the Roots blower are used under ordinary conditions; the other set being reserved for use in large melts and for emergencies. Both blowers are installed in rooms adjacent to the charging floor, and the pipes are so arranged that either cupola may receive air from either blower. The length of pipe from the blower to the cupola is about 35 ft. The Roots blower is driven through a rawhide pinion gear by a 40-hp General Electric shunt-wound motor and the Baker blower is driven by a 30-hp motor of the same style and make. The input to the motor driving the Roots blower is given in Fig. 1.

The rattlers are divided into three sections, and each section is driven by a separate motor. Two of the sections comprise three rattlers, and the third section comprises five rattlers. The rattlers are all 57 in. long by 36 in. in diameter. The larger section is driven by a 15-hp Crocker-Wheeler shunt-wound motor, and the other sections are driven by a 15-hp Holzer-Cabot and a 10-hp Westinghouse motor, respectively. Under average conditions each rattler requires about 2.3 horse-power. The dust is exhausted from the rattlers by a 36-in. fan operated at 1000 r.p.m. by a 7½-hp Holzer-Cabot motor. A test of the exhaust fan showed an input of 4.2 horse-power. The motor and fan are belt-connected. The motors for the rattlers and fan are installed in a small room adjoining the machines they operate and on a level with the shafting. The motors are controlled by switches and rheostats installed in wall cabinets at a convenient location for the men tending the rattlers.

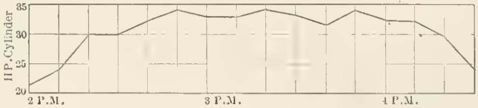


FIG. 1.—INPUT TO MOTOR DRIVING BLOWER.

The grinders, four of which are motor-driven, and five of which are belt-driven, are equipped with emery wheels. The motor-driven grinders are 5-hp Holzer-Cabot machines, with two 17-in. x 3-in. emery wheels mounted on the armature shaft. The belt-driven grinders also have two emery wheels. The foundry is well ventilated throughout by five exhaust fans. These are operated by motors ranging in rating from 2 to 5 horse-power.

The carpenter and pattern shops, both of which are equipped with electric motors, round out the installation. The carpenter shop has a 2½-hp motor, which drives a 36-in. band saw, a vertical drill, a circular saw and a grindstone. The pattern shop has a 10-hp motor driving a main shaft to which are connected by countershafting two circular saws, a 36-in. band saw, several small lathes and a tool grinder. When all the machines are in operation they require an input at the motor of 8.3 horse-power.

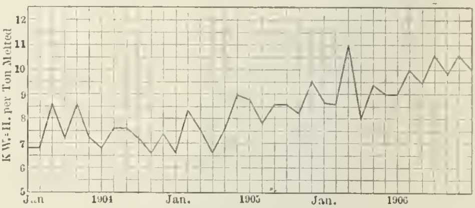


FIG. 2.—CURVE SHOWING CONSUMPTION OF ENERGY PER TON OF METAL MELTED.

The output of the foundry consists of small castings, nearly all of which are rattled and ground. The average consumption of energy per ton of melted metal for the years 1904, 1905 and 1906 is shown in Fig. 2. This includes the energy used for all purposes, although some of the motors, such as those connected to exhaust fans, have no connection with the output. In a foundry where the output consists of large castings the energy consumption per ton of metal melted would be less.

Although the direct-current motor is not so well adapted to foundry work of this kind as the induction motor, because of the dust and dirt, the installation in this instance has given entire satisfaction. If the plant were equipped with a belt drive throughout, it is estimated that from 40 to 50 horse-power would be required to drive the shafting alone. The foundry is a busy one, turning out a high grade of work; and since it has been working continuously, the test of the motors has been thorough. All motors, except those on the grinders, are of standard types, and the energy for the installation is taken from the 500-volt, direct-current mains of the Narragansett Electric Lighting Company.

The Electric Motor Load from the View Point of Central-Station Service.

By Charles K. Nichols.

When the first central stations began operation for the distribution of electric current, it was to supply a lighting load exclusively, and for several years motors were not regarded from a central-station standpoint. As the motor became more mechanically perfect, however, the central-station manager began to realize the possibility of developing a day load which would increase the general efficiency of his plant and reduce the cost per kw-hour. With a strictly lighting load the curve plotted from the station output will rise sharply between the hours of 4 and 6 p. m., depending upon the season of the year, with an extreme peak between 7 and 7:30, then gradually drop as evening advances. For the remainder of the 24 hours the plant, if operated, will be practically without load.

As the increase in kw-hours sold per dollar invested in plant means a lower average cost per kw-hour, the importance of filling the low portion of the load curve is obvious. Of course, the ideal station curve would be flat, but as it is not possible to get away from the evening peak, and as the capacity of the plant must be determined by this, for the greatest possible economy of operation the day load must be brought up as near this peak as possible, but not so as to overlap it. To prevent this overlapping of the light and power loads, it has been found advisable in some stations to make special concessions to large consumers who will agree to close down their plants at some stated time, just before the evening load comes on. This is especially necessary during the winter months, so if the customer will agree not to use current between the hours of 4 and 8 o'clock during the months of November, December, January and February, a very attractive rate may be made for large installations. With smaller customers, however, no stipulation of this kind may be made, for most of the minor industries close down daily at about 5 o'clock, before the time of the extreme peak.

The extent of the power load will to a very large degree regulate the net income of the station, and to the development of this load should the attention of the central-station manager be turned. If the motors on the line are classified according to use it will in some cases be found that the capacity connected for elevators will head the list. This load, however, is not particularly attractive, and will show a smaller income per horsepower installed than any of the industrial applications. The load factor is low, and the instantaneous demand high, which may cause an undesirable fluctuation of pressure in the immediate neighborhood, especially if it be on the end of the line. Many stations have attempted to keep this starting current at a minimum by special elevator rates, which place a penalty on heavy inrush. It is not well to be too severe in this respect, for the success of the electric-elevator machine would be jeopardized if rapid acceleration were sacrificed for a low starting current. Generally speaking, this current will seldom be less than 100 per cent above the rated capacity of the motor, even in direct-current work.

Where electricity is installed for elevator work to replace steam power, we often find that instead of changing the system entirely from hydraulic to straight electric, a motor will be put in to drive the pumps, the starting and stopping of which will be governed by a pressure regulator or a float switch, depending upon the system used. An installation of this nature is not economical, and compares with the latest types of drum and traction elevators in kw-hours per car mile, as six or eight to three.

The printing industry may form a very fair portion of the power load, as the advantages to be derived from electric drive are especially evident in the pressroom, and printers have been very ready to adopt it. It is well in soliciting this business to talk to your prospect, not in kilowatt-hours, of which he will know little or nothing, but in power cost per thousand pages of newspaper or per 100 magazines. These costs can be determined by tests made upon other plants, and information of this kind will be a most valuable asset to the solicitor. As far as possible every line of manufacture should be handled in this way. It means nothing to the average layman to tell him that you will supply him with current for 10 cents per kw-hour. He cannot see why his load factor should be 50 per cent instead of 100 per cent, but he *will* understand the relation of power cost to output, and if he is shown that his neighbor's electric power costs so many cents per 1000 impressions with presses and work similar to his, he will have some tangible evidence upon which to base his comparison.

The machine shop and wood-working plant form a very attractive load because of the practice of installing, to a large extent, individual motors, or small units for group drive, thus eliminating the pressure variation which might be evident where a single large motor is installed, demanding a high starting current. One great difficulty has been found in securing the wood-working business, owing to the disposal of waste. In most localities there is little or no chance to sell sawdust and shavings, and the customer must pay for their removal when operating his plant from central-station supply. If running his own steam plant and burning this waste under the boilers, a marked reduction in the fuel bill is evidently made.

Within the past two years contractors have been turning their attention to the application of electricity in building construction work, and its use in this connection has developed rapidly. Hoists and concrete mixers may be operated more economically by electricity than by steam, and, when motor-driven, may be installed inside the building which is being constructed. This would be practically impossible if operated by steam engine, on account of the attendant smoke and heat. Electric hoists are often moved from floor to floor, as the building progresses, thus reducing the cable length to about half that with the hoists on the ground. Not only does the ease of extending the wires make this possible, but the uniform rotary motion of the motor reduces the vibration to a minimum. Other motor-driven machines used in this work are pumps, pile-drivers, air-compressors, forges, excavating shovels, cable-ways and portable drills. Objection is often made by the central-station authorities to the extension of the distributing lines for work of so temporary a nature, but in the majority of cases the finished building will use the current. If not, the contractor should guarantee that the service will be in use for at least three months, or the cost of the introduction of the wires will be charged to him.

In the larger cities the clothing industry will give a very fair portion of customers. There is a large field for motor-driven sewing machines, cutting tables and flat-irons. Although the units in this class of work are small, the number of customers is large, and the daily working hours long, making this a very productive load.

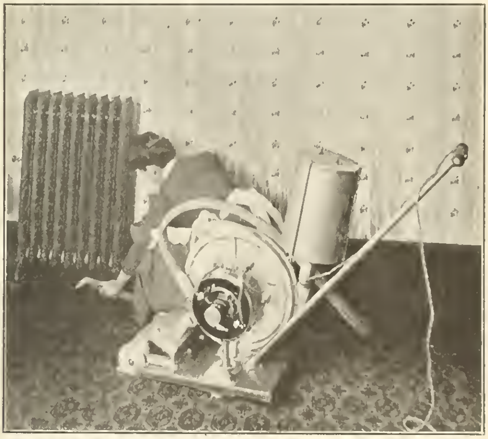


FIG. 1.—PORTABLE VACUUM CLEANER.

One of the most attractive openings for motor installation is in connection with refrigerating machines. These may be installed in butcher shops, cafés, drug stores, restaurants, dairies and residences, and operate very economically, especially where rates are made favoring long-hour users. In connection with refrigeration, the electrically-driven carbonating apparatus might be suggested. These machines may be installed in drug and confectionery stores, and the aerated water necessary for use in soda fountains supplied by them instead of from the familiar steel tanks.

Hoisting by electricity has become popular among coal dealers. Along the water-front of most of our cities many towers have been constructed and coal shipped to them in barges is hoisted and stored in bins to await distribution. From careful tests it has been found that with a 50-ft. lift the average cost is between 2 and 3 cents per ton hoisted, with current at 10 cents per kw-hour.

The various well-known appliances which have been noted are a few of those to which the central-station manager has given his attention—too much attention it may be, if such a thing were possible. When I say too much attention, I mean that if the time spent in trying to secure a very difficult prospect who is operating a machine shop, perhaps, were devoted to working up a class of business in which motor-drive is still new, the results might be much more satisfactory from every point of view. In striving for the large and prominent installations we often lose sight of the smaller and less important possibilities—the grocer, the confectioner, the baker.

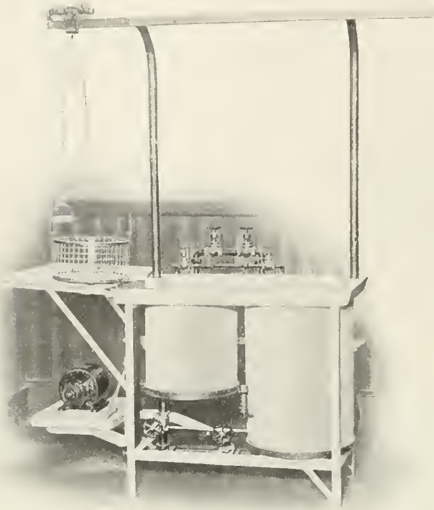


FIG. 2.—MOTOR-DRIVEN DISH-WASHING MACHINE.

Efforts should be made to secure as far as possible from every lighting customer a power load at least equal to his lighting. If this were done the effect it would have on the daily load curve would be very manifest. It may seem that this would be out of the question, but no matter what the case may be, there is always an opportunity to secure some power business. Before going into the details of this smaller work it might be well to look over some of the possibilities for power where often nothing but light is considered. Some of the power applications on the circuits of the New York Edison Company may be tabulated as follows:

Residences.—Refrigerating machines; vacuum cleaners; buffing motors; small ice-cream freezers; dish washers; sewing machines; washing machines; meat-choppers; coffee-grinders; elevator; dumbwaiter.

Churches.—Motor for organ; ventilating fans; vacuum cleaners.

Bakeries.—Dough-mixers; egg beaters; cake cutters.

Confectioners.—Carbonator; ice-cream freezer, candy puller.

Butcher Shops.—Refrigerating machines; meat choppers; sausage machine.

Groceries.—Coffee mills.

Theaters.—Vacuum cleaners; pump; motors for curtain; ventilating fans.

Cafés.—Refrigerating machines; beer pumps.

Garages.—Charging posts; compressors.

Stables.—Horse groomer; horse clipper.

These are a few instances where power may be most successfully recommended among customers which are usually considered for lighting entirely. The advantages of motor-drive are just as evident here as in other cases that might be cited, and if these advantages are made clear the customer is often eager to use some, if not all of them.

Vacuum cleaners have met with great success, not only in public buildings, but in residences as well. Two general types are in use—one which is permanently installed in the cellar, with a riser through the building, and with conveniently located outlets to which the sweepers are attached. The other is a small portable machine which may be moved from room to room as the cleaning progresses. It is estimated that a broom will remove about 5 per cent of the dirt from a room, while the cleaner will take up about 95 per cent. The broom stirs up the dust particles, which soon settle, but the vacuum apparatus removes them entirely. The cost of operation is low, lower than if cleaned by hand, when we take into consideration the thoroughness with which the work is done.

Another use for the motor in residences is in connection with the washing machine. This machine is operated by 1/8-hp to 1/12-hp motor, and it is said will finish an average-sized wash in about an hour at a cost of from 2½ to 3 cents for power. The motor-driven ironer is also used for domestic work. With it the ironing may be done in about one-fifth to one-tenth of the time required when it is done by hand.

Buffing and polishing motors will reduce labor to a great extent, as the houshold silver can be cleaned in a few minutes with one of these devices, better than if a much longer time is spent with the common polishing cloth. Electric dishwashers, too, are often installed in private residences. The usual type of this machine consists of two tanks and a wire basket suspended over them on a trolley which allows this basket to be lowered into either tank. In the first tank is an agitator in the form of a fan and driven by a small motor. Hot water is admitted into the tank and the basket filled with dishes is lowered into it. The fan, forcing the water against the dishes, soon cleans them. They are then run through the second, or rinsing tank, and immersed in clean, hot water for a few seconds; they are raised from this, removed from the basket for drying, and the basket is ready to repeat the cycle. This machine will wash dishes at the rate of 2200 pieces per hour, while the larger hotel sizes have a capacity as high as 6000.

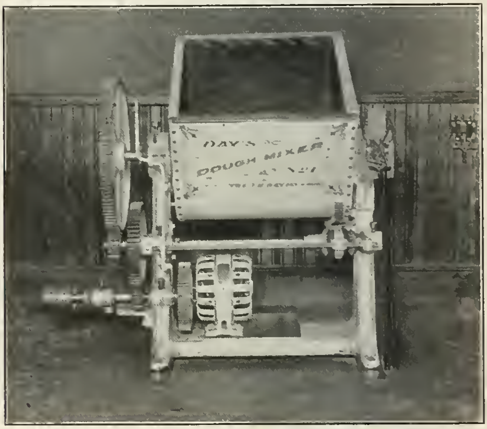


FIG. 3.—ELECTRICALLY-DRIVEN DOUGH MIXER.

Small electric elevators are now popular in residences. These machines are built for two, three or four persons. Their operation is entirely automatic, controlled by push buttons in the car, also at each floor, and is something as follows: A person opens the door at the first floor, let us say, and enters the car, closing the door behind him. Perhaps he desires to go to the third floor, so he pushes button No. 3. With no further action on his part, the car ascends to that floor and stops. He may then open the door and step off. Care should be taken to close the door again, as the car cannot be moved while the door is open, nor can the door be opened unless the car is at that floor. The door being closed and the elevator not in operation, it can be brought to a floor by merely pushing a button at the side of the shaft, and at that floor it will stop automatically. This may be considered as one of the luxuries which electricity brings to the residence.

In churches there is always a chance to install a motor for operating the organ bellows, motors for ventilating fans, or a vacuum-cleaning outfit.

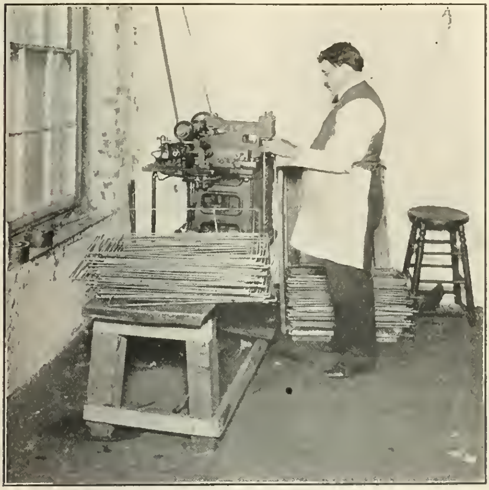


FIG. 4.—ELECTRIC WELDER.

The bakery has but recently found that electric power is not only cheaper than hand work, but that the quality of the output is more uniform, the time required for each operation is decreased, and the work is carried on under more sanitary conditions when electricity is used. Tests are shown that in dough-mixing the cost of electricity is but one-tenth of the cost of the work done by hand. This cost is about as follows:

Capacity in barrels.	Time for mixing.	Cost, cents.
1½	10 minutes	3.3
3	10 minutes	8.4
6	10 minutes	16.7

Another motor application that may be suggested to both the baker and the confectioner is in connection with ice-cream freezing. In comparing hand- with motor-driven freezers, we should realize that the result will be accomplished in much less time with the motor and the cream will be better on account of the uniform speed. The cost of production will vary slightly because to a certain extent the personal factor is introduced in packing the ice. It has been found, however, that a fair average is about three-tenths of a cent per gallon. The time required will also vary, but will probably be between 20 and 30 minutes for 40 quarts.

Butchers and grocers have taken advantage of electrically-operated meat-choppers and coffee-mills. On account of the rapidity with which these machines work they have become indispensable. Coffee may be ground at the rate of 2½ lb. per minute, and 6 lb. of meat may be chopped in the same length of time.

The electric horse-clipper and groomer is a great labor saver. By their use two horses can be clipped or groomed at once, at a cost of one cent per horse.

The general use of electric welders is rather new, but they have been found to be very satisfactory and economical machines. Alternating current is used for this work at about 22 volts. Four hundred and eighty welds per hour is the output of the machine illustrated. It would require 16 hand forges to produce the same result in this time.

In presenting these few applications it has been the intention merely to suggest possibilities that we are perhaps rather prone to overlook. Classes that may seem too small to devote much time to, but in these motor possibilities and applications that may evolve from them lie a vast field for central-station power load. If it is ever felt that we have the power situation well within our grasp and that there is little more to secure for the station, go over the territory again and canvass until every lighting customer is also a power customer and the load shown by the station curve indicates that the major part of the station is in operation at least 15 hours a day, and sufficiently well loaded to insure good economy.

Electric Refrigeration in a Meat Market.

By R. L. Lloyd.

A very successful installation of motor-driven refrigerating machines is exhibited in the wholesale and retail meat establishment of David C. Bradley, at Dock and Water Streets, Philadelphia. The present building arrangement is the result of alterations made about a year ago to an old structure, and as planned by the architect, the following rooms would need refrigeration:

On the ground floor, one large main box or cooler, 60 ft. x 17 ft. and 12 ft. high, including the bunker space which contains the brine pipes. On the second floor, three separate rooms each 20 ft. x 20 ft. x 11 ft. to be used as freezers, the temperature in each room to be maintained at about 15 deg. Fahr.

The pickling room is located at the rear of the second floor and was to be 19 ft. x 37 ft. x 11 ft. A portion of this room is partitioned off for the brine tank, located here as the most available space, even though it was directly over what would have been the engine room. Mention is made of the engine room because originally it was the intention to use steam, and it was calculated that 40 tons of refrigeration would be required—two 20-ton machines each to be direct-connected to a 30-hp engine. A 100-hp or 150-hp boiler would be necessary, as there were pumps and elevators to run, and possibly a dynamo. It was finally decided to use central-station service and larger refrigerating machines. The following machinery was installed:

Two 25-ton Vilter refrigerating machines each driven by a 50-hp Northern motor, chain geared; one triplex, plunger, brine pump driven by a 5-hp motor; one deep-well pump for condenser water operated by a 3¾-hp motor. (See Fig. 1.)

The system employs a brine circulation exclusively, all the expansion coils being located in the brine tank. This is about 5 ft. x 19 ft. x 8 ft. high, and contains over 5000 gallons of brine, which is cooled to a temperature of from 5 deg. to 8 deg. After being shut down over 20 hours the temperature rises to above 15 deg. There is also a 6-hp motor for the elevator on the same meter, making a total installation of 114¾ horse-power.

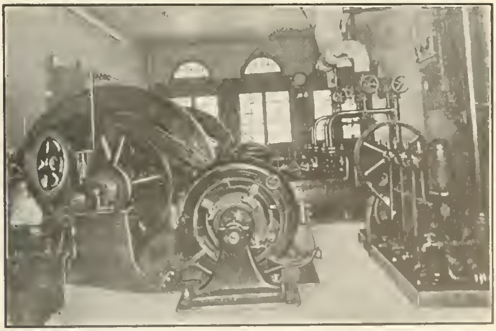


FIG. 1.—VIEW OF ENGINE ROOM.

The object in putting in two refrigerating machines was to permit one machine to rest during heavy duty in summer and also to allow for growth of the business. The two machines have never yet been needed at the same time. In fact, six hours' operation in 24 for one machine in the hottest summer weather so far encountered has been found ample. In winter weather one hour's operation for the machine and about one and one-half hour's operation of the brine pump is all that is required to produce the desired temperature.

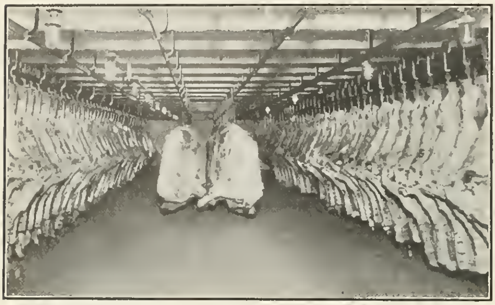


FIG. 2.—INSIDE OF THE COOLER.

The cooler usually holds about 20,000 lb. of meat and is maintained at a temperature of 35 deg. This box is well insulated with three layers of cork laid in asphalt pitch. There are three doorways to this box, and the interior is well lighted by incandescent lamps. (See Fig. 2.)

The wall cases and the counter cases in the store shown in Fig. 3 are also cooled by brine pipes. These are located above, in the wall cases and at the bottom of the counter cases. This permits of the display of choice cuts of meat without fear of deterioration.

The freezer is divided into three rooms in order to accomplish better results and to allow considerable flexibility in the accommodations. At certain seasons it is necessary to take care of more of those delicacies requiring the very low temperature and as at present arranged, one two or three sections can be utilized independently. The temperature can be maintained as low as zero in any of these rooms if necessary. A temperature of 15 deg., however, is found to be ordinarily sufficient.

The pickling room is cold enough at 35 deg., but on account of the presence of the brine tank, the temperature is usually 30 deg. with almost no circulation in the coils of this room. The absence of excess of heat which would have been unavoidable under this room if the steam plant had been installed, results in a considerable saving in the work of refrigeration. There is frequently as much as 20,000 lb. of meat in this room.

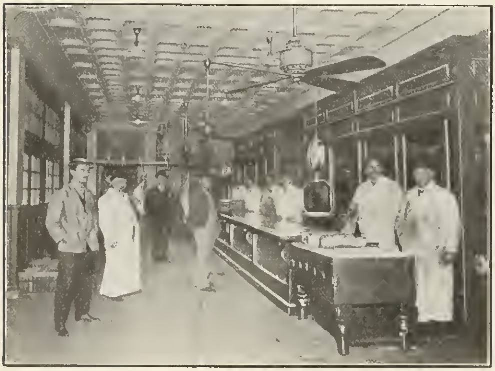


FIG. 3.—REFRIGERATED WALL AND COUNTER CASES IN STORE.

One refrigerating machine was placed in operation about March 1 and the installation was completed a month later. Since that time there has not been the slightest delay or trouble from the equipment. It has operated on a 26 per cent load factor and the results have been entirely satisfactory. Silent chain drive is used on all the motors. The condensing water is obtained from an artesian well, the water being pumped from a 60-ft. depth by the 3¾-hp motor above mentioned.

It is rather difficult to make any comparison between the cost of operation of this equipment and the cost of ice if it had been used as of old. The freezers, of course, would not have been possible and the low temperatures of the other boxes could not have been maintained. Outside storage charges would have been incurred. Calculations indicate that not less than 150 tons of ice per month would suffice. At the prevailing prices this would have cost $375. The average bill for electric energy has been about $190, and as Mr. Bradley remarked, "Who would put in a steam plant after seeing such an outfit as this?"

Central-Stations and Electric-Motor Applications.

The development of central-station power business during the past decade has been enormous, but the level in the power saturation curve of cities and towns of progressive growth has yet to be reached. Year after year the connected load of well-managed companies increases; annual gains of 20 to 30 per cent have not been uncommon of late; and while the recent financial stringency may have lowered the rate of new business increase at the end of 1907 and the beginning of 1908, there is no question that in a comparatively short time the best records of the past will be equaled or surpassed in the systematic acquirement of new industrial loads. As central stations grow in capacity their facilities for giving the highest character of reliable service increases, under good management; the weak spots receive closer scrutiny; experience with the rate problem points the way toward the successful handling of all classes of consumers, and the broadening usefulness of an invaluable public service encourages wider applications of power throughout the entire gamut of industrial machinery sizes and types.

To give a complete list of motor applications in keeping with the size of the commercially developed field would be impracticable, but the writer presents valuable data and figures heretofore unpublished which were carefully compiled in the interests of the principal Edison companies. They are the results of personal visits to representative plants throughout the United States and contact with both the technical and commercial aspects of the power business in a large number of cities. In applying motors of given sizes to industrial machinery it is well to constantly bear in mind that the conditions of each application should be carefully investigated in detail; that actual tests of the power needed are always preferable to assumption, and that in group-driven installations predictions of requisite motor capacities are far more difficult than in cases of individual drive. In the main, the following data give the average amount of power required for each machine mentioned, or the size of motor which would be sufficient to drive it direct-connected. As the sizes of machines decrease in group driving, the percentage of friction loss in belts and shafting tends to rise. Allowance must therefore be made by the solicitor, according to his experience, for the additional power demanded by the mechanical drive. It is out of the question to expect to reduce all industrial machine driving by motors to the direct-connected principle. As far as this can be done, it is generally advantageous, but the solicitor cannot be too industrious in the collection of actual engineering data of shafting, belt and pulley sizes and lengths in different kinds of group-operated installations. This has by no means been sufficiently considered in the past.

Certain fundamental advantages of electric power are present in all installations. These need not be elaborated here, but may be summed up in the characteristics of compactness, of flexibility, cleanliness, safety, reliability and economy. The degrees to which these characteristics obtain in actual installations are easily discovered by intelligent analysis of working conditions.

BAKERY TRADE.

In the bakery trade compactness, cleanliness and economy are striking advantages of motors operated on central-station service. Unclean food products are commercially outlawed in these days. The modern bakery establishment handles its raw material, stock and products on a large scale, and such labor-saving devices as motor equipments should find a much wider use in the future. Representative bakery machines and their motor requirements are as follows:

	Horse-power
12-ton ice machine	03.
Apple-parer, 5 barrels per hour	1.5
Straining-cloth washer (75 shift capacity)	3.5
3 rotary ovens, capacity each, 240 pies per hour	5.
Bread-moulding machines, shapes 7000 loaves per hour	10.
Scaling machine, weighs dough 15–32-oz., 3000 pieces per hour	2.5
6-barrel dough-mixer, 18 barrels, per hour	20.
Setting-up machine, pinching rims of pies, 3000 per hour	2.
4-cake machines, mixing frosting and dough, total	10.
Sugar pulverizer, 1000 lb., per hour	10.
9-gal. ice cream-freezer, 18 minutes per batch (173 watt-hours)	0.5
Bakery machine and carpenter shop, lathe, drill, grinder, forge	10.
Squash machine, 4-bbl. brown-bread mixer, apple chopper, meat cutter, jelly press, and 4000 plate (35-minute) pie-plate washer	7.5
Flour-sifting plant, conveyors and elevators, cleaners	3.5

Refrigeration is required 168 hours per week in a large bakery to provide cold storage for eggs, milk, butter, lard and pie filling. An apple parer will core and pare a barrel of fruit in 12 minutes, doing the work of 11 men. By hand one man can pare three barrels of apples in 10 hours. In one bakery the pie-plate washer (7500 per hour) does in two hours the work of four men. At 10 cents per kw-hour a 9-gal. ice cream freezer does its work at a cost of 0.2 cent per gallon. Small dough-mixers require from 2 to 5 hp, a 10-barrel flour-mixer 10 hp, and revolving cracker-bakers, from 1 to 3 hp.

PRINTING AND PUBLISHING TRADE.

In the printing of books, pamphlets, papers and other high-grade matter dirt is fatal to success. The greasy, oily shaft and dirty belt have no legitimate place in the high-class printing establishment. Individual driving pays here as in few other places. Representative machinery is:

	Horse-power		Horse-power
Tricolor lithograph press, 1200 impressions per hour	5	Gordon job press, 10x12 in.	0.5
Single color lithograph press, 1800 impressions per hour	2.5	Golding press, 12x18 in.	0.75
Paper-cutter, 60 in.	3.5	Envelope die press.	1.
Paper-cutter, 50 in.	2.	Book-paster	1.
Tube machine, 36-in. roll	0.16	Book-trimmer	3.
Wire-stitcher	0.16	Book-smasher	3.
Folding-machine, small	0.5	Book sewing-machine	1.5
Cut-out press	1.0	Book-embosser	3—10
Collator	0.5	Book-stitcher	0.25
Knife-grinder	3.5	Book paging-machine	0.12
Graining machine	1.	Book punching-machine	0.25
Ink-mill, large	7.5	One board-cutter	1.
Miehle pony press	1.	Profiling-machine	1.
Miehle No. 0-press	2.5	Gold dust machine	0.25
Miehle No. 00 press	3.	Book-stamper	2—5
Miehle No. 000 press	4.	Ruling-machine	0.25
Miehle No. 0000 press	5.	Round-cornering rack	0.5
Whitlock press, 25x38 in.	2.	Book-gumming rack	0 12
Cottrell press, 25x30 in.	1.5	Prouty perfecting press, 12x18 in.	1.0
Cottrell press, 38x52 in.	3.0	Linotype machine	0.25
Cottrell press, 42x56 in.	5.0	Type-casting machine	0 5
Cottrell press, 43x60 in.	5.0	Paper-baster	2.0
Cottrell press, 46x60 in.	5.0	Knife-grinder (small)	2.0
Cottrell perfecting press 39x54 in.	7.5	Oswego cutter, 44 in.	2.0
Campbell press, 35x47 in.	4.0	Oswego cutter, 36 in	1.0
Campbell pony press	2.	Sanborn cutter, 48 in.	2 0
Century press, 32x52 in.	4.	Sheridan cutter, 24 in.	0.25
Century press, 22x32 in.	1.5	Seybold embosser	5.
Scott press, 22x32 in.	1.5	Cardboard-splitter	1.
Scott press, 33x47 in.	5.	Envelope-machine	1.
Scott press, 42x55 in.	5.	Seybold 3-knife book-cutter	5.
Scott press, 26x34 in.	2.	Victory embossing-machine	1.
Cranston press, 17x22 in.	1.5	Ink-mills	1—7.5
Campbell press, 21x30 in.	1.5	Blackball embossing-machine	0.5
Century press, 42x60 in.	7.5	Monotype-machine and air pump	2.
Century press, 28x42 in.	4.	Folding-machine, 36x49 in.	1.
Century pony press	2.	Folding-machine, 40x56 in	2.
Huber press, 42 in.	2.5	Brown folder, 48 in.	2.
Huber press, 52 in.	5.	Case-roller	0.25
Huber press, 63 in.	7.5	Envelope-folder	0.7
Colts Armory press, 12x19 in	1.0	Glue-mixer	1.0
Colts Armory press, 10x12 in.	0.5		

LAUNDRY TRADE.

Until within a year or two, electric motors have not been much used in the operation of laundry machinery, but the success which has attained the pioneer installations shows that here is a remarkable field for the central station. As before stated, when machinery grows lighter the percentage of power lost in belt- and shaft-drives increases in relation to the amount of power utilized and generated. Laundry machinery requires small powered motors for direct driving, and the extensive application of direct connection between the motor and the machine is peculiarly desirable under laundry operating conditions. In some steam laundries 50 per cent of the power generated, or 100 per cent of the power utilized, is lost in belt and shaft transmission. The different departments of a modern laundry do not all operate at full load at the same time, and the flexibility of the electric drive has proved of great value. The shut-down of one motor-operated department does not affect the others, and the line losses do not continue consuming coal. Where the electric drive is employed, with individual motors, speed regulation becomes easy; the speed can readily be adjusted to the quality of material in the machine, which is often not the case in a steam-driven laundry. Cleanliness and increased comfort to employees are additional points of particular weight during hot-weather periods. A field also exists for the replacement of gas-heated flat-irons by electric irons in laundry service.

The classified equipment of a representative 220-volt, direct-current plant now in operation is given above.

MOTOR EQUIPMENT OF LAUNDRIES.

5 extractors and 4 starch 18-in. extractors, 1 hp motor each, vertical shaft direct drive, series type, speed 1150—1600 r.p.m.
4 washers, 5 ft. long, 4 ft. diameter; 2 shakers, 50-in.x60 in.; 10-hp compound constant speed, belted, motor 650 r.p.m.
2–48-in. vertical wringers, each belt driven by 5 h.p. compound motor, 1310 r.p.m.
1 shaker, 4 washing machines—10-hp motor; 2 groups.
1 shaker, 5 washing-machines—10-hp motor.
4 steam mangles, each 48-in. diameter, 105 in. long, each direct-driven, 3 hp motor, series-wound; speed range, 350–550 r.p.m.
1 freight elevator—15-hp motor.
2 No. 55 Singer sewing-machines, each direct-driven by 0.12 hp shunt motor, speed, 1050 r.p.m.
1 blanket-washer (Hunter), 6 small blanket-washers, 42x60 in.— 10-hp compound, group driven motor.
1 collar-washer, 40x42 in.; 5 washers, 42x60 in.—10-h.p. group driven motor.
1 collar dampener—0.5 hp, shunt wound motor.
1 Bishop collar-starcher, 42x14 in.—0.25-hp shunt motor, 1000 r.p.m.
8-loop shirt dry-house—2 fans, conveyor belt 2 rev. per hour, 3-hp shunt motor, 750–900 r.p.m.
Skirt dry-house—0.12-hp fan motor for hot air circulation.
4-loop Barnes & Erb collar dryer—3 rev. of belt per hour, 1 fan, 1-hp shunt motor 600–850 r.p.m.
Coat and underwear dryhouse fan—0.12 hp motor, (size uncertain).
1–24-in. coat-ironer—0.25-hp compound motor; 500–600 r.p.m.
4–24-in. coat-ironers—0.5-hp compound, constant-speed motor; 420 r.p.m.
2–36-in. body-ironers—0.5-hp compound, constant-speed motor; 420 r.p.m.
2 sleeve-ironers—12-in. cylinders; 0.12-hp shunt motors; 500 r.p.m.; frequently reverses 60 times per minute; no starting-box.
3 bosom pressers—1 hp shunt motors; 610 r.p.m.
1 bosom ironer—0.25-hp shunt motor; 450 r.p.m.
1 Bishop wristband ironer—0.12-hp shunt motor, 1000 r.p.m.
1–40-in. Hazen collar mangle—0.5-hp shunt motor, 450 r.p.m.
1 collar shaper, 1 seam dampener, 1 burnisher—group driven on 1-hp, back geared shunt motor; 1830 r.p.m.
1–6 ft. handkerchief mangle—0.5-hp shunt motor; 450 r.p.m.
Drill press, lathe, hand saw, and grinder; 10-hp group driven compound motor.

MOTOR EQUIPMENT OF WOODWORKING ESTABLISHMENTS.

	Horse-power		Horse power
6-in. moulding machine	3—5	15-in. rip-saw	5.
7-in. moulding machine	5—7.5	20-in. rip-saw	10.
8-in. moulding machine	7.5—10	30-in. rip-saw	20.
9-in. moulding machine	10—15	48-in. rip-saw	35.
8-in. crosscut saw	1.	Jig saw, small	1.
10-in. crosscut saw	2.	Shingle machine	10.
12-in. crosscut saw	3.	Shingle saw	1.
16-in. crosscut saw	5.	Wood-carver	2.
20-in. crosscut saw	7.5	Box-nailer	1.
24-in. crosscut saw	10.	Saw-set	1.
30-in. crosscut saw	15	8-in. buzz planer	1—1.5
Small band saw	1	12-in. buzz planer	1.5—2
Medium band saw, 1 in.	2	16-in. buzz planer	2—3
2-in. band saw	5	24-in. buzz planer	3—4
Tenoning and mortising machine	3	30-in. buzz planer	4—5
Saw-grinder	1.	Inside moulder	7.5—10
Wood lathe	1—5	Outside moulder	5—7.5
Wood boring-machine	1	Horizontal edger	2
Double spindle shaper, 1¾ in	7.5	Large nailer	1.5
Sticker, 9 in.	7.5	Double and single planers	7.5—15
Power-mortiser	2—4	30-in. sanders	3—5
Panel-raiser	1—3	42-in. sanders	5—7.5
Surface-sander	1—2	60-in. sanders	10
Box-dresser	1	72-in. sanders	15
Planer and matcher	6—10	Dado machines	1—2
Planer, 24-in.	15	Dowel machines	0.5—0.75
Planer, 36-in.	25	Box nailer, medium	0.75
Box-board matcher	2—3	Box dovetailer, small	10
Single-surface planer	3.5—7.5	Box dovetailer, large	[illegible]
Double-surface planer	7.5—15.	Dovetailers	2—3
Tenoner, double end	7.5—15	Mitre machine	[illegible]
Tenoner, single end	2—5	Bit-mortiser	[illegible]
8 in. rip-saw	1	Sash-mortiser	1—2
10-in. rip-saw	[illegible]	Hollow chisel mortiser	[illegible]

WOODWORKING ESTABLISHMENTS.

The supply of electric power to woodworking establishments is desirable mainly on the ground of the comparatively large motors required in handling wood stock, the decrease of fire hazard, decreased obstruction of motors and wires, and better economy of electricity compared with the non-condensing steam engine with atmospheric exhaust. No licensed engineer is necessary with electrical installation. Even in small woodyards, central-station current is making enviable records in power economy, while in large plants, all the advantages of a careful design of installation are attainable among the tools susceptible to motor drive. A list of these is given on the previous page.

MACHINE SHOPS.

Although some of the earliest examples and most modern instances of the motor drive are found in the machine shop, there remain a vast number of such establishments to be placed on central-station circuits. In the machine shop conditions tend to change and require the relocation of tools from time to time; expansion is often a pressing problem, and intensified production is essential to commercial success. Regardless of its operating efficiency, the electric motor is the ideal flexible power for general machine service. The range of metal-working tools that have received the careful study of motor designers is of immense breadth, yet there are to-day central stations operating in large manufacturing centers which are not doing 15 to 20 per cent of the business which ought to be theirs. A power connected load of only 2000 horse-power or 3000 horse-power in a manufacturing town of over 100,000 people, and with coal at $4 to $5 per ton, simply represents undeveloped opportunities. The following is a list of typical metal-working tools:

	Horse-power		Horse-power
Engine lathes, 22 in.	2.	Driving-wheel lathe, 66-in. swing	10
Engine lathes, 30 in.	2.5	Driving-wheel lathe, 90-in. swing	15
Engine lathes, 42 in.	3.5	Slab milling-machine, 26-in.	8
Engine lathes, 54 in	5.	Slab milling-machine, 36-in.	12
Engine lathes, 60 in.	6.	Slab milling-machine, 48-in.	15
Engine lathes, 72 in.	8.	Emery wheels	0.5—10
Engine lathes, 84 in.	10.	Key-seating machine	2.
Planers, single, 26-in.	5.	Cut-off saw	0.25
Planers, double, 30–36 in	9.	Speed-lathe	0.5
Planers, double, 38–40 in.	12.	Tool-lathe	1.
Planers, double, 44–48 in	14.	12-spindle drill	10.
Planers, double, 54 in.	15	Boring machine, 48-in. horizontal	2.5
Planers, double, 60 in.	18.	Boring machine, 66-in. horizontal	4.
Planers, double, 72 in.	22.	Boring machine, 72-in. horizontal	5—7.5
Planers, double, 76 in.	25.	Drill press, 24 in.	1.5
Planers, double, 84 in.	30.	Drill press, 40 in.	3.
Planers, double, 120 in	40.	Drill press, 60 in.	5.
Planers, double, 144 in.	50.	Radial drills.	2—5
Boring mill, 36-in. swing	4	Automatic screw machine	1.
Boring mill, 51-in. swing	5.	Fox lathes	1—3
Boring mill, 60-in. swing	6.5	Turret lathes	1—3
Boring mill, 72-in. swing	7.5	Pipe cutter, 0.5 in.	0.5
Boring mill, 84-in. swing	10.	Pipe cutter, 2.0 in.	1
Boring mill, 120-in. swing	12.	Pipe cutter, 4. in.	2.
Boring mill, 192-in. swing	15.	Pipe cutter, 8 in.	3.
Shaper, 16-in. stroke	3.	Pipe cutter, 12 in.	5.
Shaper, 18-in. stroke	3.5	Pipe cutter, 24 in.	10.
Shaper, 24-in. stroke	5.	Double buffer and polisher.	3—10
Shaper, 30-in. stroke	6.	Bolt cutter.	1—3
Crank slatter, 10-in. stroke.	4.	Rod straightener	5.
Crank slatter, 14-in. stroke.	5.		
Crank slatter, 18-in. stroke.	6.		
Crank slatter, 30-in. stroke.	7.5		
Forge slotter, 24-in. stroke	10.		
Forge slotter, 40-in. stroke	13.		
Forge slotter, 60-in. stroke.	15		

CANDY MAKING.

Motors of small size are required in the manufacture of confectionery, but in a large factory of this character the total load is well worth securing. Cleanliness and economy in labor are two important points in this branch of motor application.

	Horse-power		Horse-power
Marshmallow kettle	1.	Candy-rocker	0.75
Starch buck.	1.	Corn-sheller	0.5
Starch-cleaner	0.5	Sugar-grinder	5.
Jap kettle	1.	Sugar bolter.	2.
Nougat-mixer	1	Mixing-kettle	2.
Peanut roaster	0.25	Chocolate-dipper	1.
Peanut-husker	0.5	Cream-grinder	5.
Cocoa bean roaster	3	Cream-stirrer	2.
Almond-crusher	0.5	Depositor	0.5
Caramel-sizer.	3.	Printer.	0.5
Lozenge-mixer.	2.	No. 3 Lehman chocolate melanger	5.
Lozenge-roller	1	Small chocolate melanger.	3.
Dough-baker.	2	Chocolate mixing kettle	1.
Candy-puller	0.5—5	Chocolate mixer, Walters.	0.5
Candy-polisher	1.5	Chocolate roaster, Holmes.	0.5
Candy-roller.	1.	Chocolate shaking table	0.5
Candy-mixer	3.	Chocolate rolling machine.	5.
Sugar-pulverizer	15.	Chocolate dipper, Walters.	0.5
Sugar-mixer.	5.		

COOPERING.

	Horse-power		Horse-power
Large boofing machine.	5	Heading machine	2.
Stave planer	4	Barrel planer	2.
Crushing machine	5	Stave bending machine	1.

ELECTROTYPING AND STEREOTYPING.

	Horse-power		Horse-power
Boyle router	1	Trimmer	0.5
Wesel Daniel planer	2.	Saw	0.5
Rougher	2	Small planer	0.5
Drilling and jig saw	0.5	Agitator.	0.5
Beveler and grinder	1.	Bender	3
Zinc etching rocker	1.	Flat shaver	.3
Black leader	0.5	Wax shaver	0.5
Moulding press	4.	Etching machine	3
Plate reducer	2.	Etching tubs	0.5
Automatic plate machine	10.	Trimmer	3
Scorcher	0.5	Double page shaver	3.
Double page tail cutter	5.	Matrix roller	2

BUTCHER SHOPS.

	Horse-power		Horse-power
Large meat chopper, 6 knife	15.	No. 3 Boss mixer.	7.5
Lard cooler	3.	Spice mill	2
No. 66 Enterprise meat grinder	10.	9-knife meat rocker	2.
		Lard press	5

COTTON MACHINES.

	Horse-power		Horse-power
Braker cotton picker	10.	Cotton masher	7.5
Cotton carding machine	20.	Cotton tumbling barrel	2.
Finished picker	15.	Cutton dryer	20.
Small carder	2.		

Looms and spinning frames require special treatment, usually group driven.

JEWELERS.

	Horse-power		Horse-power
Polishing lathe	2.	Other lathes	0.16—2.0
Polishing stone	1.		

GROCERIES AND SPICE MILLS.

	Horse-power		Horse-power
Coffee grinders	0.5—3.	Large sugar pulverizer	15
Enterprise meat grinder	0.5—3.	Baking powder mixer.	1.
Coffee roaster	2.	Crystal grinder	2.
Coffee polisher.	2.	Flour mixer.	3—10
Spice mills	3—15	Flour packer	20.
Green coffee mixer, 30 bag	25	Filling machine	0.5
Bag stitcher	1		

FOUNDRIES.

The ability of the electric motor to withstand abuse and dirt and its freedom from shafting ills are some of the chief advantages of its use in foundries. The electric crane is an absolute necessity in the modern large foundry, and it often is the limiting factor in the speed of production. Some motor uses.

	Horse-power	
Casting rattlers.	1—10	
Casting grinders.	3—5	
Root blower, No. ¼	5	
Root blower, No. ½	6	
Root blower, No. 1 cupola.	7.	capacity, 1.5 tons per hour
Root blower, No. 2 cupola	10	capacity, 2.5 tons per hour
Root blower, No. 3 cupola.	15.	capacity, 3.5 tons per hour
Root blower, No. 4 cupola	20	capacity, 5.5 tons per hour
Root blower, No. 5 cupola	35.	capacity, 9 tons per hour
Root blower, No. 6 cupola.	45.	capacity, 13 tons per hour
Root blower, No. 7 cupola	60.	capacity, 18 tons per hour
Root blower, No. 8 cupola.	80.	capacity, 24 tons per hour
Root blower, No. 9 cupola.	100	capacity, 35 tons per hour

FEATHER MACHINES.

	Horse-power		Horse-power
Renovators	1—7.5	Feather pickers	1—3
Crusher, single	10.	Mattress tufter	2.
Crusher, double	20.	Cotton picker	1—5

ICE-CREAM MACHINERY.

	Horse-power		Horse-power
6-gal. freezer	1.	25-gal. freezer	5.
9-gal. freezer	2.	Ice crusher	1.
15-gal. freezer	3	Cream separator	5.
Bottle washer	1.		

MACARONI MACHINERY.

	Horse-power		Horse-power
Dough mixer	2.	Screw press	2.
Cut-off machine	0.25		

PAINT MACHINERY.

	Horse-power		Horse-power
Paint grinders	3—15	Packer	7.5
Screen and conveyor	5.	Lead pulverizer.	2—10
Water mill lead grinding	35.	Mixing tanks	3.
Oil mill lead grinding	20.	Lead roll	10.
Shaker mixer	3.	Buckle machine.	5
Putty cleaner.	10.	Mineral paint grinder	20.

PAPER-BOX MACHINERY.

	Horse-power		Horse-power
Scoring machine	1.	Downing machine	0.5
Corner cutter	0.12	Slitting machine	0.5
Strawboard slitter	1.	Wire stitcher	0.12
Nailing machine	0.25	Wrapping machine	0.25
Cornering machine	0.1	Crimping machine	0.33
Corner stayer	0.12	Tin press	0.66
Tube roller	0.25	Swedging machine	0.25
Spiral box machine	1	Covering machine	0.25
Baling press	5.	Dextrine mixer	2
Liner and dyer	2.		

REFRIGERATING MACHINERY.

Capacity	Horse-power	Capacity	Horse-power
1 ton, 24 hours	2.	7 tons, 24 hours	10.
2 tons, 24 hours	3.5	8 tons, 24 hours	12.
3 tons, 24 hours	5.	9 tons, 24 hours	13.5
4 tons, 24 hours	6.	10 tons, 24 hours	15.
5 tons, 24 hours	7.5	11 tons, 24 hours	25.
6 tons, 24 hours	9.		

This class of machinery offers unusual advantages in the consumption of non-peak power. Its demand is least during the season of heaviest lighting output.

SHOE FACTORIES.

These establishments are steadily being won over to the motor drive, although the group method is practically standard so far. In the manufacture of a pair of shoes by the best modern methods, over 50 distinct operations are required. The number of shoe machines in service to-day is extremely varied. Few require 3 horse-power or over, each. Among the 3-hp machines are the Mayo heeling machine, and the stitching machine. Machines requiring 2 horse-power are also few, including the McKay heel trimmer, Adams sole cutter, leveler, 4-ft. leather knife and 4-ft. die press. Under 2 horse-power, but not less than 1 horse-power, are edge setters, Buzzell head shaver, Buzzell trimmer, Union twin-edge setter and sole laying machine. The great majority of other shoe machines range from 0.2 horse-power to 0.5 horse-power each, though some run as low as 0.06 horse-power.

STRUCTURAL STEEL AND BOILER WORKS.

	Horse-power		Horse-power
Punch, ½" hole in ½" steel...	1	Shear, ½" steel...	1—3
Punch, ⅝" hole in ⅝" steel...	3	Shear, ¾" steel...	7.5
Punch, ¾" hole in ¾" steel...	5	Shear, 1" steel...	10
Punch, 1" hole in 1" steel...	7.5	Shear, 12" horizontal...	20.
Coping machine, 24-in. I-beam...	7.5	Bull dozers...	5—15
Beam shear...	20	Rotary column planer, 48 in	10.
Plate bending rolls according to size...	3—50	Cleveland straighteners...	5—15
3x3 angle shear...	5	40-in. beam saw, cold 24-in. I...	75.
8x8 angle shear...	10	Cold saw, slow speed...	5.
12-ft. gate shear...	30	Universal punch...	10
Bolt machine...	5.	Rivet machine...	5.

Cranes of all sizes are included in this class of service.

The foregoing applications represent, as has been said, but a small fraction of the total uses now made of electric motors. Outside the manufacturing field are hospitals, hotels, markets, churches (operation of partition screens, fans, organs), dental offices, business offices (a large number of small motors are now driving labor-saving appliances like addressographs, letter copiers, calculators, etc.), chemical laboratories (fans, stirrers, grinders), households—in short, every place where work is done by other than straight manual labor. In securing data upon its power business the central station has a wonderful opportunity to accelerate its acquirement of new and profitable connected load.

Power Requirements of Machine Tools.

We have published from time to time data on the power requirements of various machine tools operating under various conditions of load, feed, etc., and when operating on different metals or different grades of the same metal. Such data are of value in equipping existing machine tools with electric motors for individual or group drive; and being only ascertainable by test, data for every tool working under any and every condition of service are by no means complete. In the Dec. 1, 1906, number the motor-driven machine-tool equipment of the Hornell shops of the Erie Railroad Company was described and Mr. L. R. Pomeroy contributes to a recent number of *General Electric Review* additional information on the power requirements of railroad shop tools.

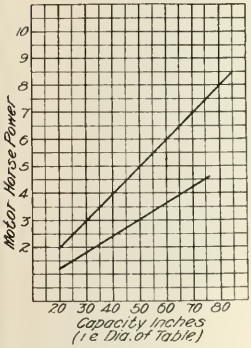


FIG. 1.—POWER REQUIREMENTS OF DRILL PRESS.

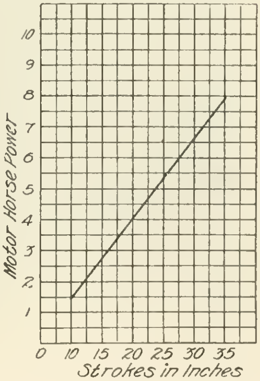


FIG. 2.—POWER REQUIREMENTS OF SHAPER.

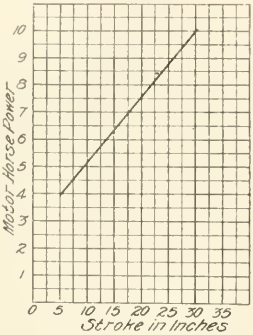


FIG. 3.—POWER REQUIREMENTS OF SLOTTER.

The curves shown in Figs. 1 to 8, together with the accompanying table, cover the horse-power requirements of the machine tools generally found in railroad repair shops. Where tools are selected for the purpose of performing extra heavy service to utilize the full capacity of the new, rapid-cutting tool steel, as is now done in manufacturing shops, the power required to drive the machine must be calculated on the basis of service required. Such cases are, however, exceptional and the curves will be found to meet the majority of conditions. The following formula may be used for calculating the power requirements of tools operating with the rapid-cutting tool steel:

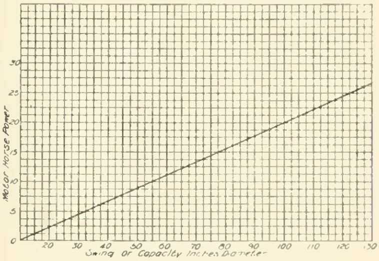


FIG. 4.—POWER REQUIREMENTS OF BORING MILL.

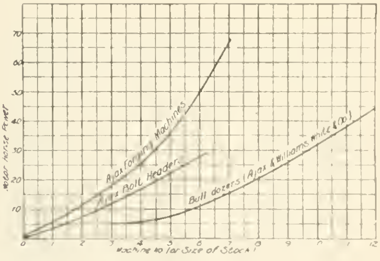


FIG. 5.—POWER REQUIREMENTS OF FORGING AND BOLT HEADING MACHINES.

$$HP \text{ to drive} = F \times D = f.p.m. \times 12 \times N \times K$$

where F is the feed in inches; D the depth of cut in inches; f.p.m. the feet per minute; N the number of tools cutting, and K a constant which for cast iron varies from 0.35 to 0.5; for soft steel or wrought iron, 0.45 to 0.7; for locomotive driving wheel tires, 0.7 to 1; and for very hard steel, 1 to 1.1.

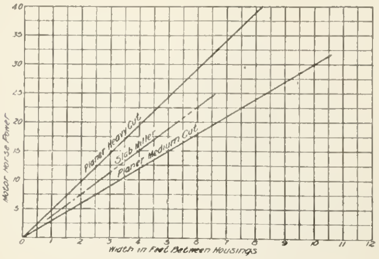


FIG. 6.—POWER REQUIREMENTS OF PLANERS.

For calculating the power required for wood-working tools the following formula may be used; the formula providing for the thickness of the belt and the allowance for centrifugal force and for the arc of contact being less than 180 deg. is taken care of in the selection of values for the constant K:

$$HP = t \times w \times f.p.m. \times K$$

or if r.p.m and not f.p.m. is known

$$HP = (t \times w \times d \times r.p.m. \times K) \div 4$$

where t is the thickness of the belt in inches; w the width of the belt in inches; d the diameter of the pulley in inches and K a constant which for a leather belt varies from 0.0062 to 0.0098; for a cotton belt, 0.0036 to 0.0068 and for a rubber belt 0.005 to 0.0082.

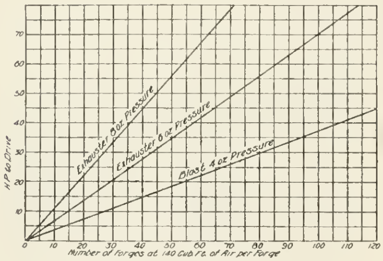


FIG. 7.—POWER REQUIREMENTS OF FANS.

Tool builders do not always discriminate between the requirements of manufacturing plants and those of railroad repair shops, and for that reason motors are often recommended that are larger than necessary. For instance, a lathe having a capacity of two cuts, each ⅝ in. by ⅛ in. at 60 feet per minute at this rate of cutting will require a 60-hp motor. Another machine built for the same class of work and used largely in axle shops and in many railroad shops is capable of taking cuts of ¾ in. by 1/12 in. at 24 feet per minute, requires 18 horse-power and is usually equipped with a 20-hp motor. While this power is correct for the full capacity of the machine, 10 horse-power will cover the requirements of the same tool on average railroad work.

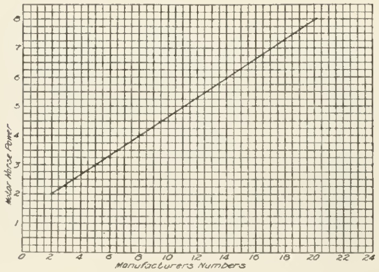


FIG. 8.—POWER REQUIREMENTS OF PIPE THREADING AND CUTTING MACHINES.

BOLT AND NUT MACHINERY, HELVE HAMMERS, MULTIPLE DRILLS, ETC.

	Motor hp required to drive
1½″ single head bolt cutter	1½
Pratt & Whitney No. 4 turret bolt cutter	2
2 spindle stay bolt cutter	2
1½″ Acme double head bolt cutter	2½
1½-2½ Acme nut facer	2½
6 spindle nut tapper	3
1½″ triple head bolt cutter	3
¾-2½″ double head bolt cutter	3
2″ triple head bolt cutter	5
4 spindle stay bolt cutter	5
Bradley hammer	7½
Niles 4 spindle multiple drill	7½

GRINDERS.

Air cock grinder	1
No. 3 Brown & Sharp universal grinder	3
Link grinder	3
Sellers universal grinder for tools	5
Norton 18″ x 96″ piston-rod grinder	5

MILLERS.

Vertical miller Becker Brainard No. 2	1
Valve miller No. 2	2
Universal miller No. 3 Brown & Sharp	2
Universal miller No. 4 Brown & Sharp	3
Universal No. 6 Becker Brainard	5
Niles heavy vertical	10

PUNCHES AND SHEARS.

No. 4 36″ throat L. & A. punch	3
No. 9 horizontal flange punch	5
No. 2 Hillis & Jones combination punch and shear	5
Alligator shear (stock 5″ x 1″)	5
Lenox rotary bevel shear	7½
56″ multiple tank plate punch with spacing table	7½
No. 3 Hillis & Jones combination punch and shear, 12″ throat	7½
No. 2 horizontal punch 20″ throat	7½
No. 3 Hillis & Jones combination punch and shear, 36″ throat	10
No. 3 angle shear 5″ x 1″ bar	10

SAWS.

	Motor hp required to drive
Band saw, 36″ wheel	3
Band saw, 42″ wheel	5
Swing cut off saw	5
Band saw, 48″ wheel	7½
Greenlee 1½ self-feed rip saw	10
Greenlee vertical aut. cut-off saw	15
40″-46″ saws	15
Auto. band resaw	20
Greenlee No. 6 aut. cut-off saw	20
Greenlee No. 3 rip saw	20
Woods No. 4 rip saw	20
Ex. heavy aut. rip saw	25

WOODWORKING TOOLS.

Fay-Egan single spindle vertical boring machine	3
Fay-Egan 3 spindle vertical boring machine	4
Fay-Egan No. 6 vertical mortiser and borer	6
Fay-Egan No. 7 tenoner or gainer	7½
Fay-Egan universal wood worker	7½
Fay-Egan 4 spindle vertical borer	7½
Fay-Egan 5 spindle vertical borer	10
14″ inside moulder	12
Fay-Egan universal tenoner and gainer	12
Fay-Egan vertical tenoner	12
Greenlee aut. vertical tenoner	15
Fay-Egan No. 3 gainer, also Greenlee	15½
Greenlee Ex. Range 5 spindle borer and mortiser	15
Greenlee vertical mortiser	15
Fay-Egan Auto. gainer, also comb. gainer and mortiser	20
Fay-Egan No. 8 vertical saw and gainer	20½
Vertical hollow chisel mortiser and borer	20
Fay-Egan 14½″ double cyl. surfacer	20½
Heavy outside moulder	20
6 roll D. C. planer and matcher	25
Double cylinder fast flooring machine	30
Double cylinder planer and matcher	30
Fay-Egan No. 8 auto. tenoner	30½
Woods No. 27 matcher	35
4 side timber planer, heavy	60

Lamp Tests in a Large Industrial Plant.

A large industrial and mining corporation which buys large quantities of incandescent lamps and wishes to test them under the operating conditions of vibration, voltage variation, etc., which occur on its property, pursues the following method in testing and purchasing incandescent lamps. Before a contract is placed, 1000 lamps are purchased in the open market of the various makes which are to be considered in competition for the contract. These 1000 lamps have samples tested for life and efficiency. After the contract has been placed with any given lamp factory, two out of every 250 lamps received are taken out for testing to determine whether they are up to specifications. One of these is ordinarily put through the test for life and efficiency. The other is kept on file for reference in case of accidental breakage of the first lamp. A variation in candle-power of 7 per cent from the rated is allowed on new lamps. The life and efficiency tests are made in the ordinary way. As a further check to life tests, however, it is customary to install wattmeters on certain lighting circuits around the plant and to fill these circuits with new lamps of the kind to be tested. These circuits have all their lamps burning continuously, the lamps never being turned off. By keeping track of the kw-hours supplied to these circuits and of the lamp renewals, a check on laboratory life tests is obtained which gives an idea of how lamps are wearing in actual commercial work.

A New Field for Electric Power.

By George H. Jones.

There are thousands of buildings, especially apartment buildings, in Chicago, and presumably in other large cities, where electric motors can be used to great advantage in connection with the steam-heating system. In most of these apartment buildings a low-pressure heating system is installed, the condensed water being returned to the boiler by means of gravity. When first installed these systems were operated at approximately 3-lb. boiler pressure. The average apartment building is put up in a very cheap manner with insufficient supports, the result being that in a very short time the building settles greatly in parts, and the effect is further aggravated by the fact that the foundations are often laid in the winter time when the frost is in the ground. This settling of the building does serious damage to the heating system. The return pipes, which were originally installed so as to give a sufficient slant for the return to the boiler of the condensed steam, are disarranged, the result being that pockets are formed in which the condensed steam settles. In order to force this water back to the boiler and heat the building properly, the boiler pressure has to be raised to from 8 lb. to 12 lb.

This difficulty may be entirely overcome by the use of a pump to draw the water of condensation back to the boiler. As steam pumps cannot be used satisfactorily at such low pressures, the field is open entirely to the electric motor. The cost of the electric pump, together with the piping, automatic starting device, etc., is comparatively small, being approximately $225. The saving in coal bills resulting from the use of this apparatus is apparent, as the reduction in pressure of each pound effects a saving of about 3 per cent on the coal bills. In addition to this saving, the motor equipment does away with the pounding in the pipes, and, furthermore, the heating system can be gotten into service in a very much shorter time than with the old arrangement.

Some installations are met with in which steam pumps are now used, these pumps exhausting into the atmosphere. Here the substitution of an electrically driven pump will also result in a great saving, as the inefficiency of small steam pumps is well known. I have in mind one case of a steam plant, operating at low pressure, supplying 24 apartments, where a steam pump was used, and it was necessary to maintain 7 lb. boiler pressure to run the pump. This pump was replaced by an electric one, and the boiler pressure reduced to 3 lb., with the result that the saving in the coal bills was something like $60 per month, whereas the cost of operating the motor was only $1.90 per month.

Although the current consumption of these motors is small, yet when we consider the thousands of installations which can be made, the aggregate amount of current that may be used should make the business well worth going after from the central-station manager's point of view, especially as steam heating may extend over eight months of the year.

Electric Elevator Service.

By R. S. Hale and R. H. Gray.

It is well known that the consumption of electricity by electric elevators varies considerably with the kind of service. The ordinary builders' tests show the variation due to load, speed, counterweighting, etc. In addition, a motor is naturally less efficient at the moment of starting than it is after it comes to speed, so that a run from the bottom to the top of a building, requiring a stop at each floor, will take considerably more electricity than a straight run without stops.

Recently a particular electric elevator showed up rather badly in consumption and the manufacturers claimed that the elevator service in the particular building was unusually severe, involving very frequent stops, which accounted for the high energy consumption.

Knowing of no data on elevator service in different buildings the writers made an investigation with the following very interesting results:

The elevators in a large, first-class hotel showed an average of 3.57 floors per stop. One floor per stop means stopping at every floor and 10 floors per stop in a 10-story building would mean running from the top to the bottom without intermediate stops.

In a large apartment house consisting of non-housekeeping suites of from one to five rooms each the elevator averaged 2.91 floors per stop.

The elevators of a large office building averaged 4.11 floors per stop from 8:30 to 9:30 when people were coming to their offices. From 3:30 to 4:30 the elevators in this same building averaged 2.06 floors per stop. This building has a dozen elevators and no very large companies as tenants.

In another office building with only two elevators the average was 4.19 floors per stop from 8:30 to 9:30 a. m. and 4.42 floors per stop from 3:30 to 4:30 p. m. This building is occupied by a single concern whose work involves frequent trips by employees to and from intermediate floors, while in an ordinary office building any particular passenger travels only from the first to his own floor.

In a large department store with large elevators the average was 1.41 floors per stop.

The hotel and apartment house elevators were operated on the basis of making only the necessary runs; that is, if a passenger wanted to go to the fifth floor, the elevator stopped at the fifth floor and then returned. The elevators in the two office buildings and the department store were operated on the basis of complete trips; that is, if an elevator started it went to the top floor and then back again even if no passengers were carried. This, of course, would naturally make a considerable difference in the number of floors per stop and probably accounts for the large number of floors per stop in the office building with only two elevators.

Blow-Off Valves for Steam Boilers.

By R. T. Strohm.

It seems to be an undisputed fact that the blow-off valve is a troublesome though necessary adjunct of the steam boiler. At more or less regular intervals it is opened for the discharge of steam, hot water and such sediment or scale as may have been carried into or formed within the boiler during the evaporation of the water. In this respect, the service that it is called upon to perform is particularly severe. To secure a tight valve for cold or hot water pressure or for steam is not a difficult matter. But when a valve is called upon to pass both solid and fluid matter and also to undergo considerable changes of temperature, it is not surprising that trouble should be experienced in keeping it tight and preventing leakage.

The desirable qualities of a blow-off valve are tightness, durability, simplicity of construction and operation, ease of repair and fair cost. Of these, the first must be classed as the most important, since the danger of using a valve that may unexpectedly allow the water to drain out of a boiler must be obvious. The blow-off from a boiler should always be arranged so that the engineer or attendant can inspect the discharge end of the pipe at any time to determine whether or not there is any leakage.

This leakage may be due to one or more of several causes. When the blow-off valve is opened, the scale and sludge that have accumulated near the end of the blow-off pipe are discharged past the valve seat with considerable velocity, thereby producing an erosive effect upon the seat that may sooner or later form grooves, permitting the escape of water even when the valve is supposed to be closed. If such action continues unchecked, the valve seat is cut deeper and conditions grow worse very rapidly.

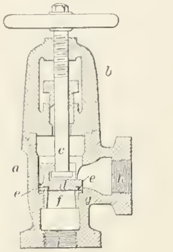


FIG. 1.—PLAIN ANGLE BLOW-OFF VALVE.

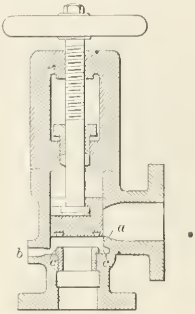


FIG. 2.—ANGLE VALVE WITH STEAM BLAST CONNECTION.

Again, particles of very hard scale may be caught between the valve seat and the plug or disc when the valve is being closed. If the disc is then forced down until there is no further passage of water, the seat or the face of the disc will be scored by the crushed scale. At the next opening of the valve, the scale will be swept away, and the indentations remaining will allow of leakage when the valve is closed again. As a consequence, the blow-off valve should be so constructed as to permit repairs to be made easily and quickly.

In Fig. 1 is shown an ordinary type of angle blow-off valve. The body *a* and the yoke *b* are of iron and are held together by bolts not shown in the illustration. The valve stem *c* is threaded where it passes through the yoke, and at its lower end carries the disc *d*. The disc is not rigidly attached to the stem, but is slotted so as to slip easily over the bolt-head at the lower end of the stem. By this construction it is possible to remove the disc very quickly, after the yoke is loosened and both stem and disc lifted out.

The under surface of the disc *d* contains a circular groove *e* of dovetail section, into which Babbitt metal is poured and hammered and afterward faced off smooth. The valve seat *f* consists of a hard brass ring screwed firmly into the valve body. This ring is rounded along its upper edge, as shown, and when the valve is closed, the Babbitt ring in the disc rests directly on the brass seat ring. The curved upper edge of the latter lessens the likelihood of scale being caught and held between the disc and the seat. Such action is still further hindered by the construction of the valve body. It will be observed that a shoulder is formed at *g*, and that it extends somewhat above the top of the valve seat. When the valve is open, the disc *d* is drawn up against the yoke, and the water from the boiler, entering the valve at *h*, is discharged at *i*. When the valve is being closed, the descending disc passes the edge of the shoulder *g* before it strikes the seat *f*. Thus, while the valve is not tightly closed at that time, the annular opening between the disc and the valve body is so small as to preclude the passage of any large particles of scale. There is, however, a rush of water under pressure, and this water, sweeping over the valve seat, washes it clean of scale, so that when the disc descends further and meets the brass ring, there is nothing to prevent the making of a tight joint.

The construction of the valve body, seat and disc of the valve illustrated in Fig. 2 is very much like that of Fig. 1. The disc is made so as to slide easily up and down in the cylindrical barrel of the body. A shoulder is formed at *a*, above the valve seat, so that when the disc is descending and reaches the position shown in the illustration, further escape of water through the valve is prevented. It will be seen that the disc must move a slight distance further before it will meet the valve seat. While it is completing this portion of its closing movement, the seat is being cleaned of any mud or scale that may have collected on it. This is accomplished by a steam blast. A small pipe is attached to the valve at *b* and is in communication with the steam space of the boiler. Thus when the flow of water is shut off by the passing of the disc below the shoulder *a*, high-pressure steam is admitted to the annular space *c* surrounding the seat, and the escape of this steam across the face of the ring is relied upon to remove any solid matter that might otherwise keep the valve from closing tightly.

The type of valve illustrated in Fig. 3 has all the advantages possessed by the one in Fig. 1, so far as cleaning the valve seat is concerned. In addition, it is so constructed as to be very durable. The valve proper is of three parts: a yoke *a*, a body *b* and a lower flange *c*. Between the lower flange and the body of the valve the valve seat *d* is placed. It is in reality a ring of T section, and both the upper and lower edges are rounded for use as a seat. The valve disc *e* is also made with two surfaces, each of which contains a soft metal ring imbedded in it. This disc is bolted to the casting above it by a small bolt *f*. Consequently, in case the valve begins to leak by reason of a damaged disc, the bolt *f* may be loosened and the disc reversed, bringing a fresh surface into contact with the valve seat. If the valve seat ring becomes scored, it may also be reversed and the valve made good as new. When both the disc and the seat ring have been worn out, they can soon be repaired. This is done by facing off the edges of the seat ring in a lathe, until all traces of scoring are removed. The disc may be heated to melt out the soft metal, and a new set of rings poured, after which both faces should be turned smooth.

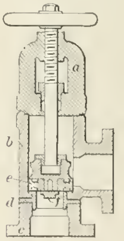


FIG. 3.—VALVE WITH REVERSIBLE DISC AND SEAT.

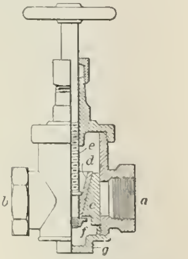


FIG. 4.—STRAIGHTWAY VALVE WITH WEDGE PLUG.

The three valves thus far mentioned are angle valves. The one shown half in section in Fig. 4, however, is a straightway valve, and instead of a flat disc moving in the direction of flow of the water through the seat ring, this valve uses an expansible or wedge plug that moves at right angles to the direction of flow of the water. In the position shown in the figure, the valve is closed and no water can pass from *a* to *b*. The wedge plug *c* is made in two parts, and when the valve is closed, one-half closes the opening from *a* and the other the opening from *b*, thus making practically a doubly sealed valve. The two parts of the plug are divided by the wedge *d* fastened to the valve stem *e* by the nut *f*. When the handwheel is turned in the proper direction to cause the valve to open, the first result is a rising of the wedge *d*, without any motion of the plug *c*. There is a small space between the nut *f* and the plug *c*, and not until the nut has risen this amount does the split plug *c* begin to rise. On further turning the stem, the plug and wedge are drawn up into the barrel of the valve, leaving a free, full opening for the discharge of water and sludge.

In closing the valve, the plug *c* descends until it strikes the cap *g*, checking the flow of water, though not completely. But, as the handwheel is turned further, the wedge *d* is forced downward between the halves of the plug and presses them hard against their seats.

The peculiar feature of the valve shown in Fig. 5 is the hollow plug, through which the discharge occurs. This plug *a* is conical and fits snugly into the conical body *b*. The discharge from the boiler enters at *c* and passes out at *d*. The valve is opened by giving a quarter turn to the handle *e* attached to the spindle *f*. This spindle is hollow, its upper end connecting with a cock *g* and its lower end with the space *h* between the valve bonnet and the plug *a*. Ports *i*, *i* lead from the space *h* to the interior of the plug. Hence, steam being allowed to enter through the cock *g*, pressure is exerted in both directions on the plug, so that it is practically balanced and will therefore turn easily. A spring *k* presses downward on the plug and keeps it tight in the valve body. The reason for constructing the valve with a central passage for the water is to prevent sediment or grit from coming in contact with the bearing surfaces and thereby cutting them.

A straightway plug valve is illustrated in Fig. 6. The plug *a* is attached to the spindle *b* and has an opening through it equal to the full area of the blow-off pipe. The valve is opened by giving the plug a quarter turn. Small ports *c* and *d* permit the pressure to be transmitted to the top and bottom of the plug when the valve is open, and the plug is then held to its seat by the excess of pressure on the larger end. By means of lugs *e* and cams *f* the plug is forced tightly to its seat after being turned so as to close the valve. The joints are metal to metal and as there is little contact of water with the wearing surfaces, the amount of abrasion is slight.

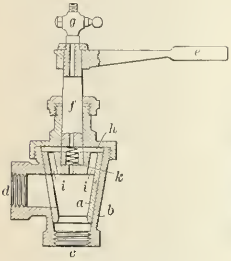


FIG. 5.—BALANCED ANGLE VALVE.

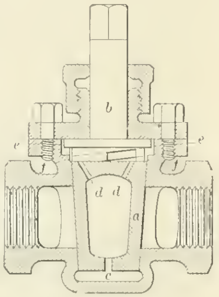


FIG. 6.—PLAIN PLUG VALVE.

A plug valve of similar construction is illustrated in Fig. 7. Here, however, the tightness is secured by means of asbestos packing *a* set in U-shaped grooves in the body of the valve. An asbestos ring *b* is also placed beneath the gland *c*. The gland is tightened by means of bolts, and the plug is thus held to its seat. A quarter turn of the stem *d* opens or closes the valve. A lug *e* is cast on the gland *c* and two shoulders *f* and *g* are formed on the stem. When the valve is fully open, the shoulder *f* strikes the lug *e* and when it is closed, the shoulder *g* rests against *e*. Thus it is impossible to turn the valve too far, either in opening or closing.

An unusual form of blow-off valve is shown in Fig. 8. It is of the straightway class, the flow being stopped by moving a disc across the seat at right angles to the current. The disc *a* is attached to an arm *b* connected to the square-headed stem *c* to which the turning wrench is applied. Thus, in opening or closing, the disc *a* swings in a circular arc, but never leaves the plane of the seat *d*. The inlet is at *e* and the outlet at *f*, so that the boiler pressure holds the valve to its seat. Additional adjustment for wear is secured by the screw *g* which maintains a tight joint between the stem *c* and the body of the valve. A spring between the disc *a* and the arm *b* holds the latter against the upper seat *h*.

A form of plug valve in which the plug is a hollow sphere is shown in Fig. 9. As may be seen, the valve gives a full straightway opening and can be operated by turning the stem a fourth of a revolution. The ball *a* fits nicely against the bearing surfaces in the valve body, but in addition adjustments and packing are provided to take up wear and prevent leakage. A ring of soft metal *b* rests against the ball *a*, and behind it is a ring of packing *c* that is compressed by the gland *d*. The metal nipple *e* prevents the soft packing from being squeezed out into the passage through the valve.

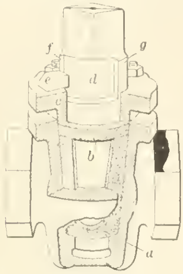


FIG. 7.—ASBESTOS PACKED PLUG VALVE.

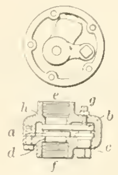


FIG. 8.—DISC BLOW-OFF VALVE.

The operation of the blow-off valve requires judgment and common sense. With quick-closing valves of the quarter-turn type, a thoughtless or ignorant attendant may close it with a sharp twist of the handle. This is to be condemned as a dangerous practice, since it is liable to cause rupture of the blow-off pipe through water-hammer. The column of water moving through the valve at high velocity possesses considerable energy, and if the column is brought to rest almost instantaneously, as by the sharp closing of the valve, the energy will be given up in the form of a heavy blow against the valve. This may result in a broken valve body or a split blow-off pipe, if nothing worse. The rapidity of opening of a blow-off valve is of little moment, since the water, by reason of its inertia, will be unable to reach a high velocity in so short a time as to cause any damage to elbows or other fittings.

The time of opening the blow-off valve, the length of time it is left open, and the frequency with which it is opened vary. It is the general practice, however, to open the blow-off when the pressure is lowered, as, for example, in the morning while getting up steam, and before the pressure has reached the normal. The quality of the feedwater, whether dirty or fairly clean, will determine the intervals at which the valve must be opened.

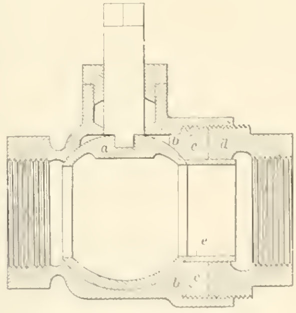


FIG. 9.—BALL PLUG VALVE.

LETTERS ON PRACTICAL SUBJECTS

EXPERIENCE WITH THE CENTRIFUGAL PUMPS.

It is generally well known that the centrifugal pumps cannot produce sufficient vacuum to raise water from a pit when the water level is much below the pump. But it apparently was not known to the people who installed a small pump in the conditions shown in Fig. 1. Of course, the pump would not operate, so that when the writer was called to look at the equipment, the owners seemed to be dissatisfied with the pump and with electricity and were about to put at the work a couple of men with hand-operated suction pumps. The pump was a small portable machine for 1050 cu. ft. per hour, with a maximum head of 30 ft. It was fitted with a flexible suction pipe 4 in. in diameter, 15 ft. long, which was apparently too large for such a pump, and the pipe was immersed in a pit with the water about 6 ft. below the pump.

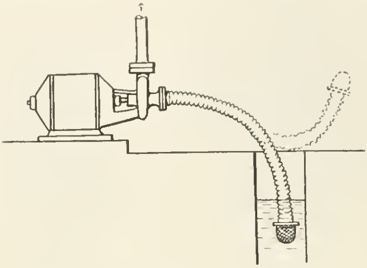


FIG. 1.—ARRANGEMENT OF PUMP SUCTION.

The writer obtained a 2.5-in. pipe and meantime decided to fill the pump with the water before starting. The outgoing pipe had already been removed and the pails with water were at hand. Two full pails were poured in, and after the pump had been started, all of the water came back violently. For the first second it seemed that the whole pit would dry in very short time, but the water stream died out quickly. Apparently it was impossible thoroughly to fill the pump and pipe with water, as it was impossible to close the inlet temporarily, which was quite inaccessible.

The suction pipe was then removed from the pit and raised, as shown by the dotted lines in Fig. 1. Three full pails of water filled the pipe and pump completely. Then the pipe was quickly thrown in the pit, and the pump was started. A heavy, steady stream followed, and when the outgoing pipe was fitted on its place, the pump continued to work successfully.

A similar trouble occurred in another instance when a large vertical pump (for 16,000 cu. ft. of water per hour), installed in the boiler room of a large steamer, refused to work, being completely covered with the water. A considerable increase of speed of the driving motor did not bring any satisfactory results. The pipes, and the pump itself, were carefully examined and nothing could be found which might indicate the cause of the trouble. However, a similar pump in the engine room picked up the water almost instantly after having been started. Apparently there were some obstructions inside the pump which could be found only by removing all parts of it. It was believed that, due to a peculiar shape of the outgoing pipe (see Fig. 2), there must be air locked in the pump so that the water could not come in touch with the blades. A .25-in. hole being drilled at *A*, the air came out whistling, and a fine stream of water after it. Then the pointer of the ammeter in the motor circuit swung from 35 to about 320 amperes, and a full stream of the water went through the outgoing pipe.

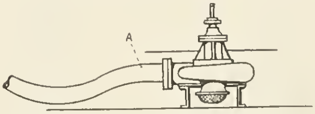


FIG. 2.—AIR-LOCKED DELIVERY PIPE.

East Pittsburg, Pa. J. Nikonow.

A PECULIAR ELECTRICAL PHENOMENON.

While employed some time ago on power-plant construction work it became my duty to install the station-lighting system on a 550-volt direct-current circuit, taking its power from the 225-kw generator used for operating a small street-railway system. When the work was well advanced, and all the different circuits had been connected to the switchboard, we threw the power on for the first time. The incandescent lamps in the different parts of the building lighted up without giving any trouble, but when the arc-lamp switch was closed there occurred a most peculiar electrical phenomenon.

The accompanying sketch shows a diagram of the wiring on the back of the switchboard, and it will be noticed that the main switch controls all of the incandescent circuits, but has nothing whatever to do with the arc-lamp circuit. This arrangement was made because it was thought desirable to have the arc lamps—which were used for the general illumination of the building—on a circuit separate from the incandescents. When the test was made, the main switch was first closed, then the different incandescent circuits were thrown on, one by one, until the leads and the main switch were carrying 10 amperes. When the arc-lamp switch was closed, however, there was a blinding flash and every light in the house went out. Upon examining the switchboard, it was found that the fuses in the arc-lamp switch were blown out, and that the switch itself was considerably damaged, but the main switch—which was not in the direct path of the short-circuit—was damaged very much more; in fact, it was nearly ruined, the binding screws being partly fused, and there were evidences that it had carried a much heavier current than the arc-lamp switch. The fuses were also blown on two or three of the individual incandescent switches, but the switches were not harmed.

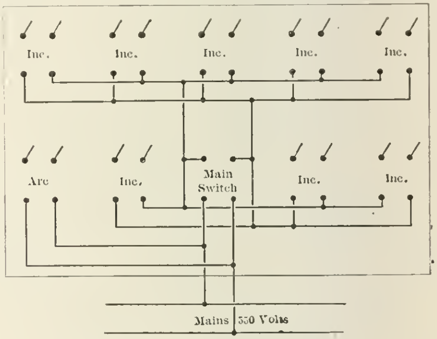


DIAGRAM OF SWITCHBOARD CONNECTIONS.

We put in new fuses throughout, and then carefully inspected the arc-lamp circuit for trouble. We found one place that looked bad and fixed it. The circuit appeared to be all right in every other place, so we gave it another trial. The short-circuit was still there, however, and this time the main switch was completely destroyed—as far as its future usefulness was concerned—and one of the main leads, a No. 12 copper wire, was fused close to its point of junction with the main switch. The arc-lamp switch was badly damaged, but could still be used.

On the following morning I discovered the cause of the accident. The arc-lamp wires had been connected to the switch so that the current flowed through the lamps in the wrong direction. This being the case, the carbons had failed to lift, and the result was a dead short-circuit. This explained the immediate cause of the trouble, but did not help me to understand why the main switch had been destroyed when, theoretically at least, it should not have been affected by the short-circuit.

Now, why should this be? Why should the current pass through the main switch at all, unless we can assign to electricity the property of inertia. The current is direct, the leads are short, and the phenomena cannot be charged to the account of self-induction. I have thought about this a great deal since the occurrence of the accident, but cannot satisfy myself in regard to its cause. Perhaps some of the readers of this may have had a similar experience, or have made some experiments that would throw light upon this question. If so, I should be glad to have the cause of the phenomenon explained.

Chicago, Ill. Frank W. Merrill.

THE OPERATION OF A SMALL ELECTRIC PLANT.

The writer has noted a mistake made in the sketch shown of a compound-wound motor in the article by Mr. W. H. Wakeman, in the February number, and would suggest that the figure referred to as illustrating the wiring of a compound-wound, direct-current motor is not correct, as the shunt-field wires are not shown connected to any part of the circuit. Neither is the relative position of the starting-box, or motor-starter, connected in the circuit, and for a man who is trying to learn to do correctly this class of work the sketch is misleading.

I quite agree with Mr. Wakeman that it is very necessary that the wires be properly located and that they be kept in place, as very few electricians who have not had experience with compound-wound motors will be able to handle a motor of this description correctly, providing they wish it to operate in the opposite direction, as invariably, instead of reversing the direction of current through the armature leads, the shunt-field wires are changed.

In order to illustrate the connections for a compound-wound motor, the writer is enclosing two sketches, Fig. 1 and Fig. 2, showing the correct connections of such a machine of the four-pole type, with all wires shown on the diagram. By noting Fig. 1 it is readily seen that both the shunt and series coils are connected so the current travels in the same direction, and in order to reverse the direction of rotation of this type of motor it is only necessary to shift the brush-holder yoke one-fourth of its complete revolution, which will then place the brushes so that the armature current is reversed in its direction through the commutator. If the leads are not long enough to allow this to be done, the relative position of the right-hand lead and left-hand lead on the brush studs should be exchanged.

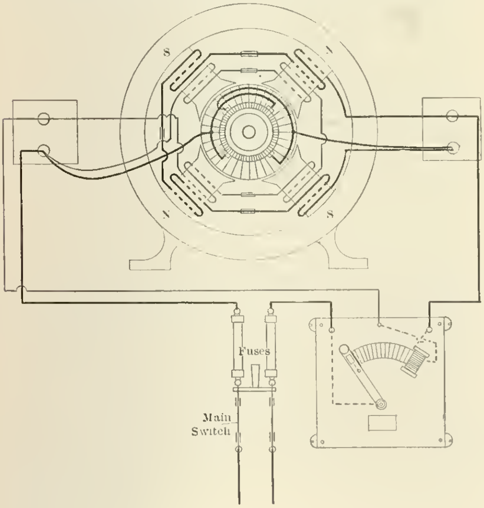


FIG. 1.—CONNECTIONS OF COMPOUND-WOUND MOTOR.

By referring to Fig. 2, a projective sketch, which illustrates the direction of current through the entire machine, it can be readily understood why it is necessary for the two field coils on each pole to carry the current in the same direction, because if they are reversed, the tendency is for the machine to increase in speed as the load is thrown on, owing to the magnetizing effect of the series coils neutralizing the effect of the shunt coils attempt to strengthen the fields, and the result would be the destruction of armature, caused by increase of speed and decrease of counter e. m. f.; this action depending, of course, upon the extent of the compounding.

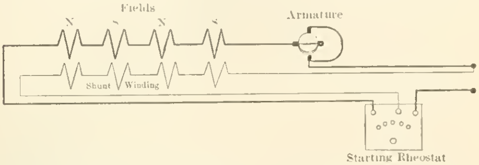


FIG. 2.—DIRECTION OF CURRENT THROUGH ENTIRE MACHINE.

In Fig. 1 the main switch and fuses are shown. It should be pointed out that link fuses are not permitted in many localities owing to wiring regulations, and the tendency of inexperienced operators to replace link fuses of one size with a larger size than the wires and fuse blocks are built to carry is censurable. With approved enclosed fuses it is impossible for the operator to replace fuses in a block with fuses of a much larger size because a fuse of one class will not fit in a cut-out block of another class.

Kansas City, Mo. Ralph B. Coleman.

SETTING OF DYNAMO BRUSHES.

I have read an article by Mr. Gardeen in the February issue, and I think there is yet something to be said with regard to brush-setting on generators.

The brushes should be set first on what is termed the mechanical neutral, which is obtained as follows: Tie a string to the head of one of the bolts which hold the poles in place and, holding the other end at the center of the end of the shaft, sight across this string to the center of the pole piece (previously marked with a piece of chalk). The mechanical neutral is in this straight line, and the brushes should be placed in such a position on the commutator that the centers of the brush, or brushes, on the particular stud come in this straight line as projected on the commutator. (This brush-setting applies for armatures in which the commutator bar is 45 electrical degrees ahead of the armature conductor to which it is attached. Practically all armatures are now wound in this manner.)

Having set the brushes as described above, the machine may be started up. If wired according to the print, which accompanies it, the machine should now build up. Next adjust the field current until approximately no-load normal voltage is obtained, and then shift brushes in the direction of rotation until black commutation, i. e., no sparking, is obtained. The brushes are now on the no-load electrical neutral. The position of electrical neutral is changed, however, as the load comes on the generator so that our no-load setting no longer gives sparkless commutation. The brushes must be carefully moved in the direction of rotation until black commutation is again obtained; now shift brushes back a trifle until sparking is just perceptible. In most cases this setting will be found the most satisfactory one. The generator will run under load the greater part of the time and therefore a brush setting which gives almost sparkless commutation under load will be the most economical, provided the no-load sparking is not bad.

Great care should always be used in shifting brushes on motors or generators under load, as too much shift may cause the machine to arc over, with serious results to both machine and operator.

In the case of a series generator we have somewhat different conditions, because normal voltage is obtained only under load. In this case we have two conditions to fill in our brush-setting —we want a given voltage and also good commutation. Shifting the brushes changes both the voltage at the terminals (and consequently the load) and the degree of sparking. The position which gives the best commutation may or may not be the position that gives normal voltage at full load. The latter is usually the case, and the brushes must then be tried in several positions until that position is found which most nearly fulfils both conditions. This requires good judgment on the part of the operator.

Sayre, Pa. Howard E. Bishop.

USING A GASOLINE TORCH.

The gasoline blow-torch is a very handy tool to have around a central station, and it is to be regretted that more engineers and mechanics do not understand that appliance better than they do. Only recently I watched a man use a torch and could not but wonder where his brains were, if he really had any gray matter at all.

The misuse of the tool commenced when it was being filled with gasoline. The tool was up-turned and the filling plug unscrewed, then the torch was propped up against a box, while the gasoline was poured into the body of the torch. A 5-gal. can of gasoline necessitated the use of both hands to hold it, hence the necessity for propping up the torch for filling. The props being insufficient, the torch fell down when partly filled and some of the gasoline was spilled.

One should never try to fill a torch from a big can. A pint or quart dish should be used for the purpose. Then the appliance can be held in one hand and filled with the other without over-filling the tank and spilling a lot of gasoline. The torch should be a little more than two-thirds full, so that there will be room for a little air in the torch and so that pumping will not have to be performed so often as when the reservoir is filled to the very top with gasoline. When there is only a thimbleful of air in the tank, the pressure falls very quickly and frequent pumping is necessary until the tank empties a little.

Pliers should not be used to unscrew the filling plug of a torch. There is a hole through the plug for putting in a screwdriver or a round iron rod. A rod should be employed for that purpose, or a monkey-wrench, which is better than either screwdriver or rod.

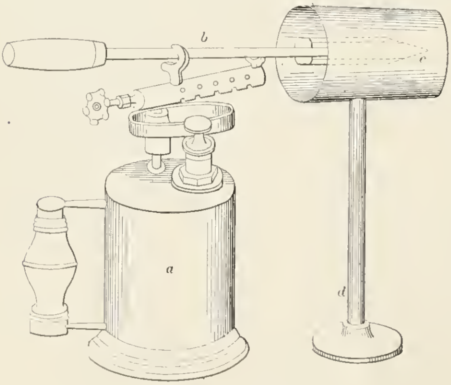


Fig. 1.—Quick Heating Attachment.

Do not use matches when starting the gasoline torch at the bench, if there is a pair of test plugs hanging over the bench and these are connected through lamps. Just touch the plugs against the torch and draw an arc on the edge of the gasoline. It is much safer than matches.

When a gasoline torch is used, 90 per cent of the heat goes off in the atmosphere without doing any work whatever. When performing certain operations it is easy to save a little of this heat. Fig. 1 shows how this can be done when heating a soldering copper. Not only is the heat saved, but the tool is heated in one-third the time necessary without the heat-saving appliance, which is merely a shield of iron or asbestos placed on a stand as shown, and so located that the tool can be heated inside the shield. The torch is represented at *a*, the soldering copper handle at *b*, the copper itself is seen inside the shield *c*, which is held where wanted by the stand *d*. The shield may be used for a little job of brazing, and a tremendous heat gotten up inside it if a few pieces of charcoal are placed inside the shield and the blast turned loose against the charcoal.

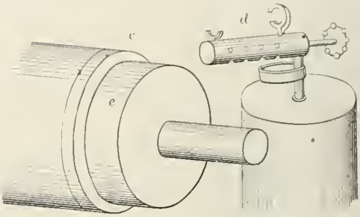


Fig. 2.—Waste of Heat While Unsoldering Armature Winding.

It is sometimes necessary to unsolder the connections of an armature, and this has to be done by unsoldering the wires from each segment. The workman usually places the torch as shown in Fig. 2, and then sits down for half an hour while a little heat goes into the commutator bars, etc., from the torch *d*. most of the heat passing by the work and never doing a particle of good.

The solder may be melted out in one-fourth the time usually taken for it by placing a piece of asbestos board on the commutator bars at *e*, to protect them from unnecessary heat, and piling a few large pieces of charcoal on top of the soldered connections, directing the torch blast into and under the charcoal. The heat will be increased many fold and the top of the armature will resemble a smith's forge in full operation. If charcoal cannot be obtained, a few pieces of wood placed around and over the soldered connections will be quickly converted into charcoal, which will ignite and very quickly add to the heat sent against the commutator connections. If no asbestos board is at hand to place over the commutator at *e*, common sheet-iron may be used, and it is also well to place a piece of sheet-iron on top of the asbestos when the latter substance is used, the iron serving to protect the asbestos from damage through hard usage.

When getting the torch ready for use, and when setting it aside, the filling plug should always be screwed firmly home. Many a time has a torch been picked up by the writer and a wet spot of gasoline-soaked wood found below the appliance. Such carelessness may lead to fire, and should not be countenanced.

Boston, Mass. John Jackson.

THE CENTRAL-STATION BOILER ROOM.

It is too often forgotten that in the operation of steam-power plants, if economical operation is to be striven for, the battle must begin in the boiler room, and the "man behind" the scoop is a personage of greater importance than is generally conceded. What follows are a few simple hints that I have found to improve the work of some old and fairly successful firemen—as firemen go.

Suppose the fireman has been called upon to push his fires in order to carry a heavy overload. It will be necessary to burn a large amount of fuel, and necessitates heavy firing, not slugging, but frequent firing, placing the required amount of fuel on the fire at proper intervals, and a strong draft will be required. Now, when the load lightens two things should be done. The fireman should place less fuel on the fire and reduce the draft, because with the thinner fire the strong draft would cause too much air to be drawn through the bed of fire, cooling the gases of combustion and causing heavy loss. Besides, the amount of heat absorbed by the boiler heating surface from the gases of combustion depends upon the time they are in contact. The more slowly the gases pass by or through the boiler surfaces, the more heat will be taken up from them and conveyed to the water in the boiler. Hence no more draft should be used than is required to secure good combustion. Where the fireman regulates the supply of water to the boilers, he should endeavor to feed them as nearly uniformly as possible. This will make possible more regular firing, and will avoid the evils due to rapid changes of temperature of the boiler and furnace. If a heavy load comes on, first push the fires, then when the effect of this is seen, increase the feed-water supply. If the feed-water supply is increased first, a heavy fall in pressure will result. I always advise firemen to get in the habit of glancing at the steam and water gages every few minutes. This requires practically no exertion of the body; close observance will enable the fireman to detect the slightest tendency of the pressure to rise or fall, and he can constantly govern his firing by these indexes. Watchfulness and willingness, with a fair degree of common sense, will make a good fireman.

The fireman should learn the color of a good fire. When he opens a furnace door and sees a white incandescent mass, he is getting heat. If he sees dense clouds of smoke floating over the grates, mixed with a dull or dark red flame, there is little heat. Most of the free gases are going up the stack in the form of soot instead of combining properly and giving up their heat to the furnace in the boiler.

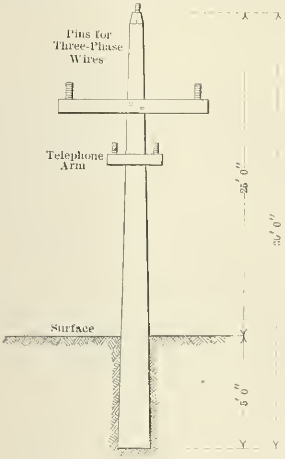


FIG. 1.—ELEVATION OF POLE.

In placing coal on the fire I advise beginning at the back of the fire, placing the first scoopful back against the bridge-wall, scattering it well, and then firing toward the front. In this way the uncovered portion of the fire can be perfectly observed, and every scoopful of coal can be placed to a nicety. If the first scoopful is placed near the doors in front, the smoke rising from the fresh coal, if it be soft or bituminous, which I have in mind, will obscure the portion of the grate that has yet to be fired, so that the last scoopfuls cannot be placed with any certainty at all.

Burlington, Ia. Wm. Westerfield.

ECONOMICAL POLE RAISING.

An engineer in charge of an electric generating station, operated by a gold mining company, located in a particularly rough and rugged part of Colorado, was once required to build a pole line of 30-ft. poles (such as shown in Fig. 1), about a mile in length. The contour of the route was such that the upper end of the line, at the mine, was at least a third of a mile higher than the lower end, at the generating station. The engineer had one experienced lineman and three laborers to assist him. It was not thought best to secure additional help, if it could be avoided, as the cost of labor was very high, a common laborer receiving $3 for ten hours' work. The problem was to build the line with this force.

Fortunately, all of the poles could be set in a straight line which necessitated no guying except at the extremities. Locations for the poles were carefully staked out and lined up with a transit. No attempt was made to secure a uniform spacing of poles, as the hillocks, ravines and low cliffs would have made such refinement out of the question. Points were so chosen for pole locations that the grade of their tops was fairly uniform. It was a comparatively simple, though tedious, matter to locate the poles and dig the holes for them with the labor available, and the poles were snaked to the points where they were to stand by contract. The tough proposition was how to set them. Even if the pole-raising pikes had been at hand, which they were not, it would have been very risky to have tried to raise poles with them on a very steep hill with inexperienced hands. If a pole had got away, it would not have stopped until it reached the bottom of the hill, and likely someone would have been killed in its descent, as the pole line crossed a much frequented trail several times. So great was the inclination of the hillside that in a great many instances it would have been impossible, in any event, to have lifted the pole near enough to the vertical with pole pikes to have insured its falling into its hole.

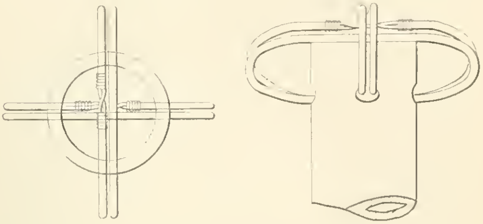


FIG. 2.—PLAN AND ELEVATION OF PIPE END.

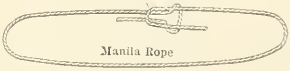


FIG. 3.—METHOD OF MAKING SLING.

The following is a description of the method in which the poles were raised. The engineer prepared one end of a 12-ft. length of 2½-in. wrought-iron pipe as shown in Fig. 2. Four ½-in. holes were drilled 90 deg. apart and about an inch from the end of the pipe, as illustrated. Through each opposite pair of holes a double loop of No. 6 gage galvanized iron wire, such as is frequently used for guying, was passed and each loop spliced with a "Western Union" splice. One hook of a set of tackle blocks was let into one of the loops and a ¾-in. manila guy rope was tied securely into each of the remaining three loops. A sling of manila rope made as indicated in Fig. 3 completed the equipment.

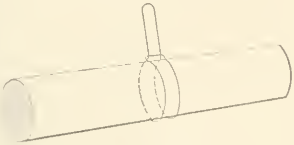


FIG. 4.—SLING APPLIED TO POLE.

Fig. 5 is intended to show how the poles were raised with the iron pipe "Jim-pole," the latter term being the technical name of the apparatus. Two men could easily carry the pipe, with its rigging, up the hill, from pole location to pole location. When the point where a pole was to be raised was reached a man would hold the pipe, its lower end on the ground, in an almost vertical position, the foot of the pipe being about 12 in. from the mouth of the pole hole. Other men made fast the guy ropes to trees, stumps, rocks or anything available. The sling being adjusted on the pole, slightly above the point of balance, about one-third of the length from the butt, three men would raise the pole by pulling on the tackle line, while a fourth guided the butt and inserted it in the hole as soon as it had been raised sufficiently. The pole was then pushed into a vertical position with long-handled shovels, or pulled into such a position with temporary guy ropes, which had been attached before raising, and the hole filled and the dirt thoroughly tramped in. The method proved to be thoroughly practical and a cheap one, and although the pipe bent threateningly at times (a 30-ft. pole weighs in the neighborhood of 450 lb.), it always assumed its normal lines when the strain was relieved. It was necessary frequently to set the base of the pipe on a piece of rock about 6 in. square to prevent its sinking into a yielding soil. After the line was completed, as far as could be judged, the pipe was as good as new except for the holes.

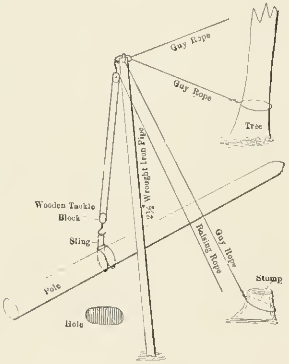


FIG. 5.—METHOD OF RAISING POLE.

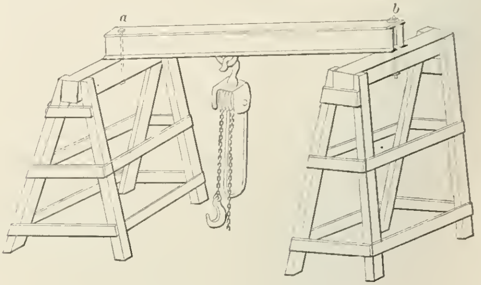
There is no reason why a similar arrangement should not be used frequently, even under less exacting conditions, as there is no question as to the economy if objects are handy to which the guy ropes may be secured.

Waterbury, Conn. T. C. Lerret.

A REPAIR JOB TROLLEY.

During some recent rush repairs made necessary by excessive wear of the shaft of a direct-connected, direct-current generator it became necessary to put in a new shaft between Saturday and Monday, and as there was no overhead crane, the handling of the generator field structure, the armature and the shaft itself was quite a problem. Two 10-in. I-beams 12 ft. long were fastened side by side and fitted with a trolley to which was attached a three-ton differential hoist. Two stout horses were prepared, each being built of a 6-in. x 8-in. timber 8 ft. long, the legs being made of 3-in. x 6-in. scantling, well braced and spiked together, and finally being bolted to the 6-in. x 8-in. backbone. The I-beam trolley run was placed on top of the trestles, and each end of the I-beam was fastened to one of the trestles by means of a bolt, as shown herewith.

The bolts *a* and *b* were the features of this piece of apparatus. The bolts were not very tight, they were left loose; but the nuts were in place and screwed down so that there was not more than ½-in. play between the I-beam and the bolt-head. In fact, the bolts were merely used for keeping the I-beams in place upon the trestles while the latter were being shifted from one position to another to accommodate the work to be done. The entire rigging was easily moved around the floor by four men, and when a piece of machinery was to be lifted into or out of place the trestle was pulled around until the I-beams were directly over the piece to be moved and the place to which it was to be moved. It was then an easy matter to raise the mass by means of the tackle and shift it to its new position by means of the trolley.

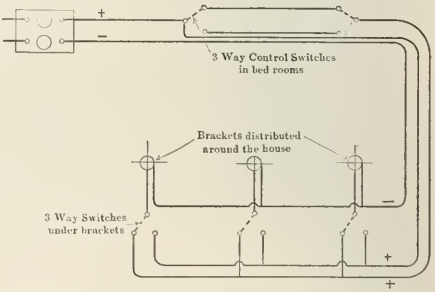


A RUSH-JOB TRESTLE TROLLEY.

Philadelphia, Pa. Henry Fuller.

EMERGENCY LIGHTS FOR RESIDENCES.

In the wiring-up of residences, it is very desirable to install a number of emergency lamps distributed around the house and controlled by a switch or switches in the bedrooms, so that general illumination throughout the entire house may be had at a moment's notice in case of emergency. Heretofore, the chief objection to this plan was that these special lamps were not available for any but emergency purposes. This is objectionable as it looks bad to have certain lamps in the room which cannot be lighted for general illumination purposes. This defect may be overcome by installing the wiring as shown on the accompanying drawing. The idea is that emergency lamps have three wires run to them. The first wire is a common negative; the second wire is positive and connected up to the emergency switch or switches in the bedroom; the third wire is also positive, but shunted around the emergency switches in the bedrooms. Each emergency lamp is provided with a three-way switch which acts as a double-throw single-pole throw-over switch. In order to use an emergency lamp for general illumination, energy is supplied to it by means of the common neutral and the third positive wire shunted around the emergency switch, as described above. It is obvious that when an individual emergency lamp is switched into circuit by means of the three-point switch directly under it, it is thrown on the emergency circuit so that it can be controlled from the emergency switches in the bedrooms.


+
−
3 Way Control Switches in bed rooms
Brackets distributed around the house
3 Way Switches under brackets
−
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WIRING DIAGRAM FOR EMERGENCY BURGLARY LAMPS.

Chicago, Ill. George H. Jones.

QUESTIONS AND ANSWERS

Kindly advise me through your columns how to paint galvanized iron signs so as to keep them always white. I am unable to locate the number in which this valuable information was given. W. W.

This information appeared on the Questions and Answers page of the September, 1906, number.

What is the composition of the alloys used for thermostats? E. E. & S. Co.

The best material for thermostats consists of a strip of tool steel backed by a strip of either copper or brass. We do not know the composition of alloys used for this purpose.

What size of wire should be used in grounding the alternating system of a residence? N. S. E.

The code specifies a wire not smaller than No. 4 B. & S. gage. The wire should have an approved rubber insulation and be connected to pipes on the street side of water meters, gas meters, etc.

In the January number directions were given for making a dry battery. Can old arc lamp carbons or discarded dynamo brushes be used for making the powdered carbon filling? H. C.

Yes. It would be well to place the carbons in boiling water for some time, and then permit them to dry well before they are converted to the powdered form.

If a transformer designed for 1100 volts primary and 110 volts secondary be connected to a 2200-volt primary circuit, thus obtaining a secondary e.m.f. of 220 volts, would the transformer overheat? E. B. H.

A transformer thus connected would give the desired voltage without affecting the efficiency appreciably. The iron loss, however, will be three times its normal value, and the temperature rise will be excessive and probably destructive.

Is it possible to ring four bells from three single push buttons as follows: Push button No. 1 to ring bell No. 1; push button No. 2 to ring bells Nos. 2 and 3, and push button No. 3 to ring all four bells at once, provided a series arrangement is used? M. W. H.

By arranging the bells in series and providing the necessary number of cells, the desired combination of bells may be rung with single push buttons. The arrangement, however, is not the best, and unless some of the vibrators of the bells are short-circuited satisfactory operation cannot be expected. A better arrangement was suggested to "B. R" in the January number.

I had occasion to rewind a 250-volt series railway-type, motor armature having 45 slots, three coils per slot. The coils were wound in slots one and eleven, and I would appreciate it if you would inform me why they were not placed in slots one and twelve, the motor being a four-pole machine. F. M. M.

In a four-pole armature containing 45 slots, it is not essential to place the coils in slots one and twelve; although the operation will probably be satisfactory if they are so placed When the coils are arranged in slots one and 11, each coil requires less copper than when placed in slots one and 12, and the commutation is somewhat better. The only requisite in winding an armature is that one side of the coil shall be under a north pole when the other side is under a south pole. It is not essential for one side to be under the middle of the north pole when the other is under the middle of the south pole; in fact, it is preferable for the throw of the coil to be shortened somewhat.

I have lately seen references to a device for testing the condition of wire hoisting ropes by means of electricity; the induced current crossing the wire being said to vary with the thickness of the cable. Where can I obtain particulars of such a device? E. R. C.

The arrangement for testing the cross-section of wire rope is probably that suggested by Mr. C. McCann before the Transvaal Institute of Mechanical Engineers. It consists of a transformer whose primary is connected to an alternating-current circuit, while the secondary is in series with an ammeter and a coil wound on a hollow bobbin. This coil is placed around the rope, whose cross-section is to be determined. The self-induction of the secondary circuit is low when the rope is not passing through the coil, but rises when the rope moves, causing a decrease in current in proportion to the self-induction produced. The instrument can be calibrated for any particular size of rope as required, and any appreciable decrease in the diameter of the rope can be noticed at once if the coil is kept permanently around the rope.

In handling two standard makes of transformers we have invariably connected them in delta, and whenever we have tried to couple them to the same secondary busbar all of the high-tension fuses have blown. Can any reason be assigned for such action? A. P. L. S.

There are a number of causes to which the result might be attributed, such as inequality in transformation, ratio, etc. It is probable, however, that the secondary delta circuits for one set of three transformers give a voltage that is 180 time-degrees out of phase with the voltage of the other set; that is to say, the secondary voltages of the one set of transformers are in proper three-phase relation, as is true also of the secondary voltages of the other transformers. One set of delta-voltages is reversed from the other side, so that it is impossible to connect them in parallel. We suggest that you close only one of the three switches of one set of buses so as to connect the two delta-voltages at one point. Then with a voltmeter measure the e.m.f. across the other switches before closing them. You will find, doubtless, that the latter voltages, which should be zero, have, in fact, double the normal value between phases. If such is the case, then each secondary coil of one set of three transformers must be reversed before the three are connected into a closed delta.

I would like some information on the following: A test for core loss on a 100-kw, 12,500-2200-volt, 25-cycle transformer showed the following results: Primary 11,170 volts, 1.08 amperes, 2122 watts or 17.6 per cent power factor. The secondary showed 2185 volts, 5.12 amperes, 1430 watts or 12.8 per cent power factor. (1) How much load (non-inductive) would be required on the secondary of two such transformers connected in open delta, three-phase, to give a power-factor of a little over 50 per cent on the primary side? (2) How much load would be required if three transformers were connected in delta to give the same results? (3) How much load would be required if three transformers connected in star were used? (4) Are there any formulas for determining the above results when the excitation current and power-factor are known? (5) Would the total core loss of three such transformers connected in delta be three times the primary loss of one or would it not be three times the primary loss of one plus three times the secondary loss of one; in other words, would not the total core losses be the total of both primary and secondary losses of all three? S. R. S.

If the transformer above mentioned is operated with its primary at 12,500 volts and its secondary on open circuit, it will consume a certain number of watts. If, now, as a second test, the transformer be operated with its secondary at 2200 volts and its primary on open circuit, it will consume exactly the same number of watts. Just why you should have received two different values of watts, we do not understand. However, if it is correct for us to assume that the value 2122 watts was obtained with the secondary on open circuit, and that the power-factor under these conditions was 17.6 per cent, and the primary current was 1.08 amperes, then the first question can be answered as follows: The primary current may be considered as consisting of two components, a power component and a wattless component. The power component is equal to the actual reading of the ammeter multiplied by the power factor; that is, it is equal to 1.08 amperes multiplied by 0.176. The wattless component is equal to the same current multiplied by the sine of the angle of which the power factor is the cosine. This current remains practically constant at all loads. When the power factor is 50 per cent, the sine of the angle, of which 0.5 is the cosine, is .866. Divide the value found for the wattless component by .866 and the result is the power component of the total primary current, and the no-load component of the primary current, as found above, is the load components of the current when the power factor is 50 per cent. The difference between this total power component of the primary current, as found above, is the load component of the current when the power factor is 50 per cent. The above method is applicable to transformers when used in any connection whatsoever. It, therefore, applies to each one of the three transformers connected in either star or delta. The core loss of a transformer depends solely upon the flux at which the core is operated. This flux varies with the voltage, and if the voltage on any one coil of a transformer remains constant when the transformer circuits are changed from single-phase to three-phase, either star or delta, the core loss is unaltered.

Suggestions for Obtaining New Motor Business.

By Norman G. Meade.

It is now generally recognized that electric drive is by no means confined to the operation of industrial establishments, as there are many other fields that have been invaded with marked success. The use of electric motors in office buildings, hotels, department stores, restaurants, cafés, laundries, bakeries, banks, amusement parks, etc., is greater than is generally known, as steam and gas engines have been largely superseded by motors for the operation of all classes of apparatus, and many operations formerly laboriously performed by hand are now accomplished by motor-driven machines with a considerable saving in operating expenses. The large demand for electric motors may be attributed to their inherent characteristics which appeal to all power users; their cleanliness, noiseless operation, simplicity of control, the minimum amount of attention necessary and their economical operation rendering them especially applicable to work of all classes and making available power for use in many places where other forms of power would be out of the question.

In the industrial field the electric motor is now being recognized as the ideal power and extends into all branches. It is a well-recognized fact that with the advent of modern manufacturing methods and the introduction of new and labor-saving machinery, operating conditions have so changed that the transmission of power from a central source, such as steam and gas engines or water wheels, is open to many objections, and electric motors have been substituted as a fitting accompaniment to recent progress. By their use long lines of shafting are eliminated, thereby saving the power consumed in overcoming friction, adding to cleanliness, removing obstructions to the diffusion of light, both natural and artificial, and greatly increasing available head room by dispensing with a large number of belts and countershafts. Furthermore, flexibility is gained that permits the operation of a few or many machines each independently of the other, the control being placed conveniently in the hands of the operatives. There are many other direct and indirect advantages which, together with economical operation by reason of increased production, have commended electric motors to all progressive manufacturers.

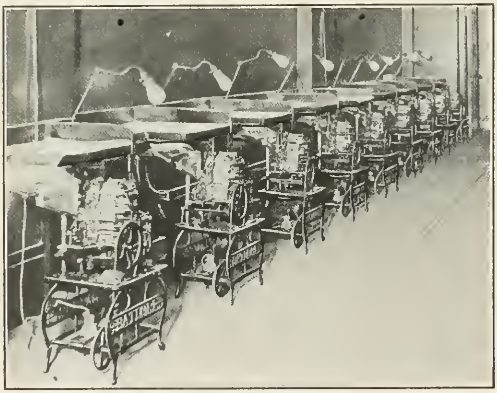


FIG. 1.—ELECTRICALLY-OPERATED COIN COUNTERS IN A LARGE BANKING HOUSE.

The rapid invasion of electric drive into all fields of business is largely due to the energetic efforts of manufacturers and central stations to enlighten power users as to the possibilities for improvement by the use of motors. It is surprising to note the great strides made in cities where an energetic campaign has been carried on. Many people have to be educated up to the adoption of modern methods and this can only be done by persistent and intelligent effort on the part of those interested in the advancement of some particular branch of industrial progress. It frequently takes considerable time to overcome the prejudices of a large number of people approached, but well-defined arguments and persistence are the key-note to success.

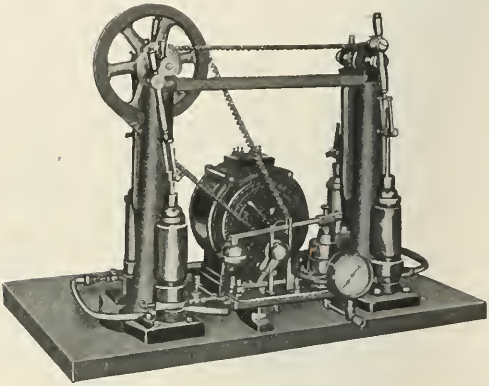


FIG. 2.—ELECTRICALLY-OPERATED BEER PUMP.

In a previous article the importance of increasing the day load of central stations was considered and a few suggestions made for conducting a new business campaign. To insure success, the new business department must be carefully organized and a definite plan of action mapped out. Local conditions will influence the programme of activity, but in all cities there are innumerable possibilities for extending the motor business.

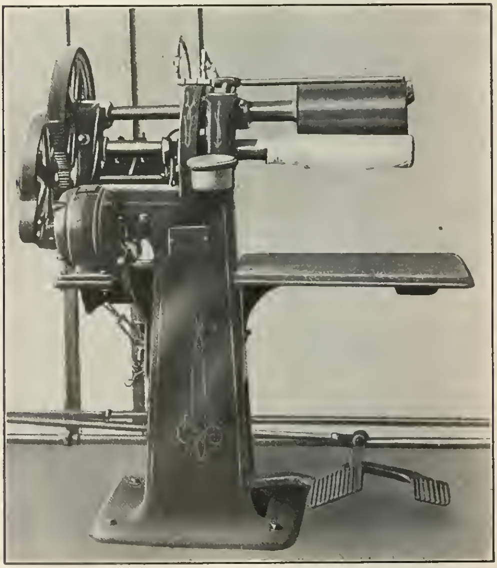


FIG. 3.—MOTOR-DRIVEN SLEEVE IRONER.

The corps of solicitors should work under the guidance of a competent manager who is capable of handling the advertising and publicity work. It is always well to classify the manufacturing interests of a city and divide them into groups, detailing one solicitor for each group. In this way each man can familiarize himself more fully with his particular branch of the work and the requirements, advantages of electric drive, etc., for each industry. Every new business department should be provided with lists of possible individual motor applications, industrial and business houses where motor drive is applicable and a separate list of industries with the various machines used, that are adapted to electric drive, classified under their particular head. The great advantage of such lists is that they really serve as a directory of electrical applications which may be added to continually. It is impossible to keep in mind the great number of machines and industries, and work would be carried on more or less at random without their aid. The solicitors should be instructed to be constantly on the watch for information of value that may be filed for future reference.

The following list of motor applications is fairly complete and will serve as a guide for new business departments:

Addressing machines, advertising devices (moving), air compressors, automatic piano-players, barrel washing and scrubbing machines, beer pumps, blowers, blue-printing machines, bottle cleaners, bread-crumbing machines, bridges (roller, lift and swing), buffing lathes, cable covering machines, cake mixers, candy pullers, capstans, car-wheel grinders, carpet-cleaning machines, cash carriers, centrifugal pumps, churns, circle swings, coal cutters, coal crushers, cocoanut grinders, coffee grinders and roasters, concrete mixers, corn shellers, cream separators, deep-well pumps, derricks, dough mixers and kneaders, dumb waiters, egg beaters, elevators, emery wheels, envelope machines, envelope sealers, escalators, fans, feed grinders, floor planers, floor polishers, flour rolls, fodder cutters, fruit-cleaning machines, fuel economizers, grain driers, grindstones, hay baling presses, hay cutters, hay forks and hoists, hoists for all purposes, horse-clipping and currying machines, ice cream freezers, ice crushers, ice handling machinery, knife grinders, lathes, looms, machine tools, mailing machines, marble lathes, meat choppers, merry-go-rounds, monotype machines, moving platforms, organ blowers, paint grinders, paper-bag machines, plunger pumps, printing presses, refrigerating machines, roller coasters, saw sharpeners, sewing machines, "shoot the chutes," stone crushers, stone dressers, stone planers, talking machines, vegetable graters, ventilating fans, washing machines, winches and wringers.

The above list relates, of course, to individual applications. The following schedule gives the industries and business establishments where electric drive can be advantageously used:

Addressing agencies, amusement parks, astronomical observatories, automobile works, bakeries, banking houses, blacksmith shops, blast furnaces, bleacheries, blue printing establishments, boiler manufacturing plants, book binding plants, boot and shoe manufacturing plants, bottle manufacturers, brass goods manufacturers, breweries and bottling works, brick yards, calico print works, candy manufacturers and confectioners, car works, carpenter and woodworking shops, carpet mills, carriage works, chocolate manufacturers, churches, cider mills, cigar factories, clothing manufacturers, cement mills, cold storage, concert halls, contractors, copper goods manufacturers, cork manufacturers, cotton mills, cotton seed oil manufacturers, creameries, dairies, department stores, docks, drop forge manufacturers, drug stores, drygoods stores, dyeing establishments, electrotypers, engravers, ferry slips, filtration plants, flour mills, foundries, furniture manufacturers, gas and steam fitters, glass manufacturers, grain elevators, grain and feed mills, hardware manufacturers, harness manufacturers, hat manufacturers, hospitals, hotels, house cleaning concerns, ice cream manufacturers, ice harvesting plants, ice making plants, jewelers and opticians, knitting mills, lace mills, laundries, libraries, livery stables, machine shops, marble works, markets, manufacturers of small tools, office buildings, packing houses, paper box manufacturers, paper mills, parks, one-cent arcades, photographers, piano manufacturers, pipe manufacturers, planing mills, plate glass works, plumbers, post offices, powder mills, printing establishments, railroad shops, residences, restaurants, rope and cord manufacturers, rubber manufacturers, saloons, sash and door manufacturers, sausage manufacturers, saw mills, schools and colleges, ship yards, shirt and overall manufacturers, silk mills, silverware works, soap manufacturers, stamping companies, steel mills, stone quarries, sugar manufacturers, tack works, tailoring establishments, tanneries, tent and awning works, textile mills, theaters, thread manufacturers, tobacco works, tube mills, wagon works, wire and cable manufacturers, woolen manufacturers and yarn mills.

So far the industries and applications have been classified separately. To fully complete the schedule there should be another sheet prepared showing the individual applications classified under the various industries somewhat in the following manner:

ACCOUNTANTS.

Adding machines, tabulating machines.

ADDRESSING AGENCIES.

Addressing machines, envelope sealers, paper cutters and printing presses.

ADVERTISING SPECIALTIES.

Revolving show cases, shifting sign boards, sign flashers, illuminated arms for window display, illuminated revolving barber poles, duplicating typewriter for window displays, fan motor to blow toy balloons for window displays.

AMUSEMENT PARKS.

Merry-go-rounds, roller coasters, shoot-the-chutes, aerial swings, carrousels, pumps, moving pictures.

APARTMENT HOUSES AND FLATS.

Automatic pianos, refrigerating and ice making machines, sewing machines, elevators, dumb waiters, air compressors for cleaning, exhaust pumps, washing machines, lawn mowers, automobile storage battery charging sets, carpet sweepers.

ASSAYERS AND CHEMISTS.

Separators, shakers and stirrers, crushers, pumps, fans and blowers.

AUTOMOBILE AND BICYCLE SHOPS.

Storage battery charging sets, hoists, buffing wheels, lathes, saws, emery straps, emery wheels, portable and stationary drills, blowers for brazing, tire pumps, automatic oiling devices.

BAKERS.

Cake mixers, dough kneaders, brakes, biscuit cutters, molding machines, flour blenders, ice cream freezers, fans, blowers, hoists, conveyors.

BANKS.

Adding machines, tabulating machines, addressing machines, envelope sealers, letter openers, coupon cutters, time stamps, ticket stampers, telautographs, fans.

BARBER SHOPS AND HAIR DRESSERS.

Massage machines, air compressors, shoe shining machines, fans, illuminated revolving barber poles.

BILLIARD AND POOL PARLORS.

Time stamps, cue chalkers, fans, blowers, dumb waiters.

BLACKSMITHS AND WAGON MANUFACTURERS.

Bellows, tire setters, portable drills, drill presses, punches and shears, hammers, saws, lathes, planers, hoists, fans, blowers, emery wheels, automatic oiling device.

BLUE PRINTING ESTABLISHMENTS.

Blue printing machines, fans.

BOAT AND SHIP BUILDERS.

Windlass, portable drills, steering gear.

BOILER MANUFACTURERS.

Portable drills, boiler shell drills, automatic oiling devices.

BOOK BINDERS.

Printing presses, paper cutters, ruling machines, stitching machines, folding and stapling presses, hoists, rahheting saws, fans, blowers

BOOT BLACKING STANDS.

Shoe shining machines, hat cleaners, fans.

BOOT AND SHOE MANUFACTURERS.

Sewing machines, button machines, stitch separators, skivers, edgers, rollers, sand paper wheels, burnishers, fans, blowers.

BREWERIES AND BOTTLING WORKS.

Bottle soakers, bottle cleaners, crowning machines, labeling machines, pasteurizers, centrifugal pumps, mash mixers, rice cookers, grain driers, sack fillers, hop shakers, hoists, conveyors, refrigerating machines, carbonating apparatus.

CARPENTER AND WOODWORKING SHOPS.

Molders, molder and panel raisers, lathes, hand saws, circular saws, grindstones, jig saws, planers, fans, blowers.

CEMENT MILLS.

Conveyors, kilns, coolers, coal crushers, tube and ball mills, tramways, sacking machines.

CHURCHES.

Organ air compressors, fans.

CLEANING AND DYEING ESTABLISHMENTS.

Centrifugal wringers, ironers, dyeing machines, washing machines, air compressors for cleaning, feather cleaners.

CLOAK AND SUIT MANUFACTURERS.

Sewing machines, buttonhole machines, bobbin winders, cloth cutters, pattern cutters, fans.

COFFEE AND TEA MERCHANTS.

Coffee grinders, coffee roasters, coffee cleaners, whips and hoists, fans, blowers, exhaust fans.

COLD STORAGE AND PRODUCE DEALERS.

Ice and refrigerating machinery, hoists, elevators.

COMMISSION MERCHANTS AND MARKETS.

Meat grinders, meat cutters and choppers, horse radish graters, elevators, ice and refrigerating machines, fans

CONCRETE MANUFACTURERS.

Concrete mixers, sand elevators, rotary screens, pumps, concrete presses.

CONFECTIONERS AND CANDY MANUFACTURERS.

Candy pulling machines, candy spinning machines, rolls, candy cutters, candy mixers, grinders, chocolate mills, cream stirrers, candy presses, candy shredders, ice cream freezers.

CONTRACTORS AND BUILDERS.

Portable drills, saws, hoists, elevators, stone dressers, floor polishers, floor planers, concrete presses, concrete mixers, stone crusher, excavator

DAIRIES AND CREAMERIES.

Churns, cream separators, milking machines, ice cream freezers, fans, pumps.

DENTISTS.

Drills, grinders, lathes, buffers, bone saws, fans.

DEPARTMENT AND GENERAL STORES.

Telautographs, shifting signs, revolving show cases, sign flashers, electric fountains, moving window displays, escalators, elevators, dumb waiters, cash carriers, hoists, air compressors.

DRUG STORES AND SODA FOUNTAINS.

Milk shakers, grinders, ice crushers, drug mills, ice and refrigerating machines, ice cream freezers, fans, carbonating apparatus.

ELECTROTYPERS.

Routers, planers, circular saws, brush wheels, drills, fans.

FOUNDRIES.

Steel saws, grinders, tumblers, portable drills, hoists, cranes, blowers.

GAS AND STEAM FITTERS.

Lathes, thread cutters, pipe cutters, hoists, punches, blowers.

GRAIN ELEVATORS AND FLOUR MILLS.

Cleaners, flour packers, corn shellers, feed grinders, rolls, elevators, conveyors, power shovels, exhaust fans, air compressors for automatic sprinkler systems.

HARNESS AND SADDLE SHOPS.

Sewing machines, skivers, buffers, rollers.

HAT MANUFACTURERS.

Hat brushers, hat blockers, hat burnishers.

HOTELS.

Telautographs, automatic pianos, elevators, dumb waiters, carbonating apparatus, knife grinders, silver buffers, dish washers, pitcher cleaners, bread crumbers, potato parers, meat choppers, dough mixers, laundry machinery, ice cream freezers, ice and refrigerating machinery, fans, vacuum cleaning outfits, carpet sweepers.

JEWELERS AND OPTICIANS.

Drills, grinding and buffing lathes, ventilating fans.

MACHINE SHOPS.

Machine tools and all appliances requiring power.

MEAT MARKETS.

Meat grinders, meat cutters and choppers, ice and refrigerating machines.

OFFICE BUILDINGS.

Passenger and freight elevators, pumps, heating and ventilating apparatus, vacuum cleaning apparatus, fire pumps.

PAPER BOX MANUFACTURERS.

Presses, dies, automatic box machines, paper cutters, hoists.

PIPE MANUFACTURERS.

Automatic oiling devices, thread cutters, pipe cutters, pipe drawers.

PLUMBERS' AND TIN SHOPS.

Hoists, wire and plate straighteners, punches and presses, buffers and grinders, thread cutters, pipe cutters, drills.

PRINTING AND PUBLISHING PLANTS.

Printing presses, neostyles, addressing machines, paper cutters, ruling machines, linotype and monotype machines, perforators, stitching machines, gumming machines, folding and stapling presses, routers, elevators.

RESIDENCES.

Automatic pianos, dumb waiters, automatic elevators, horse clippers and groomers, tire pumps, sewing machines, polishing and grinding machines, ice and refrigerating machines, vacuum cleaners, carpet sweepers, lawn mowers, washing and ironing machines.

RESTAURANTS.

Potato parers, bread crumbers, coffee grinders, dough mixers, meat choppers, pitcher cleaners, dish washers, laundry machines, ice cream freezers, knife sharpeners, automatic pianos, ice and refrigerating apparatus, dumb waiters, elevators, ventilating fans.

SALOONS.

Sign flashers, ice and refrigerating machines, automatic pianos, beer pumps, passenger, freight and dumb elevators.

SHIRT AND OVERALL MANUFACTURERS.

Sewing machines, pattern cutters, cloth cutters, fans.

SILK MILLS.

Fan for drying gloves, brushing mills, combers, beamers, warpers, spoolers, looms.

THEATERS AND CONCERT HALLS.

Curtain and stage drops, scene lifting devices.

WEAVERS AND KNIT GOODS MANUFACTURERS.

Knitting machines, looms, braiders, buttonhole machines, sewing machines, hoists.

The foregoing lists, while fairly complete, may be added to materially and should be added to as fast as possible. In addition to the lists it is advisable to have a filing cabinet, with a folder for each industry, and as fast as data are collected relative to electric drive they should be filed under respective heads. Clippings from technical papers descriptive of motor installations are a fruitful source of information. It is surprising how fast data can be collected and an information bureau for private use will prove of great value for the future work of the new business department.

The modern hotel building offers an excellent example of electric drive for many purposes and a description of the motor equipment of a prominent hotel in the East, recently inspected by the writer, will illustrate the many possibilities in this branch of business. In hotel buildings cleanliness and noiseless operation are absolutely essential to the comfort of guests, and the electric motor is ideal for this purpose, as it may be placed in any location that convenience dictates.

The hotel in question has 400 rooms and serves meals to an average of 1500 people daily. There are over 50 motors operating appliances in the various departments, including a complete modern laundry in an adjoining building.

Sanitation has been carefully looked after, the building being equipped with a complete motor-driven ventilating system. The rooms and halls are cleaned by a vacuum cleaner outfit operated by a 7½-hp direct-current motor. The outfit has a capacity of six sweepers operating at one time and pipe lines lead from the vacuum pump and tanks in the basement to all parts of the hotel. These cleaners are not only indispensable to health, but greatly reduce the expense of cleaning.

The kitchen is provided with a vegetable peeler, having a rated capacity of 400 bushels of potatoes a day, driven by a 1-hp motor; a meat chopper driven by a 1-hp motor, and a dish washer, ice-cream freezer and small grindstone group-driven by a 5-hp motor.

The laundry occupies two floors and the basement of an adjoining building. In the basement are located seven washers driven by a 15-hp motor from a line shaft. The diameter of the inside cylinder of the washers is 32 in. and the length 58 in. In addition to the washers there are three extractors each driven by a 1½-hp motor. The motors are mounted on the base of the extractors and are belted to a pulley on the spindle. There are two large mangles located on the first floor, one with five hot rolls and one with seven hot rolls, each driven by a 3-hp motor by means of gearing. The capacity of the mangles is approximately 60 ft. per minute and they are used for large pieces. On the second floor is located the equipment of small machines including a collar and cuff ironer, with a capacity of 600 pieces per hour, driven by a ¾-hp motor; sleeve ironer driven by ¼-hp motor; mangle for small work driven by a 1-hp motor and two drying rooms, belt-driven from a 2-hp motor.

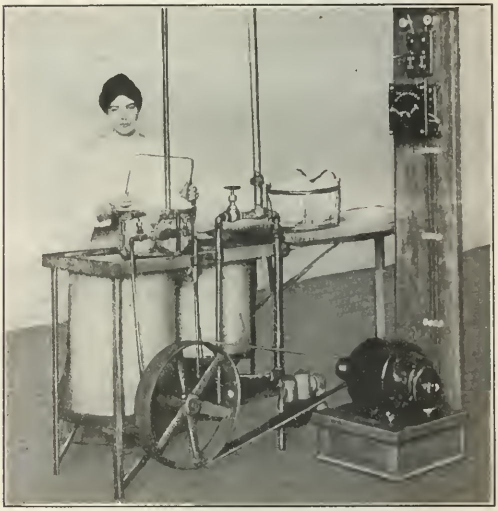


FIG. 4.—SMALL MOTOR-DRIVEN DISH WASHER.

Electric Signs at Birmingham, Ala.

An excellent electric sign development has lately taken place in the territory of the Birmingham Railway, Light & Power Company. In the Birmingham district alone, which has a population of about 50,000 inhabitants, there were 160 electric signs in service at the first of the year. The largest sign is used by a prominent clothing house, and contains 366 Edison sign lamps. The company operates about 50 signs on a meter basis, the balance being on a flat rate.

The flat rate varies from 20 cents to 30 cents per month per lamp; this includes the rental of the sign, lamp renewals, repairs, cleaning and painting. In this way the signs are kept in good electrical and mechanical condition, and are always working at the point of maximum effectiveness. The lamps burn from dusk until 11 p. m. week days and until midnight on Saturdays. One of the most interesting results from the use of display illumination has been in connection with Third Avenue, between Nineteenth and Twentieth Streets. This block is located in the heart of the business district, but for some reason the street was never popular until the abutting merchants decided to light it every night by festoons of incandescents at their own expense. Fourteen arches span the street for a distance of 500 ft., and a total of 640 8-cp lamps are in service. The brilliancy of this illumination has completely altered the character of the street in respect to popular favor.

The Steam Laundry—A Promising Field for the Sale of Electrical Energy.

Possibly the proprietors of steam laundries are more difficult to convince than others that the use of electric motors and central-station service will be less expensive than older means of power supply, because they actually require a steam boiler in their work all the year. Their argument is along the lines that the added cost of operating a steam engine under these conditions is almost negligible.

It may be of interest to note the following relative costs of the two methods, based on actual figures taken from the records of an electrically equipped laundry that has been operating satisfactorily for the last year:

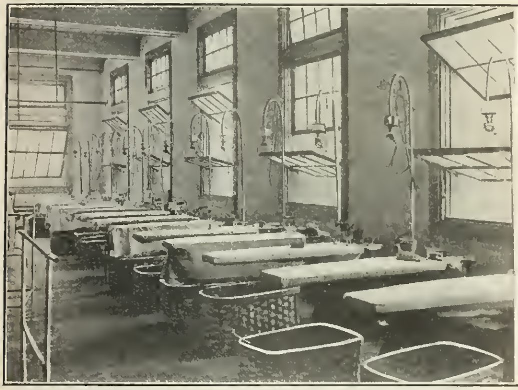


FIG. 1.—GUTHMAN'S LAUNDRY, ATLANTA, GA.

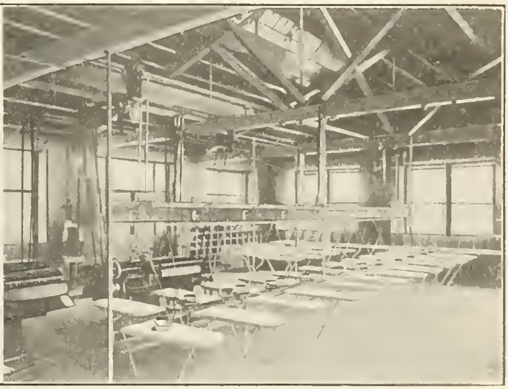


FIG. 2.—FLAT IRONS IN PHILADELPHIA HOSPITAL LAUNDRY.

WITH STEAM ENGINE.

Item.	Per Month.
Coal	$60.00
Labor	62.50
Water	16.00
Total	$138.50

WITH ELECTRIC MOTORS.

Item.	Per Month.
Coal	$25.00
Labor	12.50
Water	11.00
Electric current	45.00
Total	$93.50

These figures show a saving, over steam drive, of $45 per month, or $540 per year. This is equal to one year's interest at 36 per cent on the investment required. In addition to covering the interest on the investment at 6 per cent, the saving will return the entire cost of the change from steam to electric drive in three years and four months.

The maintenance cost of the electric system amounts to practically nothing, while with the steam engine repairs are frequent and expensive, due not only to their actual cost but also to the value of time lost during repairs, as all work must be suspended when repairs are in progress. The laundry herein referred to has in service a total of 16 direct-current motors ranging in size from ¼ to 5 hp.

The three accompanying illustrations show the typical methods used—suspending the motors from the ceiling and employing only light countershafting, and as little of that as possible.

If a prospective customer can be shown as favorable a proposition as the above, based on his present power cost and an estimate of electric power, he can no longer say, "Does it pay?" but "Can I afford to do without the electric motor?"

Another remarkable feature of the aid that electricity affords in this line of work is in connection with the equipment of laundries with electric flat-irons. During the summer months, especially in sections where the humidity is very high, the electric flat-iron has proven such a remarkable relief to the workers that the output has been doubled over former records. The quality of the work has been bettered at a time when prostrations among the employees is not uncommon, and when rush or overtime work is ordinarily out of the question, however much the proprietor desires it during the hot, dusty season, when the shirtwaist rules supreme.

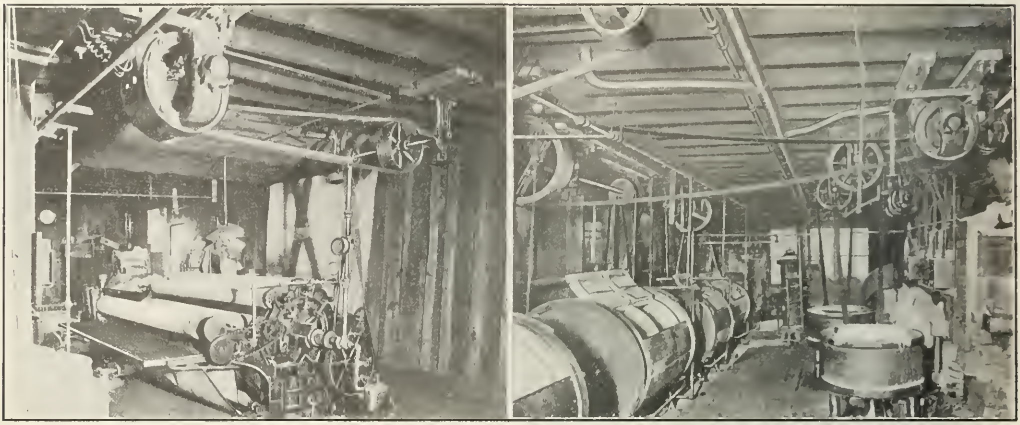
The Philadelphia Hospital Laundry affords a good example of the adaptability of electricity to laundry work. The building is a one-story substantial stone structure, with one large room for general laundry work and a smaller boiler room. Steam at both high and low pressure is supplied for general laundry purposes by water-tube boilers. A single 50-hp motor drives line shafting to which the mangles, washers, centrifugal extractors, etc., are belt-connected. The iron used is the standard 6-lb. 110-volt cartridge unit type. There are 48 of these irons installed, and an aggregate of 97,000 pieces are ironed each month. It has been found that from 20 to 30 per cent more work can be done with the electric irons than was formerly done with the same number of stove-heated irons.

Another excellent example of a modern establishment in which electricity plays an important part is the Guthman Steam Laundry, in Atlanta, Ga., which was equipped with electric drive some few years ago by the General Electric Company. In this model laundry, which rivals in equipment any similar establishment in the larger Northern cities, the majority of the machines are direct-driven by individual motors. Each mangle is driven by a 5-hp motor, while the ironing machines and starching apparatus are driven by smaller individual motors. The large dry houses are each provided with motor-driven fans for circulating the hot air. Two 15-hp motors drive separate line shafting from which are driven the washing machines and centrifugals, group drive for this apparatus being found advisable from an engineering standpoint. An electric elevator carries the work directly from the wagons to the sorting room on the top floor.

In this laundry there are installed thirty 6-lb. and ten 3-lb.

electric flat-irons of the well-known cartridge unit type. These irons superseded the same number of cumbersome and inefficient gas-heated irons.

The true verdict of the successful operation of a device is to be obtained from its commercial use. Several of the operatives were asked, independently, their opinions of the electric irons as compared with the gas-heated irons, and the invariable reply was vastly in favor of the electric iron. It has been demonstrated beyond a doubt at the Guthman Laundry that with the use of electric irons 30 per cent more work can be done by each operator each working day.



FIGS. 3 AND 4.—LAUNDRY MANGLE AND WASHING MACHINE AND EXTRACTOR.

The steam laundry is a lucrative field for the promotion of the use of electric motors for power purposes; and the fact that many of our large metropolitan central stations have connected a number of laundries to their circuits for power, as well as lights, is evidence showing that the practicability and business economy of motor drives in laundry work is now being recognized.

Decorative Street Lighting.

Through the enterprise of the Fillmore Street Improvement Association, of San Francisco, an innovation in street lighting has recently been developed. Some time ago it was decided to illuminate Fillmore Street from Fulton to Sacramento Streets, a distance of over a mile, in as decorative and effective a manner as possible. All available sources of illumination were considered, including the newer types of flaming arc lamps, and it was finally decided that the ordinary carbon-filament incandescent lamp produced the greatest decorative effect, and could be placed in a way that would be festive and pleasing to the eye. It was agreed that the different types of arc lamps gave out a more brilliant light, but that this intensely brilliant light would, owing to the contraction of the iris of the eye, detract from the illumination in the show windows.

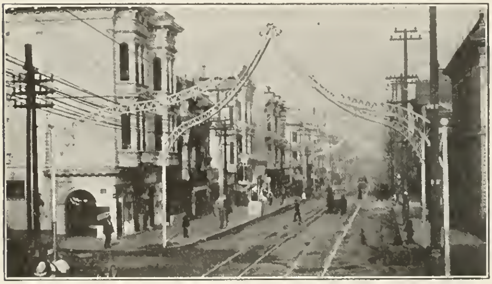


FIG. 1.—FILLMORE STREET BY DAY.

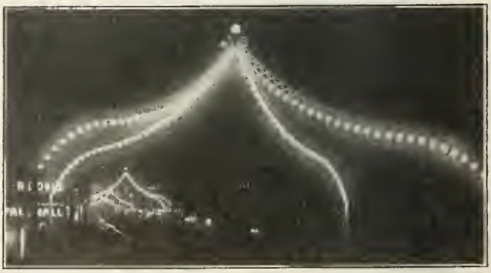


FIG. 2.—FILLMORE STREET BY NIGHT.

The design finally agreed upon consisted of a double span of curved trusses, as shown in the accompanying illustrations, erected across the four corners of each street crossing. This truss work is built up of 5-in. channel iron, with 1½-in. x ¼-in. lattice work, the four arms being fastened at the apex by a swivel joint. Each arch weighs about two tons and the maximum span from pole to pole is 82 ft. Extra heavy steel poles set in concrete support the arches.

Much difficulty was experienced in the erection of the arches, owing to the maze of overhead wires. In many places there was not a space 10-ft. square through which to work the arch. Although the street car system was in operation at all times, the work was carried on without a single accident.

There are 130 16-cp incandescent lamps on each arch. Weather-proof sign sockets are used and the wires are effectually concealed in a trough formed by fastening a plate over the flanges of the lower channel. A three-pole knife switch and fuse cut-out are placed in a cast-iron box fastened to a pole of each arch. The arch is painted white.

The lamps were first switched into circuit on Thanksgiving eve, and the arches have been illuminated each evening since that time without interruption. The results have proved very satisfactory, and the merchants are elated over the increased attractiveness of the street. The arches being placed on the street crossings, the illumination is visible for a distance of over 10 blocks either way on the cross streets.

This is probably the most elaborate system of permanent arch lighting thus far tried.

The work of designing and erecting the arches was carried forward by the Butte Engineering & Electric Company at a cost of $10,000.

Lancaster (Pa.) Central-Station Display Room.

The widely-felt hard times and business depression have apparently had no discouraging effect on the progressive business methods of the Edison Electric Illuminating Company and the Lancaster Gas Light & Fuel Company, of Lancaster City, which have recently opened a very attractive and complete electrical and gas display room. The accompanying illustrations give a general idea of the attractive exterior and show the tasteful arrangement of the exhibits.

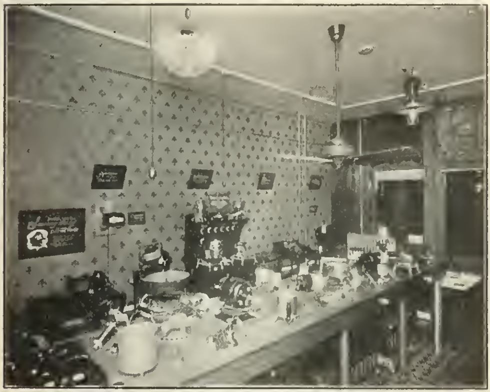


FIG. 1.—LANCASTER ELECTRIC DISPLAY.

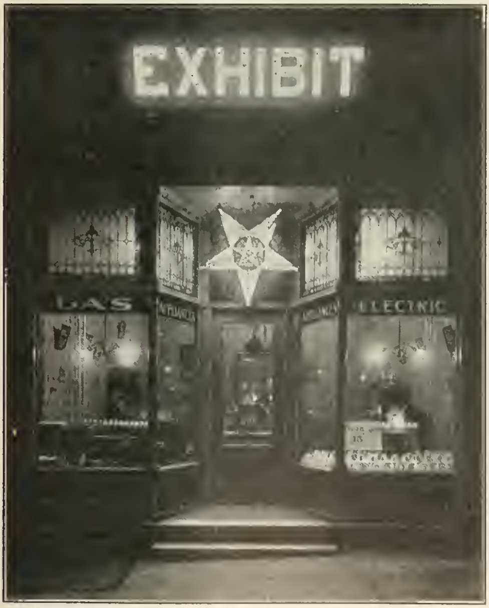


FIG. 2.—SHOW WINDOW DISPLAY, LANCASTER.

This departure in connection with the recently organized "new business" department is attracting much attention and interest is steadily increasing. Besides immediate results, as indicated in appliance sales, the plan is in addition aiding the electric-gas publicity work in a degree fully warranting the expenditure. Much of the new business is traceable to this medium, and, in brief, the investment is considered gilt edge. Mr. C. Edgar Titzel is the capable and wide-awake general manager of the above companies, and Mr. H. J. Von Nieda is superintendent of the "new business" department.

The New System of Rates at St. Louis.

The Union Electric Light & Power Company, of St. Louis, has recently put in force a new system of rates which differs considerably from the typical systems in use by American central-station companies. A recent bulletin of the company explains these rates at length in a manner calculated to be understood by the general public. In a letter addressed to the public at the beginning of this bulletin, Mr. W. V. N. Powelson, president and general manager, calls attention to the general principles underlying these rates. The value of the service rendered to any individual must, as far as practicable, be based on the cost to serve him, and not on the average cost to serve the entire body of consumers; and as the cost per kw-hour varies greatly with different classes of service, so should the price per kw-hour in justice to the several users vary greatly to different consumers.

CONNECTED LOAD IN EQUIVALENT 16 C. P. LAMPS	MINIMUM MONTHLY GUARANTEE FOR EQUIVALENT 16 C. P. LAMP CONNECTED, IN CENTS.																
	10	15	20	25	30	35	40	42½	45	47½	50	52½	55	57½	60	62½	65
UNDER 100	12	11¾	11½	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8
From 100 to 150	11¾	11½	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	6	7¾
" 150 " 200	11½	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½
" 200 " 250	11¼	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼
" 250 " 300	11	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7
" 300 " 350	10¾	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾
" 350 " 400	10½	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½
" 400 " 450	10¼	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼
" 450 " 500	10	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6
" 500 " 550	9¾	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9
" 550 " 600	9½	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8
" 600 " 650	9¼	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7
" 650 " 700	9	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6
" 700 " 800	8¾	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5
" 800 " 900	8½	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	
" 900 " 1000	8¼	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	
" 1000 " 1250	8	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4		
" 1250 " 1500	7¾	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3		
" 1500 " 1750	7½	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3			
" 1750 " 2000	7¼	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2			
" 2000 " 2250	7	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2				
" 2250 " 2500	6¾	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1				
" 2500 " 2750	6½	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1					
" 2750 " 3000	6¼	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5					
3000 & Over	6	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5						

RATES IN CENTS PER KILOWATT HOUR.

In the explanation of the rate system which follows Mr. Powelson's letter, it is explained that in the past the company has been compelled to recognize the force of the argument of the customer who maintained that he was entitled to a lower average rate if he guaranteed $5 per horse-power per month than his neighbor who would guarantee only $1 per horse-power per month. This necessitated "special" contracts. It has happened that a customer, without knowing anything about the special considerations which entitled his neighbor to a lower rate, demanded that rate for himself, although the character of his use of the service would not justify the same rate. The customer paying a higher rate than his neighbor sometimes felt that he was being discriminated against, although the character of his load was entirely different. On account of the existence of this feeling, the company explains that it has felt it necessary to codify the system of rates adopted. Under this system the service is divided into a very much larger number of classes than has ever before been attempted. Every consumer in the same class will get the same rate, without regard to his personality and importance in the community.

The fundamental principle of the St. Louis system of rates is that the customer's rate is based on the minimum monthly guarantee he is willing to make per horse-power or per 50-watt lamp connected. The rate is also lower the larger the connected load. For example, the customer having less than 100 lamps pays 12 cents per kw-hour if he guarantees only 10 cents per month per lamp. If he guarantees 65 cents per month per lamp he need pay only 8 cents per kw-hour. Between the 10-cent and 65-cent guarantees there are 15 intermediate steps. For example, by guaranteeing 45 cents per month per lamp, the customer gets a rate of 10 cents per kw-hour. The rate is also made lower as the number of connected lamps increases. For example, a customer guaranteeing 10 cents per month per lamp and having less than 100 lamps pays 12 cents per kw-hour. This is reduced by steps until for 3000 lamps or over the rate is 6 cents per kw-hour, with a 10-cent per lamp guarantee. For the 45-cent per lamp guarantee the customer with less than 100 lamps pays 10 cents per kw-hour, while the customer with 3000 lamps pays 5.2 cents per kw-hour.

All these rates are subject to further discounts based on hours' use and quantity. The discount made according to the equivalent daily hours' use of the entire connected load starts with a 6 per cent discount for a kw-hour consumption equivalent to one hour's use per day of the connected load, rising by steps to 25 per cent discount for a kw-hour consumption equivalent to 18 hours' use per day of the connected load. There is also in addition to this a discount based on the amount of the bill, which is from 5 per cent on bills of under $10 to 56 per cent on bills of over $9,000 per month. The power rates are on the same plan. A 1-hp motor customer pays 10 cents per kw-hour if he guarantees $1 per month per horse-power. If he guarantees $7.50 per month per horse-power he pays 5 cents per kw-hour. There are a number of intermediate steps between the 10- and 5-cent rate, depending on monthly guarantee, just as in the case of the lighting rate. The rate also depends on horse-power connected. Under the $1 per horse-power per month guarantee the customer with over 500 horse-power gets a 5½-cent rate. If the same customer guarantees $2 per month per horse-power the rate is 4½ cents. In order to aid the reader in the better understanding of these rates and the way they are presented, a table showing the standard lighting rates is here reproduced from the company's bulletin. The bulletin itself is a very complete document, giving all of the contract forms of the company, examples in which the different lighting rates are applied to specific cases and a number of tables which are of assistance to solicitors and customers in determining the monthly guarantee which would be likely to secure them the cheapest service.

The rates for heating and cooking circuits in residences are 12 cents per kw-hour for a minimum monthly guarantee of $2; 11 cents for a $3 guarantee; 10 cents for a $4 guarantee; 9 cents for a $5 guarantee; 8 cents for a $7.50 guarantee; 7½ cents for a $10 guarantee, and 7 cents for a $15 guarantee. There is a discount according to quantity on these cooking rates, which begins with 5 per cent on bills of $5 or under and increases 1 per cent for each $1 increase in bill up to $15, where there is a 15 per cent discount. For bills over $25 there is a 20 per cent discount.

Marion (Ind.) Central-Station Enterprise.

The Marion, Ind., *News-Tribune* dated Feb. 20 is a special electrical issue, containing eight pages devoted entirely to electrical matters. The object of issuing the special edition is stated to be to call attention to "the best lighted city in the United States, a city that has unlimited power for manufacturing purposes, and whose industries utilize, almost exclusively, electricity for light and power." The numerous illustrations included show several examples of store exterior lighting and about a score of factories which are operated electrically. Portraits and biographical sketches appear of Mr. S. H. Smith, superintendent of the Marion Light & Heating Company, and Mr. E Hollingsworth, manager of the "new business" department. The company is represented by a full-page advertisement, attractive in design and forceful in concise presentation of convincing facts. Although Marion has a population of less than 25,000, the company supplies current for the equivalent of 57,600 16-cp lamps; over 800 families use electric irons and a number of consumers do all of their cooking by electricity.

LETTER TO THE EDITORS.

Chimneyless House.

To the Editors of Electrical World:

Sirs:—Recent descriptions of houses without chimneys recall to my memory the kirk built by my great-great-grandfather, Philipse, at Tarrytown, near the Pocantico, and old St. Peter's Church, near Peekskill, both without chimneys; those using these old buildings had to keep from freezing with foot stoves. I like chimneys straight as possible in all rooms for ventilation, even where steam, hot water or electricity are used for heating. By the use of cords and pulleys, many of the electric lights in 21 East Twenty-sixth Street can be moved 60 ft. from the wall rosettes and will remain stationary when simply laid over an ordinary book, and they have worked successfully ever since electricity was put in, perhaps 20 years ago.

New York City. Cortlandt de P. Field.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Testing Large Induction Motors.—N. Pensabne-Perez.—An illustrated description of a complete Hopkinson test as applied to four large induction motors at a British works. The author first gives a complete vector diagram for induction motors with Hopkinson connections. When two induction motors having pulleys of different diameters are belted together, and their primaries connected to the same supply lines, they start up as ordinary induction motors until the machine which runs faster, reaching synchronism, becomes a generator and sends energy back to the other machine, which acts as a motor. The equilibrium will be established when the torques of the two machines are inversely proportional to their speeds. From the vector diagram it is seen that while in the induction motor the primary copper resistance and the iron losses increase the value of the power factor, the opposite is true for the synchronous generator; therefore, an induction motor working as a generator with a certain current input has a power factor lower than when working as a motor and taking the same current. The current supplied by the main is the vectorial sum of the currents taken by the two machines; it is of about the same magnitude as the motor current. This constitutes the weak point of this kind of test, because it will be necessary not only to supply the excess of power for the losses of the two machines, but also to have the alternator supplying the energy much larger than the motor to be tested; in fact, it must supply about the full kilowatt input at a very low power factor. The method of carrying out the test is described and formulas for determining the different losses with numerical applications are given.—Lond. *Elec. Rev.*, Jan. 24.

Leakage of Induction Motors.—R. Goldschmidt.—This long serial has now been concluded. A brief summary of the whole is as follows: Some important relations derived from the circle diagram are given in the form of tables, after which the author considers the calculation of the no-load current of polyphase and single-phase induction motors with half-closed and open slots. The different classes of leakage are then dealt with, slot leakage, zig-zag leakage and leakage of the coil ends. Curves are given for the leakage with different slot dimensions and also tables showing the effect of the coil ends with different classes of windings. The calculation of the leakage factor, with polyphase and single-phase motors, and the influence on it of the different forms of winding are finally shown.—Lond. *Elec.*, Nov. 29, Dec. 20, Jan. 3, 17, Feb. 7.

Reduction of Slot Openings.—R. Goldschmidt.—An illustrated English translation of his recent German paper on the method of reducing slot openings by means of iron bridge pieces.—Lond. *Elec. Rev.*, Feb. 7.

Lamps and Lighting.

Transformers for Metallic-Filament Lamps.—F. V. O'Hanlon.—An article pointing out that it pays to use low-voltage metallic-filament lamps even on high-voltage circuits with the aid of small transformers. The author claims that such transformers can be turned out quite well by anyone having a lathe and the usual tools. The advantages of a one to one autotransformer are explained, and the following problem is solved. It is required to design an autotransformer to supply energy to 35 osram lamps of 32 candle-power at 100 volts, from a primary voltage of 200, the frequency being 50. For the iron core "stalloy" (a special transformer iron of English make) stampings 0.01 in. thick are used, the dimensions of the core being as shown in Fig. 1. The windings are placed on the two longer limbs, and it is found that 532 turns of No. 14 gage wire are to be used. They are wound in six layers, and have a total length of 419 ft. Two other numerical examples are also solved, and it is pointed out that not only core-type transformers, but also shell-type transformers may be used, especially in cases of three-wire balancing or distribution.—Lond. *Elec. Rev.*, Jan. 31.

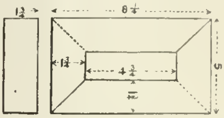


FIG. 1.—DIAGRAM OF DIMENSIONS OF TRANSFORMER CORE.

Incandescent Lamp.—A note on an arrangement due to Gelnhausen, in which the lamp is exhausted at the foot, instead of as is usual at the top. Connection to the vacuum pump is made by a glass tube which passes to the interior of the lamp. The metal cap fits tightly round the tube, and when the air has been exhausted, this tube is sealed off so that an air-tight joint is obtained. It is claimed that the arrangement is less easily damaged than that usually employed.—Lond. *Elec.*, Jan. 31.

Osram Lamp.—The German Welsbach Company now advertises osram lamps consuming one watt per hefner candle-power and adapted for use in any position for connection in parallel in sizes of 25, 32 and 50 hefner candles, at from 100 to 130 volts, and 40 to 50 hefner candles at from 200 to 250 volts. On the other hand, the 100-cp osram lamps, as well as osram lamps for connection in series, are to be used for the present in vertical position only.—*Elek. Anz.*, Feb. 6.

Power.

Electric Drive of a Large Rolling Mill.—W. A. Dick.—An illustrated description of the electric equipment of a large rolling mill at the plant of the Illinois Steel Company. The mill is a 30-in. universal reversible plate mill, with two high rolls, used for rolling plates and bars. In general, the cycle of operations in rolling a typical piece includes 13 passes through the rolls, the speed of the rolls for the initial pass being 40 r.p.m. with a gradual increase in speed for each succeeding pass up to the final, where a speed of 140 r.p.m. is required. The torque required of a driving motor was approximately 300,000 lb.-ft. for the initial pass. The torque increases slightly for the next two passes, and then gradually decreases, the final pass requiring about 60,000 lb.-ft. The horse-power required is about 2300 for the first pass, and gradually increases up to the seventh pass, where it is approximately 3500. From this point it gradually decreases until it is about 1500. The average horse-power for the entire cycle is 1300. A complete cycle, the time to roll a typical piece, is about 80 seconds. The apparatus consists of a motor for driving the rolls of a mill, a motor-generator or equalizer set with a large fly-wheel for supplying energy to the motor, and a system of control for operating the outfit. Owing to the necessity of very rapid reversals, the motor is built for direct current, and is directly coupled to the rolls. Its field is separately excited, and it is operated from the generator of the equalizer set and by a limited amount of field control. Its speed is varied at will over a wide range. It also operates as a generator in dynamic braking when stopping. The equalizer set, which supplies the necessary energy to the mill motor, consists of a direct-current generator, an alternating-current motor and a fly-wheel. The direct-current generator is separately excited, and its voltage is variable. It also acts at times as a motor, receiving energy from the motor of the rolls when the latter is braking. The alternating current motor receives its energy from a regular alternating-current supply system. The fly-wheel serves the purpose of a storage reservoir, receiving energy from the alternating-current motor at times of light load on the mill from the mill motor when that is braking and giving out energy at times of heavy load on the mill motor. The controller regulates the alternating-current motor and controls the speed and direction of rotation of the mill motor. The different machines are described in detail and illustrated The various advantages of electric drive, all of which result in a material decrease in the cost of production, are pointed out. —*Electric Journal*, February.

Thury System for Rolling Mills.—An illustrated article on the application of the direct-current series system of Thury to rolling mills and winding engines. In this system the prime movers, fly-wheels (which are necessary to take off the variations of load) and direct-current generators are all located in the power house. "The Thury system accommodates itself to all speeds, and as a result the fly-wheel becomes an accumulator of greater value and higher efficiency in the Thury than it does in any other system." As is well known, the system employs a constant current at a voltage depending on the load. The generators and motors are series wound, and are controlled by brush movement alone. The only plant outside of the generating station consists of the actual motors themselves. No flywheel sets have to be placed adjacent to the mills or winders. The advantages that such a system would have are pointed out. —Lond. *Elec. Rev.*, Jan. 24.

Electric Welding Plant.—An illustrated description of the electric winding plant at Axwell Park Colliery, which, although of small size, as compared with most main-shaft winding engines, is a complete example of the Ilgner system with fly wheel-converter.—Lond. *Elec. Eng'ing*, Jan. 30.

Electric Driving for Textile Mills.—E. L. Hill.—An article discussing the advantages of electric driving for textile mills and the question whether preference should be given to group drive or individual drive in different cases. The group-drive is by far the most common, and is usually the most economical on account of its low first cost and high efficiency. The individual-drive is specially suitable for weaving sheds. Group driving is usually the best in spinning mills. Mules should always be driven on the group system. Ring and doubling frames, on the other hand, can often be advantageously driven by separate motors, although the investment cost will be higher. It is stated that rapid progress in the electric driving of textile mills is now being made in England, and by midsummer of this year almost 6 per cent of the total spindles in Lancashire will be electrically driven.—Lond. *Elec. Eng'ing*, Jan. 30.

Electric Motors in Textile Mills.—J. Shaw.—A paper read before the Dundee Inst. of Eng. The author discusses the advantages of the electric driving of textile mills, and advocates the obtaining of the necessary energy from a supply company rather than installing an independent plant.—Lond. *Elec.*, Feb. 7.

Water for Economical Steam Generation.—J. C. W. Greth.—The first part of an article in which the author gives figures as to the savings which are accomplished in actual water-softening plants.—*Eng'ing Mag.*, February.

Traction.

Electric Traction in Great Britain.—The yearly statistical tables on electric tramways and railways in Great Britain. The total mileage of tramway track, as given in these tables, is now 3651, compared with 3362 miles last year; that is, an increase of a little under 9 per cent. This percentage increase is, therefore, less than the 10½ per cent recorded a year ago, and the 10 per cent in 1905, although the mileage increase varies very little. and thus indicates a steady development. Of the new tramways which have been opened, two have been equipped on the Dolter surface-contact system, while the G. B. surface-contact system is being adopted on a line in London. Some information is given of the lifeguards and car meters in use on the various tramways. Although such meters are not at present in general use, there is evidently a desire on the part of tramway managers to adopt some means of ascertaining those cars on which the energy consumption is excessive. With respect to the electrification of railways, the most important work has been the equipping of short sections of the London, Brighton & South Coast Railway and the Midland Railway on the single-phase overhead system, but, apparently, there is very little likelihood of any further important electrification in the immediate future. —Lond. *Elec.*, Jan. 31.

San Francisco.—A. H. Halloran.—The first parts of a fully illustrated article on the rehabilitation of San Francisco's street railway systems.—*Jour. of Elec. Power & Gas.*, Feb. 8, 15.

Tramway Accessories.—An article describing new constructions of a trolley-tension indicator, of a rail cleaner, and of a trolley-standard earthing-device.—Lond. *Elec.*, Jan. 31.

Installations, Systems and Appliances.

Great Britain.—Tables giving details of British stations with no tramway load, stations taking supply in bulk, and stations having combined lighting and traction loads. The following is a summary of the connections in kilowatts to municipal and companied stations in London and the provinces:

	Municipal.	Company.	Total.
London	80,062	214,762	294,824
Provinces	743,488	211,754	955,242
Total	823,550	426,516	1,250,066

Out of the total of 1,250,066 kw, there are 491,741 kw connected to direct-current stations, 171,922 to alternating-current stations. and 586,403 kw to combined direct-current and alternating-current stations. There has been a steady increase in connections over last year, which is most marked in the case of municipally owned stations supplying both alternating current and direct current, so that these have now the largest number of connections.—Lond. *Elec.*, Jan. 24.

Coburg.—O. Ely.—The conclusion of his illustrated article on the electric station in Coburg. This is given as an example that small electricity works may give good financial results if properly designed. The results have been so satisfactory that the municipality intends to operate the station itself in future.—*Elek. Zeit.*, Jan. 30.

Far East.—A table giving statistical data on 35 electric lighting and power stations in the Far East (Japan, China and the Philippines). The table gives detailed information on equipment, rates of charging, etc.—Lond. *Elec. Rev.*, Feb. 7.

A Field Reversal.—C. W. Kinney.—An article referring to a peculiar field reversal which occurred in a power plant consisting of a 440-volt, 150-kw, belted three-phase generator, with a 6-kw, four-pole, 125-volt, belted exciter. A few minutes before "shutting-down time" the alternator lost its field. A hurried examination showed that the negative exciter lead was broken at the brush-holder, also that three of the pole pieces were north poles, and one south. After the broken lead had been repaired, a short circuit test with a telephone receiver showed the circuit between the two armatures clear. The machines were then started up, but the exciter "picked up" voltage in the wrong direction. The only direct-current apparatus available was a couple of almost exhausted dry batteries. These were applied to the series field circuit of the exciter. They would reverse the field magnetism in the air-gap, but as soon as they were disconnected the residual field in the core still showed the wrong polarity. The batteries were then applied to the shunt field circuit. The field in the air-gap was apparently neutral, while the batteries were attached. This suggested a possible solution of the trouble. The batteries were connected in the shunt-field circuit, and then the machine was started with all the resistance in the rheostat cut out. After a few seconds the machine began to "pick up" voltage in the right direction and was then ready for use. Fig. 2 shows the cause of the field reversal. When the field circuit of the alternator was broken, the stored energy was discharged through the shunt-field circuit of the exciter, the direction of the current being opposite to the normal.—*Elec. Jour.*, February.

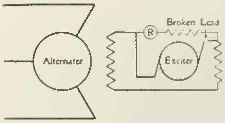


FIG. 2.—FIELD REVERSAL.

Automatic Voltage Regulator.—A. Berthier.—An illustrated description of the Lecoq automatic compensator for compensating the voltage difference due to the losses in an alternating-current line (although with a slight modification it may also be applied to direct-current lines). It consists essentially of two parts, a voltmeter regulator and a compensator. The compensator has a two-pole primary, the windings of which are connected across the circuit to be regulated, and an armature which is connected in series with the circuit to be compensated. The position of this armature determines the voltage which is added to or subtracted from the voltage of the line. To obtain automatically the movement of this device a small induction motor is employed. To let it run in either the one or the other direction and to start it, a special double winding is used. The voltmeter regulator causes the motor to turn in the one or the other direction according to whether the tension of the circuit is to be elevated or to be reduced. This apparatus consists of two solenoids and a simple system of levers in unstable equilibrium. The construction is illustrated, and it is stated that it has given good results in practice.—*La Lumière Elec.*, Jan. 25.

Induction Regulators.—An illustrated description of automatic induction regulators built by Brown, Boveri & Co., for high-tension alternating-current systems. It is designed to follow very accurately and gradually all pressure variations so as to maintain the pressure at a constant value irrespective of the load. These induction regulators have the general form of an induction motor, and constitute a transformer having fixed primary windings and movable secondary windings; the former are wound on the stator and the latter on the rotor, a four-pole disposition of the windings being usually employed. The position of the rotor with respect to the stator is controlled by a worm and wheel, and the movement of the latter depends upon a special form of Thury governor, which, by means of a special ratchet wheel and pawl mechanism, drives the worm in one direction or the other as the pressure on a controlling relay varies from the required average value. The pressure induced in the secondary windings will vary according to their position with respect to the stator coils.—Lond. *Elec.*, Feb. 7.

Protective Devices for High-Tension Transmission Circuits —An illustrated paper read before the (Brit.) Inst. of Elec. Eng. The author explains how severe strains due to excessive pressure rise may be caused by lightning, switching, etc., also how a concentration of potential may arise. This latter may be guarded against by choke coils; while for lightning, etc., four types of arresters are described—the horn, the multigap, water-jet and electrolytic. The last-named is considered to be the best.—Lond. *Elec.*, Feb. 7.

Protective Relays.—R. C. Rypinski.—A continuation of his illustrated serial. The author deals with direct-current reverse-power relays for instantaneous action and for inverse time-element action, and describes the principle of operation.—*Elec. Jour.*, February.

Protection of Electric Circuits.—R. B. Jackson.—The first part of an article on the protection of electric circuits and apparatus from lightning and similar disturbances. The author gives first general considerations of static disturbances, their causes and their effects, and then discusses apparatus and other devices found effective in reducing lightning troubles. The article is to be continued.—*Elec. Jour.*, February.

Circuit-Breakers.—F. W. Harris.—A continuation of his illustrated serial on circuit-breakers. He discusses their methods of operation (manual, electric or pneumatic), the time-limit features, calibration, overload capacity and current-breaking capacity.—*Elec. Jour.*, February.

Electrophysics and Magnetism.

Thermoelectric Properties.—A. G. Warren and M. Murphy.—An account of an experimental investigation of the thermoelectric properties of various common metals and their alloys against phosphor-bronze cast rods. The results are given in Figs. 3 and 4. The thermo-e.m.f. is within small ranges of temperature directly proportional to the difference of temperature of the junctions. The most important point brought out by the diagrams is that different specimens of the same material yield sensibly different results. In the case of phosphor-bronze the disparity which exists between the results given by the rolled rods and the other forms is especially remarkable. Copper (16) is hard-drawn wire of 16 S W G, copper 22 and 36 are samples of high-conductivity wire of 22 and 36 S W G, respectively. They were originally covered, but the covering was removed. Manganin 24, 36, 30, 26 were wires of this material of S W G, respectively, while manganine *A* and phosphor-bronze *A* were subjected to special treatment in order to determine the magnitude of the error which may be produced at a silver-soldered junction. From the curves it will be seen that the use of phosphor-bronze, cast, sheet and wire, and manganin with manganin tappings affords a ready means of considerably reducing thermoelectric errors.—Lond. *Elec.*, Jan. 31.

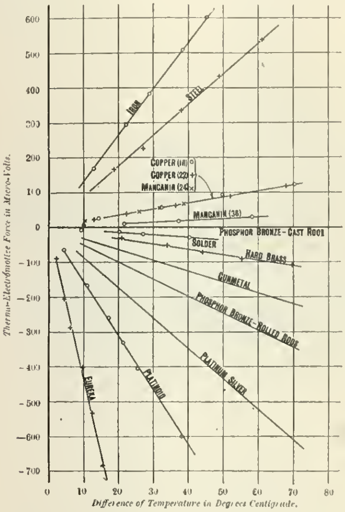


FIG. 3.—THERMO-ELECTRIC PROPERTIES.

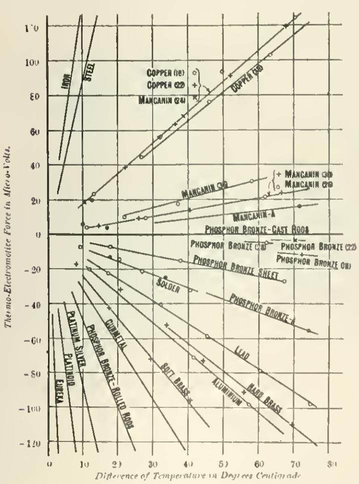


FIG. 4.—THERMO-ELECTRIC PROPERTIES.

Radioactivity.—E. Rutherford.—A Royal Inst. paper giving a summary of recent researches on radioactivity.—Lond. *Elec.*, Feb. 7.

Electrochemistry and Batteries.

Carbon Bisulphide.—E. R. Taylor.—An illustrated Franklin Inst. paper describing his process for the production of carbon bisulphide in the electric furnace, with special reference to the construction of the furnace.—*Jour. Franklin Inst.*, February.

Corrosion of Steel.—A. S. Cushman.—A Franklin Inst. paper giving an elementary exposé of the electrolytic theory of the corrosion of steel.—*Jour. Franklin Inst.*, February.

Units, Measurements and Instruments.

False Meter Connections.—C. Herz.—In a three-phase network a consumer's equipment was connected to only two wires because he had installed only lamps. The energy consumed in the lamps was metered. He then wanted to install a small three-phase motor, and this was done on the two wires already available in the house, while the third wire now was also introduced into the building. The meter connections were not changed. It was then found that the consumption of energy metered after the installation of the motor was less than before. The company thought it was due to a fraud, but it was in reality due to wrong meter connections, as will be seen from Fig. 5.

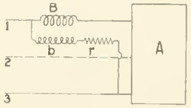


FIG. 5.—FALSE METER CONNECTIONS.

A represents the first lamps which are supplied with energy from the leads 1 and 2. The meter was so connected that the series coil *B* was in lead 1, and the voltage coil *b* was across leads 1 and 3. The energy measured is $E\ I\ T\ \cos\ \theta$, where E is the voltage across 1 and 3, I the current, T the time, and θ the angle of time-phase difference. If now *A* represents a three-phase motor instead of lamps, it is necessary also to introduce the lead 2 (shown in dotted lines) to the motor and the energy registered by the meter $E\ I\ T\ \cos\ (\theta - 30\ \text{deg.})$. The sign + before 30 deg. must be chosen if the current in the series coil *B* is in advance in time-phase of the current in lead 3; otherwise the negative sign must be chosen. Assume that the positive sign must be chosen, then the power will have a negative value (that is, the meter will run in the reverse direction) if the angle of phase-difference is greater than 60 deg., and such was the case in the installation mentioned. While no fraud was intended in this case, it is possible to use such connections for fraudulent purposes.—*La Lumière Elec.*, Feb. 4.

Inductance Measurements.—A. Campbell.—Two (Brit.) Phys Soc. papers. One deals with the use of variable mutual inductances in the measurement of small inductances and capacity. For a number of reasons mutual inductances are more easily dealt with than self-inductances. The author has developed a new design of a variable mutual inductance, which is described. In the second paper, several applications are taken up, especially the measurement of self-inductance, the comparison of nearly equal self-inductances, the comparison of mutual inductances, the measurement of capacity, and fixed standards of mutual inductance.—Lond. *Elec.*, Feb. 7.

Thermo-Electric Couple Potentiometer.—An illustrated description of a potentiometer of a special make which is designed for measuring accurately small differences of potential not exceeding 30 milli-volts, and is intended specially for use with thermo-electric couples. The method of measurement adopted in the instrument is an extension of the well-known potentiometer method, and enables the unknown potential difference to be accurately balanced by an adjustable potential difference standardized in milli-volts by means of a standard cadmium cell. This adjustment can be made by direct reading to 1/100 milli-volt, and by estimation of tenths to 1 micro-volt.—Lond. *Elec.*, Jan. 31.

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—A. Montel.—A mathematical paper showing that an antenna composed of two vertical wires of equal length placed at a certain distance from each other and supplied with currents of opposite sign at any instant has the property of sending out waves in certain directions.—*Nuovo Cimento*, Oct., 1907; *La Lumière Elec.*, Feb. 4.

Block Signals.—A set of recommendations made by a committee of the Railway Signal Association as to means for remedying the effects of foreign current on automatic block signals.—Lond. *Elec.*, Feb. 7.

Wireless Telegraphy.—W. H. Eccles.—An article giving a summary of the more important patents in wireless telegraphy issued during the past year.—Lond. *Elec.*, Jan. 31.

Miscellaneous.

Magnetic Properties of an Alloy Steel.—A note giving the results of some tests made by Siegwart on sheets of a steel whose composition was 96.4 per cent iron, 3.4 per cent silicon and 0.2 per cent manganese. The author determined by the ballistic method the induction reached in the sheets and the hysteresis losses for field strengths varying between 0.0001 and 150 gauss. The results obtained show that, for inductions between 5000 and 18,000, the alloy behaves like the best of the sheets at present used, and in intense fields—for example, 105 gauss—the induction attains 17,900. This result contradicts those of Watson, who showed that for high induction these sheets were inferior to ordinary steel. As regards hysteresis losses, Siegwart shows that these alloys are greatly superior to ordinary soft steels, especially at moderate inductions. The author also made numerous measurements in weak fields, which contradicted Lord Rayleigh's statement that the permeability is constant in fields of less than 0.04 gauss. "It is regrettable, however, that the author does not describe his method of working nor the precautions taken to prevent the large errors which may occur when delicate measurements of this kind are made in weak fields."—Lond. *Elec.*, Jan. 31.

BOOK REVIEWS.

Alternating Currents. By C. G. Lamb. New York: Longmans, Green & Co. 325 pages, 251 illustrations. Price, $3, net.

In preparing this textbook the author has assumed the reader to be familiar with the principles of direct-current machines, the elements of calculus and the elementary properties of vectors. Although mathematical formulas have been used freely, the physical relations have not been overshadowed by a mass of symbols. Many numerical examples are worked out, in order to indicate the exact significance of the mathematical expressions. The author states that the symbolic treatment appeals to only a limited number of students, and hence he has not employed it in the present volume. The treatment is based largely on the use of vectors, by means of which the explanatory matter is rendered quite simple.

Much space is devoted to the induction motor, and the results obtained from the author's analysis correspond with the physical facts. However, not all of the statements made are correct, and in some cases the treatment is misleading. For example, the author correctly assumes a sinusoidal space distribution of the flux in the air-gap of an induction motor, but in explaining why the flux is thus distributed he neglects the secondary currents which are the main factors in giving the sinusoidal shape to the flux wave. The statement that an induction generator delivers a leading current into the mains and therefore tends to improve the power-factor is incorrect, as is also the statement that the machine cannot of itself produce power. To the extent that these statements contain any element of truth, they are the more dangerous for the uninformed student. It is unfortunate for the reader that what must have been an oversight allowed the author to intimate, on page 279, that the division of load between two alternators in parallel depends upon the relative field strengths of the two machines. The book contains an instructive discussion of synchronous generators and motors. Although use has been made of the familiar "synchronous-impedance" method of dealing with the phenomena in these machines, the author has been careful to call attention to its limitations and to show in what respect the real performance of the machines differs from the calculated.

Thomas Alva Edison. By Francis Arthur Jones. New York: Thomas Y. Crowell & Company. 362 pages; illustrated. Price, $2.

This is a popular review of Edison's life up to the age of 60, and is written quite agreeably and sympathetically. Several other books of the same character exist, of earlier date. Old and new sources of information have been drawn upon, and a vivid picture is presented of a notable career already so fruitful and still being run.

The personal side of the inventor's life is fully emphasized in this interesting story. The author has treated his subject as a journalist and not as a technical writer in any sense; but has quoted with discretion a good many authorities and articles dealing with Edison's real life work as distinguished from the ordinary credulous acceptation of him as a "wizard."

Alternating Currents. By Alexander Russell. New York: The Macmillan Company. 407 pages; 132 illustrations. Price, $4.

Seldom, indeed, does an author of a book on electrophysics attempt as much as the author of the present volume. Mr. Russell set before himself the task of giving in an accurate and thorough manner a treatment of the multitude of details involved in alternating-current phenomena and to render the treatment within the understanding of engineering students. The treatment is essentially mathematical, but the author has exercised excellent judgment in making a liberal use of physical interpretations of the equations. He has kept the book within the 400-odd pages by omitting all matter of a purely descriptive nature and confining the discussion to theory. In fact, no treatment is given of transformers, motors, generators or converters, only the elementary circuits that are used in and with these machines being dealt with. The author is to be congratulated on having accomplished his task.

A Brief Guide to Vibratory Technique. By Noble M. Eberhart. Chicago: G. P. Engelhard & Company. 124 pages; 4 illustrations.

The author, who is a Chicago electro-therapeutist of standing, introduces this work with a clear statement as to the position which he thinks vibratory treatment should occupy, not as a cure-all, but as a means of effecting a cure in some cases, and in other cases as an adjunct to other treatment. It points out briefly the therapeutic action of vibratory treatment, and gives cautions as to cases where it should not be used. The remainder and greater part of the book is taken up with technical medical directions as to the treatment for various diseases. Since portable vibrators operated by small hand motors have become common, central-station men may find the book useful in connection with the introduction of vibrators among the local medical fraternity.

American-Ball "Angle Compound" Engine.

A new type of high-speed engine, the joint design of Mr. F. H. Ball, the well-known engine designer, and his son Mr. F. O. Ball, is being placed on the market by the American Engine Company under the name of the "Angle-Compound" engine.

The designers of the engine have sought to attain the extreme of simplicity and fewness of parts. While the general plan of combining a horizontal engine and a vertical engine so that both shall work on the same crank-pin is not new, there being conspicuous examples of this general type in the great engines installed in the traction power houses of New York City, engineers have not generally appreciated the many desirable features of this arrangement for high-speed engines of the single-valve type. By combining a horizontal and vertical engine on the same crank-pin, to total amount of horizontal thrust may be neutralized by counterbalance; and when the counterweight is in a vertical plane, it is opposed by the reciprocating parts of the vertical engine, so that at four points of the stroke a perfect balance is realized, and between these four points there is no position of the crank where any appreciable unbalanced condition is found.

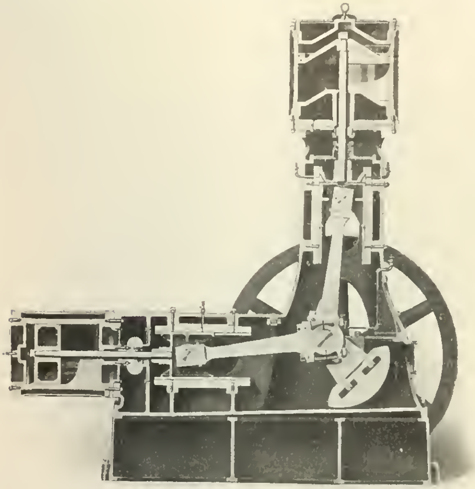
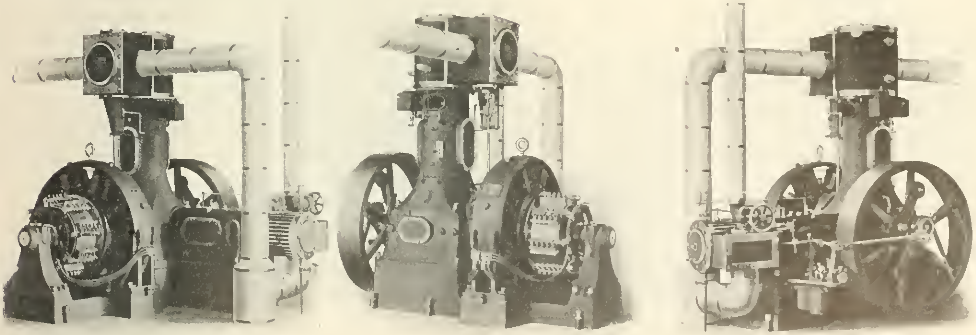


FIG. 1.—SECTIONAL VIEW OF "ANGLE COMPOUND" ENGINE.

In the "Angle-Compound" engine the conditions for perfect balance are brought about by making the low-pressure piston a very light, conical-shaped, steel structure of about the same weight as the ordinary cast-iron piston in the high-pressure cylinder. The low-pressure engine is made the vertical engine because it is thought desirable to have the larger piston rest on the piston rod rather than to drag in a horizontal cylinder.

It will be seen by reference to the several views of the engine that the high-pressure valve is driven by the usual valve gear and shaft governor, and the low-pressure by an eccentric which is enclosed in an oil-tight casing and connected with the oil-circulating system of the engine. From this eccentric a rod drives direct to the low-pressure valve stem, which is guided by a cross-head carried in guides, as shown, and this cross-head and guides are also included in the oil-circulating system of the engine. This oil-circulating system is similar to that used on the well-known American-Ball engines, except that the oil is pumped directly to the gravity storage tank on the low-pressure frame, which is kept constantly overflowing by the supply delivered to it from the pump. A double stuffing-box on the valve stem and bulkheads, and stuffing-boxes on both piston rods, prevent the water drip from mingling with the oil of the circulating system. The water drip from all these stuffing-boxes is carried off by concealed piping, so that the engine is never untidy in appearance.

A new departure has been made in the arrangement of the cross-head and guides, which are of the bored type. The cross-head is a single piece without the usual adjusting shoes, while the guides are made adjustable. These guides are carried in bored seats, and a projection from the back of the guide fits between the supports so as to resist end thrust. One of the guides is secured to the support by screws, and is only adjustable by means of shims, but the other has a pair of screws at each support to provide for delicate adjustments, and the guide is securely held against these adjusting screws by a bolt that locks the adjustment securely when set up. It is, of course, understood that the crank-pin is double the usual length, and that the connecting rods are placed side by side on this double-length pin.



FIGS. 2, 3 AND 4.—THREE VIEWS OF A DIRECT-CONNECTED UNIT.

The builders' claim that this type of engine runs more smoothly and with much less strain and shock than any other form of high-speed engine, because of its perfect balance and because it has four small impulses on the crank at each revolution instead of two large ones, would seem to have every justification. They have recently installed in their own power plant one of the new engines of 160-hp, 11-in. stroke, running about 300 r. p. m., direct-connected to one of their generators. This engine has no special foundation, except the concrete floor of the building, and has not a single foundation bolt. Nevertheless, a new full-length lead pencil may be stood on its end on the horizontal cylinder head and then on the vertical cylinder, there not being vibration enough to disturb the delicate balance of the pencil, even with a fluctuating load on the engine.

The floor space of this engine is very small for a given rating, since the horizontal engine carries a vertical engine of the same power. This also reduces the cost of foundation to the same extent, so that practically half the foundation is saved, and the balance of the engine makes the foundation problem such a very simple one that where concrete floors are used, no further foundation is ordinarily required.

For large powers these engines, combined in pairs with the generator or belt wheel between them, make an exceedingly compact unit. In these combinations the engines are used as double compounds when run non-condensing; or, where condensing water is available, as four-cylinder, triple-expansion engines. In the latter case one horizontal engine is the high-pressure, the other horizontal the intermediate-pressure, and the two vertical engines combined are the low-pressure, thus giving a large area of low-pressure piston without using any pistons of very large diameter.

Since the normal speed of an engine of this kind is high, the cost of the generator and the amount of floor space are both greatly reduced.

Developments in Motor Applications.

The universal application of electric power to supersede mechanical and manual power is no longer a question of the adaptability of the motor, for there is scarcely a service that can be mentioned for which the motor has not demonstrated its superiority in one way or another.

Many types of machines now in use owe their adoption entirely to electric power; many that formerly employed mechanical power are now chiefly heard of in connection with electrical power. The number of machines that are coming over to the electrical side is constantly increasing. As typical among them may be mentioned ironing machines, vacuum cleaners, blacksmith forges, brickmaking machinery, concrete mixers, stereotyping machinery and portable machines of various types.

IRONING MACHINES.

Motor-driven ironing machines are already well established in laundry service. Their success has led to the extensive manufacture of domestic machines, in connection with which the electric motor is of even greater importance, for the reason that mechanical power if available would not be tolerated in the househould. These machines iron all of the flat work as well as it can be ironed by hand. A girl operating the machine can perform five to ten times as much work as she could without it. Naturally this argues that it would require a very short time for an ordinary ironing and that the machine would be best suited for large households. True, its capacity is sufficient for the very largest domestic establishments and even for restaurants and small hotels, but the beauty of it is that it is economical for even a small family, for its operation only requires an eighth horse-power motor.

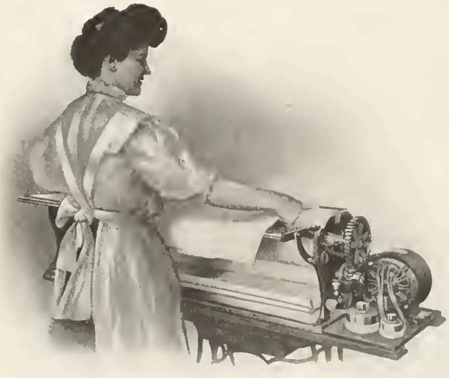


FIG. 1.—IRONING MACHINE.

FLAT-IRONS.

The convenience and cleanliness of electricity for this purpose readily leads to a demand for electric irons for such work as must be done by hand. The Westinghouse 5-lb. iron costs about 4 cents per hour on the basis of a 10-cent rate. This does not seem expensive, but if an argument is raised, the cost is effectively offset by the advantages gained in comfort, in steps saved, and in always having the iron at the proper temperature.

It is often argued that most people who have their houses wired have a servant to do the washing and ironing, and that they don't care if she does have to walk back and forth and if the fire that heats the irons does make her perspire and put her in a bad temper, for that is what she is paid for. There may be some such, but ninety-nine out of one hundred who know the difficulty of keeping good servants, will be willing to have their burdens lightened for purely selfish reasons if for no others.

The one stumbling block is first cost, but the cost of an electric motor, like everything else, should be reckoned in proportion to its life and distributed over its period of useful service instead of charged to the expenses of the current month or year.

PORTABLE VACUUM CLEANERS.

Another household convenience dependent upon electric power is the small portable vacuum cleaner which in appearance resembles the ordinary carpet sweeper more than it does the large vacuum cleaners which have been on the market for some time. It consists of a motor-driven exhaust fan which draws the air from the carpet through a slot in the machine and carries with it the dirt and dust. The dirt does not come into contact with the fan, but is retained in a special receptacle which is screened off from the fan by means of a fine cloth. A flexible hose attachment provides for the cleaning of walls, furniture, etc.

This machine has been found to be very satisfactory for residence, church and small hotel work. It can be moved from room to room and attached by means of a flexible cord to any lighting socket. Cleaning by this method is several times cheaper than by use of broom or carpet sweeper and can be done at any time desired instead of periodically, as when a contractor with a vacuum outfit is employed. Those who have been employing contractors occasionally can, by owning one of these machines, apply the same method of cleaning every day in the year if desired. Its low cost and the fact that it does equally well the cleaning that many have been willing to pay contractors a high price for doing, argue that it should become very popular in the larger households. Like other domestic apparatus, its introduction depends mainly upon the central station, and should be pushed with energy because it means in addition to a sale of the article, the continuous sale of the current it uses.

CONTRACTORS' SERVICES.

The portable steam engine has so long been looked upon by contractors as an entirely satisfactory part of their equipment that it takes pretty good performance upon the part of the motor to get them to concede its superiority, but recent experiments with Westinghouse motors in every branch of contracting service have demonstrated that they produce economies in time and operating force that deserve careful consideration. A strong point in favor of the motor is its simplicity. Whereas a licensed engineer is required to run an engine, any workman of ordinary intelligence can operate the motor. Its power supply requires nothing but a feed wire, while the steam engine requires fuel and water and the removal of ashes. The motor eliminates the smoke nuisance and the fire risk from flying sparks. It requires less space than the steam engine and offers greater latitude in the matter of location.

The use of motors for driving concrete mixers has been found especially satisfactory, since the wide variations in the load are more satisfactorily handled by a motor than by either a steam or gas engine.

ELECTROTYPING AND STEREOTYPING.

In electrotyping and stereotyping, recent experiments have demonstrated the superiority of the electric heater for the many steps in the processes that require heat. The electric heater reduces the fire risk and does away with the noxious fumes inseparable from the use of the gas flame. It concentrates the heat at the point where it is desired and greatly facilitates the operations, thus both increasing the capacity of the machine and decreasing the time required to deliver the finished plates.

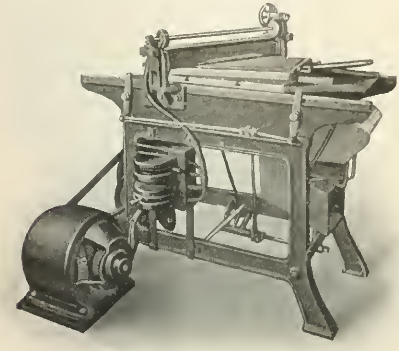


FIG. 2.—STEREOTYPERS' WAX TRIMMING KNIFE, ELECTRICALLY HEATED.

Special attention has been devoted by the Hadaway Company to the perfection of heating devices for the publishing trades and the satisfactory results obtained will undoubtedly lead to their wide adoption.

PORTABLE TOOLS.

The flexibility of the electric motor, admitting of its attachment to portable tools, is responsible for many conveniences and improvements in shop work. An example of this application is afforded by the portable lathe for use in locomotive repair shops. Where every bolt has to be fitted, as in this case, the advantage of bringing the tool to the work instead of carrying the work back and forth, is readily apparent. Through the use of a flexible feed wire and plugs, which may be located at convenient intervals, the motor-driven tool is always available regardless of the location of the work.

BLACKSMITH FORGES.

While many applications of electric motors are confined to particular territories, the blacksmith forge furnishes an application that is to be met with everywhere. As a rule, mechanics do not like to spend their time on work that does not require their skill, but this is what the blacksmith does if he works the bellows handle or turns the crank himself. Of course he may have a helper, but he will hardly prefer one to an electric motor, when the latter does the work equally well at about one-tenth the cost. Moreover, the motor makes him independent of the labor market and is always ready to work when he is.

The newest type of outfit driven by a Westinghouse motor is simplicity itself and can be operated by anyone after a few minutes' instruction. The fan is mounted on the same shaft as the motor without separate bearings and forms a very compact unit. The blacksmith can start the motor by a single turn of the switch, adjust the blast gate for the heat desired and then turn his attention to some other duty while the work in the fire is heating. It pays the central station to have motors in use where they will be seen and a motor in a blacksmith shop, especially in smaller places, has considerable value as an advertisement.

BRICKMAKING.

The machinery used in brickyards has until recently been entirely or in part driven by steam engines, but during the past year a new brickyard has begun operations where the most modern apparatus is used, with motor-drive throughout. There is no provision for any power other than electric and that is purchased from a nearby central station. Some steam is made for heating the die and the material as it is pressed out of the auger; but even though the company operating the brick plant owned and operated a nearby coal vein, the installation of a steam engine was not considered so satisfactory as the use of the purchased power from the central station mains.

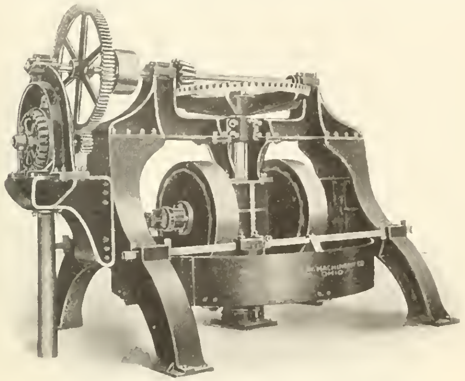


FIG. 4.—9-FT. DRY PAN FOR PULVERIZING BRICK MATERIAL.

The machines are individually driven by two-phase induction motors of standard Westinghouse design. The process of making bricks is a continuous one, so that all the machines run at the same time. Furthermore, barring accidents, there is no reason why the machines should not run steadily all day, unless there is a shortage of material. For this reason the usual economies of electric drive, permitting an idle machine to be shut down, do not exist in making bricks. As the load is very steady all day long and is large in size, the best rate of the central station was made and has proved entirely satisfactory.

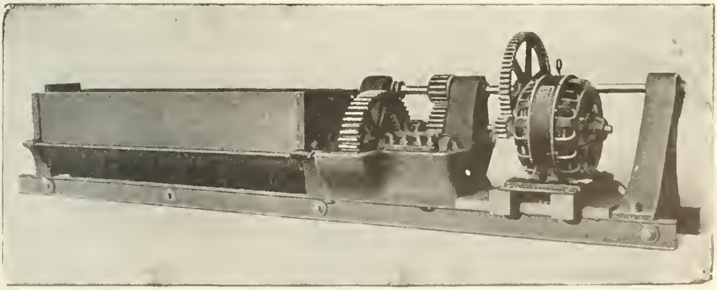


FIG. 3.—PUG MILL FOR MIXING BRICK MATERIAL.

It is to be noted that in the plant mentioned the bricks are dried in a tunnel by the heat from ovens where the bricks have been burned and are being cooled. The air is moved by large fans which operate normally during the night, allowing the bricks made during the day to dry over night, so that they are ready to be set during the following day. This use of power all night long also makes the installation particularly attractive to a central station.

WOODWORKING.

The use of electric drive in planing mills has grown rapidly because of the many advantages of electrical drive as well as the economy resulting from the use of central-station power. The older forms of equipment consisted of a line shaft from which the individual machines were belted with tight and loose pulleys. The line shaft had to be kept in motion irrespective of the number of machines at work.

As a matter of fact in a planing mill the machines are not working all the time. Even when a machine is in operation the work it does is intermittent because material cannot be fed through it without absolute continuity. Hence the power demand of any tool is fluctuating. It is also evident that the power required when working on hard wood is more than when working on soft wood. Hence the inflexible line shaft system of driving is not as suited to this class of work as the flexible method using motor-drive for each machine. The usual planing mill shows that the average power required is approximately one-third of the connected power of the motor.

Because of this intermittency of operation the central station supply of power has been gaining ground and gas-engine as well as steam-engine equipments have been displaced. As the power is used all day long the planing mill receives the benefit of the central-station rates for long-hour service.

Automatic Time Switches.

Two new types of automatic time switches have just been placed on the market by the Hartford Time Switch Company, 97 Warren Street, New York City. Of these, one is made from 75 amperes to 300 amperes, 250 volts, in single, double and triple-pole, and is a combination of the "Hartford" time switch and a standard knife switch operated by a pair of solenoids, one for opening and one for closing the circuit. The operation is as follows:

When the time is reached when the main circuit is to be closed, the operating switch is automatically thrown in contact by the time switch, which energizes the closing solenoid, and the closing of the main switch itself automatically cuts out the solenoid after its work is done. As the several operations are all performed with great rapidity, the solenoid is only in circuit the fractional part of a second.

The operation of opening the main circuit is similar to the closing; the break is practically instantaneous and the same automatic cutting-out of the operating solenoid takes place. The safety of the solenoids is carefully guarded to remove any possibility of their being burned out or injured; if for any reason the safety factors already mentioned as guarding the solenoids should fail to work, a final safeguard is provided in a fuse that blows before either solenoid could be injured. The whole switch is very simple and entirely self-contained. In installing it is only necessary to connect the line with the switch in the usual manner, and set and wind the time switch, as all the wiring for the operation of the solenoids is mounted with the switch.

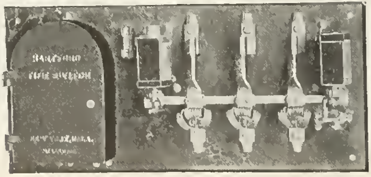


FIG. 1.—AUTOMATIC TIME SWITCH.

The other switch referred to is for high-potential circuits and operates much as that first described, excepting that the break of the main switch takes place in an oil chamber. In this switch the handling of the high-voltage current is covered with every safeguard to prevent leaking or short-circuiting. All leads are through porcelain and glass to the oil chamber, and the switch proper is constructed both with great solidity and with a large excess of carrying capacity in the blades and contacts. In operating the solenoids in this type, when no independent secondary low-voltage current can be used, a small transformer is mounted on the same board with the switch, for use on the solenoids only. As before-mentioned, the current is drawn on for the solenoid operation for only an instant, and the same safeguards mentioned in the other switch are used.

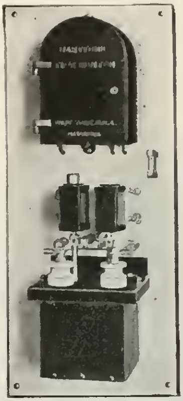
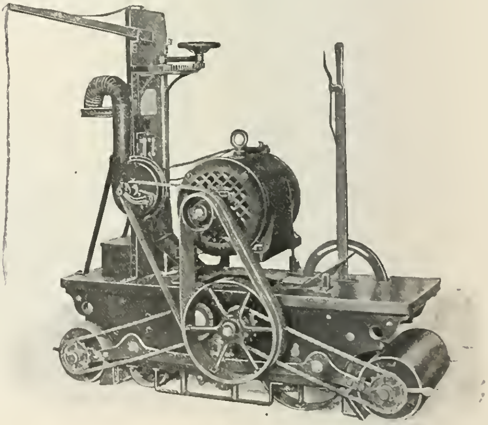


FIG. 2.—TIME SWITCH FOR HIGH POTENTIAL CIRCUITS.

Single-Phase Floor-Surfacing Machine.

It is claimed that the floor-surfacing machine illustrated herewith will do as much work as 20 men, the results being better and the cost less. The sand-paper drum is of such dimension as to insure the best finish, which is impossible to accomplish by hand-work. The machine is adapted to the surfacing of every class of floor, from pine to the finest parquetry. By a very slight change of the drums, it can be arranged to polish and wax floors. The machine is made by the American Floor-Surfacing Machine Company, Toledo, Ohio; it is operated by a 5-hp, self-starting, single-phase motor manufactured by the Century Electric Company, St. Louis, Mo.



MOTOR-DRIVEN FLOOR-SURFACING MACHINE.

Cradle-Type Direct-Current Motor.

Fig. 1 herewith shows the Bliss cradle-type of direct-current motor built by the Engineering Specialty Company, of 143 Liberty Street, New York. The motor has a square frame for convenience in attaching gear shafts, brackets or other fixtures directly to the motor frame. The most distinctive feature of the design is the cradle for supporting the armature bearings and brush-holders. One end of the cradle is enlarged for convenient and accurate attachment to the motor frame. This is shown clearly in Fig. 2. As both bearing sleeves are carried in one rigid casting, there is no possibility of defective alignment with resulting heating and cutting of the shaft. Another advantage is that the cradle arms occupy the space between the pole tips and are so proportioned that their effect on the armature is to provide a neutral magnetic field on the line of commutation, thus aiding in securing sparkless operation. The cradle also carries the brush holders, each of which is secured by two insulated screws. Double brush holders are used in all but the smallest sizes of motor. By removing four screws, the entire cradle with its armature, brush-holders and bearings can be removed from the frame. The armature is provided with a removable shaft. The construction of the various parts of the motor conforms to general practice. All parts of the motor are interchangeable and are accurately fitted. The motors may be rendered dust proof by a cap which fits closely over the commutator end.

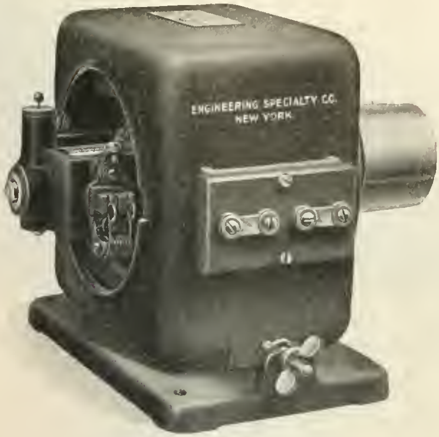


FIG. 1.—CRADLE-TYPE MOTOR.

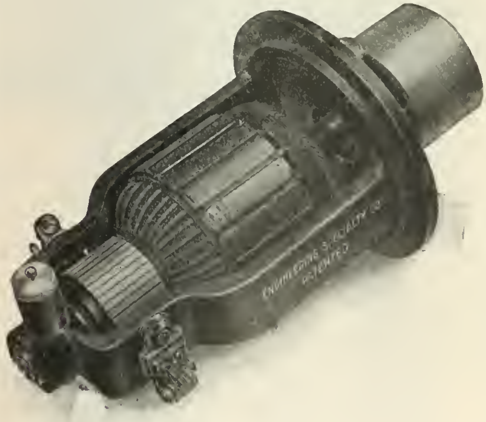
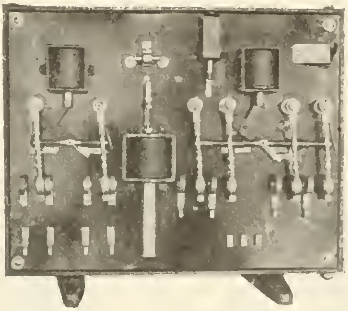


FIG. 2.—ARMATURE IN CRADLE.

Alternating-Current Motor Auto-Starter.

The accompanying illustration shows a new magnetically-operated auto-starter and transformer for alternating-current motors of the slip-ring type, now being placed on the market by the Automatic Switch Company, of New York.

The main-line switch at the right of the panel may be closed or opened by contact devices of an automatic type, such as a pressure regulating pilot switch, a thermostat, tank switch or manually-operated push buttons from a distance. At the center of the panel is shown a solenoid magnet having a dash-pot so arranged that upon the closing of the main-line switch the magnet is energized and lifts the core to the top of its stroke where by its own movement it opens the circuit supplying current to this magnet. In doing so, by means of the small magnet shown at the top of the panel, this circuit is also opened, thus allowing the core in the dash-pot controlled magnet to fall slowly until at its lowest point it closes a contacting switch, which throws the switch shown at the left of the panel from the low-voltage position at which it has stood to the high-voltage position, thus affording full voltage to the motor. The time allowance between the closing of the main-line switch and the throwing of the two-voltage switch to the full-voltage position may be regulated by the consistency of the oil in the dash-pot attached to the center magnet, and thus the motor may be allowed low voltage long enough to accelerate. By this means the inrush current is kept down to a normal and reasonable amount. None of the magnets carries current after it has performed its function. In stopping the motor, current is supplied both to the right- and left-hand switches simultaneously from the contacting device, throwing both these switches back to the original position ready for a repetition of the cycle of starting.



ALTERNATING CURRENT MOTOR AUTO-STARTER.

This device is regularly built in sizes from 3 horse-power to 100 horse-power and for 220 and 440 volts.

Electrically-Equipped Screw Pump.

The new Claiborne Station, of the New Orleans Railway & Light Company, New Orleans, has an interesting feature relating to the condensing apparatus and the means taken to prevent the sediment from the Mississippi River being drawn into the condenser intakes. Four 72-in. pipes have been provided to serve the condenser intake and discharge. All extend through the levee, and three are installed under the boiler room and one placed under the railway tracks between the boiler room and the levee. The pipes are made in 30-ft. lengths of ½ in. riveted steel, protected by a coating one-sixteenth of an inch thick applied by dipping the sections into a hot compound.

The provision made for removing sand and silt from the water pipes is comprised of water jets installed at 10-ft. intervals in the bottom of the pipes, and by a system of valves the intake and discharge may be connected at the station end with an Allis-Chalmers motor-driven screw-pump so located as to secure a flow of from 8 ft. to 10 ft. per second through the pipes. When the cleaning is to be done, the jets are first operated to loosen the deposit, which is then worked out by the flow from the pump. The pump is driven by means of a 700-hp, 550-volt induction motor directly coupled to it and in construction of its hub, guide vanes and bearing above the propeller wheel is identical with that used on the large Allis-Chalmers screw-pumps built for the New Orleans Drainage Board.

Motors for Driving Fans.

The B. F. Sturtevant Company builds such a variety of fans that it has been found necessary to have motors of all speeds and capacities, including some of special design. An adjustable-speed motor for driving centrifugal fans, shown by the accompanying engraving, Fig. 1, is rated at 15 horse-power, and has the remarkably low speed and great variation of from 80 to 165 r.p.m. Fig. 2 shows two views of the Sturtevant eight-pole motor of very low speed, less than 100 r.p.m., for driving large ventilating fans. This motor is placed on a steel-plate base and is connected to the fan shaft by a coupling. Fig. 3 shows a Sturtevant eight-pole motor arranged for attachment to the side plate of a fan. No supporting base is necessary for this type, and the fan wheel is keyed to the shaft of the armature, thus making a very compact set. In this type the shape of the motor case is such that the commutator and brushes are protected even if used as a semi-enclosed motor.

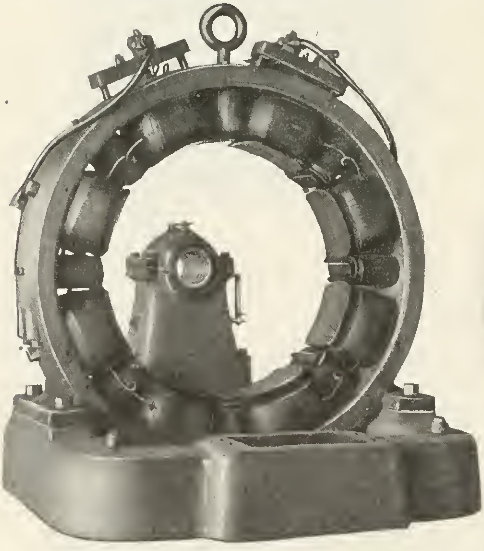


FIG. 1.—FIELD STRUCTURE OF ADJUSTABLE-SPEED MOTOR.

A unique ventilating set of small size, which is both convertible and portable, is shown in Fig. 4. This set is particularly applicable for use in power plants and machine shops for ventilating the power house and for blowing dust out of machinery. It can easily be carried about by a man, and by taking out the bolts of the side plate can be made to discharge air in any direction. These sets have dust-proof motors, which may be placed on either side of the fan. An aluminum casing makes the set of the least possible weight, while the ball-bearings reduce the power required and insure a smooth-running machine. This set is made in two sizes, one of which weighs 75 lb., and the other 100 lb. They require less than one-half horse-power, and the outlets are so small that a flexible hose may be connected thereto, thus conducting the current of air wherever desired.

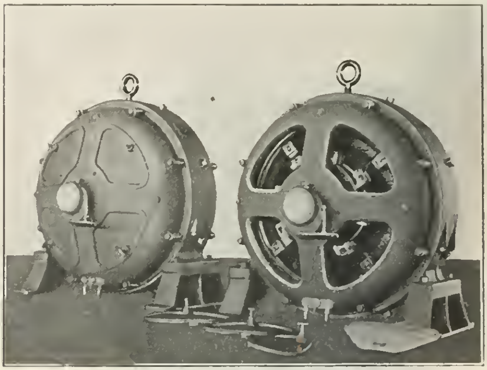


FIG. 2.—LOW-SPEED EIGHT-POLE MOTOR.

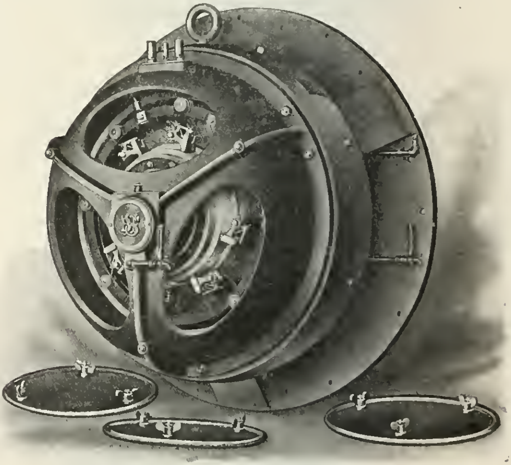


FIG. 3.—MOTOR FOR ATTACHMENT TO SIDE PLATE OF FAN.

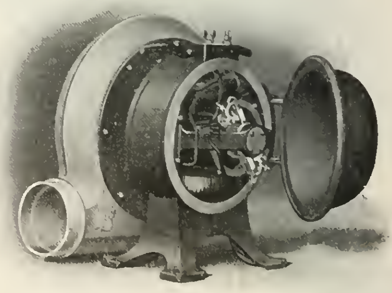


FIG. 4.—PORTABLE ELECTRIC VENTILATING SET.

For ventilating engine or boiler rooms where it is not necessary to have the set portable, an electric propeller fan is commonly used. This fan, which is shown in Fig. 5, has a small direct-connected motor, and can be placed either vertically or horizontally. The great advantage of the electric fan over either the pulley-drive or the steam engine is that of location. The fan may be placed where it will be most efficient, while the speed controller may always be placed in a convenient location. The speed of the fan is thus under instant and absolute control.

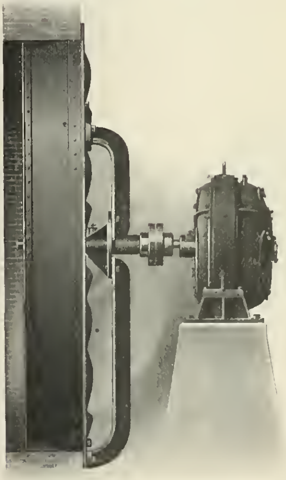
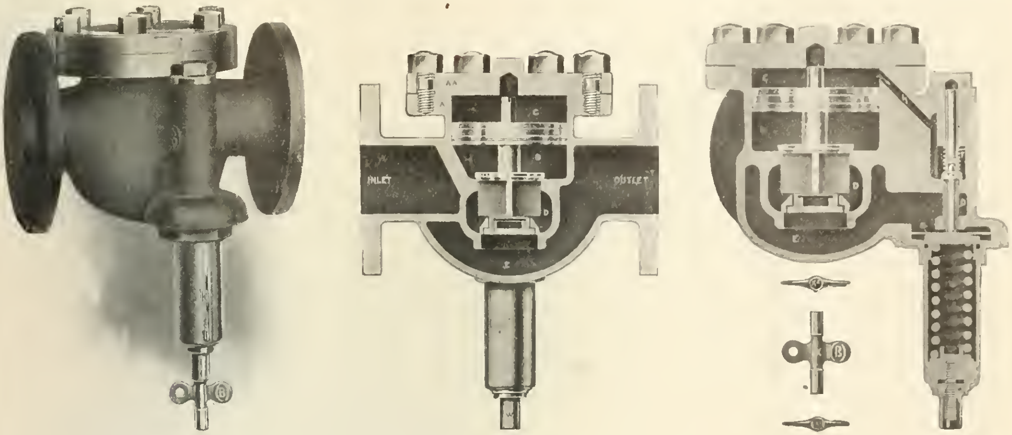


FIG. 5.—STURTEVANT MOTOR ON SEPARATE CONCRETE FOUNDATION.

Steam-Pressure Regulating Valve.

The valve shown in the accompanying illustrations is designed for maintaining a uniform low-service pressure when the steam is obtained from a boiler at a high pressure, which latter pressure may vary throughout a considerable range. The main valve is operated on the "relay" principle; an auxiliary valve, the opening or closing of which depends solely upon the pressure of the delivered steam, serves for producing the required unbalanced thrust for opening or closing the main valve. The auxiliary valve, shown at *O* in Fig. 3, is opened by means of the spring *U* and is closed by the diaphragm *S* when the pressure of steam in the outlet reaches a predetermined value. When the auxiliary valve *O* is open, steam passes through port *H* from chamber *C* and the excess pressure in chamber *B* opens the main valve *J*. When sufficient steam has been admitted to the outlet chamber *E*, the pressure on the diaphragm *S* increases and closes the auxiliary valve *O;* steam which passes through a small hole drilled in the main piston enters chamber *C* and causes the main valve *J* to close. It is stated that the main valve actually floats, opening or closing at the slightest change of pressure above the piston.

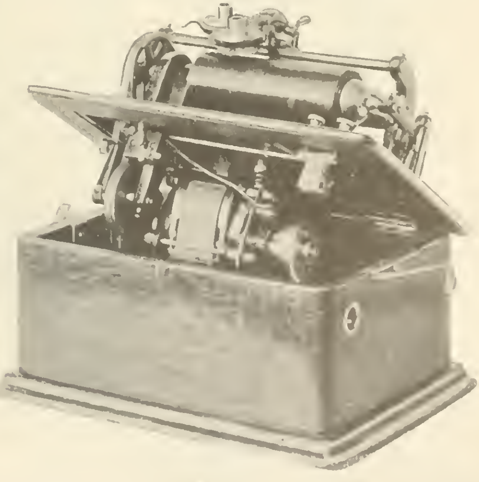


FIGS. 1, 2 AND 3.—STEAM-PRESSURE REGULATING VALVE.

The pressure regulating valve described above has been placed on the market by the Ohio Brass Company, Mansfield, Ohio.

The Electric Motor for Phonographs.

The accompanying illustrations show the alternating-current motor which the General Electric Company has built for the Edison business and amusement phonographs. The construction used is of the well-known riveted-frame design, in which the maximum radiating effect is secured for the stator punch-


BUSINESS PHONOGRAPH EQUIPPED WITH INDUCTION MOTOR.

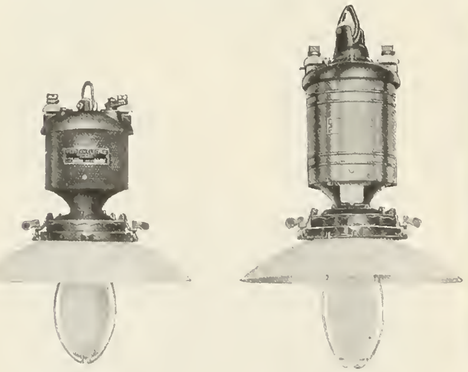
ings, the ends of which are directly and completely exposed to the air. The shape is that of an irregular hexagon, which form was chosen to permit the motor's meeting the requirements of assembly in an existing framework.

The end caps containing the bearings and lubricating devices are held in place by four bolts, two of which pass through holes in the punchings. The armature is very carefully made and balanced, and its shaft is extended at both ends beyond the caps. One end carries the pulley, which is belted to the phonograph mechanism, while the other one supports the moving element of a centrifugally-operated switch used for opening the starting phase of the winding after the armature has attained nearly full speed. A convenient terminal board is provided with means for clamping the leading-in wires and for changing direction of rotation by reversal of starting-phase leads. Tests of these motors made under actual service conditions have shown, especially with respect to heating and quietness of operation, how skilfully a design has been worked out and the construction work refined for a motor that is actually of only 1/100-hp capacity. By its use in the phonograph, our friend the business man can dictate where and when he pleases and his letters can be prepared for his signature in a separate room where the disconcerting noise of the typewriting machine may be confined, and where the operators may work at an increased efficiency because of having but one operation to perform.

Enclosed Arc Lamp for Indoor Lighting.

Recent experiments of the Western Electric Company, in which comparisons were made of the light from the enclosed arc lamp and that from the various types of lamps recently developed, are stated to have demonstrated that the latter will not be serious competitors of the enclosed carbon arc where the distinguishing of colors is an important factor.

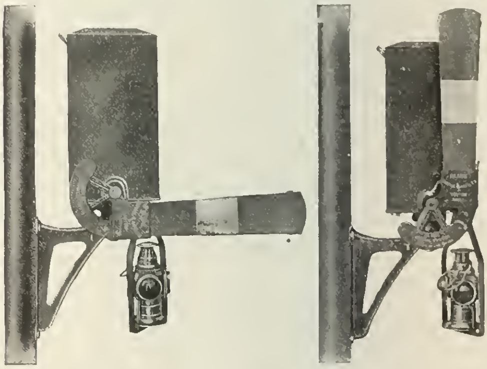
The problem of obtaining the best light distribution is also one that must always be considered by the engineer in selecting the proper type of illuminant for certain classes of illumination. Often in indoor illumination where the ceilings are low the carbon arc lamp is found unsuitable because its length does not permit of getting the light at the exact points desired. This one feature of the arc lamp has been the most serious objection to its use in indoor lighting. To overcome this and thereby still further establish the superiority of the enclosed arc lamp, the Western Electric Company has developed a special type, the "Hawthorne" short arc lamp, for indoor service. (See Fig. 1.) This lamp is only 20 in. long over all, and will permit of even distribution of light with the lowest ceilings. The glassware used on this lamp is of the same standard size used on the longer lamps, permitting of the use of both long and short lamps in installations without the necessity of carrying two lines of glassware. This lamp burns 100 hours with one trimming, and it is stated that in no way have the efficiency and utility of the lamp been sacrificed in order to reduce the length.


FIGS. 1 AND 2.—"HAWTHORNE" SHORT ARC LAMP.

Another feature that has recently been developed by the Western Electric Company in its arc-lamp designs is the indicating drop. This feature consists of an indicator which is ordinarily concealed within the case of the lamp, but drops through a slot in the lower part of the case when the lamp requires trimming. (See Fig. 2.) This feature is especially valuable where the lamps are not burned for definite intervals of time and need not be trimmed regularly. Without such an indicator, it becomes necessary to inspect the lamps regularly in order to insure against failure due to the carbons being consumed. With the indicator, warning is given before the carbon is totally consumed, and any danger of failure on this account is eliminated. It is also more economical in carbon, for by this system the carbon will be completely consumed in each case, while with the method of trimming at certain intervals of time, and especially where the lamp operates intermittently, it is frequently necessary to discard carbons that would last for several hours if allowed to remain.

Signals for Single-Phase Electric Railways.

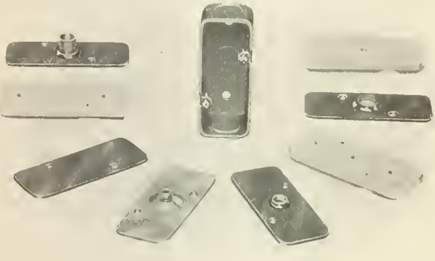
In order to meet the requirements of single-phase electric roads and steam railroads, the Blake Signal & Manufacturing Company has developed the type of signal shown herewith. These signals are similar to the company's dispatcher's signals, for telephone train dispatching, now in use on many 500-volt interurban electric roads, excepting the signal light for use after dark. On 500-volt trolley lines the most effective as well as simplest and cheapest method of getting the light for night use was to connect the 500-volt trolley or feeder circuit to an incandescent lamp circuit through a certain amount of resistance, the circuit being closed by a switch when the semaphore was set in the horizonal position. With single-phase lines or steam railroads electricity with this comparatively low tension was not available at the line signal, and it became necessary to devise some other means for getting the necessary signal light for night use.


FIGS. 1 AND 2.—SIGNALS FOR SINGLE-PHASE RAILWAYS.

This has been accomplished by supporting a standard four-lens railway switch lamp on a substantial hanger, the shaft of which goes up through the base of the signal. The end of this shaft is so connected with the semaphore shaft that when the semaphore drops to the horizontal position the lamp shaft and lamp are given a quarter turn, so that where the lamp shows a white or green light up and down the track when the semaphore is in the vertical, or "clear" position, it will show a red light up and down the track when the semaphore is set to the horizontal or "stop" position. The weight of the hanger and lamp is supported on a spiral so that not only does the weight of the lamp assist rather than retard the dropping of the semaphore to the horizontal position, but should the road or pin connecting the lamp shaft with the semaphore shaft be broken the lamp would of its own weight make a quarter turn and show a red light. This is on the side of safety and makes it impossible for the lamp to show anything but red when the semaphore is set at danger. As with all switch lamps, whether of the fork or socket type, it is impossible for a lamp to be put up showing the wrong light; that is, a light at variance with the position of the semaphore. All of the working parts of this lamp hanger are under the signal cover, where they are thoroughly protected against the weather.

Utility Box for Open-Work Wiring.

The Bossert Electric Construction Company, of Utica, N. Y., has designed the utility box shown in the accompanying engraving for open-work wiring in mills, warehouses, station platforms or other similar places where this system of wiring is used. The chief feature of advantage claimed for the box is the fact that it is provided with a number of plugged outlets giving it a wide range of application by enabling the contractor to run conduit into the box from either of the four sides or the bottom and obviating the necessity of carrying in stock a large number of special fittings, each one made for the particular purpose for which it is to be used. The box is provided with holes on the bottom for supporting screws, enabling it to be fastened in position independent of the conduit; and for this reason a more rigid installation is secured than where the conduit alone is supported. The box is provided with porcelain covers having one, two or three openings for drop cords or arc lamps and with steel covers with nipples for stage or window lighting. The box is made for either ½-in. or ¾-in. conduit.



UTILITY BOX FOR OPEN-WORK WIRING.

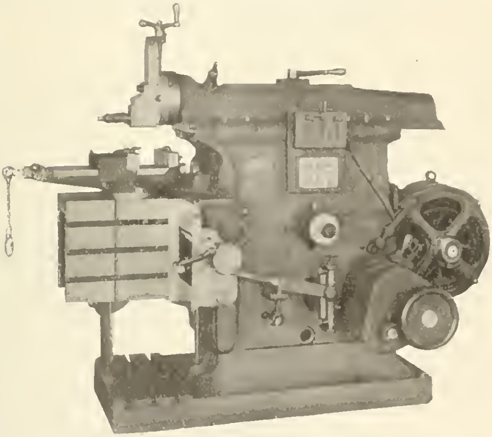
Combined Electric Washer and Wringer.

The accompanying illustration shows the electric washer made by the "1900" Washer Company, of Binghamton, N. Y. The machine consists of a wooden tub with a wringer attached, and both are arranged to be driven at will by a small motor attached to the wash-tub support. In this washer the clothes are held still while the water and soap and motion of the tub back and forth do the work. In this way delicate fabrics are not injured. The tube is driven through an upright shaft connected at the lower end to a crank which moves back and forth the little rod which is fastened to the pivot under the center of the tub bottom. This crank and rod are for the purpose of swinging the tub part way round, and then back during washing. The shaft is driven by a belt which runs from the motor to the driving wheel at the top of the shaft. This driving wheel is connected to the shaft by bevel gears, which make the shaft turn to move the tub or the driving wheel can be connected to another set of bevel gears to turn the wringer. Shifting of the power from the washer to the wringer is done by the aid of a small lever. Substantial springs are used in assisting the motor in imparting to the tub the erratic motion necessary in the washing operation. The machine is very simple in operation and has found an extensive use.

COMBINED WASHER AND WRINGER.

Motor-Driven Shaper.

A motor-driven shaper which has been designed especially to meet modern requirements is shown in the accompanying engraving. In comparison with former machines the shaper is larger and heavier in the working parts in order to obtain the fullest possible benefit from the new high-speed cutting steels. The shaper is connected to the motor by means of a silent chain enclosed in a guard. In connection with the advantages of quick speed change enjoyed through the use of the motor, a clutch and brake device is furnished for instantly stopping the machine without stopping the motor. This feature not only saves time in setting, adjusting and inspecting the work, but also saves wear and tear on the motor from frequent stopping and starting, the latter running continuously while the job is in the machine. The shaper has been designed and built by Gould & Eberhardt, Newark, N. J., the motor being of the induction type supplied by the Allis-Chalmers Company, Milwaukee, Wis.



MOTOR DRIVEN SHAPER.

Rail-Bond Protector and Auxiliary Bond.

The Chase-Shawmut Company of Newburyport, Mass., has placed upon the market the Shawmut rail-bond protector, a device designed to protect both the soldered and plug type of bond from being sheered off by wagon wheels, damaged by paving stones or ballast, injured by track crews and to discourage theft. The protector is made of heavy steel securely fastened to the rail by means of the bolts which hold the fish-plate in place, thus making its application of the simplest nature. It is of such shape as to allow inspection without re moval of fishplates, and can be applied to either new or old rails without impeding traffic.

As a means of increasing the efficiency of plug and pin bonds the same company has devised the Shawmut auxiliary bond. This consists of a copper cap with a rail-engaging flange filled with solder, which is heated and applied to the end of the bond. By giving additional contact surface the resistance at the rail joint is reduced to a minimum. It is stated that a recent test made with auxiliary bonds applied on new plug bonds just installed showed a gain of over 15 per cent in conductivity.

Corrugated Mirror Reflectors.

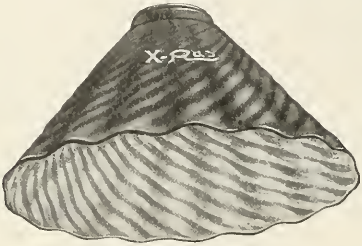


FIG. 1.—CONE REFLECTOR.

The National X-Ray Reflector Company, 247 Jackson Boulevard, Chicago, has recently added two important reflectors to its line. One of these, No. 700, shown in Fig. 1, is a deep cone reflector of the concentrating type. The distribution of light from this reflector with a 16-cp incandescent lamp is shown in Fig. 2. This reflector is similar to reflector No. 696, which this company has been manufacturing for a number of years, and which is in extensive use. The new reflector is blown in a mold instead of being hand-formed, and hence will be uniform in shape, size and corrugations. The corrugations are of a design which largely eliminate the light and dark streaks which are so likely to be found on a surface illuminated from mirrored reflectors. The conical reflector produces a fairly broad concentrated beam of light. While the concentration is not as extreme as can be produced by some conical mirrored and smooth opal reflectors, the manufacturers believe that for most purposes where a reflector of this character is needed, an extreme concentration over a very small area is not as desirable as a concentration which will give 90 candle-power over a considerable angle, as does this reflector. On account of the efficient character of the reflecting surface, this reflector shows a much higher efficiency than any of the tin or aluminum reflectors, or the common green-plated opal desk shade. It is claimed to have a more durable reflecting surface than ordinary built-up plate-mirror reflectors, and can be used in a great many locations where the streaked light cast by the older forms of mirrored reflectors would prohibit their use. This conical reflector is suited to use over desks, jewelry counters, display tables, show windows, billiard tables, and, in fact, all places where an opaque concentrating glass reflector is desirable. It gives notably excellent results for billiard-table lighting, five lamps being hung over a table, one in the center and one over each corner. The distribution of light is such as to give a strong, uniform illumination over the table with this arrangement without allowing the light to shine in the eyes of the players.

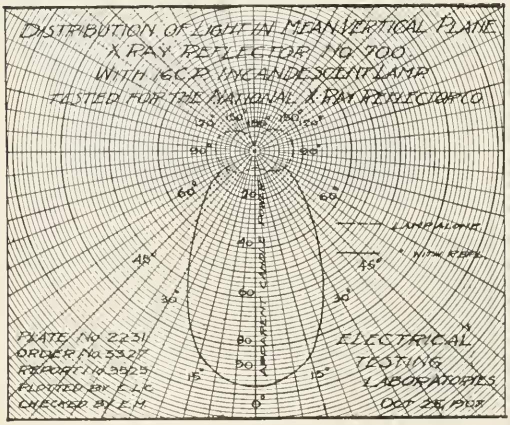


FIG. 2.—DISTRIBUTION OF LIGHT FROM CONE REFLECTOR.

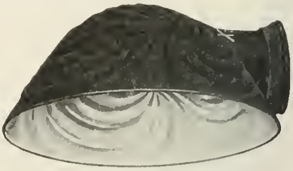


FIG. 3.—HALF PARABOLIC REFLECTOR.

In Fig. 3 is shown a new half-parabolic reflector No. 525, the distribution of light from this reflector in two planes with a 16-cp lamp being shown in Fig. 4. This reflector is suited for use over desks and blackboards, or any place where a half reflector is most properly and conveniently employed.

The silvering is applied to both of the above reflectors on the outside, and over this is placed an elastic enamel paint. The manufacturers claim great durability, and to verify these claims cite cases where these reflectors have been in continuous show-window service for five years without noticeable blackening.

In substantiation of the makers' claims for high efficiency of the reflecting surface, tests are cited which were made by the Electrical Testing Laboratories under the supervision of a committee of the Association of Edison Illuminating Companies, in the summer of 1907, in the auditorium of the New York Edison Company, the results of which have been published in the technical press. Three tests made with the room illuminated by 16-cp lamps hung pendant in deep conical reflectors similar to the No. 700, which were described, showed that from 88.3 to 79.6 per cent of the total amount of light generated by the lamps was delivered on a plane 30 in. from the floor, a higher efficiency than shown by any of the other lamps.

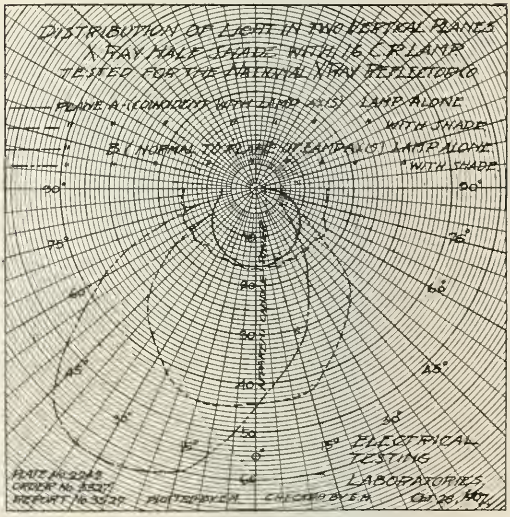


FIG. 4.—DISTRIBUTION OF LIGHT FROM HALF PARABOLIC REFLECTOR.

Motor-Driven Hydraulic Press.

An interesting incident showing a new advantage of motor drives turned up recently. A large Ohio paper mill ordered several engine-type generators of the Northern Electric Manufacturing Company, Madison, Wis. Through an oversight of the customer in his specifications, neither the engine builder nor dynamo manufacturer had made provisions for mounting the armature. When this was discovered after erecting operations had begun, it was found that no jobbing shop was in a position to handle a force-fit of about 150 tons. Accordingly the Northern Electrical Manufacturing Company shipped from its works one of its motor-driven hydraulic presses, with necessary rigging for pressing the armature on the shaft. A small generator was rigged up to furnish current and the job of pressing completed in short order. Had not the portable motor driven outfit been available, considerable delay would have been necessary, and much expense in shipping the armature and shafts to the engine builder's factory for mounting.

Lundell Fan Motors.

The Lundell single field-coil fan motors illustrated herewith, made by the Sprague Electric Company, are made for 12-in. and 16-in. fans, and are provided with a universal joint so that the fan motors may be placed in various positions. A self-feeding oil cup, which is independent of the bearing, is a feature of the construction. A speed regulating rheostat permitting three widely varying speeds is mounted in the motor base. The form of construction employed in making the fan blades renders it impossible for the blades to become loose. The importance of perfection in small details has constantly been kept in mind, so that the details of the 1908 fan are only such as previous experience has shown to be the best for the purpose. It is only in minor details that the fan motor differs from that of previous years.

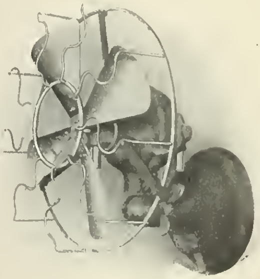


FIG. 1.—BRACKET FAN.

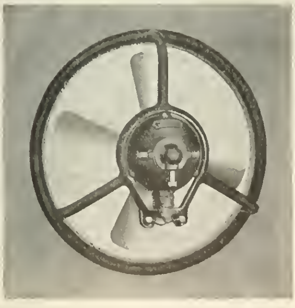


FIG. 2. EXHAUST FAN.

The midget exhaust fans, one of which is shown herewith, have their motors mounted by means of brackets so that the blades revolve in the opening made in a board or other suitable material cut to fit the top or bottom of a window. A small wall rheostat is furnished with which the speed of the motor can be suitably controlled. The motors are designed for 115 and 230-volt circuits; the 12-in. fans taking 0.43 and 0.25 ampere, respectively, and the 16-in. fans requiring 0.77 and 0.40 ampere, respectively. The motors are all given a high grade finish, which has contributed much to their popularity.

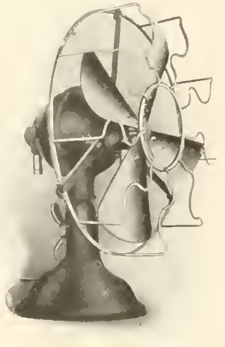


FIG. 3.—UNIVERSAL-JOINT DESK FAN.

General Electric Fan Motors for 1908.

General Electric fan motors for 1908 are somewhat plainer and more simple than those of previous design, but possess the same high degree of efficiency, speed, control and reliability. The most noticeable feature in connection with the direct-current desk motors is the universal joint with which they are equipped, and by means of which a desk motor may be instantly transformed into one of the wall-bracket type, or vice versa, without the aid of tools. Desk fans, as usual, are furnished in all different types for standard voltages and frequencies. Both direct- and alternating-current fans of the desk type are fitted with 12-in. or 16-in. blades. These, with the bracket-type fans of the same design and sizes, are available for all classes of service. Quite recently the use of the fan motor in the cold-air pipe of the hot-air furnace has been exploited as an economical addition to the heating system. The square frames of the exhaust-fan types might readily be adopted for this purpose, and a permanent installation be made. The illustration of the exhaust fan indicates the method of mounting. This type of fan is useful in both private and public kitchens, in restaurants, lavatories and stores where a permanent method of ventilation is desirable.

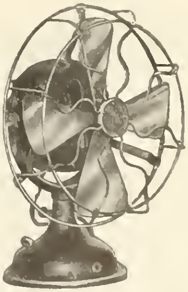


FIG. 1. ALTERNATING-CURRENT DESK FAN

The design of the ceiling and column fans, here illustrated, is radically different from that of the 1907 type. The general appearance is very simple and the motor body is much thinner, which results in a corresponding decrease in weight, while the improved ball-bearing renders the operation of the motor practically noiseless. These motors are fitted with four wooden blades having a 52-in. sweep, which suits them for the cooling of large areas without disagreeable draughts. The alternating-current ceiling fans are for operation on 60-cycle circuits, at 100-110, 112-120 and 220 volts. They are furnished in both plain and ornamental finish. The direct-current ceiling fans are for operation on circuits of 115 and 230 volts.

The speed variation of the alternating-current fans is obtained by a six-point regulating switch and reactive coil. In this way the General Electric standard desk or wall-bracket type is of well-nigh universal application, since it may be operated on slow speeds for the office desk or home, and on the higher speeds for stores and halls. Similar speed regulation is obtained in the direct-current type of desk and wall-bracket fans by a self-contained four-point switch and indestructible resistance, giving three speeds.

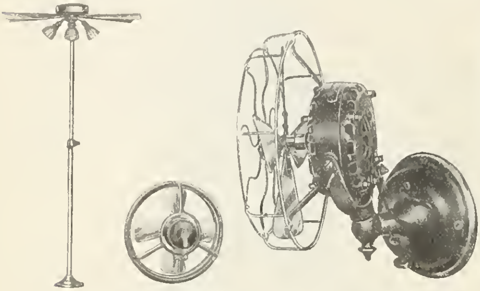


FIG. 2.—ALTERNATING-CURRENT COLUMN FAN. FIG. 3.—DIRECT-CURRENT EXHAUST FAN. FIG. 4.—ALTERNATING-CURRENT WALL FAN.

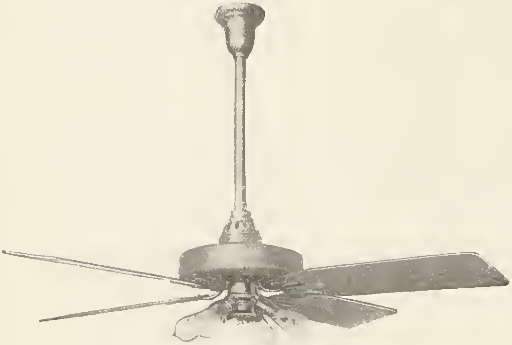


FIG. 5.—DIRECT-CURRENT CEILING FAN.

All the various types of fan motors which have been mentioned are made in standard commercial sizes, and for any commercial voltage and frequency. In general, the standard finish is black with brass trimmings, but this may be varied to meet special conditions, and fans can be decorated to match office fittings or to harmonize with the hardware in private dwellings.

Emerson Fan Motors.

The Emerson Electric Manufacturing Company offers a complete line of alternating-current induction desk, ceiling and column fans in all standard sizes and types; also a line of direct-current series desk fans. All types of desk fans are convertible into bracket fans without extra parts.

The Emerson medium-speed desk fan shown in Fig. 1 is a two-speed swivel and trunnion fan, made in 12 and 16-in. sizes. In addition, an Emerson slow-speed 12-in. two-speed swivel and trunnion residence-type desk fan is offered, equipped with six blades, as shown in Fig. 2. This fan is considerably more quiet than the medium-speed type, and is intended especially for home use.

The line of "Trojan" induction desk fans offered by the Emerson Company consists of the same sizes and types as above mentioned, but Trojan fans are equipped with triangular blades instead of the patented Parker blades used on the Emerson fans shown in Figs. 1 and 2. All induction desk fans offered by the Emerson Company have a special automatic starting device and industrial-motor form of field winding, resulting in high efficiency.

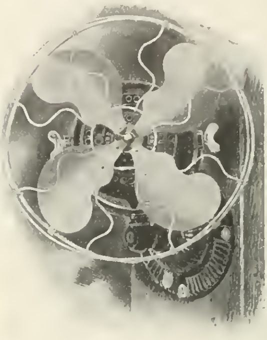


FIG 1.—CONVERTIBLE FAN.

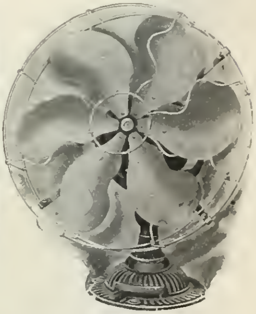


FIG. 2.—RESIDENCE FAN.

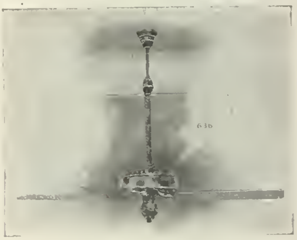


FIG. 3.—CEILING FAN.

Emerson alternating-current ceiling fans are made in two styles—a high-speed four-blade, and a slower-speed two-blade type. The latter is intended especially for residence use, small offices, etc. Emerson fans are finished in ornamental oxidized copper, furnished with adjustable hanger, and are arranged to run at three speeds.

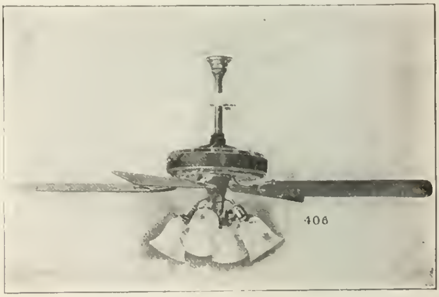


FIG. 4.—CEILING FAN WITH ELECTROLIER.

"Trojan" alternating-current ceiling fans, also made by the Emerson Company, are similar in internal design to those known as the Emerson, and are likewise made in two- and four-blade styles. Trojan fans are finished more plainly in black japan, are furnished without hanger rods, and have only two speeds.

In direct-current desk fans, the Emerson Company offers 12- and 16-in., three-speed swivel and trunnion desk styles, convertible into bracket styles. These are medium-speed types suitable for stores or large offices where maximum breeze is desired. A six-blade residence type, direct-current desk fan (a new type) is also offered this year, with a maximum speed of approximately 1100 r.p.m.

Alternating-Current "Standard" Fans.

The accompanying illustrations show several models of alternating-current fans which the Robbins & Myers Company, of Springfield, Ohio, is placing on the market this year for the first time, to supplement its line of direct current fans, each model of which has been previously described in these pages.

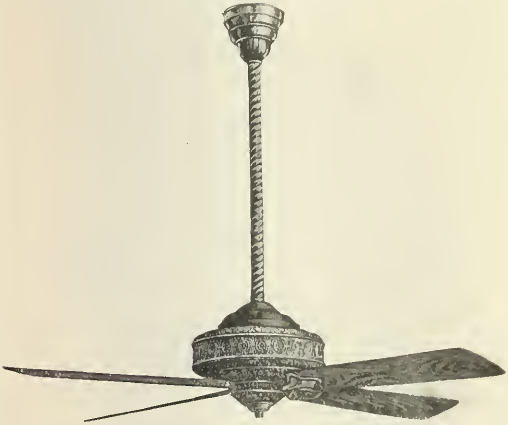


FIG. 1.—ALTERNATING-CURRENT CEILING FAN.

The alternating-current ceiling fans carry blades of 57-in. sweep, which can be run at 200, 150 and 100 r.p.m., according to the position of the switch, which also starts and stops the fan. The motor is provided with a casing directly below the fan blades, which is tapped to receive an electric light fixture should it be desired to make the combination of electrolier and fan. Owing to the large diameter of rotor necessary with ceiling fan motors of this type, and the consequent weight of the rotor, ball-bearings are used and are provided with automatic lubrication, facilitating starting and increasing the efficiency of the motor.

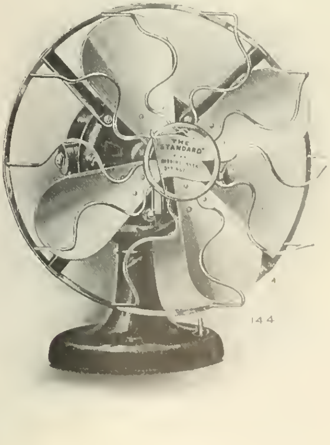


FIG. 2.—ALTERNATING-CURRENT DESK FAN

The alternating-current desk fans are provided with a switch for starting and stopping, and giving two running speeds of approximately 1300 and 1500 r.p.m. for the 12-in., and 1200 and 1500 r.p.m. for the 16 in. fans. They are convertible from desk to bracket type by the use of an adapter, and without disturbing the wiring of the motor, so that it is no longer necessary for a dealer to carry in stock both desk and bracket fans. They are provided with the usual swivel and trunnion support which allows of the adjustment of the direction of the air current.

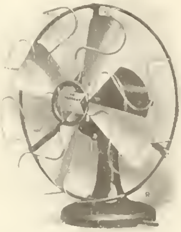


FIG. 3.—9-IN. DIRECT-CURRENT AND ALTERNATING-CURRENT DESK FAN

The extension of lighting mains into the residence districts has created a demand for a new type of fan—one which is intended for use principally in residences and small offices. This is the 9-in. fan, which is illustrated here for the first time. For this class of service the 12-in. fan has been found more powerful than necessary, and the smaller fan is finding a ready use. It is not designed as a low priced fan, but is simply smaller in size and is made as neat and artistic as possible, and special attention has been given to making it cleanly, durable and silent running, thereby adapting it to its particular field. It is provided with the usual switch in the base, giving speeds of approximately 1000 and 1700 r.p.m. This fan forms a notable exception to the rule in favor of the induction type of motor given above, in that it is provided with commutator and brushes.

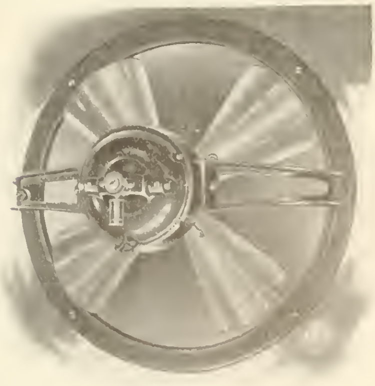


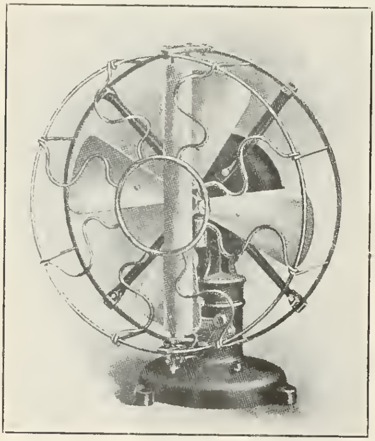
FIG. 4.—EXHAUST FAN

and the series wound motor. The 9-in. fan is also supplied wound for 110 and 220 volts, direct current.

For the last few years this company has had on the market two sizes of small exhaust fans made by adapting its 12-in. and 16-in. direct-current desk-fan motor bodies to exhaust-fan service. In addition, it is now furnishing the 12-in and 16-in. alternating-current induction type motors mounted in the same way. The accompanying illustration shows the direct-current model, which is very similar in appearance to that for alternating current.

Colonial Fan Motors.

The Colonial Fan & Motor Company, of Warren, Ohio, builds a line of direct-current desk and ceiling fan motors, which though they follow the same general design as last season's output, embody some minor improvements. One type of desk-fan motor is provided with swivel and trunnion movements, while two other types have swivel motion only. The oscillating fan built by this company is shown herewith. The rotating part travels on a tempered ball-bearing so as to limit friction to a minimum. The vane which operates the mechanism is located inside the fan guard where the air from the fan impinges on it. The actuating device is simple and positive. Collector rings and brushes placed above a two-speed switch in the base of the fan make it possible to omit the customary flexible lead connections. The motors are designed for 110- and 220-volt circuits, and are fitted with 12-in. and 16-in. fans. For railway and storage-battery service, fans are built for 25, 30, 60 and 80 volts. Two types of ceiling fan, each with a 60-in. sweep, are built. Both types are built for five different voltages, but only one type is capable of speed adjustment. The exhaust fans built by the company are of the enclosed, series-wound type, and are equipped with a speed controller, fan runner and supporting ring. The motors are designed for 110, 220 and 500 volts.


OSCILLATING DESK FAN.

Western Electric Fans.

The Western Electric Company presents for the season of 1908 several additions and improvements in its comprehensive line of fan motors and exhaust fans, while retaining the many good features which have proven their excellence in the past.

The Universal type direct-current fan motor is now put on the market in two sizes, of 12 in. and 16 in. It operates on voltages of 110 or 220 and has three speeds. This season's model is fitted with an improved oil thrower, which absolutely prevents any oil getting out of the bearing housing. This feature will meet with hearty approval from fan users who have experienced the annoyance caused by the sparking of dirty commutators. The same fan can be used as either desk or bracket type by the simple adjustment of a thumb-screw.

The Zero type, direct-current fan has an improved design of commutator and operates at 110, 220 or 500 volts. The 16-in. size has a guard of new design, and both the 12-in. and 16-in. fans have three speeds.

An entirely new fan motor is presented this year for use in telephone booths and similarly confined places which reach an oppressive temperature during the warm season, and where the use of a large fan is not only unnecessary, but expensive. It has an 8-in. fan, and is provided with spring suspension to overcome vibration. Either direct or alternating current at 110 volts can be used, and no special resistances or alternators are necessary in changing from direct to alternating current.

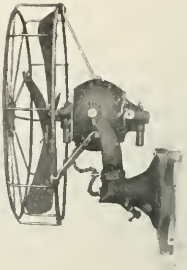


FIG. 1.—UNIVERSAL FAN.

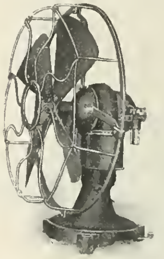


FIG. 2.—ZERO DESK FAN.

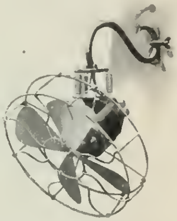


FIG. 3.—TELEPHONE-BOOTH FAN.

A new addition to the line of alternating-current fan motors is the Victor, which is supplied in both the ceiling and the desk type. The desk type is adjustable for use either as a desk or wall fan, and operates at 110 or 220 volts. A wide range in frequency is assured, as the motors are built to run on from 25 to 133 cycles.

The Western ceiling fan is now put out in two types, one operating at a single speed and the other having three speeds. The one-speed type is provided with a snap switch. In addition to the regular finish of black enamel, this type may also be given an oxidized copper finish. The voltages are 110, 220 or 500.

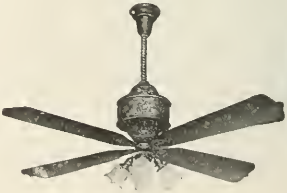


FIG. 4.—STANDARD CEILING FAN.

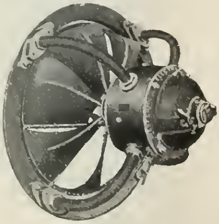


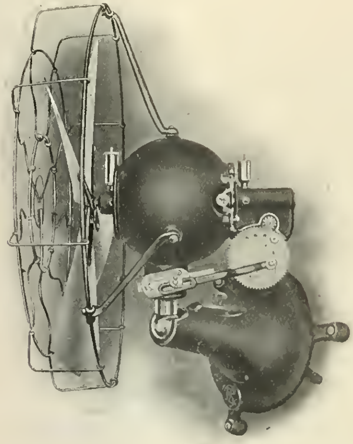
FIG. 5.—EXHAUST FAN, WITH TYPE E MOTOR.

An improvement in Western Electric exhaust fans which merits special mention is the use of new types of motors.

Type "I" motors are used on the 18, 24, 30 and 36-in. outfits, and Type "E" motors on all larger sizes. Both of these machines are standard types of industrial motors.

Eck "Hurricane" Oscillating Fan Motor.

The accompanying illustration shows the "Hurricane" oscillating fan motor built by the Eck Dynamo & Motor Company, of Belleville, N. J. The motor is provided with universal adjustment and a positive mechanical device is used to produce the oscillatory motion. A rheostat, by means of which three speeds may be obtained, is provided in the base of the pedestal.



"HURRICANE" OSCILLATING FAN.

The oscillating device is adjustable so that the motor may remain stationary or the oscillations reduced to meet requirements. The transmission device operates in an oil case, insuring positive lubrication and durability. The brush holders are of the well-known Eck type, and square brushes are used. The latter are held firmly in place and have a positive feed, so as to render them noiseless in operation as well as sparkless. The motors are equipped with 12-in. and 16-in. fans, and are designed for operation on 115- and 230-volt, direct-current circuits.

Bates Direct-Current Fan Motors.

The line of direct-current fan motors built by the D. L. Bates & Brother Company, of Dayton, Ohio, includes many types of ceiling and desk fans. All of the ceiling fan motors except one are built for 110, 167, 220, 250 and 500 volts, and the energy consumption is stated to be 90 watts on a 110-volt circuit, motors wound for higher voltages consuming power in proportion. One type of ceiling fan is shown herewith. Some of the ceiling fans are fitted with incandescent lamps, which revolve when the fan is in motion, although the wiring is independent of the motor circuit: the column fans are similarly equipped. The desk fans are built in pedestal, bracket, trunnion and universal types. The universal type shown in Fig. 2, has a 20-in. fan, the other motors being equipped with 12 and 16 in. fans. The desk fans are designed for operation on 110- and 220-volt circuits, and are provided with a base rheostat giving three speed adjustments.

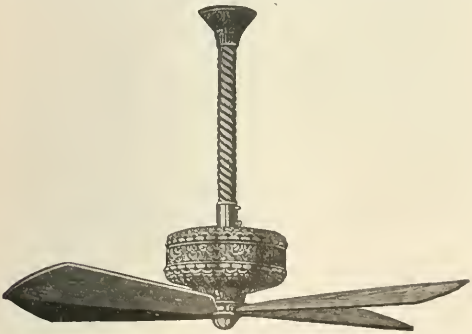


FIG. 1.—DIRECT-CURRENT CEILING FAN.

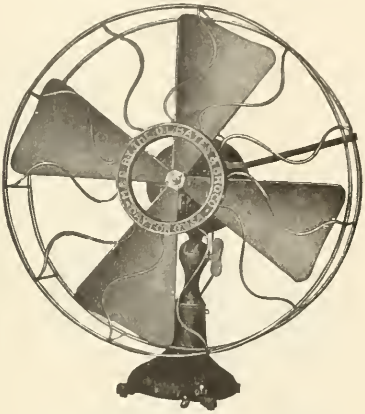


FIG. 2.—UNIVERSAL DIRECT-CURRENT DESK FAN.

Peerless Direct-Current Fan Motors.

Technically considered, the fan motors built by the Peerless Electric Company, of Warren, Ohio, continue much the same as in previous years. Only two types of ceiling fans are offered this year, the working parts of which are identical. The swivel and trunnion desk fans still retain the features for converting them into bracket fans by adjusting a thumb-screw at the trunnion, and the entire interior of the fan motors is japanned so as to prevent rust when operating in damp locations. The motors are equipped with standard-sized fans, and are designed to operate from 110- and 220-volt circuits. The oscillating fans are fitted with a shifting vane inside the fan guard and the reversals of oscillation are cushioned by the air from

DESK FAN

the blades. The fan body rotates on a ball-bearing, and the brackets that support the actuating vane are rigidly fastened to the guard. The electricity is transmitted from the main circuit through carbon brushes to collector rings mounted on the bearing shaft. The column and ceiling fan motors have speeds of 110, 170 and 220 r.p.m. The current required varies from one ampere on 110 volts to 0.23 ampere on 500 volts; the motors are also designed for 170, 220 and 250 volts.

The 1908 Westinghouse Fan Motors.

Changes do not always mean improvement, and the fan that embodies the greatest number of changes this year may still be in need of the greatest number of improvements next year. In the case of the fan motor, no new principle has lately been discovered, and the fan motors of 1908 which embody any radical improvements show at the same time that there was room for improvement. Westinghouse fans for 1908 show very slight modifications over the 1907 models for the very good reason that the 1907 fans needed very slight modifications. The design of Westinghouse fans is the work of experienced engineers who make a specialty of this branch of the electrical business, and the product that is offered to the public is thoroughly tested and tried out before it is put on the market. The result is a line of fan motors giving maximum air current for the minimum electric current.

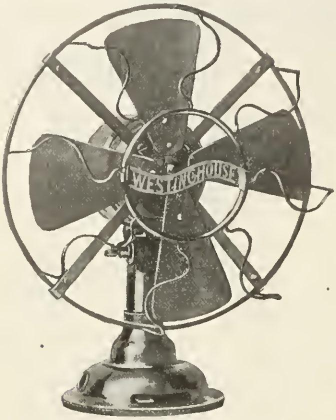


FIG. 1.—DIRECT-CURRENT FAN.

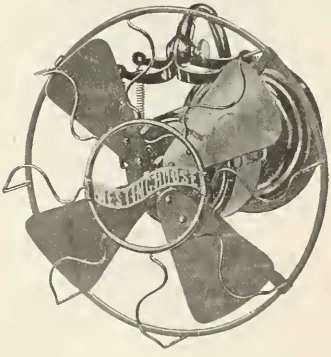


FIG. 2.—WALL BRACKET FAN.

The motors themselves are as much Westinghouse in their characteristics as the motors of large capacity made by the Westinghouse Electric & Manufacturing Company. This means that they are made of the best materials and thoroughly tested before leaving the works, and that they will run for many seasons without expense for repairs.

In comparison with the motor, the blades seem to be a simple matter, but upon them depends both the current consumption and the volume of air set in motion, which is the final test of the apparatus. Much attention has been given to the design of the blades of the desk and wall type to get the most effective movement of the air, and the result is a blade that moves the greatest possible quantity of air in the form of a solid cone so as to eliminate waste of energy in useless eddies. Consequently, the saving in current for the volume of air moved is marked when comparison is made with a fan whose blades give a strong current in front of the ends and a weak current in front of the center. The 12-in. alternating-current Westinghouse fan requires one-third less current than a 16-cp incandescent lamp, and the 16-in. alternating-current fan one-third less than two 16-cp lamps. The 16-in. direct-current fan shows about the same economy as the alternating current, while the 12-in. direct-current requires only half as much current as a 16-cp lamp.

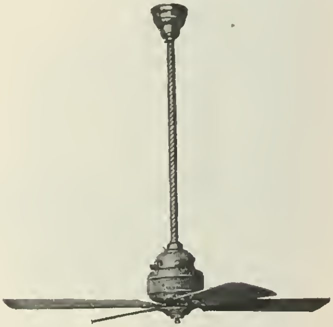


FIG. 3.—DIRECT-CURRENT CEILING FAN.

Adding to the low cost of operation the fact that a fan motor will operate several years with little or no cost for repairs, and at a low first cost, it becomes an article that is well within the means of every user of electric light whether for commercial or domestic purposes, and is removed from the list of luxuries and added to the list of necessities.

A prominent feature of Westinghouse fan motors is their comparatively noiseless operation. Special 8-in. blades, which run absolutely quiet, can be furnished with 12-in. motors, where fans are desired for sickrooms. With these blades the motors consume far less energy and, at the same time, deliver as much air as many 12-in. fans of other makes. Equally successful results may be had by using 12-in. blades on 16-in. motors.

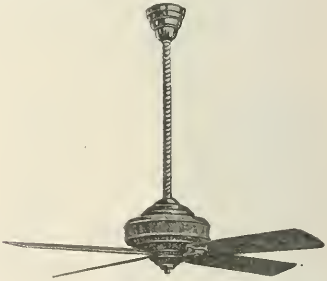


FIG. 4.—ALTERNATING-CURRENT CEILING FAN.

The Westinghouse line of fans for 1908 embraces all the different types; namely, desk, wall bracket, ceiling, ventilating, floor and counter, for both direct- and alternating-current circuits, and for all commercial voltages.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—With the advancing season, the jobbing trade shows a considerable increase, but the wholesale trade remains quiet and the retail trade very quiet. Collections are still slow and the lack of speculation is reflected in the reduced number of bank clearings. In the iron and steel trades the buying of steel rails is the chief development of the week, a number of railroads having placed considerable orders for the finished steel. The leading steel company is now operating a trifle in excess of 50 per cent of its rolling capacity, as compared with a ratio of less than 30 per cent a few months ago. In the textile manufacturing interests it is reported that the output is about three-fourths of the normal. The winter wheat crop is in excellent condition and the export of cereals continues heavy. The demand for structural material is fair and business for February was considerably in excess of that of January. *Bradstreet's* reports 254 failures for the week ending Feb. 27, against 326 last week, as compared with 194 for the same week in 1907 and 180 in 1906. An encouraging increase in orders, with growing activity, is reported for the last week, by the larger electrical manufacturing concerns, particularly in the export line. The export demand for bronze rod and copper wire is excellent and a number of new contracts of considerable importance for installations in foreign countries are under consideration. In certain foreign sections where the panic in the United States has been slow in reaching, the electrical business is just beginning to show the effects. "Chili is bankrupt and Peru little better," said an agent for a well-known electrical exporting firm, "but from other parts of the world the reports indicate that the business prospects for the next six months are excellent." The same firm says that large orders have been received from Japan, and another foreign contracting firm reports having received important specifications and inquiries from China and South America. The progress of the Westinghouse Company toward a final settlement of its financial difficulties is an encouraging feature and the increasing activity in all electrical lines furnishes some basis for the large amount of bull talk on copper metal and copper shares which has been much in vogue in Wall Street of late. The repair business and supplying of large plants prefer in such times of stringency to repair old machinery and take chances, rather than create additional fixed capital, but a number of specifications and inquiries in increasing volume have been received during the last week by dealers in electrical supplies both large and small.

BUTTE ELECTRIC & POWER COMPANY.—President C. W. Wetmore, of the Butte Electric & Power Company, of Butte, Mont., reviews the work of the corporation for the past year as follows: "During the year 1907 the company has acquired the electric-lighting properties at Livingston, Mont., including a hydro-electric plant and water rights upon the Yellowstone River near Livingston; has completed the second hydro-electric plant on the Madison River, an installation of 12,000 hp; has extended the power transmission lines of the Madison River plants to the plant at Livingston, thus uniting the powers of the Madison River and the Yellowstone; has installed a new central steam-heating station at Butte, and has made other important improvements upon its various properties. The properties of the company are in excellent condition, and the operating efficiency and earning capacity are greater than ever before in its history. Besides its reserve plants, the company has now installed hydro-electric generating capacity aggregating 20,000 hp as follows: Upon the Madison River, 15.000; upon the Big Hole River, 4000; upon the Yellowstone River, 1000. Through its subsidiary companies, the company is in possession of water rights which will admit of the development of from 30,000 to 40,000 additional hydro-electric horse-power at unusually low cost. During the year 1906 an exhaustive examination on behalf of the company was made by competent experts of the water powers of Montana and of the present and prospective market for hydro-electric power, and the conclusion reached that the demands for such power would keep pace with the probable prospective development and would ultimately exhaust the entire water-power capacity of the state. The undeveloped rights of the company are, therefore, believed to be of great value."

AMERICAN ELECTRICAL MACHINERY.—Reporting on the State of Jalisco in Western Mexico, Special Agent Arthur B. Butman states that American electrical machinery has the best reputation there, although the Germans are making strenuous efforts to obtain the Mexican trade in electrical devices. The mining machinery used in the mining districts of that region is, for the most part, of American manufacture. The American manufacturer in the case of mining machinery at least, has studied the needs of its customers, the requirements of packing and shipping, and consequently the American machinery has the higher reputation. In order to be carried over the trails in a convenient manner, most of the machinery is shipped in sections.

SPANISH ELECTRICAL CONSTRUCTION.—In the issue of the *Gaceta de Madrid* of January 21 appears a text of a Spanish decree, granting a concession to Don Luis Montesino y Espartero for the construction of an electric tramway called the Tranvia Transurbano de Madrid, from the station of Mediodia to the north station at Madrid. The Jan. 23 issue of the same paper announces that the Compania del Ferrocarril de Langreo y del Sindicato Verina Abono-Musel has been authorized to construct the necessary works for the production of electric power in the port of Musel, Spain.

THE JACOBSON MACHINE MFG. CO., Warren, Pa., states that so far it has not experienced any slack-up in orders received or business done, and that it has not laid off any men nor reduced wages since the commencement of the period of general business depression. An office has recently been opened at Atlanta, Ga., to meet the rapidly growing Southern demand for the types of gas and gasoline engines manufactured by the company.

TURBINES IN NEW HAVEN.—The United Illuminating Company, New Haven, Conn., has placed orders for two 400-hp steam turbines, which will be installed in the company's plant on George Street. The new equipment will be used in connection with the extension of incandescent lighting service in the residential districts of the city. The company has recently increased its capital stock from $1,000,000 to $1,500,000.

THE ELECTRICAL MANUFACTURING COMPANY, 926 Lafayette Street, New Orleans, has been incorporated with a capital of $25,000 for the manufacture of a high-grade line of panels and switchboards, steel outlet boxes, etc. The officers are Geo. W. Logan, president; Warren B. Reed, vice-president; E. S. D. Logan, secretary and treasurer, and Lyman C. Reed, manager.

THE WESTINGHOUSE LAMP COMPANY'S factory at Bloomfield, N. J., is now in operation, and arrangements are being made to concentrate there all lamp manufacturing. The capacity of the new plant is about 15,000,000 lamps annually. During the receivership, which ended March 1, there was no cessation of work in completing the factory and in turning out lamps.

NEW NOARK LINE.—The Johns-Manville Company has in preparation a new line of Noark service and subway boxes, embracing a large variety of types for the various classes of service. The new line will be placed on the market in about a month, when the company will issue its spring catalog

MEXICAN RAILWAY PLANT.—In the Jan. 7 issue, the *Mexican Diario Oficial* contains the text of a contract entered into by Sr. José Sarinana, representing the Compania del Ferrocarril Electrico de Lerdo a Torreon, for the construction of a line between the states of Durango and Coahuila.

ELECTRIC SUPPLIES.—From the Far East, an American consular officer reports on the possibility of selling American supplies in that territory. The Bureau of Manufactures, at Washington, D. C., will furnish further particulars to applicants.

THE WEEK IN COPPER.—The features of the week in the copper market were continued heavy shipments of metal abroad, the activity exhibited by copper stocks and the resumption in part of the operations by the Amalgamated properties in Butte. It was believed that the foreign movement was nearly ended, but exports for February were 24,640 tons, or a total of 57,659 tons since the beginning of the year as compared with 26,213 tons for February, 1907. There are those who believe that Europe is still capable of taking an indefinite amount of American copper at the present prices. The resumption of operations in Butte seems hardly to be justified by the conditions at home and abroad. Approximately 175,000,000 pounds a year will be added to the copper output by the opening of the Amalgamated mines, and this in the face of the fact that there has been little increase, if any, in the home demand for the metal. It is known that the greater part of the foreign shipments has not gone into consumption, and it is thought that the same thing will happen which took place several years ago, when, under similar conditions, a great quantity of the metal was shipped to China, only to be held there and thrown back on the home market when the price of copper had risen. A dispatch from Butte states that John D. Ryan, managing director of the Amalgamated Copper, said in reference to the copper situation: "There has been a very considerable change for the better in the market for the metal, in that the sales for European shipment have been very large within the last few weeks. There is no accumulation of copper unsold that is worth considering. The American consumption is light compared with the last few years, and the large sales made during the last six months have been mostly for export, but we are in hopes that by the time the increased products resulting from a resumption of operations will have reached the market, which will be in three or four months, the American demand will have increased sufficiently to take up the increased production." At present there are ten copper mines in operation which can yield a yearly total of 150,000,000 pounds at a cost of ten cents or less. In ordinary times the American consumption is about 50,000,000 pounds monthly, and in 1907 it was about 70,000,000, but at the present rate the monthly consumption is placed at less than 20,000,000 pounds. Persistent reports of late have been in circulation to the effect that B. B. Thayer is to succeed Henry H. Rogers as president of the Amalgamated Copper Company and there has been much talk of some sort of deal between the Amalgamated Copper Company and certain mines in Butte and others in Nevada and Utah. The Carro De Pasco Copper Company has been incorporated with a capital of $60,000,000 to mine copper, gold and other ores. Closing prices on the Metal Exchange on Monday were:

Lake	12½@12¾c.
Electrolytic	12⅜@12⅝c.
Castings	12¼@12½

The London market was as follows:

	Noon. £ s. d.	Close. £ s. d.
Standard copper, spot	57 2 6	57 7 6
Standard copper futures	57 12 6	57 17 6
Market	Weak.	Firm.
Sales of spot		300 tons
Sales of futures		900 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 12 6
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0 0

WESTINGHOUSE COMPANIES.—Following the action of Judge Lanning, of the Circuit Court of Trenton, N. J., on Feb. 24, in ordering the New Jersey receivers of the Westinghouse Lamp Company to turn over the business to the company, Judge Ward in the United States Circuit Court of New York, on Feb. 27, on the application of George Whitfield Betts, Jr., counsel for the New York receivers, entered an order directing the New York receivers of the Westinghouse Lamp Company, Charles B. Hill, Edward H. Childs and T. W. Siemon, to turn over and convey back to the company all its assets and property, and to pay claims under $500, the company having made a settlement with its larger creditors. The report of the New Jersey receivers showed that the company from the time of their appointment, and up to the time of their discharge, had earned $50,000 net profit. The present liabilities of the company was given as about $300,000, and the assets $2,500,000, exclusive of good-will, patents, etc. Under the order, the company agrees to pay in full all creditors whose claims are less than $500. All creditors having claims in excess of that amount are to be paid January 1, 1909, with interest. The final date for receiving deposits of the creditors of the Westinghouse Electric Company was March 1, but the Committee for Readjustment has given notice that it has extended the period of limitation for deposits of obligations and claims until March 31. A meeting of the stockholders of the Westinghouse Electric & Mfg. Company has been called for April 29, to consider bond and stock issues, as suggested, in place of creditors committees. An officer of the Westinghouse Electric Mfg. Company, of Pittsburg, states that the company is employing about 60 per cent of its usual quota of men. Ninety-nine per cent of the creditors, representing $7,000,000 of liabilities of the Westinghouse Machine Company, have consented to the proposed plan by which creditors are to take, in payment of their claims, five-year notes, to be retired in annual installments out of earnings. In previous years the Westinghouse Machine Company has shown net earnings of over $800,000, so that in 5 years the company would be able to retire notes close to $4,000,000. The balance would then be refunded in permanent form. During the month of Feburary the business of the Westinghouse Machine Company showed marked improvement. Last week a number of good sized orders were received in the various departments, and as a result, there was greater activity in the shops in East Pittsburg than at any time since the financial depression began. Recent shipments from the works on export delivery are reported to include several large steam engines. One of these shipments, consisting of five 125-hp compound engines, was consigned to Takata & Company, the Japanese agents of the Westinghouse companies in Tokio, for delivery to a plant in Canton, China. Another compound engine of 500-hp capacity, also included in this shipment, was consigned to the same firm, for delivery to the Japanese Railway Company of Maisha, Japan.

EASTERN PENNSYLVANIA TRACTION SYSTEM COMPLETED.—The eight miles which form the connecting link in the electric traction system of the Pottsville Union Traction Company and the Tamaquah & Lansford Street Railway Company, now known as the Eastern Pennsylvania Railway Company, were opened on Feb. 27 and are now in operation. The completion of this part of the system gives a thorough service from Pottsville to Mauch Chunk, a distance of thirty-five miles, and affords a new route to New York, from Pottsville to Mauch Chunk by the electric road and thence to New York by way of the Lehigh Valley or Central Railroad of New Jersey. Work on the connecting link which has just been completed was begun on Oct. 1, 1907. These properties and various other lighting properties in that region were constructed and are under the management of the firm of J. G. White & Company. The entire traction system embraces 107 miles of urban and interurban roads. Power for the roads and the lighting systems is furnished by a new power station at Palo Alto, which has a capacity of 5000 horse-power.

THE SOUTHWESTERN MACHINERY & SUPPLY COMPANY, of Los Angeles, Cal., recently organized for the purpose of representing manufacturers of machinery and supplies exclusively in the fast growing Southwest, is under the management of Mr. Chas. L. Michod, who has been in this same business at St. Louis, and Havana, Cuba, for the past five years. The president of the company is Mr. J. Wallace, of 42 Broadway, New York, and Mr. Theo. G. Finley, of Los Angeles, is vice-president and treasurer. Considerable business with the Mexican trade is also anticipated, but Southern Nevada, Arizona and Southern California will be the principal territory covered.

THE ELECTRIC CABLE COMPANY OF BRIDGEPORT, CONN., will re-build a modern and larger plant to replace the works which were partially destroyed by fire on Feb. 18. A portion of the old plant which was not seriously injured is now running.

THE AMERICAN WELDING COMPANY has been formed to take over the welding business heretofore conducted by the Morton Iron Works, at Brooklyn, N. Y. The business will hereafter be located at Carbondale, Pa., and will be conducted on a much larger scale than in Brooklyn.

Financial Intelligence.

THE WEEK IN WALL STREET.—Extreme sluggishness prevailed in all the stock markets of the world during the last week, London particularly vying with Wall Street in dulness. In New York the business of buying and selling stocks was very nearly at a standstill and the entire sales for the week were less than the aggregate sales of many single days in the past. The public showed not the slightest inclination of touching the market, either for investment or speculative purposes, and practically all the trading that was done was by the professionals. At the same time the market showed a rock-like tendency, exhibiting the greatest firmness upon the receipt of bear reports that would have caused a sharp downward drive in the securities affected, in ordinary times. Such upward tendency as existed was centered in a few issues, conspicuous among which were the copper stocks. The bull movement in copper is attributed to the alleged improvement of conditions in the home metal market and the stronger showing of London copper stocks. Interborough-Metropolitan shares also moved sharply upward in anticipation of the benefits which it is expected will accrue to them from new and comprehensive financing. Steel stocks advanced out of proportion to the news of the receipt by the corporation, of substantial orders from the railroads. As exhibiting the perhaps somewhat illogical firmness of the market, the announcement on Thursday morning of a receivership for the National & Great Northern Railroad, a Gould property, caused not a ripple, although for some time past the Gould properties have been weak. The practical passing of the dividends by the Erie Railroad upon its first and second preferred stock, and the news of the withdrawal by Secretary Cortelyou of $35,000,000 from the National banks, are examples of numerous pretexts which the Street might have seized upon to make a bear market, but which were ignored. All of which seems to indicate that Wall Street, for the time at least, has ceased to concern itself with immediate causes and instead has in mind the fundamental factors which may affect the situation and which at present make for optimism. For the first time in history the gold bullion and bullion in the Treasury reached and passed the billion mark last week. During the month of February the incorporations of new companies in the Eastern States was greater than during any month since last June. The aggregate of companies capitalized at more than a million dollars amounted to $113,840,000, as compared with $72,150,000 for January. The market closed strong and dull on Monday, with copper shares the feature. Closing quotations for the week ending Feb. 29 are given in the above table.

NEW YORK.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
All-Ch.	5¾	5¾	——	Int.-Met., com...	6¾	7	4,120
All-Ch. pfd......	17	17*	400	Int-Met., pfd...	17¾	20	1,625
Amal. Cop.....	47⅞	51⅞	175,540	Mackay Cos....	53	55	500
Am. D. T......	39		——	Macay Cos. pfd.	60	59⅞	900
Am. Loc........	32¾	32*	3,250	Met. St. Ry....	15	15*	200
Am. Loc. pfd..	89½	90	350	N. Y. & N. J. Tel.	80	—	——
Am. Tel. & C'bl.	44	—	——	Steel, com.....	28¾	28⅞	121,545
Am. T. & T...	106	106½*	190	Steel, pfd......	92¼	92¼	26,000
B. R. T........	40½	40⅝	19,575	W. U. Tel.....	46¼	49	2,300
Gen. Elec......	115	116*	608	West'h, com....	39	41	1,040
Hud. R. Tel...	—	—	——	West'h, pfd....	—	—	——

BOSTON.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
Am. Tel & Tel..	106	106⅞	—	Mass. E. R. pfd.	41	—	——
Cumb'lnd Tel..	—	—	—	Mexican Tel...	—	—	——
Edison El. Ill..	—	—	——	New Eng. Tel'p.	107½	—	——
Gen. Elec......	—	117¼		W'st. Tel. & Tel.	6	—	——
Mass. Elec. Ry.	10½	—	——	W. T. & T. pfd.	50	—	——

PHILADELPHIA.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
Am. Rys.......	42	42	——	Phila. Elec.....	5⅝	5¾	——
Elec. Co. of Am.	8¾	8⅝	——	Phila. R. T....	15	14½	——
Elec. Stor. B'ty.	26	26	——	Phila. Traction..	87	86	——
E. S. B'ty pfd.	—	—	——				

CHICAGO.

	Feb. 21	Feb. 28	Shares sold		Feb. 21	Feb. 28	Shares sold
Chicago City Ry.	172½*	—	——	Met. Elec. com.	18*	—	—
Com.-Edison ...	85¼	—	——	National Carbon.	50	51⅛	——
Chicago Subw'y.	16	17	——	Nat. Carbon pfd.	102	—	——
Chicago Tel. Co.	110	107⅜	——				

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*Last price quoted.

TWIN CITY RAPID TRANSIT STATEMENT.—The full report of the Twin City Rapid Transit Company for the year ending Dec. 31, 1907, has been issued. Gross income for the fiscal year is given as $6,055,742, against $5,644,988 for 1906. Expenses were $2,980,435, against $2,675,379 for 1906. In consequence of court decisions against the company, and claims outstanding at the close of 1906, proving more than was anticipated, the reserves for injuries and damages were found to be inadequate, and an adjustment of $50,000, the estimated amount of deficiency, was accordingly made in the accounts of that year, thus reducing the surplus by a corresponding amount. Deducting the interest and taxes from the net gives a surplus for 1907 of $1,852,137, against $1,832,000 for 1906. After deducting 7 per cent on the preferred stock, the balance for common dividends of $1,215,000 equals 8.1 per cent on $20,100,000 outstanding common stock. The surplus is given as $131,137, against $237,682 for the previous year.

INTERBOROUGH BOND ISSUE.—Public Service Commission, it is stated on good authority, will shortly receive an application from the Interborough Rapid Transit Company, for permission to issue bonds for $50,000,000 to provide for the company's notes and other requirements. The amount of the first installment of these bonds will be $20,000,000 and the banking firm of Lee, Higginson & Company will put out the issue when market conditions warrant, or else use them as security for an issue of notes. The mortgage will cover the company's power-houses, rolling stock, the Steinway tunnel and the Long Island properties controlled by the Interborough. At the offices of Lee, Higginson & Company and August Belmont & Company no information either affirmatively or negatively could be obtained regarding the proposed issue.

N. Y. & N. J. TELEPHONE.—At the annual meeting of the New York & New Jersey Telephone Company, H. F. Stevens was elected a director to fill the vacancy caused by the resignation of H. S. Snow. The other directors were re-elected. The statement of the New York & New Jersey Telephone Company for the year ending Dec. 31, 1907, gives the gross income as $8,807,093, against $7,447,147 for 1906, and expenditures of $6,578,143, against $5,659,654 for 1906, leaving a balance of $2,138,741, which is equivalent to 8.42 per cent of the outstanding capital stock. Dividends of $1,687,311 were declared. The surplus is given as $451,430, which, added to the previous surplus given, the total surplus amounts to $4,877,325.

GEORGIA RAILWAY & ELECTRIC COMPANY.—The report of the Georgia Railway & Electric Company for the year ending Dec. 31, 1907, shows gross receipts of $3,309,341, an increase of $414,417 over 1906. Expenses for the year were $1,663,282, an increase of $235,431 over 1906. After deducting charges, there remained a surplus of $851,384, which represents a gain of $29,984 over the previous year. Deducting the preferred dividend of $120,000, and the common dividend of $428,448, an increase of $37,499 over 1906, leaves a balance surplus of $312,936, against $320,487 for 1906.

PENNSYLVANIA ELECTRIC VEHICLE.—An order of the Vice-Chancellor of New Jersey, making available at once for distribution in liquidation to stockholders of the Pennsylvania Electric Vehicle Company the sum of $40,000 cash, has been appealed to the Court of Errors and Appeals. There are 40,000 shares of preferred stock of a full par value of $10. At the beginning of the liquidation proceedings, the appraisement of the entire assets of the company was $4 per share of preferred stock.

DIVIDENDS.—The directors of the General Electric Company have declared the regular quarterly dividend, which will be 2 per cent, payable on April 15. The directors of the Lambertville Heat, Light & Power Company, of Lambertville, N. J., have declared the regular dividend of 1 per cent on its stock, payable March. 10. The American Smelting & Refining Company has declared a quarterly dividend of 1 per cent on its common stock, payable April 15, and the regular dividend of 1¾ per cent on its preferred stock, payable April 1.

KANSAS CITY RAILWAY & LIGHT.—For the month of January, the Kansas City Railway & Light Company reports a gross business of $496,321, as compared with $479,021, for the corresponding month of 1907. The net is given as $237,490, against $241,004 for 1907. The surplus, after deducting charges, was $86,213, against $93,485 for the same month of the previous year.

CINCINNATI LIGHTING.—In a circular letter to the stockholders of the Union Gas & Electric Company, of Cincinnati, President Kenan states that the earnings of the company for the first sixteen months since taking over the local properties on a lease, after paying all charges provided for in the lease, were $481,697.10. The interest at 6 per cent on the $5,000,000 preferred stock outstanding for sixteen months was $400,000, leaving a surplus of $81,687.10. In all $1,500,000 has been spent in betterments, including the purchase of the plants and franchises of the Ohio Fuel Supply Company in Hamilton County the enlargement and improvement of the central station plant, purchase of a site for a new station where all the generating machinery may be consolidated, extension of the gas and electric distribution system, and the completion of the high-pressure natural gas system. The price of labor, the letter states, has increased 25 per cent, while the efficiency has decreased, the hours being reduced from twelve to eight per day. Materials have advanced, but the company has been unable to make any increase in the price of its service. Severe losses were sustained by two floods during the year.

BROOKLYN LIGHTING FIGURES.—The stockholders of the Kings County Electric Light & Power Company held their annual meeting last week and the first report ever made public by the corporation was given out. According to the report the earnings of the company showed an increase in gross of nearly 20 per cent. The net showed an even larger increase on account of increased dividends and increased depreciation charges. The profit and loss surplus of the company made only a slight gain for the year. The operation of both the Kings County Electric Company and the Edison Electric Company is included in the report, as the entire capital stock of the latter is owned by the former. The gross income for the year ending Dec. 31, 1907, of the company was $3,471,740, against $2,897,272 in 1906. The operating expenses were $1,786,395 for 1907, against $1,511,686 for 1906. Dividends paid were $764,000, which is $172,000 more than was paid out last year. The total profit and loss balance was $1,181,213, against $1,159,359 for 1906.

CAMDEN-TRENTON RECEIVER.—Counsel for the Camden & Trenton Railway Company states that the recent application for a receivership has in view only a temporary receiver in order to put the line on a paying basis and make a profitable business proposition. The receipts had been running behind the expenditures for some time, but efforts for a refinancing of the company were in progress at the time the receivership petition was filed by former President Massey, of Philadelphia. It was believed that when the New Jersey Short Line was completed to Elizabeth, making a through line over the Camden & Trenton and the Trenton & New Brunswick roads from Philadelphia to New York, the Camden & Trenton line would undoubtedly be a paying one, but the financial stringency had tied up the work on the short line and had also hit the Camden & Trenton line.

NATIONAL CARBON REPORT.—The net earnings of the National Carbon Company for the year ending Jan. 31, 1908, were $924,801. After charging off preferred dividends, $315,000, the surplus, $609,801, is equal to 11.07 per cent on the common stock; and after deducting depreciation, $355,050, the surplus for common stock is 4.62 per cent. Following are the respective net earnings for the five years preceding Jan. 31, 1907: $951,801, $890,763, $846,307, $736,441, $594,372. The present valuation of plant is $8,647,882, and the total assets Jan. 6, 1908, $10,608,540. The preferred stock is $4,500,000 and the common stock $5,500,000.

MARCONI COMPANY REPORT.—The annual report of the Marconi Wireless Telegraph Company of America, which will be issued during the third week in March following the annual meeting, will, it is stated, show a gross monthly business of about $5,000 for 1907 over a monthly business of $1,100 for 1905. The Marconi Company was incorporated in 1899 with a capital stock of $6,650,000, par value $100, of which $6,190,000 was issued. The experimental transatlantic station at Glace Bay, Nova Scotia, was thrown open Feb. 1 for service limited to Montreal. The station has an operating capacity of about 10,000 words a day.

NIAGARA ELECTRIC DEVELOPMENT COMPANY.—On Feb. 26, at a meeting in Toronto of the stockholders of the Electric Development Company, at which $4,800,000 of the $6,000,000 common stock was voted, the control of the company passed without a dissenting voice to Mr. Wm. MacKenzie and his associates in the Toronto Railway Company. The meeting was presided over by Sir Henry Pellatt, who stated that the company had been so harassed by the Government, the Hydro-Electric Power Commission and the municipalities, that it had been found impossible to raise necessary funds by the sale of bonds.

HUDSON RIVER ELECTRIC POWER.—The gross earnings for the month of December, 1907, of the Hudson River Electric Power Company, were $124,202, an increase of $31,954 over the gross earnings of 1906 for the same month. The operating expenses were $62,132, an increase of $12,354 over December of the previous year, leaving net, for the month of December, $62,070, an increase of $19,600 over the same month in 1906. For the three months from Oct. 1 to Dec. 31 the increase in net was $188,647 against $102,327 for 1906, which is equivalent to 84 3/10 per cent.

UNION SWITCH & SIGNAL REPORT.—In the annual report for the year ending Dec. 31, 1907, of the Union Switch & Signal Company, the gross income was given as $5,023,598 against $5,065,675 for 1906, and the expenditures $3,998,756 against $4,010,343 for 1906. The net profits were $1,024,842, equal to 45.6 per cent on both classes of stock, against net profits of $1,053,332 for 1906. The total assets were $5,806,174 and the total liabilities $3,050,288; profit and loss surplus, $2,831,418. The annual meeting will be held on March 10.

J. G. BRILL COMPANY STATEMENT.—For the twelve months ending Dec. 31, 1907, together with the nine months output of the Wason Manufacturing Company, which was acquired by the J. G. Brill Company on April 1, 1907, the gross earnings amounted to $9,211,825 and the operating expenses $7,542,185. The report gives the net earnings as $1,368,949, with dividends of $375,574 and a credit surplus account of $993,375, which, added to the previous surplus account of $709,730, gives a total surplus on Dec. 31, 1907, of $1,703,105.

GENERAL ELECTRIC EARNINGS.—According to the *Wall Street Journal* the gross shipments of the General Electric Company for the fiscal year will approximate $70,000,000, an increase of about $10,000,000 over the preceding fiscal year, ended Jan. 31. At present the company is operating about 50 per cent of its normal capacity. The directors of the company will soon take action on the quarterly dividend and it is asserted that the regular dividend at the rate of 2 per cent quarterly will be declared.

KINGS COUNTY DIRECTORS RE-ELECTED.—At the annual meeting of the Kings County Electric Light & Power Company held last week the following directors were re-elected: Frank Bailey, William Berri, A. N. Brady, N. F. Brady, H. C. Du Val, Walton Ferguson, W. W. Freeman, Bernard Gallagher, Hugh J. Grant, Seth L. Keeney, Thomas E. Murray, W. F. Sheehan and A. M. Young. Later the above were re-elected as directors of the Edison Company.

AMERICAN GAS & ELECTRIC BONDS.—The $6,282,000 of the American Gas & Electric bonds now in the treasury of the Electric Company of America are to be offered in exchange for stock of the Electric Company of America in denominations of $1,000. Convertible script will be issued for fractional lots of the stock.

PHILADELPHIA ELECTRIC COMPANY.—In reply to a request from H. J. Horan, the Philadelphia Electric Company directors have instructed that L. E. Brown & Company, accountants, be asked to examine the company's accounts and prepare a detailed statement of the expenditures represented by capital account.

CHICAGO TELEPHONE.—The Chicago Telephone new stock issue, offered to stockholders as of record Feb. 19 at par, one share for four, making the rights worth 3¾, is to be paid for as follows: March 16, 20 per cent; May 15, 20 per cent; July 15, 40 per cent; Oct. 2, 20 per cent.

WILKES-BARRE GAS & ELECTRIC STATEMENT.—For the year ending Dec. 31, 1907, the Wilkes-Barre Gas & Electric Company reports gross earnings for the year of $361,340, an increase of $44,666, and net earnings, $173,320, an increase of $29,515.

LONG ISLAND CONSOLIDATED ELECTRIC COMPANIES.—The directors of the Long Island Consolidated Electric Companies were re-elected at the annual meeting held a few days ago.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

BRIDGEPORT, ALA.—A 10-year franchise has been granted C. A. Sutliff, of South Pittsburg, Tenn., for operating an electric light and power system in Bridgeport; also the construction of a street railway system. It is planned to construct an interurban system between Bridgeport, Ala.; Copenhagen, Richard's City, Jasper and South Pittsburg, Tenn. The company will be in the market for equipment.

CORNING, CAL.—Frank Houghton, George H. Flournoy and others have filed with the county clerk at Red Bluff notices of appropriation of 13,000 inches of water, together with all the flood waters of both Elder and McCarthy Creeks, in the western part of Tehama County. It is proposed to use the water for generating electricity, irrigation of land, domestic use, etc. Stephen E. Kieffer, of Berkeley, is engineer.

DEADWOOD, CAL.—The owners of the Lappin mine are contemplating installing electrical equipment to operate the mine.

DIXON, CAL.—Plans are being made to sink a large well in the Dudley tract, lately subdivided. The water will be pumped by electricity.

NEEDLES, CAL.—Arrangements have been completed to erect an electric lighting system in Needles. A contract has been made with the Victor Gold Mining Company to furnish electrical energy for operating the system. Work has commenced on the erection of the transmission lines in the city.

OAKLAND, CAL.—The City Council has appointed a committee to confer with a like committee of the Board of Trustees of Berkeley to consider the erection of a municipal electric light plant to supply service for both cities.

OROVILLE, CAL.—The Great Western Power Company has purchased the franchise sold by the Board of Supervisors of Butte County, Feb. 15, for a pole line for the transmission of electricity in the county for $481.75. The line will be built on a private right of way.

OROVILLE, CAL.—The Northern California Mining Company, of which H. H. Yard is the chief owner, is perfecting plans for two power plants which will utilize the water of Fall River, a branch of the middle fork of the Feather River, and will be located in the Mooretown district, about 40 miles above Oroville. At one place a fall of 1000 ft. can be secured, with a minimum flow of 2000 miners' inches of water.

PASADENA, CAL.—Heman Dyer, city clerk, writes that the citizens on Feb. 20 voted to issue $20,000 in bonds for the construction of pole lines for the distribution of electricity.

RED BLUFF, CAL.—Leon Bly has filed a notice of the appropriation of 6000 inches of water to be taken from South Battle Creek. The water is to be diverted by means of a 48-in. inverted siphon and carried by flume and through a tunnel to the place of use. The water power is to be used to generate electricity.

REDLANDS, CAL.—C. S. Chesnut, president of the Home Gas & Electric Company, of Redlands, is interested in a company to be formed here to be known as the Consolidated Gas & Electric Company, with a capital stock of $1,000,000 to furnish electricity to Redlands, San Bernardino, Colton, Highgrove, Crestmore; also to supply gas to the above cities and to Riverside. The independent companies of Redlands, Colton, San Bernardino and Riverside will be taken into the new company. The electric light plant of the Home Gas & Electric Company will be enlarged and made the principal plant of the company. The main offices of the company will be located at Redlands.

RICHMOND, CAL.—Work has commenced on the construction of the power house of the Santa Fé system, which is located near the freight sheds of the company. Electricity is to replace steam power for operating the mechanical departments of the shops. The cost of the building is estimated at $14,000.

VISALIA, CAL.—Announcement has been made by the Balfour-Guthrie Company that plans are being prepared for many improvements in and about Strathmore, including the installation of an electric light system.

DENVER, COL.—A company has been incorporated to construct an electric railway from Debeque to Fruita, a distance of 40 miles. It is proposed to build a power plant on the Grand River, near Debeque, to supply electrical energy to operate the road, work on which has already commenced. An irrigation system is also being laid out to reclaim 20,000 acres. The cost of the power plant is estimated at $600,000 and about 6500 horse-power will be developed. The officers are Horace K. Devereaux, of Colorado Springs, president; J. Arthur Connell, vice-president, and E. A. Sunderlin, secretary and treasurer.

SAYBROOK, CONN.—The Shore Line Electric Railroad Company has awarded a contract to the Sperry & Sellers Company for the construction of its proposed power station in Saybrook. Plans are also being drawn for a car barn.

SOUTH NORWALK, CONN.—The city of South Norwalk has voted to furnish the East Norwalk Fire District with electrical energy at the rate of 5 cents per kw-hour. It is proposed to furnish electricity at 220 volts, direct current, not to exceed 50 hp for the first three years, to a rotary converter to be located in South Norwalk, with a minimum rate of $50 per month.

WILMINGTON, DEL.—The People's Railway Company has made application to the Street and Sewer Department for a franchise to build an electric railway on certain streets here.

WASHINGTON, D. C.—Bids will be received until March 10, at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal., Schedule 790, 6000 ft. interior communication cable, 4000 ft. bell wire, about 77,500 ft. single lighting wire, 155,000 ft. twin lighting wire, 40,000 ft. insulated wire, wiring appliances, interior fittings and conduit fixtures. Applications for proposals should designate the schedule number. E. B. Rogers is paymaster-general, U. S. N.

ATLANTA, GA.—The Atlanta & Carolina Railroad Company has awarded the contract for the construction of its railway within the city limits to Cook & Lowry, contractors. James W. English is president of the railway company.

AUGUSTA, GA.—The United States Senate has passed a bill authorizing the Twin City Power Company to construct two dams across the Savannah River above Augusta.

DUBLIN, GA.—At an election held Feb. 5 the citizens voted to issue $60,000 in bonds, the proceeds to be used for improvements to the municipal electric lighting plant and water works system.

MACON, GA.—The Macon Railway & Light Company is planning to rebuild 12 miles of track, also a two-mile addition.

MACON, GA.—The Board of Aldermen has granted a franchise to the Citizens' Electric Company. The franchise is for a term of 50 years, under the terms of which the company must have its plant under construction within ten months, and the minimum cost of the plant is to be $100,000. The company is to furnish electrical energy for lamps at a rate of not more than 10 cents per kw-hour, and to allow a discount of 10 per cent for all bills paid on or before the 10th of the month. The maximum price for electricity for motors is not to exceed 8 cents, with the same discount. The company is to furnish arc lamps of 2000 cp for street lighting for $70 each per year. After the expiration of seven years after the completion of the plant the company is to pay to the city 1 per cent of the gross receipts of the earnings of the company from all sources for the next seven years, and after the expiration of that period a per cent of the gross receipts is to be paid to the city to be continued during the life of the franchise. E. W. Gould, Howard M. Smith and others are interested in the company.

MONTEZUMA, GA.—Bids will be received by the Town Council until April 1 for the construction of a canal, water-power system and complete pumping station. Dr. C. H. Richardson is Mayor.

LEWISTON, IDAHO.—Announcement has been made that Jay P. Graves, president of the Spokane Inland Electric Railway Company, is considering the proposition of taking over the rights of way and franchises acquired by the Lewiston & Southeastern Railroad Company, and supplying the funds for the construction of the railway between Lewiston and Grangeville. The railway will be 90 miles in length.

CARLISLE, ILL.—The citizens on Feb. 26 voted to make extensions and improvements to the electric light plant and water works system, involving an expenditure of about $30,000.

CHICAGO, ILL.—A permit has been issued for the erection of the power house for the Presbyterian Hospital at 301 Hermitage Street to cost $70,000.

CHICAGO, ILL.—The City Council has passed an ordinance authorizing the Chicago Railways Company to construct an extension of its system in Harrison Street, from Kedzie Avenue to Fortieth Avenue.

DUQUOIN, ILL.—The City Council has granted a 25-year franchise to J. H. Gregory and Frank J. Schieper to erect and operate a telephone system in the city. It is said that the Kinloch Telephone Company, of St. Louis, Mo., is interested in the project and will superintend the construction of the system.

PEORIA, ILL.—Plans are being prepared by Theodore Kipp, Jr., for installing an electric light system at the county farm.

SILVIS, ILL.—The towns of Silvis and East Moline are considering the question of granting a lighting franchise to W. H. Downing, of Silvis.

ANDERSON, IND.—The Delaware & Madison Counties Telephone Company has decided to erect a new exchange building in this city. The cost of the building exclusive of equipment is estimated at $25,000. George W. Beers, of Ft. Wayne, is president of the company.

BLOOMINGTON, IND.—The Citizens' Telephone Company, recently organized, has arranged to proceed with the erection and equipment of a new central energy telephone system in this city. The officers of the company are: James A. Karsell, president; Dr. A. L. Foley, secretary, and W. H. Adams, treasurer.

CICERO, IND.—After having been in darkness for some time, on account of the lighting plant having been destroyed by fire, the city is soon to be lighted again by electricity. The Noblesville Light, Heat & Power Company is erecting a transmission line from Noblesville to Cicero, a distance of 8 miles. The town is already wired, and the franchise calls for incandescent lamps.

CLARKSVILLE, IND.—The Clarksville Telephone Company wishes to correspond with a construction company, with view of letting contract for the construction of a new plant.

DECATUR, IND.—The Fort Wayne & Springfield Railroad Company has filed a notice with the Secretary of State of an increase in the capital stock of the company from $500,000 to $1,000,000. W. H. Fledderjohan is president of the company.

ELWOOD, IND.—It is reported that the Delaware & Madison Counties Telephone Company has purchased the Central Bell Company's plant in this place, including exchange, poles, wires, etc.

EVANSVILLE, IND.—The Evansville & Eastern Traction Company is planning to construct a new railway from Evansville to Newburg, a distance of 10 miles.

EVANSVILLE, IND.—The American Long-Distance Telephone Company has secured a site on Fulton Street, on which it will erect an exchange building. Herman S. Romberg is general manager.

EVANSVILLE, IND.—The American Telephone Company has filed a $2,000 bond required as a guarantee of fulfilment of the conditions of a franchise permitting the building and equipment of a trunk line station in this city. Engineers are now at work drafting plans for the structure and lines that will have to be rebuilt.

GOSHEN, IND.—Announcement has been made that the Goshen-Battle Creek Railroad is planning to equip its railroad to be operated by electricity.

HANOVER, IND.—The Hanover College Trustees have ordered plans and specifications for the installation of a general water and lighting system in the college buildings and grounds.

NEW LISBON, IND.—The capital stock of the New Lisbon Telephone Company has been increased from $7,500 to $15,000. John A. Miller is secretary.

NEW MARION, IND.—The New Marion & Holton Telephone Company, recently incorporated, is in the market for material and labor for the construction for a new telephone system. J. N. Hess is president of the company.

OAKLAND CITY, IND.—Suit has been filed against the Cumberland Telephone Company for a permanent injunction restraining the company from further operation in the town. The company was given 30 days to vacate the streets, but the time expired, the company paying no heed to the notice. The company claims to have a perpetual franchise, under which it is operating.

PAOLI, IND.—The Town Board has decided to take over the electric plant of the Paoli Milling Company. New machinery will be installed and the output of the plant increased to supply electricity for commercial lighting as well as to light the streets. The price paid for the plant was $1,700.

TERRE HAUTE, IND.—T. F. Grover, general manager of the local power house of the Terre Haute, Indianapolis & Eastern Traction Company, states that plans are being made to enlarge the power house and install a new 500-kw generator.

IOWA FALLS, IA.—The Iowa & Northwestern Railway Company has secured franchises for an electric light plant and water works system in the town of Quasqueton. It is said that the electric railway will be built early in the spring.

QUASQUETON, IA.—Frank Vierth, city clerk, writes that Stephen B. Howard, of Waterloo, has been granted a franchise to erect an electric light plant in the town.

FRANKFORT, KAN.—Bids will be received by the city clerk until March 17 for furnishing material and labor for constructing a system of water works, separate bids for which will be received as follows: For furnishing all material and labor, except cast iron pipe, hydrants and valves, tower and tank, and pumping machinery, and constructing a complete water works system. Also for furnishing one 300-gallon per minute triplex power pump; for furnishing and erecting one 30-hp gasoline engine; for furnishing and erecting 30-hp, 720 r.p.m., 60-cycle, three-phase motor and for furnishing material and erecting steel tower and tank of 70,000 gal. capacity. Plans and specifications are on file at the office of the city clerk, Frankfort, and at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo. J. M. Shumate is city clerk.

HERRINGTON, KAN.—We are informed that the contract for the construction of the municipal electric light plant and water works system has been awarded to the Squire Electric Company, of Kansas City, Mo., for $32,750. C. H. Randall is chairman of the Water and Light Commission.

MARION, KAN.—The citizens have voted to issue $35,000 in bonds, of which $15,000 will be used to purchase the old water works system, and the remainder for repairing the plant and for erecting an electric light plant.

OPOLIS, KAN.—We are informed that the town of Opolis has decided to construct an electric light plant, the cost of which is estimated at about $3,000. James Denton is engineer.

CARROLLTON, KY.—The city is arranging to issue $20,000 in bonds, the proceeds of which to be used for extensions and improvements to the municipal electric light and water plants.

SHREVEPORT, LA.—The City Council has granted a franchise to John Lorenz to operate a street car system in this city in conjunction with the present traction system.

BIDDEFORD, ME.—Preparations are being made by the Limerick Mills to operate the worsted yarn plant by electricity.

ELLSWORTH, ME.—The Bar Harbor & Union River Power Company is preparing plans for extending its transmission line to Bar Harbor, and will soon apply to the city government for a franchise. The line will have a potential of 30,000 volts. J. A. Leonard is chief engineer.

CONOWINGO, MD.—A bill has been introduced in the State Legislature amending the charter and enlarging the powers of the Susquehanna Power Company. The company proposes to build a large dam below Conowingo for the purpose of developing power to generate electricity and erecting transmission lines to Baltimore, Wilmington and Philadelphia for the transmission of electricity. The company also proposes to build 29 miles of canals from Port Deposit, Md., to Columbia, Pa.

FEDERALSBURG, MD.—The House of Representatives has passed the bill authorizing the incorporation of the Idlewood Electric Light & Power Company.

BARRE, MASS.—Preparations are being made by the Francis Willey Company for the construction of a new dam at the former site of the American Powder Company's plant in Barre. The water power will be used to generate electricity for lamps and motors for the South Barre mill.

LYNN, MASS.—The Lynn Gas & Electric Company has received authority from the State Commission of Gas and Electricity to issue 1950 additional shares to be offered to the stockholders at $235 per share. The proceeds to be used toward the cancellation of an equal amount of obligations outstanding, and for payment of the cost of additions to the plant.

MALDEN, MASS.—The State Commission of Gas and Electricity has approved an issue of 1000 additional shares of the Malden Electric Company to be offered to the stockholders at $145 per share, the proceeds to be used to cancel an equal amount of promissory notes outstanding Nov. 30, 1907.

NEEDHAM, MASS.—The Edison Electric Illuminating Company, of Boston, has purchased the municipal electric lighting system for $11,000. In conjunction with the sale of the plant, the town enters into a contract with the company whereby it is to furnish electricity for the street lamps for a period of 20 years for $12 per lamp per year, the contract to take effect Sept. 1, 1908.

NORTH ATTLEBORO, MASS.—A petition has been filed with the Board of Selectmen asking for an appropriation of $200 to look into the finances of the electric light department.

CHARLOTTE, MICH.—The capital stock of the Grand Ledge Telephone Company has been increased from $25,000 to $50,000.

GREENVILLE, MICH.—The Council has granted a 10-year franchise to R. J. Tower to construct and operate an electric light plant. It is proposed to furnish a 24-hour service.

MANISTIQUE, MICH.—The City Council on Feb. 24 granted a 30-year franchise to the Manistique Light & Power Company, and has awarded it a franchise for lighting the streets of the city and for furnishing electricity for pumping the city water supply. This ends a contest that has figured in the town elections for the past four years.

BUFFALO, MINN.—The citizens are considering the question of installing an electric light plant and water works system, and an election may be held to vote on the proposition.

MINNEAPOLIS, MINN.—Bids will be received until March 16 by the Board of County Commissioners for the construction of a lighting plant for the county farm. Bids will be received on both electric and acetylene lighting. Hugh R. Scott is county auditor.

CHARLESTON, MISS.—W. C. Myers is reported to be interested in establishing an electric light plant in this place.

OXFORD, MISS.—R. S. Adams, Mayor, writes that the contract for machinery for the municipal electric light plant will be let about April 1. The contract for the construction of the building has already been awarded. J. R. Shinault is engineer.

LINNEUS, MO.—The citizens have voted to issue bonds to rebuild the electric light plant, which was recently destroyed by fire.

ST. LOUIS, MO.—Attorney E. C. Slevin, representing electric light promoters, has made application to the Board of Public Improvements to include a franchise in the contract for city lighting, an ordinance authorizing the letting of which will be introduced in April. He stated that certain promoters desired to bid on the contract who do not now have a franchise to lay conduits in the streets.

FAIRBURY, NEB.—The Fairbury Independent Telephone Company has awarded a contract for the construction of a new building on Fourth Street. In addition to the new building, the company plans to expend about $20,000 for new equipment and extension of lines. C. W. Bartlett is manager of the company.

WYMORE, NEB.—The citizens are considering the question of installing an electric light plant at the city pumping station to furnish electricity for lighting the city.

GOLDFIELD, NEV.—The Nevada-California Power Company has placed an order with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for two 1500-kw generators and accessories required for the equipment of its power house to be erected in Goldfield.

The plant will furnish electrical energy for the mines in the Goldfield district and in Tonopah.

MANHATTAN, NEV.—An electric power plant is being installed at the property of the Nevada Milling & Ore Purchasing Company.

RENO, NEV.—The City Council has granted a franchise to S. H. Wheeler and Charles Burke, of Reno, to construct an electric railway in Reno, from the Southern Pacific depot into the southeastern portion of the city.

WARREN, N. H.—The Warren Water & Light Company has purchased the boiler formerly used in the George Williams Mill and will install it in its electric plant.

ATLANTIC CITY, N. J.—J. W. Hackney, city engineer, writes that the contract for furnishing corner and intermediate lighting standards, bids for which were opened Feb. 24, has been awarded to the Bethlehem Foundry & Machine Company, of South Bethlehem, Pa., for $34,177.

CAMDEN, N. J.—The lighting committee of the City Council has decided to recommend the acceptance of the proposition of the Public Service Corporation to furnish electricity for lighting the city for a period of six and one-half years for $80 per arc lamp per year. Under the present contract, which expires June 30, 1909, the city pays at the rate of $109.50 per lamp per year. The Public Service Corporation proposes to date the new contract as of Jan. 1, 1908. This in itself will save the city $27,000.

JERSEY CITY, N. J.—Jabez Bruns & Sons have appointed Putnam A. Bates, 42 Broadway, New York, N. Y., to have charge of the equipment of their new factory building, in connection with which a power plant will be installed to furnish light, heat and power for the factory.

JERSEY CITY, N. J.—The Street and Water Board has authorized its president and Mayor Wittpenn to enter into a contract with the Public Service Corporation of New Jersey for lighting the streets of the city by electricity for a term of five years, beginning from Feb. 1. Under the terms of the contract the company is to furnish energy for arc lamps at the rate of $75 per lamp per year up to 2500, when the price per lamp will be reduced to $70. The city at present has between 1500 and 1600 arc lamps, for which it has been paying $97.50 per lamp per year. The new rate effects a saving of $22.50 per lamp per year.

MORRISTOWN, N. J.—The Commissioners of Morris Township on Feb. 15 granted a franchise to the Morris & Somerset Electric Company to erect transmission lines and lay conduits for street lighting on the streets and avenues of the township with certain restrictions.

PRINCETON, N. J.—The Borough Council is contemplating establishing a municipal electric light plant. A committee of three will be appointed at the next meeting of the Council to investigate the matter and report to the Council.

RAHWAY, N. J.—The Public Service Corporation has submitted a proposition to the Common Council offering to furnish electricity for lighting the town as follows: For 25 arc lamps of 1200 cp at $100 per lamp per year; 300 or more 24-cp incandescent lamps at $16 per lamp per year.

TRENTON, N. J.—The Board of Health is reported to be considering the question of installing an electric light and heating plant in the municipal hosptal.

WHARTON, N. J.—The streets of the borough are now lighted by electric lamps, electricity for which is supplied by the Dover Electric Light Company, of Dover. Thirty-five lamps have been installed on the streets and 21 more will soon be added.

SILVER CITY, N. M.—The Forest Service has issued a permit to the Forest Power Company of this city to construct and maintain an electric power house and transmission line in the Gila national forest.

ALBANY, N. Y.—Assemblyman De Groot has introduced a bill in the State Legislature providing for electricity to be furnished in the boroughs of Brooklyn and Queens at the rate of 10 cents per kw-hour. The present rate is 12 cents per kw-hour.

BABYLON, L. I., N. Y.—The Village Board has granted the Babylon Electric Light Company a 50-year franchise to furnish electricity for lamps and motors; also a franchise to furnish gas for lighting and heating purposes.

CHATHAM, N. Y.—The Chatham Electric Light, Heat & Power Company is making arrangements to establish a power service for Chatham and vicinity, and will install a 200-hp power boiler in the near future. The company also plans to extend its transmission lines from Ghent to the village of Philmont, a distance of six miles, to furnish electricty for lamps.

CLYDE, N. Y.—Parties representing the Fort Wayne Electric Company, of Syracuse, are dismantling the defunct plants of the Clyde Gas & Electric Company, of this village. The machinery, boilers and other equipment are being removed and shipped to Syracuse. The electric plant of the Clyde Gas & Electric Company was erected in 1890, but for the past six years has not been in use.

EARLVILLE, N. Y.—The plant and holdings of the Earlville Telephone Company have been purchased by Charles Chandler, of Brookfield, and Jerry D. Holey, of Earlville. The consideration is understood to be about $20,000.

HAVERSTRAW, N. Y.—The Board of Trustees has granted the West Shore Traction Company a franchise for a right of way through the town.

HUDSON, N. Y.—The directors of the Albany & Hudson Railroad Company have decided to begin work at once on the proposed improvements to the power station at Stuyvesant Falls. A new boiler will be installed and other changes made at the station to increase the output of the plant to meet the increased demand for electrical energy due to the heavy travel over the third-rail system during the summer.

SPENCERPORT, N. Y.—The Ogden Telephone Company, recently organized, is perfecting plans for the construction of a telephone system, which will include both the Spencerport and Adams Basin exchanges. A meeting of the directors will soon be held to decide whether the company shall purchase the Bell plant or build its own system. H. D. Burritt, of Ogden, is vice-president of the company.

WATERTOWN, N. Y.—The Watertown Chamber of Commerce has started a movement to purchase the telephone system of the Citizens' Telephone Company. It is proposed to install a new switchboard and other equipment. It is stated that the plant and holdings of the company can be purchased for $15,000. J. B. Wise is interested in the project.

ARLINGTON, OHIO.—The municipal electric light plant was started Feb. 11. The equipment of the plant includes a 65-kw alternating-current Warren generator and an Atlas engine and boiler.

COLUMBUS, OHIO.—The pole line of the municipal electric lighting system is being rearranged under the supervision of D. J. Fisher, director of the Service Board. It is expected that under the new system the city will save about $4,000. The street lighting system will soon be increased by 300 additional lamps, making 2400 in all. Frank Tennant is city electrician.

COLUMBUS BARRACKS, OHIO.—Bids will be received until March 14 for furnishing and delivering electric light fixtures for three double sets of lieutenants' quarters and all necessary material for electric light wiring, electric bell system and speaking tubes for the above-mentioned buildings, including conduit, wire, switches, panel boards and cabinets, annunciators, tools, etc. A complete list of the material and fixtures required divided into separate items, together with instructions to bidders and blank forms for proposals can be obtained at this office on application. Bids will be received on all or part of the items required. Captain H. J. Hirsch is in charge of construction.

FORT TOWSON, OKLA.—C. P. Walker, manager of the Fort Towson Light & Power Company writes that the high-tension plant built by the company was put into operation Feb. 20.

MENTOR, OHIO.—The citizens are considering the question of the erection of an electric light plant.

KLAMATH FALLS, ORE.—The citizens are considering the question of constructing water works, electric light plant and sewerage system.

PENDLETON, ORE.—The City Council is considering the question of establishing a municipal electric light plant. The street lighting contract was renewed with the Northwestern Gas & Electric Company for two years only.

PORTLAND, ORE.—Extensive improvements are planned for this year by the Pacific Telephone & Telegraph Company to its local system, which will involve an expenditure of about $500,000. It is proposed to extend the underground conduit system throughout the entire fire district. The company has already installed more than 150 miles of underground duct. The company will soon install a local exchange in St. John

SCIO, ORE.—It is reported that extensive repairs are needed to the municipal electric heat plant, including a new penstock, flume and water wheel.

ALLENTOWN, PA.—The Blue Ridge Traction Company has closed its power station at Danielsville, and is now receiving electrical energy for operating its system from the Lehigh Valley Transit Company.

BOYERTOWN, PA.—A permit has been granted to Louis Wanner, Jr., to install a power plant and a heating system in the building of the Boyertown Burial Casket Company at 1211-1217 Arch Street, to cost $9,067.

BUTLER, PA.—The capital stock of the Harrisville Telephone Company has been increased from $5,000 to $15,000.

EASTON, PA.—At an election to be held April 2 the citizens will be asked to vote on the proposition to issue $30,000 in bonds for extensions and improvements to the municipal electric light plant. Martin M Higgins is Mayor.

ELLWOOD CITY, PA.—A local company has been organized and application has been made for a charter to build an electric railway from Ellwood City through Burnstown, Wurtemburg and up the Slipperyrock Valley to Butler. The incorporators are J. T. Meckler, John M. Curry, J. N. Kirker and J. C. Keith, of Ellwood City.

JOHNSTOWN, PA.—Contracts will soon be let by the Cambria Steel Company for equipment to be used at the Rolling Mill Mine and the Millcreek power plant, the cost of which is estimated at $50,000. It will include two new batteries of boilers, a compound steam engine and a dynamo for the electric light plant, additional cutters, drills, etc., for the mining equipment of the plant. Powell Stackbouse is president.

McKEESPORT, PA.—Arrangements are being made by the Manor Valley Railway Company to commence work on the construction of its railway to Herminie and to West Newton. The rights-of-way are being secured for the northern division from Manor to Claridge.

NEWTOWN, PA.—The Borough Council has entered into a contract with the new electric light company to light the streets of the borough. The company is to furnish incandescent lamps of 32 cp for $27 per lamp per year.

NEWVILLE, PA.—The contract for the construction of the electric light system to light the streets of the city has been awarded to John Hosfield, of Shippensburg.

SUNBURY, PA.—The Borough Council has granted a franchise to the Sunbury & Selinsgrove Electric Street Railway Company to operate its railway on certain streets in the borough.

WEST CHESTER, PA.—The stockholders of the West Chester, Kennett & Wilmington Electric Railway Company, of West Chester, and the Oxford, West Grove & Avondale Street Railway Company have effected a merger of the properties of the two companies. The first company has 18 miles of track, and controls the Oxford, West Grove & Avondale line, which is under construction from Avondale to Oxford, a distance of 12½ miles. A portion of the road is already being operated.

ABERDEEN, S. D.—The Aberdeen Light & Power Company is said to have placed orders for the machinery for its new plant with the Minneapolis Steel & Machinery Company, and for electrical equipment with the Electric Machinery Company, both of Minneapolis, Minn. The company was recently organized with a capital stock of $200,000.

RAPID CITY, S. D.—G. B. Mansfield, secretary of the Dakota Power Company, writes that the proposed plant of the company will cost about $170,000. L. A. Richards, of Rapid City, is manager.

FAYETTEVILLE, TENN.—It is reported that the Fayetteville Electric Light & Power Company contemplates increasing the output of its power plant.

DALLAS, TEX.—W. F. Nicol, supervising architect of the Board of Education, writes that bids will soon be received for the electrical work on the new high school, now in course of erection, the cost of which is estimated at about $4,000.

FORT WORTH, TEX.—Sealed proposals will be received by the city of Fort Worth for 1200-cp 6.6 ampere alternating-current series arc lamps, complete with inner and outer globes for street lighting. Bids will be received on lots of 250, 500 and 750 lamps. J. J. Nunnally is city auditor.

HOUSTON, TEX.—The contract for the construction of the automatic telephone system for the Houston Home Telephone Company has been awarded to the Automatic Construction Company, of Houston, recently organized. The Automatic Electrical Company, of Chicago, Ill., will furnish the equipment for the system, and the Orangeburg Fibre Company has secured the contract for supplying the conduits. The contract for the cables has not yet been awarded. The cost of the work is estimated at about $800,000. F. G. Reed and John S. Slusher are the promoters of the company. McMeen & Miller, of Chicago, Ill., have prepared plans and will superintend the work.

MARBLE FALLS, TEX.—G. W. Vories, vice-president and general manager of the Granite Manufacturing Company, writes that the company has engaged the services of Dwight F. Horton, of Houston, as designing and constructing engineer to build a dam across the Colorado River at Marble Falls, for the purpose of power development and transmission of electricity, the work to be done by day labor, by the company. Electrical energy will be transmitted at 33,000 volts within a radius of 50 miles of the plant. It is proposed to install ten 1000-kw units.

NAVASOTA, TEX.—A franchise has been granted to R. A. Horlock Company to construct an electric light plant to furnish electricity for lighting the town. The equipment of the plant will consist of a 250-hp Corliss engine, a 120-kw, three-phase, 60-cycle, alternator and a 50-kw generator direct connected, switchboards, transformers, etc. R. W. Horlock is manager.

AMERICAN FORK, UTAH.—Surveys have been completed for the transmission line of the Utah County Light & Power Company from its plant at Grand Fork to Knightsville, a distance of 42 miles. The line will be operated at a potential of 44,000 volts.

MONTPELIER, VT.—Plans are being made to install a new lighting system in the Washington County Court House.

EDENBERG, VA.—H. A. Whissen & Brother have applied to the town officials for a franchise to install an electric light plant in the town.

RICHMOND, VA.—Edward W. Trafford, a consulting engineer of this city, has submitted to a joint meeting of the Council committees on water and electricity a proposition to prepare complete plans for a municipal electric light plant on the site of the old pump house, with surveys and maps of the river and water power of the city. The plans are to include a transmission line to the new pump house, the installation of electrical pumps at the pumping station and a complete system of poles and wires for street lighting covering the entire city.

PROSSER, WASH.—The Prosser Traction Company is planning to make a number of extensions to its system. The power plant will be located five miles below Prosser.

HUNTINGTON, W. VA.—At a meeting of the stockholders of the Camden Interstate Railway Company, the name of the company was changed to the Ohio Valley Traction Company, and it was decided to issue $400,000 in capital stock, which, it is said, will be used to acquire the system of the Kanawha Valley Traction Company. W. C. Sproul, of Chester, Pa., is president of both companies.

APPLETON, WIS.—C. H. Hartley and F. H. Josslyn, of Oshkosh, are negotiating with E. A. Edmonds, president of the Badger Portland Cement Company, to furnish electrical energy to operate the company's plant. Messrs. Hartley and Josslyn are members of a company which controls two water powers on the Peshtigo River, not far from Erland Junction, and, if the deal is consummated, it is proposed to erect a transmission line across Green Bay from a point midway between Peshtigo and Marinette to Little Sturgeon, a distance of 14 miles.

ASHLAND, WIS.—The City Council has decided to have plans prepared at once for the construction of a municipal electric light plant.

FOND DU LAC, WIS.—The Eastern Wisconsin Street Railway & Light Company is planning to rewire its entire system this spring.

GREEN BAY, WIS.—Bids will be received by Elmer Hall, county clerk, until March 16, for the construction of a power house for Brown County.

IOLA, WIS.—The Village Board has closed a contract with Frogner Brothers & Sons for street lighting for a term of five years. The company is to furnish 35 incandescent lamps of 32-cp each at the rate of $16.80 per lamp per year, making a total cost of $588 per year.

MILWAUKEE, WIS.—A building permit has been granted to the Continental Realty Company for the construction of a power plant on Commerce and Holton Streets at a cost of $65,000.

MILWAUKEE, WIS.—No bids were opened on Feb. 13 by the Board of Public Works for furnishing and erecting a gas producer plant at Walker and Davidson Streets, as a part of the municipal electric light plant, as it was decided to wait until the result of the election on the question of constructing the proposed municipal lighting plant.

OSHKOSH, WIS.—Two water power sites have been purchased on the Wolf River, near Royalton, by Leander Choate, Frank H. Josslyn, Emil H. Steiger and Casper Faust, all of Oshkosh. It is proposed to erect a power plant and develop between 2000 and 2500 hp. If possible, the electrical energy will be transmitted to Oshkosh to be used for lamps and motors. A delegation of business men from New London have petitioned the owners of the water power to furnish that city with electricity.

SULLIVAN, WIS.—The Sullivan Telephone Company has increased its capital stock from $10,000 to $15,000.

HAMILTON, ONT., CAN.—The City Council has appointed P. W. Sothman, chief engineer of the Hydro-Electric Commission, to prepare plans and specifications for the proposed municipal electric lighting plant.

MONTREAL, QUE., CAN.—The Park & Island Railway Company has decided to extend its line on the upper Lachine Road a distance of one mile.

NELSON, B. C., CAN.—Owing to the exorbitant figure quoted for additional energy by the West Kootenay Power Company, the city refused to consider the offer and decided to lose no time in installing an additional unit at the municipal power plant.

TORONTO, ONT., CAN.—William Mackenzie, president of the Canadian Northern Railroad, has purchased a controlling interest in the Electrical Development Company, and it is reported that the eastern lines of the Canadian Northern will be equipped to be operated by electricity to be furnished by the Electrical Development Company.

WELLANDPORT, ONT., CAN.—The Dunnville, Wellandport & Beamsville Electric Railway Company has applied to the Legislature for permission to extend its railway through the townships of Durham, South Cayuga, Rainham, Walpole and Woodhouse to Port Dover.

WINNIPEG, MAN., CAN.—The Law Amendments Committee of the Manitoba Legislature has given a decision against allowing the city of Winnipeg to deal in electricity for domestic purposes. F. E. Cambridge, city electrician.

New Industrial Companies.

THE GRAVITY ELECTRICAL COMPANY, of Milwaukee, Wis., has been incorporated, with a capital stock of $30,000, by Frank J. Kipp, Louis Auer and Fred B. Peterson.

THE ENTERPRISE ELECTRIC WORKS, of San Francisco, Cal., have been incorporated, with a capital stock of $24,000, by Frank Jones, G. E. Roe, Bertha Roe and Mary E. Jones.

THE WORLD TELEPHONE MANUFACTURING COMPANY, of Seattle, Wash., has filed articles of incorporation, with a capital stock of $1,000,000, by Charles McGonigle and Gustave S. Staly.

THE REVERSIBLE GAS ENGINE COMPANY, of Portland, Me., has been incorporated, with a capital stock of $100,000. G. H. Sturgis is president and F. D. Marshall treasurer, both of Portland, Me.

THE ELECTRICAL REPAIR & CONSTRUCTION COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $10,000, by Edward Snyder and others. The company will deal in motors and other electrical apparatus and equipment.

THE UNITED STATES ART BENT GLASS COMPANY, of Hartford, Conn., has filed a certificate of incorporation, with a capital stock of $20,000. The company proposes to manufacture various articles of ornamental glass and electric lamp appliances.

THE HARRIMAN ENGINE COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing machinery. W. R. Harriman, of Malden, is president of the company and J. E. Harriman, of Brookline, is treasurer.

THE ACTOGRAPH COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $30,000. The company proposes to manufacture and deal in moving picture machines. The incorporators are: A. V. Jones, H. M. Browne, of New York, and H. W. Mills, of Jersey City, N. J.

THE BLEYLE ELECTRIC COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000, by E. Theodore I. Thygeson, of Brooklyn, N. Y.; Frank K. Hoffman, of New York, N. Y., and Timothy J. Murphy, of Newark, N. J. The company proposes to manufacture electric motors, dynamos, etc.

THE UTILITY FIXTURES COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $20,000, for the purpose of manufacturing electric lamps, lighting devices, lamp fixtures, etc. The incorporators are: Thomas Donahue, John A. Potter and James O. Tyron, all of New York, N. Y.

Company Elections.

KING'S MILLS, ARK.—At the annual meeting of the Union Telephone Company the following-named officers were elected: E. W. Holt, president; J. T. Spurlock, vice-president; D. Rogers, secretary; James C. Holt, treasurer, and J. P. Hart, manager.

LITTLE ROCK, ARK.—The Long Distance Telephone Company, which was organized to build independent telephone lines throughout the State, has elected officers as follows: W. D. Hearn, of Pine Bluff, president; Charles F. Speed, of Monroe, La., secretary; E. R. Wynne, Bald Knob, treasurer, and E. L. Bracy, of Little Rock, general manager. The capital stock of the company is placed at $300,000.

GRASS VALLEY, CAL.—At the annual meeting of the Clear Creek Telephone Company the following named officers were elected: Samuel Weeks, president; Garfield Robson, vice-president, and F. Schwartz, secretary and treasurer.

CHICAGO, ILL.—At a meeting of the directors of the Western Electric Company two changes were made in the board. H. A. Halligan and J. W. Johnston resigned, and were succeeded by J. I. Waterbury, of New York, N. Y., and W. H. Miner, of Chicago, Ill.

ANDERSON, IND.—At the annual meeting of the Delaware & Madison Counties Telephone Company the following-named officers were elected: George W. Beers, of Fort Wayne, president; W. H. Quick, of Anderson, vice-president; Theodore F. Rose, of Muncie, secretary, and W. E. Hitchcock, of Muncie, treasurer. The company has decided to make large extensions to its system this year.

IDA GROVE, IA.—At the annual meeting of the Ida County Mutual Telephone Company the following-named officers were elected: R. E. Todd, president; J. I. Hess, vice-president; W. C. Forney, secretary, and A. A. Reuch, treasurer.

BLANFORD, MASS.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: A. L. Lewis, president; Alonzo Barnes, vice-president; James E. Severy, secretary, and J. A. Smithies, treasurer.

NORTHPORT, MICH.—At the annual meeting of the Leelanau Mutual Telephone Company the following-named officers were elected: William J. Thomas, president; Charles B. Kehl, secretary, and James L. Kehl, treasurer.

BARNESTON, NEB.—At the annual meeting of the Farmers' Mutual Telephone Company the following-named officers were elected: D. Starn, president; William Townsend, secretary, and A. Elmen, treasurer.

KEENE, N. H.—At the annual meeting of the Keene Gas & Electric Company the following-named officers were elected: William H. Elliot, president; Wallace L. Mason, vice-president, and George M. Rossman, treasurer.

ALBANY, N. Y.—The directors of the Waterford & Cohoes Railroad Company have elected the following-named officers: L. F. Loree, president; C. S. Simms and W. H. Williams, vice-presidents; J. J. Hagen, secretary; James McCredie, treasurer, and Edgar S. Fassett, general manager.

ELMIRA, N. Y.—At the annual meeting of the New York & Pennsylvania Telephone & Telegraph Company the following named officers were elected: U. N. Bethell, president; H. F. Stevens, vice-president; William J. Farquhar, secretary; W. N. Eastabrook, treasurer; E. Rogers, general manager.

MARIETTA, OHIO.—At the annual meeting of the Marietta Telephone Company the following named officers were elected: A. L. Gracey, president; J. S. H. Torner, vice-president; A. C. Davis, secretary and general manager; W. J. Speer, treasurer; W. W. McMahon, assistant manager.

NEW LEXINGTON, OHIO.—At the annual meeting of the Perry County Telephone Company the following-named officers were elected: P. M. Cullinan, president; George C. Forquer, vice-president; T. M. Potter, secretary and treasurer, and T. H. Wall, general manager.

YOUNGSTOWN, OHIO.—At the annual meeting of the Mahoning & Shenango Railway & Light Company the following named officers were elected: E. N. Sanderson, president; Randall Montgomery and M. E. McCaskey, vice-presidents; Leighton Calkins, secretary, and S. C. Rogers, treasurer.

PORTLAND, ORE.—At the annual meeting of the Pacific States Telephone & Telegraph Company the following-named officers were elected: E. J. Zimmer, president; Louis Glass, vice-president; F. W. Eaton, secretary and treasurer, and J. H. Thatcher, assistant secretary and assistant treasurer.

EBENSBURG, PA.—At the annual meeting of the North Cambria Farmers' Telephone Company the following-named officers were elected: Peter C. S. Strittmatter, president; Otto Anna, secretary; directors: H. M. Gooderman, S. A. Westrick, Dr. H. Somerville, Edward Brawley, James A. Farbaugh and S. A. Ryan, and the officers named above.

MEADVILLE, PA.—At the annual meeting of the Meadville Telephone Company the present officers were re-elected for the ensuing year as follows: W. J. Maddox, president; J. D. Downing, vice-president; H. M. Dickson, secretary, and C. S. Burwell, treasurer.

EAU CLAIRE, WIS.—At the annual meeting of the Ludington Telephone Company the following-named officers were elected. Gust. Roessler, president; Herman Berlin, vice-president, and J. E. Zetzman, treasurer. The directors voted to make several extensions in this county the coming summer.

FOND DU LAC, WIS.—At the annual meeting of the Eastern Wisconsin Railway & Light Company, the Fond du Lac Street Railway & Light Company and the Fond du Lac Gas Company the following named officers were re-elected: N. C. Draper, vice-president and general manager; H. F. Whitcomb, Jr., vice-president and secretary, and W. E. Cole, treasurer.

HAMILTON, ONT.—At the annual meeting of the Dominion Power & Transmission Company the present officers were re-elected as follows. Col. Gibson, president; John Knox and James Dixon, vice-presidents; W. C. Hawkins, secretary and general manager, and John Moodie, treasurer.

New Incorporations.

NORTH SAN JUAN, CAL. The Northern Power & Water Company has been organized in Nevada County for the purpose of constructing a large power and water system in this section. It is the intention of the company to form a large chain of lakes or reservoirs to carry pure water to the San Francisco Bay cities, to dredge Shady Creek for gold and to build a large dam below Sweetland, below which a hydroelectric power plant will be installed.

HARTFORD, CONN.—Articles of incorporation have been filed with the Secretary of State for the Connecticut Home Telephone Company. The capital stock of the company is placed at $ 00,000, and the incorporators are L. Lewis Sperry, of Hartford; J. H. Hale, of Glastonbury; R. P. Lyon, of Hartford, and Membert R. Crosby, of Glastonbury.

CALHOUN, ILL.—The Calhoun Farmers' Co-operative Telephone Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are: C. D. Hunter, F. F. Bennett, M. H. Barnes and C. Temple.

MOLINE, ILL.—The United Light & Power Company has been incorporated, with a capital stock of $60,000, by W. H. Downing, Edward Burke and others.

TAYLORVILLE, ILL.—The Taylorville Street Railway, Light, Heat & Power Company has been organized for the purpose of constructing an electric railway and power plant in this city. The incorporators are I. J. Perkins, Albert Morgan, J. A. Adams and W. B. Adams, of Taylorville, and Mrs. Alice Moore, of St. Louis, Mo.

ALEXANDRIA, IND.—The Alexandria Telephone Company has been organized, and proposes to construct rural lines in and about Alexandria. Application has been made for a franchise, and it is expected that work on the system will commence at an early date. William Ellsworth is president of the company.

CANAAN, IND. The citizens of this city have organized an independent telephone company, which will be known as the Canaan Central Telephone Company. The directors of the company are H. C. Woodfill, James Barber, Clarence Shaddy, M. C. O'Neal, T. J. Vanosdel, T. A. Spencer, Lee Flint, P. Vestile, Marcus Taylor and others.

CLARKSVILLE, IND.—The Clarksville Telephone Company has been incorporated, with a capital stock of $1,500. The officers are: B. O. Brattain, president; Harry Layton, secretary, and Harry Lyant, treasurer.

NEW MARION, IND.—The New Marion & Dabney Holton Telephone Company has filed articles of incorporation with the Secretary of State, with a capital stock of $12,000. Joseph N. Hess, Lawrence Miller and others are directors.

WEST LEBANON, IND.—Articles of incorporation have been filed for the Farmers' & Merchants' Co-operative Telephone Company with a capital stock of $30,000, by Hugh Brenner, G. W. Day, Will A. White, A. J. Johnson and others.

LA CENTER, KY.—The citizens of La Center have organized an independent telephone company to compete with the East Tennessee Telephone Company. The company is capitalized at $25,000, and the officers are: Dr. T. M. Baker, president; W. H. Viets, vice-president; Samuel McGee, secretary, and John W. Moore, treasurer.

SOUTH PARIS, ME.—Articles of incorporation have been filed for the Citizens' Telephone & Telegraph Company with the Secretary of State, with a capital stock of $10,000. The company proposes to operate telephone and telegraph lines in the towns of Paris and Norway. John F. Plummer is president, and Charles W. Bowker, treasurer, both of South Paris.

EYGLAND, MINN.—The Eygland Telephone Company has been incorporated, with a capital stock of $50,000, by John Logan, Anthon Linden and Gunder Nomland.

PRATT, MINN.—The Pratt Rural Telephone Company has been organized to build a telephone line from Pratt to Owatonna. The officers of the company are W. A. Degner, president; A. J. Thamert, vice-president; G. Thiele, secretary, and L. A. Degner, treasurer.

ST. CLOUD, MINN.—The Le Sauk Telephone Company has been organized to build a rural telephone line. E. S. Clement is secretary.

BLOOMFIELD, MO.—The Bloomfield Electric Light, Heat, Power & Water Company has been incorporated with a capital stock of $10,000 by James B. Buck, Thomas J. Toole, A. D. Wilcox and others.

FREEBURG, MO.—The Drum Hill Telephone Company has been incoroporated, with a capital stock of $1,000, by E. A. Eckert, P. Petri and N. Schlueter.

BIG TIMBER, MONT.—The Northern Telephone Company has been incorporated, with a capital stock of $20,000, by Theodore S. Lavold and others.

MISSOULA, MONT.—Articles of incorporation have been filed for the Grant Creek Telephone Company, with a capital stock of $1,000, by G. O. Phelps, A. C. Hollenbeck, John Richli and Michael Flynn, Sr.

RENO, NEV.—The Malad Power Company has filed articles of incorporation and may compete for local business with the Reno Power, Light & Water Company. The company owns power plants near Sheridan in the Sierra Nevada Mountains, and the directors claim they have sufficient power to furnish the towns of Reno, Carson, Virginia, Dayton, Goldhill, Yerington and Fallon. The incorporators are J. H. Richards, R. E. Cavaney and E. L. Hice, capitalists from Idaho.

THE NATIONAL TELEPHONE RECORDER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by Jacques Reiser, Hermaun M. Braun and Laurence Goldberg, all of New York, N. Y.

THE KOZESNIK ELECTRIC THIRD-RAIL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by B. Hartman, A. Hartman, C. Kozesnik, of New York, N. Y., and G. A. Harris, of Astoria. The company proposes to manufacture a safety third-rail.

NEW YORK, N. Y.—The F. & M. Illuminating Company has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The directors are Charles Palkenheim, of Brooklyn; Edmund Magen and Ernest J. Magen, of New York, N. Y.

GENESEO, N. Y.—The C. S. & S. Telephone Company has been incorporated, with a capital stock of $5,000, by C. H. White, E. B. Wilhelm and H. L. May, of Conesus.

PALMYRA, OHIO.—The Palmyra Telephone Company has filed articles of incorporation with a capital stock of $10,000. H. S. Wilson is president of the company and S. A. Church, secretary and treasurer.

EDDYVILLE, OKLA.—The Eddyville Northern Telephone Company has been incorporated with W. T. Woody, president, and James Wolf, secretary. The Eddyville Northwestern Telephone Company has been incorporated with W. J. Lawson, president, and W. O. Porter, secretary, and also the Eddyville Southwestern Telephone Company with A. B. Walter, president, and Charles Wiley, secretary. The village trustees have granted a franchise to the Eddyville Telephone Exchange.

WINTON, PA.—The Winton Electric Company has been incorporated with a capital stock of $5,000. The directors are Grant Pelton, of Scranton, treasurer; William M. Clark, of Carbondale, and Edward S. Jones, of Olyphant.

WORTHINGTON, PA.—The West Penn Telephone Company has been formed to connect Worthington, Sherrett and Montgomeryville. The new line will be built by the Kittanning Telephone Company and will be operated from the local company's office.

FULTON, S. D.—The Fulton & Alexandria Telephone Company has been organized and the following officers elected: Kenneth Brown, president; S. P. Chapman, secretary and treasurer.

WINFRED, S. D.—The Winfred Telephone Company has been organized to install a local telephone system. M. Chapin is secretary.

YORKTOWN, TEX.—The Yorktown Light & Ice Company has been incorporated with a capital stock of $7,500 by Richard Eckhardt, Charles J. Eckhardt and R. J. Motsch. The company has purchased the local electric light plant owned by Koenig & Son, and will make extensive improvements to the system. The price paid for the plant is said to be $20,000.

CEDAR CITY, UTAH.—The Iron County Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The directors are: Henry W. Lunt, Evan E. Williams, Charles S. Wilkinson, George W. Decker, Thomas J. Jones, John G. Pace and William Ford.

CEDAR CITY, UTAH.—Articles of incorporation have been filed for the Iron County Telephone Company with the Secretary of State with a capital stock of $10,000. The directors are Harry W. Lunt, Evan E. Williams, Charles S. Wilkinson, George W. Decker, Thomas J. Jones, John C. Pace and William Ford.

EXCHANGE, W. VA.—The Braxton Citizens' Telephone Company has been incorporated, with a capital stock of $10,000. The incorporators are: E. C. Jones, Lester Gerwig, J. M. Cutlip, W. N. Ditlip, O. F. Floyd, W. A. Bosley, J. T. Lockard and S. S. Shaver, all of Exchange; J. I. Hefner, of Cutlip, and P. H. Murphy, of Cassaway.

ASHLAND, WIS.—The Ashland Power Company has been incorporated, with a capital stock of $100,000, by C. T. Bundy, R. P. Wixcox and I. S. Smith.

FOND DU LAC, WIS.—The Briggs Electric Company has been incorporated, with a capital stock of $15,000, by W. F. Briggs, Albert T. Mellin and A. L. Briggs.

HILLSBORO, WIS.—The Hillsboro Light & Power Company has been incorporated, with a capital stock of $10,000, by Rollin F. Myers and others.

SOLDIERS' GROVE, WIS.—Articles of incorporation have been filed for the Crawford-Vernon Mutual Telephone Company by P. N. Peterson, K. M. Hooverson, A. E. Christenson and others.

BYRON, ONT., CAN.—The Byron Telephone Company has been incorporated, with a capital stock of $15,000.

MILESTONE, SASK., CAN.—The Milestone Southwestern Telephone Company is being organized here to build a line 30 miles long to the southwest of this town to connect with a proposed rural telephone system. Address J. J. Courtnay.

Legal.

ELECTRIC LIGHT RECEIVERSHIP.—Vice-Chancellor Walkner on Feb. 26 appointed Mitchell B. Perkins temporary receiver of the Bordentown Electric Light Company, of Bordentown, N. J., and the Cinnaminson Electric Light Company, of Riverside, N. J. The application for a receiver was made by Whitney & Kemmerer and the Bryan-Marsh Company, of Philadelphia, Pa. It is said that the financial condition which caused the receivership application was caused by their connection with the Camden & Trenton Railway Company, now in the hands of a receiver.

ARMATURE CONSTRUCTION LITIGATION.—The United States Circuit Court of Appeals for the District of New Jersey has sustained an opinion rendered some time ago in favor of the Westinghouse Electric Manufacturing Company, against the Prudential Insurance Company, of New York, restraining the latter from further infringement of the Nolan patent in the use of a direct-current generator manufactured by the Bullock Electric Manufacturing Company. The decision held that claims Nos. 2 and 4 of the Nolan patent are valid and have been infringed. The infringement related to a means for clamping the armature laminæ in place, a split ring partially located in a circumferential groove in the armature spider being used to hold the clamping plate in position, the ring itself being held from centrifugal movement by a shoulder upon the clamping plate.

REDDING, CAL.—An interesting suit is being tried in the Superior Court of this city before Judge Finch. The Battle Creek Power Company, which is owned by the Northern California Power Company, seeks to condemn a reservoir site on ground claimed by the Pacific Power Company. The suit will involve a new point—Can one public service corporation condemn the property of another public service corporation? The Northern California Power Company is building a large dam across Battle Creek for the purpose of creating a storage reservoir and taking water out of the stream at a considerable elevation in the rocky gorge. The dam will be 150 ft. high and will back the water up the creek for miles and completely submerge the power house site of the Pacific Power Company. Can this be done lawfully? The decision in this suit will answer the question.

SACRAMENTO, CAL.—The judgment of the Tehama County Superior Court in the case of W. H. Gurnsey vs. the Northern California Power Company, defendant and appellant, for ejectment, has been reversed by the California Appellate Court. It appears that in October, 1902, the Board of Supervisors of Tehama County gave the power company permission to run its power wires on poles along certain county roads which crossed about two miles of the plaintiff's property. After the wires had been strung Gurnsey brought suit for ejectment and won out in the Tehama County Superior Court. The defendant appealed. The Appellate Court held that a demurrer to the answer of the corporation filed by the plaintiff was not but should have been overruled, and, further, that the lines were for the purpose of promoting the general welfare, and the plaintiff did not claim that he had been injured by their presence.

VISALIA, CAL.—Judge Wallace has handed down a written opinion in the case of A. G. Wishon against the Globe Light & Power Company and others, involving the right to divert a quantity of water from points on Tule River, both being within the Sierra Forest reserve, deciding in favor of defendants and against plaintiff. The points at issue were whether James W. Pursell, predecessor in interest to the Globe Light & Power Company, after first filing his notice of appropriation in Sept. 26, 1902, complied with the requirements of the law subsequent to that time, although he was stopped by Forest Supervisor White on behalf of the federal government, pending a permit to carry on the work. The permit was obtained in July, 1906, and later, in September, the Globe Light & Power Company, which had acquired Bursell's interest, resumed work. A like permit was granted to plaintiff in August. Judge Wallace holds that defendants have prosecuted the work as required by law with a reasonable diligence. The other point at issue of whether defendants properly posted its notices is also decided in its favor, the court taking judicial notice that the property contained in the description given is located within the Sierra forest reserve.

Personal.

MR. ARTHUR WEST, formerly chief engineer of the Westinghouse Machine Company, severed his connection with that company on Jan. 31.

MR. H. E. CHUBBUCK, of Ottawa, Ill., has been appointed general manager of the Wichita Railroad & Light Company, of Wichita, Kan., succeeding Mr. S. L. Nelson, of Peoria, Ill.

DR. LEE DE FOREST was married Feb. 25 to Miss Nora Stanton Blatch, a granddaughter of Mrs. Elizabeth Cady Stanton. The bride is a graduate from the civil engineering course of Cornell University.

MR. J. S. WEBSTER has, since the completion of his work in preparing plans and specifications for the large Butlers Brothers' building in Minneapolis, had permanent offices at 21 North Sixth Street, Minneapolis, Minn.

MR. ALEC. HENDERSON has been pushing conduit interests in the Pacific, and his friends are in receipt of letters and picture postal cards from Honolulu. As an old globe trotter, Mr. Henderson is quite at home in the Sandwich Islands.

MR. H. ASKIN has resigned his position as superintendent of the Barnes Electric Light & Power Company, of Maquoketa, Iowa, to take effect March 15. Mr. Askin's name is well known in central station circles from his unique and successful new business methods.

CAPTAIN GODFFREY L. CARDEN, U. S. R. M., who is on a mission to Europe from the Department of Commerce and Labor, to report on the machinery situation there with respect to American export trade, has already turned in several reports relating to the machine-tool industry in Prussia.

MR. FORD HUNTINGTON, who has been treasurer of the New York Telephone Company for several years, has been elected permanent treasurer of the New York & New Jersey Telephone Company to succeed Henry Sanger Snow, who has been indicted for misappropriating $148,000 in the stock and bonds of the company.

MR. ARTHUR B. SHEPARD will represent the Electric Machinery Company, of Minneapolis, in northern Ohio, with headquarters at Cleveland. Mr. Shepard has for the past seven years been manager of the Cleveland office of the General Electric Company, and previously was on the engineering staff of that company at Schenectady, N. Y.

MR. MOULTON, for the past six years with the New York office of the Fort Wayne Electric Works, has accepted a position with the Manhattan Electrical Supply Company as special representative. His extended experience in all branches of the electrical business, dating back to 1889, and his large acquaintance with the trade in general, should prove of value to the already efficient staff of the Manhattan company.

MR. F. O. BROILI, superintendent of the Truckee River General Electric Company, of Reno, Nev., resigned his position to take effect on March 1. His position will be filled by Mr. George Campbell, at present manager of the Reno Power, Light & Water Company. Mr. Broili has for the past four years been in charge of the plants along the Truckee, supplying power to the towns of Carson, Virginia, Yerington and Reno.

MR. HERBERT G. LOWELL has been elected manager of the municipal lighting plant of Templeton, Mass. Mr. Lowell, who had an active part in the construction of the plant, was formerly a member of the Manila staff of the J. G. White Company, and has been engaged in electrical engineering work in Canton, China, and Bombay, India, in the latter place, having been connected with the construction of electric railway lines.

DR. G. F. KUNZ.—Dr. George Frederick Kunz, president of the American Scenic and Historical Preservation Society, and connected with the United States Geological Survey, received through the Norwegian Chargé d'Affaires at Washington last week from King Haakon VII, the Cross of the First Class of the Royal Order of St. Olav in recognition of his distinguished services to science in the department of mineralogy. Dr. Kunz is well known in the electrical field, and is a member of the American Society of Mechanical Engineers.

MR. ARTHUR B. LISLE was chosen general manager of the Narragansett Electric Lighting Company, of Providence, on Tuesday, Feb. 25. The office was formerly held by Mr. M. J. Perry, who was also president for many years, but at his resignation the two offices were separated. Mr. Lisle was assistant general manager of the company in 1905, when he resigned. He worked his way up in the company from an office clerkship. He is connected with the banking firm of D. A. Peirce & Company, is a director of several manufacturing interests, and treasurer of the Putnam Light & Power Company, of Putnam, Conn.

MR. F. E. REIDHEAD, who for the past five years has been manager for Stone & Webster, of the Columbus (Ga.) Power Company, has been transferred to the management of the Paducah, Ky., properties of the same company, consisting of the electric railway, central station and gas plants. Mr. Reidhead was formerly general superintendent of the Minneapolis General Electric Company.

MR. JOHN S. BLEECKER has taken charge of the electric light and power, railway and gas properties of Stone & Webster at Columbus, Ga. Previous to this assignment Mr. Bleecker was manager of the Paducah, Ky., properties of the same company.

MR. U. N. BETHEL has been re-elected president, and Mr. Walden Hopkins, secretary of the New Jersey Telephone Company. Mr. Ford Huntington was elected permanent treasurer to succeed Mr. H. S. Snow, now under indictment, and Mr. H. B. Thurber succeeds J. C. Reilly as second vice-president, taking up the duties of that office in addition to those of general manager of the Brooklyn and New York companies. Mr. Reilly will be attached to the president's office. Mr. Walter Brown has been chosen auditor to succeed Mr. J. L. Hamar, who will remain as auditor of the Manhattan company as well. The changes made are in accordance with the plan commenced about two years ago to merge the management of the New York and Brooklyn companies.

Obituary.

MR. WILLIAM HALL HAMMOND, a brother of Mr. John Hays Hammond, the mining engineer, died on Jan. 19, at San Mateo, Cal. Mr. Hammond was a native of San Francisco, 51 years of age. He was president of the Mt. Whitney Power Company, a million-dollar corporation, in which Mr. John Hays Hammond is the controlling owner.

MR. ORRIN S. WERNTZ, treasurer of the National-Acme Manufacturing Company since its organization, died Feb. 6, aged 32. Mr. Werntz was born in Canal Fulton, Ohio, and removed to Cleveland early in life. His first position was with the National Screw & Tack Company, until the organization of the National-Acme Manufacturing Company. His late illness was of about one month's duration, his last visit to the office having been on Jan. 4. A wife and young son survive him.

MR. THOMAS CARSON BARR, for twenty years prominent in street railway circles in New Jersey and a pioneer in electrifying surface roads in Newark, died at his home in Orange, N. J., Feb. 26. Mr. Barr became interested in the street railways of Newark in 1889 and four years later became president. In the early 90's he published the *Newark Times*. He afterwards sold out his interest and later conducted a morning newspaper in Trenton. He was formerly president of the Orange Club, and at the time of his death was a member of the board of governors. He was also a member of the Essex County Club, of West Orange; Union League Club, of Philadelphia, Pa.; Lawyers' Club, of New York; Essex Club, of Newark; Trenton Country Club and the Lotus Club, of Trenton.

Unclassified Items.

SHREVEPORT, LA.—The Shreveport Suburban Railway Company has been chartered with a capital stock of $50,000. John Lorenz is president and J. B. Atkins, secretary and treasurer. The company has already commenced work on the construction of its new electric railway.

COVINGTON, LA.—Preliminary arrangements have been completed for the construction of an electric railway from Covington and Abita Springs to Mandeville, work on construction of which is expected to commence in the near future. E. A. Leonval, of Covington, is interested in the enterprise.

HUNTINGTON PARK, CAL.—Articles of incorporation have been filed for the Huntington Park Gas & Electric Company. The capital stock of the company is placed at $20,000, and the directors are E. B. De Le Matyr, J. J. Curren and H. F. Leukfeld.

NEEDLES, CAL.—Application has been made to the Board of County Supervisors for a franchise to erect transmission lines from the power house of the Victor mines to Needles to supply electricity for lamps in this town.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, of 42 West Jackson Boulevard, Chicago, Ill., has been advised that its new No. 903 attachment plug has been passed upon and approved.

MR. ARTHUR B. LISLE has been elected general manager of the Narragansett Electric Lighting Company, of Providence, R. I., to succeed Mr. Marsden J. Perry, resigned. Mr. Lisle was connected with the company for twelve years, and at one time was assistant general manager. About three years ago he retired to enter the firm of D. A. Peirce & Company.

PANAMA, N. Y.—The water power plant of the Panama Power Company was put into operation Jan. 24. The equipment consists of a Leffel turbine operating under a head of 70 feet; a 30-kw, three-phase, 60-cycle 2200-volt Westinghouse generator. At present the plant furnishes electricity for 300 incandescent lamps. The company contemplates establishing a power service in the spring and will install motors to operate the grist mill, creamery and other concerns. The purchase of another turbine is anticipated in the near future. E. M. Wiltsie is secretary and manager.

VIENNA, S. D.—The Lunde Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are C. N. Christopherson, A. P. Lunde and Edward E. Peterson.

WOONSOCKET, S. D.—The Warren Telephone Company has been incorporated with a capital stock of $1,500 by J. P. O'Neill, C. W. Hopper, T. J. Raus and W. A. Rummelhart.

SISSETON, S. D.—Articles of incorporation have been filed for the Sisseton Telephone Company with a capital stock of $10,000 by N. T. Axness and Knute Bowe.

NYACK, N. Y.—The Rockland Railroad Company has been granted a franchise by the Board of Trustees to construct and operate a street railroad in and through the village.

GREENVILLE, OHIO.—The City Council has granted a franchise to the Mercer Construction Company to build and operate a street car system in the city. The company has secured the right of way between this city and Mercer and from Mercer to Sharon.

Business Notes.

THE HOBART ELECTRIC COMPANY, of Troy, Ohio, is making arrangements to establish a Western branch in Des Moines, Ia. J. E. Williams will be local manager.

MR. GEORGE P. HUTCHINS has removed his business from 500 Fifth Avenue to 11 West Thirty-second Street, New York, where he is associated with the Homer W. Hedge Company, general advertising agents, and will manage the technical department of the business.

THE WISCONSIN ENGINE COMPANY, Corliss, Wis., manufacturer of Corliss steam engines, gas engines, pumping engines, air and gas compressors, has established a branch office in Atlanta, Ga., with offices and rooms in the Candler Building. Mr. Julius M. Dashiell has been appointed sales manager.

THE WAGNER ELECTRIC'S CANADIAN OFFICE.—The Wagner Electric Manufacturing Company, of St. Louis, has appointed Mr. Alfred Collyer as district manager of Canada sales of the Wagner company, with offices in the Bell Telephone Building at Montreal, Que. Mr. Collyer's title will be sales manager for Canada.

ELECTRIC MACHINERY COMPANY'S CLEVELAND OFFICE.—The Electric Machinery Company, of Minneapolis, Minn., has opened an office at Cleveland, Ohio, which will be in charge of Mr. Arthur B. Shepard, who for the past seven years has been manager of the Cleveland office of the General Electric Company.

THE JACOBSON MACHINE MANUFACTURING COMPANY, of Warren, Pa., has recently established a Southern office at Atlanta, Ga., where there will be carried a full stock of gas and gasoline engines of its manufacture, also a stock of repair parts. The office will be in charge of Mr. C. R. Morrison, who for some time been traveling representative of the company in the Southern States. The office and storeroom are located at 676 Marietta Street, Atlanta, Ga.

DOSSERT & COMPANY, of New York, have received what is probably the largest order for terminal lugs ever used on a single installation in this country. The material is for use in the wiring of the immense terminal buildings at Cortlandt, Church and Fulton Streets, New York, of the Hudson & Manhattan Railway Company operating the tunnels under the Hudson River which have just been opened to the public. These terminals are of the Dossert solderless type, comprising front connection, back connection, angle and swivel lugs, and range in size from 2,000,000 circ. mils down to No. 4 cable. Part of the order comes from the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., and is for lugs to be used on fuse blocks of the enclosed type. Approximately, 1000 lugs are required for the switchboards and panel boards of the buildings.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting at Savery Hotel, Des Moines, Ia., April 22 and 23.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia. Next meeting, Cedar Rapids, Ia., second Tuesday March, 1908.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting at Des Moines, Ia., in April.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

Kentucky Independent Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Massachusetts Street Railway Association. Secretary; Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Central Station Men's Association. A. H. Lane, Glencoe, Minn., chairman.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, Kansas City, May 6 and 7.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. Z. Pierson, St. Charles, Mo. Next meeting at Marquette Hotel, St. Louis, April 23, 24 and 25.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York. Next meeting at Chicago, May 19, 20, 21 and 22, 1908.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, May 4 to 9.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio. Next meeting, Columbus, March 19.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio. Next meeting at Columbus, May 15 and 16.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Charles W. Ford, Oklahoma City, Okla.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D. Next meeting at Yankton, S. D., January 13 and 14.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting at El Paso, Texas, in March.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass. Next meeting, March, 1908.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 25, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

879,885. INTERLOCKING RELAY; Edward McClintock, St. Paul, Minn. App. filed April 30, 1907. Has a relay mechanism whereby a signal will be operated when the train is moving in one direction but will be silent or inoperative when the train is moving in the opposite direction.

879,886. HIGHWAY CROSSING SIGNAL FOR ELECTRIC ROADS; Edward McClintock, St. Paul, Minn. App filed April 30, 1907. Relates to modifications of the above particularly adapted for use at a crossing.

879,887. METHOD FOR REGULATING ELECTRIC GENERATORS; George S. Neeley, St. Louis, Mo. App. filed May 9, 1907. Means for automatically regulating the field density of an electric generator, providing a constant voltage in the work circuit by an arrangement of magnets which controls the field resistance by a differential action.

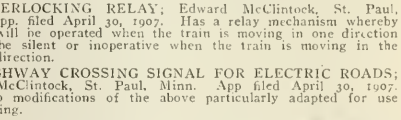
879,859. APPARATUS FOR PRODUCING VERY THIN SHEET METAL; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed March 1, 1905. Apparatus for producing thin metallic strips or films, comprising in combination an electro-deposition bath, a cathode in said bath formed of copper-aluminum alloy in which the percentage of copper largely predominates, and an anode arranged adjacent to said cathode, substantially as set forth.

879,927. POLE SHOE FOR DYNAMO ELECTRIC MACHINES; Robert B. Treat, Newark, N. J. App. filed April 9, 1906. A form of construction for the tips of pole shoes designed to prevent crowding of the lines of magnetic force therein and resultant displacement of the field. The pole tips have an elongated perforation inclined to the face of the pole shoe at the tips thereof.

879,940. GROUND-CONNECTION CLAMP; William H. Blood., Jr., Wellesley, Mass. App. filed March 23, 1905. Clamp designed to engage a pipe with the greatest possible conducting efficiency so as to carry away comparatively heavy currents therefrom.

879,943. TROLLEY POLE SUPPORT; James L. Chase, Ayer, Mass. App. filed Aug. 23, 1907. Patentee has a weighted arm raising the trolley pole through a gear segment and means for tripping the rack from the gear to retrieve the pole when the latter leaves the wire.

879,949. COIL RETAINER FOR DYNAMO ELECTRIC MACHINES; Gano Dunn, East Orange, N. J. App. filed June 3, 1907. The armature slots have undercut grooves near their outer edges, in which are received small plates or blocks which are inserted by a rotary movement by the means of a suitable tool, instead of being slid longitudinally into place.



879,940.—Ground-Connection Clamp.

880,011. DYNAMO ELECTRIC MACHINE; Henry Chitty, Strand, London, England. App. filed June 2, 1904. A means for controlling the field density at the pole piece of an electric generator. The pole has a perforation of trapezoidal section extending therethrough at the region of its normally densest field, and an iron bridging piece extends from this point to the next adjacent pole of the generator.

880,020. VAULT LINING; Jacob L. Grass, Minneapolis, Minn. App. filed July 13, 1907. Patentee provides plates held on the interior of a safe or vault by especial circuit closing devices so as to actuate an alarm in case the bolts are tampered with in any way.

880,021. TROLLEY; George H. Gross, Binghamton, N. Y. App. filed April 26, 1906. In place of the usual bearing, patentee has a fixed grooved ring over which a trolley wheel of ring-shaped or annular form is positioned to rotate.

880,027. METHOD OF MAKING ELECTRODES; Ernest W. Junger, Kneippbaden, Sweden. App. filed Apr. 4, 1907. The method of producing electroactive substances for secondary batteries which comprises binding small particles of magnetic metal by a hydrate of one of these metals, and taking certain other steps specified.

880,037. METHOD OF TREATING GASES AND GAS MIXTURES BY MEANS OF VOLTAIC ARCS; Albert J. Petersson, Alby, Sweden. App. filed Aug. 23, 1904. The method of treating gases by means of voltaic arcs, which consists in leading gases through a furnace chamber, creating the said arcs between electrodes in the said furnace chamber, and creating electrodynamic forces by means of electric currents of greater intensity than that of the current creating the arcs for displacing the latter, substantially as and for the purpose set forth.

880,044. TRANSMITTER; Samuel W. Rothermel, New York, N. Y. App. filed Jan. 5, 1906. A typewriter transmitter having a continuously rotating toothed cylinder with which gears having cams are adapted to be lowered selectively by depression of the keys.

880,046. HIGH-FREQUENCY DISCHARGE APPARATUS; James E. Seeley, Los Angeles, Cal. App. filed Nov. 26, 1906. A means for producing high-frequency electrical discharges by the use of either alternating or direct current. Has induction means for producing the discharge which will operate as a tranformer on alternating currents to supply energy by induction from the supply line to the charging circuit.

880,055. ARC-LIGHT ELECTRODE CONTAINING METAL WITHIN THE SAME; Hermann Viertel, Charlottenburg, Germany. App. filed April 16,1907. A method of manufacturing arc light electrodes, consisting of filling the interstices of a reticulated metal tube with core material and inserting said tube into a hollow carbon casing and drying the same.

880,072. RAILWAY SIGNAL APPARATUS; Frank Graziano, New Orleans, La. App. filed June 15, 1907. Has a track apparatus comprising a grating with spaced bars and terminals arranged below the upper surface of the grating and adapted to form parts of normally open electric circuits which are completed by tappets depending from the cars and passing between the gratings

880,079. RADIATOR; George Hodgdon, Wilkinsburg, Pa. App. filed June 8, 1907. A radiator of substantially the ordinary outward appearance and containing water which is heated by resistance coils.

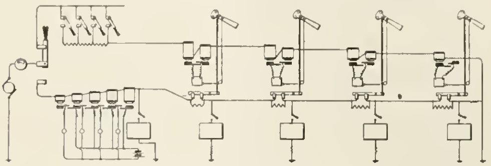
880,107. ELECTRIC TROLLEY, Leonard Smith, North Tonawanda, N. Y. App. filed Dec. 9, 1905. The trolley harp is pivoted to the upper end of the pole and has a limited movement at such point by virtue of a spring and bolt connection.

880,121. ELECTRICAL INSULATOR; Daniel G. Bolton, Camden, N. J. App. filed Nov 23, 1906. An electric insulator comprising a pin, disks thereon spaced apart, and a sleeve or bushing of flexible insulating material around the pin between the disks.

880,134. ALARM SIGNAL MECHANISM; Ellsworth E. Flora and Robert J. Zorge, Chicago, Ill. App. filed June 19, 1907 Means for giving warning to an engineer or motorman of the opening of a switch or draw. Includes an apparatus alongside the track rails for positioning a torpedo thereon in case the train approaches when the switch is open.

880,136. SIGNAL SYSTEM; Julian A. Gehrung, New York, N. Y. App. filed Feb. 2, 1907. Provides a signal system particularly adapted to suit the requirements of railroad traffic in rural and undeveloped sections of the country. Secures a complete semaphore control of the railroad line under the surveillance of the despatcher at a city terminus and provides for telegraphic communication to the train at whatever point of the line it may be. This is accomplished by two wires or conductors extending along the roadway. There is further provided a means to give an indication or check on the accuracy of the system so that any conditions such as broken wires, short circuited wires or leakage, or any other defect is at once notified to the despatcher's office.

880,152. ELECTRIC SIGNAL FOR ELEVATORS; Charles E. Moore, Los Angeles, Cal. App. filed March 7, 1906. Relates to signals displayed in an elevator cage and provides an efficient signal which will disclose to the operator in charge of the cage as soon as a passenger on a floor decides to go either up or down. Includes complete electrical and mechanical features.


880,136.—Signal System.

880,160. BURGLAR ALARM SYSTEM AND APPARATUS THEREFOR. Milton R. Ney and Samuel S. Ullman, Washington, D. C. App. filed Sept. 25, 1907. Patentee insets in the door jamb a depressible plunger which co-operates with a telephone circuit so as to give an alarm thereon when the door is open.

880,167. COMBINED LOCK AND ELECTRIC SWITCH. William M. Shannon and George K. Taylor, Columbia, S. C. Relates to a door lock switch for electric lights by means of which the lighting circuits in a room controlled by the door will be opened or disconnected when the person last leaving the room closes the door after having first thrown on the dead latch to prevent the door being opened from the outside except by a proper key.

880,196. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed March 21, 1904. The combination of a conduit, a socket intersecting said conduit, a tube extending into said socket, and a nut engaging said tube and having a passage therein through which said tube and conduit communicate, substantially as specified.

880,168. COMBINED LOCK AND ELECTRIC SWITCH; William M. Shannon and George K. Taylor, Columbia, S. C. App. filed Aug. 22, 1907. Relates to modifications of the above.

880,203. INSULATOR; John D. E. Duncan, Brooklyn, N. Y. App. filed Sept. 9, 1907. Compound petticoated insulator for high potential currents having an arcing ring incorporated therewith.

880,209. ELECTRICALLY OPERATED CLOCK; Harleigh Gillette, Chicago, Ill. App. filed March 27, 1907. Relates to complete escapement action of a secondary clock which is operated by the intermittent energization of an electromagnet.

880,218. SIGNAL MECHANISM FOR BLOCK SIGNAL SYSTEMS; Harry L. Johnson, Topeka, Kans. App. filed April 2, 1907. Signal mechanism for electric block signal systems having a main battery to alternately energize primary or main and secondary electromagnets; has a local battery and a local electromagnet signal circuit and connections whereby the making of the circuit through the main battery shall complete the local and signal circuits successively.

880,266. ELECTROMAGNETIC CLUTCH; Heinrich Ast, Vienna, Austria-Hungary. App. filed June 15, 1906. Patentee has two disk or iron-clad magnets operating face to face with an independently rotatable element therebetween having a passage for the circulation of a cooling medium.

880,271. METHOD OF FORMING RAIL BONDS, ETC.; Eugene M. Bournonville, Jersey City, N. J. App. filed Sept. 20, 1907. The method of connecting rails and other metal bodies comprising heating the metal of the parts to be connected to a point short of the melting point, then increasing the temperature of one of said parts until a portion thereof melts and becomes unified with the heated portion of the other part.

880,272. THERMO ELECTRICAL SYSTEM; William H. Bristol, New York, N. Y. App. filed Nov. 11, 1907. Provides a thermostatic apparatus which is designed to indicate sudden changes of temperature but which is unresponsive to gradual changes.

880,320. RAILWAY SIGNALING SYSTEM; Wilmer W. Salmon, Rochester, N. Y. App. filed July 3, 1907. Block signal system having sectionally energized track rails connected by inductive bonds and which are used as return conductors for the power current. The blocks are sectionally energized by alternating currents which are short circuited to operate the signals.

880,338. ELECTRIC-ARC FURNACE; Sidney D. Spence, Chattanooga, Tenn. App. filed Dec. 17, 1906. An electric-arc furnace having vertically adjustable inner electrodes, side electrodes, pivotally mounted longitudinally adjustable arms carrying said side electrodes and means to raise and lower said arms and hence also said side electrodes.

880,367. BATTERY; Frank A. Decker, Philadalphia, Pa. App. filed May 9, 1905. In a battery, a cell having a base with a set of interior depressions therein, an exterior conducting strip, conducting screws passing through said strip and base into the respective depressions, and electrodes within said cells having depending parts disposed in said depressions.

880,368. BATTERY; Frank A. Decker, Philadelphia, Pa. App. filed March 21, 1904. In an electrochemical apparatus, a plate having overlapping indentations in its opposite sides, substantially as specified.

880,373. PROCESS OF ACCELERATING THE SEPARATION OF NITROGLYCERIN FROM ACIDS; Richard Escales and Milano Novak, Munich, Germany. App. filed Sept. 5, 1907. The process of separating nitroglycerin from mixed acids, which consists in passing an electric current between electrodes through a liquid mixture of acids and nitroglycerin.

880,395. TROLLEY WHEEL SPRING; Ralph E. Noble, Chicago, Ill. App. filed July 3, 1907. The harp has arms with longitudinal recesses therein, which recesses receive the looped portions of blade springs interposed between the wheel and the arms of the harp to establish good electrical contact.

880,398. ELECTROMECHANICAL SLOT FOR SIGNALS; George S. Pflasterer, Nashville, Tenn. App filed Aug. 29, 1907. Signal operating mechanism of the "electromechanical slot" type for use on railways in which a signal set for safety or clear is through the intermediary of electrically controlled appliances shifted upon the reversal of the normal condition of the electric circuit in which the governing magnet is included.

880,405. PROCESS FOR PRODUCING PORELESS AND WELL-ADHERING ELECTRODEPOSITS; Harry Schmidt, Cologne, Germany. App. filed Aug. 7, 1907. The process of producing poreless and well-adhering electrodeposits, which consists in first providing the metal to be electroplated with a coating of a metal or alloy which melts at a lower temperature than the final electrodeposit.

880,416. WIRE-SUSPENDING DEVICE; Herbert E. Stevens, Macdonaldton, Pa. App. filed Nov. 9, 1906. The cross arm of the pole is recessed vertically from its under face so as to receive a pair of co-operating wedge elements which together form a cup. One of the wedge elements has a lug to which the depending insulator is fixed so that the weight thereof constantly tightens said wedges in their recess.

880,418. INSULATOR FOR HIGH-TENSION CONDUCTORS; Samuel H. Summerscales, Winnipeg, Manitoba, Canada. App. filed Nov. 23, 1906. Provides a pyramidal vitreous block with horizontal grooves on its side faces in which various conductors are supported.

880,420. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Dec. 1, 1905. A bifunctional storage battery plate embracing a series of narrow strip-like anodes and a series of intervening cathodes of similar structure; in combination with layers of porous insulating media between said anodes and cathodes and conducting binding means at each end of the plate constituting respectively the plus and minus poles thereof, substantially as described.

880,421. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App filed Oct. 29, 1907. A bifunctional storage battery plate, embracing anode and cathode strips of ribbons, and intermediate porous insulating strips grooved on their opposite faces; in combination with active material located in said grooves and prevented thereby from being released, substantially as described.

880,422. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed July 3, 1907. A bifunctional storage battery plate composed of interleaved strip of ribbon-like anodes and cathodes sustained at their lateral edges by insulating frames, substantially as described.

880,423. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Oct. 29, 1907. A bifunctional storage battery plate, embracing elements comprising anode and cathode strips and interleaved porous insulating media; in combination with porous retaining plates adapted to be held against the edges of said elements, substantially as described.

880,424. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Oct. 29, 1907. A bifunctional storage battery plate, embracing a rigid base provided with grooves on its opposite faces and anode and cathode strips located in said grooves in definite or fixed relation to each other, substantially as described.

880,425. STORAGE BATTERY PLATE; Alfred O. Tate, Toronto, Canada. App. filed Oct. 29, 1907. A bifunctional storage battery embracing anode and cathode strips sustained in grooves on the exterior faces of a hollow base plate provided with liquid conveying openings from the central opening of the base plate, substantially as described.

880,429. COIL RETAINER FOR DYNAMO ELECTRIC MACHINES; Robert B. Treat, Newark, N. J. App. filed Nov. 12, 1907. The slots of the armature are undercut at their edges to receive small resilient plates which are sprung into place.

880,435. ELECTRIC ARC LAMP; Thomas E. Adams, Cleveland, O. App. filed Aug. 11, 1905. A construction of cap or cover for the arc-enclosing globe designed to provide a simple and efficient means for prolonging the life of the carbons.

880,437. BRUSH HOLDER; Albert Ball, Claremont, N. H. App. filed Nov. 30, 1906. A brush holder of the ring type which is engaged upon the field frame by circumferentially disposed lamping devices.

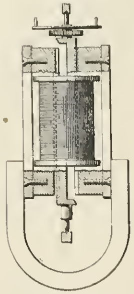
880,464. APPARATUS FOR TREATING GASES AND GAS MIXTURES BY MEANS OF VOLTAIC ARCS; Albert J. Petersson, Alby, Sweden. App. filed Sept. 6, 1905. In an apparatus for treating gases by means of voltaic arcs, the combination of a furnace chamber, electrodes extending in the same general direction in the said furnace chamber, a source of electric current connected to the said electrodes for creating the said arcs between the latter, and means for creating electrodynamic forces for strengthening the displacing action on the arcs exerted by the currents flowing through the electrodes to the said arcs, substantially as and for the purpose set forth.

880,477. CONDUCTING CONDUIT FOR VEHICLES; Francis M. Brinckerhoff, New York, N. Y. App. filed March 12, 1907. Patentee has tubular passages in the car roof extending down through the pivots of the bogy trucks into the castings of the motors so as to cool the same.

880,484. PROCESS OF PRODUCING VERY THIN SHEET METAL; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed June 29, 1904. An improved process for producing metallic sheets or foils, which consists in electrolytically depositing a thin metal film on a polished surface of an aluminum-copper bar of suitable form extending through the coil, and means to rotate the bar to close the magnetic circuit between diagonally opposite poles, substantially as described.

880,485. MAGNETO-ELECTRIC INDUCTOR; Martin Fischer, Zurich, Switzerland. App. filed July 5, 1900. Electric generators of the type having a permanent magnet with an armature between its poles and arranged to close the magnetic circuit, and consisting of a soft iron core carrying an induction coil in combination with means for controlling the direction of the magnetic flux with relation to the coil.

880,489. PROCESS OF PRODUCING MAGNESIUM; Franz von Kugelgen, et al., Halcombs Rock, Va. App. filed June 9, 1905. The process of producing magnetism by dissolving magnesium oxid in a fused bath of magnesium fluorid and one or more fluorids of metals more electro-positive than magnesium, and subjecting the same to electrolysis.


880,485. — Magneto-Electric Inductor.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. XX   NEW YORK, SATURDAY, MARCH 14, 1908.   No. 11.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. HAROLD S. BUTTENHEIM, Secretary.
A. E. CLIFFORD, 2d Vice-President. CURTIS E. WHITTLESEY, Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE............................1015 Schofield Building
PHILADELPHIA OFFICE.........................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico..........................per year, $3.00
Dominion of Canada..4.50
Other Foreign Countries within the Postal Union...................6.00
25 shillings   25 marks   31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue* 16,000 *copies are printed.*

NEW YORK, SATURDAY, MARCH 14, 1908.

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OUR PATENT OFFICE SYSTEM.

Elsewhere will be found an article by Mr. H. Ward Leonard which voices the dissatisfaction that in recent years has been steadily arising against the workings of our present patent system, and which promises in time to bring the entire matter forward as a national, and perhaps even a political, issue. We shall here comment on only one phase of the situation presented by Mr. Leonard, and also refer to another phase not brought forward in the article, though perhaps of paramount importance in any general consideration of the patent situation. The article by Mr. Leonard, as well as another in this issue by Mr. Joseph B. Baker, lays stress upon the parsimonious policy of the government in the payment of the staff of Patent Office examiners. In view of the large profit derived from the operations of the Patent Office, and the highly important and difficult character of the work of the examiners, the utterly inadequate salaries now paid are a reproach to Congress, and illustrate its growing incapacity to deal with governmental administrative matters divorced from any relationship to politics. Salaries double those now paid would scarcely compensate for the kind of service that is involved in the extremely technical and complicated work incident to passing on applications for patents; and it is a reflection upon all technical men that their fellows engaged in this work should be so shamefully compensated for their labors.

We cannot agree, however, with those who would rate the qualifications of the present members of the examining staff by the scale of salaries they receive, nor in the implication that those who use the Patent Office as a stepping-stone to future employment outside of the public service are an element superior to the examiners who choose to consider that the Patent Office offers a decent career to the self-respecting man. The character of the work in the Patent Office calls for qualities of patient research, trained judgment and absorption of self in daily duties demanded in few employments, and those who possess in the highest degree these qualifications are the ones most likely to remain permanent members of the staff. The details of the necessary work of the world are carried on by this class of men, and not by those always ready to pass from one employment to another in order to better their personal condition. As a matter of common justice, the present scale of examiners' salaries should be very largely raised, though as remarked by a former Patent Commissioner, this would probably not in itself greatly reduce resignations from the force. But there are two practical considerations entering into the demand for improvement of Patent Office efficiency which Congress cannot brush aside as easily as one based merely on justice. These are, first, a scale of salaries which will attract applicants for entry into the service in sufficient number not only to fill vacancies, but to enable the best available material to be selected; and second, an enlargement of the staff which will obviate over-working its members, and overcome the demoralization that cannot fail to be incident to knowledge by an examiner that, owing to the limited time allowed for research, he has allowed a patent which further examination might indicate should have been refused.

The important point to which neither of the articles refers is the shifting in recent years of the constitutional function of the Patent Office—to encourage invention and reward the inventor for the benefit of the public—until at present the practical working of our patent system has only a secondary relation to these objects. It cannot, of course, be charged that the Patent Office has knowingly permitted this change to take place, or even that without the aid of stringent legislation by Congress, it could, with full knowledge of the situation, have offered any effective resistance. The fact remains, however, that under the present statutes and the rules of the Patent Office, it is possible so to surround an art by protective or subsidiary patents, and by patents on changes or improvements incident to the natural evolution of the art, that the independent inventor has absolutely no incentive to exercise his ability in that particular field; and as the incentive to invention by those within the field is a minimum, owing to lack of reward beyond a strengthening of salaried positions, the total effect on real progress by invention is lamentable. Moreover, the industrial effect of the existence of long lines of patents of this character is to close the field to others who might desire to enter it as manufacturers. It is doubtless the existence of this situation which in recent years has considerably lowered the inventive activity of this country along some lines, as compared with several of the European countries, and which falling off is yearly becoming more noticeable. The most aggravated form of this perversion of the intent of patent monopoly is in the patenting of the steps of engineering evolution. A new application of electrical energy, or an old one applied on a large scale, requires, say, apparatus of a larger size or differing in detail from existing apparatus. In the design to meet the new requirements, necessarily features are introduced differing or absent from those of the older apparatus; and should these present the slightest point of novelty they apparently can, under the present rules of the Patent Office, be made subject to patents. A patent once granted, it is apt to control the advancement in the art on account of the enormous expense now attendant on patent litigation; and even if litigated, our patent courts as now constituted appear to lay inordinate stress on the presumption of invention in cases where others have not previously availed themselves of the idea in suit. A remedy for this condition will involve a thorough overhauling of statute law and of the existing practice of the Patent Office, together with the constitution of patent courts which will be able to appreciate the difference between an invention entitled to a patent monopoly, and a change in design necessitated and indicated by the evolution of an art.

The Conservation of Hydraulic Resources.

The recent report of the Secretary of Agriculture on the Southern Appalachian and White Mountains watersheds and the address of Mr. Pinchot last week before the Institute bring to the fore the interest that is being aroused in the economic importance of forest protection. There are many ways in which protection of the forests is a public benefit and there is general agreement that something ought to be done before denudation is carried to a finish; but just how the best results can be achieved is quite another matter. As regards the effect of forest destruction upon water-powers, exact or even approximate concrete data are very meager. A comparison of the flow conditions from a forested watershed, as in the case of the upper Hudson, with those from the denuded slopes on the Pacific Coast, tells a grim story of the ultimate results. It is to regretted, however, that neither Mr. Pinchot's publicity department nor any other branch of the government service has actually gathered any definite data on the effects of deforestation on stream flow in any existing stream large or small. Measurements are now being made which will ultimately lead to valuable results if the necessary appropriations are kept up. Meanwhile, if one tackles any of the government departments for information, he gets a bunch of euphonious platitudes and nothing more. What exact knowledge at present exists is locked up in the desks of a few hydraulic engineers who have studied the matter.

The really critical connection between forestry and hydraulic resources is not so much the amount of cutting as what happens afterward. With utter disregard of results and with the utmost contempt for the rights of the people, even the greediest timber-hogs could not cut on the watersheds of most streams fast enough to do permanent damage by the mere removal of trees. On some Western streams, it is true, an area once stripped remains so; but usually the second growth, if given a fair chance, shields the humus quite as effectively as the first growth within a very few years. But as a rule it does not get this chance. The timber-hog strips the earth of the trees and leaves the litter of dead branches and stumps behind. Then the process of repair is checked and presently, if indeed the weak saplings of the second growth have begun to make their way through the tangle, fire comes and wipes them out, charring the humus to its very bottom if the soil is thin, and leaving for years a blackened waste dotted with struggling bushes. On mountain slopes the soft humus may meet a different fate, being furrowed and washed away by the rains until little but the rock below is left. The White Mountains show terrible destruction of this sort wrought within a decade or two. The preservation of the forests requires not only the restriction of reckless cutting, but drastic regulations as to clearing away waste and the prevention of fires.

It is not easy to locate the causes of the destructive forest fires, since the causes generally keep mum. The careless sportsman and camper gets the opprobrium of most of the trouble, but if the truth were known we are inclined to think that the native resident burning over a stubblefield or freshly-cleared pasture, or setting deliberately fires in the hope of bettering next year's berry crop, would be found responsible in the great majority of cases. The strongest argument for creating forest reserves in the control of the government is that such reserves can be, at some expense, pretty well protected. That is precisely why national forest reserves are unpopular with their immediate neighbors. It is practically impossible by State laws enforced by local talent adequately to protect either forests or game, since local law breakers are, and always will be, generally winked at unless the forest or game warden has a personal grudge against some of them. Government control is better than State control for the same reason that regulars can deal with a desperate strike more efficiently than local militia. The States, however, can and should do something to help along the good cause. Most large streams involve Interstate relations which make it doubly difficult to protect their watersheds save by national action. The thing to be done is to move quickly even if the methods are not ideal and the results sometimes open to criticism.

Looping Versus Cutting Theories of Electromagnetic Induction.

The interesting article of Mr. Carl Hering, appearing at page 558 this week, raises from a long slumber an old and well-beloved subject for debate. When we have a conductor such as a coil of cotton-covered copper wire closing its circuit, say, through a milliammeter, and situated movably with respect to the magnetic field of a magnet, then we know that, in general, any relative movement between the coil and the magnetic flux will tend to set up an electric current in the coil, and a magnetic current against the flux. Special movements may be found in which this effect is not produced, but ordinarily movement produced the effect noted. We have two theories, or more properly, convenient working hypotheses, for explaining quantitatively, if not physically, the induced electromotive force accompanying the motion. One is the cutting conception, and the other is the linking or looping conception. According to the first, any element of conductor of length l cms, cutting through a perpendicular impressed flux density of B gausses, with a perpendicular component of velocity v cms per second, has an e.m.f. induced in it of $B\,l\,v$ absolute volts. The total e.m.f. in the coil at any instant is then the sum total of all the elementary e.m.fs. due to the various cutting elements of the conductor in the circuit. The second hypothesis states that if ϕ be the total magnetic flux linked with all of the turns of the coil, and therefore included within the circuit, then $d\phi/dt$ or the instantaneous rate of change in this total linked flux expressed in maxwells per second, will be equal to the total instantaneous induced e.m.f. in absolute volts. It is easy to see that for a simple closed metallic circuit situated in free space and continuously movable with respect to a magnetic flux, either of these methods expresses the quantitative facts as experience reveals them; indeed, each necessarily includes the other as a corollary, because under the conditions assumed there can be no cutting without changing the flux linking, except in special cases, where the cuttings are equal opposite and mutually annulling. Likewise, there can be no change in linking without flux entering or leaving the circuit and cutting correspondingly in the process.

The conditions being usually as above described, many writers and engineers are accustomed to regard the two conceptions as applying equally under all possible conditions. Some prefer to discuss and consider all electromagnetic induction on the cutting hypothesis, while others prefer the looping hypothesis. Mr. Hering brings up, however, a very ingenious and instructive experiment to show that the two methods are by no means always equivalent, and that it is possible by employing a discontinuous metallic boundary, as with a copper strip moving between two fixed springs, to change the linking of flux with a circuit without inducing e.m.f therein, the cutting of the boundary being avoided. According, therefore, to the test afforded by Mr. Hering's experiment, it seems indisputable that in the cases of the simple metallic conducing circuit and a magnetic flux with simple relative motion between the two, the cutting conception is the fundamental or primordial one, which will hold in every such case, even when the circuit boundary is discontinuous; while the looping or linking conception is a secondary summation hypothesis that must be carefully scrutinized to see that it applies in any given complex case.

The subject does not, however, seem to be exhausted here There are other cases not so easy to settle. Let us consider an ordinary direct-current dynamo with the usual commutator. We arrive at the same induced voltage in the armature whether we compute that voltage on the cutting or linkage method, although, as above stated, when the copper wires lie on the armature surface, as in the smooth-core type of armature. Mr. Hering's experiment seems to prove that the cutting conception is the fundamental one. Now, suppose, however, that the armature wires are deeply imbedded below the surface of the armature core, as in tooth-cored machines; or go further, for the sake of clear differentiation, and wind the coil on the spoke of a wheel armature. We now compute our voltage by the linking or looping method, but we fail to see our way to arrive at a result by the cutting hypothesis. In fact, experiment seems to show that deep in the grooves of an unsaturated armature core, the armature wires never reside in, or cut through, a magnetic field of any appreciable intensity. Conversely, in a direct-current motor, with a smooth-cored armature, it is held that the torque, or electromagnetic pull of the machine, is exerted on the substance of the copper wires, whereas in a tooth-cored armature the torque is not exerted on the wires except in a small degree or from leakage field. The electromagnetic pull is taken almost entirely by the iron teeth of the armature. Similar considerations apply to the e.m.f. induced in the secondary coil of alternating-current transformer with iron core. We can follow the induced e.m.f. in the transformer clearly enough on the link hypothesis, but we fail by the cutting rival. It looks as though iron cores upset the latter, or constituted an exception.

Not only do we have trouble with the cutting conception when we use closed or nearly-closed ferric magnetic circuits. but we also have trouble with it when we have no conductor at all. We know that any magnetic disturbance in free space remote from conductors induces electromotive forces and current in that space. We believe that all radiation, and in particular all luminous radiation, is due to the generation and propagation of such induced e.m.fs. But here we have no cutting conductors. Nevertheless, all of the effects so far as we yet understand them are in conformity with the linking or looping conception and can only be comprehended artificially by the cutting conception with the aid of artificial and purely imaginary cutting conductors. When, therefore, we deal with wires or loops in relative motion to magnetic flux, Mr. Hering's experiment appears to us to make the cutting conception primordial. When it comes to iron-cored apparatus, such as tooth-cored dynamos or transformers, the case appears reversed; and when, as in electromagnetic wave motion through non-conductors, there are no conductors to cut, it would seem very hard to use the cutting conception at all.

Annual Convention of the A. I. E. E.

At the annual convention of the American Institute of Electrical Engineers, which will be held in June, at a place not yet selected, the following papers will be read:

"Notes on Electric Locomotive Tests," by George Gibbs; "Determination of Power Factor on Unbalanced Three-Phase Systems," by Austin Burt; "Conductor Rail Measurement," by S. B. Fortenbaugh; "A New Large Generator for Niagara Falls," by B. A. Behrend; "Experimental Observations of Electrical Stresses Caused by Arcing Grounds," by Ernst J. Berg; "The Design of High-Tension Water-Power Stations," by D. B. Rushmore; "Notes on the Development of Electric Heating," by W. S. Hadaway, Jr.; "Steam Turbine Plant—Some Possibilities Resulting from Recent Engineering Developments," by J. R. Bibbins. It is expected that papers will be read also by Harold Pender, C. M. Goddard, G. B. Werner, C. E. Waddell and Carl Hering.

Special sessions of the institute will be held under the direction of the high-tension, railway, and education sub-committees.

N. E. L. A. Convention.

Final plans for the exhibition in connection with the Chicago convention of the National Electric Light Association were adopted at a meeting of the Exhibition Committee last Thursday, March 5, in the board room of the association. Under the resolution adopted at the close of last year's convention, this committee is composed entirely of class D members. This class comprises individual members of the association, as distinguished from class A or company members.

The exhibition will be held in the large hall on the top floor of the Auditorium Hotel and the committee announces the engagement of the well-known Chicago architects, Messrs. D. H. Burnham & Company, for the planning of the booths and decorations. Through the courtesy of the Electrical Trades Exposition Company, the railings, posts, cables and other material used at the recent Chicago Electrical Show will be utilized, but the general effect will be entirely original.

The plans provide for 63 booths, ranging in size from 44 sq. ft. to 123 sq. ft. and, as heretofore, two or more sections may be combined into larger ones. Upon the whole, the area of exhibition space is about the same as that of last year.

Perhaps the most interesting feature in the decorations will be the color scheme, to which much attention has been given. Appropriate to the times, the tungsten lamp will play an important part in the illumination of the hall. The object sought will be a uniform distribution of soft white light, rather than extreme brilliancy.

The convenience of members and their guests has not been overlooked. Convenient to the elevators, a large coat room will be provided at which garments and packages may be checked. Near the passageway leading to the Convention Hall will be located a counter at which convention papers may be left. Judging from inquiries already received by the committee's secretary, the demand for space will be even greater than in former years.

Thursday, May 21, has been set aside as "Commercial Day," and a committee on the program of the day, of which Mr. C. W. Lee is chairman, has prepared a lengthy list of subjects for discussion, as follows: Preparations for a campaign, to be discussed under five heads; contract agent and the representative (six heads); the display room (three heads); advertising (three heads); publicity (two heads); creating demands for electricity (three heads); evolution of the business building (three heads); the electrical contractor (two heads); "Co-operative Commercialism," by Mr. J. R. Crouse; "Illuminating Engineering as a Commercial Factor," by Mr. V. R. Lansingh. An opening address will also be delivered by an electrical engineer, not yet selected, on the relationship between the engineering and commercial departments, and the meeting will be concluded by the award of prizes offered by the Co-operative Electrical Development Association for the best form of solicitor's hand-book in the competition.

New York Electrical Show.

The large electrical companies will be well represented at the Second Annual Electrical Show, which will be held in the Madison Square Garden, New York City, from Oct. 3 to 14. Arrangements thus far completed indicate that the exhibition will go far ahead, both in size, number of exhibits and elaborateness in decoration, of the exhibition of last year. Following is a partial list of the larger companies which have already engaged floor space:

The Habirshaw Wire Company, two sections; New York Edison Company, eight sections; Brooklyn Edison Company, entire rear of the hall; Monotone Construction Company, one space; Driver-Harris Wire Company, two spaces; Tel-electric Company, three spaces; Excello-Arc Company, one space; Mogul Paint Company, one space; Cary Company, two spaces; Federal Sign Company, two spaces; Electric Motor & Equipment Company, two spaces; National Lamp Association, two spaces; F. Alexander Company, one space.

Among the exhibits will be cows milked by electricity, as last year. Mr. Max Lowenthal, of the Electric Home Supply Company, will deliver a series of lectures on heating by means of electricity and other electrical devices. There will be a series of lectures on the general subject of electricity, wireless telegraphy, telephones, motors, etc., one lecture being given each evening of the show. It is planned to give up Saturday night, Oct. 10, to the organization of electrical salesmen, known as the "Rejuvenated Sons of Jove," when special features will be provided and initiations of the Sons will take place. It has been arranged to have the wireless telephone, and negotiations with a view to bringing the gyroscopic train and its inventor from England are now under way. The Miles Brothers Moving Picture Company will give a series of exhibitions showing the various applications of electricity. Elaborate decorations are planned for the Garden, and the exhibition will be a tungsten show throughout.

Tests of German Tungsten Lamps.

A European central-station correspondent sends us the following results of a test of 10 German tungsten lamps made under his direction on a central-station circuit.

The lamps were run on a circuit for 1020 hours. One went out at the end of 380 hours, while another broke at the end of 585 hours; the rest kept up their life, and it was not thought necessary to test further than 1020 hours. The lamps were 25 candle-power and the maker claimed they could be used in an inclined position. Five of the lamps were placed in a vertical position, while the other five were inclined at an angle of 45 deg. The one that broke at 380 hours was in a vertical position, while the other that broke at 585 hours was in an inclined position. A curious fact pertaining to these lamps is that at the end of 1000 hours they have a candle-power higher than at starting. The 25-cp lamps as sold by the maker were tested before they were inserted on the circuit and gave a mean of 19 candles with 1.6 watts per candle; at the end of 10 hours they advanced to 21 candles, at 20 hours to 22.5 candles, at 30 hours to 24 candles, and after 1020 hours they gave a mean of 27 candles with a mean of 1.13 watts per candle. Our correspondent adds that lamps with such a characteristic and which will stand the current for such a long length of time are sealing the doom of the carbon lamp. The tests were made on a service circuit with a variation of 2 to 3 per cent in the voltage.

The Patent Office Scandal.

It is stated that the Commissioner of Patents has asked the government to bring suit to annul the Heany tungsten lamp patent on the ground that it was fraudulently obtained. Such a suit would be brought in the United States Circuit Court in the residence district of the inventor at York, Pa. Mr. Heany has a large number of patent applications before the office at the present time.

Suggested Changes in the Electrical Code.

Secretary Goddard, of the Underwriters' National Electric Association, has sent out the usual bulletin containing the committee reports and suggestions for changes in the National Electrical Code, which will be considered at the meeting of the electrical committee to be held at 32 Nassau Street, New York, on March 25 and 26. The bulletin contains 10 closely-printed pages, so that only a very brief abstract can be given of it here. Reports of committees appointed on the following topics will be received: Mercury vapor lamps, rheostats, transformers, wiring of electric cranes, rules 24 A-c, 25 d, 25 f and 49 A-b, recodification of National Electrical Code, circuit breakers, variable-speed motors, outline lighting, street railways, switches and cut-outs, rule 13 A, together with reports from the laboratories. The suggested changes, other than those recommended by the special committees, cover three pages of the bulletin.

The recommendations of the committee on rheostats do not cover construction and installation of automatic apparatus, but consist in amendments to rules dealing with the construction of rheostats. The amended rules, if adopted, will call for resistances so constructed that if the conductor be fused, the arc or attendant flame shall be confined within the rheostat. The committee on transformers has recommended the adoption of new rules covering the installation of transformers on low potential systems. A complete set of rules is proposed covering the wiring of electric cranes, and also a set of rules governing the construction and testing of circuit breakers. In order that there may be no dispute regarding the wiring of varying speed alternating-current motors, motors of this type will be required to be marked with the maximum current which they can safely carry for thirty minutes, starting cold. The report of the committee on switches and cut-outs has to do chiefly with rules governing the construction of panel boards and cabinets.

Despite the fact that the committee on Rule 13 A had conferred with committees from the National Electric Light Association, Association of Edison Illuminating Companies, American Institute of Electrical Engineers and the National Electrical Inspectors' Association on the grounding of low potential circuits, it is not ready to accept the amended rule which has been suggested by these interests in the conference, and asks that the matter be referred back to them for further consideration and report. Thus the matter of grounding low potential systems has dragged along year after year with no definite action by the insurance authorities, notwithstanding the unanimity of opinion of other interests that the proper grounding of low-potential circuits would be in the interests of humanity, and could not be considered a fire risk.

The long list of suggested changes in rules and miscellaneous suggestions deals principally with minor alterations in specific rules and these are of such a nature that it is safe to say over 90 per cent of them will receive no action. The electrical committee has always been averse to making any changes other than those made necessary by progress in the art or such as have been shown by some field experience to be necessary to safeguard against hazard. Oftentimes construction that is seemingly inferior does not offer any fire hazard, so that while better construction is recommended to the underwriters, and may be desirable, the cheaper construction is tolerated for the reason stated.

Discussion on Incandescent Lamps at Minnesota Convention.

At the meeting of Minnesota central-station men at Minneapolis, Feb. 28 and 29, at which the Minnesota Electrical Association was formed, representatives of lamp manufacturing companies were called upon to make some statements, and some interesting ideas were brought out. Mr. Samuel Furst spoke briefly on the tungsten lamp. He said that tungsten filaments were obtained by various processes, but that one of the commonest (presumably that employed by American manufacturers) was by the formation of an amalgam of mercury and tungsten, which was squirted through a diamond die to form the filament. The mercury is then driven off, leaving pure tungsten. The cost of manufacturing the tungsten lamp, aside from the production of the filament, was not greater than that of any other incandescent lamp. The filaments were expensive because a diamond die will only last long enough to squirt 200 or 300 ft. of filament, after which it would become worn and enlarged too much for further use. He stated that this was the reason for the high price of the lamp.

Mr. John G. Boyd, representing another lamp company, gave an extended talk on incandescent lamp conditions in general as actually found among central stations. He expressed the opinion that the new high-efficiency lamps would not result in any great reduction in the output of common carbon-filament lamps, and as an indication of how lamp manufacturers viewed the matter, he stated that factory facilities for the manufacture of carbon-filament lamps are to-day being increased. The increase of business due to the introduction of higher efficiency lamps would be sufficient not only to consume great quantities of high-efficiency lamps, but an increasing number of carbon lamps. The tantalum lamp might to some extent encroach on the field of the carbon-filament for miscellaneous use where freedom from vibration and the vertical position of the lamp were not essential.

He then outlined from his experience as a traveling lamp salesman for a number of years past showing the deplorable conditions found in the great majority of central-station distributing systems. The majority of his evenings each week, he said, were regularly spent with a portable voltmeter testing voltage at different points in central-station distributing systems. The conditions were something astonishing as to voltage. Comparatively few kept within a variation of 3 per cent from the rated lamp voltage. Town after town could be found lighted from one end to the other with blackened lamps. Such blackened lamps were due entirely to the negligence of the central-station manager and the fact that he ignored these conditions. In the same part of the same town he had recently obtained voltage readings of 94 and 129 volts. The voltage was supposed to be about 106. He thought it in order for central-station men to investigate whether they were getting the best results from their present carbon filaments. Varying conditions of voltage causing great variations in lamp efficiencies were shown to be very productive of complaints.

Rockford Edison Dinner.

As briefly noted recently in these columns, the Rockford Edison Company last month carried out an excellent idea by giving a dinner to the electrical contractors, architects, sign manufacturers, local press and all directly interested in local electrical development. This dinner was said by the local press to be one of the most elaborate ever served in Rockford. Mr. F. H. Golding, formerly assistant general manager of the Dayton (Ohio) Lighting Company, has recently taken charge of the Rockford Edison Company as general manager. This company is one of the American Gas & Electric Company properties under the control of Mr. Henry L. Doherty, and under Mr. Golding's management very active steps are being taken to expand the business of the Rockford Edison Company, which has heretofore been confined to the down-town district and a few of the principal residence streets. Besides the local speakers at the Rockford Edison banquet, Mr. J. Robert Crouse, of Cleveland, gave an address on "Coöperation." About 50 were present at the dinner. The company has recently adopted the mottoes "Boost for a Brighter, Bigger, Busier Rockford," and "Watch Rockford Grow," in its advertising. The dinner was designed to be a material aid in carrying out these mottoes. An extensive account of the dinner was given in issues of the Rockford daily papers the following day. In one of these Rockford papers there was also recently a three-column illustrated article, dated Montpelier, Vt., giving a description of the house of J. E. Davidson, which is thoroughly equipped for electrical applications of every kind.

Investigation of New York City Break-down Service.

Break-down service was further investigated by Commissioner Maltbie at a second hearing held last Thursday. Mr. W. W. Freeman, vice-president of the Edison Electric Illuminating Company of Brooklyn, was again called to the stand and testified that the $21.50 which he gave at the last hearing as the cost per kilowatt for the installation of break-down service was merely a statement of what computations indicated to be the actual carrying costs of the service, without allowing for general expense. Adding to the carrying costs the item general expense, brings the cost per kilowatt of installation of break-down service to $27.27. Taking the exact items of cost for the year 1907, which do not pertain directly to the manufacture and distribution of current, or to certain distribution items that do not generally pertain to break-down service, these items aggregate $1,746,397. The item of general expenses, including executive, fiscal, accounting, advertising and canvassing, was given by Mr. Freeman as $370,643, of which $40,827 was insurance, $20,600 legal and damages; taxes, $175,500; technical expenses, metering, engineering and purchasing, $84,560; street and installation maintenance, including the emergency service and street conductor repairs, $130,548. Interest and discount charges were $672,785, and depreciation charges, $242,931. The total connections of the Brooklyn system for the year ending June 30, 1907, were in the aggregate equivalent to 1,280,424 16-cp lamps or 64,021 kilowatts.

The average readiness-to-serve cost was determined by dividing the costs and the connected load into the total cost, as given above, and was found to be $27.27 per connected kilowatt for the year. The figures given do not include the company's production, generating and repair costs, nor substation operating and maintenance cost, all of which pertain to the manufacturing and distributing of current and vary almost proportionately with the output, nor do they include the company's cost for incandescent and arc lamp maintenance, which costs are not estimated in break-down service. They do not include dividend charges, surplus balance or any allowance whatever for return on invested capital, except such as is represented in bonds, the interest of which must be paid as a fixed charge. The average figures as given would be increased by the cost of any current consumed, charge for which would be included in the service charge, not exceeding the amount of $30 per kilowatt per annum. The average receipts per kilowatt of connected load for 1907, Mr. Freeman stated, was close to $50. In reply to the question as to whether or not he thought the present system the fair method of charging, Mr. Freeman said, "I think our present basis of charge is the only feasible basis for handling this class of business, with such adjustment of price as is necessary to meet the present conditions." Mr. Freeman said the break-down service might be divided into two elements: first, insurance, and, second, current supply.

In a few large services, Mr. Freeman said, the principle of readiness to serve has recently been adopted, as, for instance, in the high-pressure pumping stations, where the elements are similar to break-down installations. That feature had been introduced and contracts made, based on pure readiness-to-serve charge of $24 per kilowatt yearly, with additional charge for current used. This same system might be applicable to break-down service, but it will be difficult, he remarked, to devise such a schedule, and make clear to a break-down consumer that he is served with current as reasonably as the general public. Mr. Freeman considered the present system more favorable to the consumer, as the current is given without charge up to the point of guarantee, and when the consumer has need for current and uses the amount up to the guarantee, he is in exactly the same position as a corresponding consumer who is without a plant; in short, he gets his insurance without charge by purchasing the proper amount of current. Experience shows that the consumer who makes a break-down contract will invariably use the current up to the amount of his contract. Several of the break-down consumers, customers of the Brooklyn Edison Company, Mr. Freeman said, had cost the company a considerable amount in reinforcing its system and had been a decided element in determining costs. Connections were made by the Broooklyn company from the street mains to the buildings, generally at the switchboard, and the service simply connected to the meter, requiring the consumer to provide the throw-over switch. In some cases it was necessary to string wires and put in conduits to the premises. The Brooklyn Edison Company has 10 break-down customers, which, in 1907, consumed a total of 512,206 kw-hours, for which the company received $25,206.80, making an average per kw-hour of 4.92 cents. Four of these customers are paying at retail rate per current, and six are paying the special wholesale contract rate.

Mr. Walter F. Wells, general superintendent of the Brooklyn company, testified that in many cases the installation of break-down service caused low pressure in the mains in the neighborhood of where the service was connected. The consumer gave no notice of when he required current, and when low pressure was brought about by sudden demands, the effect was more serious than that caused by storms, since the company always received some intimation of a coming storm, and had an opportunity to make preparations. Mr. Wells thought it impracticable to provide a system by which the break-down consumer could be given notice when he needed current.

Mr. Arthur Williams, general inspector of the Edison Company, said that he had none of the applications for break-down service on hand, which had been made about two years ago, at the time when such service was discontinued. Many of those applications, Mr. Williams said, were made by letter or verbally. The change in the policy of the Edison Company came shortly after July 1, 1905, when the Legislature had established a consumers' rate and the Edison Company had interpreted the new rate to mean that a minimum charge could not be made higher than 10 cents per kw-hour, and, therefore, had no other course open than to decline to give break-down service, which service might entail a large loss upon the company. The break-down customers originally paid at the rate of 20 cents per kw-hour. In 1898 the price was reduced to 15 cents, and on July 1, 1905, to 10 cents. There were still a few who received current at less than 10 cents on the books of the Edison Company, but all were large consumers. The average price, during 1907, for the 123 consumers of break-down current was 5.54 cents per kw-hour, and did not include the cost of incandescent lamp and other service. In 1907, 2,416,973 kw-hours were supplied at 4.15 cents per kw-hour, practically two-thirds of the entire consumption. The reduction of the rate to 10 cents affected 114 of the class. Of the 123 consumers of this class, 105 use light exclusively, 41 use power also, nine of which are exclusively power consumers. The remaining plant and wholesale schedule were not affected.

A legal question arose as to whether the company could ask any customer to make a minimum guarantee, through the operation of which the average price of a current consumed exceeded 10 cents per kw-hour. Some of the present customers using the break-down service, Mr. Williams said, may average more than 10 cents per kw-hour, having continued on the basis of their former contracts. During the last two years no break-down service was given to customers not on the list, or without contracts, with the understanding that they were to have such service at the 10-cent rate. Mr. Williams considered that a $40 break-down charge for service, including both insurance and current up to a value of $30, is slightly less than would be the cost of a service that was purely insurance. He substantiated Mr. Freeman in saying that the present method would be fairer than to separate insurance and current charges. A rate based solely upon the current consumed would not be fair to the company. Illustrating the maximum demand, Mr. Williams gave the results of a series of tests of 16 large private plants which took place in the winter of 1903-04. The current used by the entire 16 averaged 90 per cent of the installation at the time of maximum load. In one case as high as 98 per cent was required; other ratios were 97, 83, 96 per cent and one as low as 72 per cent. The time of the greatest demand was between 5 and 5:30 in the afternoon.

Mr. Lieb, third vice-president of the Edison Company, said that should the demand for break-down service assume considerable importance, which had not hitherto been the case, it would be necessary, for the company's own protection, to devise new service arrangements. It would be necessary to introduce an automatic-service switch which would be an overload switch, so that an amount of current over that specifically provided for in his guarantee contract could not be taken by the consumer. Also a device would be required to prevent pumping back of current and to prevent the meter from registering backward, which often actually happens. "As to the question of averages," said Mr. Lieb, "it is clear to me that to ask the application of our average rates to special class like the break-down is not unlike asking an insurance company to accept such break-down risks as consumption, inebriates, etc., at the rates fixed by their ordinary mortality tables. Break-down service makes the problem more difficult in respect to lighting, as there are certain peak hours which come with mathematical certainty in winter, which must be considered, and in summer we have atmospheric storms, which produce loads which equal almost the peak hours of winter, and which oftentimes double the load in half an hour." The several special service devices necessary to obviate absence of break-down service might cost from $50 to $250 or $300 per installation. Mr. Lieb said that there was no fundamental reason against separating insurance or readiness-to-serve and current cost, provided that the respective rates were reasonable and equitable. Except the complication of rates which might ensue, he added, that on such a basis the readiness-to-serve charge for insurance would perhaps, on analysis, be found to be too near the $30 rate to make such a rate practical. When asked if in case it was found that practically all of those wishing break-down service thought the present price prohibitive, he could make a suggestion to relieve the situation, Mr. Lieb said, "I would say, Mr. Commissioner, not officially, and I make this statement from what I know to be the general attitude of the company, that if after considering these questions, and the various points of view which have been laid before the Commission, the Commission feels that the rate we have proposed is inequitable, I feel quite certain that the company will be glad to take up the matter from the point of view of any suggestion which the Commission might have to offer." After Mr. Lieb's testimony, the hearing was adjourned until Wednesday afternoon of the following week.

The Readiness-to-Serve Cost of Gas Supply.

It is now generally recognized that "load-factor" systems of charging for electrical energy are reasonable, equitable and desirable, and during the past several years the applicability of these systems to charges for gas has been the subject for considerable discussion in the gas field. In a paper read before the New England Association of Gas Engineers, Mr. W. H. Gardiner, Jr., took up the subject, and after showing that the theory of readiness-to-serve costs and output cost is as logical for gas as Dr. Hopkinson made it for electricity, he formulated the following conclusions: 1. That the cost of gas supply may properly be separated into readiness-to-serve cost and output cost. 2. That the load-factor theory of costs and rates is applicable in principle to gas supply. 3. That the storage holder at the works merely minimizes the investment in generating equipment and the cost of maintaining and running the same, but does not eliminate or subordinate the readiness-to-serve costs. 4. That as a holder at the works does not assist the mains, services and meters as it does the generating equipment, all apparatus between the holder and the customer's burners must be ample to meet the aggregate and individual maximum momentary demands as in an electrical equipment without storage batteries. 5. But that, if in addition to the holder at the works there are one or more outlying holders, these play essentially the same functions as outlying storage-battery substations do in an electric supply system.

Salaries of Patent Office Examiners.

By Joseph B. Baker.

The distressing Patent Office scandal, of which an account was given in these columns last week, has a bearing on a cause of inefficiency, delay, and even risk of wrongdoing—the last evidenced in the present instance of alleged fraud involving Third Assistant Examiner Barton—in the operation of the Patent Office. This cause is the parsimony of Congress in failing to authorize higher pay for examiners, whereby the standard of the personnel in that division of the Patent Office may be kept sufficiently high.

As stated last week, on the authority of Commissioner Moore, notwithstanding the many opportunities for corruption in the Patent Office presented by the incalculable pecuniary interests involved in patents, and by the reliance that must be placed upon the integrity of the individual examiner owing to the technical and judicial character of the work of the office, no examiner has ever been proved to be false to his trust in all the 118 years of the existence of our Patent Office system. An instance of alleged fraud in connection with the Bell telephone caveat that might come to mind is not pertinent for the reason that the charge was not proved. The examiner involved, who had been principal examiner in the Electrical Division, was out of office at the time the charge of fraud was brought, and gave conflicting testimony.

This favorable showing is accounted for largely by the fact that the approximately 300 members of the examining corps are all college graduates and nearly all have been graduated in general and patent law; and this body of scientific men has been considered, not only in this country, but in all countries having a patent system, to be the equal, if not the superior, of any like corps of men in existence.

Certifications of men eligible for appointment as assistant examiners are made upon Civil Service examination, but it has been impossible from 1902 down to the present date for the Civil Service Commission to furnish the Patent Office with a sufficient number of technically-educated men competent to examine and pass upon inventions in all the known arts. The Patent Office has been for years unsuccessfully trying to compete with large moneyed corporations for the services of such men. The latter are led to enter professional work outside of the Patent Office by the offer of a salary to start as high or higher than the office is authorized to pay, coupled with a promise of more rapid advancement. Or, if they enter the Patent Office at all, it is only for a time, with the fixed intention of making use of the experience as a sort of graduate course following their training in college or technical school, and then resigning at the first favorable opportunity to accept a higher salary with an engineering or manufacturing corporation, or perhaps a still larger income as an employee or member of an established law firm.

The salary of an assistant examiner begins at $1,200, and reaches a maximum, after years of service, of $1,800. Although there is, of course, the chance of promotion to the position of principal examiner at $2,500, and to other higher positions in the office, the low run of the salaries and the circumstances stated prevent the Patent Office from getting and keeping good men. It works out practically that men entering the office fresh from their legal or technical studies take up their work in the light of a "tour of duty," during which they acquire valuable experience and make acquaintances among attorneys and inventors, and especially establish affiliations with the great corporations interested in patent work, leading sooner or later—often at the end of three years from the time they enter the office—to their resignation. The "patent departments" of the big corporations are recruited almost entirely from the United States Patent Office in this way. For example, it was pointed out recently that the General Electric Company had 12 or more men who were formerly examiners in the office. Again, two-thirds of the personnel of patent law firms throughout the country are graduates of the office. A man getting $1,400 in the government work will leave for a salary of $1,800 "outside," and one getting $1,600 will leave for $2,000—the better offer being accompanied either by the direct promise of a "raise" at the end of a stated interval or by the practical certainty of obtaining one in the more remunerative environment of commercial work. In the 1907 report of the Commissioner of Patents it is stated that 135 examiners out of a corps of 300 have resigned in a period of less than five years.

From the viewpoint of efficient operation of the office, this state of affairs not only kills all *esprit de corps* in the staff of examiners, but results very harmfully to the service of the office, since the work is hampered and delayed by the constantly changing personnel. There is a great press of work, and the examiners must dispose of many cases hurriedly and therefore ineffectively, with the result of vexatious delays, complaints and, worse still, the passing of applications to issue that are not ready for patent. The two or three years that a man remains in the office is too short a time to train him as a good examiner, capable of getting out the work efficiently and quickly. On the other hand, the few men who do remain are rather looked down upon by the majority who leave to accept more lucrative work. This condition may be summarized by the statement that the present force is too small, is ill paid, changes too often, and is overworked.

The dearth of well-equipped men has led to the recruiting of examiners by the rerating of men who fail to pass the minimum standard on the Civil Service examination. Barton, the third assistant examiner, who has been indicted with the inventor Heany and the patent attorney Everding, for alleged fraudulent practices, was one of the men accepted under the sub-standard rating. It would seem, in view of the disadvantages to the work of the office, which have just been pointed out, resulting from the competition of outside concerns, and in view also of this discovery of fraudulent practices by an appointee to the office under a lowered standard, that the salaries of examiners ought to be leveled up to a more practical point.

The Commissioner has made repeated application to Congress for alleviation of this serious state of things. He has recently set forth the urgent need of more examiners, *at a higher salary*, in accordance with the following scale:

Commissioner	$6,000
Assistant Commissioner	4,500
Examiners-in-Chief	4,000
Principal examiners	3,000
Additional to, Principal Examiners while serving as Chief Clerk, Examiner of Classification, of Interferences, or of Trade Marks and Designs	600
First Assistant Examiners	2,400
Second Assistant Examiners	2,100
Third Assistant Examiners	1,800
Fourth Assistant Examiners	1,500

Representative Currier, of New Hampshire, the chairman of the House Committee on Patents, is quoted as saying, "Higher pay is the only remedy I know of for this constant shifting and changing in the office which is so detrimental to the efficiency of the service. There is no question but that salaries in the Patent Office must be made sufficiently attractive to satisfy desirable men and keep them in the service."

Average Costs of House Wiring in Chicago.

The Commonwealth Edison Company of Chicago has now been wiring old houses located on its service lines on the installment payment plan since last summer. A regular schedule of costs per outlet and per lamp was drawn up for the use of solicitors. This was given in these columns in the issue of Oct. 5, 1907. The company now gives the average costs of wiring and fixtures in 70 of the houses wired on this plan as follows: One-story frame, $88; one-story brick, $96; two-story frame, $144; two-story brick, $183.

This indicates that those availing themselves of the offer to have their houses wired on the installment-payment plan are using plenty of outlets and a fairly good grade of fixtures. Wiring costs represent first-class construction with wires in flexible steel-armored conduit. In many cases in a city like Chicago, hardwood floors are in use, which also helps bring up the cost of wiring.

The Long Acre Light & Power Company.

The affairs of the Long Acre Light & Power Company were considered last Saturday by Public Service Commissioner Maltbie, preliminary to a later hearing on the request of the Long Acre Company to increase its capital stock and issue bonds. The present stockholders of the company, on Feb. 1, were given at follows: William Harris, three shares; Henry B. Harris, three shares; George E. Bouchie, trustee, 490 shares; Edgar Van Etten, one share; W. W. Walters, one share; William H. Lamprecht, one share; John C. Sheehan, two shares; G. Tracy Rogers, one share.

Walter K. Knight, general engineer of the company, testified that he had held his present position 12 months. The capital stock of the company, he said, was 500 shares of $100 each. No dividends had been declared. Under a mortgage to the Metropolitan Trust Company, there had been a bond issue of $1,000,000, with $600,000 worth of the bonds outstanding. The outstanding bonds were not sold for cash, but given as purchase money bonds on property bought by the company. The remaining $400,000 worth of bonds was in the treasury. Of the outstanding, $100,000 of the $600,000 was held as collateral by the American & British Company as security for the performance of the contract between the Long Acre Company and the American & British Manufacturing Company. Mr. Knight testified that there was about $93,000 of unsecured indebtedness against his company. Beginning with the first of this year, he said that the company had commenced to supply current, and that it had never done so before that time. In the early part of 1907 work was started to put in operation a small power plant in the basement of a building belonging to the Manhattan Transit Company. When the franchise was first obtained it was operated by the American Electric Illuminating Company, and was continued in operation until the wires were removed by order of the city, under the general rule that all overhead wires should be torn down. The Consolidated Telegraph & Electrical Subway Company had constructed one-half mile of subway duct, and the Long Acre Company had made six or seven connections in houses during January, Mr. Knight testified.

He gave the estimated cost of construction of an electrical power plant of 75,000 kilowatts as $28,829,240, which was equivalent to $345.03 per kilowatt. A smaller plant of 25,000-kw capacity would cost $11,436,722, or $383.11 per kilowatt. In the memorandum of construction expense which he handed to the commissioner, there were included items which ordinarily would not go under the head of "construction expense," such as $300,000 as the cost of the smaller plant, which was credited to general office administration expenses, insurance and taxes for two years. Other items which do not ordinarily come under construction expenses were $1,050,000 for the retirement of the present bond issue at $105; also $1,000,000 for two years' interest at 6 per cent during the construction of the smaller plant; $125,000 for installing meters, and meter charges of $250,000; a subsidiary conduit charge of $660,000, and a charge for a conduit system of $250,000 based on the present price of lead-covered cable. He said it was proposed to sell bonds at par, and the interest to be paid had been suggested as 6 per cent.

A large trust company, he testified, had said that it would regard the bonds as a good investment, and offer them to its clients. It was brought out that the final intention of the Long Acre Company is to erect a power house of ample capacity, and that a New York City block had already been selected on the river front which, with buildings and docks, cost $945,000 for the large, and $165,000 for the 125,000-kw plant. Mr. Knight said that the schedule had been verified by E. K. Hill, chief engineer of the American & British Manufacturing Company, and by Mr. Wilkinson, of the Wilkinson Steam Turbine Company. The Long Acre Company proposes to supply the Boroughs of Manhattan and Bronx, and would be the only competitive company in the territory mentioned.

In answer to a question by the commissioner, as to how he thought the supplying of current by the Long Acre Company would benefit the public, Mr. Knight said that outside of the general desirability of having some competition where public service was rendered by private corporations, he believed that a large part of the city was inadequately supplied with power. In explanation of this statement, he said that there were more private houses in New York than in any other city of equal size which were unsupplied by electric light. He proposed to make installations upon a contract which would enable the consumer to defray the expenses of a whole or part of the installation. He said he had in mind a wiring company which would undertake the wiring, as this work would not be done by the Long Acre Company, and that the relations between the wiring company and the power company would be only that of friendly business operations. He thought that the new company would stimulate the old companies to give better service, at least until things were so regulated by public commissions that stimulation was unnecessary. Ultimately, Mr. Knight said he believed that all such public utilities would be owned by the people, and he regarded competition in the electrical lighting field in New York as a temporary expedient. He testified that there was nothing in the incorporation papers of the Long Acre Company regarding the cost of current, and nothing in the franchise which might limit the charges for current, the only guarantee of lower rates being the selfish interest on the part of the competing companies. He admitted that the existing systems in the Borough of Manhattan was substantially up to date with regard to generation and distribution of power, but said they were sadly handicapped by fixed charges accumulated in the past decade, and he believed that they were far behind so far as electric lamps were concerned. He said there should be no trouble in getting lamps at least three times as economical as those used at present, for instance, in the room where the commission was holding its sitting, and added that in his estimation the light unit of the future would be 50 candle-power instead of 16.

Explaining what he meant by "fixed charges" mentioned, he said that they were charges which came from the consolidation of the various companies, from time to time, and which were on the books of the present companies, in the form of bond or preferred stock issues. Between 1878 and 1908, Mr. Knight said, there had been three complete turn-overs of the electrical power situation, and added that in his opinion similar changes would occur in the future as had occurred in the past. He said he would look with favor upon an independent company which should strive to enter the electrical field 15 or 20 years from the present date in the same manner that his company was seeking to gain a foothold to-day.

The Long Acre Light & Power Company was incorporated April 23, 1903. A franchise was granted to the American Manufacturing Company on May 31, 1887, "to erect poles, hang wires, and fixtures, construct and use wires, conduits and conductors" for electrical purposes. The American Electric Manufacturing Company assigned the franchise to Fred E. Townsend, April 18, 1888. Mr. Townsend assigned to the American Electric Illuminating Company on April 19, 1889. On Nov. 8, 1897, a judgment against the Electric Illuminating Company in favor of Francis Dalton was granted by the Supreme Court. John W. Ward, of Brooklyn, was appointed permanent receiver. The only property of the company being a franchise to do business, with no other assets, the Supreme Court, on Nov. 26, 1897, issued an order directing Receiver Ward to sell the company's franchise at public auction, which took place at Hempstead, Queens County, on Dec. 14, 1897 Martin Minturn bought the franchise for $100, and in 1906 assigned it to the Long Acre Electric Light & Power Company. On Oct. 15, 1906, the board of directors authorized an issue of 1000 bonds of $1,000 each, payable Oct. 15, 1956, with interest at 4 per cent. These bonds were secured by a mortgage on the property of the company made out in favor of the Metropolitan Trust Company. On Jan. 17, 1908, the stockholders voted to increase the capital stock of the company from $50,000 to $10,000,000, issuing 100,000 shares of stock at par value of $100 each, which would be known as preferred stock, with interest at 7 per cent. It was also voted to mortgage the property and franchise of the company for $50,000,000 to secure the proposed bond issue of $50,000,000.

The question of the increase of stock and bond issue will be decided at a future hearing of the Public Service Commission.

Etienne de Fodor.

Mr. Etienne de Fodor, of Budapest, Hungary, was a guest of honor last month at a celebration having for its purpose to mark the completion of a decade of service by Mr. de Fodor as director and general manager of the Budapest General Electric Company. An incident of the occasion was the presentation by a large number of friends, both without and within the General Electric Company, of an elaborately executed address on parchment, designed by the well-known artist, Muller-Apenroth. It was also announced that the Hungarian Electrical Society, of which Professor Zipernowsky is president, has commissioned the sculptor Muranyi to make a bas-relief bust portrait for presentation to the subject to commemorate the celebration, a duplicate of which will ornament the hall of the society.

Mr. de Fodor was among the early Edison pioneers, having, in 1881, taken an active part in introducing the Edison system on the Continent, and was the first to erect a central station on the Edison three-wire system in Europe; this was the station at Athens, Greece, constructed by the Continental Edison Company of Paris, with which Mr. de Fodor was connected for many years as engineer in various parts of Europe.

ETIENNE DE FODOR

Before Mr. de Fodor began the direction of the affairs of the General Electric Company 10 years ago, the stock was paying 4 per cent and was quoted at 200; at the present time the stock is paying 7 per cent and is quoted at 320. During the early years of his administration he thoroughly reorganized and modernized the technical and commercial departments of the company, and without increasing its capitalization has trebled the generating capacity of the station and put down many kilometers of underground cable.

Mr. de Fodor is the author of several books on electrical subjects, printed and published in the early part of his successful career, and is a frequent contributor to technical journals, and occasionally to the daily press. He has lately been appointed gas expert on a commission which is to consider the question of the municipal ownership of the Budapest gas works, and recently published a pamphlet in the interest of a "Smokeless Budapest," in which illustrations give a striking contrast between the smokeless chimneys of the station of the General Electric Company and those of a number of large manufacturing companies, which latter are represented belching forth large volumes of black smoke. He is a member of the American Institute of Electrical Engineers, and of several

European electrical societies. It may be added that he speaks and writes English, Hungarian, French, German and Greek.

A man of broad views and wide sympathies, the activities of Mr. de Fodor are not confined entirely to his administrative and technical work. He is prominent in Budapest club circles and was interested in the founding and organization of the Société Littéraire Française de Budapest, of which the Countess Apponyi is the president and Mr. de Fodor secretary.

The Conservation of Natural Resources.

A special meeting of the American Institute of Electrical Engineers, held on March 5, was devoted to a serious consideration of the conservation of natural resources.

President H. G. Stott stated that at the present rate of consumption the supply of anthracite coal, which is a fixed quantity and cannot be replenished, will be exhausted. The forests are being depleted very rapidly, but fortunately they can be replenished. The forests being replenished, the water falls will give a more constant supply of energy, which can be used in place of coal and thus the coal need not be used.

Mr. Gifford Pinchot, Forester of the United States Department of Agriculture, gave an interesting talk on the many ways in which the natural resources of the country are being dissipated. Mr. Pinchot said that certain of the renewable resources, such as game, fishes and birds, which at one time were threatened with destruction, have reached and passed the period of greatest danger and there is a certainty of continued supply in the future. The minerals are the non-renewable resources. Although everyone knows that the supply of coal is limited, yet coal is used uneconomically by almost all. Only about 50 per cent of the coal that has been stored in the earth is properly mined, the other 50 per cent being left in such condition as to be unobtainable in the future. Of the former about 90 per cent is wasted, so that practically only about 5 per cent of the stored energy is usefully employed Natural gas has been handled in the same wasteful way, the assumption being made initially that the supply was unlimited. Moreover, many of the oilfields are exhausted, and within a comparatively short time, the oil supply will disappear.

According to the best figures that the forest service has been able to obtain, at the present rate of consumption there is in this country standing timber for only about 20 years. Wood is not less necessary in present civilization than coal, so that the country is soon to face a very serious problem, because there is no foreign supply of timber from which to meet the demand. There has never appeared a universal substitute for wood; even with steel and reinforced concrete used in buildings, the demand for wood has steadily increased. Fortunately the forests can be renewed, and about 165,000,000 acres of forests have been established in the West. However, these forests will be able to supply only a small part of the certain demand in the future.

There is no body of men as intelligently posted on the subject of the natural resources of the country as the engineers. It is the business of the engineer to make the best possible use of the resources at hand. It is his duty to see that the knowledge concerning the present waste of the natural resources and the means that should be employed to conserve them be brought to the attention of the great body of our people.

Dr. F. A. C. Perrine, who explained a large collection of stereopticon views, remarked that in distinction to renewable and exhaustible resources, water-power is the one resource which cannot be exhausted, because it continually renews itself. The energy from the waterfalls can be used by the present generation, and the source can be left to the next generation, without having injured the water that flows to the ocean to be evaporated. Each horse-power of hydro-electric development saves for commercial and chemical purposes and for domestic use in future generations 12 tons of coal per year. Only in domestic service and chemical action is coal indispensable, while it is not well adapted as a source of energy for industrial purposes. It is desirable, therefore, from many view-points that every water-power within the United States be completely developed without delay.

Osram German Metallic Filament Lamps.

A recent issue of a German electrical journal contains an advertisement of the German Welsbach Company, the makers of the "osram" tungsten filament lamp, which announces 1.1-watt lamps adapted for use in any position. An illustration in the advertisement shows lamps in a horizontal position in a fixture. The ends of the filament loops are, however, supported by an arrangement similar to that used with tantalum filaments. The lamps are made for 100 to 130 volts, and 22, 28 and 44 candle-power; also for 200 to 250 volts, and 35 and 44 candle-power.

Hungarian Electrical Society.

The Hungarian Electrical Society has commenced the issue of an organ called the *Elektrotechnika*, which will have a relation to the society similar to that of the *Elektrotechnische Zeitschrift* to the German electrical engineering association and a number of other Continental technical journals to engineering associations. The Hungarian society was founded in 1901, with Prof. Straub, of the Budapest School of Arts, as first president. The present officers are: Prof. Zipernowsky, president; vice-presidents, W. Chatel and F. Tihanyi; secretary, M. Zsakula. The membership of the society is now 450.

Pittsfield A. I. E. E. Meeting.

At a meeting of the Pittsfield Section of the American Institute of Electrical Engineers, held March 5, Mr. H. L. Smith presented an original paper on "Forestry and Hydro-Electric Development," illustrated in delivery by lantern slides.

Following the lecture, Mr. W. W. Colton described local forest conditions and the forestry work which is being done in this vicinity. Mr. N. J. Neal, of Boston, also took part in the discussion and described the conditions of many of the great timber tracts in the North, West and in the South, which he had noted and commented upon the wasteful methods of some of the lumbermen in these sections. Mr. Joseph Insull described a recent trip to England, and compared the wastefulness of the American farmers with similar conditions in England, where an attempt is made to cultivate and utilize every inch of land.

Grand Rapids Advertising Men's Meeting.

The Grand Rapids (Mich.) Advertisers' Club recently held a banquet at the Hotel Pantlind, Grand Rapids, at which advertising by electricity was brought into prominence by Mr. H. W. Hillman, sales manager of the Grand Rapids-Muskegon Power Company. Mr. Hillman was one of the speakers of the evening, his subject being "Electricity in Advertising." He took up the possibilities of the electric sign and the proper use of illumination in the display and sale of goods. Supplementing his remarks he planned and carried out a very elaborate electrical display at the banquet, which was one of the principal features of the evening. This not only was enjoyed by the banqueters, but by hundreds of callers at the banquet room the previous afternoon. Festoons of incandescent lamps were hung in profusion across the banquet hall. At one end of the hall was apparatus for producing disruptive discharges or artificial lightning. At the other end of the room was a great electric serpent. On the speaker's table were seven bouquets of gorgeous electric roses. Outside the hotel was a large electric sign across the front of the building, informing the city at large that a Grand Rapids Ad Club banquet was in progress. A sample of a well-illuminated show window was also shown in the banquet room as a very practical and important method of electric advertising.

A. I. E. E. Membership.

Prof. Elihu Thomson has recently expressed the following opinion concerning the value of membership in the American Institute of Electrical Engineers:

"To one who is engaged in or interested in electrical engineering work and progress, it seems to me that membership in the American Institute of Electrical Engineers is very desirable, not only from the prominent part which the Institute takes in the discussion of important topics, but for its work in connection with standardization, international congresses and other meetings of engineers. A member of the institute becomes associated with the large body of men who represent the accumulated experience since the beginning of the art, many of them the most active in its advance work. Aside from the mutual aid of sympathy in work, and matters more or less personal, the *Transactions* of the institute constitute an invaluable reference record, containing original papers and discussions of great worth to anyone who is endeavoring to keep in touch with the development in this field."

The General Electric Schenectady Plant.

An address was given before the Schenectady Section of the American Institute of Electrical Engineers on Feb. 29 by Mr. G. E. Emmons, works manager of the General Electric Company, on "An Outline of Management of the Schenectady Works." The hall was filled to its utmost capacity.

The meeting was called to order by Mr. E. B. Raymond, acting chairman.

Mr. Emmons spoke briefly of the time when, in 1881, he was engaged as bookkeeper for the American Electric Company, in New Britain, Conn., of which Prof. Elihu Thomson was chief engineer and Mr. E. W. Rice his assistant, and where only a small number of hands were employed. A short time after this, the Brush Electric Company, of Cleveland, Ohio, purchased most of the stock of the company. Certain capitalists in Lynn, Mass., however, became interested in the company, purchased it, changed its name to the Thomson-Houston Electric Company and in 1883 moved the business to Lynn. Mr. Emmons traced the growth of the company to the time of its consolidation with the Edison Company, of Schenectady, and its absorption of several smaller companies. He referred to the panic of 1893, and the action of the board of managers in concentrating the business at Schenectady, although at that time the Lynn factory was the most important.

A plan of the Schenectady works in 1893 was shown, and compared with a plan of the works at the present time. In 1893 the floor space covered by buildings was six acres, and number of hands employed 2800, whereas in 1907 the floor space was 89 acres and 15,300 hands were employed.

A synopsis of the system under which the plant is managed was given. The manufacturing committee passes upon requests for appropriations and discusses and decides policies, subject, however, to the approval of the executive committee. The plant is divided up into sections, each section being under the supervision of a section superintendent, he in turn being under the supervision of the general superintendent, and he, together with the electrical and mechanical superintendents, works engineer, etc., is under the works manager.

Mr. Emmons went somewhat into detail regarding the work of the production department, referred to as the most important department; also the cost department, and the method and importance of knowing just what apparatus costs. Methods of paying for labor by day work, piece work and the premium system were mentioned, the latter being explained as follows: A premium is given if a piece of work is done in less time than it was estimated it would require, the premium consisting of an equal division of the time saved; that is, the employee is paid at the regular day rate for the number of days it takes to do the work, and is also paid at the same rate for one half the time saved.

On March 5, Mr. Langdon Gibson gave a stereopticon lecture to the section on the subject, "With Lieutenant Peary on His First Arctic Expedition."

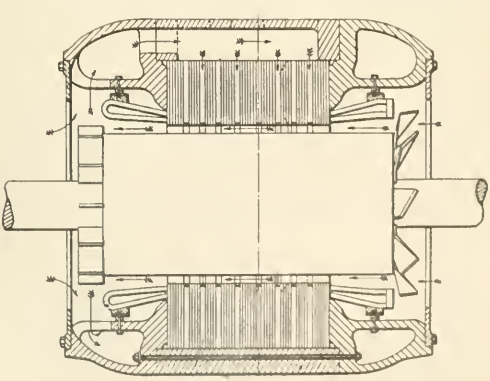
Assistant Secretary for A. I. E. E.

By recent resolution of the board of directors of the American Institute of Electrical Engineers, the office of assistant secretary was created, and Mr. Frederick L. Hutchinson was appointed to that position, dating from March 1. Mr. Hutchinson began his business experience in the service of the Pennsylvania Railroad Company in one of its large freight offices in New York City, where he had several years' experience in general office work. In 1889 he resigned to enter Cornell University in the electrical engineering course. Immediately after graduation, in 1893, he entered the employ of the Westinghouse Electric & Manufacturing Company. After a few years' experience in the factory, testing, drafting and sales departments, he was transferred to the publication department, where for several years he had charge of the preparation of the technical publications of the company, including a large number of articles for the engineering press. In 1901, he resigned to become manager of the publication department of the C. W. Hunt Company, Staten Island. The following year he resigned to go with the National Electric Company, of Milwaukee, as advertising manager, and a year later was made manager of electrical sales for the same company. Since 1904 Mr. Hutchinson has been connected with the institute offices under Secretary Ralph W. Pope.

This action of the board of directors marks another step in the development of the institute, the activities of which are constantly increasing. The membership of the organization has increased more than 25 per cent during the past year, and now exceeds 5400. There are now 37 active sections or branches located in the principal electrical centers of the country. The diversity and amount of work that is being carried on by various committees of the institute is also steadily increasing. The work of many of these committees is of great and lasting benefit, not only to the electrical profession, but also indirectly to the general public, and without doubt the influence of the institute is greater now than ever before.

Ventilated Turbo-Generator.

Unless special means are used to prevent streams of air from flowing at an extremely high velocity from radial passageways of the rotor of a turbo-generator and impinging upon the stationary windings and core, a very disagreeable and objectionable noise is produced. A patent issued Jan. 14 to Mr Charles E. Lord describes a method of ventilating a high-speed machine in such a way that the noise is reduced to a minimum. As



LORD VENTILATED TURBO-GENERATOR.

indicated in the accompanying illustration, the air which serves for cooling the rotor does not pass directly to the stator, but it follows a restricted path through the stationary member. The ventilating passageways in the stator are arranged concentrically about the axis of the rotor, and means are provided for cutting off direct communication between the ventilating passageways and the air-gap of the machine.

CURRENT NEWS AND NOTES.

THE SOUTHWESTERN CONVENTION.—The Southwestern Electrical and Gas Association convention dates are May 7, 8 and 9 at El Paso, Tex. Mr. R. B. Stichter, Dallas, Tex., is secretary of the association.

OHIO INDEPENDENT TELEPHONE ASSOCIATION.—The next annual meeting of the Ohio Independent Telephone Association will be held at Columbus, March 19. Mr. Ralph Reamer, Portsmouth, Ohio, is secretary of the association.

CHICAGO CENTRAL-STATION GROWTH.—The Commonwealth Edison Company, of Chicago, had an increase of 34 per cent in its central-station business for 1907 over the year previous. The connected motor load is 171,880 horsepower, and the lighting load the equivalent of 2,141,790 16-cp lamps.

DEFUNCT. PLANTS.—Under the title of "A Danger Signal," Mr. A. H. Grant, of the M. O. Publishing Bureau, New York City, has issued a list of defunct municipal lighting plants in the United States, with a preface discussing the subject. Data are given with regard to just about 100 plants, and some of them are dealt with in detail.

DANGER OF ROENTGEN RAYS.—Dr. Hall-Edwards, of Birmingham, England, the pioneer operator in Roentgen rays in Great Britain, has had his left hand amputated owing to having contracted the disease known as "X-ray dermatitis." His right hand is affected, but may be saved. Notwithstanding this experience, Dr. Hall-Edwards declares his intention of resuming his special work in this line as soon as he is able to do so.

CLOCKS IN PARIS.—Advices from Paris state that the commission appointed a year ago to insure unvarying public clocks for Paris has reported that the city was responsible for 444 clocks, of which 40 are pneumatic and 14 are regulated by electricity from the observatory. The commission is considering the question of increasing the number of clocks and arranging an electric circuit for regulating all clocks in public buildings.

PROF. HENRI POINCARE, the eminent mathematical physicist, has become one of the "Forty Immortals" by election to the French Academy. He has for many years been a member of the Academy of Science. Prof. Poincaré was a delegate from the French government at the St. Louis International Congress, where he made an address against further additions to electrical and magnetic units by international congresses.

TRAIN DESPATCHING BY TELEPHONE.—Since the passage of the nine-hour telegraphers' law, the Chicago, Milwaukee & St. Paul Railroad has been experimenting with a system of telephoning with the idea of regulating the despatching of trains by telephone instead of telegraph. If the results prove favorable, it may mean that telegraphy will be to some extent abolished in favor of the telephone on the new Pacific Coast extension.

INTERBOROUGH QUARTERLY REPORT.—The report of the Interborough Rapid Transit Company, including Manhattan Division, for the quarter ended Dec. 31, 1907, was as follows: Gross income, $6,301,496; expenses, $2,602,095; net income, $3,699,401; other income, $306,941; total income, $4,006,342; total charges, $2,725,751; surplus, $1,280,591. For the same period in 1906 the items were as follows: Gross income, $5,815,232; expenses, $2,365,166; net income, $3,450,066; other income, $194,657; total income, $3,644,723; total charges, $2,472,906; surplus, $1,171,817.

WISCONSIN HEARING ON CENTRAL-STATION STANDARDS.—The Railroad Commission of Wisconsin had a hearing of electric companies March 3 and 4, at which the questions of standards of electric and gas service were discussed. Representatives of many gas and electric-light companies of the state were present. Dr. E. P. Hyde, representing the United States Bureau of Standards, was also in attendance. The question of proper methods of testing meters, errors commonly found in meters, limits of voltage regulation consistent with good service, and other matters were discussed.

THE NEBRASKA ELECTRICAL TRADES ASSOCIATION will hold its first annual electrical show in the Auditorium, at Omaha, from May 4 to 9. The decorative lighting of the building will be excellent. Among the more attractive features of the show will be a cottage which will be equipped with every known electrical device applicable to home comfort and convenience. It is expected that the show will surpass in beauty of decorative lighting any show every held west of Chicago. The date for the show was originally set from April 13 to April 18, but this has been changed as above.

PRICE OF ELECTRICAL ENERGY IN NEW YORK.—A bill introduced in the New York Assembly, on March 3, relating to the price of electrical energy in the City of New York, has been referred to the Committee on Electricity, Gas and Water Supply. According to this bill, which was prepared by Assemblyman Hackett, the maximum rate for energy is to be reduced from 10 cents to 8 cents per kw-hour. The yearly rate for arc lighting is to be decreased as follows: Lamps consuming 450 watts at the arc, from $100 to $85; lamps consuming 325 watts, from $90 to $75; lamps consuming 250 watts, from $65 to $55. These prices are to include care and maintenance.

MR. EDISON'S ILLNESS.—Mr. T. A. Edison has so far recovered from his recent operation for mastoiditis, in New York City, that Mrs. Edison has been able this week to take him home to Glenmont, their residence on the Orange Mountains. Just before this illness, the family were making plans to go south as usual to their plantation in Florida; and this program will be carried out as soon as Mr. Edison is able to stand the fatigue of the journey. He is now in excellent condition, and has all his wonted keen interest in affairs. Longevity is an Edison characteristic, several of the inventor's ancestors having passed the century mark, so that Mr. Edison ventures to indulge the hope that he still has many years of work ahead of him.

RADIUM DATA.—At the meeting of the Royal Society in London last week, Dr. Thorpe, director of the Government Laboratory, announced the result of investigations regarding the atomic weight of radium, a subject of special interest in connection with the true position of radium in the system of chemical elements. Dr. Thorpe's researches showed that the atomic weight of radium was about 227 times greater than hydrogen, which is the unit of weight commonly adopted by chemists. This value is in good agreement with that suggested by Mme. Curie. Prof. K. Ohnes, of Leyden, Holland, announces that he has solidified helium. Prof. Ohnes in his telegram to Prof. Dewar, of the Royal Institution, said that the last evaporating parts showed considerable vapor and the pressure of air was so great that the conversion took place without the intermission of a liquid state.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.—The next meeting of the National Electrical Contractors' Association will be held in Chicago July 15 next. Mr. W. H. Morton, 94 Genesee Street, Utica, N. Y., is secretary of the association.

ELECTRIC RAILWAY ACCOUNTING.—The Interstate Commerce Commission is preparing a classification of operating expenses applying to electric railways under its jurisdiction. A circular has been issued to the accounting officers of electric railways, asking for data and suggestions on the subject.

WESTERN PACIFIC RAILROAD TO USE ELECTRICITY.—Mr. Guy C. Earle, vice-president of the Great Western Power Company at Big Bend on the Feather River, has stated that the Western Pacific Railroad, now being built to San Francisco, will use electricity for motive power.

THE MACHINERY CLUB of New York will occupy its new club rooms in the Hudson Terminal Buildings May 1. The club is the result of an attempt on the part of the machinery interests of New York to establish a common headquarters where kindred interests might congregate for mutual advantage. The club membership is now nearly 800

JAPANESE WATER-POWER DEVELOPMENT.—An Anglo-Japanese Company, with a capital of $5,250,000, will develop several large water powers in southern Japan for electrical generation. Work on one of 27,000 horse-power and another of 8000 horse-power will be commenced the present year. A third water-power of 60,000 horse-power will be taken up in the future. The three falls are on the Oi River, and among the cities to which electrical energy will be transmitted is Shizuoka.

TELEPHONES ON RAILROADS.—According to a dispatch from Topeka, Kan., telephones are to be used in the transaction of railway business on the Missouri Pacific system in Kansas. Telegraph operators, however, are to be located at about every fourth station, and these scattered stations will handle train orders. The telephones will not be used for this purpose, but for other railway business. If a message is to be sent from a telephone station it will be telephoned to the nearest telegraph station and there put upon the telegraph wires.

OHIO INDEPENDENT TELEPHONE ASSOCIATION.—The Ohio Independent Telephone Association has issued in neat pamphlet form a roster of the delegates elected to attend the annual convention of the association, to be held at Hartman Hotel, Columbus, March 19. Each of the nine districts in the territory of the association will be well represented, the largest number being from the first and ninth districts, of which Mr. A. J. Curren, Elyria, and S. E. Ward, Mansfield, are the respective secretaries. A table gives the number of independent telephones in the nine districts as 307,674, against 165,941 Bell telephones. The number of independent stockholders is no less than 25,458.

WISCONSIN COMMISSION RATE DECISION.—The Railroad Commission of Wisconsin, which now has the regulation of electric light and power rates and the issue of electric light and power company stock and bonds, has rendered a number of decisions authorizing changes of rates by various central-station companies. One of the latest of these is in regard to the application of the Portage Electric Light Company for authority to change its rates. The company had a system of flat rates and also a system of meter rates, in which the discount was according to quantity consumed. The commission authorizes the discontinuance of the flat rate and a change in the meter rates so as to give lower rates to consumers using current the greatest number of hours.

IOWA STREET AND INTERURBAN RAILWAY CONVENTION.—The convention of the Iowa Street and Interurban Railway Association will be held at Des Moines, Iowa, April 23 and 24. The Iowa Electrical Association holds its convention at the same place April 22 and 23, according to the usual arrangement of dates for the lighting and railway conventions of Iowa. Secretary L. D. Mathes, of the Iowa Street and Interurban Railway Association, announces that the executive committee has provided space for exhibition purposes at the Savery Hotel, which is to be headquarters, and this space will be free to exhibitors. Those desiring to have exhibits at the convention should communicate with Mr. W. G. Owen, general superintendent of the Des Moines Railway Company.

A CORRECTION.—In the account in our issue of March 7 of the first hearing of the gas and electric companies before Commissioner Maltbie, it was stated that Mr. Arthur Williams, of the New York Edison Company, testified that $300 to $400 per kilowatt was a fair average cost of installing a distributing and generating system. An examination of the official record shows that Mr. Williams gave $300 to $400 as a fair average cost, in his judgment, for installing an overhead system, and that his purpose in giving these figures was to show that $30 per kilowatt yearly charge of the Edison Company was reasonable, in that it was but 10 per cent of $300, which is less than the lowest average cost of small systems using overhead construction. Mr. Williams added later in his testimony that these figures would not bear upon the situation in New York or any of the larger cities.

WIRELESS REGULATION.—Senator Hale has introduced a bill, to go into effect July 1, 1908, requiring a federal license for foreign and inter-state communication by wireless telegraphy, which is to be put completely under the jurisdiction of the government. The license can be abolished by the President in times of war. The bill imposes a license on land stations of $100 a year and a license of $5 a vessel on all equipped with wireless apparatus. Violations of the rules would not only mean a heavy fine, but also that the government could appropriate the apparatus of the company or vessel that had violated the statute. The most severe penalty is provided for interference with messages sent or intended for government officials, or the malicious use or operation of wireless instruments under license by the government. Another feature is a provision that makes it compulsory for all licensed wireless operators to act as relays for messages received by them. The act makes it the duty of every person or corporation using or operating wireless under a license issued by the United States to answer wireless calls and signals from any other person or corporation so licensed.

EDISON COMPANY MAKES RECORD.—A record, in bridge installation at least, was made by the New York Edison Company when on 24 hours' notice the company took over the contract, last Wednesday, for lighting the entire Brooklyn Bridge. Formerly the bridge lights had been supplied with current by the old power house which stood at the Brooklyn end, and which in times past operated the cable cars across the span. For some time the lighting from this source has been unsatisfactory, and it was found that it would be more economical to light the structure from the Edison mains rather than continue to maintain the power house. The Edison Company placed its entire down-town force at work on the change, the company's mains in Park Row were tapped, and within 24 hours after the company had received notice, the installation was completed. But 35 minutes, near noon, elapsed between the shutting off of the former current and the turning on of the Edison current. The contract calls for the lighting of both terminals, both anchorages and the span. The maximum demand is 1600 amperes. The Edison Company now lights practically all the city bridges and operates all the drawbridges with two exceptions.

SAN FRANCISCO STREET LIGHTING.—On Feb. 1 4665 gas and 1795 electric lamps were used for street lighting in the city of San Francisco.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—The next annual meeting of this association will be held at Atlantic City, N. J., Oct. 13 next. Mr. George W. Tillson, Park Row Building, New York City, is president of the association.

OHIO MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.—The Ohio Society of Mechanical, Electrical and Steam Engineers will hold its next meeting in Columbus, May 15 and 16. Mr. F. W. Ballard, 104 Canal Street, Cleveland, Ohio, is secretary.

GAS "ARC" LAMPS.—The Cleveland Inspection Bureau in a recent report severely condemns the use of gas "arc" lamps for interior illumination, which are stated to introduce serious fire hazard. Details are given of the manner in which this type of lamp caused three recent fires in Cleveland.

PROTECTING NIAGARA.—A British "scientist" named Spencer has come to this country to inform the authorities at Washington that if and because less water goes over Niagara Falls, the recession and degeneration of the cataract will be the more rapid. The general, commonsense opinion is, on the contrary, that owing to the diversion of some of the water by power enterprises, the erosion and dissipation of the bed of the torrent cannot but be less.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Promotions and appointments in the electrical engineering department of Massachusetts Institute of Technology have, during the past year, been made as follows: Prof. Harrison W. Smith, from assistant professor of electrical engineering to associate professor; Messrs. H. G. Crane and W. V. Lyon, from assistants to instructors; Messrs. C. W. Green, A. E. Harold, R. G. Hudson, C. C. Knipmeyer and G. B. Thomas have been appointed assistants in electrical engineering.

MARCONI ON WIRELESS.—At a public luncheon recently given to Marconi by the president of the Liverpool Chamber of Commerce, at which the Lord Mayor and many of the leading business men of the city were present, the guest, in the course of some remarks, said that whether the wireless telegraphic service will injure or displace the cable service is still a matter of speculation, but it depends a good deal on what the cables can do in the way of cheaper rates.

INDUSTRIAL EDUCATION.—Representative Davis, of Minnesota, has received from President Roosevelt a strong endorsement of his bill for the establishment of industrial high schools. According to the terms of the bill, aid from the general government in semi-annual payments will be given to such schools if the State government will provide the grounds and necessary buildings. The subjects to be taught are the agricultural and mechanic art and domestic science. The schools will presumably be modeled after the manual training high schools now part of the school systems of some cities.

NEW ELECTRIC SMELTERS.—Next to the converters in the smelter at Great Falls, Mont., the new converter stands of the Mammoth Copper Mining Company, Kennet, Cal., are the largest in the country and are ready to be blown in and commence the work of turning out blister copper from 98 to 99 per cent pure, in place of the matte product which has previously been shipped East for refining. Electricity will furnish the power and the huge converter shells, when lined and charged with hot metal, will weigh 64 tons and will be operated by hydraulic power. A delay has been caused by the installation of necessary transformers at the electric company's substation. The new converters, which have 90 in. x 150 in. interior diameters, will give employment to a large force of men.

EAGLES, CRANES AND HIGH-TENSION INSULATORS.—The only trouble thus far experienced with the New Kern River—Los Angeles town—transmission line is annoyance caused by eagles and cranes, which at dusk climb up under the insulators at the top of the high towers to keep warm. About the time an eagle gives a good-night yawn and stretches himself preparatory to going asleep, his wings come in contact with the wires and the king of the air is a dead one. Chief Engineer Schuetze, of the Los Angeles Edison Company, says he had counted as many as forty-three dead eagles on the ground at the base of the transmission towers and as high as eighteen cranes. A wire guard is being placed on the transmission towers, with a sharp point, to keep the eagles away. When an eagle, with his outstretched wings, forms a short circuit, the transmission of power is affected about ten seconds.

NEW RESEARCH LABORATORY FOR WORCESTER POLYTECHNIC.—A new research laboratory is being equipped at the Worcester Polytechnic Institute in connection with the department of electrical engineering, and it is hoped to place it in operation next fall. Orders have been placed with various American and European instrument makers for a complete equipment of standard instruments and units, which will be furnished with certificates, either from the Reichsanstalt, the British Board of Trade, or the National Bureau of Standards. Among the electrical researches which are now under way at the institute are investigations by Mr. H. R. Goddard of the behavior of selenium cells, and by Mr. C. B. Harrington of the electrical conductivity of porcelains at high temperatures, the object being to throw light on the condition of materials suitable for high-tension insulators.

ELECTRIC PROPULSION OF SHIPS.—In a recent paper read before the Institution of Engineers and Shipbuilders of Scotland, Mr. Henry A. Mavor advocated for ship propulsion induction motors direct connected to propeller shafts, current being supplied from turbo-generators. Among the notable advantages adduced is the reversibility of the electric motor, and its use would dispense with the present objectionable, heavy and costly go-astern turbines on the propeller shaft. Mr. Mavor gave details relating to a supposed ship of 17,000 horse-power having propellers 8 ft. 1½ in. diameter running at 377 r.p.m. and a speed of 20¾ knots. The probable maximum efficiency of the propellers, he said, would be 62 per cent, and an electric equipment would permit of the use of propellers of about 14 ft. diameter at 140 r.p.m., and an efficiency not less than 70 per cent —an improvement more than sufficient to cover the loss in the electric motors. The slower speed propellers would be free from the risks of cavitation troubles which arose when the resistance was increased on a propeller already producing a high value of thrust per unit area. It would be found that the steam turbo-alternator as used on land in sizes corresponding to those then under discussion could deliver an electric horse-power to the motors for 12.2 lb. of steam per hp-hour, allowance having been made for all intermediate losses and for 4 per cent for driving auxiliaries, no superheat being used, so as to make the comparison with normal marine practice. This figure was startlingly lower than anything which had been touched at sea. It was for full speed and power, but the comparison must also be made at low speeds and powers, and more particularly at the normal working speed of the ship.. There was certainty of economy in this comparison, because of the higher speed of revolution of the turbine, which in the electric case ran at the same speed for all powers, while, of course, the direct-connected turbine had to vary its speed with the speed of the ship. In the example given an estimate had been made of the weight, with the result that it appeared probable that the decrease in the weight of the steam equipment would more than compensate for the heavy, slow-running motors and propellers. The cost would probably closely follow the weight.

New York's Electrically-Operated, High-Pressure Water System for Fire Protection.

Although surrounded by water on all sides, the City of New York has never possessed facilities for concentrating a sufficient volume of water on fires in the congested parts of the city. The city's system of water pipes in these districts had outgrown itself years ago, and what with low pressure and small pipes the damage from fires increased, risks became greater and insurance rates expanded in proportion. The Department of Water Supply, Gas and Electricity finally induced the Board of Estimate and Apportionment to authorize the expenditure of $3,950,400 for a high-pressure water system for the Borough of Manhattan and about $1,300,000 for the system of the Borough of Brooklyn. The high-pressure water system in Brooklyn can now be used for fighting fires, and it is expected that the system in Manhattan will be ready for operation very soon. The pumps are operated by induction motors, the aggregate rating of the motors now installed in the four stations being 15,000 horse-power. The system is designed to use either salt water or fresh, and for the present fresh water only will be used.

BROOKLYN SYSTEM.

The high-pressure service in Brooklyn serves an area of 1360 acres. The area embraces the territory extending along the water front from Erie Basin to the New York Navy Yard, and inland as far as Flatbush Avenue. This includes the shopping district, the great store-house district and the section in which the principal high office buildings are situated. When the system is in working order, fire engines may be withdrawn from the section, for any one of the 700 special hydants will supply water at a pressure sufficient to throw it upon flames far beyond reach of the streams furnished by the fire engines now in use. With the eight pumps at the two pumping stations at work, 48 streams of water may be concentrated at any part of the system with a pressure of between 200 lb. and 300 lb. to the square inch. Each stream would send theoretically 500 gal. of water per minute. If found necessary six more pumps can be installed, space being provided for them in the stations, so that 84 streams can be concentrated at any part of the system. The pumps can [illegible] a stream of water 700 ft. up through the standpipes of the office buildings. The trouble thus far experienced with a lower pressure in Brooklyn is to control the hose. If the full pressure of 300 lb. per square inch were used, provided it could be controlled, the stream of water would be as destructive as the fire which it is intended to extinguish.

There are about 22 miles of special mains, varying in diameter from 8 in. to 20 in., installed at present. The main pumping station in Brooklyn is located at Joralemon and Furman Streets, a few hundred feet from the East River. This station is nearing completion and will have five pumps, each of which will be direct-connected to an 800-hp, three phase induction motor. The station at St. Edwards and Willoughby Streets is completed and ready for business. A view of this station is shown in Fig. 1 and plan and sectional views are given in Fig. 3.

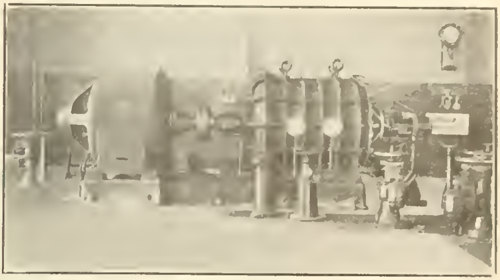


FIG. 2.—INDUCTION-MOTOR DRIVEN CENTRIFUGAL PUMP.

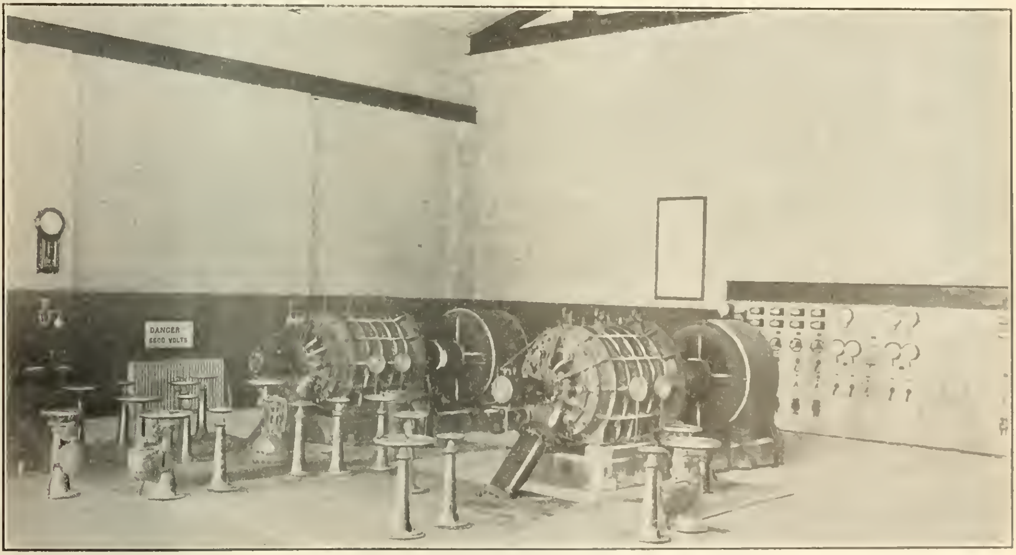


FIG. 1.—PUMPING STATION AT ST. EDWARDS AND WILLOUGHBY STREETS, BROOKLYN

The present equipment at the St. Edwards Street station consists of three Worthington centrifugal pumps each of which is driven by an 800-hp induction motor of General Electric design. Energy for all of the motors in Brooklyn is supplied from the mains of the Edison Electric Illuminating Company and the safeguards adopted by the Edison company give the high-pressure system a reliability far in excess of the system previously used. The St. Edwards Street station is connected by duplicate cables with the Gold Street station of the Edison company. Cables having a cross-section of 250,000 circ. mils are used to feed the busbars in the pumping station with three-phase currents at a potential of 6600 volts; the motors using current at this potential. Three cables run from the Gold Street station of the Edison company to the Joralemon Street pumping station and every precaution known has been taken to render the service reliable. The service is further safeguarded by the interconnections between the Gold Street and the Bay Ridge stations of the Edison company and between the storage batteries floating on the system. These connections supply a guaranty of almost absolute continuity of service; but in case of some unforeseen catastrophe by which both these sources of supply might be cut off, there are cable connections with the power stations of the Brooklyn Rapid Transit Company and also with the system of the New York Edison Company, so that the city may draw its electrical energy from any one of all the large generating stations in Brooklyn or from any of the stations of the New York Edison Company in Manhattan. By the terms of the contract the Edison Electric Illuminating Company must install and maintain sufficient electrical machinery, cables, etc., to permit the starting of any three motors in one pumping station simultaneously whenever required.

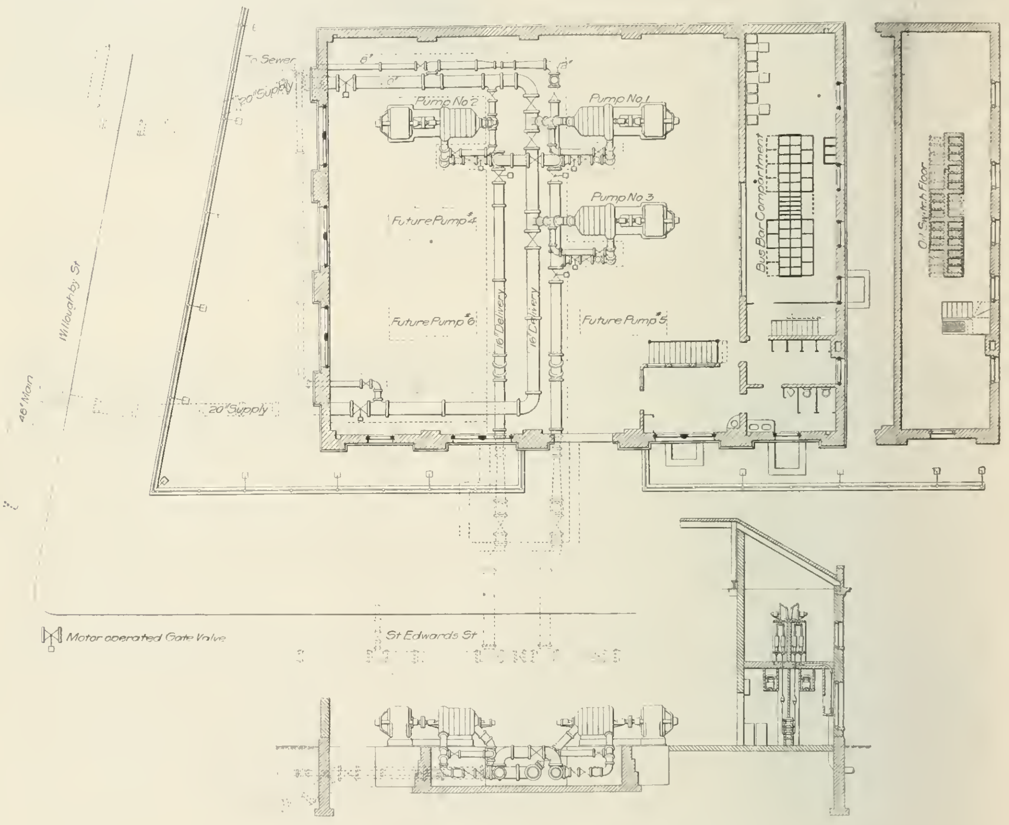


FIG. 3.—PLAN AND SECTIONAL VIEWS OF THE ST. EDWARDS STREET STATION.

In order to give the Edison company immediate information when energy is required, a fire gong is placed in both the main generating stations, together with a list of fire alarms in the district covered by the high-pressure system. The city has also arranged to supplement this service by installing telephone wires from both the pumping stations and the main telephone switchboard of the Edison company. Private wires also connect the two pumping stations. The plan at present arranged calls for the starting of one pump in the St. Edwards Street station on the first alarm from the high-pressure district. A second pump will be started on a second fire alarm if the pressure drops sufficiently to justify it, and so on, until all pumps are in operation.

All high-tension feeder connections between the main generating stations and substations of the Edison company being under the direction of the system operator, city employees in the pumping stations connected to the high-tension lines of the Edison company are required to obey instructions received from the system operator as to which feed line to connect to. The switch gear and connections are so well shown in Fig. 3 that further comment is unnecessary. The pumps are required to take full load in about one-half minute's time, so that when a fire is reported the pressure on the mains will be high enough for all requirements by the time the firemen reach the scene and attach the hose. By means of the telephone connections available, the firemen can have the pressure increased or diminished as required. The pumps combined can place 35,000,000 gal. of water on a fire in 24 hours. This amount of water is equal to that used for fire purposes in the Boroughs of Brooklyn and Queens in one year.

The main station is supplied with water by a 30-in. line connected with a 48-in. main in Willoughby Street and a 24-in. main in Furman Street, which in turn is fed from a 48-in. main in Atlantic Avenue. Three 24-in. mains will connect the station with the river. Two 20-in. and one 30-in. main feed the pumps in the St. Edwards Street station. The contract price for the electricity supplied by the Edison Electric Illuminating Company is $3,660 per month as a readiness to serve charge and $.015 per kw-hour for all energy used. The main pumping station and its equipment cost $181,000 and the St. Edwards Street station and its equipment cost $114,500. The interest on the city's investment in the system and the cost of maintenance will approximate $78,000 yearly. At the same time insurance premiums will be reduced about $300,000 yearly.

MANHATTAN SYSTEM.

The high-pressure water system in Manhattan is intended to protect an area extending from City Hall to Twenty-fifth Street and from the Hudson River to Second Avenue and East Broadway. The system comprises about 63 miles of mains varying in diameter from 12 to 24 in. Two pumping stations are provided: one near the Gansevoort Market on the Hudson River and the other at the corner of Oliver and South Streets near the East River. Each station will contain five pumping units and have space reserved for three additional units. Fig. 4 shows plan and sections of the Gansevoort Street pumping station, the lay-out of which does not differ materially from that of the station at Oliver and South Streets, so that the one description will apply to both.

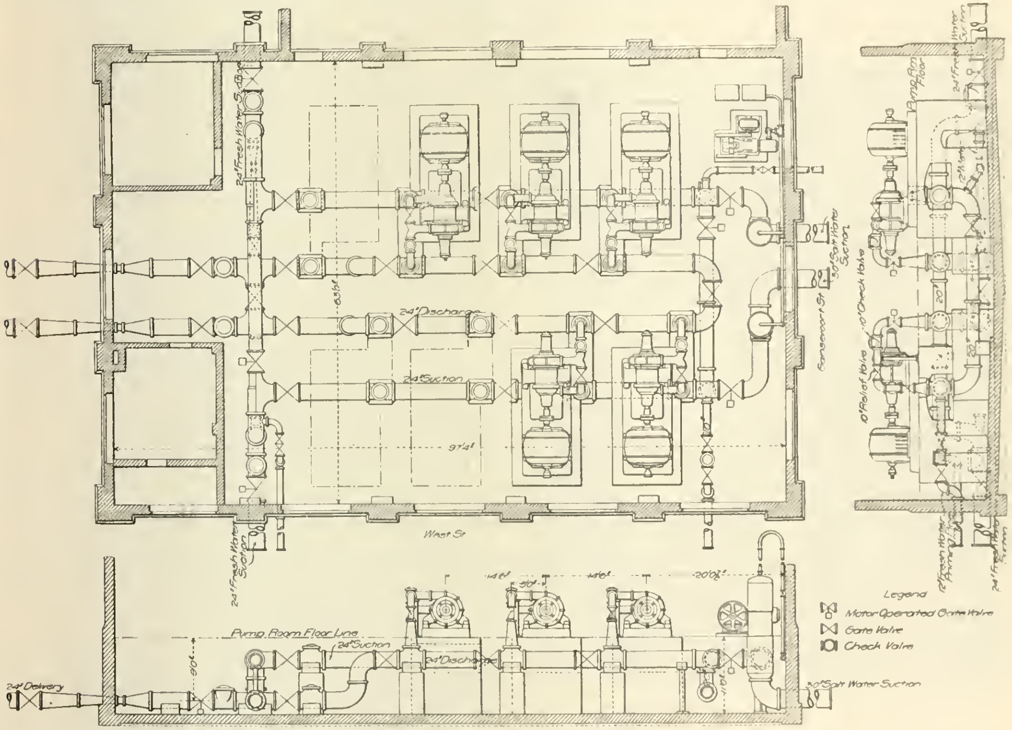


FIG. 4.—PLAN AND SECTIONAL VIEW OF THE GANSEVOORT STATION IN MANHATTAN

The pumps are of the horizontal, multi-stage centrifugal type, each pump having six stages and being able to deliver 3000 gal. of water per minute against a discharge head of 300 lb. per square inch, when operating at 750 r.p.m. with a suction lift not exceeding 20 ft. The pumps are designed so that the discharge pressure can be varied between 100 lb. and 300 lb by means of a special regulating valve. The pumps are of Allis-Chalmers make and each is direct-connected to its motor by a special flexible coupling. The motors are designed for operation on three-phase, 25-cycle, 6600-volt circuits like those in the Brooklyn stations. In starting an iron grid resistance is connected in the secondary circuit and gradually cut out by means of a hand-wheel on the motor panel. When the resistance is cut out the rotor is short-circuited by means of solenoids, controlled from the main motor panel through auxiliary switches. The controllers and motors are so designed that the pumps can be brought to full speed from standstill in approximately 30 seconds. An interlocking arrangement is provided so that the motor cannot be connected to the line when the rotor is short-circuited.

The rates charged by the New York Edison Company on condition that the entire equipment in both stations shall not be operated simultaneously is $24 per year per kilowatt rating of motors connected as a readiness-to-serve charge and $0.15 per kw-hour for energy used.

The electric energy for driving the motors is taken from the mains of the New York Edison Company, the current being at a potential of 6600 volts. Each pumping station is connected to the Edison generating station by two 250,000 circ. mil, three phase cables in addition to two reserve feeders running to the pumping stations from Edison substations. The feeders and other wires enter the building through the basement of the switchboard section, the latter being practically isolated from the rest of the building. On the first floor of the switchboard section are the main line and motor switches. These are of the oil-break, remote-control type installed in standard fireproof brick compartments. The switchboard is in the common wall between the switching section and the pump room. The busbars are placed in fireproof compartments on the second floor of the switchboard section.

In order that there may be no delay occasioned by priming the pumps when they are to handle salt water, three motor-driven vacuum pumps are provided. A system of signal boxes has been so designed that a fire in any part of the district can be watched from at least one telephone box and orders readily transmitted to the engineer at the pumping station in regard to the requisite pressure and the quantity of water required, as well as to use of fresh or salt water.

The salt water supply will be taken from a reinforced concrete screen chamber through two 36-in. mains. The fresh water supply is taken from a number of large mains of the city water supply system. As indicated in the engraving, many of the gate valves are motor-operated. The capacity of each of the pumping stations is 15,000 gal. per minute, aggregating for both 43,000,000 gal. per day. This amount is equal to two-thirds of the total quantity of fresh water used in the Borough of Manhattan for fire purposes during the year 1903.

Fireboat connections are located on the river front at points where they can render the best service and on the ends of piers when practicable. A double female-swivel increaser is provided for the use of fireboats in connecting their larger hose with the smaller nozzle of the hydrants on the docks. The construction of the distribution system in both boroughs has involved some very difficult work, owing to the large number of public service pipes of various kinds already in place in the congested parts of the city. As there will be ordinarily little or no flow in the mains, they are laid about 6 ft. below the surface of the street, and where the pipes are brought near the surface, special arrangements are made to prevent freezing During the winter water will be slowly pumped from one station to the other at intervals as an additional precaution against freezing. Before the mains were covered they were tested in convenient sections with a pressure of 450 lb. per square inch. The mains are designed to withstand a regular working pressure of 300 lb. per square inch, and have a very large factor of safety. The hydrants are within 400 ft. of any building, and there are enough hydrants so that the entire capacity of both stations can be concentrated on a block with a length of hose not exceeding 500 ft.

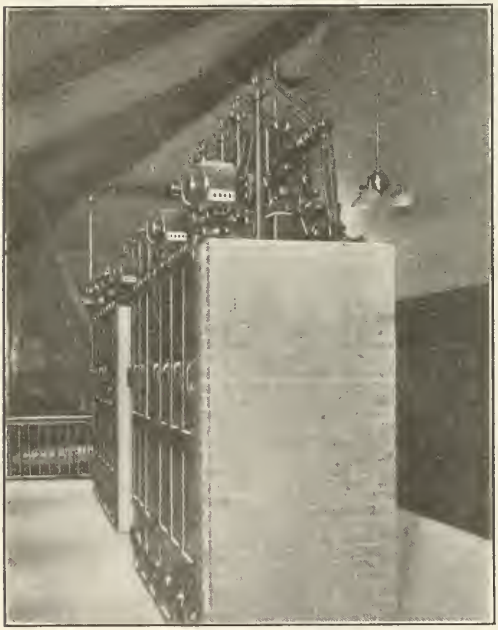


FIG. 5.—HIGH-TENSION SWITCHES IN BROOKLYN STATION.

We are indebted to Messrs. J. W. McCay and J. Goodman, of the Brooklyn office of the Department of Water Supply, Gas and Electricity for information on the Brooklyn system, and to Mr. I. M. DeVarona, chief engineer of the Department of Water Supply, Gas and Electricity, for information on the Manhattan system. The Allis-Chalmers Company supplied the pumping station machinery and appliances in each station, the contract price for each being $199,625.50. The D'Olier Engineering Company, of Philadelphia, was the general contractor for the Brooklyn stations.

A New Factor in Induction; the "Loop" vs. the "Cutting Lines of Force" Laws.

By Carl Hering.

FOR many years there has been a controversy as to which of the two forms of the law of electromagnetic induction is the better one to teach and use, the one originally proposed by the remarkable experimenter Faraday or the one originally proposed by that remarkable mathematical physicist Maxwell. The former is popularly referred to as the theory of "cutting lines of force" and the latter as the "loop" or "linking" theory. A recent crucial experiment made by the writer again opens up this controversy. Faraday, who was one of the world's greatest experimenters, was a man who sought the truth whatever it may be, and was not biased by any predetermined notions which he was anxious to prove or defend. This feature in a man's character is what some writers have said distinguishes the great man from the little man.

Maxwell, who was one of the world's greatest mathematical physicists, developed the mathematical relations without which the present enormous progress in applied electricity would have been impossible. He made discoveries and deductions concerning quantitative relations which were remarkable and were of the greatest value. The nature of his work, however, led him into the dangerous realm of mathematical generalizations. And having the instincts of a mathematician, he had implicit faith in mathematical expressions.

Generalizations are as dangerous as exterpolations of curves beyond the limits of the known points. While both at times may prove to be safe and may be of the greatest value, a careful writer will do well to always state the limiting conditions beyond which the results are mathematical deductions or generalizations, as distinguished from actual observations. A very inadequate and perhaps even a faulty generalized law may sometimes be made universally applicable by skilful "interpretations" or manipulations which sometimes are little short of jugglery. Some authors of alleged universal scientific laws, or their followers, have at times shown the unscientific spirit, so common among lawyers, of desperately defending an incomplete or faulty statement, by resorting to so-called interpretations or jugglery, rather than to come forth in a truly scientific spirit by acknowledging the deficiency and adopting something else that is less deficient. It ought to be axiomatic that a scientific law which requires no interpretations is a better one than one which does, other things being equal. The test of a law is its capability of predicting correctly before the interpretations necessary to make it apply are known.

The reason why this controversy has been so interminable seems to be that by means of various more or less skilful interpretations both laws could be made to apply correctly to every known case; hence, it has been a matter of choice. A wise and broad-minded teacher taught both. In the writer's opinion, the student ought to be taught that which will give him most directly the clearest and simplest conception of all problems, usual or unusual, and which will require the least interpretations of a given statement to make it apply to any particular case; the unusual ones of to-day may be the usual ones of to-morrow.

Faraday's early statement of the law (1831, paragraph 114) is to the effect that when a conductor cuts or intersects magnetic lines of force, a current tends to be induced. He naïvely says, "The law . . . is very simple, though difficult to express." He clearly describes that the intersection is a relative one; that is, either the conductor may move across the flux (as we now call it) or the flux may move across the conductor, all that is necessary being that they cut across each other. Hence, as he himself describes, it applies as well to self and mutual induction, like in transformers in which the flux moves and the wire is at rest, as it does to dynamos in which the wire moves and the flux is at rest, or as we now know, to induction motors in which both move. He clearly describes (par. 238, published in

1832) how the flux forms around a wire in which a current starts, and how this flux expands and cuts neighboring wires, or contracts again on the cessation of the current, originating and vanishing again in the conductor itself. He describes (par. 3192) that the induction, moreover, is located where this "cutting" takes place, and there only, the rest of the circuit being merely a conductor. Moreover, in 1832, par. 256, he suggests, in his usual reserve style, the following statement of the general law, which shows that he clearly appreciated that the induction was localized in that part where the intersection took place (as distinguished from being a function of the complete electric circuit or loop, as some of his followers seemed to think); also that it would take place in a piece of wire or a wire with ends, as distinguished from an endless wire forming a loop or closed circuit. He also shows here that it is what we now call the e.m.f. which is induced and not the current, the latter being merely the result of the e.m.f when it can act through a closed circuit, hence, the rest of the circuit has nothing to do with the real induction, but concerns only the flow of a current. His own quaint language is as follows: "If a terminated wire move so as to cut a magnetic curve, a power is called into action which tends to urge an electric current through it; but this current cannot be brought into existence unless provision be made at the ends of the wire for its discharge and renewal." .

About 20 years later (1851, par. 3087) he again states his law and discusses the phenomenon at some length in the pages which follow. He here uses the words "circuit" and "loop" apparently for the first time, and in paragraph 3160 he speaks of a "loop forming a complete circuit" and lines of force passing into and out of it, which expression doubtless gave rise to the later generalization of Maxwell. But even here (par. 3170) he emphasizes the word "intersections" by italicizing it in the expression: "The disk apparatus shows well the dependence of the induced current upon the *intersection* of the lines of force." He also (par. 3172) italicizes in the following: "All the results described are those obtained with *moving metals.*" All this shows the importance which he still attached to the actual cutting of the flux by the conductor.

The so-called "loop" law, of which the "linking" law is apparently an offspring, is stated by Maxwell, himself its originator, in his own classic works, Sec. 531, Vol. II, in the following terms:

"The whole of these phenomena may be summed up in one law. When the number of lines of magnetic induction which pass through the secondary circuit[1] in the positive direction is altered, an e.m.f. acts round the circuit, which is measured by the rate of decrease of the magnetic induction through the circuit."

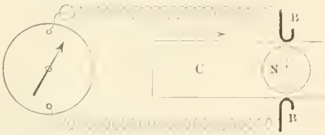
A more modern and also very distinguished authority, J. J. Thomson, states this same law in these terms, which amount to the same thing:

"Whenever the number of tubes of magnetic induction passing through a circuit is changing, there is an e.m.f acting round the circuit equal to the rate of diminution in the number of tubes of magnetic induction which pass through the circuit."

Taking this law *as stated* by these high authorities, it will be seen that neither of them specifies the fact which we must learn subsequently, that it applies only when the circuit is closed and may or may not be correct when it is open. The student is left to find this out for himself, and that the law is, therefore, not universal, as he was led to believe.

In the controversy between the advocates of the two different statements of the law, it is of interest to call attention to a very early experiment of Faraday's which seems to have been forgotten by his opponents. Also to a modification of it, which is suggested by a recent experiment of the writer[2], which would have thrown considerable light on the subject of induction to such a keen and honest observer of facts as Faraday was.

The experiment of Faraday is the one described in his paragraph 101 (hence, preceding the first statement of his law) published in 1831, and shown in Fig. 16, plate 1, of his classic "Researches." A copper strip *C* in the adjoining figure was mounted to be moved lengthwise between two fixed brush contacts *B B*, which were connected to a galvanometer. The pole of a magnet was placed above the strip, as shown by the circle, just between the brushes at *N* so that its flux passed through this strip. A dotted line has been added by the writer to indicate the center line of the path of the current or the completion of the electric "circuit" or loop through the copper strip. When this strip was moved lengthwise, Faraday found that induction took place; the conducting metal had cut this flux.



FARADAY'S EXPERIMENT.

It will be noticed, however, that there has been absolutely no change of flux embraced by the electric circuit or loop during this movement. Moreover, there have been absolutely no linkages produced. Nor has the "circuit" moved in the least, across the flux; it is merely the conductor which has moved.

Had Faraday continued this interesting and instructive experiment in the following way, he would have obtained a further confirmation of his views and a further insight into the nature of induction, and might perhaps have prevented the subsequent discussion of his opponents.

If the magnet had been moved across the dotted line while the strip was at rest, the same induction would have taken place, and the loop theory would then have applied very directly, as the flux enclosed by the circuit would have been changed. If both the magnet and the strip had been moved together at the same speed so that the flux crossed the dotted line, induction would have resulted as before, according to the loop theory, or the theory of linkages, because the flux enclosed by the circuit has then been changed from zero to a maximum or the reverse; or the complete linking or unlinking of the flux and the circuit has then been accomplished; or, in still different terms, the electric "circuit" has been cut by all the lines. But as may not be generally known, there will not be any induction whatsoever; the "conductor" has not cut the lines of force, as it remained stationary with respect to them.

Nowhere have I been able to find that Faraday himself states that the electric "circuit" must cut the flux, but always that it is the "wire" or "conductor" or "metal" which must cut it. If he has been quoted by others as using that term "circuit" in this sense, it is his interpreters and not Faraday himself who made this change, which was no doubt responsible for the "loop" law. This apparently insignificant difference seems now to be important in view of the experiment recently made by the writer. The circuit may do the cutting without the wire moving, but then there is no induction, while if the conductor moves and the circuit does not, there is induction; hence, the distinction becomes imperative.

Although Faraday himself states the law as it is now found to be correct, he did not seem to appreciate this distinction, as he did not specify it as far as the writer can find out, and it is safe to assume that such a careful observer and experimenter as Faraday was would certainly have called special attention to it had he taken notice of it, especially as some of his own experiments showed this difference, and the results depended on this distinction. One of the reasons why he failed to notice it seems to have been because he always considered the conductors and never the circuit *per se*. as distinct from the conductor. It was his followers who introduced the conception of the circuit or loop as such, and they did not seem to have gone back to Faraday's experiments to see whether the two terms were really strictly equivalents.

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[1] He had just previously shown that a magnet and a primary circuit are here equivalent.

[2] A paper read by the writer on Feb. 10, 1908, before the Philadelphia Branch of the American Institute of Electrical Engineers, on "An Imperfection in the Usual Statement of the Fundamental Law of Induction." It has not yet been published.

Maxwell does not seem to have called attention to this distinction during induction, although he did recognize the converse of it, namely, that it is the conductor and not the circuit or current path which is attracted or repelled by a magnet, thereby unconsciously contradicting the Hall effect which was discovered later.

I fail to find anywhere in Faraday's works that he states or even suggests that the phenomenon of induction was a function of a *closed circuit or loop as such,* but always that it was a function of the actual cutting and occurred where the cutting took place, whether a loop was formed or not; the cutting was the primary and essential action, the circuit or loop was secondary and unessential to the induction, being simply a means to enable a current to flow and to circulate.

The "loop" law, as stated by Maxwell and his followers, teaches us less because it does not teach us that the induction is located at any particular part of the circuit; it even conveys the wrong impression to the mind of the student that the induction is a function of the loop as such, and, therefore, takes place evenly all around, like the even stretching or evenly distributed forces in a rubber balloon in which the enclosed air is increased or diminished. Maxwell and Thomson both say that "the e.m.f. acts around the circuit."

Concerning the "linking" law, the same comments apply, as it is a mere modification of the loop law. One has merely to read the linking law on to the modification of Faraday's experiment described above, to see how badly it would mislead the student if it is given as a universal law, unqualified by various limitations and conditions. For instance, we are taught that if linking takes place there will be induction, and by inference if no linking takes place there will be no induction. But in that new experiment exactly the contrary is true; when the copper strip is moved together with the magnet, linking takes place, but there is no induction; while, when the copper strip alone moves, there is no linking, but there is induction. Faraday's opponents will have to do considerable "interpreting," little short of juggling, to make their theory fit this case; the observed results will now help them to make the interpretations which they had not thought of before. But as this linking law is at times very useful and convenient, it might be better to properly define its correct limits than to attempt to make a universal law of it.

In Faraday's experiment with induction in a straight wire with free ends (par. 256, mentioned above) if he had connected two large spheres to the two ends of the "terminated" wire, during the cutting process, he would have found them charged after the induction, according to his views of induction. In such a case there is not even a semblance of a circuit or loop, and hence there cannot, of course, be such a thing as a change of flux in a loop, nor are there any linkages whatsoever.

Another illustration is the case of a nearly closed circuit like the letter C; if the flux be introduced through the opening, no e.m.f. will be induced, even though the flux in the inside is thereby increased; but if introduced from the other side or anywhere else so as to *cross the conductor,* an e.m.f. will be induced.

Faraday's statement of the law, which is so simple and so easily conceived by students, seems to explain directly and without the need of any "interpretations" the induction in all usual or unusual cases, in many of which the loop and linking laws require considerable manipulations and interpretations which are more apt to confuse and discourage than to instruct and encourage the student. In fact, the writer does not know of a single case, no matter how odd or unusual, in which Faraday's law does not apply directly and clearly, giving the correct answer without any reserve or doubt, thus making it safe to use it to predict the results in new cases, both qualitatively and quantitatively. It, therefore, appears to be a universal law. In locating the induction it even teaches us what the other not only does not but even misleads. It seems strange that there should be so many opponents to it and that they should oppose it so vehemently. Fashion, prejudice or habit seem to be the only explanations; mathematical physicists may have good reasons to prefer the loop law, but do these reasons apply to the beginner, student or engineer who may not have to use these higher mathematical conceptions?

The "loop" law teaches us nothing when the circuit is open; the student is then puzzled to apply it; and when nearly closed, thus at least resembling a loop, it may give correct or incorrect results. There is not even an intimation of this important condition; the student is left to find it out for himself. It is, therefore, even very dangerous to use as a universal law. The student is, moreover, unable to form a correct mental picture of induction and must accept the law blindly, on faith—a method which may be satisfactory in theology, but is a very unsatisfactory way of teaching science to a capable student who does his own thinking.

It is not denied here that the loop or linking law can be "interpreted" to fit all cases after the observed results have shown how it ought to have been interpreted originally. Nor is it denied that Maxwell was familiar with Faraday's experiments. Maxwell may have elsewhere in his works discussed induction under conditions which do not come directly under his law. If so, his followers are to blame for quoting him incompletely or imperfectly, just as Faraday's followers are now to blame if they have quoted him as using the term "circuit" for "conductor."

In view of this new modification of Faraday's experiment, the writer hopes that new interest will be awakened in favor of the much abused Faraday version of the law. It is also hoped that teachers will now appreciate the value of teaching Faraday's version and will caution their students against accepting the Maxwell version, as usually stated, to be universal. It is also hoped that this experiment will call attention to the harm done by the loose and imperfect way in which important information is sometimes published and republished in text-books on which the student and the practising engineer depend.

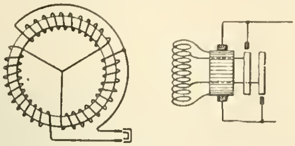
Much time, mental labor and money have been wasted in the development of various forms of the long looked-for commutatorless direct-current generator, which proved to be inoperative. all of which could have been saved, and turned to a more profitable direction, had the phenomenon and laws of induction and magnetism been more clearly and correctly understood; this waste must be charged to those who did the teaching, in books or verbally.

The crucial and severest test of a scientific law is whether it can predict previously unknown results correctly. With the loop or linking law only, could anyone have predicted with certainty the correct results in that experiment? Let teachers try this with those of their students who have not been taught Faraday's version. Able authorities who were not ashamed to be frank and honest have confessed that the results surprised them and that they would have predicted wrongly. Does not such a state of affairs prove that the generally taught loop or linking law has not only been imperfect, but even misleading? Even if some were only left in doubt of the result, it shows that the law is imperfect. Whatever the opponents of Faraday may say in defense of their position, it cannot be disputed that the loop or linking law *does not* instruct us what the result in that experiment will be.

Self-Starting, Single-Phase Induction Motor.

A patent issued Feb. 11 to Mr. James J. Wood shows a form of single-phase induction motor started from rest as a repulsion motor which differs considerably in mechanical arrangement from the well-known motors of this general type now in successful use. According to the usual arrangement the primary circuit is placed on the station and certain changes are made in the secondary (motor) circuits in order to convert the machine from a repulsion motor to an induction motor. According to Mr. Wood's arrangement the primary circuit is on the rotor, and the secondary circuit, which is on the stator, is changed when converting the machine from an "inverted" repulsion motor to an induction motor with revolving primary. The stator and rotor circuits of the motor are shown in Figs. 1 and 2.

During the starting period brushes rest on the commutator in the primary circuit and the stator (secondary) winding is short-circuited upon itself along a definite line at a certain angle to the line of contact of the commutator brushes. Thus the machine starts from rest as an "inverted" repulsion motor. For normal running the brushes are lifted from the commutator and two other brushes are joined to collector rings, while the stator is further short-circuited along a plurality of lines, thereby causing the machine to become a single-phase induction motor with its secondary circuit on the stator core.



FIGS. 1 AND 2.—STATOR AND ROTOR CIRCUITS OF WOOD SINGLE-PHASE MOTOR.

Does the Inventor Get a Square Deal at the Hands of the United States Government?

By H. Ward Leonard.

The report of the Commissioner of Patents for the year ending Dec. 31, 1907, contains irrefutable evidence that the government is neglecting its obligations to inventors who pay to the Patent Office nearly $2,000,000 per annum in order to secure patent protection for their inventions.

The Constitution of the United States says: "Congress shall have power . . . to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries."

The greatest inventor of all the ages, if he were living to-day, might publish his most valuable discovery under the implied contract with the United States Government that it would "secure" to him by a United States patent the exclusive right for a limited time to his discovery, and, after receiving his United States patent he would find that although he had performed his part of the contract fully and in good faith, he had not secured the exclusive right to his invention for 17 years as expected.

He would find that no large corporate interest would respect his patent rights unless he was able and prepared to spend many of the 17 years and tens of thousands of dollars to establish the correctness of the judgment of the government in granting the patent to him, which was exactly what he had already paid the govenment to do. Under no conceivable practical circumstances would he be "secured" by the government in having for 17 years the exclusive right to his discovery, which is what he was led to expect he would receive in return for disclosing his discovery, and paying all the necessary costs of the government investigation of his claim as the original inventor, and all other costs of every kind incidental to the grant of the patent to him.

The recent report of the Commissioner says: . . . "the surplus in the treasury to the credit of the Patent Office which on Jan. 1, 1908, was $6,706,181.64. This surplus of the net receipts over all expenditures has been derived entirely from the fees paid by the inventors of the country, directly or indirectly."

In speaking of the "insufficient force of examiners and clerks," the Commissioner says:

"Their efforts under these conditions were at best spasmodic and simply resulted in thousands of actions being made which were nothing more than frivolous. . . . A great many applications were passed to issue that were not ready for patent, with the result that the inventors and owners of meritorious inventions forfeited valuable rights by these careless, ill-considered and hasty actions on the part of the office. . . . Complaints against the conduct of affairs in this office have been numerous, and many have been based upon good and sufficient grounds."

It seems evident from these quotations and from facts familiar to all who have to do with patents that inventors are not justly treated by the government as to the granting of patents. Every year our patent system becomes more complicated, more expensive to the inventor of a valuable discovery, more untrustworthy, more unjust and more absurd. The rights and opinions of the inventors themselves seem to be considered of no importance as compared with those of patent lawyers and large corporate interests, many of which exist solely upon the discoveries of unrewarded inventors.

The cost of obtaining a valid patent for a meritorious invention increases yearly. The fees to the government are a mere pittance compared to the cost to which the inventor is subjected when he employs a competent, reliable patent lawyer to obtain his patent. This is explained to some extent by the Commissioner's report where it refers to the "thousands of actions being made which were nothing more than frivolous."

To an ordinary business man our whole patent system seems to be based upon many absurd assumptions, among which may be enumerated the following:

1. It is assumed that the half-paid men who act as examiners are invariably and absolutely trustworthy and are incapable of intentionally or unintentionally betraying the trust imposed in them when the inventor confidentially discloses his discoveries to the Patent Office, or of acting unfairly as between rival applicants. The Commissioner says in his said report:

"The office has become merely a post-graduate school for the technical and legal education of young college men who enter the service. The General Electric Company has in its patent department 12 or more men who were formerly examiners in this office, and other corporations have taken hundreds from the office."

All of these same corporations no doubt find it desirable to place certain of their employees under fidelity bonds to insure them against actual stealing of money entrusted to them, but the United States patent system is based upon the assumption that each one of these "hundreds" of half-paid examiners who eventually enter patent departments of these corporations at good salaries, will perfectly guard the interests of the inventors whose secret discoveries were entrusted with them while they were employed at the Patent Office.

No doubt the examiners are as good as and no better than the average college graduate. As to whether such men are invariably and absolutely trustworthy the records of the public press clearly show. One fact is evident—the "corporations" find that it pays them to hire these Patent Office examiners by the "hundreds" or they would not do so.

2. The United States patent system puts a premium upon forgery and perjury. When a contest arises between an applicant who tells the truth and one who is willing to forge documents and perjure himself, the Patent Office usually grants the patent to the rascal, who has probably succeeded in selling to some large corporation his application, at a good price, contingent, of course, upon his being declared by the Patent Office the inventor and consequently securing the patent

3. One pessimistic examiner of the "frivolous" type will prevent an inventor from securing a patent on an important discovery because it is so far in advance of the art as not to be appreciated by him; and another optimistic examiner of the "frivolous" type will insist that there is patentable inventions in a certain combination, and so perfect is the judgment of such an examiner assumed to be, that the Patent Office Rules absurdly provide that no appeal can be taken from such an examiner's decision affirming a patentable invention. The courts, however, seem to consider such examiners' decisions as of little value in determining the question of invention.

4. Patents are improperly issued by the score to applicants whose applications ought to be placed in interference with prior applications of other inventors.

Perhaps nothing else can be expected of inexperienced, half-paid, over-worked young men who have to examine and act on more than three patent applications per day, as an average.

But when such improperly issued patents are issued to powerful corporations with patent departments regularly strengthened by such examiners fresh from the Patent Office, what is the position of the real first inventor, who had in good faith filed a prior application and can only get his patent after spending thousands of dollars and years of time in interference proceedings, which when finished leave him without the security which the Constitution intended he should get for the publication of his discovery, the government having already granted an irrevocable patent to the wrong man, who has sold it to a powerful interest.

All of these injustices cited are based upon the repeated personal experiences of the writer in the Patent Office. Many more and different injustices could be cited by him or any other inventor who has taken out many patents at his own expense.

It is interesting to note that statistics given in the Commissioner's report show that during the 10 years ending Dec. 31, 1907, the number of patents issued was 60 per cent of the number of applications filed during that period. But for the 10 years ending with 1857 the number of patents issued was only 48 per cent of the applications filed. These figures seem to reflect the improper issuance of patents to which the report refers. It is, of course, evident that each year it becomes more difficult to know the entire past art, and the difficulties of treating inventors justly under a patent system based on unattainable knowledge and unattainable integrity will necessarily increase under the existing practice as the years go on.

When one remembers that it evidently pays some patent lawyers to advertise in every publication in the land to "patent your inventions," it is apparent that all but a small percentage of the patents which issue are merely a means of securing govermental aid in mulcting inexperienced men into applying for a detail patent upon a worthless modification of a well-known device.

A French patent has printed on its face and in several other conspicuous places: "without guarantee of the government," and although the patent application and publication must conform to many properly rigid rules, the patent recites clearly that the patent is delivered without guarantee of the existence, the novelty or the merit of the invention or of the truthfulness or accuracy of the description. The inventor is faithfully protected by the French government through its courts, but that government lends no aid to those who endeavor to mislead the alleged inventor, or other parties, as to the patent.

The United States patent, which is merely a publication of a conditional grant, much delayed and much interfered with, and often unfairly suppressed by the government examination, says on its face: "These letters patent are to grant to the said .... his heirs or assigns for the terms of 17 years the exclusive right to make, use and vend the said invention throughout the United States and the Territories thereof."

This "grant" of "the exclusive right" to the "said invention" is promptly repudiated by the government when the inventor tries to exercise his rights; and after all of his discouraging experiences with the "frivolous" examiners he finds he has less protection in the courts than even the French patentee, because his United States patent depends, not on the real invention which he made and published in good faith, but on the contrary, depends principally upon the refined use of peculiar phrases and punctuation points in a series of ridiculously spun-out claims necessitated by the United States patent system in order to prevent an infringer from hiding behind some semicolon or other equally absurd shield.

The United States Government, as we have seen, gets $2,000,000 in profit per annum out of the inventors. The patent lawyers get at least $10,000,000 from the invenors for taking out these patents. The public gets the benefit of the discoveries. What do the individual inventors get for their discoveries?

It is probably true that the average United States inventor would be better off if there were no United States patents of the present kind. In that case the inventor could use his money in marketing his discovery, and his manufacture would not be embarrassed by the many improperly granted patents to wealthy competitors, which patents he must to-day respect because of his inability to spend the necessary money in litigations. Of course, so long as the present patent system exists, an inventor cannot afford to not take out patents while his competitors are patenting every conceivable detail.

It seems evident merely from the Commissioner's report that the individual inventor is most unjustly treated by the United States Government. The public seems likely eventually to suffer the consequences of a monopoly of monopolies, due to many delayed patents in every new field, if present tendencies continue. All of these difficulties will be solved as soon as Congress "*secures* to inventors for a limited time the exclusive right to their discoveries," as the Constitution provides.

Since the preceding part of this article was written the daily press has published the fact that a Patent Office examiner, a patent lawyer, and an inventor have been indicted by the grand jury for fraudulent acts in connection with records at the Patent Office.

The Commissioner of Patents is quoted as saying: "Notwithstanding the vast moneyed interests involved in patents and the consequent many opportunities for corruption arising therefrom and from the necessity of relying upon the integrity of each individual examiner, owing to the technical and judicial character of the work of the Patent Office, no examiner has ever been shown false hitherto to the trust imposed upon him in all the 118 years of the existence of the United States patent system."

This 118 years record seems to be either a proof of the exceptional integrity of the half-paid young men who act as examiners, or else a proof of the inability of the ordinary individual inventor to pursue, detect and correct unjust treatment at the Patent Office. It is illuminating to read that this alleged bold fraud involving a conspiracy between at least three men, required two independent forces of detectives and the strength and influence of a great manufacturing corporation to expose it.

Suppose the case had been reversed and the inventor who was unjustly treated had been the average individual inventor, unable to employ a force of detectives as a means of securing justice in the Patent Office, would he have secured justice?

Radical changes in our patent system are needed if the inventor is to secure the reward which the United States Constitution intended that he should get.

The existing defects of our patent system are to a certain extent due to the fact that it has been molded into its present shape by the suggestions of patent lawyers and representatives of influential corporations, and it is not likely that the inventor's reward or the public interest was the thought uppermost in their minds at all times in making the suggestions.

It should be remembered that the new and useful result is the product of the inventor, and that he, personally, must get the reward if the spirit of the Constitutional provision is to be observed, and if the patenting of inventions is to be done in a way such as to produce the best results for the nation as a whole.

In considering modifications of our patent system Congress should be greatly influenced by the views of experienced, practical, independent inventors. Such inventors would probably be fairly represented by those inventors, each of whom during the preceding five years has had issued to him, at least 20 unassigned patents. The fact that the 20 patents were unassigned would indicate that the inventor himself was bearing all expenses and this would necessarily imply a fair degree of independence and experience on the part of the inventor, and that some of the inventions, at least, had proved to be of practical value.

If all such inventors, as determined by the Patent Office records, were invited by a special committee of Congress, appointed for the purpose, to come before such committee and express their views as to desirable modifications in our patent system, Congress might learn how inadequately the Constitution is being complied with and might see the great and increasing damage to the public interest which is the inevitable result of the existing patent system.

Some Early Telephone Journals.

By Fred DeLand.

In 1879 it was the intention of the parent Bell company to issue a monthly publication entitled *The Telephonic Journal* and to have it edited "by Mr. Francis Blake, Jr., the inventor of the Blake transmitter, and for many years connected with the scientific work of the United States Coast Survey." This publication was not to be "a mere advertising sheet," nor would it "assume an attitude of partisanship." It was intended to be the "official organ of communication" between the parent company and "its numerous agencies and sub-agencies throughout the country," just as the *Journal of the Telegraph* was for the Western Union. Furthermore, it was "hoped that nothing will prevent its being conducted as a liberal medium of intercommunication between all who, as a matter of science or business, are interested in the development of this most wonderful and valuable invention—the speaking telephone."

The original "proprietors" of the telephone had advocated the need of such a magazine early in 1878, and had tried to induce Alexander Graham Bell to write a series of articles for such a publication. But he was too busily occupied in his technical and professional work to devote any time to journalism; moreover, he had a strong dislike to controversial journalism. His friends knew that opposing interests caused many items to appear misrepresenting the facts concerning the invention of the electric-speaking telephone, "aspersions alike unworthy of journalism and science," statements that appeared to have considerable weight with the public, and that their efforts were aided by pseudo-scientific publications that appeared to find a joy in leading their readers to believe that Bell's original method and apparatus were "simply improvements upon something previously done in the same line by others, such as Oersted, Reiss, Gray."

The Telephonic Journal was to have been a 16-page paper, 10¼ in. x 7 in. in size, two columns to the page. Four pages were to be devoted to selected advertisements, if that amount of advertising matter could be secured. Of the first number 5000 copies were to be circulated and not less than that number of each succeeding issue. The rate for a full-page advertisement was to be $30 for each insertion, $15 for a half-page, and $8 for a quarter-page. This periodical was well-planned and had ample financial backing, but no issue ever appeared. For on April 11, 1879, the parent company stated that: "We are compelled to announce a delay in the issue of the first number, caused by the illness of Mr. Francis Blake, Jr." Mr. Blake fell sick early in the spring of 1879, and when he regained his health and returned to Boston the project was abandoned, as the necessity no longer existed for giving expression to the views of the Bell company in contradistinction to those of its opponents.

Several months before the parent company proposed to issue its "official organ of communication," a few of the operating companies, or individuals associated with the pioneer companies, issued periodical telephone publications, though nearly all these journals enjoyed only a brief existence. Just where the first telephone publication was issued is still to be determined. In 1877, several local weekly newspapers adopted the title *The Telephone*, but they were in no sense class or technical publications.

One of the first trade journals was an eight-page periodical bearing the title *Telephone*, which was issued by S. D. Mott in November, 1877. The subscription price was 50 cents a year and the first number bears the date line: "No. 1. Vol. 1. New York and Boston. November 3, 1877." It contained but a meager quantity of telephone news, some local gossip, a few literary items, and quite a number of advertisements of dealers in groceries and househould necessities. One item read, in part:

"Prof. A. Graham Bell's telephone consists now of but three metal portions and is contained in a casing of wood or light hard rubber."

The Telephone Record was issued in Albany, N. Y., by Charles H. Sewall in the summer of 1878. Referring to this publication the *Evening Journal* of Sept. 6, 1878, states:

"*The Telephone Record*. This neatly-printed little pamphlet for September has just been issued and possesses a fund of information in regard to the management and use of the telephone, besides some entertaining reading matter and a full list of subscribers."

Another of the early telephone publications was *The Telephone Journal*, the initial number being dated Chicago, October, 1878. It was issued from the telephone exchange, 125 LaSalle Street, by the "Bell Telephone Company, Proprietors." In one sense this periodical could be called the organ of the parent company, as the second of the parent companies owned a controlling interest in the Chicago telephone exchange system. But the periodical was issued as a local sheet, although it carried the announcement that "numbers of copies will also be sent to the agents of this company in the different cities of the union for distribution." The editorial announcement claimed that the *Journal* was established "in the interests of our patrons (and) will be issued monthly or oftener as required, will contain such items of telephonic and general information as will be interesting, and we trust will be found a valuable aid to those desirous of informing themselves on the subject of telephonic communication. It will be distributed gratuitously to our subscribers as issued."

The first number of the second volume of *The Telephone Journal*, published in January, 1879, contained a list of subscribers to the telephone exchanges in Chicago and also in Louisville. The Chicago list contained over 600 names.

In March, 1879, the first number of a monthly periodical bearing the lengthy title: *The Southern Herald of the Telephone* was issued at Richmond, Va., by James M. Ormes, "general agent for Bell's telephone."

The *Telephonic Exchange Reporter* was established in Cincinnati, in August, 1880, by James W. See, editor and publisher. It was a three-column eight-page monthly, 12½ in. x 8½ in. in size, and devoted to the "business interests of telephonic exchanges." It was well edited and ought to have been well supported, even though the subscription price, $4 a year or 35 cents a number, may have appeared high. But it went the way of other good publications, only six numbers appearing. Its attitude on prevailing issues may be inferred from the following paragraph:

"In 1876 Mr. Bell patented a new system of telegraphy, as he called it, which we now call telephony. He patented the fundamental devices requisite to transmit undulating currents over wires. His patent relates to the fundamental elements requisite in telephones. He cared nothing for its shape or form. He was not patenting the form. At the head of the title-page of this journal will be seen at the left a view of the Bell telephone of 1876 (Fig. 7 in the patent), and at the right a view of the Bell telephone of 1880 (the rubber-encased hand telephone). They are both the patented 'Telegraphy' of 1870, and countless changes can be run on forms, and the golden keynote of the patent is still there." . . .

The issue for September, 1880, contained an article giving an electrical and mechanical description of the magneto generator, with illustrations of certain ringing devices, while a future article was promised on the testing and repairing of these ringers. There was an article on individual signal systems, a good report of the first national telephone convention, and a description of the equipment exhibited there. There was also a column of answers to seekers for information concerning telephone exchanges.

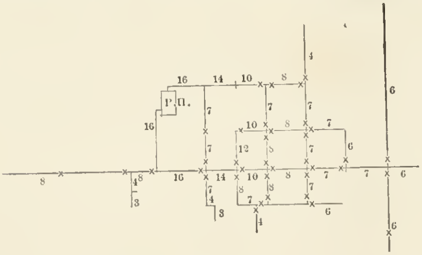
At the first telephone convention, held in September, 1880, a committee on "Telephone Journal" was appointed. But the three gentlemen evidently were not in sympathy with the subject, for they reported back: "We would not have time to attend to the matter and wish to have our names withdrawn from the committee."

At the second telephone convention held in Chicago in 1881, it was stated that "in some way and under some auspices a telephone journal devoted to the exchange and general telephone interests, should be established as early as possible. The establishing of a journal of the right character, and which would give us all the information possible, should be our object, and the time does not seem ripe yet for starting such a journal. The men to do it certainly have not been found."

Central-Station Heating at Birmingham, Ala.

The Birmingham Railway, Light & Power Company has been supplying steam-heating service from its generating station for about five years, and the development of this business has progressed to the point where there is practically no isolated heating plant within the central business district of the city. The radius of distribution from the plant is about one mile.

Practically the entire commercial center of the city is heated by the company, including the Florence and Morris Hotels, the 15-story Brown-Marx Building, Southern and Athletic clubs, the postoffice, county court house, Louisville & Nashville passenger and freight stations, First National Bank and the Woodward 12-story building. These structures are lighted as well as heated by the company. Four apartment houses and nine residences are also included in the system, which consists of 21,912 ft. of mains, varying from 16 in. to 3 in. in diameter, and representing an investment of about $200,000, including services from the mains to the curb-line. The latter vary from 2 in. to 4 in. in diameter. The general design is that of the American District Heating Company, of Lockport, N. Y.



LAYOUT OF MAINS, BIRMINGHAM, ALA.

A sketch of the layout of mains is illustrated herewith. From the power house *P H*, two 16-in. mains are run underground to distributing mains located beneath the principal business streets. These mains are in general valved at the intersections, and are so connected as to insure continuous service in case of trouble on either of the power-house lines or any other central part of the system. The mains are of standard, wrought-iron pipe laid from 5 ft. to 8 ft. below the surface of the ground, the condensation being drained into the sewers through traps located at low points on the system. Valve manholes are located at practically every block, and the traps are in manholes varying from three per block to one every four or five blocks. About 175 customers are supplied.

The pipes are supported on cast-iron girders or saddles, 8 ft. apart. The exteriors of the pipes are wrapped with asbestos paper bound on spirally with copper wire. The saddles rest on a 4-in. circular conduit of tongued and grooved white pine, the latter being lined with tin on the inside. An air space separates the pipe from the conduit, and the exterior of the conduit is wrapped with three-ply tar paper. In the bottom of the trench is a 4-in. drain tile covered with crushed stone. The expansion joints and anchor specials are placed in brick boxes containing a mixture of shavings and asbestos cement. A test recently made by the company showed a condensation loss of 0.204 lb. per square foot of underground pipe surface per hour.

The smaller supplies for the system are kept in the basement of the company's office building at First Avenue and Twenty-first Street. These include valves, fittings and small piping. The larger piping is kept at the storeyard on Eighth Avenue at Thirteenth Street. The system is operated on a temperature guarantee of 70 deg. at zero outside. A combination of exhaust and live steam is used, the pressure being varied from 4 lb. to 8 lb., according to the temperature and wind conditions. Last year the average pressure at the remotest point on the mains was 4 lb. The season extends from Nov. 1 to April 30, inclusive. Two methods of charging are in use, the flat rate and the meter rate. The flat rates are as follows:

Sq. ft. heating surface installed.	Per sq. ft. per season.
150— 300	$0.20
300— 450	.25
450— 600	.24
600—1000	.23
1000—1500	.22
1800—2700	.21
Above 2700	.20

The meter rate is as follows: Eighty-five cents per 1000 lb. for the first 10,000 lb. condensed per month; 75 cents per 1000 lb. for the second 10,000 lb. condensed per month; 65 cents per 1000 lb. for the third 10,000 lb. condensed per month; 60 cents per 1000 lb. for the next 20,000 lb. condensed per month; 55 cents per 1000 lb. for the next 20,000 lb. condensed per month; 50 cents per 1000 lb. for the next 30,000 lb. condensed per month; 45 cents per 1000 lb. above 100,000 lb. condensed per month. Ten per cent discount is allowed for prompt payment.

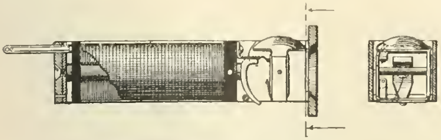
The company has not lost a customer since it began the steam-heating business. There is a minimum charge of 60 cents per 1000 lb. based on 200 lb. condensation per square foot of radiating surface per season. Thus far meters have been used on the smaller loads. The American Company's Simplex meter is used, the capacities varying from 150 lb. to 1500 lb. per hour. Excellent results have been obtained from these meters. An automatic recording thermometer is kept in service at the company's offices, and in case of any sudden and violent change in the weather conditions, the power house is instructed to alter the pressure correspondingly. Ordinarily no adjustment is necessary under 12 or 15 deg. external temperature variation. The company maintains close supervision over the designs of the heating installations, and checks the radiating surface required by Carpenter's rule. Judgment is, of course, necessary in the application of this rule. The rule in Birmingham is:

Add the area of the glass surface of the room in square feet to one-fourth the exposed wall surface. To this total add from one-fifty-fifth to three-fifty-fifths the contents of the room in cubic feet (one-fifty-fifth for upper floors, two-fifty-fifths for rooms on the lower floors, and three-fifty-fifths for large halls). Multiply the final sum by one-quarter, and the result will be the radiating surface needed in square feet. The company makes a rough floor plan of the building, showing windows and doors, locates the radiators and sends carbon copies to the heating contractors who bid for the work. Office buildings are figured at the ratio of 1 sq. ft. of radiating surface to 100 cu. ft. of building contents. The sizes of pipes are also figured by the company for each installation. At present maintenance is handled by two mechanics and three laborers. Depreciation is just beginning to make itself felt as a sensible factor in the operation of the system. A shut-down has not occurred since the service began. During the summer months steam is kept on one line to supply the hotels, barber shops and restaurants.

New Telephone Patents.

NEW APPARATUS.

The electromagnetic signal having a shutter moving behind a window, with the energization of the magnet, is probably the oldest form of common battery signal; and while the lamp has superseded this arrangement in many cases, there is still a constant demand for it. Probably the most successful of all types of such signals is what has become known as the bull's-eye. Such a signal is shown below in part section. The non-magnetic shaft is held freely in bearings formed in the two legs of the return pole piece. This latter is in the shape of a long, narrow V, within which the coil and core are mounted, and upon the ends of the legs of which the face plate is secured. The movable part consists of a frame carrying at one end a light bull's-eye of metal, and at the other an armature. Heretofore this armature has carried a curved tapered spur, the narrow point of which approaches the end of the core. The present patent covers an arrangement slightly different, in this case the spur being attached to the core as an extension pole piece. When the coil is energized it is seen that the armature will ride up in front of the widening pole piece to display the bull's-eye target. This arrangement has been patented by E. W. Brackett, of Elyria, Ohio, the patent being assigned to the Dean Electric Company.


BRACKETT SWITCHBOARD SIGNAL.

Henry C. Thomson, of Boston, has also obtained a patent for a signal, assigned to the Electric Goods Manufacturing Company. His arrangement comprises a combined jack and signal, designed to be mounted in banks, with provision for a transparent protecting strip in front of the signal part to protect it.

An improvement in transmitters has been patented by W. W. Dean, of Elyria, Ohio. This relates to what may be called the inverted solid-back type. This type of transmitter has the cup of the microphone button attached to the diaphragm, while the face electrode, mounted in the cup through the auxiliary mica diaphragm, is secured rigidly to the bridge. In the improved type the main diaphragm is perforated and bent so that an annular flange is formed, turned inwardly. The bottom of the button rests upon this flange, to close the perforation. This button bottom is of thin metal, over the inner surface of which is secured, by being rolled on, a thin film of platinum. This forms one electrode. The flange of the main diaphragm serves as a stiffener and damper, while the diaphragm-like electrode serves in the capacity of an extra diaphragm sensitive to high overtones.

Another improvement in apparatus is the hook switch patented by W. H. Bruce, Jr., of Springfield, Ohio. This is a removable lever switch. The springs and spindle are mounted upon the base piece. An auxiliary lever swings about the spindle and carries the arm which shifts the springs. The main lever has a slot in it which straddles both the spindle and a lug of the auxiliary lever. The lever is held in place by a sleeve which is mounted upon the spindle, and is pressed toward the lever by a spring. The end of this sleeve carries an annular flange, which fits an annular groove in the face of the lever. At the outer end of the sleeve a button is formed to aid in withdrawing the sleeve to release the lever.

NEW CIRCUITS.

In the line of new circuits, Mr. C. S. Winston, of Chicago, has brought out an improved trunk for toll local use. The toll is magneto for clearing out drops, while the local is common battery with a full complement of signals. In such cases, the local end in the majority of cases gets a subscriber's clearing-out signal long before the toll, but it is not safe for her to do so lest the toll-clearing signal fail. To obviate this in the present system, the local is permitted to disconnect immediately, this very act being sufficient to throw the toll cord signal. This is accomplished through the aid of an auxiliary relay introduced into the trunk circuit for this purpose.

A patent has been granted to the estate of A. L. Parcelle, of Boston, for an arrangement of circuits by which the transmitter becomes virtually double-acting. Two induction-coil primaries are arranged so that an increase of current in one is accompanied by a decrease in the other, and the primaries are so poled that these two effects are cumulative. The transmitter is arranged to affect one primary directly, any change in the current in this circuit being accompanied by a substantially opposite change in the other.

LETTERS TO THE EDITORS.

Turbine Economies.

To the Editors of Electrical World:

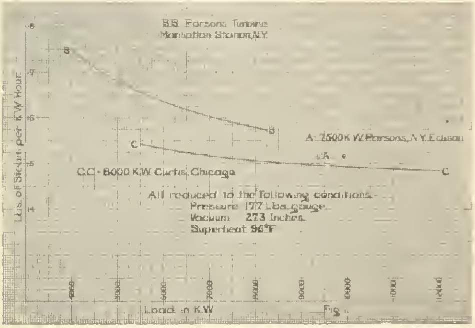


FIG. 1.—TURBINE TEST CURVES

A.—New York Edison test.
BB.—Test of Parsons turbine in Manhattan station, corrected for pressure, vacuum and superheat to New York Edison test conditions, by rates used in report of New York Edison test.
CC.—Curtis turbine in Chicago under same conditions.

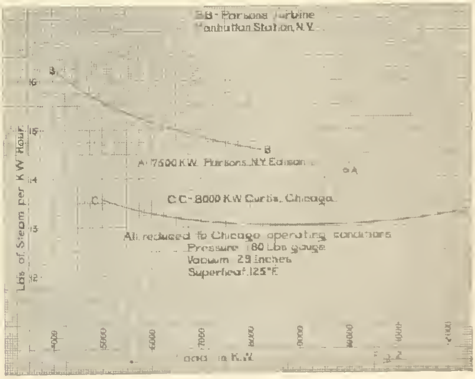


FIG. 2.—TURBINE TEST CURVES.

A.—New York Edison test reduced to Chicago operating conditions by rates used in report of New York Edison test
BB.—Test of Manhattan Parsons turbine reduced to same conditions by same rates.
CC.—Curtis turbine in Chicago under same conditions

SIRS:—In an article in your issue of Feb. 29 Mr. J. R. Bibbins has criticized my letter in your issue of Jan. 11, and again reversed the order of merit in comparing tests of Curtis and Parsons turbines. On further investigating the matter, I find that I made a mistake in transcribing the test curve of Parsons turbine in Manhattan station, and I have corrected this error in the accompanying curve sheets. This error arose from the fact that the load on the curve given in the *Electric Journal* was stated in per cent of full load, and that I was mistaken in the full-load rating, so that my transcribed curves were put in the wrong position on the sheets.

Mr. Bibbins now gives curves showing far better results than my corrected curves, but these certainly have no relation to the Manhattan test which my curve is intended to illustrate. Mr. Bibbins also gives as correct, curves showing results greatly inferior to those shown by my curves, but his evidences and reasoning are insufficient. Load flow lines in turbines are not necessarily straight, and vacuum, superheat and pressure variations are not necessarily in accordance with theory.

My curves for the Chicago Curtis turbines are derived from the tests previously published, by correction factors taken from superheat, pressure, and vacuum curves made by Professors Bull and Breckenridge. Their tests comprise more than 20 runs in addition to the runs reported in my paper presented before the National Electric Light Association last year at its Washington convention. Their rates of correction derived from these separate tests may be somewhat in error, but several of these tests were under conditions nearly corresponding to points on my curves and none of them when corrected indicates a result more than one-quarter of a pound different from those which I show. The correctness of my curves is also borne out by several tests on smaller machines, which show results nearly as good.

Schenectady, N. Y. W. L. R. Emmet.

Steam Turbine Tests.

To the Editors of Electrical World:

Sirs:—I was very glad to read in your issue of Feb. 29 the article by Mr. J. R. Bibbins, with reference to the steam consumption tests of steam turbines. I have written for the past four years on this very point, asking that these tests be reported accurately and with results referred to a certain definite basis. It would seem to me advisable that some standard basis of reference should be settled upon, and all steam tests referred to that. Another point worthy of noting is the fact that many tests are reported which include only the steam used by the turbine unit itself, the auxiliaries not being taken into consideration. If they are steam-driven, their steam should be charged against the turbine; and if they are electrically-driven, the power required to operate them should be charged against the turbine. This is not done in many cases.

Boston, Mass. Henry D. Jackson.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Theory of Direct-Current Generators.—P. Riebesell.—An interesting mathematical paper on the theory of the direct-current generator with special reference to commutation. The differential equations of the short-circuit current are developed in general form for the case that a large number of segments of the commutator are covered by a brush. The field in the commutation zone is investigated in detail and a discussion is given of the magnetic influence of the main poles and the interpoles, of the armature flux and of the short-circuit current. An approximate formula is given for the "commutating e.m.f." Then the total e.m.f. is calculated and what the author calls the "main equation" is given. The solution of the simultaneous differential equations leads to results essentially different from the old commutation theory. The discrepancy between theory and practice with regard to the best conditions (as indicated by the formula $R\,T/L > 1$) is solved.—*Ann. d. Phys.*, 1908, No. 1.

Voltage Drop and Stray Field in Transformers.—G. Benischke.—An account of experiments made by the author by a special method to determine the influence of the type of winding upon the voltage drop. By measuring the primary current I_1, and the secondary current I_2 at short circuit, it is possible to find the coefficient of straying from the equation

$$\frac{I_2}{I_1} = K\frac{N_1}{N_2} = \sqrt{1-\delta}\,\frac{N_1}{N_2}$$

when N_1 and N_2 are the number of primary and secondary forms respectively, K the magnetic coupling coefficient and δ the Behn-Eschenburg coefficient of straying. The latter two coefficients are defined by the equations

$$M^2 = k^2 L_1 L_2$$
$$M^2 = (1 - \delta)\, L_1 L_2$$

where M is the coefficient of mutual induction and L_1 and L_2 the coefficient of self-induction of the primary and secondary windings, respectively. In order to form an opinion of a transformer which cannot be tested in normal operation, the short-circuit voltage is generally used; that is, that voltage which must be impressed upon the primary terminals in order to get the normal current with short-circuited secondary. The author shows, however, that this is not sufficient and that it is also necessary to know the watt consumption or the power factor. The knowledge of these values is necessary for plotting the diagram of Kapp. Kapp's method of plotting the diagram is only correct for a transformer without stray field. The latter when short-circuited behaves like a non-inductive resistance; the magnetization is zero. From a no-load and a short-circuit test, the voltage drop can be calculated for any load and for any power factor. Instead of the short-circuit test a measurement of the two currents may be made at that load for which the voltage drop is to be determined.—*Elek. Zeit.*, Jan. 23.—A communication by F. Kade describing several methods for determining the voltage drop, with critical remarks by G. Benischke.—*Elek. Zeit.*, Feb. 20.

Small Synchronous Motor and Rectifier.—A. Soulier.—Small synchronous motors offer difficulties on account of the necessity of synchronizing in starting, while hunting troubles are also encountered. The author wants to overcome these difficulties in the following way: The motor *N I S* in Fig. 1 is a small direct-current machine, shunt-wound, with four poles, so as to obtain synchronism with a frequency of 50 cycles per second for an armature speed of 1500 r.p.m. In order to start the motor with alternating current, its commutator is connected through the brushes *F G* to the alternating-current network *A B* through the intermediary of an "electro-mechanical valve" *H*. The latter is essentially a vibrating plate which is operated by the alternating current which magnetizes a polarized electromagnet. This permits current to pass in only one direction, since during the time of the other half-wave the contact is opened. The rectified current thus produced is supplied through the brushes *F G* to the armature *I*, which now begins to run with increasing speed, the speed being regulated by means of the rheostat *R*. By means of the transformer *C* it is then possible to supply alternating current to the two slip rings *D* and *E*, which are connected with two or more points of the armature. This is done when the synchronizing lamp shows that synchronism is obtained. The switch *T* is then closed

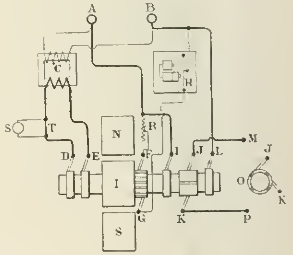


FIG. 1.—SMALL SYNCHRONOUS MOTOR AND RECTIFIER.

and the synchronizing lamp short-circuited. The chief feature of the device is that it is not necessary to make the connection exactly at the point of synchronism, so that unskilled laborers can handle the device. It would now be possible to stop the rectifier *H*, but in this case surging troubles would be experienced. They can be avoided by allowing the rectifier *H* to remain in operation. The figure shows the application of this device to the rectification of alternating current for charging a battery of from 40 to 50 cells. The alternating current is supplied through the brushes *L I* to a commutator-rectifier, the direct current being taken off through the brushes *J* and *K*. The power absorbed by a synchronous motor driving such a rectifier for charging a battery of 44 cells with 30 amperes at 120 volts is 250 watts, and this is said to be the only loss.—*L'Ind. Elec.*, Feb. 10.

Mercury-Vapor Rectifier.—K. Hahn.—The first part of an illustrated paper read before the Berlin Elec. Soc. on the mercury-vapor rectifier of Schott & Gen. in Jena.—*Elek. Zeit.*, Feb. 20.

Manufacture of Motors.—A. Rothert.—A paper in which the author shows that small and medium-sized motors for direct current and for polyphase currents can be profitably manufactured under present conditions only in large quantities. It is necessary to manufacture either whole machines or parts of machines in quantity. For this purpose a detailed standardization is necessary. It is necessary to standardize first whole machines so as to be applicable without changes for as many purposes as possible; second, to standardize parts of one and the same machine to become as independent of voltage and speed as possible; third, to standardize parts that are used in different types of machines in order to make them in as large quantities as possible. Different details are discussed, and a series of direct-current motors is referred to as an example which shows how standardization can be practically realized and what advantages it has for the manufacturer and what savings can be produced in cost of storage and capital invested. Instead of making whole motors, only a certain number of armatures are kept in store, and a much smaller number of field coils and a still smaller number of frames. The whole machines are set up together from these parts when an order is received and this can be done in a very short time. It is finally shown that by means of a card index it is possible to keep a record of the armatures, frames, etc., that are in store and that are being made.—*Elek. Zeit.*, Feb. 13 and 20.

Losses in Pole Shoes Due to Armature Teeth.—T. F. Wall and S. P. Smith.—An illustrated paper read before the New Castle section of the (British) Inst. Elec. Eng. The authors describe the results of some experiments made to determine the loss in a dynamo-electric machine due to the pulsation of the flux set up in the pole shoe by the movement of the armature teeth across the pole face. The following equation is obtained for the losses in pole shoes due to eddy currents induced by the pulsations in the field set up by the armature teeth:

$$W_p = K\left(\frac{t_1 - z_1}{\delta}\right)^{3.5} B^{2.1} \left(\frac{Zn}{60}\right)^{1.5} 10^{-11}$$

watts per sq. dem. of pole faces; where k is a constant depending on the iron, etc., t_1 is the tooth-pitch at armature circumference, z_1 the tooth-width at armature circumference, $t_1 - z_1$ the slot-opening at armature circumference, δ the mean length of air-gap (all measured in the same unit of length). B is the flux density, Z the number of armature teeth and n the speed in revolutions per minute. It is, however, easier to study the problem by means of curves. The most important of those given by the authors, as reproduced in Fig. 2, shows the relation between the losses in the pole-shoe and the ratio of the slot-opening to the length of the air gap. This curve—which was taken at a fairly high flux density in the gap (6000) and a moderately high speed (900)—shows that, provided the ratio of slot-opening to air gap does not exceed 1.5, the losses in the shoe are practically zero. Even when this ratio is as high as 1.8, the eddy losses are only about 3 watts, and probably the designer's practical rule of keeping this ratio below 2 can be accepted as about right. At any rate, this may safely be taken as the limit at which it is necessary to discard solid pole shoes in favor of laminated. In other words, unless the gap is very small, or the flux density is very great, or the speed is very high, the use of laminated shoes is not necessary, for the small increase thereby gained in efficiency does not compensate for the increased cost of construction.—Lond. *Elec. Eng'ing*, Feb. 13; Lond. *Elec.*, Feb. 14.

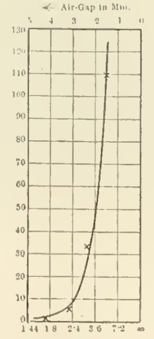


FIG. 2.—RELATION BETWEEN LOSSES IN POLE SHOE AND RATIO SLOT OPENING TO AIR GAP.

Vertical-Axle Machines.—J. Reyval.—An article giving illustrated notes on the construction of dynamos and motors with vertical axles.—*La Lumière Elec.*, Feb. 15.

Lamps and Lighting.

Flame Arc Lamp.—An illustrated description of the Jandus "regenerative" flame arc lamp for direct current. It is a long burning enclosed arc lamp with the two electrodes in a vertical position one above the other. The lower electrode is the positive and is fixed; the negative slides in a tube vertically above it. Surrounding the arc is a clear-glass cylinder, and outside this again is a translucent globe. The arc enclosure is in free communication at the top and the bottom with a pair of curved tubes surrounding the outer globe. The products of combustion are thus able to circulate, passing downward through the side tubes and upward through the center of the lamp. It is found that the rapid circulation induced almost entirely prevents any deposit on the inner glass, the matter from the fumes being left in the base and the cooler metal tubes. Moreover, the matter in suspension is subjected over and over again to the action of the arc, and the chemicals thus exercise their function on the flame many times before settlement finally takes place. For this reason the name "regenerative" is applied to the lamp. The total consumption of chemicals amounts to only about 15 grains per hour, in consequence of the repeated use they undergo. The arc in the Jandus regenerative flame-lamp is about an inch in length, but burns with great steadiness. The current taken in the 550-watt size is 5.5 amperes at 100 volts, or about half the current at twice the voltage usual in open-type flame lamps. The life of a pair of electrodes is 70 hours. The upper electrode is a plain carbon rod, but the lower one is of very special construction. It is star-shaped in section, with about eight rays, the deep grooves between which are filled with a chemical composition so that the whole is approximately circular.—Lond. *Eng'ing*, Feb. 21

Power.

Swedish Water-Power Development.—An article on new projects of State installations at Trollhattan Falls, Sweden. It is now proposed that the State power station, which is being constructed at Trollhattan, should have a capacity of some 76,000 horse-power. It is stated that further extension ought to be considered, otherwise the developments may be confronted by serious difficulties. Details are given of the proposed regulation of the Göta River.—Lond. *Eng'ing*, Feb. 21.

Hydroelectric Stations in Switzerland.—The first part of an article giving chiefly notes on the hydraulic equipment of Swiss hydroelectric stations. Plants of from 5000 to 6000 horse-power are generally equipped with five or six machines rated at 1000 or 1200 horse-power.—*L'Ind. Elec.*, Feb. 10.

Water-Power Station.—An illustrated description of the water-power generating station at Trezzo, Italy, which contains an equipment of nine 1000-kw alternators driven by low-fall vertical-shaft turbines. Owing to a sharp bend in the River Adda, very simple hydraulic arrangements are possible. A steam reserve plant is also provided. In the switchgear a somewhat elaborate arrangement of busbars is used. A feature of the transmission system is the employment of iron wire for short branch lines.—Lond. *Elec. Eng'ing*, Feb. 13.

Italian Energy Transmission.—The first part of an illustrated description of the transmission system from Caffaro to Brescia, which supplies energy to the caustic soda works in Brescia and for lamps and motors in several towns. There are five alternators each with an output of 150 amperes at from 9000 to 10,500 volts with a frequency of 42.—Lond. *Elec.*, Feb. 14.

Rolling Mill.—G. Hooghwinkel.—A paper read before the Sheffield Society of Engineers and Metallurgists in which the author discusses the driving of rolling mills of the heaviest type by steam engines, by gas engines and by electric motors, particulars of the cost being given. The advantages of the electric drive are summarized and discussed and examples are given from Continental works. Finally the driving of reversing mills is considered.—Lond. *Elec.*, Feb. 14.

Water for Steam Generation.—J. C. W. Greth.—A second article on the savings which may be effected by water-softening systems. The author records the actual savings effected in a large number of cases, the figures being given from complete records from the books, covering a length of time sufficient to assure a true average.—*Eng'ing Mag.*, March.

Steam Turbine.—A fully illustrated article of the Zoelly steam turbine on which about 200,000 horse-power are now in use, principally in Germany, and which is being built in England.—Lond. *Elec. Rev.*, Feb. 14.

Traction.

Turbo-Electric Ship Propulsion.—A note on a recent paper by H. A. Mavor before the Inst. of Engs. and Shipbuilders of Scotland, reviving the suggestion of using electric gearing between the turbine and the propeller of a steamship. From a mechanical standpoint, the scheme has very great advantages, and in view of the extremely low prices at which turbo-generators are now obtainable, it is possible that the financial considerations, which have hitherto prevented its adoption, may no longer be prohibitive. In marine-turbine practice the economic necessity of keeping up the blade speed to a reasonable fraction of that of the passing steam, while at the same time securing a fair efficiency for the propeller, has rendered imperative the adoption of very large and expensive turbines, in which, nevertheless, the steam consumption has been substantially greater than it is in the case of the much smaller and lighter turbines used in electric-light stations. At present prices the marine turbine costs probably from $30 to $35 per horse-power, taking the turbine alone, while recently an offer was made to a British central station for two 4000-kw units, bringing the actual cost of the turbine per electric horse-power below $12.50. This difference in prices leaves a considerable margin out of which to provide for the required slow-speed motor and large-diameter propeller. Mr. Mavor, in his paper, proposes to use a polyphase motor, the primary of which shall not be fixed, but arranged so that it can rotate independently of the moving secondary. It is in this way that he provides for the changes of speed necessary in service, and for starting up without great loss of energy. This movable primary Mr. Mavor calls a "spinner," and outside of it he proposes to place a fixed stator, the "spinner" therefore revolving between this and the secondary on the propeller shaft. By this arrangement three speeds of propeller shaft, in either direction, would be obtainable without loss of efficiency, which should suffice for all the essential requirements of marine service. The turbine would run at a constant speed whatever the speed of the propeller, so that no cruising turbine would be necessary on a warship fitted as proposed. Including the steam taken by auxiliaries, Mr. Mavor claims that an electric hp-hour at the motors would be obtained for 12.2 lb. of steam under the usual conditions of marine practice, where superheat is not commonly employed.—Lond. *Eng'ing*, Feb. 21.

Electric Railways.—E. B. Pannell.—An abstract of a paper read before the Northampton Institute Eng'ing Society on some problems of electric railway operation. The weight of train per passenger on various railways in different countries varies between 0.40 and 0.76 ton. For the Berlin-Zossen high-speed experimental line it was 1.86 tons. Similarly the rated horsepower per passenger varies between 3.75 and 6.9; on the Berlin-Zossen line it was 20. Concerning the effect of initial acceleration an increase from 0.75 to 1.5 miles per hour per second is attended with a saving of 30 per cent in energy consumption. The gear ratio should be as high as possible provided schedule speed can be maintained. Some figures are given of the comparative weights of alternating-current and direct-current train equipments. The total weight of a six-car train fully equipped is given as 210 tons for direct-current motors, 235 tons for compensated series motors and 225 tons for compensated repulsion motors (for a frequency of 25). The author is of the opinion that a single-phase motor is not suited to heavy and severe railway service. The peaked efficiency curve of the single-phase motor when running on constant voltage is a disadvantage, as it prevents economical automatic regulation. The author thinks that the next few years will witness an appreciable increase in the average working voltage of direct-current railway systems.—Lond. *Elec. Eng.*, Feb. 14.

Single-Phase Traction.—Henry.—A continuation of his illustrated serial on single-phase traction on European railroads In the present installment the Finzi system is described. Concerning its practical applications the following notes are given: In 1905 a motor-car was equipped with the Finzi system to run on a section of the Valtellina three-phase railway. The car is provided with four 100-hp motors. The tests are not yet concluded. The motors have given an efficiency of 88 per cent at normal speed with full load without excessive heating. At the Milan Exposition the railroad connecting the two principal parts of the exposition was equipped with the Finzi system, the frequency being 15. Two lines in course of erection, of 15 and 20 km. length, respectively, to be equipped with the Finzi system, are the Intra-Pallanza-Fondo Toce and Monza-Meda roads. An e.m.f. of only 600 volts will be used, since these roads pass through various villages where a higher e.m.f would not be permitted. The frequency will be 25.—*L'Electricien*, Feb. 8.

Single-Phase Traction.—S. M. Kintner.—An address on the alternating-current railway motor with special reference to Westinghouse practice.—*Proc. Engineers' Soc. Western Pa.*, February.

Installations, Systems and Appliances.

Protective Devices for High-Tension Circuits.—J. S. Peck.—A paper read before the (Brit.) Inst. Elec. Eng. The author considers the nature of the "static" strains produced by lightning, switching, grounding or by an occurrence which causes an abrupt change in static potential, which may appear as high pressure to earth or between wires, or as a concentration of potential upon a portion of the circuit. To relieve the high pressure between line and ground or between wires, lightning arresters are used. To protect apparatus from concentration of potential, choke coils may be placed in series with the apparatus to be protected. Lightning arresters usually consist of an air-gap in series with a current-limiting and an arc-suppressing device. Four types of lightning arresters are in general use—the horn, the multigap, the water-jet, and the electrolytic. The electrolytic is the last type to enter the commercial field, and while the time it has been in active service is short, the author considers that there are indications that it will afford greater protection than any other arrester yet produced.—Lond. *Elec. Eng'ing*, Feb. 6.—In the long discussion of the paper which was held in London and in Manchester, G. Kapp pointed out that since there are waves with nodes and anti-nodes along a line, it may happen that the lightning protector is put where there is a node; there is in this case no protection. The only remedy seems to be to put enough protectors on the line to hit an anti-node somewhere. The theoretical rise of pressure on opening a circuit is the current multiplied by the square root of the ratio of henrys to farads. If this formula is applied to any current, even at the quite innocent pressure of 210 volts, it will be seen that there is an enormous rise of pressure because the capacity is so small; the only explanation why it is possible to use 500-volt apparatus in the tramways every day without trouble, according to Kapp, is that a high electric pressure if it lasts only a thousandth of a second does no harm.

In order to make an ordinary horn arrester discharge at the voltage which is not too much above the normal one must set the horns so close that anything accidentally coming between, such as a fly or a spider, will sometimes cause a discharge. When it discharges and the horns are close together, an arc is formed; a little metal is melted, forming a globule, which protrudes so that the arrester has to be set again. To avoid this difficulty, Mr. Zapf has designed an arrester, shown in Fig. 3, in which the horns can be set at a suitable distance, such as an inch apart, for 20,000 volts. The arrester by itself, of course, would not discharge; but he has adopted a kind of trigger arrangement. The arrester is connected to earth through a high-resistance box, provided with a platinum point with a screw adjustment; this point forms a gap which can be set very close. There is only a very slight discharge owing to the high resistance in series. Professor Kapp also showed a diagram, reproduced in Fig. 4, illustrating a method by which the danger of the increase of the e.m.f. on the first few portions of an apparatus can be avoided by raising the voltage gradually. This is done by a sort of autotransformer, the secondary of which is connected at points which can be shifted. Thus very few volts can be impressed at first, so that the charge with the first rush of current will be very small. The contact points are then run along to the end, and when they have the same potential as the busbars, the main switch can be closed. In disconnecting, the same thing can be done. The combination apparatus can be used for paralleling generators without synchronizing even if the speeds differ by as much as 1½ per cent. The autotransformer is so arranged that a quarter of the pressure is obtained. The current is so strong that the machines are immediately drawn into step. The whole process can be completed in a few seconds instead of many minutes, as in the case where it is necessary to synchronize accurately. W. H. Patchell thought that the ordinary horn pipe arrester is worse than useless in many cases. Facing one side of the horn with carbon overcomes the building up of the metallic bubbles and so upsetting calibration, so that it is possible to work more closely with a carbon-copper horn instead of with only the copper horn. He has tried this for e.m.fs. up to 40,000 volts, and it gave the same point time after time on the voltmeter. H. Brazil said that the Charing Cross Company had 14 of these arresters in use, and over periods of six months at a time it has been found that, year after year, these arresters have retained the same sparking voltage in spite of a large number of discharges having taken place. On the Charing Cross system an indicator has been used for three or four years and some hundreds of discharges have been recorded quite satisfactorily. An examination of these records indicates that during the summer—the time of light load—there are a very much larger number. This, he thinks, was due to the fact that the cables are then less loaded; that is, the conditions are more nearly those of open circuit, which are the conditions likely to produce high potentials. The other conditions shown by the indicators are bad paralleling, faulty transformers, etc. Frequently the e.m.f. increased to more than 50 per cent above the normal.—Lond. *Elec. Eng'ing*, Feb. 13.

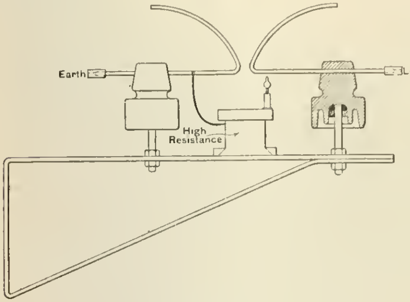


FIG. 3.—DIAGRAM OF ZAPF LIGHTNING ARRESTER.

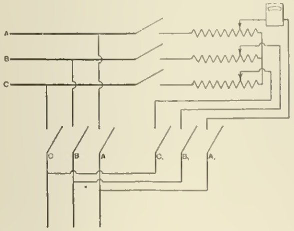


FIG. 4.—DIAGRAM OF CABLE-CHARGING ARRANGEMENT.

Cologne.—A review, illustrated by diagrams, of the development of the electric station of Cologne, which was the first large German station using the alternating-current system. The steam turbine was introduced in this plant in 1905, and two more steam turbines were installed in 1906 in order to take care of the rapid increase in load. A second station is also planned. A motor-generator substation provides the direct-current for traction. The highest load of the generating station in 1906, omitting the substation, which occurred on Dec. 28, amounted to 4600 kilowatts, equivalent to 92,000 "normal lamps." Since the equivalent of the connections on that date was 264,700 normal lamps, it will be seen that 34.80 per cent of all connected lamps were simultaneously in operation. The maximum load of the substation was 3400 kilowatts. The total maximum load on the generating station was 7700 kilowatts. The average coal consumption per kw-hour has been reduced from 1.46 kg. to 1.40 kg. during the past year, that is by 4.2 per cent. The total energy generated was 21,708,286 kw-hours, which is an increase of 22.4 per cent over the preceding year. The total energy sold was 18,582,989 kw-hours. —*Jour. f. Gasbel. u. Wasserversorg.*, Jan. 11.

Brickwork for Central Stations.—An article discussing the special care which should be taken in connection with brickwork in central-station construction.—Lond. *Elec. Eng.*, Feb. 14.

Earthing.—H. Zipp.—The first parts of a discussion of the advisability of earthing electric installations as a preventive against excessive voltages.—*Elek. u. Masch. Betr.*, Jan. 5 and 20.

Electrophysics and Magnetism.

Discharge of Electricity from Pointed Conductors.—J. Zeleny.—An account of an experimental investigation in which there were obtained results from which it is possible to find the current that would flow in dry air to a plane 1.5 cm distant, from points of any diameter, at any potential, when these points are either steel sewing needles of the usual taper, or 12 deg. cones. Both the potential required to start a discharge from a point of any diameter and the current flowing from any point at any potential can be represented by a formula, for the positive discharge from either of the two kinds of points mentioned. The potential required to produce a current from the finest needles or cones is considerably greater than is necessary when fine cylindrical wires are used. Masses of iron oxide form at the tips of steel needles during the positive discharge from them, and to a much less extent during the negative discharge. The negative discharge from the points shows considerable irregularity, especially for the smaller currents. The current flowing to a spherical surface from a point placed at its center of curvature distributes itself quite uniformly over the whole surface of the hemisphere opposite. With diminution of pressure the discharge between a point and a plane (distance = 1 cm) takes place at gradually lower and lower potentials, and the current increases more and more rapidly with change of voltage. Below a gas pressure equivalent to one centimeter of mercury the potential required for the discharge drops rapidly to about 400 volts as the pressure is reduced to a few hundredths of a centimeter, and then at about a hundredth of a centimeter it begins to increase again rapidly.—*Phys. Rev.*, February.

Selenium.—G. Athanasiadis.—An account of an experimental investigation of the relation between conductivity of selenium and illumination. Within the range studied by the author the older formulas of Hopius and Hesehus are found to give appreciable errors. The author proposes the following formula, which agrees well with his experimental results. The illumination may be expressed as $i = k\ (k - a)\ b$, where k is the conductivity and a and b are constants.—*Ann. d. Phys.*, 1908, No. 1.

Electric Science.—E. E. Fournier d'Albe.—The first part of a summary of progress of electric science during 1907.—Lond. *Elec.*, Feb. 14.

Electrochemistry and Batteries.

High-Pressure Electric Furnace.—R. S. Hutton and J. E. Petavel.—An illustrated description of an electric furnace which can be used either as resistance or arc furnace and is designed to withstand gaseous pressures as high as 200 atmospheres. One of the special subjects studied was the behavior of the electric arc under high pressure. Different chemical reactions were studied at high pressures, like the production of calcium carbide, fusion of silica, formation of carborundum and the direct reduction of alumina by carbon. The study of the later problem shows interesting possibilities.—*Electrochem. and Met. Ind.*, March.

Refining of Gold and Silver.—J. W. Richards.—In an installment of his serial on metallurgical calculations the author deals with the metallurgy of silver and gold, and discusses the electrolytic refining of silver bullion and the Wohlwill process of gold refining. He also gives tables of the vapor tension of silver and gold.—*Electrochem. and Met. Ind.*, March.

Fixation of Atmospheric Nitrogen.—R. Swingedaw.—A summary of different processes for the fixation of atmospheric nitrogen with special reference to the methods of MacDougall, Atmospheric Products Company, Kowalski, Birkeland and Eyde.—*La Lumière Elec.*, Feb. 15.

Units, Measurements and Instruments.

German Meter Practice.—A. Königswerther.—The use of a flat rate of charging for energy is gradually being discontinued by German central stations, and where it is still used devices are generally employed which prevent the possibility of lighting simultaneously more than the maximum number of lamps agreed upon. Such devices are either automatic circuit-breakers or devices which cause an automatic periodic opening and closing of the circuit as soon as more than the maximum permitted current is taken from the mains. In this case the flickering of the lamps forces the consumer to reduce the number of lamps which are lighted at the same time. The use of meters is continually increasing. In direct-current plants the motor meter free from iron is most generally used, and no essential change has been made in the original construction of Thomson. In order to obviate the necessity of using a commutator, meters with an oscillating system and electromagnetic relay are also being used. Besides the revolving and oscillating motor meters, pendulum meters are used where very great accuracy is required. Besides watt-hour meters, ampere-hour meters are also extensively used in direct-current plants. While in England electrolytic meters and mercury motor meters, according to the Ferranti principle, are used, the meter in exclusive use in Continental Europe has a permanent magnetic field in which the armature runs, the current being supplied to it by means of brushes and commutator. The brushes are connected to the terminals of a resistance so that only a small part of the current passes through the brushes and commutator. In single-phase and polyphase systems induction meters are used almost exclusively, and much progress has been made in their construction in a relatively short time. In net works with three conductors the energy is generally measured according to the two-wattmeter method. In many German central stations single meters are no longer sufficient since many stations now have different rates for lamps and for motors, or other more complicated systems of charging. The double-tariff meter is widely used in Germany. Formerly the change from one tariff to the other tariff was accomplished by means of a clock, but since this means a certain complication the change from one tariff to the other is now also carried out without any clock, directly from the central station, by using the cable-testing wires. The maximum demand indicator is also largely used in Germany. It is expected that "quarter meters" for prepayment will also soon be used to a large extent.—*Elek. Zeit.*, Feb. 13.

Photometer.—C. Raulus.—An illustrated description of a portable incandescent-lamp photometer of E. Edgcumber which permits one to measure simultaneously the candle-power, the watts and the specific consumption in watts per candle. The principle of the instrument is the same as that of the consumption meter of Hyde and Brooks, but the instrument differs from the latter in the arrangement. The formulas on which the instrument is founded are given, together with some results obtained in the laboratory of the municipal central station of Munich.—*Elek. Zeit.*, Feb. 20.

Spectrophotometer.—R. A. Houstoun.—A paper describing an attachment which may be fitted to any spectrometer or spectroscope converting it into a spectrophotometer, and which may be removed at once when the ordinary use of the instrument is desired. A method for applying the instrument to the measurement of absorption in the ultraviolet is also described.—*Phil. Mag.*, February.

Power Factor and Two-Wattmeter Method.—F. Kuderna.—An illustrated article describing a simple graphical method for determining the power factor of three-phase circuits from the readings taken in the two-wattmeter method.—*Elek. u. Masch.* (Vienna), Feb. 9.

Telegraphy, Telephony and Signals.

Wireless Telegraphy and Telephony.—Count G. von Arco.—A paper read before the Dresden Elec. Soc. in presence of the German emperor on the present status of wireless telegraphy and telephony. It is stated that at present there are about 1500 wireless telegraph stations, of which more than one-half use the Telefunken system. The longest distance of transmission from the station in Nauen, Germany, was 2700 km with a steamer of the Hamburg-South American line. After a change in the station, which is to be made soon, it is hoped to send messages over a distance of 5000 km. Wireless telegraphy is used largely for military and navy purposes. The German navy has 12 coast stations. The army uses portable stations which can be rendered ready for service within from 5 to 30 minutes. Instead of the Poulsen system of producing undamped oscillations by means of an arc enclosed in a hydrogen atmosphere, the Telefunken Company uses open and artificially cooled arcs.—*Elek. Zeit.*, Feb. 20.

Telephone Progress.—B. S. Cohen.—A brief review of telephone progress during the past year, especially in Great Britain. There are now more than 141,000 stations in London. Some notes are given on the extension of underground cables, on new rates, on measurements and on progress in wireless telephony. The National Telephone Company has for some time been engaged in the study of the Pupin system of loading cables, and has now commenced the installation of large numbers of loading coils into working trunk junction lines. At the present date the company has either loaded or has in hand the loading of 581 circuit-miles of trunk junctions.—Lond. *Elec.*, Feb. 7.

Physiological Effects of Electricity.—Müllendorf.—A paper in which the author endeavors to classify the different physiological effects of electricity on the human body—*Elek. Zeit.*, Jan. 30.

Duplex Telegraphy.—H. Marchand-Thiriar.—An illustrated description of a method which enables one with the use of two ordinary telegraph sets to transmit simultaneously telegrams on one wire to two other telegraph sets in another station or to two different stations.—*Elek. Zeit.*, Feb. 13.

Miscellaneous.

Electric Heating.—An illustrated description of a system patented by A. F. Berry for electric heating and cooking by alternating current in which a metal plate is heated principally by eddy currents produced by transformer action from an embedded winding.—Lond. *Elec. Eng'ing*, Feb. 13.

Glass.—The first part of an article on the new problems which electrical engineering has placed before the glass manufacturer, especially for making globes for metallic-vapor lamps which must be able to withstand very high temperatures in order to be effective. Reference is made of the fusing of quartz. The article is to be continued.—*Elek. Anz.*, Feb. 13.

German Imports and Exports.—Tables showing German electrical imports and exports during December, 1907.—*Elek. Anz.*, Feb. 9.

BOOK REVIEW.

Was Sind und Wie Entstehen Erfindungen? By Josef Lowy. Wien: A. Hartleben. 18 pages. Price, 1 mark.

A brief philosophical and technical essay on the definition of an invention and on the conditions which lead to invention in the minds of industrial workers. The subject is treated from the standpoint of the doctrine of evolution. The pamphlet possesses interest for the philosopher rather than for the inventor.

Banquet of Simplex Electrical Company.

The third annual banquet of the employees of the Simplex Electrical Company was held at the American House, Boston, Mass., on March 5. The officers of the firm were the guests. The president, Mr. Everett Morse, discussed the profit-sharing plan in force at the factory, by which the employees share profits with the company. The vice-president, Mr. Henry A. Morse, gave a talk with stereopticon views on the New York-Bermuda yacht race of 1907, which he won. Songs enlivened the occasion, one of which, "The Simplex Forever," was written for the occasion. The profit-sharing dividends this year were practically as large as last year's in spite of the depressed business situation during part of 1907.

Holophane Street-Lighting Reflectors.

With the idea of radically improving present street lighting the Holophane Company has produced a globe or reflector for use in connection with the various artificial light sources out-of-doors. The following ends were sought: First, to do away with the bright patches of light and to distribute equally the light rays in desired directions; second, so to construct a globe or reflector that the maximum light rays will be thrown not only out toward the street, but up and down the street as well; third, to obtain this distribution by a globe or reflector which would not be affected, to any marked degree, by the elements; fourth, to protect the eye as far as possible from the high intrinsic brilliancy of our modern light sources without much loss by absorption; fifth, to obtain a globe or reflector for out-of-door use that would be tough and not easily broken, and would in turn protect the lamp as much as possible. After much experimenting with various ideas, the Holophane Company developed the reflector shown in Fig. 1 to meet the foregoing requirements. It has two faces, or more literally speaking, a face and a back. The face, or that portion which faces the street proper (the left half in Fig. 1), has a smooth exterior with a series of vertical reflecting and refracting prisms on the interior. The back, or that portion which is toward the sidewalk (the right half of Fig. 1), has a series of vertical totally reflecting prisms on the exterior and a smooth interior. As all prisms are vertical they do not afford an easy resting-place for dust, and rain will, to a large measure, assist in keeping it clean.

The distribution given by this reflector is shown in the curves in Figs. 2 and 3. Fig. 2 represents the intensity observed in a plane taken 10 deg. below the horizontal, while the unit, consisting of a 40-cp clear Gem lamp and Holophane reflector No. 243, was revolved around its vertical axis. I may here be observed that as all prisms on this reflector are vertical, several different types of lamps may be used in connection with it, as the vertical position of the filament will not materially alter the distribution curve shown in Fig. 2. It will be noticed by referring to this curve that the maximum intensity in the above described plane is found at 65 deg. both sides of a zero plane perpendicular to the sidewalk, or in other words 25 deg. out from the curb line toward the street. By setting the maximum intensity at this point, the strongest rays are thrown past such obstructions on the curb line as trees, poles, posts, etc., and by throwing the light rays 10 deg. below the horizontal the rays are spread out in such a manner that they uniformly illuminate the street proper. The comparatively small amount of light thrown toward the sidewalk is ample to illuminate it so that it permits of easy vision without undue brilliance. The annoyance to house holders of having a brilliant light source in front of their house is entirely overcome. The widespread use of eye-shades on lamp posts is evidence that a reflector of this feature would be a welcome improvement.

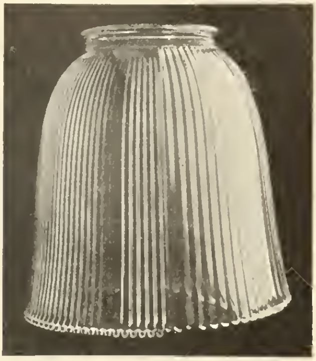


Fig. 1.—Holophane Reflector.

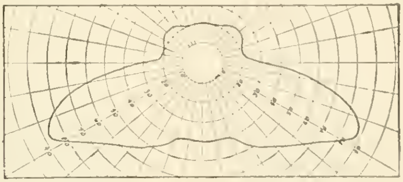


Fig. 2.—Distribution of Light in Horizontal Plane.

Fig. 3 represents the intensity observed through a 65-deg. vertical plane (25 deg. from the curb line toward street) or a vertical plane through the maximum intensity point shown in Fig. 2, and indicates the even distribution of light.

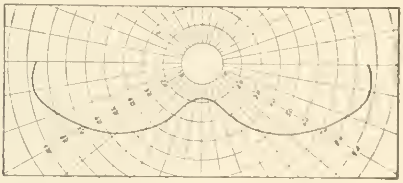
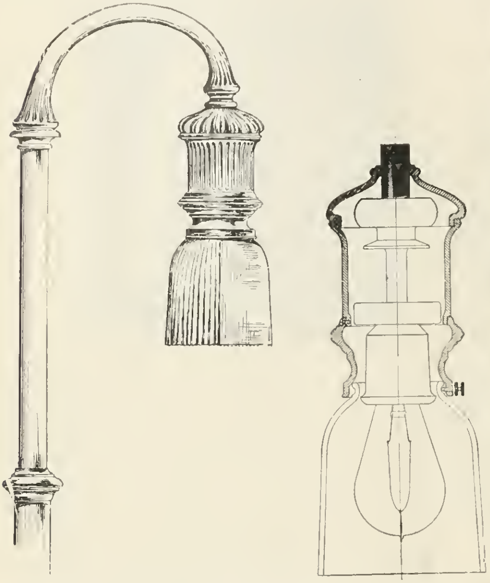


Fig. 3.—Distribution of Light in Vertical Plane.

A suggestion for the upper part of a fixture (pole or post) on which this reflector may be used is shown in Fig. 4, while Fig. 5 is the cross section or detail drawing of the reflector, holder, socket, insulating joint, etc. It will be noticed that this reflector will, to a large measure, correct the general faulty appearance of the incandescent lamp when used with the ordinary type of flat reflector on a post, inasmuch as in the latter case the small lamp appears to be altogether out of proportion in comparison with the post which supports it, and therefore destroys the symmetry or proportion of the unit as a whole. The unit as suggested by Fig. 4 gives an appearance of size which overcomes this awkwardness.

Reflectors of this type are being made for incandescent gas mantles as well as incandescent electric lamps. Exhaustive tests are now being undertaken to secure as much data of the reflectors in actual use as can be secured to supplement the laboratory tests here recorded. These data will shortly be available.



FIGS. 4 AND 5.—LAMP ON POLE AND CROSS-SECTION OF REFLECTOR, HOLDER, ETC.

The Duntley Portable Vacuum Cleaner.

One of the smallest vacuum-cleaning outfits yet produced is the Duntley, made by the Chicago Pneumatic Tool Company. This outfit uses an electric motor of only one-sixth horsepower and weighs complete 70 lb. It is shown in operation in Fig. 1. The motor is small enough to be attached to any lamp socket without violating the Underwriters' National Electrical Code rules as to the amount of current permitted to be taken from an ordinary lamp outlet. The motor operates through a gear and crank a pair of bellows which produce the necessary suction or vacuum. It is not claimed that a machine of this kind will produce sufficient vacuum to clean thoroughly rugs and tapestries which have not been cleaned before with the compressed-air or vacuum process. It is claimed, however, that when once a rug has been thoroughly cleaned, it can be thereafter kept clean by reasonably frequent use of the Duntley outfit.

The outfit, weighing only 70 lb., and being placed on castors, is easily moved from one room to another, and can be taken up and down stairs easily by two men. Ten ft. of hose and a set of nozzles and brushes for all kinds of work are furnished. The dust, after being drawn in through the hose, passes through a glass device which indicates whether dust is being drawn from the work, and so shows whether further application is necessary. After passing through the indicator, the dust is drawn into a separating and settling device, in which it is filtered out of the air by a cloth. No water is used in the machine. The separating box occupies the upper part of the box enclosing the machine, and can be withdrawn like a drawer and taken to a proper place for cleaning. The outfit sells for $125 complete, equipped with either alternating- or direct-current motor.

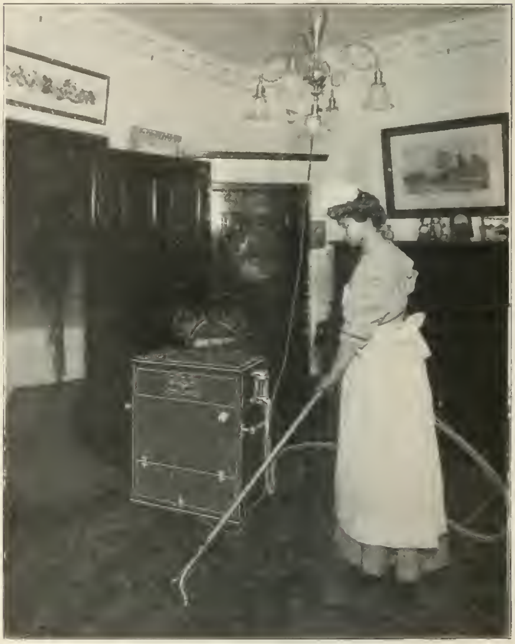


FIG. 1.—SMALL PORTABLE VACUUM-CLEANING OUTFIT.

For heavier work the same company makes a stationary or semi-portable plant operated by a 2½-hp electric motor. This is used by the Hygienic Renovating Companies, of Chicago and Philadelphia. Similar companies will probably be organized soon in other large cities. This plant is shown in Fig. 2, and is

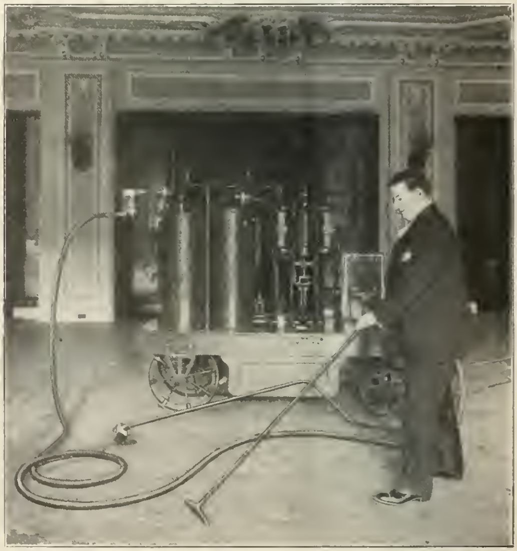


FIG. 2.—LARGE PORTABLE OUTFIT IN HOTEL.

capable of doing both dry cleaning and scrubbing. It is operated by a 2½-hp electric motor, and weighs about 1000 lb. complete. It is intended for stationary use in a large building, or, if necessary, can be readily moved from one building to another, or from one floor to another. This machine, it is claimed, will maintain about 15 in. of vacuum when at work. It is small enough to be moved from floor to floor with an elevator in large buildings, and thus obviate the necessity of piping a building for the vacuum-cleaning system. Besides the regular vacuum cleaning there is possible with this plant what is known as "shampooing." Vacuum cleaning will always dispose of loose dirt on a carpet, but frequently dirt becomes solidified in the nap. "Shampooing" removes this dirt, which is so thoroughly caked into the fabric as to be immovable by ordinary means. In a tank on the machine is stored a preparation of soft soap. This soap is forced by compressed air through the hose and handle to a scrubbing brush. The operator, by pressure on a valve, releases soap from time to time so that it is distributed over the small portion of the surface being cleaned. The brush is used just as if it were a scrubbing-brush. As soon as one portion of the rug is cleaned, an operator follows with a vacuum nozzle and the soap and moisture are drawn up through the holes and back into the storage tanks. Only enough soap is used to clean the nap, the body of the fabric remaining dry. The nap will dry in a heated room in about 30 minutes, so it is not necessary to remove the rug from the floor.

Galvanized Steel Poles for Electric Energy Transmission Lines.

The Great Western Power Company, of California, has adopted the Milliken pole shown in the accompanying illustrations for use along its high-voltage transmission line. It is intended eventually to extend these lines a total distance of about 1000 miles. Energy is transmitted at 100,000 volts on two three-wire circuits. In view of the high voltage, and the consequent danger to life and risk from fire involved, great care was exercised in selecting the poles.

The pole is designed with three cross-arms, it being intended to support a feed wire on the outer end of each cross-arm by suspending insulators. The top of the pole is arranged to take a guard wire. The poles are intended to be placed about 750 ft. apart. The bottom of the lowest cross-arm is 51 ft. 2 in. above the ground level, the second cross-arm is 10 ft. above the first, and the third cross arm is 10 ft. above the second. The extreme top of the pole, carrying a guard wire, is 5 ft. 1 in. above the bottom of the highest cross arm. The feed wires are 17 ft. 1 in. from each other in a horizontal plane for the two upper cross-arms, and 18 ft. 1 in. for the lowest cross arm, thus making all feed wires 6 ft. 5 in. from the nearest part of the pole proper measured in a horizontal direction.

The bottom of the pole at the ground level occupies an area 17 ft. square. The stub ends of the pole—that is, the portion of the pole in the ground—are separate pieces of steel of such length as to allow 6 ft. for bedding in the ground.

These poles are constructed entirely of structural steel shapes and are designed to produce a pole of given strength and stiffness, with a minimum amount of material. There are a great many duplicate pieces, thus making it a simple matter for the purchaser to put it together in the field

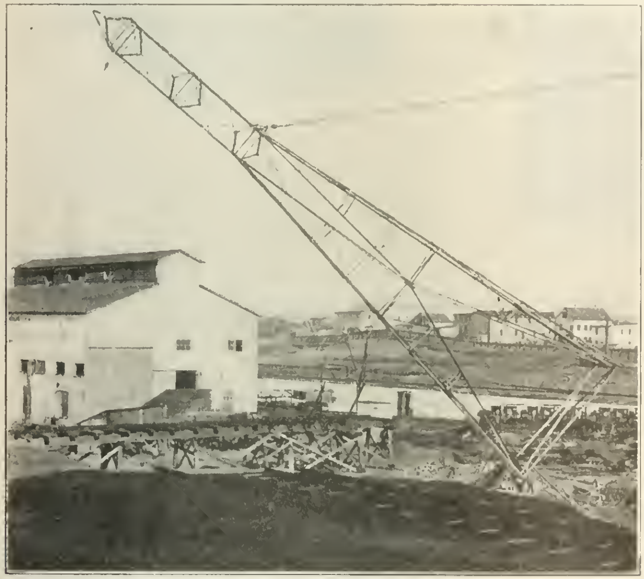


FIG. 1.—VIEW OF POLE DURING ERECTION.

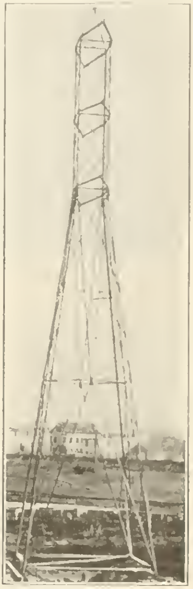


FIG. 2.—SIDE VIEW OF POLE IN PLACE.

Very complete and careful tests of the strength of these poles were made before their regular manufacture was started The pole was erected in a vertical position on an immovable concrete foundation. The strains were applied by means of weights hanging from a fixed structure, and the amount of load and deflection was easily determined. The pole was designed to withstand the following tests:

When tested in a vertical position, on an immovable foundation, and with a proper margin of safety a simultaneous horizontal side pull of 1000 lb. at the top and 500 lb. at each of the three cross arms, or, in other words, a total strain of 8500 lb.: the cross-arms were to support a suspended weight of 1000 lb. at their extreme end, and any one of the cross-arms to carry at one of these ends a horizontal pull along the line of 3000 lb.

The receivers of Milliken Brothers (Inc.), 11 Broadway, New York City, are manufacturing these poles at Milliken, Staten Island, N. Y., where complete arrangements have been made in the bridge and structural shops for producing this particular class of structural material.

These poles are put together with bolts, and to reduce freight charges are shipped "knocked down." Fig. 1, which shows a pole partly erected, indicates that the poles are stiff enough in themselves to withstand being erected in one piece, thus obviating the necessity of erecting them piecemeal from the ground up.

New Laboratory Standard Instruments.

Voltmeters and ammeters that are in everyday use in the shop or on outside work are continually liable to injury, and for most accurate results it is essential that they be checked at frequent intervals with standard instruments. For this purpose and also for very exacting laboratory work, the American Instrument Company, Newark, N. J., has recently developed a line of instruments as shown in Fig. 1.

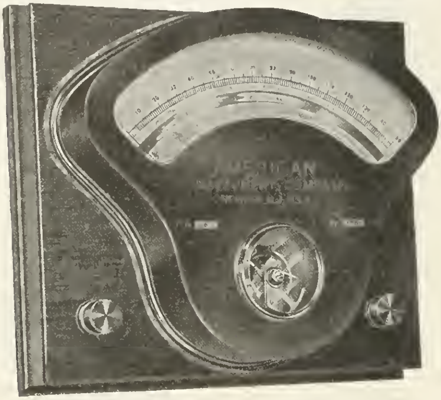


FIG. 1.—"AMERICAN" PORTABLE STANDARD VOLTMETER.

In accordance with the best recognized practice for direct-current measurements, these instruments are built on the permanent-magnet, moving-coil system. They are direct-reading, very strongly built, and at the same time very sensitive. The scales are 7 in. long, which is fully 25 per cent greater than is usual for such instruments. The instruments are guaranteed correct within one-fifth of one per cent of their capacity and a careful observer can easily estimate to tenths of a division. Besides having a large, clear scale, the opening through which it is read is also unusually large. This allows plenty of light to enter, and there is no crowding on the ends or at the top or bottom—a feature which has not always received proper attention. The pointer moves over an unbreakable mirror just below the scale, so that readings are made without error due to parallax.

FIG. 2.—"AMERICAN" INTERCHANGEABLE MULTIPLIER.

These instruments are standardized electrically as well as mechanically. The voltmeters have an exact resistance of 100 ohms per volt. Milli-voltmeters when intended for use in ampere measurements in connection with interchangeable shunts are adjusted to just 4 ohms resistance, including leads, and require 200 milli-volts for full deflection. Manganin is used both in the voltmeter series resistance and for the resistance material in the shunts, so that in both cases the accuracy is not impaired by temperature changes.

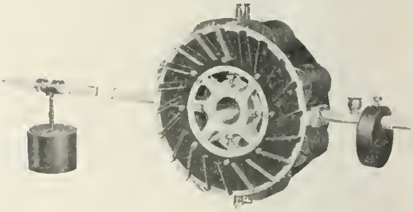
Up to 750 volts, voltmeters are self-contained, for higher ranges interchangeable multipliers are used, as shown in Fig. 2. They are mounted in flat ventilated cases, which can easily be stacked together and held in position by metal straps connecting the binding posts. Owing to the fact that all voltmeters have exact resistance of 100 ohms per volt, it is clear that any multiplier may be used with any voltmeter which reduces the cost and adds great flexibility where several instruments are used.

FIG. 1.—"AMERICAN" STANDARD INTERCHANGEABLE SHUNT.

For current measurements milli-voltmeters are furnished for use with "American" interchangeable shunts, as shown in Fig. 3, one or more being mounted in the same box, as desired. Each shunt is adjusted to give exactly 200 milli-volts potential drop on full-load with a milli-voltmeter of 4 ohms resistance connected to its potential binding-posts. This makes them interchangeable, and adds greatly to the value and flexibility of the instruments. Any number may be used with one instrument, and additional ranges added as required. Mechanically these shunts are strongly constructed, and of ample dimensions, so that they may be left in circuit continuously without overheating.

Electric Brake for Motor Testing.

Many of the disadvantages and defects of the Prony brake for testing motors have been eliminated in the eddy-current brake. There are no sources of appreciable error. The brake is very sensitive, and it maintains a steady load independent of the fluctuations in the speed. Moreover, it is cleanly and can easily be applied to any size or type of motor.


EDDY-CURRENT TESTING BRAKE.

The brake consists of two copper disks, each of which is mounted on a cast-aluminum spider. These are made fast, one at either end of a sleeve which is keyed to the shaft of the motor under test. Riding loose on this sleeve and between the two copper disks is an aluminum casting carrying a number of electromagnets wound to have alternate polarity. These magnets consist of well-ventilated coils on circular cores fitted with pole pieces. To the outside of each copper disk is secured a ring of wrought iron which revolves with the copper and at the same time forms a path for the magnetic flux. These iron rings are fitted with cooling vanes which dissipate the heat generated. When the motor is running the magnetic flux in traversing the moving copper induces eddy currents which absorb the energy of the motor in heating the disks. At the same time the flux tends to drag round the magnet system and levers. By suitably adjusting the exciting current the torque causes the lever with its weights to float. The power is determined from the product of the torque and the rotative speed.

The above described brake has been placed on the market by Morris & Lister, Coventry, England.

Operation of an Allis-Chalmers Turbo-Generator in the Memphis Central Station.

The Memphis Consolidated Gas & Electric Company, of Memphis, Tenn., during the latter part of November, 1906, placed in service a 1500-kw Allis-Chalmers turbo-generator unit, together with complete condensing and auxiliary apparatus. This unit, which follows the standard Allis-Chalmers design for 60 cycles, 2500 volts, three-phase, has been in continuous operation since that time, running from 14 to 18 hours per day, excepting Sundays, with a load ranging from 1200 to 2000 kilowatts. During this period there has been no shutdown whatever, attributable to the prime mover.

Direct-Current Motor.

The accompanying illustration shows a motor of moderate cost and high efficiency recently placed on the market by the Electric Construction Company of London and Wolverhampton, England. The machine is equipped with ball-bearings so that the frictional losses are reduced to a minimum. The motor may be placed in any position, provided the shaft is horizontal, without any adjustment of the bearings; no oil is used, the bearings being covered with grease, which serves for long periods without replenishment, and which cannot creep to the commutator or windings.

DIRECT-CURRENT MOTOR.

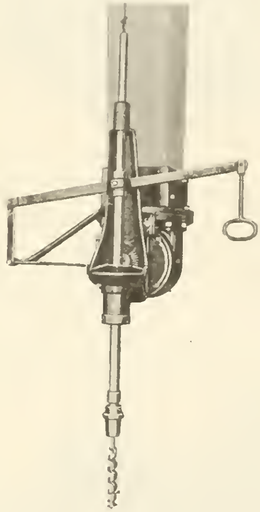
In the larger sizes commutating poles are used. It is claimed that in the smaller sizes the limit of temperature is reached before the sparking limit, and it is unnecessary to use commutating poles which involve a labor cost out of all proportion to the saving in copper.

Motor-Driven Wood-Boring Machine.

The wood-boring machine shown in the accompanying illustrations was designed by the mechanical superintendent's department for use in the General Electric Company's new carpenter shop at the Schenectady plant. The machine was designed to bore ¾ in. and 1 in. holes, with 3 in. counterbores, in spruce varying from 3 in. to 14 in. thick.

The motor is of ½ horse-power and drives the drill at a speed of about 1200 r.p.m. through bevel gears. No speed control whatever is used, as the operator has full control of the boring by means of the hand lever.

The construction of this device is such that by removing the bolts shown on the upper side of the flange, the motor and drill spindle can be turned through a complete circle and then bolted to the position required, the weight of the apparatus during this operation being suspended by a pin 1 in. in diameter located at the center of the flanges. The spindle is counterbalanced by a weight which passes over a pulley fastened to the supporting beam.



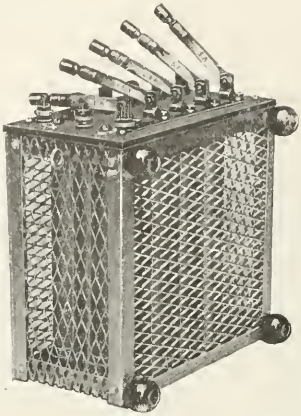
MOTOR-DRIVEN WOOD-BORING MACHINE.

This machine gives absolutely no trouble when boring through the heaviest timbers, and the operators claim that by its use they can accomplish about twice as much work as with the former belt-driven machines.

Rheostat for Load on Energy Meters.

The accompanying illustration shows a load rheostat for use while testing watt-hour meters, which has been designed to replace the unsatisfactory fragile lamp-banks and inconvenient water-rheostat frequently employed for this purpose. The rheostat is built up of standard Ward Leonard resistance units, which are said to be dust-proof, rust-proof, non-abrasive and permanent in resistance. It has been designed to afford load-divisions corresponding to 0.5, 1.0, 2.5, 5, 07.5, 10.0, 12.5 and 15 amperes on a 120-volt circuit. The various steps or combinations are obtained by paralleling the several resistance units. Each unit is designed to carry the full current that can be produced in it by the full line e.m.f. It is claimed that if, through error. the units are subjected to 240 volts they will not burn out for a long time, during which time the operator or tester will surely discover his mistake and rectify it.

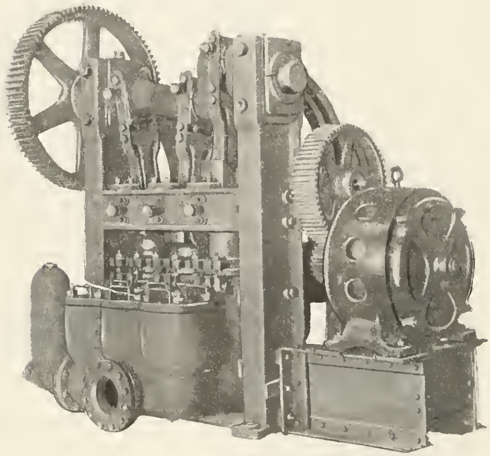
The above-described rheostats are constructed with due regard to portability. They are of convenient shape, and weigh very little, while being mechanically strong. They have recently been placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y.



LOAD RHEOSTAT.

Motor-Driven Triplex Pump.

The Aldrich motor-driven vertical triplex pump has been designed, as its builders, the Allentown Rolling Mills, state, to meet the requirements of general pump work. These pumps are built in sizes up to 500 gal., and for lift up to 300 ft. When driven by induction motors, such as the one shown in the illustration, which is of the standard Allis-Chalmers type, they require practically no attention and take up very little space, the motor being mounted on a base attached directly to the vertical standards. This ties the pump and motor together in one compact, self-contained machine.



ROLLING-MILLS PUMP DRIVEN BY INDUCTION MOTOR.

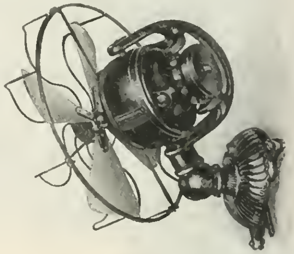
The crank shaft is maintained in a rigid manner by a journal which is entirely separate from the vertical standards, and held in position by key-bolts. By means of a wedge underneath the journal the pump can be adjusted while in motion. A similar device also permits the complete regulation of the bronze adjustable bearings with which the connecting rods are fitted. In order to give the best support to the journals, the working barrels and guides are supported with a parabolic base, the vertical standards being entirely separate.

The fundamental condition of economy in pumping is a slow velocity of water. If the valve and water areas are small, causing a high velocity, the loss is great, for the reason that the friction increases as the square of the velocity. The Aldrich triplex pump has been designed to meet these conditions. the valve areas being built so that the speed of the water, as it passes through the pump, is about 3 ft. per second. There is approximately 13 per cent variation in volume of water passing through a pump, consequently, the suction and discharge pipes of these pumps are fitted with chambers which equalize the flow to a uniform speed.

The suction valve is located on one side of the working barrel, while the discharge valve is on the other. These valves are so constructed that they are accessible through covers held in position by heavy stud bolts. The interior of the working barrel is of spherical section. In order to reduce the vibration in the gearing to a minimum and thus lengthen the life of the pump, the ring oil-bearings are supported by a heavy bracket on the vertical standards, giving them a substantial support on the pinion shaft. Induction motors are used to drive these units wherever alternating current is available, but direct-current motors are also fitted to the pumps for direct-current circuits.

Diehl Oscillating Fans.

The oscillating fan built by the Diehl Manufacturing Company, of Elizabethport, N. J., differs from all other oscillating fans on the market. The fan is provided with the split ball feature used in the universal fans made by the company and can therefore be adjusted in the same manner for desk or bracket use as desired. The oscillating fans are made with 12-in. and 16-in. blades and are provided with regulators giving the usual three speeds. The oscillating action is derived from the motor shaft through differential gears which are entirely enclosed in a suitable case filled with grease. The case revolves slowly by virtue of the differential mechanism and carries rubber-faced studs on a portion of its periphery The bracket carries the motor on ball bearings, and is arranged to form ways upon which the studs act by friction and give the motor the desired oscillatory movement. An examination of the engraving reveals the mode of operation very plainly.



OSCILLATING FAN.

There being no positive connection between the moving parts and the bracket the motor body may be moved at will. When the circuit is closed, normal conditions obtain at once. The oscillating feature is operative at any angle and at any speed of the fan, no blade or other obstruction being placed in front of the fan to obtain this motion. When used as a bracket fan, the angle is so fixed that the blades are in a plane about 15 deg. from the vertical and the air current is directed downward to that extent. The blades have a sweep of 90 deg. The fans are intended for direct-current circuits only and are built for potentials of 110 and 230 volts.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—As a whole the tone of trade during the last week was slightly more optimistic, and with the advance of the spring season, distributive trade shows growth. But cautious and conservative buying, largely of staples, has been the rule. Retail trade is backward, and although money is easier, collections are still the source of much complaint. Whatever slight change in the iron and steel trade took place, was for the better, as the figures for the weekly furnace capacity as of March 1 show a gain of about 10 per cent over those of Feb. 1. Commodities dealt in on the exchanges showed a more confident tone and the steady decreases in the stocks of wheat in the United States tend to encourage the feeling that we have exported close to the country's full quota for the present cereal year. The monthly trade in a number of lines compared with the monthly trade of a year ago seems to indicate a general decrease of about 25 per cent in volume. For the week ending March 5, *Bradstreet's* reports 287 business failures against 254 last week, 172 in the like week in 1907, 177 in 1906, 190 in 1905 and 200 in 1904. In the electrical field the conditions seemed to have improved more during the last week than in general trade, although the change is only apparent when one week's business is compared with the business of the preceding week. "It is hard to generalize," said the head of one of the large electric public utilities companies, "because the situation is much complicated. Certain branches of our business show a heavy falling off from similar periods in the previous year, other departments remain about the same and still others show a considerable gain. The course of the business world, it seems to me, might be compared to a curve. We go up gradually, and when we have attained the top of the arc it is comparatively easy to maintain the position as long as things run smoothly. But the drop comes and then the task of reconstructing the upward curve is extremely tedious and difficult." The head of a well-known wire manufacturing concern, whose whole horizon two weeks ago was tinged with the deepest ultramarine, reports an increase of 50 per cent in last week's business over the business of the week before and with prospects of this week's business becoming still better. In general the electrical situation is much stronger.

THE WEEK IN COPPER.—Inquiries among the large consumers of electrolytic copper indicate that the demand for the metal has shown but little if any increase in the last week. With the falling off of the London market, an attempt is being made to stimulate the home demand, and while the ultimate chances of accomplishing this are much better than they were a month or two ago, yet the American, up-to-date, has been extremely cautious in coming into the market. One of the most favorable indications for the resumption of a good buying movement is the increase in the working forces and schedules of the various large electric companies. Almost without exception these concerns have been operating on a hand to-mouth basis, and a further dip in copper prices, it is thought, would bring forth a good volume of buying orders. Since the first of March the decline in the price of refined copper of ¼ cent brought out a little business, mostly for export, and the market showed signs of a reaction from the downward trend on Tuesday. Shipments of 10,181,651 pounds of copper from New York in the week ended Feb. 29, brings the total from the first of the year up to 121,000,000 pounds, and makes a total in the 23 weeks ended Feb. 29, of 333,221,700 pounds. Since the beginning of the month 4791 tons were exported from the port of New York. Closing prices on the Metal Exchange Monday were as follows:

Lake	12⅜@12½
Electrolytic	12¼@12⅜
Castings	12⅛@12¼

The London market was as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	57 5 0	57 15 0
Standard copper, futures	57 15 0	58 5 0
Market	Firm.	Firm.
Sales of spot		300 tons
Sales of futures		1,000 tons

Extreme fluctuations for the year

	Highest	Lowe
Electrolytic copper, spot	1[illegible]4	12¼
Lake copper, spot	13[illegible]8	12⅜
Casting copper, spot	13½	12⅛
London, spot	64 [illegible] 6	£56 10
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0

The resumption of mining operations at Butte by the Amalgamated Company has caused no little amount of discussion among the consumers of electrolytic copper, and various theories have been advanced to account for the move, which appears to be unwarranted by present conditions. "We are all more or less at sea on the action of the Amalgamated Company in opening its mines at this time," said the copper purchasing agent of an electrical concern which is said to be one of the heaviest buyers of electrolytic copper in the country. "For granting that there is no surplus, and that the exported copper has gone into consumption, which is extremely unlikely, even then there is no home market for the metal, nor does there seem to be an immediate probability of one. I am not buying a dollar's worth of copper more than I can be absolutely sure of disposing of at once, nor can I discover any one else who is buying or seems likely to buy copper in any quantities. Personally, I am of the opinion that of the vast amount of copper exported during the last six months, the greater part has been bought for speculative purposes, and the greater part of the remainder has been deposited simply as collateral. In face of the attenuated home demand, and the possibility of reshipments from abroad at the first sign of higher prices, I am mystified at the reopening of the mines at Butte. If it is a manipulative move, an attempt to 'rig' the market, it has not borne fruit as yet, as there are no unusually large sales of copper shares recorded."

EXPORTS OF ELECTRICAL MACHINERY.—Figures for 1907 show a gratifying increase in the amount of electrical machinery exported to foreign countries over the preceding year, and bear out the statement, often made, that the foreign consumer is feeling that American electrical machinery has superior qualities of adaptation and therefore is purchasing it in larger quantities each year. The total value of this class of exports for 1907 was $9,735,230, an increase of $1,460,477 over 1906. The value of these exports in 1906 to British North America was $1,943,983; to Mexico, $1,040,097; Japan, $960,146; United Kingdom, $1,219,302; Brazil, $530,494; France, $276,750, and other countries $2,294,981. During 1907 the exports of electrical machinery to British North America were valued at $1,543,450, to Mexico, $1,551,562; Japan, $1,411,209; United Kingdom $1,131,711; Brazil, $979,730; France, $848,711, and other countries $2,268,837. By the above figures it will be seen that with the exception of British North America, the United Kingdom and the class grouped as "other countries," which showed a falling off, there was a marked increase in the whole list of the total value of electrical machinery exported. The falling of exports to the first mentioned figure is to be attributed to the establishment there of a growing number of branch works of American electrical manufacturing companies.

COPPER CONSUMPTION BY ELECTRIC COMPANIES.—During the fiscal year of 1907-8 the three largest electrical companies consumed 141,000,000 lb. of copper in the manufacture of a total of about $153,000,000 of electrical goods against a production in the previous year of $102,343,454 and a copper consumption of about 150,000,000 lb. The General Electric Company ended its fiscal year Jan. 31, the Western Electric on Nov. 30 and the Westinghouse Electric will close its year on March 31. During 1907-8 the General Electric Company used 65,000,000 lb. of copper, the Western Electric 48,000,000 lb., and the Westinghouse Electric, 28,000,000 lb. These figures show that in 1907-8 the General Electric Company increased its copper consumption over 1906-7 by 10,000,000 lb., while the amount consumed by the Western Electric was 17,000,000 less and the total of copper used by the Westinghouse Company was 2,000,000 lb. less than during the previous year. According to January business reported by these companies, it is estimated that their copper consumption is, at present, not over the rate of 80,000,000 lb. a year, which is a decrease of 61,000,000 lb. or 43 per cent from the copper consumption of the last fiscal year.

TURBINE BUSINESS HOLDS UP.—In spite of the fact that, along with other electrical companies, the business of the General Electric Company has decreased very considerably from what it was a year ago, the turbine department has, it is stated, more than maintained its own, there having been practically no diminution in sales during the last four or five months, the result, it is said, of a campaign of education which has been conducted during the last few years. During the fiscal year ended Jan. 31, the General Electric Company sold a total of 320 turbines as compared with 280 in the previous year, an increase of about 15 per cent as compared with the 7 per cent increase for 1906. It is stated that the money invested in steam turbines of the Parsons and Curtis type, at present in use, amounts to more than $39,000,000, the aggregate capacity of the turbines being 1,550,000 kw.

ALLIS-CHALMERS STEAM TURBINE IN MINNEAPOLIS MILLS.—The Washburn-Crosby Company, of Minneapolis, operating, by hydraulic power at the Falls of St. Anthony, a group of flour mills which are among the largest in the world, has found it necessary of late years to depend more and more upon steam and electric power for the enormous amount of energy required to turn the long lines of machinery involved in the "continuous" process of flour making; and the most recent development in this respect is the purchase of an Allis-Chalmers steam turbo-generator of 1500 kw, or about 2000-hp capacity. This will generate three-phase, 60-cycle alternating currents at 480 volts, for operating induction motors to drive the new "C" mills. This turbine operates on steam at 180 lb. gage pressure, and is designed for a speed of 1800 revolutions per minute. It will be run condensing.

GERMANS GET NEWARK PLATINUM PLANT.—German interests have acquired the platinum refining plant of the Croselmire & Ackor Company, one of the biggest in the East, at Newark, N. J. The business has been taken over by Franz Eisenbach & Co., of Berlin, who purchased all the stock of the company. Both Messrs Croselmire and Ackor now withdraw from the concern, and their intentions are at present unknown, but it is to be hoped that the electrical field will not lose them entirely. They have a wide circle of friends and acquaintances in it.

ELECTRICAL MACHINERY IN THE TRANSVAAL.—The total capacity of machinery and plant erected in the Transvaal gold mines during the year ending June 30, 1907, was 314,457 horse-power and its aggregate value $106,214,215, including electric generators, electric hoists and various other kinds of electrical machinery. The value of electric generators and engines purchased for the Transvaal gold mines and allied concerns during the official year is given as $244,450.

ASBESTOS WOOD.—The Asbestos Wood Company, which manufactures the new heat and electrical insulating material invented by Prof. C. L. Norton, of the Massachusetts Institute of Technology, has made a selling arrangement with the H. W. Johns-Manville Company. A considerable market has already been developed for asbestos wood for fire-resistance purposes and "Ebony" asbestos wood for use in the chemical arts.

PACKARD AND ELECTRIC VEHICLE.—It is reported that the Packard Motor Car Company is negotiating for the purchase of the plant of the Electric Vehicle Company, of Hartford. Mr. Milton J. Budlong, formerly president and manager of the Electric Vehicle Company, has resigned as general manager of the Association of Licensed Automobile Manufacturers to join the Packard Company.

Financial Intelligence.

THE WEEK IN WALL STREET.—The course of the stock market during the last week is well illustrated by the prices of twenty of the active railroad stocks dealt with on the Exchange, which failed, until Saturday's session, to fluctuate a full point in any one day. Since the middle of February Wall Street has refused to be wrought up over any form of news, either good or bad. The announcement of the opening of the Knickerbocker Trust Company on March 26 caused a sharp upward flurry on Saturday, and the general average for the week was about a point higher than that of the previous week. The market is what the traders call a "creeping bull" market, with strength centering in Union Pacific, the Hill stocks and United States Steel issues. Further cuts in copper dividends affected Amalgamated and other mining stocks. For the month of February transactions on the New York Stock Exchange totalled 9,917,723 shares, a decrease of 6,697,935 shares, or 40 per cent over January, and a decrease of 39 per cent over February, 1907. While there was little active demand for stocks, on the other hand, professional bears found that the market was resting on a solid bottom. The strength of the market is interpreted to mean that liquidation has spent its strength, and that a large portion of stocks have passed into the hands of persons who actually own them, and who are convinced that the prices of stocks more than discount actual or pending adverse developments. It is pointed out that an entirely new set of influences is necessary to bring about a movement of the market in either direction, as under present conditions ordinary stock gambling is powerless to affect values appreciably.

NEW YORK.

	Feb. 28.	Mar. 6.	Shares Sold.		Feb. 28.	Mar. 6.	Shares Sold.
All-Ch.	5¾	5½	800	Int.-Met., com..	7	7¼*	422
All-Ch. pfd....	17*	14¼	1,500	Int.-Met., pfd..	20	19	600
Amal. Cop.....	51⅞	50½	238,032	Mackay Cos....	55	54*	100
Am. D. T.....	—	39	———	Mackay Cos. pfd.	59⅞	61½	100
Am. Loc.......	32*	34¼	25,000	Met. St. Ry....	15*	19	———
Am. Loc. pfd..	90	90½*	100	N. Y. & N. J. Tel.	—	100*	10
Am. Tel. & C'bl.	—	54*	100	Steel, com.....	28⅞	30⅜	134,720
Am. T. & T...	106½*	106¾*	270	Steel, pfd......	92¼	93⅝	30,236
B. R. T........	40⅝	—	———	W. U. Tel.....	49	47½	3,010
Gen. Elec......	116*	116½	1,311	West'h, com....	41	40*	800
Hud. R. Tel...	—	—	———	West'h, pfd....	—	50	———

BOSTON.

	Feb. 28.	Mar. 6.	Shares Sold.		Feb. 28.	Mar. 6.	Shares Sold.
Am. Tel. & Tel..	106⅞	106½	———	Mass. E. R. pfd.	—	43½	———
Cumb'lnd Tel..	—	—	———	Mex. Tel. pfd..	—	5	———
Edison El. Ill...	—	203*	———	New Eng. Tel'p.	—	107	———
Gen. Elec......	117¼.	116	———	W'st Tel. & Tel.	—	—	———
Mass. Elec. Ry.	—	9¾	———	W. T. & T. pfd.	—	—	———

PHILADELPHIA.

	Feb. 28.	Mar. 6.	Shares Sold.		Feb. 28.	Mar. 6.	Shares Sold.
Am. Rys.......	42	43	———	Phila. Elec.....	5¾	7¼	———
Elec. Co. of Am.	8⅝	8¾	———	Phila. R. T....	14½	14½	———
Elec. Stor. B'ty.	26	26½	———	Phila. Traction..	86	86½	———
E. S. B'ty pfd..	—	—	———				

CHICAGO.

	Feb. 28.	Mar. 6.	Shares Sold.		Feb. 28.	Mar. 6.	Shares Sold.
Chicago City Ry.	—	172	———	Met. Elec. com..	—	17	———
Com.-Edison ...	—	86*	———	National Carbon.	51⅛	50	———
Chicago Subw'y.	17	—	———	Nat. Carbon pfd.	—	100	———
Chicago Tel. Co.	107⅜	109¾	—				

*Last price quoted.

WESTINGHOUSE COMPANIES.—Satisfactory progress is being made in the readjustment plans of the Westinghouse companies. The creditors' committee of the Westinghouse Machine Company has declared operative the extension of time to meet its financial obligations on the plan formulated and submitted to the creditors last December. Practically all of the replies received from the creditors gave consent to the arrangement. The method agreed upon is that the company shall give the creditors three-year bonds of the denomination of $500, with interest at 6 per cent. The company is now in a position to ask for the discharge of the receivers, and it is expected that such an application will be made to the courts this week. Those creditors whose accounts do not exceed $500 will be paid in cash, and those who hold claims for more than $500 will accept bonds. Among those who took part in the meeting, when it was agreed to extend the time for deposits until March 31, were Horace E. Smith, of Philadelphia; Fred B. Mosley, of Boston; Fred Underwood and John F. Wallace, of New York. By the plan adopted, about $7,000,000 of the indebtedness will be arranged for. The number of assents to the plan which has been received is more than 99½ per cent, and there remains now but the formal application to be made to the courts to discharge the receivers. Before Judge Young, at Pittsburg, on March 2, the right of Kissel, Kinnicut & Company, of New York, who hold $100,000 in short term notes of the Westinghouse Electric & Manufacturing Company, to intervene in the receivership proceedings, brought in the United States Court there, was argued. Answer to the petition was made by H. H. Westinghouse and the Atha Steel Company, who brought the suit under which the receivers were appointed. Mr. Kinnicut argued that by the receivership his company had been deprived of its right to bring suit for the recovery of its claim and was in danger of being damaged by the proposed settlement of the creditors' committee. Attorney Smith declared the petition to intervene would probably be followed by other petitions to overthrow the receivership. Judge Young refused to grant the petition of Kissel, Kinnicut & Company. The remaining essential feature of the readjustment committee's plan, which is now receiving attention, is the raising of $7,000,000 from the sale of assenting stock, which is necessary to make the plan a complete success. Large merchandise creditors of the company have taken steps to organize a committee which will carry on its work in full co-operation with the general readjustment committee. The Electric Company has ordered the working force increased 25 per cent. The Security Investment Company, of Pittsburg, which is now in the hands of a receiver, and owns about 40 per cent of the assenting stock, all of which is pledged as collateral for its notes, organized a creditors' committee about a month ago. The plan formulated by this committee, will, it is expected, be submitted at a very early date to all the creditors. As soon as the plan is definitely formulated, it is proposed to ask the remaining stockholders of the company to make their subscriptions for their pro rata amount, the general basis for which was communicated to them by the circular authorized by the board of directors of the Westinghouse Electric & Manufacturing Company, dated Jan. 22.

WESTERN ELECTRIC REPORT.—The statement in the annual report of the Western Electric Company that for the year ended Nov. 30 last, "taking the business of the year as a whole, no profits were earned," has excited considerable discussion in view of the $53,000,000 business of the company for the last year. The statement finds its explanation in the custom of the company at the end of each fiscal year of revising its inventories upon the basis of existing conditions. In accordance with the contracts of the Western Electric Company with the American Telephone subsidiaries, it agrees to supply telephone apparatus at prices no higher than the same goods can be purchased elsewhere. When the decrease in American Telephone construction began to be felt, the Western Electric Company found itself with considerable supplies of stocks and raw materials on its hands, and at the close of the fiscal year, in accordance with the conservative policy of the company, the loss on the stock and manufactured materials was charged off against earnings, as in all probability the materials and stocks will be sold on a much lower basis than would have been the case six months ago. In 1906 the company increased its plant and forces to handle a business of more than $70,000,000 and the sudden decline to $50,000,000 rendered it impossible to lower the cost of manufacture with corresponding rapidity. Hence the cost per unit has been somewhat over that of previous years. But with a surplus of $20,000,000 the payment of dividends of $1,200,000 is an easy matter.

INTERBOROUGH BOND ISSUE.—The $55,000,000 bond issue of the Interborough Rapid Transit Company, announcement of which was made in these columns last week, was officially made public later when the Interborough Company applied to the Public Service Commission for authority to execute a mortgage on all the company's property, including the lease of the Subway, to secure the issue. The company asked permission to issue immediately bonds to an amount not exceeding $18,000,000 for the purpose of refunding or securing the extension of its said series of $15,000,000 face value gold notes maturing May 1, 1908, and bonds to the value of $12,000,000 face value for the purpose of refunding its present outstanding indebtedness (other than its gold notes), and for providing funds for its immediate needs. No negotiations for the sale of the bonds had been made and so the company asked permission to issue promissory notes to be dated May 1, 1908, payable within three years, with interest not to exceed 6 per cent, and to secure which it will pledge not more than $30,000,000 of the proposed bond issue. In the petition the outstanding indebtedness of the company was given as follows: $15,000,000 of 4 per cent gold notes, payable May 1, 1908; $10,000,000 of three-year 5 per cent gold notes, due March 1, 1910—neither of which issues are secured by mortgage; time and demand loans totalling $5,120,172, and accounts payable $5,232,553.

CHICAGO TELEPHONE COMPANY.—No dividend was declared at the regular meeting of the directors of the Chicago Telephone Company last week, owing, it is stated, to the absence of a quorum. President A. D. Wheeler was out of town at the time and it is thought that on his return a second meeting would be called and the regular quarterly rate of 2½ per cent will be ordered paid. President Wheeler arrived in Chicago on Friday, and confirmed the report that it had been decided to continue paying dividends at the former rate of 10 per cent a year. "Owing to the fact that we have been unable to bring together a quorum of directors at this time, the dividend was not declared on the usual day, last Wednesday," said Mr. Wheeler, "and, moreover, the circumstances are such that it probably will be impossible to get them together before the middle or latter part of the month. There need be no apprehension as regards the delay, however, as it has been determined to maintain the former dividend rate of 2½ per cent quarterly, which rate will be paid to the stockholders when it is due them, March 31." Chicago Telephone's instrument report, showing the gains this year, is as follows: For January and February, 5442, as compared with a gain of 5710 a year ago. Total telephones in service, 208,250 as against 176,669 a year ago, making an increase of 31,581 telephones.

CHICAGO CITY RAILWAY.—A quarterly dividend of 1½ per cent, payable March 30 to stocks of record March 9, has been declared by the directors of the Chicago City Railway Company. The books of the company close March 10 and reopen March 14. Within a week $5,000,000 has been raised by the company for immediate improvement and extension of the street car properties of the North and West Sides. A first offer of $2,500,000 in first mortgage bonds was sold within an hour and was oversubscribed by a large sum. A large part of the second offering of $2,500,000 was sold in advance and the remainder put on the open market. There is no longer any question as to whether the successor to the Union Traction Company can live up to its agreement with the city. The new bond offering was made at 5½ per cent and accrued interest.

NEW ORLEANS RAILWAY & LIGHT COMPANY.—For the year ended Dec. 31, 1907, the New Orleans Railway & Light Company reports a total gross earning of $6,041,291, as compared with $5,773,190 for 1906, and total expenses of $3,270,397 as compared with $3,074,015 for the previous year. Net earnings in 1907 were $2,770,894, and $2,699,175 in 1906. Preferred dividends of $312,500 were declared which was $187,500 less than the preferred dividends of the previous year. After allowing for the full 5 per cent on the $10,000,000 preferred stock, the balance for the common is equal to 1.22 per cent on the $20,000,000 outstanding. The surplus for 1907 was given as $432,776, as compared with $298,275 for 1906.

CHICAGO & MILWAUKEE ELECTRIC CERTIFICATES.—To allow completion of the electric road the majority holders of the Chicago & Milwaukee Electric bonds have authorized the following committee to consent to an issue of receiver's certificates not to exceed $1,000,000: John B. Clarke and C. B. Shed, of Chicago, and Messrs. Lash, Somerville and Cassels, of Toronto. The Chicago Title & Trust Company and the National Trust Company of Toronto will accept deposits under the agreement. The protective committee, headed by F. J. Lisman, represents a majority of the Illinois division bonds of 1922 of the Chicago & Milwaukee Electric Company.

CENTRAL TELEPHONE'S DEFICIT.—For the fiscal year ending Dec. 31, 1907, the Central New York Telephone Company reports a deficit of $150,777 after payment of interest charges of $310,825, as compared with a deficit of $143,006 for 1906. The gross income for 1907 was $821,210, an increase of $178,775 over 1906, and expenses were $661,162, an increase of $8,560 over the previous year. At the close of the year the company had 26,129 stations as compared with 28,120 at the close of 1906, a loss in twelve months of 1,991. The company has a floating debt of $5,821,000.

WESTERN UNION MEETING.—The directors of the Western Union Telegraph Company will meet March 11, when it is expected that another stock dividend will be declared. During the last few weeks the gross business of the company has shown much improvement, but is considerably smaller than that of a year ago. The policy of the company in reducing expenses will, however, enable it to make a better showing than would otherwise be possible.

UNITED TRACTION & ELECTRIC DIVIDEND.—The regular quarterly dividend of 1½ per cent, payable April 1, was declared last week at a meeting of the directors of the United Traction & Electric Company of New Jersey. The books of the company close March 10 and reopen April 2.

INTERBOROUGH RAPID TRANSIT DIVIDEND.—At a regular meeting of the directors of the Interborough Rapid Transit Company, held last Thursday, the regular quarterly dividend of 2¼ per cent was authorized.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

ANNISTON, ALA.—The contract which the Anniston Electric & Gas Company holds with the city of Anniston will expire in July, and at the request of the City Council the company has submitted a new contract by which it agrees to furnish the city with 100 arc lamps for $65 per lamp per year on a 10-year contract. The city now has 86 lamps, for which it pays $75 each per year.

BINGHAMTON, ALA.—The Binghamton Electric Light, Heat & Power Company has nearly completed the installation of an additional 1000 horse-power in its plant on Court Street, which will give the plant an output of 3000 horse-power.

GADSDEN, ALA.—Arrangements are being made by the Western Union and Postal Telegraph Companies to place their wires underground on Broad Street.

HUNTSVILLE, ALA.—The Huntsville Railway, Light & Power Company has duplicated the generating equipment in its plant and is ready to meet all demands made upon it. The cost of the improvements involved an expenditure of about $30,000.

MONTGOMERY, ALA.—The Montgomery Traction Company is planning to make extensive improvements to its system, including rebuilding part of its system and increasing the equipment, involving an expenditure of about $100,000.

VALDEZ, ALASKA.—An electric light and power plant is soon to be installed at Cordova by the Copper River Electric Telephone & Power Company.

CHICO, CAL.—The Chico Gas & Electric Company is extending its lighting system in this city, and has recently installed a 600-light transformer. A transmission line will soon be erected to the Diamond Match Company's factory, and a line will also be extended into Chapmantown to furnish electricity in that section.

EUREKA, CAL.—Application has been made to the City Council by E. C. Sharpe to erect and maintain a telephone system in this city for a period of 50 years.

GRIDLEY, CAL.—The electric light plant of the Gridley Electric Light & Power Company has been purchased by R. F. Beebe, who it is said will make extensive improvements.

KERNVILLE, CAL.—It is reported that the Edison Electric Company, of Los Angeles, will commence work on the construction of another power plant on the Kern River next August. The new power plant, it is stated, will be located in the canyon above Kernville, and will involve an expenditure of $1,000,000. F. C. Finkle will have charge of the work.

LODI, CAL.—The City Trustees are considering the question of installing an electric light plant and water works system.

LOS ANGELES, CAL.—The Los Angeles Pacific Electric Railway Company is planning to make improvements to its system in Playa del Rey, the cost of which is estimated at $50,000.

PETALUMA, CAL.—The California Gas & Electric Company will commence work at once on the erection of a substation to be located on the Whitney Block.

RED BLUFF, CAL.—The Town Trustees have made a contract with the Northern California Power Company to supply the city with 30 arc lamps at $5.85 each per month, and 19 incandescent lamps at 25 cents each per month.

REDDING, CAL.—Notice of the appropriation of 28,000 miners' inches of water for electrical purposes has been filed by Leon Bly, former chief engineer of the Pacific Power Company. The streams covered are Darrah Creek, Battle Creek and Baldwin Creek.

SAN BERNARDINO, CAL.—The San Bernardino Valley Traction Company has made arrangements with the Pacific Light & Power Company for electrical energy to operate its system. Electricity for operating the traction system will be supplied from the plants in the Santa Ana Canyon.

SAN FRANCISCO, CAL.—The merchants and business men of lower Geary Street have raised $3,840 for lighting Geary Street from Market to Mason Streets. The trustees of the Geary Street Improvement Club have awarded contracts for 32 steel arc lamp poles to cost $120 each. Provision has been made to have the poles adapted to carry trolley wires.

SANTA MARIA, CAL.—The Santa Maria Electric & Gas Company is making a number of improvements to its system, including the rebuilding of the power house, installing new boilers and engines, rebuilding transmission lines, and is also making arrangements to furnish electrical energy to operate the electric railway between Santa Maria and Guadalupe. The company purchased the plant and holdings of the Valley Electric Company about six months ago. C. P. Baird is manager of the company.

LYONS, COL.—The Rocky Mountain Hydro-Electric Company has commenced work on the construction of a hydro-electric plant on the North St. Vrain Creek, near Lyons. About 6000 horse-power will be developed. The officers of the company are: Frank V. Gay, of Clay Center, Kan., president; William Karrigan, of Lyons, first vice-president and in charge of construction; Fred C. Otto, of Riley, Kan., second vice-president; Allan G. Wilson, of Clay Center, Kan., secretary; R. M. Jones, of Denver, chief engineer, and L. H. Dieterich, of Lyons, resident engineer.

DANBURY, CONN.—The Danbury & Bethel Gas & Electric Company has submitted a proposition to the City Council, whereby the street lamps can be lighted all night instead of until one o'clock as at present, for an additional cost of $1,000 per year. The moonlight schedule would be continued as at present.

NEW BRITAIN, CONN.—The Connecticut Company has entered into an agreement with the Hartford Electric Company whereby the latter company will furnish electricity for operating the street railway system and for lamps and motors in the New Britain district. For several years the electrical energy used in New Britain, Southington, Plainville and Berlin has been supplied from the plant of the New Milford Company located at Bull's Bridge, on the Housatonic River, transmitted over high-tension lines, a distance of 55 miles. The service has not been satisfactory. Under the new arrangement electrical energy will be transmitted from Hartford to the substation at Black Rock, using the cables formerly employed in connection with the third-rail electric system. New transformers will be installed in the Black Rock substation.

WASHINGTON, D. C.—Bids will be received until March 24 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal., schedule 855-945 lb. copper brass tubing, etc. Portsmouth, N. H., schedule 862, motor-driven punch. Bids will also be received until March 31 as follows: Mare Island, Cal., schedule 871. 24 portable ammeters; miscellaneous interior fittings; 396 lb. micanite plate; miscellaneous spare parts and globes for arc lamps; 560 lb. copper wire, miscellaneous sheet copper. Schedule 873, 13,000 ft. steel tubing. Applications for proposals should designate the schedule desired by number. E. B. Rogers is paymaster-general.

PENSACOLA, FLA.—A new telephone company has been organized by prominent citizens of this city, who propose to install a telephone system between this city and Mobile.

VALKARIA, FLA.—The Tropical Telephone Company is contemplating extending its lines from this city to Fort Pierce, a distance of about 40 miles.

AMERICUS, GA.—Contracts have been awarded by the Americus Railway & Light Company for machinery and equipment for its power house as follows: For electrical equipment in duplicate, including two turbo-generator sets, rated at 550 horse-power, to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa.; condensing apparatus to the Wheeler Condenser & Engineering Company, of Cartaret, N. J.; to Casey & Hedges, Chattanooga, Tenn., for two boilers of 500 horse-power each, equipped with super heaters; to Henry R. Worthington, of New York, N. Y., for pumps, including two boiler-feed, one centrifugal and one triplex pump, operated by a 100-hp motor; the total cost aggregating about $100,000.

BOWDEN, GA.—Plans are being made to rebuild and enlarge the exchange of the local telephone system, and also to extend the lines into the surrounding country. B. W. Little will have charge of the work

COLUMBUS, GA.—The State Railroad Commission has granted the Columbus Automatic Telephone Company permission to issue additional stock to the amount of $10,000 and equipment notes amounting to $14,981.

MILLEDGEVILLE, GA.—The Oconee Milling Company has applied to the City Council for a franchise to supply electricity in this city for lamps and motors. The company is planning to develop about 800 horse-power on the Oconee River and will generate electricity to operate its mills and for other purposes.

TENNILLE, GA.—The municipal electric light plant was destroyed by fire March 3, causing a loss of $7,000.

CHICAGO, ILL.—The bondholders of the Chicago & Milwaukee Electric Railway Company have agreed to an issue of $1,000,000 receivers' certificates for the completion of the road. John V. Clarke and C. B. Shedd, of Chicago, and others were appointed a committee to arrange the details and to represent the bondholders in the Federal Court.

CHICAGO, ILL.—An appropriation of $500,000 has been made in the city's annual budget for extending the street lighting system. It is proposed to install 5500 new arc lamps, electrical energy for which will be secured from the Sanitary District of Chicago.

McHENRY, ILL.—It is reported that Messrs. Page & Howell are negotiating with the McHenry Electric Light, Heat & Power Company for the purchase of its overhead equipment, and in case the deal goes through, it is said that a new plant will be installed.

PEORIA, ILL.—The City Council has passed an ordinance requiring the Postal Telegraph & Cable Company to place its wires underground before the expiration of the present year

ELKHART, IND.—The Lake Shore Railroad Company has begun the work of building a simplex telephone and telegraph system along its entire line from Buffalo to Chicago. The work will proceed in both directions from Elkhart. These lines will be devoted to long-distance communication only, and in consequence only the larger cities along the line will be connected with the two terminals.

ELWOOD, IND.—The Elwood Trust Company has been appointed receiver of the Citizens' Heat & Light Company, of this city, upon application of the American Trust & Savings Bank, of Chicago, Ill. Foreclosure of a mortgage of $375,000 is asked.

FRANKLIN, IND.—T. O. Ballard writes that he has just been granted an electric light franchise for a period of 25 years, and is now planning to erect a plant and install two gas producer units of 150 kw each, alternating current.

GOSHEN, IND.—The Home Telephone Company has taken over the Goshen plant and wires of the Central Union Telephone Company (Bell system).

JASONVILLE, IND.—The Coalmont Telephone Company has been granted a franchise to establish a telephone system in this place.

VALPARAISO, IND.—The State Automatic Telephone Company has applied to the City Council for a franchise to erect an automatic telephone system in this city. The company is also seeking franchises in other places in this part of the state, and should franchises be granted the company will extend its system to Chesterton, Hammond, East Chicago and Hobart. The company is capitalized at $500,000.

WINONA LAKE, IND.—The Winona Interurban Railway Company has placed a contract with the Pittsburg Underground Company for 526,000 lb. of copper wire, with which to equip the Warsaw-Peru extension of the Winona extension.

DES MOINES, IA.—The Mutual Telephone Company has issued $475,000 in bonds. In addition to the improvements and extension of the local system the company plans to add to its system by absorbing certain independent lines covering the territory near Des Moines.

HAMPTON, IA.—An election will soon be held to vote on the question of issuing $12,000 in bonds for electric lighting

HARTLEY, IA.—The citizens are considering the question of issuing electric light bonds to the amount of $12,000.

IOWA FALLS, IA.—The plant and holdings of the Central Iowa Telephone Company have been purchased by W. V. Shipley, who is said to represent a syndicate of stockholders residing at La Porte City and Iowa Falls. This company maintains independent toll lines between the exchanges at Hampton, Iowa Falls and Eagle Grove.

UNION, IA.—A company is being formed to furnish electricity in Union and Whitten for lamps.

STERLING, KAN.—The City Council is considering the question of establishing a municipal electric light plant.

GLASGOW, KY.—The Mutual Telephone Company has consummated a deal whereby it comes into control of about 50 or 60 miles of telephone lines owned by T. D. Hayes, of Sulphur Well. The Motual company now owns practically all the lines in that section of the country.

JACKSON, KY.—The local electric light plant has been taken over by J. W. Norwood, representing Benjamin T. Head, of Lexington, and other capitalists. It is reported that the company will apply for a 20-year franchise, and will also install a water works system.

OWENSBURG, KY.—The City Council has decided to increase the ootput of the municipal electric light plant.

MONROE, LA.—The City Council has decided to increase the equipment of the municipal electric light plant and will install a 000-hp engine, a 400-kw generator, two 300-hp boilers, an electric pump and all necessary connections and appliances.

FARMINGTON, ME.—It is reported that C. O. Sturtevant will erect an electric light plant at Anson, from which he will furnish electricity for lamps in this town.

LISBON, MAINE.—The citizens have voted to instruct the Selectmen to enter into a contract with the Lisbon Falls Gas & Electric Company for a term of five years to furnish 100 lamps at $16 per lamp per year for incandescent lamps of 25-cp and $20 each per year for 32-cp lamps to burn until 1:00 o'clock, moonlight schedule.

RICHMOND, MAINE.—A committee has been appointed to confer with different companies to ascertain the cost of lighting the village streets with either gas or electricity.

ANNAPOLIS, MD.—A bill has been introduced to the State Legislature to incorporate the Washington & Maryland Railway Company. The capital stock of the company is placed at $25,000, and it proposes to construct an electric railway from Washington, D. C., to Ritchie Station, a distance of 10 miles. The incorporators are Horace Crozier, Samuel C. Cox, T. V. Van Clageet, Snowden Hill, Alfred G. Shaw, Ernst Gerstenberg and Albert Carey.

BALTIMORE, MD.—It is reported that the Crown Cork & Steel Company is contemplating building an addition to its power house at Highlandtown, plans for which have been prepared by Charles M. Anderson, 324 North Charles Street, Baltimore.

EASTON, MD.—An election will be held April 2 to vote on the proposition to issue $30,000 in bonds for the construction of a municipal electric light, heat and power plant, plans for which have been prepared by Williams, Proctor & Potts, of New York, N. Y. Martin M. Higgins is Mayor. This information was published erroneously as coming from Easton, Pa., in the issue of March 7.

DALTON, MASS.—Arrangements are being made to operate the machinery in the plant of the Pittsfield Spark Coil Company by electricity, which will be supplied by the Dalton Power Company. The latter company has recently installed a large gas engine in its plant and is now able to furnish more electrical energy than is needed to operate the machinery in the paper mills in Craneville.

HOLYOKE, MASS.—Manager W. H. Snow, of the municipal electric lighting department, has awarded contracts to the General Electric Company for one motor-driven exciter set and one turbo-driven exciter set.

HOLYOKE, MASS.—The Skinner Manufacturing Company is said to be contemplating the erection of an electric power plant to supply the Whitcomb Building and other buildings owned by the company with electricity.

LUDLOW, MASS.—The Ludlow Manufacturing Associates have issued a notice to consumers of electricity for lamps that beginning with March [illegible] there will be a reduction of 25 per cent in the rate charged for the service, the new rate being 12 cents per kw-hour to all consumers, with a minimum charge of $10 for one year's service.

MILTON, MASS.—The Edison Electric Illuminating Company proposes to install 50 new tungsten lamps on Canton Avenoe, to replace the 32-cp incandescent now in use.

PEABODY, MASS.—The annual report submitted by the electric light commissioners shows that the operating expenses of the municipal electric light plant were $26,449, and the earnings, including the cost of the incandescent service in the town buildings, were $25,396, making the cost of the street lighting only $1,05[illegible]. The commissioners state that the plant has done excellent service, considering its condition, and they urge the expenditure of $55,000, as recommended by the special committee to make the necessary changes and improvements to meet the demands upon it. The street lighting system consists of 189 arc lamps and [illegible] incandescent lamps.

SHREWSBURY, MASS.—The citizens, at the next town meeting, will vote on the proposition of establishing a municipal electric light plant.

WEIR, MASS.—The citizens are considering the question of having the naphtha street lamps replaced by electric lamps, and application has been made to the Taunton City government for extension of the electric service to this village.

WESTFIELD, MASS.—The ninth annual report of the monicipal gas and electric light plant shows a gross profit of $22,669, of which $13,405 was from the electric department and $9,521 from the gas department. It will be necessary to improve and enlarge the plant to meet the requirements made upon it. The cost of the improvements is estimated at $20,000 and will include the installation of new boilers, at a cost of $6,000; new transformers and new meters, as required by the electric light commission, etc.

WILLIAMSTOWN, MASS.—The Board of Selectmen has granted the Williamstown Gas Company permission to erect and maintain a transmission line on the Bridges and North Hoosac roads to furnish electricity for lamps for residences in the White Oaks.

WILMINGTON, MASS.—The citizens are considering the question of establishing an electric lighting system, the cost of which is estimated at $15,000.

BAY CITY, MICH.—The Michigan State Telephone Company has commenced work on the extension of the local system, which will involve an expenditure of between $75,000 and $80,000. About 26 miles of cables will be erected and 700 new poles set

BAY CITY, MICH.—The Valley Telephone Company contemplates extensive improvements to its system in this city, including a general overhauling of the local exchange and placing its wires in underground conduits. The cost of the work is estimated at $150,000.

GREENVILLE, MICH.—R. J. Tower has acquired the [illegible] water power in North Greenville and has been granted a 30-year franchise to install an electric light and power plant and to distribute electricity in this city. He has also been given the contract for city and street lighting for a period of 10 years. Under the terms of the contract not less than 50 street lamps of 2000 cp each are to be used at the rate of $50 each per year, to burn until 1 a. m., moonlight schedule, and $[illegible] per lamp per year more when the lamps are lighted from [illegible] a. m. until daylight.

HARTFORD, MICH.—Local citizens are considering the installation of a municipal lighting plant. H. L. Gleason is chairman of an investigating committee

HILLMAN, MICH.—A franchise for an electric light plant and water works system has been granted to David Watson, of Alpena, and [illegible] Rouse. The franchise is for a period of 40 years

L'ANSE, MICH.—A site has been secured on Falls River by the village for a power and lighting plant

LAURIUM, MICH.—The Houghton County Street Railway Company has completed plans for the construction of a new substation in this place.

MANISTEE, MICH.—The Manistee Light & Traction Company is consolidating its two power houses, which heretofore have furnished electricity for the lighting and traction systems. Other improvements will also be made.

MONROE, MICH.—The city is considering the question of issuing $50,000 in bonds for improving the municipal electric light plant.

PELLSTON, MICH.—The capital stock of the Pellston Light & Power Company has been increased from $35,000 to $50,000.

PONTIAC, MICH.—William H. Osmun is seeking a franchise to distribute electricity for lamps and motors in this city. He proposes to carry out the plans of the defunct Clinton River Power Company.

ALBERT LEA, MINN.—The telephone exchange of the Albert Lea & Northwestern Telephone Company was destroyed by fire recently, entailing a loss of about $10,000.

CROOKSTON, MINN.—The Crookston Water Works, Power & Lighting Company has purchased a site comprising more than 1,000 acres, eleven miles northeast of the city, where it proposes to construct a dam. E. Peterson is superintendent of the company.

GRAND LEDGE, MINN.—The Grand Ledge Telephone Company has been reorganized and the capital stock of the company increased from $25,000 to $50,000.

MINNEAPOLIS, MINN.—The City Council has granted the Twin City Rapid Transit Company permission to construct an underground conduit system on the East Side.

ROCHESTER, MINN.—The City Council has granted a franchise to the Dan Patch Air Line to construct its line through the city. M. W. Savage is president of the company.

ST. PAUL, MINN.—Edmund Pennington, vice-president and general manager of the Minneapolis, St. Paul & Sault Ste. Marie Railroad, has announced that the company will install telephone service throughout the entire system from the Twin Cities to the coast, via the Soo-Spokane route.

ST. PETER, MINN.—The City Council is considering the question of purchasing a new generator and making repairs to the power house.

GALENA, MO.—The City Council is considering the question of establishing a municipal electric light plant.

HUNTSVILLE, MO.—S. W. Neeper, referee in bankruptcy, has authorized the Trustees of the Huntsville Light & Power Company to sell the property of the company free from all incumbrances.

KANSAS CITY, MO.—The contract for installing the new electric lighting apparatus in the new general hospital was awarded to the Hodge Electrical Construction Company, of this city, for $30,041.

LINNEUS, MO.—The city has decided to rebuild the municipal electric light plant, and will install a 100-hp engine and boiler, electric switchboard, etc. O. P. Vroom is engineer in charge.

ST. JAMES, MO.—The citizens have voted to accept the proposition submitted by C. Koeln, of St. Louis, Mo., to install an electric light plant.

WILLOW SPRINGS, MO.—A ten-year franchise has been granted to the Willow Springs, L. & L. D. Telephone Company to construct and maintain a telephone system along the Hutton Valley and the Peace Valley road.

CULBERTSON, NEB.—The question of erecting an electric light plant in this city in the near future is under consideration. It is proposed to dam the river at this place to furnish power for operating the plant. George V. Eisenhart is interested in the project.

MALMO, NEB.—The citizens have decided to postpone action for one year in regard to the establishment of a municipal water works and electric light plant.

PENDER, NEB.—H. O. Woodruff, manager of the Electrical Supply Company, representing Sioux City creditors of the electric plant at Pender, has purchased the plant, and has put it in operation again. It is said that the plant will be enlarged.

PENDER, NEB.—A franchise has been granted to Neal M. Nye to establish an electric light plant in the town.

GOLDFIELD, NEV.—The Nevada-California Power Company has let the contract for the construction of a dam on Middle Lake to Collins & Young, of Los Angeles, Cal. The dam will be 1100 ft. long, 75 ft. high at the highest point. C. D. Poole is manager.

RAWHIDE, NEV.—Thomas Kearns, owner of the Kearns leases at Rawhide, is perfecting plans for the installation of a water works system, electric lighting plant and the erection of a stamp mill. Orders have been placed for engines and pumps, which will be installed in the plant on the flat, five miles below the town. It is stated that the improvements will cost $135,000.

SPARKS, NEV.—Announcement has been made that the Southern Pacific Railroad Company will soon install an electric power plant to furnish electricity for lamps and motors at its shops in this place. The plant will have an output of 540 hp and will cost over $30,000. J. F. Dunn is superintendent of motive power.

SCHURZ, NEV.—Announcement has been made that a custom mill of 150 tons' capacity will be erected at this place. In addition, an electric railroad will be built from Schurz to Rawhide, a distance of 28 miles. It is proposed to develop the water power of Walker River, which will also be used for operating the mill. James Sword, of Salt Lake City, Utah, is interested in the enterprise.

WADSWORTH, NEV.—H. W. Esden, president of the Wadsworth Power, Light & Water Company, who is planning to build a power plant to furnish electricity to Fallon, Fairview, Wonder and Rawhide, has incorporated a company and will soon begin the construction of a power plant on the Truckee River near Derby. The company is known as the Sierra Power Company, which has capitalization of $100,000. The incorporators are: J. G. Harris, H. W. Esden and E. R. Dodge.

CONCORD, N. H.—The Concord Electric Company has decided to erect a large steam power plant at Sewalls Falls to be used as an auxiliary to the water power plant. The present plan is to move the equipment from the Bridge Street station to Sewalls Falls, and to install new boilers, a two-stage Curtis steam turbine and auxiliary apparatus. In addition to this plant the company will maintain the street railway plant at West Concord, and will have recourse to the steam plant at the Boston & Maine shops.

WEST STEWARTSTOWN, N. H.—The William F. Allen Company has purchased the electric light plant at Colebrook, owned by the W. E. & W. Drew Electric Company, and took possession of the plant March 1. The first-named company has furnished electrical energy for operating the Colebrook plant since October, 1897. The William F. Allen Company now furnishes electricity for lamps in West Stewartstown, Riverside, and Colebrook, N. H.; Canaan and Beecher Falls, Vt. The company will establish a day service in the early spring. William F. Allen is treasurer.

ASBURY PARK, N. J.—Harry J. Rockafeller, of Sunset Hall, has applied to the City Council for a franchise to construct and operate an electric light plant in this city.

MONTCLAIR, N. J.—Surveys are now being made for the Public Service Corporation for its proposed railway to be built from Upper Montclair to Paterson.

TRENTON, N. J.—The State Legislature has passed the bill making an appropriation of $20,000 for a new power and lighting plant at the Soldiers' Home at Vineland.

ALBION, N. Y.—The Village Trustees have decided to request the A. L. Swett Electric Light & Power Company, of Medina, to extend its transmission lines to Albion to furnish electricity in this town.

BUFFALO, N. Y.—Plans are being considered for the construction of a municipal conduit system whereby the cost of the arc lamps for street lighting could be greatly reduced. It is proposed to appropriate $100,000, of which $20,000 will be used at once, when available, to take possession of the space to which the city is entitled in the conduits used by the Cataract Power & Conduit Company. The remaining $80,000 will be used to make the connecting links in the conduits so that a more comprehensive system may be begun and through which the city buildings and streets may be lighted at a much lower rate than is now being paid to the General Electric Company.

LAWRENCE, N. Y.—The Village Trustees have voted to light the roads in the village recently annexed to the village of Lawrence, which was formerly named Cedarhurst.

SCHENECTADY, N. Y.—Plans are being prepared by the executive committee of the Schenectady Illuminating Company for the removal of the Dock Street plant, which is now being used jointly with the Schenectady Railway Company as a substation, and for the erection of a new and larger plant on the site of the Mohawk Gas Works on South Centre Street.

TRENTON, N. Y.—The Board of Health has applied to the City Council for an appropriation of $1,500 for the purpose of wiring the new building for the Municipal Hospital and installing a gasoline engine and a dynamo. The energy will also be used to pump the water for the institution as well as for lighting the buildings. The Board of Health has also instituted negotiations with Hamilton Township Committee, which, it is said, is contemplating placing a number of electric lamps in the vicinity of the hospital, with a view of making arrangements to make connections with the hospital to furnish electricity for lamps.

FAYETTEVILLE, N. C.—The Cape Fear Power Company is furnishing electrical energy to operate the Holt-Morgan Cotton Mills from its hydro-electric plant located near Fayetteville. It is understood that the other mills will be operated by electricity as fast as motors can be installed.

HIGH POINT, N. C.—The contract for the erection of the new building for the Southern Bell Telephone Company has been awarded to the General Contract & Construction Company, of Atlanta, Ga., to cost between $6,000 and $7,000.

SILER, N. C.—The Siler City Telephone Company is planning to entirely rebuild its plant in this city.

BELLEVILLE, OHIO.—The local electric light plant recently destroyed by fire, owned by Theodore L. Garber & Sons, has been rebuilt and will be ready to put in operation in a short time. E. G. Garber is manager.

COLUMBUS, OHIO.—The Senate has passed the Shuler bill to amend the municipal code so that municipalities will have the power to sell electrical energy for commercial purposes.

HUDSON, OHIO.—Plans are being prepared by D. M. Hosford, engineer, Caxton Building, Cleveland, for a water works system, electric light plant and other municipal improvements. Bids, it is said, will be received by the engineer the latter part of this month.

LIMA, OHIO.—The City Council has voted to issue $80,000 in bonds for the construction of a municipal electric light plant. The Council proposes to accept the estimates submitted by E. R. Young, of Toledo, who agrees to construct the plant at the price named ready for operation with sufficient output for residence and commercial consumption.

MADISONVILLE, OHIO.—It is reported that the City Council has decided to install new equipment in the municipal electric light plant.

ROCKY RIVER, OHIO.—The capital stock of the Rocky River Water, Light & Power Company has been increased from $100,000 to $250,000. The company contemplates installing an electric light plant to furnish electricity to light the town.

PORTLAND, ORE.—The United Railways Company has filed amended articles of incorporation, showing plans for the construction of over 150 miles of electric railways, work on which will commence as soon as an agreement is effected with the City Council permitting the company to enter the city. The cost of the roads is estimated at more than $6,000,000. For the present, electricity to operate the system will be secured from the Portland Railway & Light Company. A. C. Emmons is secretary and general counsel.

SALEM, ORE.—The transmission line of the Portland Railway, Light & Power Company has been completed from Oregon City to Salem, a distance of 50 miles, and the company is now furnishing electricity for lamps and to operate the street car system in this city.

BRADFORD, PA.—The Union Telephone Company is making arrangements to extend and improve its service in this city, involving an expenditure of between $50,000 and $60,000.

ELLWOOD, PA.—The substation of the Ellwood Power Company was destroyed March 1 by an explosion, causing a loss of about $60,000. The station supplied electrical energy for operating most of the mills in West Pittsburg, and for lamps in Ellwood, West Pittsburg, Zelienople, and Wampum. S. A. Roeloff is president of the company.

NEWVILLE, PA.—The electric plant which will furnish electricity for street lighting in this town will be located on the mountain near Roxbury. Joseph Hosfield, of Shippensburg, has the contract for constructing the plant.

PROVIDENCE, R. I.—Bids will be received by William K. Reynolds, chairman of the committee on City Hospital, at the office of the clerk of committees, City Hall, until March 18, for the general construction, plumbing and gas piping, heating and ventilating, electric lighting and other electrical equipment for several buildings proposed for a city hospital. Plans and specifications may be seen at the offices of French & Hubbard, Albany Building, Boston, Mass., engineers.

COLUMBIA, S. C.—The street lighting system will be extended to the Elmwood extension of the city limits, and electric street lamps will soon be placed on the streets.

DEADWOOD, S. D.—The Dakota shaft of the Imperial Mining Company is now operated by electricity. The old steam plant will not be dismantled, but will be held for emergency purposes and the boilers used for heating purposes. It is proposed to install later electric equipment at the other shafts and workings of the company.

MINOT, S. D.—A stock company is being organized for the purpose of erecting a new power plant to meet the requirements of the entire city. J. A. Brunner is interested in the enterprise.

SUMMIT, S. D.—The Town Board is said to be considering plans for establishing a light and water system.

WAGNER, S. D.—Plans are being considered for the construction of an electric railway from Wagner to Sioux Falls, a distance of 125 miles. John Absher, secretary of the Aberdeen Light & Power Company, is interested in the enterprise.

HEREFORD, TEX.—The City Council has granted a franchise to Messrs. Obethier & Meadows to erect an electric plant to supply the city with electricity.

NEW BRAUNFELS, TEX.—The Dittlinger Lime Company is contemplating installing an electric light plant to light its factory and grounds.

PORT ARTHUR, TEX.—The Port Arthur Water, Light & Power Company is planning to increase the output of its electric plant, and will install additional machinery, including an engine and generator.

YOAKUM, TEX.—Prominent capitalists of this city are contemplating the erection of another electric light plant, and if a franchise is granted by the City Council, work on the plant will be pushed vigorously.

MOAB, UTAH.—A deal has been consummated by which Cooper, Martin & Company, D. L. Goudelock and H. G. Green have purchased the entire interests of J. N. Corbin in the La Sal and Blue Mountain Telephone lines. It is expected that the two lines will be consolidated.

OGDEN, UTAH.—It is reported that the business men propose to organize and establish a co-operating lighting plant to furnish light for the business houses. For further information, address G. M. Browning.

SALEM, VA.—The Virginia & Tennessee Telephone Company is considering plans to improve its local plant, including the installation of the common battery system.

CENTRALIA, WASH. The Home Telephone & Telegraph Company is making arrangements to build a local exchange. B. E. Clements is manager.

LEAVENWORTH, WASH.—Plans are being made by the Great Northern Railway Company to operate its trains across the Cascade Mountains from Leavenworth to Skykomish by electricity by Aug. 1. A hydro electric plant is being erected by the company in Tumwater canyon, where 12,000 hp will be developed. Gerrish & Gerrish are reported to have the contract for the construction of the plant, including the building of a steel pipe line 1600 ft. long and 9½ ft. in diameter, across the Wenatchee River and connecting to a steel tank having a capacity of 1,000,000 gal. Four electric motors having a rating of 1300 hp are now being built by the General Electric Company, of Schenectady, N. Y., for the company.

POMEROY, WASH.—The North Coast Power Company, organized by Frank McKean and associates, have purchased the Pomeroy electric light and power plant, the consideration being $100,000. Announcement has been made by Mr. McKean that interests behind him are contemplating the construction of an electric railway from Lewiston to Asotin and thence to Pomeroy.

SEATTLE, WASH.—The Seattle-Tacoma Power Company is constructing a new station on Western Avenue, which it expects to occupy in May. It will contain a 1000-kw generator driven by a compound engine supplied by a new boiler equipment of 2000 hp. The exhaust steam from the engine will be used in the heating system of the downtown district originally installed by the Mutual Light & Heat Company and taken over by the Seattle-Tacoma Power Company in 1905. At first, 1500 horsepower will be developed, and later another unit of the same rating will be added to the equipment.

SEATTLE, WASH.—F. X. Waldron & Company, of Seattle, have been granted a franchise by the Board of County Commissioners to construct and operate an electric railway system and electric light plant on Bashon Island, work on which will commence at once. The road will be about 12½ miles in length. The power plant will be erected near Lisabeula at a cost of about $75,000. The cost of the entire system is estimated at about $350,000.

GRAFTON, W. VA.—Plans are being considered by the Grafton Traction Company for the extension of its lines through South Grafton to the west side, a distance of 1½ miles. John T. McGraw is president.

EAU CLAIRE, WIS.—The Council committee has reported in favor of giving the contract for lighting the streets with arc and incandescent lamps to the Chippewa Valley Railway, Light & Power Company. The Council has granted a contract to the Welsbach Street Lighting Company of America for lighting the streets with Welsbach lamps, by which the Chippewa Valley Company claims that the city will pay nearly $1,800 more for the gas lamps than the electric lamps would cost.

MENOMONEE FALLS, WIS.—The Menomonee Falls Telephone Company has filed an amendment to its articles of incorporation, increasing its capital stock from $5,000 to $15,000.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has authorized the construction of new toll lines to Green Bay and to Madison, involving an expenditure of $100,000. The work of extending the system in Milwaukee and vicinity will be continued.

MONROE, WIS.—A committee has been appointed by the City Council to investigate the street lighting system, with a view of improving the same. For further information address E. F. Bauman.

EDMONTON, ALB., CAN.—The ratepayers have voted $60,000 for extensions to the electric light and power plant and also $40,000 additional for the municipal telephone system. For further information address City Electrician Ormsby.

EDMONTON, ALB., CAN.—The City Council has awarded a contract to the Automatic Machine Company, of Chicago, Ill., for the installation of a Strowger telephone system. The company agrees to guarantee the city against suit by the Lorimer Automatic Company, of Toronto, whose contract was recently canceled on account of delay in installing the system and will put up a $25,000 bond to have its system in operation by April 20, 1908.

NELSON, B. C., CAN.—Cecil B. Smith, C.E., recommends adding another unit at the civic power plant at Bonnington Falls, work on which will be commenced as soon as possible.

MELITA, MAN., CAN.—The Melita-Arthur Telephone Company has applied to the Manitoba Legislature for permission to increase its capital stock from $10,000 to $50,000. Also for permission to make a number of extensions.

WINNIPEG, MAN., CAN.—Mayor Ashdown states nothing will be decided with regard to the construction of the civic power plant at Lac Du Bonnet until the financial statement has been issued. Cecil B. Smith is still civic power expert.

GUELPH, ONT., CAN.—The City Council has decided to accept the proposal of the Hydro-Electric Commission for the supply of Niagara power to the town. The cost of the system is estimated at $52,[illegible] David Scroggie is town clerk.

OTTAWA, ONT., CAN.—Plans are being considered for the construction of the proposed Chaudiere dam by J. P. McRae and William Kennedy. The cost of the dam is estimated at $100,000, the construction of which will commence this season.

TORONTO, ONT., CAN.—The Dominion Power & Transmission Company, recently incorporated, with a capital stock of $2[illegible], will commence construction as early as possible in the spring. For further information address S. C. Crowell, of Toronto, Ont.

TORONTO, ONT., CAN.—The Board of Control contemplates entering into negotiations with the Toronto Electric Light Company for the purchase of the company's plant. Engineer Dow has informed the Board of Control that if more electrical energy is to be supplied to the city another transmission line will have to be erected as the present transmission line is taxed to its limit.

NEW CARLISLE, QUE., CAN.—The Bonaventure & Gaspe Telephone Company is applying for incorporation to build and operate telephone systems in New Brunswick and Quebec. For further information address John H. Kelly.

New Industrial Companies.

THE BALTIMORE ELECTRICAL SUPPLY COMPANY, of Baltimore, Md., has filed articles of incorporation, with a capital stock of $40,000. The incorporators are: Patrick T. Flannery, Frank Kernan, Edward J. Coyle and others.

THE CAMPBELL ELECTRICAL COMPANY, of Pittsburg, Pa., has been incorporated with a capital stock of $5,000. W. E. DuBarry is treasurer, and the directors are Alfred Campbell, W. E. DuBarry and H. E. DuBarry, all of Pittsburg.

THE SALAMANCA ENGINE-IRON COMPANY, of Salamanca, N. Y., has been incorporated with a capital stock of $25,000 by H. Charles E. B. Weed and N. Kilby, of Salamanca. The company proposes to manufacture kerosene oil engines, etc.

THE B. & H. FIBRE MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by G. S. Steere, A. C. Williams and L. R. Steere, of Chicago, Ill. The purpose of the company is to manufacture talking machine needles.

THE CLARK MULTIPLE ENGINE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000. The directors are: De Witt C. Hayes, of White Plains; Raymond E. Mahen, of Brooklyn, and George L. Ernhardt, of New York, N. Y.

THE SUPERIOR LIGHTING & EQUIPMENT COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $100,000 by Ethelbert T. Ford, Wilson T. Siebert and Fred. Nussbaum. The company proposes to manufacture and deal in railway supplies and equipment.

THE FRED A. KINSMAN COMPANY, of Long Branch, N. J., has filed articles of incorporation with a capital stock of $50,000. The company proposes to do a mechanical and electrical engineering and supply business. The incorporators are: H. C. Newton, E. E. Michens, and F. A. Kinsman, all of Long Branch.

THE LANDAY BROTHERS, INC., of New York, N. Y., have filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing phonographs, talking machines and their specialties. The incorporators are J. B. Landay, M. Landay and M. A. Sloan, all of New York City.

THE SOUTHERN ELECTRIC CONSTRUCTION COMPANY, of Atlanta, Ga., has been formed by the consolidation of the Southern Construction Company and the Gilham-Clayton Company and will soon file articles of incorporation. The officers of the company are: Joseph W. Little, president; P. G. Gilham, vice-president; J. Frank Beck, secretary and treasurer, and J. M. Clayton, superintendent of construction.

THE PACIFIC ELECTRIC CONSTRUCTION COMPANY, of San Francisco, Cal., has been organized with a capital stock of $50,000. The general offices of the company will be located in San Francisco, with branches in all the principal cities of the coast from San Diego, Cal., to Seattle, Wash. The officers of the company are: H. S. Johnson, president, and C. E. Nestor, secretary and treasurer. The new company will take over the work already under way by the Northwstern Pacific Electric Company. The company will handle a complete stock of electrical and telephone supplies, and electrical construction of every description will be carried on, especially the building and equipment of rural telephone lines.

Company Elections.

HUNTINGTON, IND.—At the annual meeting of the Dubois County Telephone Company the following-named officers were elected: H. Landgrebe, president; C. R. Ramsbrok, vice-president; H. C. Rothert, secretary, and P. Dilly, treasurer.

MAJENCIA, IND.—At the annual meeting of the Majencia Telephone Company the following named officers were elected: John P. Shutt, president; Anderson Potts, vice-president, and I. L. Smith, secretary.

ALLERTON, IA.—At the annual meeting of the Allerton Telephone Company the following-named officers were elected: G. F. Knerr, president; E. P. Phillips, secretary and treasurer; Isaac Porter, W. H. Davis and W. L. Dougherty, directors.

BALTIMORE, MD.—At the annual meeting of the Maryland Telephone Company the following-named officers were elected: F. H. Bethel, president; C. E. Bryan, vice-president and general manager, and A. P. Crenshaw, secretary and treasurer.

SOMERSET, MD.—At the annual meeting of the Somerset Water & Power Company the following-named officers were elected: D. A. Smith, president; Lee D. Latimer, vice-president; J. W. Stohlman, secretary and treasurer, and P. K. Thurston, assistant secretary and assistant treasurer.

CHARLOTTE, MICH.—At the annual meeting of the Grand Ledge Telephone Company the following-named officers were elected: D. C. Kennedy, president; W. H. Oding, vice-president; Harry Tanner, secretary; Claude Barton, treasurer, and D. D. Shane, general manager.

CONCORD, N. H.—At the annual meeting of the White Mountain Telephone Company the following-named officers were elected: Allen Hollis, of Concord, president; D. B. Keniston, of Plymouth, vice-president, and George H. Adams, of Plymouth, clerk.

ALBANY, N. Y.—At the annual meeting of the Hudson River Telephone Company the following-named officers were elected: U. N. Bethell, president; H. F. Stevens, vice-president; F. G. Wood, secretary and treasurer, and L. S. Greenleaf, of Albany, general manager. Theodore N. Vail, of Boston, Mass., was elected chairman of board of directors.

NEW YORK, N. Y.—At the annual meeting of the New York & New Jersey Telephone Company, Theodore N. Vail was re-elected chairman of the board; U. N. Bethell, president; H. F. Thurber, formerly general manager, was elected second vice-president; Waldron Hopkins, secretary; Ford Huntington, treasurer, and Walter Brown, auditor.

SCHENECTADY, N. Y.—At the annual meeting of the Schenectady Railway Company, Edgar S. Fassett and Alfred H. Harris were elected to the board. C. C. Sims was elected vice-president; A. T. Linn, Jr., auditor; Edward F. Peck was re-elected general manager, and the other officers were also re-elected.

UTICA, N. Y.—At the annual meeting of the Central New York Telephone & Telegraph Company the following-named officers were elected: U. N. Bethell, president; H. F. Stevens, vice-president; F. G. Wood, secretary and treasurer, and W. W. Nicholson, general manager.

CINCINNATI, OHIO.—At the annual meeting of the Cincinnati & Suburban Telephone Company the following-named officers were elected: John Kilgour, president; Bayard Kilgour, vice-president and general manager; Volney Elstun, secretary and assistant treasurer, and William A. Blanchard, treasurer.

CLEVELAND, OHIO.—At the annual meeting of the National Carbon Company the following-named officers were elected: James Parmelee, president; Myron T. Herrick and Webb C. Hayes, vice-presidents; D. D. Dickson, vice-president and general manager; J. S. Crider, secretary, and H. E. Hackenburg, treasurer.

CLEVELAND, OHIO.—At the annual meeting of the Cuyahoga Telephone Company the following-named officers were elected: James S. Brailey, Jr., president; H. A. Everett, vice-president; W. L. Cary, Jr., secretary; H. B. Taylor, treasurer, and C. Y. McVey, general manager.

SALT LAKE CITY, UTAH.—At the annual meeting of the Rocky Mountain Bell Telephone Company the following-named officers were re-elected: H. V. Lane, president; W. S. McCormick, vice-president and treasurer; Robert B. Harkness, secretary, and D. S. Murray, general manager.

BLACK RIVER FALLS, WIS.—At the annual meeting of the Central Wisconsin Telephone Company the following-named officers were elected for the ensuing year: H. A. Bright, president; George F. Cooper, vice-president; E. A. Miller, secretary and general manager, and S. H. Gorden, treasurer.

MILWAUKEE, WIS.—At the annual meeting of the Wisconsin Telephone Company the following-named officers were elected: Alonzo Burt, president; John Balch, vice-president and treasurer; Charles A. Grant, Boston, Mass.; G. M. Hubbard, assistant secretary, and H. O. Seymour, general manager.

New Incorporations.

LOS ANGELES, CAL.—The Huntington Park Gas & Electric Company has been incorporated, with a capital stock of $20,000. The directors are: E. B. De La Matyr, J. J. Curran and H. F. Leukfeld.

SAN FRANCISCO, CAL.—Consumers' Light & Power Company has been incorporated, with a capital stock of $100,000, by James Fisher, J. H. Gage, C. H. Forbes, E. J. Molony and Louis Zeh.

SAN FRANCISCO, CAL.—The Clear Lake Power & Irrigation Company, a corporation capitalized at $10,000,000 to handle the overflow waters from Lake County for irrigation purposes and for the generation of electricity, has filed articles of incorporation in this city. Charles S. Wheeler is the attorney for the company. The directors named are: J. W. Reeves, Gilbert Boalt, Joseph B. Kennedy, Clarence E. Sheets, Laurence J. Kennedy, James Moriarty and Charles H. McDonagh. Mr. Wheeler states that the company has 200,000 acres in Yolo County which will be irrigated with water from Clear Lake. The irrigating system is partly constructed. About 45,000 electrical horse-power will be developed and transmitted to San Francisco and neighboring cities.

ATLANTA, GA.—George E. Turner, of New York, N. Y., assisted by R. L. Sibley, of Atlanta, is organizing a company in Atlanta, which will operate the wireless telephone system. The company will be known as the Southern States Coast Company, and will be one of the component companies of the Radio Telephone Company. The subsidiary company will have charge of the Atlantic Coast from Cape Hatteras to Key West, and the capital stock will be placed at $2,000,000.

GAINESVILLE, GA.—The Gainescille & Concord Telephone Company has been incorporated by B. M. Head, T. W. Staton, T. E. Highsmith and others.

PEORIA, ILL.—The Union Independent Telephone Company has been incorporated with a capital stock of $200,000.

SPRINGFIELD, ILL.—The Chicago, Milwaukee & Gary Railway Company has been issued a license by the Secretary of State. The capital stock of the company is placed at $10,000,000, and the incorporators are: Hallock W. Seaman, Benjamin H. Harris, William P. McSwiney, Frank H. Clark and Jonas Wolfe. When completed the road will extend from Milwaukee, Wis., on the north to Rockford, Ill., on the west, Momence on the south and Gary, Ind., on the east. The main system will consist of 260 miles.

BLOOMINGTON, IND.—The Citizens' Telephone Company has been organized with a capital stock of $25,000. The officers are: James A. Karsell, president; Dr. Foley, secretary, and W. H. Adams, treasurer.

BLOOMINGTON, IND. The Southern Indiana Telephone Company has been organized in this city for the purpose of constructing rural lines in Monroe, Morgan, Brown and Green counties. L. K. Holmes, of Bloomington, is president, and Silas M. Johnson, secretary, of the company.

HAMMOND, IND.—The Citizens' Light & Power Company has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. Alexander J. Campbell and Johannes Kopelke are the directors.

NOBLESVILLE, IND.—The Bethlehem Telephone Company has been incorporated, with a capital stock of $3,000. The officers of the company are: W. A. Young, president; H. A. Leonard, vice-president; A. F. Kimaman, secretary and treasurer.

MYERSVILLE, MD.—A bill has been introduced in the State Legislature for the incorporation of the Catoctin & Pen Mar Railway Company. The capital stock of the company is placed at $50,000, with the privilege of increasing it to $500,000. Authority is given the company to construct a railroad from Myersville to Pen Mar, to be operated by steam or electricity, and also to generate and sell electricity. The incorporators are Albert L. Hauver, Alvey J. Smith, Michael Klein and others.

BRIDGMAN, MICH.—Articles of incorporation have been filed for the Bridgman Telephone Company by R. J. Stahelim, F. H. Whipple, O. A. D. Baldwin, F. A. Clark and others. The capital stock of the company is placed at $5,000.

SAULT STE. MARIE, MICH.—The St. Mary's Telephone Company has filed articles of incorporation, with a capital stock of $15,000.

CLARA CITY, MINN.—Articles of incorporation have been filed for the Clara City Telephone Company, with a capital stock of $20,000, by Jacob Steffens, J. W. Caspers and D. W. Ammermann.

DANUBE, MINN.—The Danube Telephone Company has been incorporated, with a capital stock of $5,000, by Otto Schmidt, F. A. Schroeder, N. T. Knott, L. C. Hinrichs and others.

FAIRMONT, MINN.—The Schwieger Rural Telephone Company has been organized for the purpose of building a telephone line from Fairmont to Fraser. The officers are: Louis Steuber, president, secretary and treasurer; Herman Schwieger, vice-president.

GLYNDON, MINN.—Articles of incorporation have been filed for the Glyndon Telephone Company with the Secretary of State by G. A. Erstad, Walter Shave, E. G. Tracy, C. H. Bassett, J. H. Halverson, N. H. Statham and D. J. Shea.

OSTRANDER, MINN.—The Ostrander Telephone Company has filed articles of incorporation, with a capital stock of $10,500. The incorporators are: W. L. Maust, L. H. Norgaarden, C. L. Christensen, J. R. Roberts, William Aurlie and J. A. Benson.

ST. LOUIS, MO.—The Light & Development Company has been incorporated with a capital stock of $5,000. The officers of the company are: Hugo Wurdack, president; W. A. Smith, vice-president; Horace W. Beck, secretary, and E. M. Kurtz, treasurer. The object of the company is to distribute electricity for lamps, heat and motors.

ST. PAUL, MINN.—The Western Co-operative Rural Telephone Company has been incorporated, with a capital stock of $3,000, by W. J. Toombe, O. N. Shalberg and G. H. Beamish.

CANTON, N. Y. The Victor Telephone Company has been organized and the following officers elected: H. Audinwood, president; Grant Thurber, vice-president; B. Herrick, secretary and treasurer.

NEW YORK, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Telepost Company of New York. The company is capitalized at $100,000 and proposes to construct and operate telephone and telegraph lines. The directors are: R. H. Sellers, Thomas Coyngton, C. H. Stillman, Oscar Jacobs, of New York, and C. W. Dunn, of Brooklyn.

FAYETTEVILLE, OHIO.—The Fayetteville Telephone Company has filed articles of incorporation, with a capital stock of $20,000. The incorporators are Frank J. McCafferty, T. A. Connolly, John Evans, William C. M. McCafferty and Thomas Banches.

FELICITY, OHIO.—Articles of incorporation have been filed for the Felicity Home Telephone Company, with a capital stock of $10,000, by G. E. McCullough, J. W. Morris, D. C. Warner, S. H. Swope and J. C. Beach.

LEMOYNE, OHIO.—Steps have been taken toward organizing the Lemoyne Telephone Company with a capital stock of $2,500. The promoters are: Joseph Herman, A. C. Root, Fred Van Camp, E. A. Truman, Oscar Dennis and others.

VANLUE, OHIO.—The Vanlue Mutual Telephone Company has been incorporated with a capital stock of $10,000. The officers are George Russell, president; L. C. Clark, vice-president; G. W. Snook, secretary, and J. J. Herman, treasurer.

ALPHO, ORE.—Articles of incorporation have been filed for the Blachley & Deadwood Telephone Company, with a capital stock of $1,000, by J. Rust, Frank Parker and O. Wilcutt.

FOMBELL, PA.—The Fombell Telephone Company has been incorporated for the purpose of constructing and maintaining a telephone system in Beaver and Butler counties. F. D. Ph[illegible] J. F. S[illegible] and F. H. Stamm are among the incorporators.

NEW PHILADELPHIA, OHIO.—The Kinsey Telephone Company has been chartered, with a capital stock of $10,000, by A. S. Kinsey, William Kinsey, W. P. Kinsey and others.

NASHVILLE, TENN.—Articles of incorporation have been filed with the Secretary of State for the Northwestern Dixie Telephone Company, with a capital stock of $1,000, by J. M. Roseberry, J. W. Mize[illegible], J. W. Bunn, G. H. Wright, J. B. Dunn and others.

NASHVILLE, TENN.—Articles of incorporation have been filed with the Secretary of State for the Holston Valley Telephone Company, of Sullivan County, by Dr. C. W. Fleenor, M. F. Mock, Phillip Painte[illegible] W. J. Minnick, M. L. King and E. M. Nutty.

HUNTINGTON, W. VA.—The Citizens Light & Ice Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: H. H. Hughes, J. E. Thompson, R. P. Aleshire and others.

BELOIT, WIS.—The South Beloit Water, Gas & Electric Company has been incorporated, with a capital stock of $10,000, by W. H. Carpenter, W. G. McCarthy and John W. Amand.

CORNING, WIS.—The Corning Telephone Company has been incorporated with a capital stock of $3,000 by Julius Weckworth, Frederick Holz, Heinhard Meyer and others.

GRANTSBURG, WIS.—The Spooner Evergreen Valley Telephone Company has been formed and the following-named officers elected: Peter Brown, president; Levi Ailport, vice-president; George W. Harmon, secretary, and J. D. Thomas, treasurer.

BELLA COLLA, B. C., CAN.—The Bella Colla Telephone Company has been organized and the following officers elected: Iver Fougner, president; G. P. Ohlson, vice-president; P. A. McBeth, secretary-treasurer. It was decided to at once arrange for ordering material and construct [illegible] to start as soon as possible.

Legal.

RECEIVERSHIP FOR THE BARRIETT ELECTRIC MANUFACTURING COMPANY.—Attorney Philip C. Swing has been appointed receiver of the Barriett Electric Manufacturing Company, of Cincinnati, Ohio, on application of its president, Henry Burkhold. Several suits brought against the company and pressure of claims are said to have caused the action. The assets are placed at $20,000, while the liabilities are claimed to amount to $15,000. Mr. Burkhold filed the suit as a stockholder and creditor, claiming $1,000 due him for money advanced and security on obligations aggregating $4,000. The company has on hand, ready for completion, motors worth about $5,000 and contracts for $2,000 more. The company was organized to take over the old Barriett Electric Company, which was sold after the death of Samuel L. Barriett, its president, some time ago. The receiver is the secretary and treasurer of the company.

LIGHTING AGREEMENT DECLARED LAWFUL.—The full bench of the Supreme Court of Massachusetts, on Feb. 29, in the cases of Charles G. Weld against the Edison Illuminating Company and the Board of Gas and Electric Light Commissioners sustained the validity of an agreement made between public service corporations for the division of undeveloped territory between them so as to avoid duplication of service. Mr. Weld owns a house at 45 Bay State Road, and wanted the Edison company compelled to furnish him with electricity. The company has its wires in his house and had furnished him with electricity up to 1902. In that year the company made an arrangement with the Brookline Gas Company whereby the latter company bought the Edison company's wires and conduits west of Deerfield Street in the Back Bay. Both companies agreed that the Brookline company should supply electricity exclusively in the territory west of Deerfield Street, and the Edison company the territory east of it. Mr. Weld has since been getting his electricity from the Brookline company to run a motor in his house. The Edison company he claimed could furnish better service and claimed that it was legally bound to furnish it as a public service corporation. He claimed the arrangement between the two companies was in violation of the law.

Personal.

MR. WILLIAM DUTTON, of Pittsfield, Mass., has been appointed superintendent of the Lee Electric Company to fill the vacancy caused by the death of Wr. William E. Usher.

MR. F. W. YOUNG has resigned his position as special representative of the Westinghouse Electric & Manufacturing Company's detail and supply department, of Pittsburg, Pa., to accept a position as sales manager with the Central Electric Company, of Chicago, Ill.

MR. A. M. BARRON, for many years general manager and treasurer of the Consolidated Light, Power & Ice Company, of Joplin, Mo., has been appointed general manager of the Citizens' Electric Company, of Eureka Springs, Ark., which operates the Citizens' Electric Railway and the electric light and public utility plants in Eureka Springs.

MRS. H. S. SNOW, the wife of the defaulting treasurer of the New York & New Jersey Telephone Company, who has disappeared, has received $25,000 from Mr. Andrew Carnegie as a grateful acknowledgment of the kindness done him in earlier telegraphic days by her father, the late David Brooks, well known as a pioneer telegrapher and electrical inventor.

MR. H. S. PUTNAM will present a paper on "Electric Power Development" before the Electrical Engineering Society of Columbia University, in the Engineering Building of the university, this city, at 8.15 p. m. on March 20.

MR. A. PRESS, who was formerly connected with the Siemens & Halske interests, and has also become widely known in the electrical field in this country, has been appointed chief electrical engineer for the American Transformer Company, of Newark, N. J.

MR. H. S. REYNOLDS.—Mr. Howard S. Reynolds, who has filled a confidential position on the staff of Calvert Townley, vice-president of the New York, New Haven & Hartford Railroad Company, has resigned. Prior to the acquisition of the Connecticut Railway & Lighting Company by the Connecticut company, Mr. Reynolds was assistant manager of that corporation. Since going with Vice-President Townley, Mr. Reynolds had been assigned important special duties of a widely varying nature.

MR. W. E. DODDS, head of the steam engine department of the Allis-Chalmers Company of Milwaukee, has resigned his position and will take a prolonged rest before resuming professional work of any kind. Mr. Dodds is well known as a mechanical engineer and his affiliation with the Allis-Chalmers Company dates back to the régime of Mr. Edwin Reynolds, who developed the works of the old Edward P. Allis Company. He was assistant to Mr. Reynolds for a number of years and since the retirement of his chief has been prominently identified with the development of the steam-engine department of the Allis-Chalmers Company at Milwaukee.

Trade Publications.

ANNUNCIATORS for house and elevator service are treated in Bulletin No. 150A, of the Holtzer-Cabot Electric Company, Brookline Station, Boston, Mass.

STEEL-ARMORED HOSE for steam or compressed air is discussed in Bulletin No. 507, of the Sprague Electric Company, 527 West Thirty-fourth Street, New York.

STEAM LOCOMOTIVES.—Record No. 64, of the Baldwin Locomotive Works, Philadelphia, Pa., gives detailed descriptions of locomotives built for the Central Railroad of Brazil.

TRANSFORMERS for all purposes, all frequencies and all transformation voltages are described in Bulletin No. 78, of the Wagner Electric Manufacturing Company, St. Louis, Mo.

RUBBER-BELT CONVEYORS.—The Jeffrey Manufacturing Company, Columbus, Ohio, has issued a booklet, showing the application of rubber-belt conveyors for handling materials of various kinds.

METAL-WORKING MACHINERY.—List No. 15, of the Niles-Bement-Pond Company, 111 Broadway, New York, contains descriptions of 340 different second-hand metal-working machines.

DIRECT-CURRENT FANS.—The Colonial Fan & Motor Company, Warren, Ohio, has issued a neatly illustrated catalogue dealing with direct-current desk, bracket, oscillating ceiling and exhaust fans.

THERMOMETERS, PYROMETERS AND HYDROMETERS are thoroughly described and illustrated in catalogue section 27, of the Schaeffer & Budenberg Manufacturing Company, 23 Dey Street, New York.

STEAM HEATING.—Part five of the general catalogue of Warren Webster & Company, Camden, N. J., contains an excellent discussion of the advantageous features of the Webster system of steam circulation for heating purposes.

SINGLE-PHASE MOTORS of the split-phase, self-starting type, are described in Bulletin No. 304B, of the Holtzer-Cabot Electric Company, Brookline Station, Boston, Mass. These machines are built for ratings ranging from 0.1-hp to 2-hp.

DRY BATTERIES.—An interesting post-card folder, entitled "Telephone Tribulations," has been issued by the F. Bissell Company, 226 Huron Street, Toledo, Ohio, for calling attention to its 1900 dry cell, which involves the minimum of trouble.

STEAM TURBINES.—Bulletin No. 501, of the De Laval Steam Turbine Company, Trenton, N. J., is devoted to steam turbines and turbine-driven machinery, such as direct-current and alternating-current generators, blowers and centrifugal pumps.

ELECTRIC LIGHTING SUPPLIES, including moulding and conduit receptacles and rosettes, insulators and lamp sockets are listed and described in Bulletin No. 51, of the H. T. Paiste Company, Philadelphia, Pa.

WATER-TUBE BOILERS.—Catalogue No. 60, of the Murray Iron Works, Burlington, Iowa, is a neatly executed publication dealing with water-tube boilers. A few of the buildings in which Murray water-tube boilers have been installed are illustrated.

COOKING DEVICES.—Booklet No. 572, of Veritys, Ltd., Aston, Birmingham, England, gives a popular discussion of electricity for domestic purposes. Views are given, and cost of operation is stated of various electric heating and cooking devices.

MACHINE TOOLS.—Circular No. 72, of the Garvin Machine Company, Spring and Varick Streets, New York, contains 32 pages dealing with machine tools for all duties. The company has issued a folder giving a list of second-hand machine tools now in stock.

TELEPHONE SUPPLIES.—The Stromberg-Carlson Telephone Manufacturing Company, 70 West Jackson Boulevard, Chicago, Ill., has been mailing to its customers return post cards calling attention to flux-solder, cords for telephone switchboards, ring-through coils, switchboard cable.

LAMP GUARDS AND SHADES.—In a folder recently issued by Harvey Hubbell, Inc., Bridgeport, Conn., one is reminded of the fact that "A lamp in a Hubbell guard is worth two gone to smash." A second folder illustrates in a striking manner that Hubbell shades hang true by plumb and level.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—The annual catalogue of the M. I. T. shows that, including those of 1907, 3877 students have graduated since 1868, the year of the first graduating class. Of this number, 640 studied electrical engineering, and 590 are now engaged in electrical engineering work. The graduating class of 1907 numbered 207, 32 being in the electrical engineering department.

MACHINE-TOOL MOTOR APPLICATIONS.—In a handsome booklet, known as Bulletin No. 4548, the General Electric Company, of Schenectady, N. Y., illustrates typical examples of direct and alternating-current motors installed on a great variety of lathes, drills, grinders, punchers, shears, boring mills and similar tools, which are suggestive of their almost limitless adaptability to this character of service.

DIRECT-CURRENT MOTORS.—Bulletin No. 313, of the Holtzer-Cabot Electric Company, Brookline Station, Boston, Mass., describes direct-current motors rated at .125-hp and .167-hp. Motors rated at from .75-hp to 10-hp are treated in Bulletin No. 314 of the same company. Motor-generator sets for transforming direct current to either direct current or alternating current are listed and outlined on page 20A of Bulletin No. 302A.

SINGLE-PHASE MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has issued a special bulletin, giving an excellent outline of the advantageous characteristics of the commutator-type, single-phase induction motor, from the central station point of view. The bargain list of the same company deals with second-hand single-phase motors that are offered at a considerable reduction from regular price, although they are in perfect condition and are fully guaranteed.

ELECTRIC FANS.—One of the most artistic electric fan catalogues of the season is Bulletin No. 4560, just issued by the General Electric Company. The 1908 fan motors are plainer and handsomer than those of previous design. The direct-current fans are equipped with a universal joint by means of which a desk motor may be instantly transformed into one of the wall-bracket type without the aid of tools. Descriptions are included of ceiling fans, exhaust fans, and some miscellaneous small motors for blower, drills, buffing and polishing machines, sewing machines, etc. The general color scheme of the book is cream and brown, light tint blocks being used on all the pages. The frontispiece is an excellent reproduction of the painting "Fame," by Edith Prellwitz, and the cover is a portrait medallion in bright colors.

ELECTRICAL SPECIALTIES.—Edwards & Co., 140th and Exterior Streets, New York, have just issued a very attractive and substantial catalog of their varied line of electrical specialties. It contains 220 pages, and is profusely illustrated. Among the many devices shown are annunciators for all purposes, burglar alarms, electric bells of all kinds, switches, fire-alarm apparatus, door openers, push buttons, gas lighting apparatus, induction coils, etc. The paper used is of fine quality, which brings out the illustrations very clearly, the illustrations themselves being of high class. The special features of the various devices are pointed out and price lists and code words are given. At the back are given wiring diagrams for clock, burglar and fire alarms, annunciators, etc.; also a very complete index of the contents of the catalog. Attention is called to a number of changes in prices to take effect March 16. Copies of this catalog may be obtained from Edwards & Co., or from their selling agent, the Western Electric Company.

Unclassified Items.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 17, to furnish at the navy yards and naval stations the following supplies: Boston, Mass.: Schedule 856—5259 lb. brass tubing. Annapolis, Md.: Schedule 882—9000 ft. copper conductor; 100 lb. bell wire; 23,840 ft. copper wire. Bids will also be received until March 24 at Norfolk, Va.: Schedule 885—2000 lb. sal ammoniac. Washington, D. C.: Schedule 897—1100 pairs lamp carbons; 500 incandescent lamps; electrical supplies. Norfolk, Va.: Schedule 896—4680 lb. sheet copper. Portsmouth, N. H.: Schedule 888—8000 lb. brazier's copper. Norfolk, Va.: Schedule 894—800 lb. copper tubing. Also until April 7, at Mare Island, Cal.: Schedule 898—9445 ft. single conductor. Applications for proposals should designate the schedule desired by number. E. B. Rogers is paymaster-general.

SULLIVAN, IND.—A. S. Courtwright is planning to make application to the Town Council for a franchise to light the streets and residences of the town.

MITCHELL, S. D.—The Mitchell Illuminating & Power Company contemplates extending and improving its electric lighting service and will install new machinery in its plant.

SWANVILLE, MINN.—It is reported that J. C. Rose, of Fergus Falls, contemplates developing water power for an electric light plant. Nothing definite has yet been decided upon.

BUTLER, PA.—The Butler & Pittsburg Electric Railway Company is installing a turbo-generator set in its power station at Renfrew.

IRWIN, PA.—Governor Stuart has approved the application for a charter made by the Irwin-Herminie Electric Railway Company, which proposes to build an electric railway from Herminie to Irwin.

HARRISBURG, PA.—The West Liberty & Suburban Street Railway Company has filed a notice of an increase of indebtedness to $250,000, to be secured by an issue of first mortgage bonds.

LANCASTER, PA.—The Elizabethtown & Florin Street Railway Company has filed a notice of extension of route. The extension will pass through Florin, Mt. Joy and Elizabethtown, with the ultimate extension at Middletown, where connection will be made with the Central Pennsylvania Traction system. The company is capitalized at $220,000. The road, when completed, will be leased to the Conestoga Traction Company.

LEXINGTON, KY.—It is reported that Louis des Cognetts and C. N. Manning, of this city, are contemplating the construction of an electric railway from Barbourville to Manchester, a distance of about 24 miles.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company is considering the question of extending its railway to Pass Christian. William S. Gorenflo is general superintendent.

TAYLORVILLE, ILL.—The City Council has granted a franchise to the St. Louis, Terre Haute & Quincy Interurban Company, giving the company permission to construct its railway through this city.

ASHLAND, WIS.—The Ashland Power Company has been granted permission by the State Railway Company to issue $100,000 in capital stock, and $300,000 in bonds for the purchase and the development of water powers, and buying and developing the properties of the Ashland Light, Power & Street Railway Company, and the extension of the railway system of the latter company. The plan contemplates the extension of the interurban railway between Ashland and Washburn, and the transmission of electricity from Copper Falls to Ashland.

RACINE, WIS.—The Milwaukee Electric Railway Company will install additional engines in its power house in Racine, having a rating of 2500 horse-power.

NEW IBERIA, LA.—Work has commenced by the Teche Electric Railway & Light Company on the construction of its electric railway from New Iberia to Jeanerette, which will include 21 miles of track. The plans of the company contemplate the construction of about 100 miles of track and an investment of several million dollars. The officers of the company are P. M. Schneidau, president, and H. R. Fine, secretary and manager.

GREENSBORO, N. C.—A franchise has been granted to Charles L. Van Noppen and associates for the construction of an electric street railway in this place.

McCONNELLSVILLE, OHIO.—The McConnellsville-Malta Electric Company has increased its capital stock from $20,000 to $30,000.

LORAIN, OHIO.—Mayor King has sent a message to the City Council urging that the subject of street and commercial lighting be taken up at once, to the end that arrangements may be made for service after the expiration of the contract with the Citizens' Gas & Electric Company, in 1909. The Mayor urges that if a more favorable contract cannot be made, steps be taken toward the construction of a municipal lighting plant.

CINCINNATI, OHIO.—At the annual meeting of the Union Gas & Electric Company, the following officers were elected for the ensuing year: Norman G. Kenan, president; George W. Young, vice-president; Theodore Clauss, secretary; John F. Campbell, of New York, treasurer; executive committee: Olaf Ussing, A. B. Leach, A. S. White, George W. Young and Oscar Gubelman.

Business Notes.

THE MILWAUKEE TELEPHONE & MANUFACTURING COMPANY, of Milwaukee, Wis., has filed an amendment to its charter, increasing its capital stock from $25,000 to $50,000.

DOSSERT SOLDERLESS TERMINAL LUGS will be furnished on the switchboards now being manufactured by E. C. Tibbals & Co., for the new building of the Brooklyn Academy of Music.

THE STEEL CITY ELECTRIC COMPANY, of Pittsburg, has appointed Mr. Wm. G. Campbell as its New York representative. The address of the New York office is 220 Broadway (St. Paul Building).

DETROIT STOKERS.—Edwin H. Ludeman & Co. have arranged with the Detroit Stoker & Sounding Company, of Detroit, Mich., to represent it throughout the Eastern States and for all export trade in connection with the sale of the Detroit Automatic Stoker.

THE WESTERN WIRE SALES COMPANY, of Chicago, announces that Richard Wick succeeds J. Allen Haines as president and that F. B. Keller succeeds A. Conro Fiero as vice-president. F. W. Pagel is sales manager. Messrs. Haines and Fiero have retired from the company.

THE ENGINEERING & CONSTRUCTION COMPANY, of Henderson, Ky., has been admitted to do business in Indiana, with principal office in Evansville. B. C. Hubbard is state agent. The company proposes to do surveying, designing and to contract for the construction of water works, electric light plants and railroads, etc.

F. A. LAWSON & COMPANY, 209 Monadnock Building, San Francisco, Cal., have secured the Pacific Coast agency for Dossert & Company's solderless cable connectors and terminals, and have already placed large orders for Dossert joints. F. A. Lawson & Company report great activity in the electrical construction field on the Coast.

THE WISCONSIN ENGINE COMPANY, of Corliss, Wis., has received the resignation of Mr. Frank Engelhardt, who was in charge of the Chicago sales office of this company. The Wisconsin Engine Company has decided to close the Chicago office on March 1, 1908, and for the time being to conduct the business from that district under the direct charge of Mr. C. T. Myers, general sales manager at Corliss.

THE STANDARD TELEPHONE MANUFACTURING COMPANY, of Portsmouth, Ohio, which began operations recently, has effected a reorganization, and the following officers have been elected: William R. Fee, president and general manager; John E. Williams, vice-president; Carl Ecker, secretary, and Earl Rardin, treasurer. The company was incorporated with a capital stock of $50,000, and, in addition to manufacturing telephone switchboards, will also carry jobbing stock of electrical supplies. The plant is located in the Damarin Building on West Front Street

HARVEY & HILL.—The firm of Harvey & Hill, consisting of Elbert A. Harvey and Halbert P. Hill, has been formed to carry on business as engineers, manufacturers and purveyors of producer gas plants, complete power and lighting plants and Hill electrical specialties. Mr. Harvey was formerly treasurer and general manager of the Acme Gas Company, Chicago, and is now president and general manager of the Industrial Gas Company, New York. Mr. Hill was formerly district manager of the Allis-Chalmers Company, St. Louis office, and later connected with the De La Vergne Machine Company, New York. The above company will take over the sales of the apparatus manufactured by the Industrial Gas Company, and also a complete line of power and lighting apparatus, and manufacture a number of electrical specialties patented by Mr. Hill. The temporary quarters of this company are now in the Flatiron Building, but the permanent address will be 1880-1883 Manhattan and Hudson Railway Companies Fulton Building.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 3, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

880,521. FIRE ALARM; William Glenck, Newark, N. J. App. filed June 14, 1907. Particular construction of circuit closer for a fire alarm, making use of a celluloid cap, which is destroyed by fire to release a spring.

880,537. TELEPHONE DICTATING SYSTEM OR APPARATUS; John W. Kelly, Jr., Camden, N. J. App. filed April 27, 1907. A complete telephone dictating apparatus, adapted also for intercommunicating purposes in factories and business houses where there are many department heads, any one of which may wish to dictate to a selected stenographer or talk to another department. Makes use of a loud ear piece and a very sensitive transmitter so that dictation can be carried on from any point in the manager's room.

880,544. GROUND-DETECTOR; Justus C. Lawler, Colorado Springs, Col. App. filed Feb. 17, 1906. A three-phase static ground detector designed to quickly detect and locate a leak. Stated to be sensitive enough to indicate when a line touches a tree or where in damp weather a broken insulator may cause a leak.

880,547. TRANSFORMER FURNACE; Axel R. Lindblad and Otto Stalhane, Ludvika, Sweden. App. filed Nov. 5, 1906. Patentee has a rectangular coil threaded through a circular trough of insulating material in which the molten contents constitute a closed secondary circuit.

880,565. FAULT LOCATING APPARATUS; Lloyd C. Nicholson, Buffalo, N. Y. App. filed March 7, 1907. Relates to the location of faults of electric circuits, and particularly the location of a fault on an alternating current high-tension transmission line. Makes use of a transformer, which becomes active under leakage conditions and has a measuring instrument in its secondary circuit.

880,579. CARBON ELECTRODE FOR ELECTRICAL BLEACHING APPARATUS; Paul Schoop, Nuremberg, Germany. App. filed Nov 26, 1906. In a contact for carbon electrodes of electrolytic apparatus, the combination with the electrode having a threaded hole formed therein, of a perforated precious metal lead and a hard carbon screw passed through the perforation in the lead and screwed into the electrode.

880,599. PROCESS FOR ELECTROLYTICALLY PRODUCING PERSULFATES; Gustav Teichner, et al., Nuremberg, Germany. App. filed Feb. 12, 1906. A process for producing persulfates, which consists in subjecting the solutions of the corresponding sulfates to electrolytic action and periodically adding thereto, during the electrolysis reducing agents adapted to reduce the Caro-acid as it is formed.

880,617. ELECTRIC CIRCUIT CONTROLLER; Christopher Bach, Jr., Milwaukee, Wis. App. filed Dec. 13, 1906. A rotary adjustable switch for opening and closing an electric circuit at predetermined intervals. Is specially designed for flashlight circuits of illuminating display signs and the like.

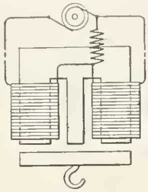
880,655. TROLLEY WIRE FINDER; Ferdinand Gundorph, Portlaod, Ore. App. filed May 29, 1907. The trolley barp has a pair of arms joined thereto, which may be impelled by a cord into a position to guide the wheel on to the wire

880,662. AUTOMATIC ELECTRIC FIRE ALARM SIGNAL; Edward E. Hayden, Washington, D. C. App. filed May 11, 1906. A circuit closer, having substantially the form of a push button, and including a coil of compound metals which contracts when heated to depress the push button.

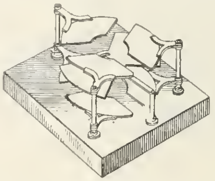
880,668. BURGLAR ALARM; William E. Jones, Minneapolis, Minn. App. filed June 8, 1907. A sectional bell, housing or enclosing case, designed to protect the bell actuating and controlling circuits from interference, either from within or outside of the protected apartment.

880,677. DEVICE FOR THREADING CONDUITS AND FOR ANALAGOUS PURPOSES; Edward M. Mars, Chicago, Ill. App. filed Jan. 16, 1904. Device adapted to creep through a telephone conduit by the actuation of a pull cord. Has two devices which move toward and from one another and alternately bind on the walls of the conduit.

880,689. PRIMARY BATTERY; William M. McDougall, et al., East Orange, N. J. App. filed March 9, 1907. A primary battery for use in electric mining lamps and other relations requiring a compact reliable constant current source. The electric connections are all made through the bottom of the cell and the zinc is supported in such a way that it is not exposed to the action of the acid, either at the top or bottom layers thereof, which are especially corrosive.



880,888.—Electromagnet.



880,544.—Ground Detector.

880,691. ELECTRIC ALARM; Theodor Norpoth, St. Louis, Mo. App. filed April 10, 1907. A mechanism, including a battery plate and circuit closing device, and designed to be connected with a door to be protected by a cord.

880,703. BATTERY; George M. Wheeler, et al., Brooklyn, N. Y. App. filed July 11, 1907. A pocket battery, comprising a plurality of cells, and a readily removable wrapper of flexible material, comprising a central portion, having a pair of side extensions folded around said cells to inclose them, and also having a top and bottom extension folded over the ends of said cells.

880,705. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Aug. 30, 1905. A system of electrical generation and distribution, in which both direct and alternating currents are employed. Has means for converting either form of electrical energy into the other and for controlling their relations. Claims are directed to commutator features of the motor generator.

880,706. ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Jan. 12, 1906. Relates to modifications of the above.

880,716. ELECTROTHERMAL GARMENT; Burton R. Charles, Portland, Ore. App. filed Otc. 15, 1907. A form of dressing gown, having a resistance element included in the fabric so as to warm the same. The controlling switch is located in the pocket of the garment so as to be inconspicuous.

880,743. ELECTRIC FURNACE PROCESS; Franz von Kugelgen, et al., Holcombs Rock, Va. App. filed April 10, 1905. The method which consists in treating in an electric furnace a pyro-conductive charge by passing through it from a carbon electrode in contact with it a current sufficient to maintain the charge molten, and cooling said electrode sufficiently to protect it from attack by the portion of the charge in contact with it.

880,760. PRODUCING METALS BY ELECTROLYSIS; George O. Seward, et al., Holcombs Rock, Va. App. filed April 24, 1906. In the electrolysis of fused electrolytes, causing the metal to separate in a molten state at a submerged cathode, rise through the electrolyte, and collect and solidify under a movable protective cover in contact with the electrolyte.

880,762. SIGNALING SYSTEM; Bernard Staub, New York, N. Y. App. filed Nov. 5, 1906. An apparatus designed to be of very simple construction and adapted to transmit certain code signals for burglar alarm purposes when actuated.

880,770. SIGNALING CIRCUIT FOR RAILWAYS; Joseph A. Wilson, Westfield, N. J. App. filed Feb. 10, 1902. The track rails are divided into block sections and are energized by local batteries. Makes use of what are termed neutralizing relays to secure the overlap or distant signals.

880,788. MEANS OF FORMING ELECTRICALLY BONDED RAIL JOINTS; Horatio G. Gillmor, Bath, Me. App. filed March 27, 1906. Includes a chair having upwardly extending arms, binding plates and bars between said chair and the rails, and wedges driven in between the arms of said chair and said bars.

880,789. MEANS OF FORMING JOINTS IN ELECTRICAL CONDUCTORS; Horatio G. Gillmor, Bath, Me. App. filed Feb. 4, 1907. Relates to modifications of the above.

880,838. HIGH-POTENTIAL TRANSFORMER; Chester H. Thordarson, Chicago, Ill. App. filed April 17, 1905. High-potential transformer having flat coil windings separated by flaring insulating disks. The windings flare outward in a double conical formation.

880,850. FLEXIBLE CONDUIT; James S. Wilson, Chelsea, Mass. App. filed May 20, 1907. The conduit has an inner wall composed of a spiral strip forming a tube, and a braided cover with fastening members at intervals between said tube and cover.

880,851. RAILWAY SIGNALING SYSTEM; Joseph A. Wilson, Westfield, N. J. App. filed Aug. 10, 1906. Provides a system in which one or more signals are controlled by electric circuits, including electromagnets, each of which has a plurality of coils and operating the signals by the reversal of the current through some of the coils of the magnets.

880,854. LIGHTNING PROTECTOR ATTACHMENT FOR TREES; John P. A. Anderson, Madrid, Ia. App. filed Feb. 23, 1907. Has a metallic conductor, embracing the trunk of the tree and in electrical connection with the ground, and co-acting metallic conductors clamped to the main conductor and embracing the branches of the tree.

880,882. FLEXIBLE TUBE; Winfred W. Harris, Winthrop, Mass. App. filed June 7, 1905. Flexible loom conduit having a lining of spiral form with a weakened portion at an angle to the spiral path formed by the edges of the strip, whereby the path on one intersects the path of the other at predetermined points.

880,888. ELECTROMAGNET; Winthrop K. Howe, Buffalo, N. Y. App. filed April 26, 1906. A traction magnet for alternating currents, comprising a magnetic core having a plurality of poles and provided with a number of magnetizing coils, and means whereby currents may flow in a local path or shunt circuit through one of said coils.

880,940. ELECTRIC BELL; Charles J. Wagner, Chicago, Ill. App. filed Aug. 15, 1907. Form of electromagnet having a straight iron core with U-shaped centrally pivoted armature having a clapper, which vibrates between two poles.

880,957. STORAGE-BATTERY ELECTRODE; J. W. Aylsworth, East Orange, N. J. App. filed April 28, 1905. A storage-battery electrode, comprising a conducting support and electrolytically deposited, hydrated peroxid of nickel applied to the same, substantially as set forth.

880,963. TROLLEY POLE; Henry Bouchard, Austin, Tex. App. filed April 16, 1907. Has a bracket and a trolley pole pivoted thereto and comprising a plurality of telescoping sections. Includes means for fixing the pole with respect to the bracket, and means whereby the extension of the pole will release the retaining means. Has a spring acting normally to extend the pole.

880,971. INSULATOR; George W. Carter, Canyonville, Ore. App. filed May 8, 1907. The insulator is transversely grooved to receive a tie wire, which clamps over the line wire and passes through an aperture in the supporting pin of the insulator.

880,976. TROLLEY MECHANISM; William J. Craig, Pine Bluff, Ark. App. filed Sept. 6, 1907. The trolley pole is mounted on a swiveling table on the car roof, and can be withdrawn by a link which depends into the body of the car.

880,978. ELECTRODE ELEMENT FOR STORAGE BATTERIES; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed March 2, 1905. An electrode element, comprising a perforated inclosing pocket non-deformable under normal working conditions, containing a highly compressed mass of active material and a net-work of conducting paths formed of overlapping flakes extending throughout the active mass and in contact with the pocket walls, and with which the particles of active material are deformably compressed into intimate contact, substantially as set forth.

880,979. METHOD OF MAKING STORAGE-BATTERY ELECTRODES; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed Nov. 2, 1905. The method of making electrode elements, which consists in introducing a mixture of particles of active material and flake-like conducting material within non-deformable inclosing pockets, and in applying a pressure to such material sufficient to crush or deform the active particles and cause them to substantially follow the contour of the conducting flakes, as and for the purposes set forth.

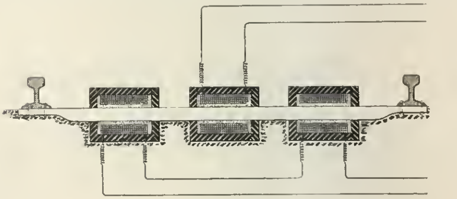
881,005. SIGNALING SYTEM; Edward E. Kleinschmidt, New York, N. Y. App. filed Dec. 29, 1905. Has a plurality of signaling stations established at suitable points along the road, each station having a designating number. Upon the passage of a car or train at a given station, the despatcher is notified by the operation of a visual signal which gives the number of the station. Makes use of a messenger call principle.

881,010. PROCESS FOR PRODUCING ELECTRIC RESISTANCE BODIES; Johann Krannichfeldt, Cologne, Germany. App. filed Nov. 1, 1907. Consists in mixing good and bad electric conductors, and subjecting said mixture to an electric influence while in a condition of mobility, to establish a definite position of the conducting particles and then allowing it to solidify.

881,015. ELECTRIC ARC LAMP; Louis C. H. Mensing, Rugby, England. App. filed Feb. 9, 1905. A flaming arc lamp of the type having downwardly convergent electrodes. The electrodes are grasped by guides on the armature of a solenoid magnet, which serves to strike and regulate the arc.

881,017. HEATING DEVICE; William E. H. Morse, Algona, Ia. App. filed April 25, 1907. Has a hemispherical shell and an incandescent electric light attached therein and projecting therefrom to form a handle. May be applied to radiate toward any portion of the human body or other object.

881,049. ART OF LIBERATING ALUMINUM AND OTHER METALS; Henry S. Blackmore, Mount Vernon, N. Y. App. filed Oct. 29, 1904. The process of reducing metal, which consists in exposing a substance containing a metal and oxygen to electrolysis, while employing an electrode containing aluminum methid $(Al_4\ C_3)$.



881,005.—Signaling System.

881,087. ELECTRIC INSOLE; Robert A. Stevenson and John T. Story, New York, N. Y. App. filed Dec. 14, 1905. The sole of the shoe includes a galvanic pile at the toe and heel and connected to produce an electric circuit through the foot of the wearer.

12,756. TELEPHONE SYSTEM; Edward J. Burke, Brooklyn, N. Y. App. filed Oct. 25, 1907. In a multiple board central system, the combination of a plurality of subscribers' stations, a plurality of jacks connected together and to each of the said subscribers' stations by a single line, a pair of plugs connected together by a single strand, a lamp associated with each of the said lamps to produce lights of different characters to indicate when a connection is desired and when the conversation is completed.

12,757. INCANDESCENT LAMP SOCKET; Frank E. Seely, Bridgeport, Conn. App. filed Jan. 2, 1908. An incandescent lamp socket of the type having a sheet metal body and cover, which interlock by prongs and elastic clips of a special form.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, MARCH 21, 1908. No. 12.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office..............................590 Old Colony Building
Cleveland Office..............................1015 Schofield Building
Philadelphia Office.......................Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico	per year, $3.00
Dominion of Canada	4.50
Other Foreign Countries within the Postal Union	6.00

25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, MARCH 21, 1908.

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Dividends in Scrip.

The Western Union Telegraph Company is paying another dividend in scrip in order to avoid paying out cash. This is not an unknown practice in the history of the corporation, for in addition to the action of the same kind last January, it is on record that the company paid a 10 per cent stock dividend in 1862 in addition to 5 per cent in cash. There may be other instances in its long career. The net earnings for the March quarter are placed at $1,100,000, or $400,000 less than in 1907, and if the regular dividend were paid in cash a deficit would be left of $563,000. The question arises whether it would not be better to "face the music" and pass the dividend altogether. The point involved is that the company is not anticipating or paying dividends out of unearned moneys yet unearned, but is, in a sense, capitalizing undistributed earnings that are represented by an accumulated surplus of $14,000,000. In this connection it is to be noted that this dividend which is to come out of the $1,413,000 stock still lying in the treasury, would come under the prohibition of the Public Service Commission if, as is now proposed, telegraph and telephone corporations were subjected to the rule of that body. This new authority has illustrated its point of view by refusing to allow the Erie Railroad to issue ten-year, interest-bearing scrip for the dividend declared on the first and second preferred stocks last August. In this instance the objection of the Commission seems to have been that the issuance of the scrip for such a purpose was really the payment of present dividends out of future earnings, instead of actual earnings in the past; but it is believed that the Commission is broadly against scrip dividends as "extras" or in lieu of cash needed for the conduct of the business. We can well imagine the pride of the Western Union management which would lead it to maintain its long and unbroken dividend record, and there is no doubt that such a sentiment underlies the present action. The company was hit by the late strike to the tune of probably not much short of $3,000,000 all told, and this cannot be made up in a hurry from an industry that has expanded but slowly for years. We understand that very thorough reorganizations and improvements are now being enforced for the sake of economy and efficiency all over the system.

Government Regulation of Wireless Telegraphy.

The several bills now before Congress for the regulation of wireless telegraphy are an indication of a condition which undoubtedly calls for some action eventually on the part of the Federal authority. None of the present bills, however, appears to represent a sufficiently mature or broad consideration of the subject to which they relate, and the Hale Senate bill is no less than pernicious in some of its provisions. With the ether as a common medium of transmission, which medium can be pre-empted at pleasure by a youth for amateur play, or at any moment rendered unavailable for serious purposes by malicious disturbances from stations of competing wireless companies, the need of some regulation of its use cannot be gainsaid. The Hale bill, however, would in effect make the ether an instrument of warfare and in time of peace an appanage of the military establishment. It was in this spirit that wireless regulation was discussed at the Berlin conference of 1906, and the international agreement there drafted appears to have very properly been pigeon-holed by the committee of the Senate before which it came for consideration in the form of a treaty. But we now have in the Hale bill an attempt to enact by indirection some of the most criticised features of the Berlin agreement, which are rendered more objectionable by limitations in the sole interest of our military establishment. This attitude recalls the recommendation of a naval authority several years ago, that the coal fields of Eastern Pennsylvania—the source of supply of some millions of people—should be pre-empted for war purposes.

Any regulation of wireless telegraphy should be based on a full recognition of the fact that the art is now in its infancy and that its proper development demands freedom from every unnecessary restraint. Assuming that the government has some sort of prescriptive right to an art with which a long line of scientists and inventors has endowed the world, it does not follow that this right cannot be exercised with due regard to the use of the same art for non-governmental purposes. If in time of peace occasions arise of sufficient importance to call for a temporary pre-emption of the ether by the government, any inconvenience thereby occasioned to commercial and private interests can be borne with some equanimity. But there should be some assurance that such interruptions are incident to matters of real importance—that all private interests are not sacrificed to routine communications that might just as well be transmitted by wire, or by trivial communications between officials. By defining in some manner the nature of government communications by wireless, and requiring a copy of every communication to be filed for critical examination as to its real importance, a gross abuse of the wireless privilege by overofficious or inconsiderate officials would be averted.

In other words, in time of peace the pre-emption of the ether on the part of the government should only be for emergency purposes, and any official making an emergency call should be held strictly responsible for the rightful use of the privilege. In time of war, of course, wireless telegraphy would, in common with all the peaceful arts of civilization, have to resign any claim to consideration; but as a recompense it should not be held in abeyance in time of peace in accordance with what appears to be a policy for the exaltation of the military over the other classes of American people—which classes would be the ones to give their resources and offer up their lives in national defense, and not even balk if the nation should become committed through vainglorious bravado to a war of foreign aggression. None will, we believe, deny the need of some regulation of wireless telegraphy, but the character of such regulation should be the subject of careful discussion in which the interests of the art and of the people as a whole should receive merited attention. A means to this end would be the authorization by Congress of a commission to study the subject and report recommendations, the membership to be so chosen that the military and bureaucratic elements shall not dominate. We sincerely hope that no action will be taken by Congress until the subject of regulation has received in this country much broader and much wiser consideration than is evidenced in the bills thus far offered at Washington.

A New Form of "Efficiency" Photometer.

In our issue of Dec. 2, 1905 (page 942), Messrs. Hyde and Brooks described a form of photometer which not only measured the horizontal intensity of a lamp, but which also directly measured its so-called "efficiency" in watts per candle, a quantity which is really an inefficiency, or reciprocal of an efficiency. In this photometer the carriage was movable and the lamps compared were fixed. A graded resistance coil, shaped like a harp, was used in such a manner that the movement of the photometer carriage to the balance position automatically introduced such resistance into the circuit of a wattmeter as caused it to indicate the watts-per-candle of the lamp under test. In a recent number of the *Elektrotechnische Zeitschrift* appears an article by Herr C. Paulus, abstracted in the Digest, describing a modification of this apparatus, in which the photometer carriage is fixed and the lamp under test is moved. It is shown that a uniform or ungraded resistance coil may be used with this arrangement, thus simplifying the structure. The photometer described is a portable one and gives the watts consumed, the horizontal candles and the watts per candle all by direct readings.

Influence of the Height of Suspension Upon Uniform Illumination.

One of the problems confronting the illuminating engineer is to produce upon a given level surface, either on tables within a hall or on a certain space of ground out of doors, a uniform intensity of illumination perpendicular to that surface. The article of Mr. Alfred A. Wohlauer, on page 601 of this issue, deals with one aspect of this problem. It is really a continuation or extension of a preceding article, printed in the issue of Dec. 21 last, and the two articles should be taken together in order to arrive at a clear understanding of the facts presented In the first article it was shown that in order to illumine uniformly a plane circular horizontal surface from a single lamp suspended, say, immediately above the center, a certain polar curve of intensity was required from the lamp. The intensity would have to be a certain minimum immediately beneath the lamp and then move off toward infinity in a nearly straight line at an angle of nearly 30 deg. below the horizontal. No actual lamp could be expected to give such a distribution of candle-power even as far as 45 deg. from the lower vertical. By means of a suitable reflector, the required distribution might be secured as far as 45 deg., but this would mean hanging a very powerful lamp at a height equal to the radius of the plane surface to be illumined. Consequently, the problem practically resolved itself into the lighting of the surface by means of a number of similar equidistant lamps supported at a uniform elevation. It was shown that there existed theoretically a certain peg-top shaped polar curve which, for a given ratio of elevation to spacing interval, afforded a simple straight line law of diminishing illumination along any line in the illumined plane connecting the feet of perpendiculars below the lamps, the illumination from one lamp falling to zero at the adjacent perpendicular.

It is easy to see that once such a straight line law of falling off in illumination is produced along any radius from a lamp, the total illumination due to all the lamps will attain the same uniform value at all points on the rectilinear network of lines joining adjacent lamp perpendiculars, or along the edges of squares on the illumined surface having lamps over their corners. Within the squares, the illumination will tend to be somewhat in excess of this value, although the difference would not be serious from a practical standpoint. In the present article it is shown that if we suppose a flat surface to be illumined in the manner above outlined—that is, by means of uniform lamps uniformly spaced at the junctions of a uniform rectangular net—and an upright cord fastened to each lamp over a supporting pulley, for the purpose of adjusting the lamp elevation, then if the polar distribution of intensity is selected for the existing ratio of height to spacing, we know that practically uniform illumination can be produced all over the surface. The illumination of each lamp will fall uniformly from a maximum at the foot of its own cord to zero at the feet of the adjacent cords. Intermediate points will receive illumination from not less than two, nor more than four, lamps.

If now we lower away on all the cords to the same extent, so as to reduce uniformly the elevation of all the lamps, we should no longer secure uniform illumination. It would be greater everywhere, but it would be much greater at each cord than at intermediate points. In order to restore uniform illumination for the lowered lamp level, it would be necessary to change the lamp reflectors so as to produce another polar curve. If, however, we lift away equally on all cords so as to raise uniformly the elevation of all lamps above the original level, we should still retain the same nearly uniform illumination. The illumination from any one lamp would now diminish from a maximum at its own cord, by a straight line law, to zero at a radius greater than the distance interval separating the lamps. At all points on the rectangular network the illumination would be constant and the same as when the lamps were at the original level. In general, the illumination at any one point would be contributed by more lamps than two on the network or than four within the squares. The curious result thus follows that, provided we are not standing near the edge of the illumined surface, the illumination will remain substantially unaltered no matter how far we increase the height of all the lamps above the original level for which their polar curve was provided.

Steam Road Electrification.

One can hardly classify this topic as sensational in its novelty, but in these days it is always timely and worth considering. The discussion which Mr. Fowler contributes to our columns is certainly an interesting one in its bearings on the nature of the electrical equipment, and is a strong plea for the single-phase system on the solid ground of economy. The fact is that in all comparisons of this sort there is substantial failure to agree upon fundamental data and even upon corresponding modes of thought. Every comparison with respect to steam-road electrification is faulty in its basis because thus far it seems to have been practically impossible for the advocates of steam and of electric traction to argue upon a common plane or to talk the same language. For example, Mr. Fowler's thesis practically reduces to the following: If a railroad wants to do electric interurban work it can do it cheaper and better by electricity than by steam. To which the steam road advocate responds that he'll be hanged if he wants to do electric interurban work and that for a first-class local service by steam locomotives the steam locomotive is indubitably the proper thing.

With this difference between the basic proportions the data can hardly be expected to be closely coherent. In the article before us the costs per train-mile by steam and per car-mile by electricity have really nothing more to do with each other than the prices-current for Portland cement and for glue; and this although Mr. Fowler is unquestionably right in his contention that for efficient local passenger service electricity is decidedly the best and cheapest motive power, which indeed most steam railway men are willing to confess if not twitted with the unpleasant fact. Experience has already proved the deadly character of the electrical competitor. As to single-phase vs. "standard" practice, we have for years been trying to hammer home the fact that working conductors at 500 to 700 volts are unscientific and uneconomical for the distribution of electrical energy over anything but trivial distances, and we rejoice with Mr. Fowler at the success of some of the high-voltage single-phase systems, particularly in the far West. Our friends out on the Coast have a way of going ahead and doing things that is very gratifying. Everything points to the steady improvement of the single-phase system, which is now passing through the stages of evolution that seem necessary in the growth of every new thing. Just how far it can be utilized in general tramway work is as yet problematical, but it assuredly is doing capital work on some of the interurban lines.

Truth to tell, the chief obstacle in the more general application of electricity to railway service is financial rather than technical or operative. If one were the president of a big railway system and had been struggling strenuously for a couple of decades to pay dividends on his stock with the water spigot always open, and the printing presses working overtime getting out subsidiary securities to purchase other people's private reservoirs before they could undermine your own, he is apt to be brought to the verge of nervous prostration upon seeing looming up ahead the need of re-equipment to be paid for in real money. And particularly, when he realizes that a lot of fellows are prowling around trying to dynamite his reservoir walls. To be entirely serious, there is little doubt that a good many roads see the necessity for "electrifying" part of the service and would be glad to do so were it not for the difficulty of financing the proposition in these days of unsettled railway values and the possibility of further and more serious disturbances before things settle down to a more stable condition. All the things which are now apparent, well trained railway men have seen approaching for some time past. It is little to be wondered at that they have thought it best to make haste very slowly, particularly in view of the radical changes in transportation methods that would be likely to follow in the train of electrification and which would involve some experimenting on a colossal scale. From a purely technical standpoint Mr. Fowler and other engineers who have discussed the subject have made out a very strong case, and the course of events is steadily proving it. It will take much time, however, to bring about the changes that sooner or later must come. It is necessary first that the railroad business should get out of its present sorry condition into one of reasonably permanent stability. Then in due season the changes will come, and in the interim they will become easier and cheaper to make.

Public Service Rate Decision.

Judge Hough, of the United States Circuit Court of the City of New York, declined, last week, to fix a rate at which gas could be sold in New York City. The United States Court had previously decided that the 80-cent rate fixed by the Legislature was confiscatory, and an application was made to the court to fix a rate that would be constitutional; this was declined on the ground that such action would be contrary to the oft-repeated opinion of the highest court in the country that no court can fix a rate. Judge Hough intimated that the whole matter would have to be carried before the United States Supreme Court. Under the 80-cent gas law, and within the entire valuation which he had fixed, the net income would be less than 6 per cent, and the rate of 6 per cent was stated to be "the lowest rate in the City of New York that could be considered legislatively fair to those who are already engaged in the manufacture and supply of gas and cannot readily escape therefrom."

The Peoria Electrolysis Suit Again.

The suit in equity of the Peoria Water Company, controlled by the United Waters Company, of Boston, against the Peoria Railway Company involving damages to the plaintiffs' water pipes by electrolytic action of stray return current from the defendants' lines, which was begun about 10 years ago, had another hearing before Special Master Frank L. Wean, in Chicago, last week. Ten years ago a special master of the United States Circuit Court, sitting on the evidence presented, made a report in favor of the plaintiffs. No action was taken by the court on the master's report, and last October the Peoria Water Company again applied for argument on the case. The defendants agreed to another hearing before a special master at which new evidence could be submitted, and their case was presented last week. On the conclusion of the hearing of the defendants' evidence, the case was adjourned until April 7, when the plaintiffs will present their side of the case. No final decision of the court is expected before the next fall term. If the report of the master is favorable to the plaintiffs, and the court approves the finding, an injunction will be issued against the defendants, enjoining them from using the single trolley, which will be the same in effect as the issuance of a writ of mandamus, compelling the defendants to use the double trolley.

The case is important because it is the first which has been brought in the United States Circuit Court, and because the United Waters Company, of Boston, which is back of the plaintiffs, owns a large number of water plants throughout the United States. The plaintiffs were represented at the hearing by D. C. Mauray, chief engineer of the Peoria Water Company, who is recognized as an authority on the effects of electrolysis. The defendants were represented by Judge I. C. Pinckney, attorney of record, and Edward E. Winters, consulting engineer, of New York, who presented the technical arguments and evidence.

Adverse Report on Hydro-Electric Development Near Minneapolis.

A commission consisting of Majors Judson and Kimball, of the United States Army, and Mr. J. E. Woodwell, have made a report to the Secretary of War adverse to the present development of electric power in connection with dams now completed or under construction by the United States between St. Paul and Minneapolis, Minn., the primary purpose of the dams being to assist navigation on the upper Mississippi. Several propositions for utilizing the heads rendered available by the dams are discussed, and are reported against on the grounds that any development made at the present time would be of relatively small generating capacity, and would stand in the way of a future comprehensive development. The commission believes that within 20 or 25 years, and perhaps within a much shorter period, it will be economically desirable that there be erected a high dam at the lowest suitable point between St. Paul and the site of one of the present dams, the backwater from which would extend to the lower tailrace at Minneapolis. In this way there could be obtained a head of probably 35 ft. at lower stages, and it would be practicable to develop from 15,000 to 20,000 horse-power.

Electric Light Rate Ordinance in Chicago.

For some time an ordinance relative to electric lighting, power and heating rates which may be charged by the Commonwealth Edison Company has been under consideration in Chicago. The rate ordinance as recommended to the Council by its committee on gas, oil and electric light, authorizes until next August a gross maximum rate for lighting of 15 cents per kw-hour up to the equivalent of 30 hours' use per month of the customer's maximum requirements, and 9 cents for energy used in excess of that amount. This is the company's present rate. One cent per kw-hour discount is now given for prompt payment within 10 days from date of bill. After July 31, 1908, the rates are to be 13 and 8 cents, and for the last three years of the period covered by the ordinance, from Aug. 1, 1909, to July 31, 1912, the rates are to be 13 and 7 cents. For power the rate is prescribed as 11 cents per kw-hour for the first 30 hours' use of the maximum demand, and 6 cents for energy used in excess of this. The minimum charge is to be 50 cents per horse-power per month. The proposed ordinance has brought out considerable discussion, in which nothing showing the rates to be otherwise than fair has been presented.

In a discussion of the ordinance which was held at the City Club, President Insull gave the rate at which the street and elevated railways of Chicago are supplied. These companies pay $15 per year for each kilowatt of maximum demand as a readiness-to-serve charge. This maximum demand is measured at the switchboard of the company's generating plant at Fisk Street. In addition to this, ½ cent per kw-hour is paid for all energy required, as measured at the generating station. It was further stated in this discussion that the company loses money on the business of small offices and apartments, but makes it up by a little higher charge to the big consumers, a point generally recognized by students of the problem.

Light and Color in Decoration Discussed in Chicago.

The Chicago Section of the Illuminating Engineering Society discussed the paper by Mr. George L. Hunter on "Light and Color in Decoration" on March 12. The meeting was held following dinner in the Breakfast Room of the Grand Pacific Hotel. Mr. Frederick J. Pearson opened the discussion with some remarks to the effect that the aim should be to follow as nearly as possible the color and illuminating effects found in nature. He cited examples of those dealing in decoration who had been most notably successful and who followed nature's colors.

Chairman Cravath presented a written discussion, explaining that in many cases the illumination on walls and ceilings might be considerably reduced without impairing the general effect, and that by so reducing this general illumination and directing it to particular places in a room where higher illumination is needed, the results are much more satisfactory to the user. He gave one well-known practical example of this. Illuminating engineers were not especially interested in illuminating the floor as a floor, because light directed in the direction of the floor was useful for practical purposes on objects placed between the sources of light and the floor. He thought it well, however, that Mr. Hunter had called attention to the importance of properly lighting walls and ceilings, because some might carry the idea of reducing the illumination in these parts of the room too far.

New York Subway Signal System.

In an exhaustive report upon the subject of the signal and interlocking system in use in the New York subway, Mr. Bion J. Arnold has recommended to the Public Service Commission that improvements be made in the signal apparatus by which less headway for express trains may be obtained without sacrificing the safety of passengers, and that after these improvements are perfected, the local tracks be equipped with the same block-signal system as is now used on the express tracks. Mr. Arnold also criticises the present plan of express stations, and says that if they were double-decked or otherwise planned to allow the movement of express trains alternating on one and the other side of express platforms, the capacity of the subways would be increased fully 50 per cent. The signal changes he recommends would make possible a headway of 90 seconds, or 40 trains an hour, on both express and local tracks. At present the rate is about 30 trains an hour.

As a temporary means of increasing the efficiency of the existing signal system, Mr. Arnold suggests a visual and audible signal to be given by the stopped train to a subway platform station attendant that the entering train has been delayed to the extent of a full stop. He also suggests a manually-operated switch whereby an attendant can release the emergency stop holding the entering train and giving it the signal to proceed after the leaving train has begun to move. Much time is now lost, he says, because the proceed signal is not given to the motorman of the entering train until the last car of the leaving train has left the platform.

In regard to the signal system for the local tracks, Mr. Arnold says that the only difference between train movements on the different tracks is that more frequent stops are made by local trains. As the introduction of more frequent stops between the terminals introduces a risk, the need for safety signals on the local tracks is really greater than it is on the express tracks. "It would, therefore, appear," he says, "that if the practical degree of safety decided upon for subway operation demands the installation of the signal system and automatic stopping devices on the express tracks, the same or similar equipment is necessary on the local tracks."

Mr. Arnold's conclusions are as follows:

(1) The subway signal system is in the main modern, effective and well maintained.

(2) There is no reason, so far as the signal system is concerned, why a 90-second headway cannot be maintained.

(3) This 90-second headway will eventually be desirable upon both local and express tracks.

(4) The signal system at the present time does not afford positive safety at the approach to stations, as the motormen are relied upon to reduce the speed of the trains.

(5) In addition to the excessive platform waits additional time is lost at each station stop by holding the following train a considerable distance out of the station until the leaving train has entirely cleared the platform.

(6) As at present operated delays at the station platform have a cumulative effect upon the following trains so that even one prolonged stop may disarrange the schedule for the entire hour.

The report recommends the following changes:

1. That the necessary steps be taken to develop and install an automatic speed-control signal system to be used as an auxiliary at station blocks which will allow the incoming train to safely approach the rear of the train at the platform and to enter the platform promptly upon the leaving of the outgoing train without sacrificing any of the standard of safety which is now maintained between stations.

2. That during the development of the system there be installed at every express station the changes in the block-signal system proposed by the Interborough Company for Grand Central Station. The equipment required for these changes will reduce the present possible headway by seven seconds, and could ultimately become a part of the permanent recommended arrangement.

3. That the subway officials consider for the purpose of effecting temporary relief the installation of a manually operated permissive signal at every express station to be used to expedite a delayed incoming train and thus overcome the cumulative effects on the schedule of a prolonged station wait.

4. That the local tracks be protected by a complete block-signal system, when the automatic speed control system herein suggested has been perfected.

5. That, when the load on the subway increases to such an extent as to require additional conductors for carrying the electrical energy to and from the trains, the present signal system be altered so as to utilize both rails for carrying the return current, and at the same time make the system conform to the latest accepted practice whereby the signal system detects and indicates a broken or removed rail, provided the system shall at that time have proven superior to the single-rail system.

Wireless Companies Oppose Hale Bill.

Characterizing the Hale bill, introduced in the United States Senate on March 6, as the third in a series of attempts to get around a promise of the leaders of the House, who, it is said, had agreed to shelve action on the recommendation of the United States delegates to the International Wireless Telegraph Convention held in Berlin, November, 1906, both the Marconi Company and the United Wireless Telegraph Company are bitterly opposed to the Hale measure in its present form.

Briefly, the Hale bill empowers the United States government to control and regulate all wireless communications in the United States and its possessions. The government would stop doing all commercial business now carried on under a section in a circular issued by the Bureau of Equipment of the United States Navy. It would make it incumbent upon commercial companies to obtain licenses for each vessel and land station equipped, the license fee being 5 per cent of the cost of equipment. Interference would be a penal offense punishable either by a fine of $2,000 or a year's imprisonment, or both. It leaves the zone of transmission which would be free to the jurisdiction of each state, thereby making it incumbent on each state to pass laws covering the matter of zones. The part of the measure which has caused the greatest amount of protest is section 8, as follows:

"That it shall be the duty of every person or corporation using or operating a wireless telegraph apparatus pursuant to a license granted under this act to answer wireless calls and signals from and for any other person or corporation so licensed; to receive all messages or signals tendered for transmission to any other neighboring or connecting apparatus, and at the price customarily asked and received for such service; to transmit the same to such neighboring or connecting apparatus without discrimination and without regard to the system of telegraphy by which such calls, signals or messages are made, and a neglect or refusal to observe the requirements of this section when practicable, shall be cause for revocation of license."

"This section clearly shows," said Mr S. S. Begart, vice-president of the United Wireless Telegraph Company, "that the intention of the bill is to cover the same grounds provided by the Berlin treaty and now held in abeyance by the Senate."

There are two other wireless bills before the House at present, one introduced by Mr. Shepard and another by Representative J. Peters, of Massachusetts, which, if passed, would have the effect of making wireless telegraphy a government monopoly. In the second section of the Peters bill it specifically provides that the use of magnetic waves of 374 to 425 meters is prohibited except for official stations. "The passage of this bill," Mr. Bogart said, "would throw out all long-distance commercial stations and practically would make wireless telegraphy inoperative." The Shepard bill provides that the originating or transmitting of false messages purporting to be official is a penal offense, and this section receives the approval of all the companies. But sections 5 and 6, to break in or interfere with any wireless station transmitting official messages, are not so well understood. As a matter of fact, it would be extremely difficult, if not impossible, for the United States government or the state governments to pass laws preventing interference. All this legislation, or rather attempted legislation, by those who have no adequate knowledge of the subject with which they are attempting to deal, is entirely unnecessary. Should these measures be passed, the government should have a general signal that would permit it to break in and take the circuit when commercial messages being sent are concluded, which signal should be recognized by all companies, and also an emergency "break-in" signal. Then the government should compel all the companies to recognize a certain distress signal no matter when or by whom it was given.

Vice-President Bottomley, of the Marconi Company, said that, in his belief, the bills represented an attempt of the government to establish a monopoly, and that the government was controverting its past policy of keeping clear of the field of commercial enterprise.

The Long Acre Company Hearing.

The Public Service Commission, investigating the electric light companies of New York, held a second meeting last Thursday to consider the affairs of the Long Acre Company. Mr. Walter H. Knight, chief engineer of the Long Acre Electric Light & Power Company, corrected his previous testimony to read, that of the amount of outstanding bonds of the company $500,000 of the $1,000,000 signed had been sold and $100,000 hypothecated as collateral to the agreement between the Long Acre Company and the American & British Manufacturing Company. Mr. Knight stated that the Long Acre Company gave the formal order for labor and materials for the construction of its power plant July 3, 1907, and purchased the present plant Dec. 16, 1907. The contract between the Long Acre Company and the American & British Mfg. Company requires the Long Acre Company to employ the American & British Company to furnish all materials, and to furnish and perform all the work and labor necessary to the construction of the Long Acre plant at a profit of 15 per cent. As general collateral the Long Acre Company deposited $100,000 of the face value of the first mortgage 4 per cent bonds. Mr. Knight testified that his company had no receipts for the year ending June 30, 1907, and that there were some expenditures in connection with incorporation matters, but he could not say whether or not these expenditures had been reported to the Commission.

Mr. Henry W. King, counsel for the Long Acre Company when the franchise was purchased, said he had been unable to get the books of the old American Electric Manufacturing Company, but that he did get trace of the books of the American Electric Illuminating Company at the time when this company went into the hands of Receiver John M. Ward. At Mr. Ward's death the books were lost and have not yet been recovered. During his search for these books he said that he had learned that in 1889 the American Electric & Illuminating Company had operated a plant in East Twenty-fifth Street on Avenue A, extending through to East Twenty-fourth Street, in which were two arc dynamos of 50-light capacity, and wires had been strung down Avenue A to Houston Street. The terms of the franchise stated that certain compensation should be paid to the city, "one full arc-light of power equal to the average required at the time, in contracts with the city for such electric lights, for every 50 arc lights furnished by the company to consumers." Mr. King said that the Long Acre Company has never supplied lamps to consumers, but that under the terms of the contract four arc lights had been supplied by the American Company to the city, and, at the time mentioned, the company was supplying 90 arc lamps to private consumers. The franchise also provided that a sum equal to one cent for each lineal foot occupied by the company in the streets, should be paid to the city, but it was brought out that there was nothing to show that such payment had been made, and that the Long Acre Company has not made any such payments. Mr. George E. Bouchie, who voted 490 shares of the Long Acre Company, was trustee for the Manhattan Transit Company, Mr. King testified. Other individuals who held shares, owned them in their own name, with the right to dispose of them, but with the moral obligation, according to Mr. King, not to sell them. Mr. King said that the 490 shares were not loaned by the Manhattan Company for the purpose of voting.

Mr. Knight was recalled to the stand and stated that the company had been engaged in constructing a small central power plant and placing ducts to street conduits. At present the company was engaged in making subsidiary connections to its customers, with a view to supplying them with current from the power plant situated on Second Avenue and Forty-seventh Street. At this time, he said, only the Manhattan Transit Company was connected to mains of the Long Acre Company. The Consolidated Subway Company had constructed one-half mile of subway, and six or seven house connections had been made on the west side of Second Avenue, from the south side of Forty-second Street to the north side of Forty-eighth Street. The income to the Long Acre Company from the Manhattan Transit Company was about $400 or $500 a month. He testified that the Long Acre Company had been formed four years ago, not with the intention of purchasing an old franchise, but of getting a new one, which could be operated in the area included between Thirty-third and Fifty-ninth Streets. When the corporation was unable to obtain a new franchise from the Board of Aldermen, its attention was called to the old franchise. Mr. Knight said that since Jan. 15 he had become a stockholder in the Long Acre Company to the extent of one share. Among other constructions planned in addition to the one at Forty-seventh Street and Second Avenue, was a substation storage-battery station at that point. When asked how many new contracts with consumers had been made, he said that they had engagements for six or seven customers on the block bounded by Second Avenue, Forty-eighth and Forty-seventh Streets, and an offer to supply power to the Criterion Theater when the theater's present contract expired, which would be around the beginning of 1909. He thought the income from the Criterion Theater would be about $500 a month. The connection between the Manhattan Traction Company and the Long Acre Company was that the former owned 490 shares of stock of the latter, and that the Long Acre Company was situated on the property of the Transit Company. There was no litigation by the Long Acre Company for or against it, Mr. Knight said.

Mr. W. H. King gave the following inventory of the Long Acre Company, which was taken Feb. 1, 1908: Two 75-hp Diesel oil engines; one 5-panel main switchboard; two 6-in. kw generators; six wattmeters; one 10,000-gal. oil tank; two 10-hp motors and regulators; one ½-hp motor and regulator; one lot enclosed fuses; 1200 ft. lead-covered cable; wiring and connections to cable. The total valuation of the inventory was placed at $1,600. This, added to the cash in the treasury of $18,010.24, gives a total of $34,010.24.

When asked what advantages the consumers would derive from the new company Mr. King said that "competition is the life of trade," and if this were not so the old electric companies would not have combined. The consumers would have an open market, and the Public Service Commission could prevent the Consolidated Gas Company from getting control of the Long Acre Company, preventing the transfer of stock. He said it would not be the policy of the company to sell current below cost, but that it could sell at a profit and still sell at lower rates than the rates prevailing at present. The guarantee that an exorbitant price would not be charged was that such a price would kill itself by competition. He believed that the corporation laws of New York were not sufficient to prevent individuals who owned stock in the Consolidated Gas Company from buying up the Long Acre stock and thus virtually controlling both companies, and added that there might be two or three ways whereby competition could be eliminated. Mr. King called Commissioner Maltbie's attention to the fact that the Long Acre franchise is the only existing franchise not controlled by the Consolidated Gas Company, and said that if the commission refused to allow the Long Acre Company to go ahead, the matter of competition was settled for all time in New York City, as his experience had shown that it was practically impossible to get a new franchise from the Board of Aldermen. He believed that the Long Acre Company could sell current at a considerably less rate that the present 10 cent per kw-hour maximum, and thought he would be willing to have some contract clause in the franchise to sell current at a less ratio to the cost of production than that existing at present. He was of the opinion that the demand for lower prices created by competition would stimulate inventive activity, which would lessen the cost of production and distribution. The hearing was adjourned to March 17.

Electric Haulage of Canal Boats.

A paper by Mr. Lewis B. Stillwell and Mr. H. St. Clair Putnam, read at the meeting of the American Institute of Electrical Engineers on March 13, reported the results of tests on the electric haulage of boats along the Lehigh Canal near Mauch Chunk, Pa. The boats used in the tests weighed from 135 to 139 tons loaded, and from 23 to 24.2 tons when empty. The energy consumption in watt-hours per ton-mile varied from 11.3 with four loaded boats at an average speed of 1.4 miles per hour to 20.0 with one boat at an average speed of 2.81 miles per hour, when a direct-current locomotive was used; when a direct-current traction was employed the consumption for four loaded boats was 12.0 watt-hours per ton-mile and 21.0 watt-hours for one boat. Special tests showed that the efficiencies of the locomotive and the tractors were almost equal, that of the locomotive being slightly higher. The authors suggest that the maximum speed between locks should be chosen as four miles per hour with one loaded boat and three miles per hour with four loaded boats. They estimate the total time in transit over 106.2 miles of canal, including locking, to be 160 hours with four boats and 75 with one boat.

In the discussion which followed the reading of the paper it was pointed out that, in view of the agitation for interior waterways, the question of electric haulage was opportune. Mr. Richard Lamb drew attention to the fact that canal transportation is essentially and always will be very slow, because of the shallowness of the water in the canals. If speeds are increased, the bow wave damages the banks and at a certain speed the canal boat absolutely stands still, touching bottom. Dr. Steinmetz, speaking from casual observations made of traffic on the Erie Canal, said that while mule power was antiquated, it was a question whether under actual conditions of operation mule haulage was not more economical than electric haulage. He also called attention to the fact that canals being public waterways, electric propulsion could not be insisted on to the exclusion of mule or steam propulsion, or any other established methods of propulsion. Moreover, canal traffic is intermittent and equipments designed to take care of the maximum traffic would probably be idle during certain parts of the year and run uneconomically during other parts of the year. He likened a canal to a country road on which a trolley line is built. There was not much traffic on the country road, because the traffice went over the trolley line; but the country road was maintained nevertheless for possible use. If electric haulage on canals were to show a superior efficiency, it would be because a new volume of traffic was created. Mr. Stillwell in summing up said that the subject of mule versus electric power was investigated by Mr. Putnam, and the results showed that if a canal were working at anything approximating to its full capacity, electric haulage in general would pay handsomely.

March Meeting of the New York Section of the I. E. S.

In a paper on "The Relation of Illuminating Engineering to Architecture from the Engineer's Standpoint," read before the New York Section of the Illuminating Engineering Society on March 12, Mr. E. L. Elliott stated that there is a very considerable degree of feeling among modern architects that the engineer and his work constitute a sort of necessary defilement of the rarefied spiritual atmosphere in which they should by right dwell. The modern architect seems to have only anchorage in which he has implicit faith and that is veneration for antiquity. The much admired ancient structures were wonderful embodiments of the highest degree of artistic taste and originality, but they remain as monuments of the most debased form of human labor conceivable, namely, hopeless and abject slavery. Strictly speaking, there are no remnants of any ancient structure which show the application of true engineering principles. Building to-day has become almost entirely an engineering problem; and with the vast increase in the complexity of life which characterizes modern civilization, has arisen the necessity of subdividing the general problem of construction into a number of distinct branches. Among these are the purely mechanical construction, which has given rise to structural engineering; the methods of heating and ventilating, with its special engineering; electrical equipment, with its electrical engineering; provisions for sanitation, with its sanitary engineering; and lastly, the necessities for artificial illumination, demanding illuminating engineering. All but the last mentioned of these special branches of engineering have gradually been necessitated in the evolution of building, and have been accepted by both architect and client. It is only the last that is still to some extent in the undeveloped state. The advent of the illuminating engineer as a specialist should be hailed with greater delight and relief by the architect than by any other member of the community. Having satisfied himself of the competency of the illuminating engineer, just as he would satisfy himself of the competency of the electrical, or construction engineer, the architect can turn over the plans of the building, with the specifications of the use or uses to which it is to be put, and probably also a statement of the illuminant to be used, and leave the entire technical problem to the illuminating engineer. A careful analysis of the respective provinces of the illuminating engineer and the architect discloses no more ground for mutual disagreement and distrust than between the architect and any other engineering specialist.

In opening the discussion Mr. Bassett Jones, Jr., explained that Grecian structures represent the highest attainment in architecture, because they were erected at a period when man was best able to appreciate true beauty, and in a locality where beauty was demanded by the general public. The best examples of architecture in modern buildings are found in those copied as faithfully as possible from Grecian structures.

Mr. W. H. Gardner remarked that the appearance of many of the modern buildings fails to please because of the complicated decorations. Beauty in architecture reaches its highest type when simplicity is adhered to.

Mr. A. J. Marshall expressed his dislike for contentions among the various interests represented in the membership of the society, and stated that best results will be obtained when the architect and the illuminating engineer reach a mutual understanding as to the duties that each should perform.

Mr. Elliott said that his paper was intended to point out the true condition of artificial illumination, to outline the points of difference as viewed by the architect and the illuminating engineer and to register a plea for more effective co-operation.

Mr. Norman Macbeth illustrated and described an original device for calculating illumination. The device, based on the so-called "inverse-square" law, allows either the illumination, the candle-power or the distance to be determined provided two of these three quantities are known. It consists of a logarithmic slide rule arranged in disk form for convenience in gradation. One of the scales (height) is arranged in "inverse" order, so that multiplication is equivalent to division by the square of the number indicated. Another concentric scale shows what multiplication factor is accounting for the cube of the cosine of the angle of deviation from the normal to the plane to be illuminated.

Zambesi-Johannesburg Transmission.

At a meeting of the Pittsburg Section of the American Institute of Electrical Engineers, held on March 4, at which there was an audience of more than 400, Mr. Ralph D. Mershon explained the commercial features of the Zambesi-Johannesburg transmission scheme. At the present time there is used along the Rand, near Johannesburg, power amounting to 65,000 kilowatts. The Zambesi Falls, which are 2.5 times as high as Niagara, can supply at least 225,000 kilowatts at low water. The Victoria Falls Power Company expects eventually to transmit energy from the Falls 700 miles to Johannesburg. In order, however, to eliminate the heavy investment which would be required if energy were to be transmitted at once from the Falls it has been suggested to construct a steam-driven generating station near Johannesburg for use during the period of building up a market for a large amount of electrical energy. Although the Thury direct-current system has been proposed for the 700-mile transmission system, it is probable that an alternating-current system will be adopted.

Chicago Lamp-Post Competition.

The Chicago Architectural Club recently held a prize competition for the design of a street lamp post, bracket and pedestal. The prizes, amounting to $200, were given by the Commonwealth Edison Company and James B. Clow & Sons. It was specified that the post shall be designed for incandescent lamps of 75 and 100 horizontal candle-power, the number of arms on the post to be not less than two nor more than four, with possibly an extra globe on top. This competition was started because of the interest that was being taken in improved street lighting in Chicago. The competition brought out eight designs. Most of these, it appeared in the discussion which followed the award, were rather too elaborate for economical production in cast iron. As to the arrangement of lamps, that adopted by most of the competitors was to hang lamps pendent on the ends of four arms and place one lamp upright on top of the post.

Additions to New York Central Electric Equipment.

The N. Y. C. & H. R. R. R. has decided to increase its equipment of electric locomotives for its New York suburban traffic. For this purpose it has ordered from the General Electric Company 12 direct-current locomotives to be delivered in about six months. These locomotives will be similar to those now in use for bipolar 600-volt motors receiving energy from an inverted third rail.

CURRENT NEWS AND NOTES.

NATIONAL CONFERENCE ON STANDARD ELECTRICAL RULES.—The annual meeting of the National Conference on Standard Electrical Rules will be held at the Edison Auditorium, 44 West Twenty-seventh Street, New York, on Friday, March 27, at 1 o'clock in the afternoon. This meeting will follow that of the electrical committee of the Underwriters' National Electric Association, representing the National Board of Fire Underwriters, and will consider changes made in the National Electrical Code.

A WELCOME TO PHOENIX.—The board of trade of Phœnix and Maricopa, Ariz., telegraphed recently Mr. T. A. Edison, on his recovery, offering him "free of all charges the use of the best residence obtainable furnished in this city, together with a carriage and coachman for as long as he will honor us with his company." This generous offer, with details as to the charms of the place, was sent to Mrs. Edison with the remark: "We reverently invoke the grace of God upon our great countryman in this hour of his trial, and affectionately urge his acceptance of our hospitality." All of which is extremely handsome, but Mr. Edison believes he can find greater seclusion and rest on his own plantation in Florida.

PUBLIC SERVICE COMMISSIONS VS. MUNICIPAL OWNERSHIP.—Mr. Glenn Marston, the municipal statistician, gave a lecture on "Public Ownership and the Public Service Commissions" before the students of Hobart College on March 6. Mr. Marston said that the commissions in New York and Wisconsin are formed under the most advanced laws for public regulation in the country. Their power over lighting companies enables them, on proper complaint, to give the public all the advantages which can be derived from competition without the possibility of future high rates when the competitors come together. The main part of his address was given to a discussion of the check on public ownership which has followed the creation of the public service commissions. In states where commissions exist all the objects sought by public ownership advocates are accomplished through public control without risking a large amount of public money in a commercial venture which usually turns out unprofitable.

GOVERNMENT ELECTRICAL TESTING.—The British Government has approved the recommendations of a committee which was appointed to determine if the National Physical Laboratory competes unduly with private enterprise in commercial testing work. The committee in its report classifies commercial testing under two heads, "contractual" and "investigatory." The former means ordinary testing of materials to see whether they meet the specifications of a particular contract; investigatory testing covers all other testing work. The committee leaves the Laboratory free as regards the latter; as regards contractual testing, it reserves this for private enterprise as a general rule, with the following exceptions: First, the Laboratory can take any work for which private establishments are not equipped. Secondly, it can take any work that is sent to it by arbitrators, judges or disputants. Thirdly, it can take work for government departments. As a further safeguard it is recommended that where the same tests are carried out in the Laboratory and also by outside parties, the fees of the former should be at least as high as the current rates; while in the case of reference testing (i. e., to settle disputes) they should be distinctly higher. The Laboratory should also charge much higher fees when it is asked to defer publication of the results for a period of years.

METALLIC-FILAMENT LAMPS IN ENGLAND.—According to our London contemporary, *Electrical Times,* the use of the metallic-filament lamp in England has spread consternation among the gas companies. In replying to statements in the press relating to the effect of the new lamp on the gas industry, representatives of the latter "have written pathetically earnest letters of remonstrance, pointing out that gas really is *not* dearer, that it really is *not* more unhealthy, that doctors swear by it, and so on. Gas managers no longer talk so glibly about '5 or 10 times the cost.' They have been pulled up with too painful a jerk to carry on the tale—except when treating with obvious simpletons." The claim having been made that a 64-cp gas mantle only takes 3 cu. ft. of gas per hour, it was met by a central-station manager, who said that he finds 5 cu. ft. is the average consumption, and 30 or 40 candle-power the average illumination. Our contemporary continues that the gas challenge is now, "Come and compete with us in the laboratory." "The tables are turned. The gas companies used to tell us contemptuously that the public had no use for laboratory tests, they wanted practical results. Yet now the challenge of the same people—not to prove that gas is one-tenth the cost, but to prove it merely equal value for the same money—is couched in terms that are applicable only to the gas tester's laboratory at the gasworks."

TELEGRAPH POLES IN PHILADELPHIA.—The Philadelphia Council has passed an ordinance giving the chief of the City Electrical Bureau the power to cut down the wires and poles of the Postal Telegraph Company should that company fail to pay to the city a $16,000 claim within 30 days.

PUBLIC SERVICE STOCK DIVIDENDS.—The Public Service Commission of the Second District of New York has decided that it is not lawful for electric corporations to issue stock in payment of dividends. The decision was in a case involving the Babylon Electric Light Company, which had asked for authority to issue $60,000 capital stock.

FEATHER RIVER POWER DEVELOPMENT.—The Western Pacific R. R. Co. is stated to have a force of 1100 men at work upon its electrical power development plant. A tunnel 3 miles long and 18½ x 20 ft. in the clear, cut through rock and lined with concrete, has been completed. It is stated that the plant when finished will have a capacity of 120,000 hp

ANNUAL CONVENTION OF THE A. I. E. E.—The committee appointed to select a location for the next annual convention of the American Institute of Electrical Engineers has reported in favor of Atlantic City, N. J., with headquarters at the Hotel Traymore, and the Board of Directors has approved the selection. The convention will begin on June 29 and is expected to close on July 2.

PRATT ELECTRICAL STUDENTS ORGANIZE.—The students of the three classes which make up the industrial electrical course of Pratt Institute, Brooklyn, namely, the classes in electrical design, advanced electrical, and elementary electricity and mechanics, have formed an organization. A permanent chairman has been elected, and also a governing body consisting of three students from each class.

WAIPORI POWER PLANT.—In an article in our issues of Nov. 23-30, 1907, describing the Waipori power plant in New Zealand, the names of the following gentlemen, who assisted Mr. W. G. T. Goodman in carrying out the work, should have appeared: Mr. J. T. Wolf, who assisted in designing the electrical portion; Mr. E. E. Stark, who was at one time engineer of the Waipori Company and is now city electrical engineer in charge of the plant; Mr. E. W. Eckland, who supervised the converter-station work. Mr. F. R. Shepherd, who supervised the substation and low-tension transmission line, and Mr. J. Bowman, who supervised the erection of the building.

ROCHESTER INCREASED TELEPHONE RATES ILLEGAL.—The Appellate Division of the Supreme Court of the Fourth Department has declared illegal a recent increase of rates made by the Rochester Telephone Company. The decision was based upon a suit in which the old rate of $48 per year had been raised to $60, and held that municipal consent was required to raise rates by a condition attached to the telephone franchise. The contention of the telephone company was that in New York State the fixing of rates was not within the scope of a municipality. The court held that the telephone company is estopped from questioning the right of the city to regulate rates and from repudiating that part of its agreement with the city limiting telephone rates.

A. I. E. E. NOMINATIONS.—The Board of Directors of the American Institute of Electrical Engineers has selected the following nominees for the forthcoming annual election: President, Mr. L. A. Ferguson, Chicago. Vice-presidents, Messrs. C. C. Chesney, Pittsfield; Calvert Townley, New Haven; Bancroft Gherardi, New York. Managers, Messrs. D. B. Rushmore, Schenectady; H. E. Clifford, Boston; W. G. Carlton, New York; C. A. Stone, Schenectady. Treasurer, Mr. G. A. Hamilton, New York. Secretary, Mr. Ralph W. Pope, New York. The following were transferred from the grade of associate to full member: Mr. Henry James Shedlock Heather, Johannesburg, Transvaal; Mr. Howard Saunders Warren, New York, and Mr. Walter F. Wells, Brooklyn.

MARCONI ON WIRELESS.—In a lecture delivered last Friday before the Royal Institution in London, Marconi stated that communication across the Atlantic by his new plant has never been interrupted for more than a few hours at a time since the commencement of commercial work on Oct. 17. Mr. Marconi referred to the difficulty met with in transmitting during certain hours of the day. These periods, he said, come in the morning and evening, when daylight or darkness extends only part way across the Atlantic. He read a letter from the *New York Times,* in which it was stated that since October last that journal had received from its correspondents in England and on the Continent news dispatches totaling 68,404 words, promptly and efficiently transmitted by wireless.

NOBLE ELECTRIC IRON SMELTER.—The new experimental furnace at the Noble electric iron smelter, at Heroult, on Pitt River, near Redding, Cal., has been run continuously for several days, turning out 2400 lb. of pig iron every 24 hours. The new furnace is the design of Prof. Dorsey Lyon, of Stanford University, who superintended its construction and is directing its operation. The recent test run was very satisfactory, the furnace being tapped regularly every four hours. The Lyon furnace differs from the Heroult electric furnace in that it is operated by a single-phase current, the other being of the three-phase type. After a month's thorough test of the Lyon furnace a larger one will be constructed so to make a thorough test on a commercial basis of the process.

JAPANESE WATER POWERS.—Consul-General Henry B. Miller, of Yokohama, gives the following account of several of the numerous proposed Japanese water-power developments: In the case of one power site on the Tashiragawa the construction of a tunnel 3½ miles long would, it is stated, secure about 66,000 horse-power, and at another power site by means of about 10 miles of tunnel and a certain amount of open canal construction 150,000 horse-power could, it is reported, be secured. In the first instance there is a good reservoir site for storage, while in the second instance advantage would be taken of natural lakes. These sites, and others which have been surveyed, are in the Fujiyama district. Additional sources of power are near Nikko, where Lake Chuzenj would form the large reservoir, and where with four miles of tunneling a fall of 2,000 ft. could be secured; also in the Lake Inawashiro district, where the construction of four miles of tunneling would provide upward of 50,000 horse-power. An inspection of the principal sites and a study of the rainfall statistics over many years point to the probability of the initial plants giving, even during periods of drought, 300,000 horse-power. A favorable feature of the scheme is that the power sites provisionally selected are located within a comparatively short distance of Tokyo, where at the outset the bulk of the power would be taken. Between the capital and the sites referred to there is a minimum transmission distance of 80 miles and a maximum of 150 miles. It is estimated that the present requirements of Tokyo represent 48,000 horse-power, and that plants which will call for an additional 20,000 horse-power are in process of erection. These figures do not, however, include the electric road from Tokyo to Yokohama, or the elevated road which is being constructed by the government in Tokyo. One of the chief power sites is within 135 miles of the old capital, Kyoto, and Osaka, the Manchester of Japan, is only 160 miles distant. It is believed that with the growth of the interurban tramway systems in Japan there would be an immense field for cheap water power. Owing to the high price of coal the cost of steam power is high, and the utilization of water power should prove an important factor in the industrial development of Japan.

WESTINGHOUSE INTERESTS OPPOSE SALOONS.—According to a Pittsburg dispatch the Westinghouse interests have asked the court that no more liquor licenses be granted for the town of East Pittsburg, where the Westinghouse works are located.

KANSAS CITY RAILWAY & LIGHT.—The report of the Kansas City Railway & Light Company for the eight months ending Jan. 31, shows gross earnings of $4,175,058, and a surplus of $866,793, as against $789,797 for the same period of the previous year.

CONSERVATION OF NATURAL RESOURCES.—The April meeting of the American Society of Mechanical Engineers will be devoted to a consideration of the subject, "The Conservation of Natural Resources." Dr. H. S. Pritchett will deliver an address on "The Engineer as the Trustee of Our Natural Resources."

N. Y., N. H. & H. ELECTRIC SERVICE.—The electric service of the Hartford Railroad Company between New York City and Stamford, Conn., is being gradually extended. The Westinghouse single-phase electric locomotive now operates 12 through trains. It took an average of only three minutes to cut off the steam locomotives and attach the electric engines, and the running in all cases was smooth and on time.

ELECTROCHEMICAL COMMISSION.—Prof. E. Mascart, of France, has accepted the presidency of the Electrochemical Commission. This body, which has a central office in London, is the result of a recommendation of the St. Louis International Electrical Congress, and is supported by subscriptions from the various national electrical engineering associations of the world. It is understood that the presidency had been offered to Lord Kelvin just prior to his death.

CARNEGIE PENSIONS WAR TELEGRAPHERS.—Andrew Carnegie has placed on his pension rolls, at the rate of $144 per year, the names of such members of the Civil War military telegraph corps as a committee of the corps shall recommend. There were about 1200 of the telegraphers who served in the Civil War; less than 200 survive, and of these about 10 per cent are in needy circumstances. Congress had refused appeals to grant pensions to the survivors of the Civil War telegraph service.

A CORRECTION.—In the article entitled "Single-Phase Railway in Virginia" in the issue dated March 7, an error appears in the statement regarding the engineers in charge of the work. The consulting engineers for the work were Mr. S. W. Huff, formerly general manager of the Virginia Passenger & Power Company, and now president of the Coney Island & Brooklyn Railway Company, and Mr. George H. Whitfield, mechanical and electrical engineer of the Virginia Passenger & Power Company.

BREAK-DOWN CONSUMERS' HEARING.—Public Service Commissioner Maltbie, on March 10, held an informal conference with the consumers of break-down current in New York, to find out what their attitude is toward the $30 break-down rate fixed by the New York Edison Company. The consensus of opinion, as reported, was that the charge was prohibitive. The suggestion was made that the cost of insurance be kept distinct from the current charge, or at least that the basis of calculating the charge for break-down service be the maximum of current needed and used, rather than the kilowatt installation.

PIONEER TELEPHONY.—The recent death in Detroit of Mr. George W. Balch recalls the early days of telephony. In 1877 he organized the Telephone & Telegraph Construction Company, of which he became president, and the same year constructed several short telephone lines in Detroit, two being between the works and office of the Michigan Car Company and the Detroit water works, respectively. In 1878 he established what has been claimed to be the first telephone exchange in the world, which commenced with four or five lines, with 8 or 10 subscribers on each line. In 1879 the company constructed a line between Detroit and Port Huron.

BIDWELLS FOUND GUILTY.—Benson Bidwell and his son Charles F. Bidwell, promoters of the Bidwell "cold motor" scheme, have been found guilty of obtaining money by false pretences for operating a confidence game. The court instructed the jury that it could find the Bidwells guilty on only one count, whereby a verdict for operating a confidence game was gained, which is a penitentiary offence. During the trial it was shown that the Bidwells had received about $225,000 for stock sold. It was also shown that the Bidwell motor was kept cold by passing liquid carbonic acid gas through the field frame. Benson Bidwell is a brother of George and Austin Bidwell, who in 1872 victimized the Bank of England by means of forged bills to the amount of $1,000,000.

SOUTHWESTERN CONVENTION.—The Southwestern Electrical & Gas Association, which is to hold its convention at El Paso, Tex., May 7, 8 and 9, 1908, has selected the St. Regis Hotel as headquarters, and the management of the hotel has agreed to permit the use of two sample rooms in the basement for exhibition purposes, these sample rooms to be given free of charge for this purpose. If this space is not found sufficient for all who wish to make an exhibit, President H. T. Edgar announces that an effort will be made whereby all the exhibits can be shown together. Current for exhibits can be obtained from the El Paso Electric Railway Company, either single or two-phase, 60-cycle, 104 or 208 volts. Those wishing to exhibit should notify President H. T. Edgar, care of Northern Texas Traction Company, Fort Worth, Tex.

ELECTRICAL CURRENCY.—In these days of clearing-house certificates, scrip and other makeshifts for ready money, it is not surprising to find a new medium of exchange, which, for want of a better name, has been designated as "electrical currency." The proprietor of a certain large down-town café in New York not long ago was repeatedly puzzled to find that many of the 16-cp lamps in his restaurant had been unscrewed from their sockets and removed. As the lamps were supplied by the Edison Company and apparently were non-negotiable, the loss remained unexplained until at length it was found that a certain saloon down in the Bowery accepted the lamps in place of cash, at the rate of one lamp for each mug of beer. "As each lamp costs us in the neighborhood of 13 cents," said an officer of the Edison company, "it is quite evident that the drinks are on us."

TRANSATLANTIC CABLE JUBILEE.—Aug. 17 will be the fiftieth anniversary of sending the first cable message across the Atlantic Ocean. In August of 1857, the first attempt to lay a cable was made, but about 300 miles from the Irish coast a strain caused by a sudden dipping of the sea bottom caused the cable to part, and the attempt was for the time abandoned. A message of 90 words from Queen Victoria to President Buchanan, which took 67 minutes to transmit, was sent through the 1858 cable, but after a few following short messages it ceased to transmit signals. One of the electricians on the U. S. S. *Niagara,* which, together with the British war vessel, *Agamemnon,* laid this cable, always maintained that no message was ever sent, and that the message to Buchanan from Queen Victoria was "cooked up" for commercial purposes, his ground being that the cable had ceased to test out long before reaching the Newfoundland coast, and that on several occasions in paying it out accidents had occurred that had destroyed the insulation of the cable. In 1865 another unsuccessful attempt was made to lay an Atlantic cable, and the first operative cable was not laid until 1866.

Wireless Telegraph Plant at the United States Naval Academy.

By Lieut.-Com. W. H. G. Bullard, U. S. N.

THE wireless station at the United States Naval Academy, Annapolis, Maryland, forms one of a chain of stations under government control extending on the Atlantic Coast from Frenchmen's Bay, Maine, to Galveston, Texas. Other stations in this chain are located at Guantanamo, Cuba; San Juan, Porto Rico; Culebra and Colon.

The station was established in June, 1904, not as a transmitting station for long distance, but rather as a relay station to forward such messages as it would be able to pick up from other stations or from vessels bound up or down the coast.

For this reason the power installed was small, the station set having only a rated capacity of 2.4 kilowatts. This power is obtained from a storage battery furnished by the Electric Storage Battery Company of Philadelphia, Pa., and consists of 40 cells, giving a normal voltage of 80 volts. When occasion demands, this battery is charged from power obtained from the main power station supplying the Naval Academy with light and heat.

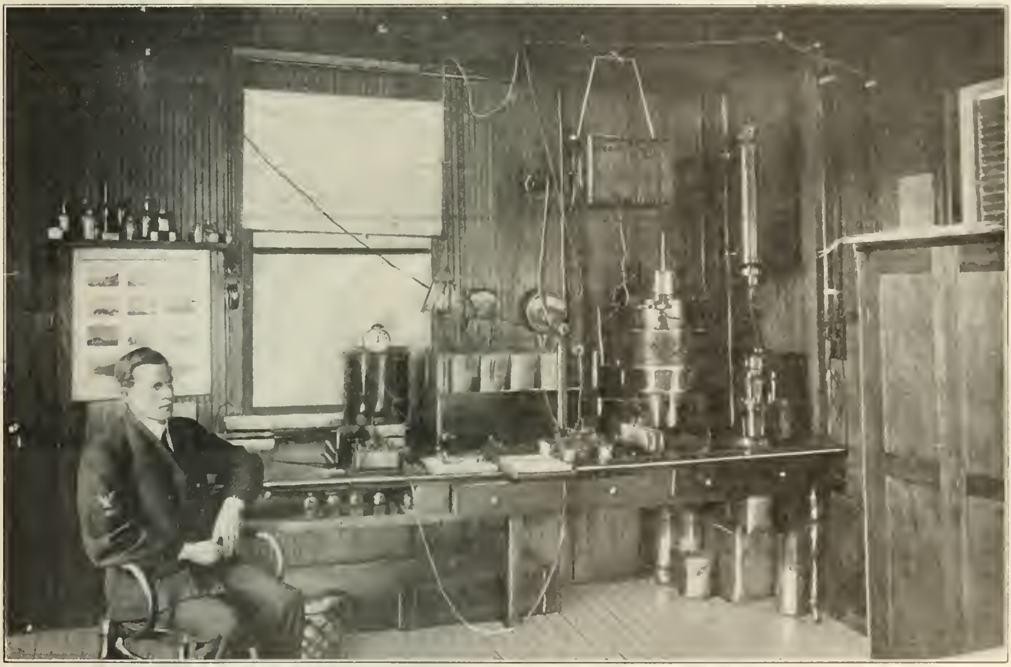


FIG. 1.—REGULAR WIRELESS STATION PLANT.

The transmitting circuit contains the induction coil, condensers, inductance and spark gap of the well-known Slaby Arco type. The direct current from the storage battery is led to the primary of the induction coil, and the make-and-break is effected by means of a mercury turbine interrupter, making 1600 revolutions per minute. With a line voltage of 80 volts, a maximum of about 25 amperes may be used in the primary windings. The condenser consists of seven leyden jars, connected in multiple with a total capacity of .014 microfarad. The inductance is a spiral conductor of No. 8 copper wire, consisting of 9.9 turns of a mean diameter of 17 in. The spark gap is a single break between zinc electrodes with a normal length of ¾ centimeter and a maximum length of 2⅛ centimeters.

The receiving device now used is of the De Forest type of electrolytic cell used in connection with the head telephones of the Schmidt-Wilckes make. This cell uses a Wollaston wire, glass jacketed, and of .006 in. diameter, as the anode, and a platinum wire as the cathode, in a solution of pure nitric acid. In connection with this cell is used a primary battery, with potentiometer. Associated with the detector in the receiving circuit is a capacity .005 microfarad with a variable inductance of two coils of copper wire wound with 500 turns on each coil.

The aerial is a loop of a total length of 1034 ft., consisting of four wires of phosphor bronze. It has a horizontal length of 100 ft. and a vertical length of 166 ft. The aerial is coupled direct to the transmitter inductance and has a natural wave length of 335 meters. The wave length ordinarily used is 318 meters for the lower hump and 420 for the upper. With the coupled circuit for 425 meters, the lower hump is 348 meters and the upper hump is 500 meters.

In the Department of Electrical Engineering at the Naval Academy and entirely distinct from the working station described above, is installed a 5-kw Stone wireless-telegraph plant, made by the Stone Telegraph & Telephone Company of Boston, Mass. This is used for the sole purpose of demonstration and for the instruction of midshipmen in their electrical course. The set is installed in a large room with all the working parts and wiring in the open so they may be easily got at and inspected.

The power is obtained from the Academy power plant, direct current of 110 volts being converted by means of a motor-generator into an alternating current of the same voltage. The current is controlled through a switchboard, containing the proper switches and rheostats to regulate the fields of both machines of the motor-generator; voltmeters, ammeters and reactance for the alternating current, and an automatic starting resistance for the motor. The motor-generator is started by the single operation of closing a double-pole switch on the operator's table.

The distinguishing features of the Stone set are the multiple arrangement of the transmitting inductance, the series key for making signals, the spark gap and the "weeding-out" circuit of the receiver. The set is inductively coupled to the aerial and consists of four coils in parallel for the primary, connected inductively as an air transformer to four coils in parallel in the secondary. One terminal of each secondary coil is connected to the aerial through a loading coil and the other to ground. With the high frequency of the alternating current—120 cycles per second—and the large inductance, this is necessary to produce the short wave-length desired.

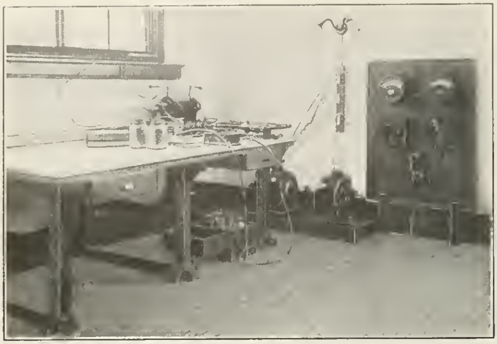


FIG. 2.—"HOME MADE" WIRELESS SET.

In this system, the circuit is made and broken to produce the proper signals on the high-potential side of the induction coil. This obviates breaking the heavy current of the primary and the consequent arcing and burning of the key contacts. The high-potential side is made and broken in both leads of the mains by a line of contacts in series. These contacts are actuated by small electromagnets, wired in series with the low-potential current of 110 volts. Inserted in this circuit is a resistance to reduce the current through the electromagnets to about one ampere. The key that operates the series keys is on the operator's table, and is a simple telegraph key whose terminals are connected to a small condenser. Making and breaking this auxiliary current has the effect of making and breaking the line on the high-potential side of the induction coil.

The spark gap consists of a series of parallel brass rods through which the spark occurs, and it can be regulated by a rod on one terminal which slides over them, cutting out more or less of the rods. To remove the metallic vapor formed at the spark, a strong blast of air is blown over it from an auxiliary blower.

The receiving circuit contains the usual inductance and capacities, and normally consists of three circuits, all inductively connected. The third circuit contains the electrolytic detector and head telephones. The middle circuit is termed the "weeding-out" circuit and is used when sharp tuning is necessary to cut out interference. All the capacities are of the variable sliding type, and the primary inductance of the sliding bare wire type. Arrangements are made for varying the mutual induction of all the circuits by moving one inductance in relation to the other in each circuit.

The condenser is of the glass-plate tin-foil type, made up in four sections, one being connected to each of the four primary circuits of the oscillating transformer. Its dielectric is castor oil, which is used to reduce the violet discharge at the edges of the tin foil on the glass plates.

In connection with the instruction of midshipmen, there is installed in the Department of Electrical Engineering another small wireless telegraphy plant of no particular make or system, but containing all the elements required for the proper sending and receiving of signals. The power is transformed from the Academy plant voltage to a lower voltage of continuous current by a small rotary transformer. This direct current is used with an ordinary induction coil with a hammer make-and-break; a battery of leyden jars forms the condenser and a helix of copper wire the inductance.

For receiving, a small incandescent lamp is used as a detector, the filament being removed and the interior filled with nitric acid introduced to cover the platinum points of the leading-in wires. This is used in connection with an ordinary telephone receiver. It may not be amiss to state that all of the apparatus has been made from the odds and ends to be found in a physical laboratory, but it well illustrates the principles, and the sending and receiving are both very efficient. This home-made plant is entirely at the disposal of the midshipmen under instruction, who can perform any experiments they please, make such connections as they fancy, and get such results as they may.

All midshipmen are required to take the same course in all branches of electricity, and wireless work forms a small but very important part of the course. At the outset of the course in wireless work, a general lecture is given to the whole class, in which are explained by figures and sketches the general principles of the science, what is expected to be done and how it is to be done. This first lecture takes up the elementary sending and receiving circuits, the operation of the transmitter to produce the electromagnetic waves and that of the receiver to detect and record their presence. This lecture is followed later, when the actual apparatus is understood, by one on the adjustments required, on the tuning of the different circuits, with a description and exhibition of the different forms of wave meters.

After the first lecture, the midshipmen are divided into squads in charge of an officer and sent to the "home-made" plant spoken of above, where the lecture is supplemented by an inspection of the apparatus and the actual phenomena of transmitting and receiving are observed. This tends to awaken an interest, questions thick and fast are the result, and the session rapidly develops into another lecture. After the general principles are well grasped and the functions of each separate piece of apparatus is well understood, they are taken by squads to the other two plants in turn. At the Department plant they can observe the working of each individual part and trace each connection; and at the working plant they can witness official messages being sent and received by expert operators. At each place they are under the direct supervision of an officer instructor, who follows out all the details, explains all parts, and requires all to record in note-books what they have seen or heard or done. These note-books are written up in smooth style after the instruction period is over, and are then submitted for inspection and correction. The students are required to make diagrams of all the connections, indicate all apparatus,

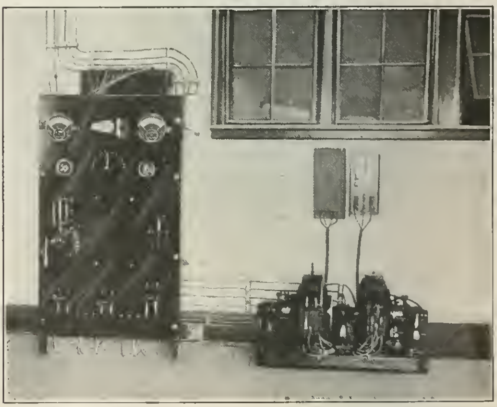


FIG. 3.—AUTOMATIC SWITCHBOARD AND MOTOR-GENERATOR.

state functions of each individual piece, and state what occurs in each portion of the circuit from the time current is turned on until it is broken.

After a lecture on the tuning of the various circuits, which is given to the whole class at a time, they are again taken by squads and shown by expert operators how to find the natural vibration period of each circuit; how to tune any circuit to a given wave length; how to couple the circuits, and how to find the resultant wave length. They are each required to obtain data by which the form of the wave sent out may be plotted and are required to plot different wave forms for different conditions.

In all, each midshipman receives eight hours' practical instruction with the wireless plant, in addition to the time devoted to lectures and to section room work, where each is required to recite on lessons previously assigned. This last requires about five hours of time, each recitation period being one hour. There is no attempt to make expert operators out of the midshipmen students, but rather to make them familiar with the general principles involved, with as much actual apparatus as possible, and to make them capable of taking charge of a wireless plant on ship board, and to make all adjustments and be prepared for any emergencies or accidents that may occur.

A new wireless plant of 20-kw capacity has been contracted for by the Bureau of Equipment, Navy Department, to be installed at the Naval Academy, which will make one more plant that can be utilized for instruction and demonstration purposes, and an installation of wireless telephones will shortly be made to aid in the general course of instruction.

Water Power.

The March number of the *General Electric Review* contains a paper by R. E. Horton presenting a résumé of the advantages that may result from the substitution of central hydroelectric power stations with short transmission lines to the mills, in place of the present systems of power development and distribution at many existing water-power centers.

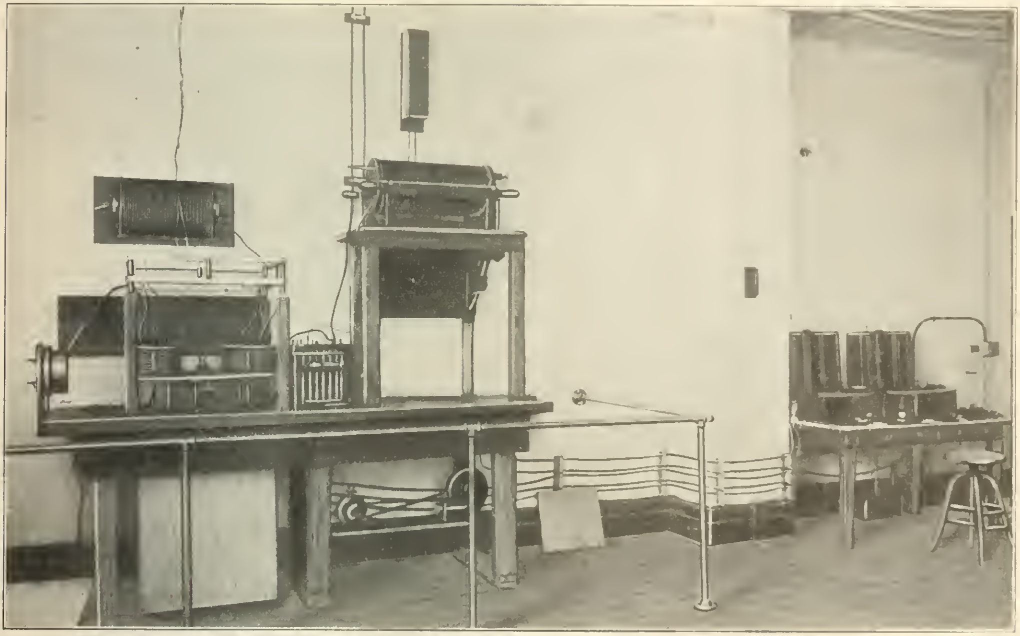


FIG. 4.—STONE TRANSMITTING APPARATUS AT LEFT. TWO RECEIVERS AT RIGHT.

Influence of the Height of Suspension Upon Uniform Illumination.

By Alfred A. Wohlauer.

In an article which appeared in the issue of Electrical World for Dec. 21, 1907, the present writer attempted to deduce methods that lead to uniform illumination of large horizontal planes by means of a multitude of lamps properly distributed over the whole area.

This problem is of importance at the present time where new kinds of incandescent lamps, as well as the small-size arc lamps, make such a method of illumination for large rooms advisable on account of cheapness and the agreeable influence upon the eyes. Moreover, the same rules hold true also for outdoor lighting where still larger areas and powerful arc lamps are concerned. For this and for other reasons it seems to the writer worth while to dwell somewhat exhaustively on the influence which the height of suspension of the lamps exercises upon uniform illumination.

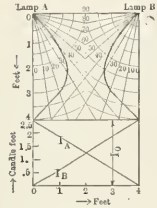
It has been pointed out by F. W. Weinbeer that for every type of lamp or for the corresponding polar-curve a certain height of suspension can be calculated as the minimum allowable for uniform illumination. He stated that the lamp units can be raised above the minimum height without impairing the intensity of illumination or the uniformity of light distribution. However, a suspension lower than the minimum will result in non-uniform illumination if the distances between the lamps and the shape of the polar-curve remain the same.

The facts stated by Weinbeer are applicable to the theoretical curves of the previous article, which represent the case of minimum height of suspension, corresponding to a certain value of K. ($K = \frac{D}{H}$, where $D =$ distance between two lamps, and $H =$ the height of suspension.) A suspension lower than H without a change of the other values, as K, D, polar-curves, etc., results in non-uniform illumination, as illustrated by Figs. 1 and 2. In Fig. 1, where $H = 4$, $D = 4$, as in Fig. 3 of the previous article, the illumination I_{ab} is uniform, while in

Fig. 2, where the suspension is 1 ft. lower, the variable illumination curve I_{ab} will be obtained. This is due to the fact that the illumination curve of a single lamp passes through zero at the points S and T (of Fig. 2), where the illumination of the other lamp has not yet reached its maximum value equal to the desired uniform illumination.

On the other hand, an increase of the height of suspension above H changes neither the intensity nor the uniformity of illumination, provided again that the other factors, such as distance, polar-curves, etc., remain unchanged.

This may be considered as an important law of illuminating engineering, and it is, therefore, pertinent to thoroughly investigate it in order to bring about its clear understanding



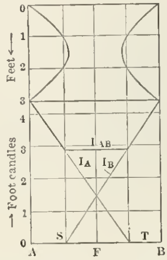


FIG. I.—UNIFORM ILLUMINATION, MINIMUM HEIGHT OF SUSPENSION. FIG. B.—NON-UNIFORM ILLUMINATION, LOWER SUSPENSION.

It is well to start with the illumination produced by a single lamp and to remember that the illumination of a single lamp decreases proportionally to the square of the height of suspension, as illustrated by curve RST of Fig. 4, and by Table I.

TABLE I.—INTENSITIES OF HORIZONTAL ILLUMINATION FROM ONE LAMP.

Height, feet.	Illumination below lamps.
2	10
3	4.44
4	2.5
5	1.6
6	1.11
7	.82
8	.625
9	.494
10	.4

The uniformity becomes better with increased height of suspension, or, in other words, the relation between maximum and minimum illumination decreases toward unity. (Fig. 3.)

If (not more than) two lamps are employed, and if the polar-curves have a shape as suggested in the article mentioned above, the following conditions will prevail. The line between the points A and B (the foot of the perpendiculars from the lamp centers) will be uniformly illuminated if the height of suspension is such that the illumination curve of one lamp passes through zero just where the maximum illumination of the next lamp sets in.

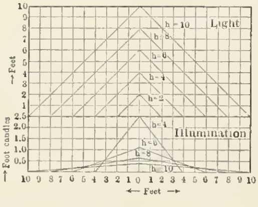


FIG. 3.—INFLUENCE OF HEIGHT OF SUSPENSION UPON INTENSITY AND UNIFORMITY OF ILLUMINATION FROM ONE LAMP.

If the height of suspension is smaller, the illumination will not be uniform, as illustrated in Fig. 2; the illumination of the point F, which is just in the center of the line AB, will vary according to curve VS of Fig. 4, while the illumination in the points just below the lamps is the same as if one lamp alone were present, which is illustrated by curve RS, in Fig. 4. S is the minimum height of suspension (see Fig. 4).

If the lamp is suspended higher than the limit for uniform illumination, the light distribution will remain uniform along the line AB, but it will decrease with the height of suspension, although not proportional to the square of the height of suspension. (Table II.) This is illustrated by the curve SU of Fig. 4, which gives the illumination for the points A and B, as well as for the point F, and shows that the illumination is practically the same for all three points. The values of this curve and of Table II are calculated by means of the following formulas:

TABLE II.—INTENSITIES OF HORIZONTAL ILLUMINATION FROM TWO LAMPS.

Height, feet.	Foot-candle illumination. Below lamp.	Foot-candle illumination. Between lamps.
2	10	0
2.25	7.8	1.66
2.5	6.4	2.56
3	4.4	2.96
3.5	3.25	2.8
4	2.5	2.5
5	1.92	1.92
6	1.48	1.48
7	1.16	1.16
8	.94	.94
9	.77	.77
10	.64	.64

$$I_A = \frac{L}{h^2} + \frac{L}{h^2}\left(1 - \frac{H}{h}\right) \qquad (1)$$

$$I_F = \frac{L}{h^2}\left(2 - \frac{H}{h}\right) \qquad (2)$$

in which

L = candle-power illumination vertically downward.
h = variable distance in feet from lamp to surface.
H = height in feet of suspension for uniform illumination.
I = foot-candle illumination.

(Index A or F in the tables refer to the corresponding point on the surface.)

In equation (1) the quantity $\frac{L}{h^2}\left(1 - \frac{H}{h}\right)$ reduces to zero for $h < H$.

If $h > H$, equations (1) and (2) are identical, which proves that the illumination I_{ab} is uniform for h larger than H.

The illumination of the space outside of the line AB will not be discussed in this article.

If a multitude of lamps is employed to illuminate a certain area, the illumination will be practically uniform if the conditions comply with the laws deduced in above-mentioned article.

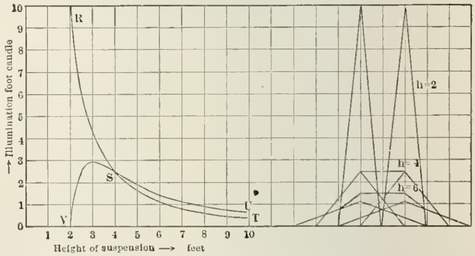


FIG. 4.—INFLUENCE OF HEIGHT OF SUSPENSION UPON ILLUMINATION DUE TO TWO LAMPS.

A suspension of the lamps lower than corresponding to the above laws results in non-uniform illumination, as stated above. There is no difference if one, two or more lamps are employed.

For higher suspension than "minimum height of suspension," equations can be deduced from which the values of illumination for different heights of suspension can be calculated. These equations are extremely long and are rather complex for the general case, but they will be considerably reduced and simplified if the relation $\frac{h}{H}$ does not exceed practical values.

From such equations, the values of illumination for different points have been calculated, also graphical determinations have been employed, and it has been found that the number of lamps which participate in the illumination of a certain point increases with the height of suspension, and while the illumination due to a single lamp decreases proportionally to the square of the height of suspension, the total illumination remains the same, however much the lamps are raised above the surface.

Equations (3) and (4) have been used to calculate the illumination for the point *A*, just below the lamp and for *E*, the point of intersection of the diagonals. These equations consist of a number of members indicating the number of lamps which participate in the illumination of the point in question. For instance, in equation (3), the first member $\frac{L}{h^2}$ gives the illumination produced by the lamp just above the point *A*. The next member $\frac{L}{h^2}\left(1.1 - 1.2\,\frac{H}{h}\right)$ represents the illumination from the lamps nearest to lamp *A*, the next following member, the illumination from the next set of lamps, etc. The number of these members, as said, increases with the height of suspension, while a member is zero as long as the expression in parentheses remains zero or less than that value.

$$\left.\begin{aligned} I_A = \frac{L_v}{h^2} &+ \frac{4L_v}{h^2}\left(1.1 - 1.2\,\frac{H}{h}\right) \\ &+ \frac{4L_v}{h^2}\left(1.1 - 1.7\,\frac{H}{h}\right) \\ &+ \frac{4L_v}{h^2}\left(1.1 - 2.4\,\frac{H}{h}\right) \\ &+ \frac{4L_v}{h^2}\left(1.1 - 3.4\,\frac{H}{h}\right) \\ &+ \frac{8L_v}{h^2}\left(1.1 - 2.7\,\frac{H}{h}\right) \quad \text{etc.} \end{aligned}\right\} \tag{3}$$

$$\left.\begin{aligned} I_E = {} & \frac{4L_v}{h^2}\left(1.1 - .85\,\frac{H}{h}\right) + \\ & \frac{4L_v}{h^2}\left(1.1 - 2.55\,\frac{H}{h}\right) + \\ & \frac{8L_v}{h^2}\left(1.1 - 1.9\,\frac{H}{h}\right) + \\ & \frac{8L_v}{h^2}\left(1.1 - 3.06\,\frac{H}{h}\right) + \\ & \frac{8L_v}{h^2}\left(1.1 - 3.34\,\frac{H}{h}\right) + \text{etc.} \end{aligned}\right\} \tag{4}$$

The equations (3) and (4) are based on a distribution of light such as is represented by Fig. 5, which is taken from the article mentioned above; as shown in Figs. 6 and 7 of that article, this distribution provides practically uniform illumination over the whole area at the minimum height of suspension.

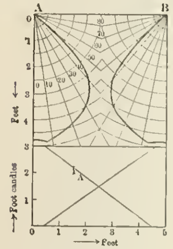


FIG. 5.—POLAR CURVES FOR UNIFORM ILLUMINATION.

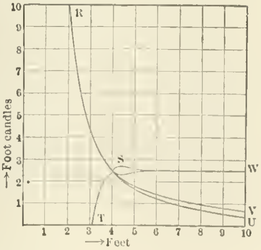


FIG. 6.—ILLUMINATION BY A MULTITUDE OF LAMPS.

The illumination under a certain lamp, which comes from this lamp, is uniform for an area within a circle, the radius of which is .085 times the distance between two lamps, and beyond this area the illumination from this lamp decreases regularly to zero at a point where the maximum illumination of the next lamp begins.

As an example, the equations have been used for the calculation of the intensities of illumination at different heights of suspension introducing into the equations as constants the values, $D = 4$ ft., $H = 4$ ft., and $L_v = 40$ candles.

The results of the calculations are represented in Fig. 6 and Table III. *S* illustrates again the conditions for minimum height of suspension; the curves *RS* and *ST* refer to lower suspension, *RS* giving the illumination just below the lamps, *TS* the illumination at the point of intersection of the diagonals. The line *SW*, however, shows the illumination for suspensions higher than the minimum and proves that the illumination remains practically constant and uniform if the lamps are raised above the minimum height of suspension.

TABLE III.—INTENSITIES OF ILLUMINATION FROM A MULTITUDE OF LAMPS.

Height, feet.	Foot-candle illumination. Below lamps.	At intersection of diagonals.
2	10	0
2.25	7.8	0
2.5	6.4	0
3	4.4	0
3.5	3.25	1.75
4	2.5	2.5
4.5	2.35	2.65
5	2.45	2.55
6	2.48	2.53
7	2.49	2.51
8	2.5	2.5
9	2.5	2.5
10	2.5	2.5

This law might be derived more systematically by an extensive use of mathematics. It is believed, however, that the above method is rather desirable, as the facts are brought out in a more comprehensive form.

From the above law it is permissible to draw the following conclusion, which is also of importance for illuminating engineering: It is not necessary to make the distance *D* between two lamps less than the minimum height of suspension *H*; in other words, the factor *K* need not be smaller than 1.

For example, if the plane should be illuminated with an intensity of three foot-candles and, for instance, lamps having a candle-power of 75 candles vertically downward are available, the minimum height of suspension would be $H = \sqrt{\frac{L_v}{I}} = \sqrt{\frac{75}{3}} = 5$, and, therefore, the distance between the lamps also $= 5$ for polar curves of $K = 1$ and larger than that for greater values of *K*. If it is necessary for reasons of practicability, æsthetics, etc., to suspend the lamps higher than 5 ft., one may do so without impairing the intensity of illumination or the uniformity of light distribution, but it is not necessary to change the polar-curve into one of which *K* is less than 1.

It is even better to suspend the lamps above their minimum height of suspension since, as shown in the above discussion, the uniformity of illumination is improved by increasing the height of suspension.

Commutators of Traction Motors.

The Elektrotechnische Zeitschrift for Feb. 20, referring to the report of the Municipal tramways of Frankfort, describes some troubles experienced with commutators. The copper segments of the commutator are insulated from each other by mica insulation and it was found in one case after a large number of motors had been supplied that the commutators were subjected to considerable wear and tear, due to excessive sparking at the brushes. It was found that the mica insulation was projecting slightly above the copper segments so that the contact between the carbon brush and copper segments was not as good as necessary. The mica insulation was cut down below the copper by about 1.5 mm. This proved very successful. It was first feared that carbon powder might collect on the mica and thus produce a connection between two adjacent segments and a special brush for removing this powder was used, but experience has shown that this is unnecessary. Any powder which might collect is at once driven off by centrifugal force combined with the air draft. A special machine has been constructed for deepening the mica insulation.

The Value of Electrification as a Steam-Railroad Improvement.

By Clarence P. Fowler.

While the wholesale electrification of trunk lines of steam roads may ultimately become a fact, yet such complete and radical changes in equipment and methods of operation will doubtless have their origin in the partial adoption of electricity as a motive-power for handling local passenger traffic of the suburban or interurban type, gradual extensions following until electrified sections merge into one. The electrification of long-distance lines is coming every day more within the range of commercial possibility, largely as a result of the introduction of the simple and economical single-phase railway system and partly due to better-distributed traffic, which was of a more concentrated nature in years past.

Considerable discussion has taken place during the past year on the technical aspect of electrification problems, such as, for example, detail studies of designs of equipments, the best system to employ, etc. The purpose of the present article will be to briefly deal with the commercial features of steam-railroad electrification as relating to local passenger traffic, pointing out the large inroads that the electric interurban railroads have made upon the local passenger traffic of parallel steam lines, by reference to authentic and up-to-date statistics, believing that results of actual experiences form the basis for the strongest arguments pointing to the financial gains which may be expected from the adoption of electricity as a motive-power by the steam railroads.

The financial phase of the problem relating to the net return on the investment required to electrify naturally forms one of the most important elements from the standpoint of steam-railroad management, and it is this feature which must ultimately be the final argument controlling a decision for or against improvements of this character.

Interurban electric railways in the United States now have approximately 20,000 miles of track in successful operation—surely a marvelous growth since the time of their inception, only some 10 years ago. The growth and success of these roads are not peculiar to any particular community, as they will be found in successful operation in the states of Illinois, Ohio, Indiana, Michigan, New York, New Jersey, Pennsylvania and New England, as well as some quite extensive and up-to-date electric interurbans in the Pacific Coast States, where the famous Inland Empire Single-Phase Railway System is in operation with its 225 miles of track located in Washington and Idaho. This road is admitted by steam-railroad men as quite the equal of any steam road in the country, not only doing an extensive passenger business, but also handling a large amount of freight in trains and exchanging it with steam roads —notably with the Great Northern Railway system.

Perhaps the chief distinguishing feature in methods of train operation with electric traction, as compared with steam, is found in the train-lengths and frequency of service offered by the two respective systems, the former being commercially capable of operating frequent short trains or even single cars, as compared with relatively long trains at infrequent intervals by steam traction.

The reasons for this are purely economic in character, as may be easily seen from a consideration of the operative costs of the moving unit for the two systems in question. Having found the cost of operating a steam passenger train a mile, it will be noted that it is practically constant and independent of the train-length. The cost of operating a passenger train a mile for six representative steam roads reporting to one of the Eastern state railroad commissions for 1906 is as follows:

TABLE I.

Road.	Total expense per passenger train-mile.
A	$1.15
B	0.84
C	0.77
D	0.99
E	1.18
F	1.43
Average	$1.06

The cost of operation per car mile for six interurban railway systems, including all expenses of operation, taxes and fixed charges, as reported to three of the state railroad commissions for the year 1906, is:

TABLE II.

Road.	Cost.
A	$0.17
B	0.22
C	0.215
D	0.18
E	0.21
F	0.23
Average	$0.204

From the above it is apparent that the low cost per mile of the moving unit with the electric service, and, therefore, low unit load required to pay expenses, is the underlying principle which places steam locomotive-hauled trains at a disadvantage. If it be assumed that the average rate received per passenger per mile is 1.5 cents, it will be seen from the average cost of operating an electric and steam train, as given in Tables I and II, that an average occupancy of about 14 passengers per mile will pay expenses with the electric service, whereas steam-train service would require an average of about 70 passengers per mile. Putting it another way, the electric system can render five times as frequent service as steam and meet all expenses of operation.

The superior service thus inherently possible with electric traction has eminently adapted it to suburban and interurban passenger traffic, and the general increase in this class of traffic has been one of the most notable features of the electric service, as exemplified in the modern interurban road. Experience has demonstrated that the amount of traffic in most cases has increased commensurately with the transportation facilities offered.

The normal location of the interurban road is parallel to the steam road, and, being so located, becomes a competitor with the latter for local passenger traffic. As such, it not only absorbs most of the existing traffic of this character from its steam rival, but in a short time creates new traffic many times greater than that which originally existed. As bearing on the ability of the interurban road to take most, if not all, of the local passenger business of parallel steam lines, the Department of Commerce and Labor of the United States has published statistics showing that 14 different interurban roads operating in seven different states, from New York to Iowa, and paralleling steam roads, did from 90 to 100 per cent of the local passenger business in the competing territory. By reference also to statistics published by the Interstate Commerce Commission it will be noted that the average length of journey per passenger on steam trains in the United States prior to the introduction of interurban roads, from 1892 to 1897, increased from 23.82 miles to 25.04 miles, an increase of only 5 per cent. In 1897 the inauguration of the alternating-current system for electric railways made the longer distance interurban road commercially feasible, and during the five years 1897 to 1902 the Interstate Commerce Commission records the increase of the average length of journey per passenger on steam trains in the United States from 25.04 miles to 30.3 miles, an increase of about 21 per cent, which no doubt was partly a result of the curtailment of local passenger traffic of steam roads due to interurban electric-railway competition. As late as October, 1907, the *Railroad Gazette* published some very interesting data on the electric railway as a competitor of the steam road. The *Gazette* tabulated official reports from some 111 interurban roads in 25 different states, thus giving representative returns from practically all quarters of the United States. The aggregate mileage of the roads so reporting was 3361, and a great part of the roads listed did, as is usual, from 90 per cent to 100 per cent of the local passenger business.

Two concrete examples are given below which illustrate, quite pointedly, the effect of interurban railway competition upon the local passenger traffic of parallel steam roads. These instances are taken from one of the Central Western states where perhaps the interurban road has reached its highest state of development. Numerous examples of this character could be given, but as these here noted are typical, they will suffice to bring out clearly the point in question.

CASE I.

Distance between extreme points of competition	29 miles
Local passenger earnings of steam road, per mile, 1895	$2,750
Local passenger earnings of steam road, per mile, 1906	570
Local passenger earnings of electric competitor, per mile, 1906	4,950
Total passenger earnings of steam and electric, per mile, 1906.	$5,520
Percentage of total local passenger business done by electric road, 90 per cent.	

The business done by the interurban road represented a loss to steam road made up as follows:

Loss of original passenger business $2,750—570 per mile	$2,180
Loss of newly created passenger business which steam road could probably induce if electrified, $5,520—2,750	2,770
Total loss of passenger business to steam road	$4,950
From U. S. mail, freight and express, the electric earned	566
Grand total loss to steam road	$5,516

CASE II.

Distance between extreme points of competition	26 miles
Local passenger earnings of steam road, per mile, 1895	$1,020
Local passenger earnings of steam road, per mile, 1906	150
Local passenger earnings of electric competitor, per mile, 1906	5,150
Total passenger earnings of steam and electric, per mile, 1906	$5,300
Percentages of total local passenger business done by electric road = 98 per cent.	

The business done by the interurban road represents a loss to the steam road as follows:

	Per mile.
Loss of original passenger business	$1,020 — 150 = $ 870
Loss of newly created passenger business which steam road could probably induce if electrified	$5,300 — 1,020 = 4,280
Total loss of passenger business to steam road	$5,150
From U. S. mail, freight and express, the electric earned	352
Grand total loss to steam road	$5,502

Some idea of the relative importance of local or short-haul passenger business to steam roads may be gained when it is remembered that the average journey per passenger on all steam railroads in the United States in 1905 was reported by the Interstate Commerce Commission to be only 32.21 miles.

The great value of local passenger traffic to steam roads is further demonstrated by the accompanying table which gives the relative amount of passenger earnings due to through and local passenger traffic for six of the principal steam railroad systems of the United States:

TABLE III.

Road.	Total passenger earnings, per cent. Through.	Local.
1	15	85
2	12	88
3	16	84
4	25	75
5	12	88
6	19	81
Average	16.5	83.5

The figures in Table III illustrate the large proportion of the total passenger earnings on steam roads that result from the local or short-haul passenger, and show conclusively that steam-railroad systems cannot well afford to lose this class of traffic. This is, however, as may be seen from statistics already given, the very business which is at present most severely attacked by the parallel interurban road.

As a result of a carefully conducted canvass, the *Street Railway Journal* obtained official reports, as late as October, 1907, of more than 100 new interurban electric-railway projects, aggregating some 5000 miles of track located in 35 states of the Union. These reports furnish detailed statements as to the name of the railway company, names of officers and proposed route. The writer has gone over the various routes covered by these enterprises with a view to ascertaining what percentage of these new railway ventures are projected in the territory now occupied by steam roads. The results of this study are as follows:

(1) Proposed electric interurban railways which parallel steam roads, 83.

(2) Steam railroad systems paralleled, 48.

(3) Proportion of proposed 5000 miles of interurban electric railways which parallel steam roads, 4600 miles.

(4) Percentage of total mileage paralleling steam roads, 92 per cent.

The mileage given above as paralleling steam roads is doubtless only a small portion of that which will be put in operation in the whole of the United States at no remote date, but it serves as some criterion of what may be expected by the steam roads in this direction. It also demonstrates ample proof of the belief of the promoters that these roads may be counted on to give a good account of themselves by absorbing, as usual, most or all of the local passenger traffic of the competing steam road and by stimulating the "riding habit," which is productive of much new traffic in virtue of the superior service rendered by the interurban road.

By the statistics thus far given it has been shown that:

(1) It is commercially impracticable to render as frequent service with steam locomotive-hauled trains as with electric traction.

(2) When steam and electric interurban roads compete for local passenger business the latter, in virtue of the service they are so well qualified to render, take away practically all the local business from the former, in addition to a large amount of new traffic created.

(3) By far the greater proportion of passenger revenue on steam roads is obtained from local passenger traffic, hence the advisability of conserving this source of income.

(4) The great success of interurban roads as competitors of steam roads has given rise to a continued tendency to project new electric railway enterprises in the territory occupied by steam roads as evidenced by the 4600 miles of the proposed 5000 miles of interurban railways so located.

From what has been said it is apparent that if the steam roads persist in the present methods of handling local passenger traffic, they must suffer the loss that will inevitably result from future parallel interurban competition, so that in considering the electrification of a section of a steam road, not at present paralleled by an electric competitor, it is not sufficient to compare existing local passenger earnings under steam operation with future local passenger earnings under electrical operation, but greatly reduced local passenger earnings under steam operation (due to ultimate competition with a parallel interurban road) should be compared with future earnings if the section under consideration be electrified.

The well-managed interurban road in its present advanced state of development is admitted to approach closely to steam railroad practice, differing only in motive-power, in the operation of single cars or short trains at frequent intervals, and having free access to cities where steam locomotive propelled trains would, of course, not be tolerated.

These questions naturally arise: What move are the steam roads going to make? Do they propose to let their local passenger business dwindle to naught when they can, by the use of the same motive-power which their electric competitors find so efficient, retain their present and create much new short-haul passenger business?

The parallel interurban road becomes an impossibility by the prior electrification of the steam road unless the available traffic be of considerable proportions or unless the steam road is very unfavorably located to attract it. If the steam road has been paralleled by an interurban road previous to electrification, the former can doubtless recover much of its lost business. This condition of affairs already exists on a steam road in England, where competition from a parallel tramway is keen

In the partial electrification of steam-railroad lines for handling passenger traffic of the suburban or interurban class, the experience gained from the interurban road must to some extent be the guide.

Table IV is a statement of gross earnings, operating expenses, taxes and fixed charges of a dozen representative interurban roads in the Central Western States These interurban roads are all competitors with steam roads for local passenger traffic and are selected as having very little city mileage, most all of it being interurban.

It is seen from this table that the average gross earnings from all sources per mile of track of the roads listed is $4,750 and the average ratio of operating expenses, taxes and fixed charges to gross earnings is 87 per cent. It is fully recognized that the extent of population of the territory traversed, habits of the people, earning power of the population, effects of large urban centers of inducing traffic toward them, etc., have a bearing upon the earning power of the interurban road, so that gross earnings of $4,750 per mile are probably somewhat high for the average well-managed road of this class in the United States; therefore, it can be conservatively assumed that the average of the proposed roads composing the 4600 miles parallel to steam roads earn, say, 75 per cent of the above amount, or $3,500 per mile.

TABLE IV.

Per mile of track.

Road.	Gross earnings, 1906.	Operating expenses, including taxes and fixed charges.	Net Income.	Per cent of operating expenses, taxes and fixed charges to gross earnings.
1	$2,800	$2,300	$500	82
2	6,600	6,000	600	91
3	8,300	7,300	1,000	88
4	5,400	4,600	800	84.5
5	4.850	4,100	750	85
6	6,000	5,100	900	85
7	4,900	4,050	850	83
8	3,150	2,650	500	84.5
9	3,050	2,775	275	91
10	2,250	1,820	430	81
11	3,650	3,450	200	95
12	5,750	5,350	400	93
Average	$4,750	$4,124	$600	87

From the previous cases cited it may be seen that the business done by an interurban road means a loss to the steam road made up of loss of original business, loss of new business created, and, finally, loss of freight, express and United States mail carried by the former. It will be interesting to see what will be the probable distribution of this loss to the average steam road composing the 4600 miles parallel to the proposed interurban railways previously mentioned. If the freight, mail and express business is properly pushed, this end of the business would probably average $500 per mile gross, leaving $3,000 per mile for gross passenger earnings, and this will represent probably 90 per cent of the total passenger business in the competing territory or the total passenger business would probably aggregate $\frac{\$3000}{.9} = \$3,333$ per mile. As the service given by an electric road usually increases the total business from two to five times, as has been noted, the original earnings of the average steam road would approximate, say $\frac{\$3333}{3} = \$1,111$ per mile.

The total business that will, therefore, probably be done by the proposed average interurban road represents an estimated loss made up as follows:

Loss of original passenger business .... $1,111 — $333 =	$ 778
Loss of newly created passenger business .... $3,333 — $1,111 =	2,222
Loss of freight, mail and express business	500
Total estimated loss of average steam road	$3,500

On this basis the total estimated loss of gross business to 4600 miles of competing steam roads would be 4600 × $3,500 = $16,100,000.00.

Since the average percentage of operating expenses, taxes and fixed charges for the 12 interurban roads given in Table IV average about 87 per cent, and if in order to be conservative it be assumed that the average interurban road of the 4600 miles proposed averages about 90 per cent, this will give a total estimated loss of profit to the 4600 miles of competing steam roads of 4600 × $350 = $1,610,000.00.

Now, it should not be forgotten that the ratio of operating expenses, taxes and fixed charges to gross earnings of 90 per cent is obtained by roads now using the system employing high-tension transmission, feeding the cars from a 600-volt trolley and feeders supplied from rotary-converter stations, which system is relatively high in capital cost and cost of operation, as will be shown, and the competition caused by electric interurban roads will beyond all question become more and more acute as the introduction of the single-phase system proceeds.

A brief review of the chief commercial advantages which recommend the use of the single-phase system rather than the standard 600-volt direct-current system will show:

(1) Simplicity in system as a whole.

(2) High trolley voltage, permitting:

(a) Reduction in cost of feeder copper.

(b) Reduction in number of sub-stations.

(3) Elimination of rotating machinery, requiring attendance, from substations.

For the purpose of demonstrating the decrease in operating expenses that will result through the use of the 11,000-volt single-phase system instead of the standard 600-volt direct-current alternating-current system, the following comparison is made between the capital and operative costs of two single-track interurban roads 100 miles long, each equipped with these systems:

Weight of direct-current car and load, 40 tons.

Weight of single-phase car and load, 42 tons.

Schedule speed, 25 miles per hour.

Number of stops are such that average energy consumption is assumed to be 70-watt hours per ton-mile at the rims of the car wheel. Cars are operated on one-hour headway.

1.—CAPITAL COSTS.

Considering only the electrical equipment of the two systems under comparison and leaving out items that are common to both, such as right-of-way, roadbed and track, telephone, etc., the average capital cost per mile of single track for equipping the 100-mile interurban road (or 100-mile section of single-track steam road) with a 11,000-volt, single-phase system and 600-volt direct-current alternating-current systems, is as follows:

Equipment	Average capital cost per mile of single track. 600-v. standard A.C.-D.C. system.	11,000-v. single-phase system.
10 cars: direct current, $10,000 each; alternating current, $13,500 each	$1,000	$1,350
Electric power plant, 1000 kw.: direct current, $120 per kw; alternating current, $120 per kw	1,200	1,200
High-tension transmission line	650	1,000
Sub-stations: direct current, 10 substations costing $140,000; alternating current, 4 substations costing $25,000	1,400	250
Direct-current overhead trolley and bonding of track	2,150	....
Alternating-current overhead trolley, catenary construction, with wooden poles and track bonding	....	3,200
Direct-current, low-tension feeders, per mile	2,000	....
Totals	$8,400	$7,000

2.—OPERATING EXPENSES AND FIXED CHARGES.

The operating expenses of the 600-volt direct-current-alternating-current system and the 11,000-volt single-phase system may be considered as practically the same, except in the particulars noted below, in which the latter system shows quite a material saving. A detailed comparison is as follows:

(a) A reduction in the fixed charges results from a lower capital cost as given in the previous schedule.

(b) A reduction in the cost of labor is due to the absence of attendance, in substations, which is required by the rotary converter or motor-generator substation forming a part of the alternating-current—direct-current system.

(c) A reduction in the average losses occurs in the single-phase system between power-house and cars, thereby requiring less generated energy at the power house.

What seems to be a fair comparison of the average efficiency of the two systems in their entirety from main-station switchboard to rims of car-wheels is made up as follows:

	Average operating efficiency, per cent. 600-volt direct-current—alternating-current system.	11,000-volt single-phase system.
Power-station step-up transformers	97	97
High-tension transmission system	95	95
Substation step-down transformers	95	95
Substation rotary converters	83	..
Distributing system	85	90
Car equipment (complete)	75	72
Average over-all efficiency main-station switchboard to rims of car-wheels	47	57

With the above average efficiencies the energy required at the power-station busbars per ton-mile would be for the

(a) 600-volt direct-current—alternating-current system $\frac{70}{0.47} =$ 149 watt-hours per ton-mile.

(b) 11,000-volt single-phase system $\frac{70}{0.57} = 123$ watt-hours per ton-mile.

The density of traffic on the average interurban system operating cars on an hour headway, including extra runs made, approximates 15,000 car-miles per mile of track per annum. Taking this figure as representing the traffic density on the 100-mile road, the ton-miles per mile of track per annum for the two systems would be:

(a) Alternating-current—direct-current 600-volt system = 40 × 15,000 = 600,000 ton-miles per mile of track per annum.

(b) 11,009-volt single-phase system = 42 × 15,000 = 630,000 ton-miles per mile of track per annum.

Since the average energy consumption per ton-mile at the power-station busbars required by the alternating-current—direct-current 600-volt system has been found to be 149 watt-hours per ton-mile, and as this system has a traffic density of 600,000 ton-miles per mile of track per annum, the total energy consumption at power house per mile of track per annum in this case is 600,000 × 149 = 89,400 kw-hours per mile of track per annum.

Similarly, the total power-house energy consumption per mile of track per annum for the single-phase 11,000-volt system is 630,000 × 123 = 77,490 kw-hours per mile of track per annum.

An itemized statement of comparative operative costs and fixed charges covered by the three elements for the two systems as enumerated above are as follows:

	Per mile of track per annum.		
	600-volt direct-current—alternating-current system	11,000-volt single-phase system.	Saving in favor of single-phase system.
Annual fixed charges at 11 per cent of capital cost........	$924	$770	$154
Substation labor required for 10 rotary substations—one man in each at $900 per year, two shifts, total cost, $18,000	180	....	180
Taking 0.5 cent as the amount per kw-hour covering that portion of the fuel, water, oil and supplies which is proportional of the output of the station, results in a cost for the 600-volt direct-current—alternating-current system of 89,400 kw-hours at 0.5 cent...............	447	....	....
11,000-volt single-phase system, 77,490 kw-hours at 0.5 cent.	....	387	60
Totals	$1,551	$1,157	$394

Applying the above saving of $394 per mile of track per annum (due to use of single-phase system) to the case of the average proposed interurban road parallel to the 4600 miles of steam roads previously considered, the estimated loss of profit to the latter under single-phase operation would be $350 + $394 = $744 per mile. This is 10.6 per cent on $7,000, the investment per mile required to electrify the average single-track section of a steam road for local passenger traffic. The total estimated loss of profit to this 4600 miles of steam roads, due to proposed interurban competition of the latter, which if equipped with the single-phase system, would therefore be 4600 × $744 = $3,422,400 per annum—truly quite a formidable figure when calculated for the total proposed mileage. While but an estimate of the future, it may not be far amiss, and it is an indication of what losses the steam railroads will likely sustain based on past experiences of a similar nature.

It should be noted that, in order to be conservative, no credit has been given the electrical system for the value of the steam locomotive and possibly other steam railroad equipment, released from electrified section, for use on other parts of the system. This is quite an important item, as it would reduce the net average cost of equipping the portion of the steam road under consideration.

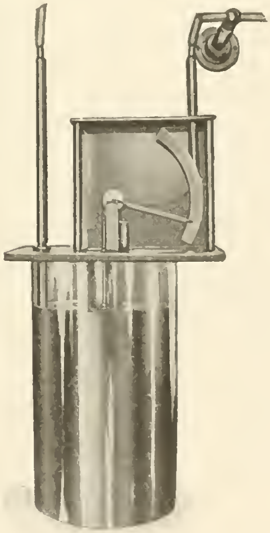
The economy effected by the use of the single-phase system over the alternating-current—direct-current system will not only tend to render competition between steam and parallel interurban roads, which are equipped with the former system, more strenuous for the steam road, but will doubtless greatly increase the number and extent of interurban roads that will be built in the field at present belonging exclusively to the steam road, unless the latter take the proper measures, to prevent the construction of parallel interurbans, and the consequent dissipation of the chief source of their passenger earnings, by electrifying their lines.

In conclusion, the writer cannot do better than quote from the admirable paper entitled "The Relation of the Interurban to the Steam Road," read by Mr. T. Jay Tomlinson, of the Pennsylvania Railroad, before the Association of Transportation and Car Accounting Officers, held at Chicago, Dec. 10 and 11, 1907. What Mr. Tomlinson has to say should carry considerable weight as coming from a steam railroad man connected with one of the principal railroad systems in the United States. He sums up the present situation as follows:

"The tendency and demand of the day are for frequent, rapid service—rapid at frequent intervals rather than one or two very fast trains and a sparse, slow service. The immediate problem of the steam roads is to provide such service at lowest costs as will retain their revenue or see it taken by aggressive competitors who also contemplate attracting freight traffic. The apparent solution is electrification of existing steam lines for passenger service."

High-Tension Electrostatic Voltmeter.

Considerable difficulty has been encountered in measuring very high pressures, although many types of instruments are utilized which give satisfactory results for electromotive force up to 25,000 volts. Accurate readings can be obtained by using a transformer, if all leakage is prevented, and non-inductive resistances may be utilized to advantage as multipliers. Other high-tension instruments have been designed with condensers in series, employed as multipliers. But difficulties have been encountered due to the various frequencies employed, it being hardly possible to construct an instrument with the same dielectric coefficient as the condenser.


HIGH-TENSION ELECTROSTATIC VOLTMETER.

The voltmeter described below has given excellent results. It is of the electrostatic type, and was recently designed by Prof. August Grau, of Vienna, Austria, for measuring electromotive force not exceeding 90,000 volts.

The apparatus consists of a glass jar filled with oil which is used as a dielectric, with a glass plate resting on three supports at the bottom. A metallic cylinder is supported on this plate, forming one plate of the voltmeter, the connections being made to this cylinder, which is 5 3/5 in. high and 8 in. in diameter by a wire placed in a porcelain tube passing through the oil. A smaller cylinder, 4 2/5 in. long and 1 1/5 in. in diameter, is placed concentric with the larger cylinder suspended by a copper wire surrounded by a glass tube. A thin plate is attached to the lower end of this small cylinder with a lead weight of 200 grams under the plate. A glass rod projects from the weight to hold the movable system, which is concentric with the large fixed cylinder. There is also a fine wire passing over a pulley connected with a counter weight, the pulley having the pointer attached to it and multiplying the suction of the cylinder, which travels up and down, the proper reading being indicated on the scale. The other side of the high-tension circuit is connected to the movable system, the conductor passing to the pulley through a porcelain tube, while in order to damp the motion of the cylinder a plate is fastened to the lower end of it. There are three friction rollers fastened to the glass plate which holds the glass rod in position, the latter passing through an opening in the plate.

There should be a wide field of usefulness for this electrostatic voltmeter in measuring the electromotive force of high-tension energy transmission lines and apparatus.

Remarkable Improvement in a Central-Station Load.

It is rare that we can direct attention to so notable an improvement in a central-station company's load within a period of a few months as has recently taken place at Winona, Minn. The Winona Railway & Light Company had a load factor (ratio of average to peak load) for November, 1906, of 33 per cent, and for December of the same year, 36.2 per cent. In November, 1907, this had increased to 56.8 per cent, and in December, 1907, it was 53.5 per cent. The lowering of the load factor for December, as compared with November, was due to factories closing for the holidays and because of the business depression. The explanation of this improved condition lies mainly in the increase of connected motor load. In December, 1906, the connected motor load was 1016 horse-power. In the summer of 1907 Mr. A. V. Schroeder, formerly of Springfield, Ill., took the management of the company and began a vigorous campaign to get motor business from the numerous small factories in the town, as well as from some of the large ones. As a result of these efforts, 810 horse-power in motors was added during 1907, bringing the total horse-power of motors connected up to 1826 in December, 1907, with an improvement in the load factor as already noted. The soliciting was done by the manager. These motors range in size from 2 to 60 horse-power. They are mainly between the sizes of 5 and 15 horse-power. The population of the city is about 20,000.

The kw-hour output for 1906 was 1,222,000, and for 1907 2,490,000. Of course, much of this motor business was taken at low rates, but that it had a most beneficial effect financially is indicated by the fact that the gross power earnings increased 110 per cent over 1906, and the light earnings 40 per cent. The increase in lamp load has been equal to 5148 lamps of 50 watts capacity. The connected lamp load now equals 25,345 such lamps. There are 800 electric irons connected. Winona is one of the banner small cities of the country in the number of electric automobiles used; there are 35 such vehicles in the town. A 110-220-volt charging circuit is run to the garages from the down-town district, where direct-current service is given. The rate for automobile charging is 5 cents per kw-hour.

The foregoing figures make a rather remarkable showing, especially in view of the fact that there is competition from another central-station company in the same city, the rival company having water power to supply a part of its output. As a result of this competition, lighting rates have been cut to pieces both in residence and business districts, current being sold by the Winona Railway & Light Company at 3 cents per kw-hour on the main business street, and correspondingly low rates in residence districts. This competition has resulted in a liberal use of electric light, but at such absurd rates that there is, of course, practically no profit in the lighting end of the business. In fact, the experience of this company the past year seems to be a striking demonstration of the fact that it is not the short-hour lighting business that enables a central station to pay. The company furnishes arc lamps and Holophane and "Arcburst" clusters free. Lamp renewals are free. Many Gem lamp units are in use.

OPERATING ECONOMIES.

The increase in net earnings for the year were due to increase of gross earnings and reduction in operating cost per kw-hour. The company has a modern station equipped with two 500-kw Curtis turbines three years old. Considerable reduction has been made in the cost of fuel per kw-hour by changing to a cheaper coal, as well as by the improved load factor on the station. Formerly Hocking Valley or three-fourths screenings were used which cost $4.10 per ton. The coal now used is from the Zigler field in southern Illinois. It costs $2.65 per ton. This coal is high in b.t.u. and low in sulphur as compared with many other Western coals. The station is now consuming 6.06 lb. of coal per kw-hour, which is practically the same that it was consuming formerly with Eastern coal costing $1.45 per ton more.

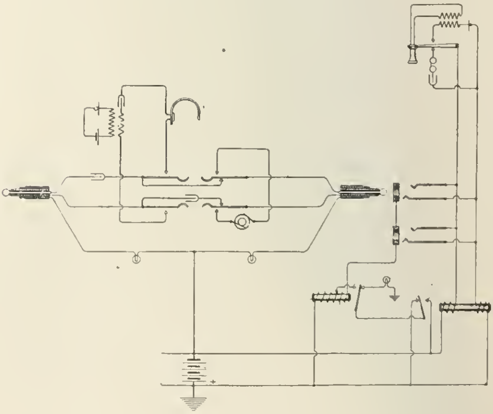
Another economy has been the substitution of steam-driven circulating pumps for the condensers in place of motor-driven pumps. By heating the feed water with the exhaust steam from these circulating pumps, the temperature of the feed is kept at 212, while before it was at times as low as 140 deg.

The Winona Railway & Light Company is now controlled by the La Crosse Water Power Company, which has built a dam at Hatfield on the Wisconsin River. The power station is two miles below the dam, and the water is utilized at a 96-ft. head. Two 45,000-volt transmission lines will be run to Galesville, from which point two lines will be run to Winona and two lines to La Crosse. The initial power development, for which machinery has been ordered, is 8000 horse-power. There will be two 4000-hp wheels. Eight thousand horse-power more will be available. The steam turbine plant at Winona is to be enlarged to form a steam reserve for the water-power plant.

New Telephone Patents.

NEW CIRCUITS.

A common-battery switchboard circuit of rather simple design is here shown in the invention of S. B. Fowler, of Lafayette, Ind. It will be seen that the cord circuit contains no relays, the two relays of the line circuit serving all purposes. When the line relay operates, it closes the line lamp circuit. This is in turn broken by the operation of the control relay, the resistance of which is so high as not to permit the



FOWLER SWITCHBOARD CIRCUIT.

illumination of the supervisory lamp. The control relay in its operated condition connects a shunt to one of its windings as far as the back contact of the line relay. When this latter falls back, the shunt, without releasing the control relay, permits the flow of normal current in the supervisory lamp.

Whenever it becomes necessary to combine automatic and manual systems in the same exchange, the trunks must be adapted to terminate as lines of the automatic on one end, and as manual lines at the other. In such cases, the trunks are assigned some line number, or the equivalent of it in the automatic system, and a sending apparatus must be provided at the manual end for sending calls toward automatic subscribers. Such a trunk forms the subject of a patent granted to C. S. Winston, of Chicago, and assigned to the Kellogg Switchboard & Supply Company. This circuit is so arranged that in case an operator at the manual end makes a misplug, the correction of the error will have no effect on the setting of the automatic. However, as soon as the call is over, the disconnection of the trunk allows the apparatus to restore. This is accomplished by a plug-seat switch socket, which controls the restoring circuit. The contacts become operated only when the trunk plug falls home upon its seat.

PARTY-LINE LOCK-OUT SYSTEMS.

With common-battery party-line one of the simplest means of lock-out control is a high-resistance relay bridged across the line at each station, these relays being so proportioned that all will be shunted out by the use of any of the stations. There are three recently issued patents for systems depending upon this principle. W. M. Bruce, Jr., of Springfield, Ohio, employs a relay which will operate to close the talking circuit of a calling station, if the line be clear, and will hold up in the operated position while its own station-talking apparatus is connected. However, with this condition existing none of the relays at the other stations will start to operate even though their circuits be closed.

A. E. Poole, of Wheeling, W. Va., has obtained patents for two systems. In both he uses a double-wound relay, one winding of which at the calling station becomes a part of the controlling circuit. With this holding winding circuit closed, all other relays are shunted out. With this opened, as with a push-button key, a second station can come in on the line with the first. When the receivers are returned to the hooks, both operating and locking coils are de-energized.

HARMONIC RINGING.

Harmonic ringing is usually accomplished by tuning the bell vibrators to different distinctive pitches, each corresponding to the pitch or periodicity of one current supply. There has been issued to W. W. Dean, and assigned to the Kellogg Company, a patent in which a ringing relay supplements the bell. This relay nominally maintains a shunt about the bell at its station. When the reed of the harmonic relay becomes actuated by the arrival of current of the proper rate, its end strikes a rather inert pendulum-like contact device and drives it with cumulative effect away from its contact and there holds it. The bell thus relieved of its shunt operates to call the subscriber. The relay at each station of any line must fail on all but its particular frequency of current, and the bell at each station must, of course, operate upon currents which affect its relay.

POCKET TELEPHONE SYSTEM.

A novelty in telephone systems is covered by a patent issued to N. L. Weingott, of Warsaw, Russia. This system contemplates a series of jack boxes attached to the lines and located at convenient places, and a pocket telephone apparatus to be carried about on the person of the subscriber for service. This telephone terminates in a plug for the jack box, so that any convenient one may be used. The jack boxes are adjustable to several different settings, each of which requires a different kind of plug. It is proposed to rent plugs for a certain period, at the end of which time all jacks will be readjusted. At this time then all subscribers must turn in their old plugs and rent new ones to meet the new adjustment.

COMBINED SIGNAL AND TELEPHONE SYSTEM.

A combined messenger, telephone and fire-alarm system has been invented by J. G. Nolen, of Chicago. A series of thermostats control a circuit associated with a master messenger call box. This box is set and latched, but upon the operation of any thermostat of the series it releases. One code wheel sends in an alarm to the messenger office, while another sets up a peculiar and distinctive flashing of the telephone line lamp of the particular line at the switchboard of the telephone company.

CABLE TERMINAL.

Mr. F. B. Cook, of Chicago, has obtained a patent for another one of his multiple cable terminals with removable arresters. In this case, two rings or bands in parallel planes and set one above the other, form supports for the wire terminals and for the arresters. A pot-head must be used on the cable branch, the wires from which feed the top ring of terminals. Four wings at right angles serve to hold the rings and four guides for the cylindrical metal cover.

LETTERS TO THE EDITORS.

Congress and Wireless Telegraphy.

To the Editors of Electrical World:

Sirs:—The public has probably little idea of the serious menace to the future of wireless telegraphy which is offered by the Hale bill to regulate wireless telegraphy, now before Congress. Strenuous efforts have been made by government officials to force the ratification of a proposed international agreement drawn up at the International Wireless Conference held in Berlin, Germany, during October and November of 1906. This agreement, which was to take effect June, 1908, necessitated action by the present Congress, and was referred to the Committee on Foreign Relations, of which Senator Cullom is chairman. The committee for a month or more had hearings at which various departments of the government and wireless companies were represented, and the matter was finally pigeon-holed. Not to be balked, however, the Navy Department fathered the bill now before Congress, which embodies all the evils contained in the Berlin agreement.

It would be interesting to know whether the various government officials are acting blindly or are knowingly attempting to force legislation that will have the immediate effect of arresting the development of a valuable art and deprive the public of a service that would in time give them trans-oceanic telegraphy at one-tenth the rates now paid for cable service.

The bill, which would give the government full control of the wireless field, deals with existing conditions without considering the fact that wireless is still in its infancy and is making enormous strides each year. Where would our telegraph service be to-day had the government taken control of it in the forties and said there could be only one wire between two places? It is true that there is a great deal of interference between wireless stations to-day, but is it to the best interests of all to have the government take control and say there shall be only one station in a given locality for the reason that another nearby station would cause interference? It would be far better to let the situation stand as it is and give inventors an opportunity to overcome the present difficulties; and from my practical work in this field, I know that it will not be many months before this is accomplished.

Under the proposed act we would be compelled to go to the government for a license whenever we wished to build a station, in which case a permit would be granted if the station is to be in a locality distant from other stations. For instance assume that we desire to establish an independent trans-Atlantic wireless service and we apply to the government for a permit, the locality being, say, somewhere on the New England Coast. There are already numerous stations the entire length of the coast, and if we were fortunate enough to obtain a permit at all it would be with restrictions to hours during which none of the other stations cares to operate. Moreover, is it to be supposed that the telegraph and cable companies will, if the Hale bill is enacted, remain passive and allow us to establish trans-Atlantic service when a protest and a little influence used in Washington will prevent it?

The telegraph and cable companies have been very persistent in publicly ignoring wireless telegraphy as a competitor, but a recent circular issued to the managers of all its offices by the Western Union Telegraph Company indicates the real attitude. In this circular it is ordered that all messages offered by the Marconi Company for transmission to points on this side, must be treated as local messages, be dated at Glace Bay, N. B., and be charged for at the local rate. "Code messages cannot be accepted in such messages, which must be fully addressed in accordance with the rules governing the transmission of domestic messages. If the Marconi wishes to give any indication of other origin, they must do so in the body of the message. The message must be checked at full commercial rate, whether addressed to a newspaper, individual or firm. Messages addressed to parties on the other side routed via Marconi wireless or Glace Bay, cannot be accepted. We will, however, of course, accept messages addressed to the Marconi Company, or anyone else at Glace Bay, but no other direction or indication can appear in the address. Such messages should be checked at full commercial rates, and the tolls to Glace Bay only collected. We cannot under any circumstances accept the Marconi tolls or anything beyond Glace Bay on these messages, but must treat them solely and wholly as local messages between the point of origin and Glace Bay."

It is very easy to read between the lines of this circular and note that the telegraph companies are realizing their danger from competition; and with the government innocently (?) acting in their interest, the public would be deprived of all the benefits of legitimate competition.

As for the development of wireless telegraphy, we have only to compare the present conditions in Great Britain and this country. When the Marconi Company was first formed it obtained a 10-year license or contract from the English government; as a result it is the only company to-day in England, and the English battle-ships have only such apparatus as the Marconi Company can give them. On the other hand, in the United States there are now seven or eight companies in vigorous competition, which has resulted in improvement of apparatus and increase of efficiency to such an extent that our navy to-day stands first in wireless and holds the record for long-distance marine communication. Our merchant marine is also getting the advantage of competition and receiving wireless service at reasonable rates, while the English merchant marine is compelled to use the Marconi system or none, and at whatever price demanded.

As to the grievance of the government with respect to interference, I may cite a case that happened on the Sound last fall. A government message was being sent from Washington to Newport via Fire Island (all land stations); complaint was made because Sound boats interfered with the transmission and it was asked that boat work should cease when government plants were sending. In time of peace, and when both the Western Union and Postal Telegraph Companies are rendering efficient service between Washington and Newport, is it just to make such a demand and use wireless to the detriment of the service of boats which are dependent wholly upon the wireless?

It is lack of capital that is holding back the development of wireless telegraphy, which lack is largely due to the uncertain status of the industry owing to threatened interference by the government; but, even with dearth of capital, I firmly believe that within five years, barring government interference, we will see it successfully competing with cables and trunk lines, and that trans-oceanic rates will be cut down to a fraction of what they are to-day. From my experience and observation, I am thoroughly convinced that within 10 years the laying of trans-oceanic cables will entirely cease, and while the use of the present cables will undoubtedly be continued, the wireless system will be installed and maintained at a cost less than what would be the interest on the cost of a new cable.

The art of wireless telegraphy is still young. Scarcely a decade has passed since its practical value was first demonstrated. Important improvements are constantly being made, and with increasing knowledge of etheric radiation inventors will still further perfect the art unless all incentive to do so is removed by governmental action such as the Hale bill authorizes.

Providence, R. I. Walter W. Massie.

Grounding the Secondary.

To the Editors of Electrical World:

Sirs:—In your issue of March 14, on page 545, in commenting on the Bulletin of our Electrical Committee, the following statement is made in regard to matter of Rule 13 A:

"Despite the fact that the Committee on Rule 13 A had conferred with committees from the National Electric Light Association, Association of Edison Illuminating Companies, American Institute of Electrical Engineers and the National Electrical Inspectors' Association, on the grounding of low-potential circuits, it is not ready to accept the amended rule which has been suggested by these interests in the conference and asks that the matter be referred back to them for further consideration and report."

To be in accordance with the true statement of the case, this paragraph should have read as follows:

Owing to the fact that the Committee on Rule 13 A, appointed at the request of the electrical interests to confer with committees from the National Electric Light Association, Association of Edison Illuminating Companies, American Institute of Electrical Engineers and the National Electrical Inspectors' Association has been offered no opportunity for such conference and were not advised of the rule for grounding low-potential circuits suggested by these interests, until Feb. 5, which was five days after the limit fixed for any matter to appear in the advance Bulletin, it was decided, after consultation with the representatives of the electrical interests, that owing to the impossibility of giving the matter careful consideration in season to have it included in the Bulletin, the only course which could be pursued was to insert the recommendations in the Bulletin for the information of all concerned and ask to have the report referred back to the committee for further consideration. This course was taken by the committee so that consideration might be given and final action taken in season to include the result in the October supplement, which would be the first opportunity of sending out any of the results of the March meeting generally, because the committee were fully convinced that the lack of opportunity to give this proposed rule consideration was entirely due to oversight on the part of interests whose aim is to have harmonious co-operation on all such subjects, and the committee therefore expressed themselves as desirous of doing everything in their power to avoid any embarrassment on account of complications which had arisen.

With this correct statement of the facts in the case the second sentence of the paragraph in question probably would have been modified by you also.

Boston, Mass. C. M. Goddard,

Secretary Underwriters' National Electric Association.

[The facts above presented were not stated in the advance Bulletin sent out by the Underwriters' National Electric Association. The committee on Rule 13 A was appointed last March to report on a subject which has been a bone of contention between the electric lighting and insurance interests for years. The underwriters have always been averse to making the grounding of secondaries mandatory on the plea that a fire risk is introduced, and have refused to recognize the humanitarian side of the question. The grounding of alternating-current services is quite common among electric lighting companies, and the rules proposed do not differ radically from those now in force except that the word "must" is substituted dorf. The solenoid *S*, in series with an adjusting resistor and a series resistor, is in this case in the secondary circuit of an oil transformer, which transforms down from 10,000 volts to 110 volts. An alternative arrangement in the case of an alternating-current generating station is that in which each generator has its own exciter, which may be either shunt or compound wound. Each exciter has a regulator of the continuous-current type in its field circuit, the solenoid of which consists of two windings. The inner windings are connected in parallel across the terminals of a small auxiliary continuous-current generator, driven by a synchronous motor connected to the alternating-current mains. The outer windings are in series, and are connected in the main circuit of the auxiliary continuous-current generator. In this main circuit are also an adjustable resistor and the variable resistor *R* of a regulator of the alternating-current mains, either direct or through a transformer, according as to whether the main voltage is low or high. This arrangement works in the following manner: The inner windings of the continuous-current regulators tend to hold up the plungers, thus leaving all the sections of the resistor *R* in circuit. The outer windings act in an opposite direction, and tend to overcome the m.m.f. of the inner windings, thus letting down the plungers and short-circuiting some of the sections of the resistor *R*. Should the voltage of the system fall, the resistor of the alternating-circuit regulator is short-circuited; the current in the main circuit of the auxiliary generator increases; the m.m.f. of the outer windings overpowers that of the inner windings, and the field currents of the exciters are increased. The regulators can be adapted to suit practically any arrangement for excitation.—Lond. *Elec. Eng'ing*, Feb. 27.

Wires, Wiring and Conduits.

High-Tension Cables.—R. Apt.—A paper read before the Berlin Elec. Soc'y. on high-tension cables for energy transmission. Impregnated paper is now universally employed for insulation. The paper used for high-tension cables has an average perforation e.m.f. of about 20,000 volts per mm of thickness. Formerly attempts were made to render the insulation resistance as high as possible. Modern practice, however, differs from this, since insulation resistance and perforation strength are independent of each other. Moreover, highly insulated materials generally render the proper insulation hard and brittle, especially at low temperatures. For energy transmission over long distances three-phase currents are generally used. Concentric three-phase cables, which were the first to be used, have almost entirely been abandoned in favor of three-conductor cables. The rules of the German Association of Electrical Engineers forbid the use of concentric cables for e.m.fs. above 3000 volts. However, with increasing e.m.f. the construction of three-conductor cables also offers difficulties, and in general it is not advisable to make three-conductor cables for e.m.fs. above 30,000 volts, at least when transmission over a long distance is intended. For e.m.fs. above this value the older type of the single-conductor cable is to be used, and the author believes that for very high voltages these are the cables of the future. The author then gives a review of the theory originally due to O'Gorman showing that the different layers in the insulating material of a cable are subjected to very different dielectric stresses according to their distances from the conductor. O'Gorman has suggested the use of "graded" cables, but the present author thinks that the present methods for doing so will not be much used in practice except in special cases. He then discusses the losses in single-conductor cables, giving first the formulas for the losses in the lead cover. For iron-armored cable there are also hysteresis and eddy current losses in the iron. The author thinks it is not impossible that on account of the lower cost of the transmission line, the series direct-current Thury system may play a more important rôle in energy transmission in the future than heretofore. Especially for cables, direct current has important advantages. The author shows that in the case of transmitting considerable amounts of energy over long distances through a cable, the single-phase system has advantages over the three phase system. The author finally describes a high-tension cable installation which has been made by the Allgem. Elek. Ges. for the County of Durham Electrical Power Distributing Company, in northern England. In this case, a cable of more than 100 km has been laid for the first time for a voltage of 20,000. It is a three-conductor cable, and the following tests were specified: Each cable section was first tested in three phase connection for 24 hours at 30,000 volts. The cable was then tested at 50,000 volts for 15 minutes, and finally all three conductors were tested against the lead cover for 15 minutes at 50,000 volts. It was also specified that a piece of cable after bending three times and back around a diameter 12 times its own, should still withstand an e.m.f. of 80,000 volts for two minutes. After the cable had been laid, the whole line was tested at 40,000 volts between the phases and the lead cover for half an hour. Since the longest branches of the system are more than 12 km, and the charging current is about 3 amperes per kilometer at 40,000 volts and 40 periods, the tests were made with the aid of a choking coil, as indicated in Fig. 2 where *A* is a double-pole switch, *B* the starting water resistor, *C* a voltmeter, *D* a regulation resistor, *E* an ammeter, *F* transformer, *G* voltmeter, *H* choking coil, *J* ammeter, *K* protective device for excess voltages, and *L* liquid resistor for this protective device. The leading charging current of the cable was compensated by the lagging current of the choking coil so that the testing transformer had to be dimensioned according to only the losses, and, therefore, was of small size. This method is said to have proven very successful in all cases where great lengths of cable were to be tested at high voltages. In the discussion which followed the reading of the paper, Schrottke stated that lightning storms are not such very dangerous enemies of overhead transmission lines as is sometimes thought. On account of the very high cost of cables compared with overhead transmission lines, the latter will be almost universally used in future, and only in special cases on short portions of a line, where special conditions prevail, say, up to 20 km length, will cables be used. Apt agreed with him in this respect to a certain extent, but said that a modern cable, though more expensive, is more reliable with respect to continuous service than an overhead line built according to the latest principles and provided with the best protective devices. Lichtenstein thought that it would take quite a while before cables for an e.m.f. of 40,000 volts would be built, and that reliable three conductor cables which can be built for this e.m.f. are cheaper than single-conductor cables.—*Elek. Zeit.*, Feb. 20 and 27.

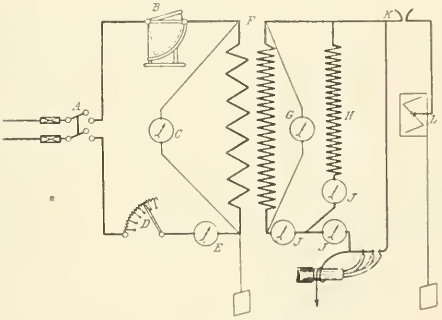


FIG. 2.—TESTING HIGH-TENSION CABLES.

Electrophysics and Magnetism.

Flames as Rectifiers.—A. Cathiard.—The author showed some time ago that a flame may act as a rectifier for an alternating current of high tension and low intensity. The unidirectional character of the discharge is confirmed by the oscillograph. He now announces that in this case a true disintegration of the cathode is produced. It is accompanied by the appearance of a very brilliant point on the cathode, whereas the anode is merely surrounded by a diffuse violet tuft. If two identical parallel electrodes, say, two cylinders, are mounted in the same horizontal plane, and one of them is immersed in a flame containing no solid conductors in suspension, the electrode so immersed is always a cathode. On transferring the flame to the anode it at once becomes the cathode. The experiment is easily shown with cylindrical rods of homogeneous close-grained carbon, which are specially suitable for anodes.—*Comptes Rendus,* Feb. 3; abstracted in Lon. *Elec. Eng'ing,* Feb. 20.

Electrochemistry and Batteries.

Electrometallurgy of Iron and Steel.—S. A. Tucker.—The conclusion of his illustrated article giving a summary of the present condition of electrometallurgy of iron and steel. In the present installment the author deals with the processes of Kjellin, Keller and Girod.—*Gen. Elec. Rev.,* March.

Entropy.—E. Kohl.—A mathematical paper discussing the entropy function in the interchange of chemical and electrical energy.—*Ann. d. Phys.,* 1908, No. 1.

Units, Measurements and Instruments.

Torsion Meters.—J. H. Gibson.—A paper read before the North East Coast Institution of Engineers and Shipbuilders on torsion meters as applied to the measurement of the power of marine steam turbines.—Lond *Elec. Rev.,* Feb. 14.

Speed Indicator.—S. Herzog.—An illustrated description of a speed indicator of Swiss make, especially intended for railways, registering the mean speed in one second and also showing the total length of run.—*La Lumière Elec.,* Feb. 8.

Telegraphy, Telephony and Signals.

Measurement of Wave Lengths in Wireless Telegraphy.—C. C. Monckton.—With the approach of the international control of radio-telegraphy, the standardization of wave meters has become a matter of considerable importance and standard international inductances and capacities are required. The author has recently measured the wave lengths of several ship installations about 50 miles distant. It was afterward established that his measurements were within one-half per cent of those taken on the ships with standard inductances and capacities of another nation. These tests were made with the apparatus shown in Fig 3. J is a single turn of inductance coil in the aerial circuit, and I is the coil of standard inductance, its distance from J being capable of variation. K is a standard air condenser of variable capacity, D is a detector, P a potentiometer arrangement, and T a telephone receiver. The two receiving circuits are brought into tune by varying the inductance of L and the capacity of K. The coil I is then moved away from J till the sound in the telephone receiver is just audible; it will then be found that, when the circuits are in good tune with the sending station, if the capacity is altered in the slightest degree either way, the sound in the telephone receiver is lost. The wave-length λ can then be calculated from the formula: $\lambda = 60{,}000 \sqrt{CL}$, where C is the capacity of the condenser in microfarads, and L the inductance of the movable coil in millihenrys. This method of measuring wave-lengths may be employed up to distances where signals can be received satisfactorily.—Lond. *Elec. Eng'ing,* Feb. 20.

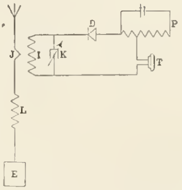


FIG. 3.—MEASUREMENT OF WAVE LENGTHS.

Telephone Rates.—At the recent general meeting of the (London) National Telephone Company, G. Franklin discussed at length the question of message rates versus unlimited-service rates. He quoted some remarks of the Postmaster-General that some unlimited-service subscribers who originally made 3000 calls per year had, in the course of a few years, increased this number to 11,000 per year, using the same line. Franklin also stated that the National Company had many cases of flat-rate lines used to such an extent that 24 per cent of the total calls had become ineffective owing to the lines being engaged. Some subscribers thought nothing of sending from 250 to 300 calls per day, with the result that nobody else could get into communication with them. Moreover, it is peculiar to the telephone business that the larger the number of subscribers, the greater the capital cost per subscriber; the following illustration of this was given: With an exchange for 1000 subscribers, the capital outlay on switchboards and junctions would be $20 per subscriber, but if there were 10,000 subscribers, the capital cost would be $65 per subscriber.—Lond. *Elec. Eng'ing,* Feb. 27.

Miscellaneous.

Porcelain.—E. L. Barringer.—An illustrated article on the manufacture of porcelain for electrical purposes. There are two classes of electrical porcelain, namely, dry-process porcelain and wet-process porcelain, the difference being that in dry-process porcelain the mixture of raw materials is reduced to the form of a damp powder and pressed into shape in steel dies in screw presses; whereas in wet-process porcelain the raw material is mixed to a stiff mud or dough, made into a blank form, partially dried, and turned on a lathe to the final shape. Dry-process porcelain is used for wiring fixtures, knobs, cleats, receptacles, attaching plugs, switch bases, etc. Wet-process porcelain is used for high-tension insulators, such as are necessary for oil switches, transmission lines and transformers. This porcelain is more dense, and possesses a higher insulating value than the dry-process porcelain. The different steps in the manufacture of both classes of electrical porcelain are described and illustrated.—*Gen. Elec. Rev.,* March.

Hand-Tool Heater for Bookbinders.

Electric heat in the bookbindery presents decided advantages over gas. Being absolutely clean it prevents spoilage, and being more efficient, reliable and convenient, it enables the workman to devote more attention to his work and to get better results.

BOOKBINDERS' ELECTRIC HEATER.

One of the most successful of the electrical devices now manufactured for the bookbinder is the Hadaway hand-tool heater. It consists of an electrically heated plate surrounded by a platform of heavy wire fabric. It is large enough to heat a number of tools at a time, and the platform provides a suitable support for the handles of the tools being heated, and a convenient place to cool off the tools that have been used. This method of heating the tools is much more expedient and satisfactory than individual heating and does away with the tangle of flexible cords or small gas pipes that would otherwise be required. It permits greater freedom to the workman and enables him to always maintain the exact temperature required.

The extreme simplicity of the device is shown by the accompanying illustration. It is manufactured by the Hadaway Electrical Heating & Engineering Company and sold by the Westinghouse Electric & Manufacturing Company.

Portable Cable-Testing Galvanometer.

To meet a demand for a high-sensibility portable galvanometer for use under conditions and in places where the laboratory types cannot be used, the Leeds & Northrup Company, of Philadelphia, have placed on the market the instrument illustrated below.

This instrument consists of one of its high-sensibility galvanometers slightly modified and mounted on a light tripod. It has ample sensibility, is quick in its action, has a positive zero and is dead beat. The tube containing the suspended system and the magnet are constructed in two units so that the tube may be removed and another substituted at any time: or, if any adjustments are to be made to the coil or system, the tube can be removed from the magnet and laid horizontally on the table. The entire system is visible by means of the open-glass front given to the tube. This glass front slides in grooves and will come out readily. A simple device on the back of the instrument clamps the coil when not in use, while a spring in the top of the tube relieves the strains on the suspension while the instrument is unclamped. The suspension, thus protected, is not readily broken.

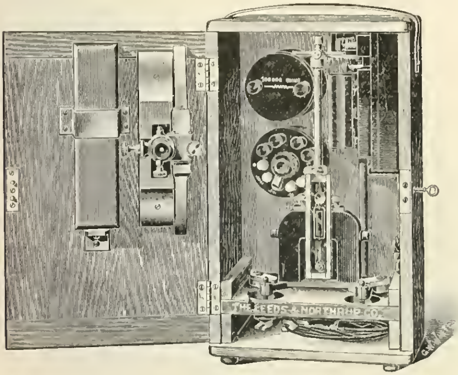


FIG. 1.—GALVANOMETER IN CASE.

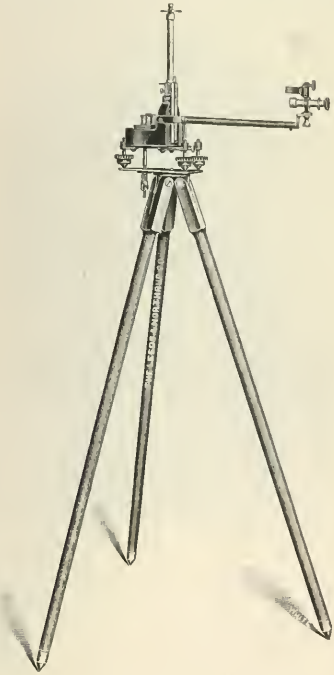


FIG. 2.—GALVANOMETER ON TRIPOD.

The entire galvanometer is insulated from earth by means of the three leveling screws. These screws are made in part of hard rubber so shaped that they are "petticoated." Two small indicators, one mounted on the coil and the other on the galvanometer, enable one to level the galvanometer so that the coil always comes to exactly the same position in the field.

The readings are made with a small high-power telescope carried at the end of a short, removable arm. The optical system is so arranged that it is easy "to find the scale." The galvanometer is clamped to the tripod by a wing nut.

With the exception of the tripod the galvanometer complete with repair outfit packs in a case 8 in. x 9 in. x 15¼ in. The illustrations show the galvanometer mounted on the tripod and packed in its box, together with an Ayrton shunt, 100,000 ohms and battery key. A condenser may also be packed in. Such an equipment combines the advantages of the portable combination sets with those non-portable sets made up of a number of individual instruments.

Wire Connectors.

To eliminate the crudeness and expensiveness of soldered connection, especially those made on the outside line wires, the Yonkers Specialty Company, Yonkers, N. Y., is manufacturing a line of connectors and taps for use without solder. Fig. 1 shows a flat two-way connector. To a flat brass plate is attached an upper plate of spring brass. The end screws, which hold the wires, are tapped into the base plate. The spring brass serves as a washer plate and also keeps the screws permanently locked. Fig. 2 shows a flat tap connector for joining small branch wires to main-line wires. The jaws, which are adapted to a variety of sizes of main-line wires, are tightly secured by a large screw and nut.

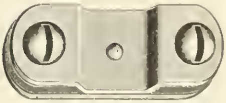


FIG. 1.—FLAT TWO-WAY CONNECTOR.

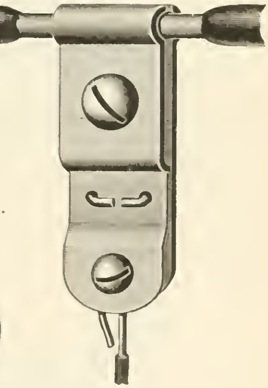


FIG. 2.—FLAT TAP CONNECTOR.

Electrical Apparatus for Laboratories.

In districts embracing chemical industries, laboratories, etc., the central-station manager might increase his sales of electrical energy by recommending the use of such devices as centrifugal machines, rotating and stirring motors, bottle shakers, vacuum pumps, electrically heated ovens, etc. The International Instrument Company, of Cambridge, Mass., builds a line of such machines. Chemists find it economical to hasten the precipitation of fine sediment by the use of centrifuges. Fig. 1 shows a machine designed for this work, ball bearings being used and a special motor wound for speeds up to 3000 r.p.m. Chemical laboratories are usually equipped with electricity and the advantages of the electric motor for performing many operations quickly is readily appreciated. A sugar and salt drying, cylindrical-basket centrifuge is shown in Fig. 2. Almost every dairy and public health laboratory regularly tests the quality of milk by the Babcock method. Hand and steam-driven machines are still frequently used; but these are easily replaced by electrically driven testers. It is also part of the business of health departments to test milk for bacteria and an instrument for readily doing this work is shown in Fig. 4. This centrifuge is made especially for this purpose.

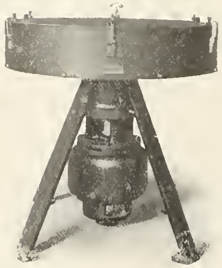


FIG. 1.—HIGH-SPEED CHEMICAL CENTRIFUGE.

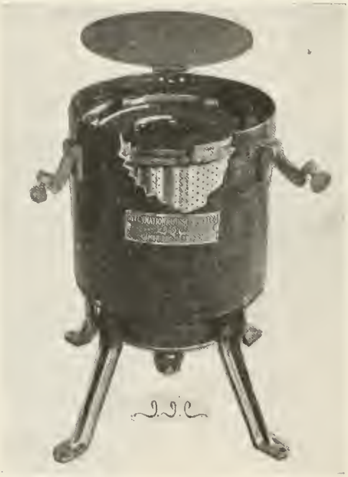


FIG. 2.—SUGAR AND SALT DRYING CENTRIFUGE.

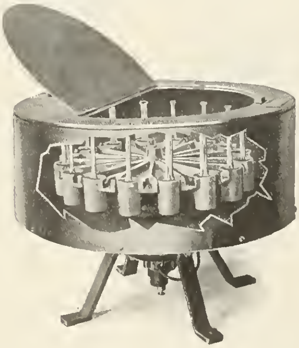


FIG. 3.—SIXTEEN-BOTTLE MILK TESTER.

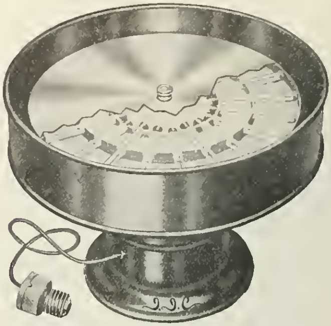
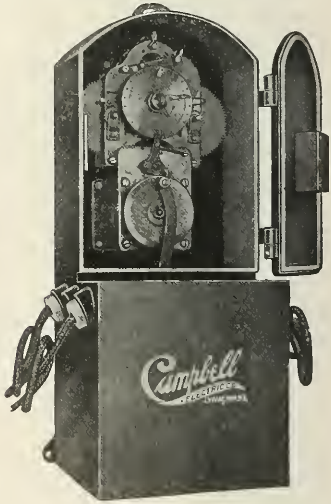


FIG. 4.—CENTRIFUGE FOR TESTING BACTERIA IN MILK.

Time Switch for Electric Circuits.

The Campbell Electric Company, of Lynn, Mass., is the manufacturer of the eight-day time switch shown herewith. The switch is said to possess many novel features, chief among which is the isolation of the knife switch in a compartment separate from that of the clock mechanism. Like other time switches on the market, the clock-work mechanism may be set to throw the switch into and out of circuit at any predetermined time, it being possible to set the mechanism to operate to the minute. The manufacturer claims that the device is water- and dust-proof, and that the quick-break feature of the knife-switch mechanism eliminates injurious arcing at the contacts. The company also builds a time switch for high-voltage service. In this type of switch, the circuit is opened in oil. Switches of the latter type are designed for operation on circuits having potentials as high as 3000 volts. The time switches for low-potential circuits are rated at 25, 50 and 100 amperes, the blades being spaced for 250 volts. The switches are made with double and triple poles.



EIGHT-DAY TIME SWITCH.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Sentiment in the industrial world during the last week was more optimistic, there being considerable improvement in general distributing trade. The excellent weather was favorable for farm work, and reports from the winter wheat crop are good. Actual progress is slow; collections are backward, and the prices of staples, as for some time past, tended lower; but the spring-like weather extending over a large area, stimulated the volume of spring business. Securities advanced somewhat, as shown by the sale of $5,000,000 50-year 4 per cent tax exempt bonds in New York, which were 16 times oversubscribed, and which brought what is probably the highest basis price ever obtained in this country for other than a government bond. Building operations show an increase of about 12 per cent over January, but are 40 per cent below the operations of February, 1907. Gross railway earnings for February show a decrease of 9.6 per cent from February a year ago. In general, the iron and steel trade has not developed during the last week as much as was expected, but the tone shows improvement. *Bradstreet's* reports business failures for the week ending March 12 number 276, against 287 last week, 186 in the like week of 1907, 187 in 1906, 186 in 1905, and 193 in 1904. The wire trade, especially electrolytic wire, shows considerable activity, and a heavy demand is expected by spring. There is considerably more activity than a week ago in the whole electric field. The Westinghouse Electric Company reports a greater export business for this February than for February a year ago. The Western Electric Company, in line with the policy of practically all the large companies and most of the smaller ones, has for some time past been reducing operating expenses, outstanding indebtedness, and bringing the ratio of production nearer to the ratio of demand. Electrical people are far from discouraged over the situation, for the electrical business is recovering more rapidly than many other lines of trade.

WESTINGHOUSE COMPANIES.—Reports from the various Westinghouse companies show an excellent volume of business and a number of large contracts, especially in export trade. The Westinghouse Lamp Company, which, by order of the New York and New Jersey Federal courts, was taken from the receivers and returned to the stockholders, is again doing business under the executive officers as formerly. The management announces that during the receivership the company was operated at a considerable profit, and that there was no cessation in the usual development and productive work in the factories. Operations have been begun in the new factory at Watessing, N. J., and arrangements are now under way to concentrate all the manufacturing at that point. The new buildings, completed last summer, are entirely of concrete, and admirably adapted for the purposes for which they were erected. When operated at full capacity the new plant will have an output of 15,000,000 incandescent lamps yearly. The business of the Electric Company shows, so far for March, a substantial increase over the same period in February, and the export branch was in excess of the same corresponding period last year. The company is operating about 60 per cent of its normal capacity. It developed last week that the Lackawanna & Wyoming Valley Rapid Transit Company, owned by the Westinghouse Electric & Manufacturing Company, defaulted on the interest due Feb. 1 last, on its first mortgage 5 per cent bonds. To protect the interests of the Westinghouse Company Judge James S. Young, in the United States Circuit Court, made an order allowing the receivers, E. M. Kerr, T. H. Given and H. S. A. Stewart, to pay $150,000 to the Mercantile Trust Company of New York, and to receive coupons of bonds deposited as collateral. Nearly all of the bonds of the transit company are owned by the Westinghouse Company, and plans have been made for the leasing of the road. According to the order of Judge Young the receivers are to receive $100,000 treasury bonds of the Lackawanna Company as security for the interest payment. Through a quiet agreement signed by 90 per cent of his creditors, an extension of time on his personal debts, amounting, it is estimated, to be about $8,000,000, has been granted to Mr. George Westinghouse. This three-year agreement will, it is stated, tie up 60,000 shares of the Westinghouse Electric & Manufacturing Company stock, and 30,000 shares of Westinghouse Air-Brake stock. With the announcement that these shares will not come into the market a better market should follow for the Westinghouse stocks. The annual meeting of the district managers of the Westinghouse Electric Manufacturing Company was held at the general offices of the company in East Pittsburg last week. There were twenty-three managers present, and the gathering was to discuss the prospective business in their various territories. It was learned from one of the managers who was present that the general tone was hopeful. He said: "Our men from the Western part of the country were a unit in the opinion that they did not look for any falling off in the business for the coming year from that of last year, which was one of the best years in the history of the company. The Eastern men, however, were not so sanguine; indeed, they freely expressed themselves that they did not look for a repetition of the prosperous time which prevailed during the first nine months of 1907. They had already experienced a great diminution in trade. But even they felt that the worst was over, and that many indications had shown themselves within the last 30 days which would lead them to the conclusion that in a general way business would begin to pick up again from now on, and that on the whole the electrical business of 1908, compared with 1907, would not show as great a loss as had been anticipated."

ALLIS-CHALMERS SALES.—Among recent sales of the Allis-Chalmers Company are the following: Electric generators, motors, transformers, etc., to leading coal companies: The Elkins Coal & Coke Company, Morgantown, W. Va.; Big Coal Company, of Pittsburg, Pa.; Berwind-White Coal Mining Company, Windber, Pa.; East Tennessee Coal Company, Jellico, Tenn.; Frick Coal & Coke Company, Pittsburg, Pa.; McKell Coal & Coke Company, Kilsyth, W. Va.; United States Coal & Coke Company, Gary, W. Va.; Ellsworth Coal Company, Ellsworth, Pa.; W. J. Rainey Company, Connellsville, Pa.; Merchants' Coal Company, Boswell, Pa.; Woodward Iron (& Coal) Company, Woodward, Ala.; Somerset Coal Company, Jennerstown, Pa.; Pittsburg Coal Company, Grindstone, Pa.; Monongahela River Consolidated Coal & Coke Company, Milesville, Pa.; Buffalo & Susquehanna Coal & Coke Company, Du Bois, Pa.; Norfolk & Western Ry. Company's Coal Mining Department, River Coal Company, National Mining Company; various subsidiary companies of the United States Steel Corporation and other iron and steel plants, and numerous smaller operators scattered throughout the anthracite and bituminous coal producing sections of Pennsylvania, West Virginia, Ohio, Indiana, Illinois and the South.

THE BUSINESS SITUATION.—Mr. F. M. Herr, general manager of the Westinghouse Electric & Manufacturing Company, says that, in his opinion, the low water mark in business was reached last January; that the month of February showed a marked improvement, and that the first two weeks' business in March gives further indications of improvement. He said: "We have in our works about 8500 men employed regularly at present, which is 75 per cent of our normal force. The small work, apparently, has not been much affected. The number of orders received for small motors and switchboard appliances has been very large. For heavy machinery there has not been a great demand, but our repair department has been rushed. During the last two months we have done more repair work than for a year. Our foreign business is also keeping up splendidly."

BARCELONA ELECTRIC TRAMWAY PLANT.—In the Feb. 7 issue of the *Gaceta de Madrid* it was announced that the Compania del Ferrocarril de Sarria, Barcelona, Spain, has applied for a concession for an electric tramway in Barcelona and that a period of one month from the date of publication has been appointed for the presentation of proposals.

SPEEDY FINANCIAL RECOVERY EXPECTED.—Inquiries among the telephone, telegraph and cable companies show that the period of financial stress through which the country has just passed and from which it is rapidly recovering, has not affected these lines of business nearly so much as similar crises in the past. All of them have suffered with the rest of the commercial world, but all of them report considerable improvement in the immediate past and prospects for an early return to normal conditions. Speaking for the Commercial Cable Company, Vice-President C. G. Ward sums up the situation in the telephone and telegraph field. "There is, perhaps, no better barometer of business conditions," he said, "than the cable business, which responds to every marked change of conditions in the financial world. While our company has suffered along with the rest we have not felt the effects of the panic nearly as much as we did after certain panics in previous years. Moreover, conditions have improved so much in the last two months and our business has held up so well in the last six weeks, that it seems almost safe to prophesy that we will recover more quickly from this last panic than ever before. The reason for this is not a mystery, for any one can see that we have no fundamental causes for continued depression, such as overproduction or short crops. On the contrary, the farmers are wealthy and the American people are too impatient to let things stagnate for any length of time unless they are compelled, which is not the case at present. However, the Presidential year is always more or less of a deadweight. Business slackening has taken place so many times in the past during the prenomination period that business men have come to regard this slowing down as a natural and normal occurrence which must be reckoned with in forecasting the business year. The 1906 year was a phenomenally prosperous period, one that cannot be taken as a criterion. Any recovery from a period of financial stress must, in the nature of things, be more or less slow. But we are satisfied with a gradual increase and satisfied to take from two to three years to attain the height of prosperity from which we may fall in a month or a night. Business history is a record of such rises and declines, and in this particular instance it seems to me that the recovery from the fall will be more rapid than ever heretofore."

Western Union officers anticipate an increase in the telegraph business in the spring. The company is doing a normal business, everything considered, and conditions are improving, but in the last few months the Western Union's business was smaller than in the same period during previous years. "The business of the company is picking up," said Secretary Brewer, "and we expect a further increase in April as conditions now indicate."

WESTINGHOUSE APPARATUS IN MEXICO.—In 1906 Mexico was third among the large importers of electrical machinery from the United States, being exceeded by British North America and the United Kingdom. In 1907, with electrical imports valued at $1,551,562, Mexico headed the list. Indications point that 1908 will equal, if not surpass, the record of last year. The Westinghouse Electric & Manufacturing Company has just completed important and extensive installations for various companies in Mexico. These include a 500-hp rotary converter with switchboard appliances for the Guanajuata Consolidated Mining & Milling Company which will operate mining machinery; several large-sized motors for the La Tula Mining Company, and a number of electric motors for the Lake Chapala Company, which will drive an equal number of centrifugal pumps forcing water over the territory of the Chapala Company for irrigation purposes. In one of the mining camps of Guanajuata, the Pinginco mines, 250 Westinghouse electric motors are operated, ranging in capacity from 5 hp to 200 hp. The largest soap factory in the Republic of Mexico, which produces 82 per cent of the entire soap used in that country, has ordered recently from the Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company a duplication of its power generating plant for the operation of its works, consisting of a gas producer, a gas engine, an electric generator and the necessary switchboard appliances. The company also uses between forty and fifty Westinghouse motors to operate some of the soap-making machinery in its works. The San Rafael Paper Manufacturing Company, which is situated about 36 miles from the City of Mexico, has recently completed the installation of a large number of motors varying in capacity from 10 hp to 150 hp. They will be used in the operation of machines and tools in the company's factory. The electric current is obtained from the Mexico Light & Power Company at a potential of 20,000 volts. Six 120-kw oil insulated transformers reduce this current to a working pressure of 440 volts. A switchboard to control the various transformers and motor circuits is furnished with the contract as well as a number of individual switchboard panels located near each motor. This installation is considered the most modern and economical plant of its kind in the Republic of Mexico.

ELECTRICAL DEVELOPMENT COMPANY.—At a meeting of the directors of the Electrical Development Company, held in Toronto on March 10, it was reported that the value of the property is $17,000,000 or $18,000,000 and that the company had paid all its liabilities, including $140,000 interest on the bonds. At the end of the year there was a deficiency of $160,000, which showing was considered good in view of circumstances. The old board of directors was re-elected and the present officers are as follows: President, Sir Henry M. Pellatt; first vice-president, Mr. Frederic Nichols; second vice-president, Mr. William Mackenzie. The chairman stated that the company had done everything possible to make some arrangement with the government, but so many limitations and curtailments of the area in which the company was to operate were asked that the negotiations had been terminated. On the same day Prime Minister Whitney made a statement to the Legislature on the subject of the company. He said that a proposition had been made to the government to take over the company's plant and transmission lines, but this could not be considered, as the administration had practically concluded an agreement to take its supply of power from the Ontario Power Company. There were also agreements by which the government was bound not to generate energy at Niagara. To secure possession of the company's plant and transmission lines, the Province would have to incur a liability of more than $20,000,000.

BRITISH TELEPHONE COMPANY IN MEXICO.—With a capital stock of $1,000,000 a British company with headquarters in London is being formed to install an extensive system of long-distance and local telephone exchanges in Southern Mexico. It is planned to expend more in the proposed improvements than the amount of the capital stock. During the preliminary work Francisco Alfaro, a well-known lawyer of Mexico City, is the representative of the company in Mexico. The company will operate under a concession which Manuel S. de Corbera and J. Sitzenstatter, of Mexico City, obtained from the Federal government for a long-distance line between Mexico City and Vera Cruz, including the building of various lines in the state of Vera Cruz and the establishment of exchanges in the cities of Vera Cruz, Cordova, Orizaba and other places. Besides telephones, the concession gives the right to establish wireless-telephone stations throughout the territory in which the company will operate. Work has already been begun constructing underground telephone systems and more than 5 kilometers of conduits have already been laid in Vera Cruz. Telephone cables in the other towns will also be placed underground. The new enterprise is being vigorously supported by Governor Dehesa, of Vera Cruz.

NEW BALTIMORE ELECTRIC COMPANY.—There will be a hearing soon at Annapolis on the project to obtain a charter from the Maryland Legislature for a new electric lighting company in Baltimore. The connection of John W. Van Dyke, vice-president of the Standard Oil Company of Pennsylvania, has given rise to the report that Standard Oil interests are behind the plan. The new lighting company proposes to operate in connection with the Baltimore Heating & Refrigerating Company, using the steam generated for heating to run its plant before being turned into the heat mains. This, it is claimed, will not interfere with the heating qualities of the steam.

ELECTRICAL SUPPLY BIDS ADVERTISED.—The Bureau of Supplies and Accounts, Washington, D. C., will open bids on March 31 for a quantity of electrical supplies for the Navy Department, including cross arms, insulated wire, steel enameled conduit, fuses, 18 motors, rubber tape and miscellaneous electrical supplies. The following bids will be opened April 14: 21,800 ft. of single conductor, one 10-hp motor and miscellaneous electrical supplies.

WESTINGHOUSE GETS INTERBOROUGH LAMP CONTRACT.—Recently the annual contract to supply incandescent lamps for the entire Interborough Rapid Transit system was awarded to the Westinghouse Lamp Company. This includes lamps for the Subway, the elevated stations, cars and tunnel lighting. It is estimated that the Interborough company uses 350,000 lamps yearly, mostly of 16 candle-power.

THE WEEK IN COPPER.—During the week there was a better buying movement on the part of the domestic consumers, and while this buying was only in small lots and for contracts in hand, it has been gradually growing, due to the fact that the manufacturers have been forced to take larger amounts owing to the increase in the volume of orders for finished material. Manufacturers also report a much larger volume of inquiry which will take a good tonnage of the raw metal. Stocks in the yards of consumers are now almost nil, and, under ordinary conditions, they would be buying for six months ahead. It is a matter of history that the American consumer has never taken advantage of the low prices of metal to make long engagements, as is invariably done by the European consumer. On Monday the market touched 13c., with a majority of the dealers holding firm at that price, and many experts expressed an opinion that the market is now on the high road to further advancement. The export movement has dwindled enough to allow the foreign manufacturers to handle their present stocks, and it is thought that if the price is shaded again that the foreign demand will support the market as formerly, even if home consumers persist in staying out. Exports from the port of New York since March 1 have been 10,662 tons, and European statistics of copper for the first half of March show a gain of 1210 tons in stocks, while the amount afloat increased 1520 tons. The exports from Atlantic ports for the week ended March 12, were 7100 tons, and since the first of March 9376 tons. The rumor that producers have again entered into an agreement to maintain prices seems to please the palate of Wall Street, but in copper circles there is nothing to substantiate the report, as selling interests are actively competing for what small business there is to be had. Closing prices on the Metal Exchange Monday were as follows:

Lake	12¾ @ 13c.
Electrolytic	12⅝ @ 12⅞c.
Castings	12½ @ 12¾c.

The London Market was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	59 2 6	59 5 0
Standard copper, futures	59 10 0	59 12 6
Market	Strong.	Irregular.
Sales of spot		200 tons
Sales of futures		600 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 10 0
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0 0

The reverberatory furnaces of the Washoe smelters of the Amalgamated Company were blown in last Friday. These smelters are said to be the largest in the world, reducing about 10,000 tons daily. It will be 60 or 90 days before any of the copper from the shipping mines will make its appearance on the market. The North Butte property is now operating to its full capacity, and the Anaconda and the Butte coalition will soon have their output up to normal. It is said that the mines are being worked with greater efficiency than for years past, and it is expected that operating costs this year will be lower than they have been in a long time. The *Boston News Bureau* figures the production of copper in the United States, Mexico and Canada for the month of February, at 65,036,750 pounds, compared with 85,288,106 pounds in February, 1907, a decrease of 20,251,356 pounds.

WESTERN EXPORT DEVELOPMENT.—Although the total business of the Western Electric Company for 1907 showed a falling off of $16,521,163 from the record of $69,245,331 for 1906, the foreign business was even larger in 1907 than in 1906. Shortly after the Western Electric Company began the manufacture of telephones in 1876, the foreign demand increased so rapidly, and the necessity for making quicker and more frequent deliveries than were possible from the American factories, led to the establishment of factories and supply houses throughout the various countries of Europe and the Far East. The first foreign house was opened at Antwerp in 1882, and other houses were subsequently established at London, Berlin, Paris, Milan, Vienna, St. Petersburg and Tokio, and selling agencies at Johannesburg, South Africa, and Sydney, Australia. From these distributing houses, supplied in part by the factories which are a part of their organization, but largely by the American factories, the business in Europe and the Oriental countries has been developed. In addition to the regular output of the foreign factories, shipments of telephones and power switchboards, street-railway generators and motors, lighting material and electrical supplies of all kinds, are made from the American factories to the foreign houses and distributed by them to the trade in their respective territories. As indicating the progressive tendencies of the Oriental peoples it is interesting to note that the telephone has been much more readily adopted by them than by some of the older countries of Europe—Russia and Italy suffering particularly by the comparison. During the past year large consignments of telephone apparatus have gone forward to Japan and China, including a large switchboard equipment especially constructed for the exchange at Seoul, Corea. This switchboard, a lamp-signaling multiple switchboard of the most approved type, has a capacity of several thousand lines, and replaces a magneto board of an antiquated pattern which the city of Seoul had entirely outgrown. The board, with the desks, power board and all auxiliary equipment, was built at the company's Chicago factory, and is now being installed by the Tokio house, through whom the original contract had been placed. The development of the business in Mexico, the West Indies, and Central and South America, which is handled by the New York house, has also been very rapid in the last few years. Hardly a steamship leaves New York harbor for South American ports which does not contain as a part of its cargo, large consignments of telephonic apparatus and electrical supplies for these countries. During the last year modern central-battery telephone systems have been installed in Mexico City, Panama, Rio de Janeiro, Trinidad and other cities of the Latin-American countries, while numerous smaller magneto switchboards and private systems have been installed throughout this entire territory. Cuba, in line with its recent industrial development has also invested largely in telephone apparatus, a large percentage of which is the product of Western Electric factories. A feature of the export business which is frequently given very little attention by shippers is the question of packing. The export department of the Western Electric Company since its organization has made a study of this feature of the work. Shipments for export are packed by special packers in a department entirely distinct from the regular packing department, and the most careful attention is given to all the details.

ELECTRICAL EQUIPMENT FOR NEW BOSTON BRIDGE.—Contracts have been let for two electrically-driven air compressors to be used in operating the new Northern Avenue Bridge, in Boston, over the Fort Point Channel. The Ingersoll-Rand Company will supply these; and the air receivers, eight in number, and of steel construction, will be furnished by the Roberts Iron Works Company, of Cambridge, Mass. Two steam engines for turning the draw span will be supplied by the Mead-Morrison Company, of Cambridge, and the Walworth Construction & Supply Company, of Boston, will furnish and install the operating machinery. It is proposed to use compressed air under 200 lbs. pressure for operating the draw. The structure will be turned through two independent sets of gearing by two engines, operated by air instead of by steam; air-brakes being provided to regulate the swinging. The ends of the four trusses are to be raised by eight cast-steel levers lifted by air cylinders 16 in. in diameter. A centering device operated by a small air cylinder is to be used to bring the draw into exact position on closing. The air is to be compressed and stored in a power house located on the down-stream end of the draw fender pier; this house to provide quarters for the men who will operate the draw.

CANADIAN CROCKER-WHEELER COMPANY, LIMITED.—Another promising sign of returning confidence in the business situation is the organization of the Canadian Crocker-Wheeler Company, Limited, for the manufacture and sale in Canada of the well and favorably known Crocker-Wheeler apparatus. The latter company, as is well known, manufactures practically all types of direct current and alternating-current motors and generators, motor-generator sets, frequency changers, etc. Among its specialties are direct-current motors for special purposes, such as machine-tool and printing-press drives, and steel mill work. For the latter, a line of motors has been specially developed which has been found to fully meet the very severe conditions which exist in steel mills. Crocker-Wheeler alternating-current generators up to 2000-kw capacity have been in successful operation in Canada for some years. The officers of the company are as follows: Mr. Fritz E. Lovell, president; Mr. R. A. Stinson, vice-president; Mr. F. John Bell, secretary-treasurer. The head office is located in the Street Railway Chambers, Place d'Armes Hill, Montreal.

ALLIS-CHALMERS TURBINE FOR ATHENS, GA.—The Athens (Ga.) Electric Railway Company will add a second steam turbine, of 1000-kw capacity, to its plant, which, with the generator designed for direct-connection to it, is now being built by Allis-Chalmers Company, at its West Allis shops. The unit will deliver three-phase, 60-cycle current at a terminal pressure of 2300 volts, and excitation is to be obtained from a 40-kw induction motor-generator set, also of Allis-Chalmers manufacture.

Financial Intelligence.

THE WEEK IN WALL STREET.—After three weeks of nearly complete stagnation, characterized by stubborn resistance to unfavorable news developments, the stock market threw aside its apathy, and toward the end of last week rose in leaps and bounds, closing higher on Saturday than for a long time. The movement was wholly professional, and the upward turn was lost on Monday under a rush of selling orders, but the advance was welcomed as indicative of the possibilities of the market, and undoubtedly the fundamental reason for the rise was that some of the biggest financial interests in the country have been, and are accumulating stocks. The Hill stocks were again the object of bullish manipulation, and the feature of the market on Friday was the rapid advance of Amalgamated Copper. The Gould stocks were heavy, but the United States Steel stocks showed strength in anticipation of the next report, which, it is believed, will be excellent. There were many indications of lowering rates for money, both here and abroad. The government report showed that the winter has been most favorable for crops of any in recent years. During the week the New York banks lost more than $8,000,000 cash to the Treasury, but the only result was to stiffen time loan rates a trifle. The offering of $4,000,000 of New York State 4 per cent bonds, which were 16 times oversubscribed, showed that there is abundant money waiting to rush into good investments. The process of strengthening the cash situation is still in operation. The government figures on foreign trade for the month of February show a falling off in exports of merchandise as compared with any of the preceding three months, but the total of $167,800,000, makes, nevertheless, a record for the month of February. Monday's closing quotations were as follows:

NEW YORK.

	Mar. 6.	Mar. 16.	Shares sold.		Mar. 6.	Mar. 16.	Shares sold.
All-Ch.	5½	6⅝	1,600	Int.-Met., com..	7¼*	7½	2,915
All-Ch. pfd....	14¼	17⅜	1,300	Int.-Met., pfd...	19	19¾	6,580
Amal. Cop.....	50½	55¼	292,850	Mackay Cos....	54*	56½	600
Am. D. T......	39	39*	——	Mackay Cos. pfd.	61½	62*	800
Am. Loc.......	34¼	37	14,930	Met. St. Ry....	19	16	125
Am. Loc. pfd..	90½*	91½	2,900	N. Y. & N. J. Tel.	100*	98*	332
Am. Tel. & C'bl.	54*	50*	5	Steel, com.....	30⅜	33	477,092
Am. T. & T....	106¾	108¼*	500	Steel, pfd......	93⅝	97¼	50,455
B. R. T.......	—	43¾	98,685	W. U. Tel.....	47½	49	3,275
Gen. Elec......	116½	120¼	3,849	West'h, com....	40*	40	1,675
Hud. R. Tel....	—	—	——	West'h, pfd....	50	59½*	——

BOSTON.

	Mar. 6.	Mar. 16.	Shares sold.		Mar. 6.	Mar. 16.	Shares sold.
Am. Tel. & Tel..	106½	109¾	——	Mass. E. R. pfd.	43½	47½	——
Cumb'lnd Tel...	—	106¼	——	Mex. Tel. pfd..	5	5	——
Edison El. Ill..	203*	202	——	New Eng. Tel'p.	107	110	——
Gen. Elec......	116	122½	——	W'st Tel. & Tel.	—	7¼	——
Mass. Elec. Ry.	9¾	10½	——	W. T. & T. pfd.	—	64½	——

PHILADELPHIA.

	Mar. 6.	Mar. 16.	Shares sold.		Mar. 6.	Mar. 16.	Shares sold.
Am. Rys.......	43	42¾	——	Phila. Elec...	7¼	7¾	——
Elec. Co. of Am.	8¾	9⅛	——	Phila. R. T.....	14½	16⅝	——
Elec. Stor. B'ty.	26½	28	——	Phila. Traction..	86½	—	——
E. S. B'ty pfd..	—	—	——				

CHICAGO.

	Mar. 6.	Mar. 16.	Shares sold.		Mar. 6.	Mar. 16.	Shares sold.
Chicago City Ry.	172	150	——	Met. Elec. com..	17	17	——
Com.-Edison ...	86*	90	——	National Carbon.	50	52	——
Chicago Subw'y.	—	—	——	Nat. Carbon pfd.	100	103	——
Chicago Tel. Co.	109¾	112	——				

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*Last price quoted.
Shares sold are for week March 9-14.

COLUMBUS EDISON.—The stockholders of the Columbus Edison Company have voted to increase the capital stock of the company from $1,000,000 to $1,500,000.

UNION TRACTION DIVIDEND.—The directors of the Union Traction Company of Indiana have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable April 1.

MICHIGAN LIGHT DIVIDEND.—The quarterly dividend of 1 per cent on the common stock and 1½ per cent on the preferred stock, payable April 1, has been declared by the directors of the Michigan Light Company.

TO SPEND $2,000,000 IN ELECTRIFICATION.—Dispatches from Chicago state that the Northwestern & Burlington Railroad will begin to electrify the Wood Street freight yards on April 1, at a cost of about $2,000,000.

BOSTON ELEVATED PAYS DIVIDEND.—A dividend rental of $1.75 per share will be paid on April 1 on the common stock in accordance with the provision of the lease of the West End Street Railway Company to the Boston Elevated Railway Company.

UNION SWITCH & SIGNAL DIVIDEND.—At their last meeting the regular quarterly dividend of 3 per cent on the common and preferred stocks was declared by the directors of the Union Switch & Signal Company. The dividend will be payable April 10.

CANADIAN GENERAL ELECTRIC CUTS DIVIDEND.—At the last meeting of the directors of the Canadian General Electric Company the dividend was cut from the 10 per cent basis, which the company has been paying for the last ten years, to a 7 per cent annual basis. The stock of the company, which has dropped to 90 from par since the first of the year, sold as high as $235 in 1901, and as high as $178 in 1905. It was said by one in authority that the dividend reduction was merely a precautionary measure taken in view of the uncertainty of industrial conditions. The quarterly dividend of 1¾ per cent on the three months ending March 31, on the common stock, represents a ¾ per cent reduction on the 2½ per cent quarterly dividend declared heretofore. The directors also declared a semi-annual dividend of 3½ per cent on the preferred stock.

UTICA GAS & ELECTRIC BOND ISSUE.—N. W. Harris & Company are offering $1,000,000 of Utica Gas & Electric Company refunding and extension mortgage 5 per cent tax exempt gold bonds at 92½ and accrued interest, netting about 5½ per cent. This company does the entire gas business and practically the entire electric light and manufacturing power business in Utica, Little Falls, Herkimer, Mohawk, Ilion, Frankfort and other municipalities in the Mohawk Valley. It is stated that for the year ending Dec. 31, 1907, the net earnings of the company applicable to the interest on the refunding and extension mortgage bonds was more than 2½ times the interest charge. This issue of bonds is exempt from taxation by the State, counties, cities, towns, villages, school districts or other local sub-divisions therein, a rather unusual feature in connection with New York State corporation bonds. Fifty-year, 5 per cent bonds of the Utica Gas & Electric Company, to the value of $500,000 are offered by Perry, Coffin & Burr, Boston, at 92½. The gross earnings of the company for the year ending Dec. 31, 1907, were $772,728; net earnings, $399,594 and surplus, $180,094. The generating capacity of the electric plant of the company is 8000 hp at Trenton Falls, 3400 hp at Dolgeville—both hydro-electric—and 8000 hp at Utica in two steam plants.

INTERBOROUGH-METROPOLITAN BOND ISSUE.—The first hearing on the application of the Interborough-Metropolitan Company for permission to mortgage its property for $55,000,000 to secure an immediate issue of $30,000,000 in bonds for refunding present indebtedness, and the optional future issue of $25,000,000 in bonds for such additional equipment or purchase of property as might be deemed wise, was held by the Public Service Commission on Monday of this week. George W. Wickersham, counsel for the company, explained the details of the proposed mortgage and bond issue in accordance with the formal petition. Edward F. J. Gaynor, auditor of the company, testified that about $5,200,000 had been paid to capital account of the operating receipts. This money was due from capital account, he said, and would in time be paid back. After the hearing Mr. Ivins, special counsel for the Public Service Commission, said that the use of money from operating receipts for capital account was not unusual, and that it was highly creditable, as the money might have been paid out in dividends. It was also brought out that the Interborough-Metropolitan owed the Rapid Transit Construction Company, which built the Brooklyn extension of the subway, $7,431,306.71 on account of the excess cost of the work over the contract price. Already $3,300,000 has been paid in excess of the contract. The hearing was adjourned for a week.

GENERAL ELECTRIC COMPANY'S YEAR.—The annual report of the General Electric Company for the year ended Jan. 31, 1908, which will be issued in May, will, it is reported, show gross orders billed to customers of approximately $70,000,000 and net earnings for dividends on the $65,167,100 capital stock, of about $9,800,000 or 15 per cent. The share earnings for the company in the previous fiscal year ending Jan. 31, 1907, were $8,427,842 equal to 13.2 per cent on the $63,572,800 stock outstanding at the end of that year. The figures for last year establish a new high record, which was made possible by the large amount of business carried over from the 1906 year and the large volume of orders booked during the first six months of the year just ended. In the fiscal year of 1904 the company shipped to its customers a total of $41,699,617 of electrical supplies and apparatus and the total of $70,000,000 for the last year is an increase of about $30,000,000 or 70 per cent. Net earnings have increased from $7,865,376 in 1904 to about $9,800,000 last year, a gain of $2,000,000 or 25 per cent, which means that the ratio of net profits to gross earnings, which in 1904 was 18.8 per cent, declined in 1908 to 14 per cent, a shrinkage in four years of nearly 5 per cent. Since 1903 the selling policy of the General Electric Company has undergone a radical change. In 1903 the company did a gross business of $36,685,598 and net profits were $10,232,839, equal to 28 per cent of gross earnings for dividends. Results for 1907-8 show that this ratio has been cut exactly in two and in the interval gross sales have nearly doubled. The reduction in price of electrical apparatus made is stated to be in accordance with the policy of the General Electric Company that the surest way of maintaining its position in the electrical field is to accept a moderate rather than an exorbitant ratio of profit. Between 1904 and 1907 the outstanding stock has increased from $43,866,700 to $65,167,400 and the dividend percentage on the outstanding stock for the last five years beginning with 1904 was 17.9, 13.9, 13.4, 13.2, 15. The amount of business booked during the last four months of the 1907 year was about 50 per cent smaller than during the first five or six months.

WHITNEY COMPANY REORGANIZATION PLAN.—Bondholders in the Whitney Company, the $10,000,000 corporation organized to develop water power on the Yadkin River in North Carolina, and which went into a receiver's hands last month, have received an offer of a plan of reorganization. The Whitney Company went into receivership soon after the failure on the Pittsburg Stock Exchange of the firm of Whitney, Stephenson & Company. E. F. Buchanan, of the banking firm of A. O. Brown & Company, of New York, who was interested in the financing of the Whitney Company, was recently elected president of the company and is the author of the reorganization plan. The plan calls for the formation of a new company with $5,000,000 7 per cent non-cumulative preferred stock, $5,000,000 common stock, $5,000,000 first-mortgage 5 per cent 20-year bonds and $5,000,000 6 per cent second-mortgage 60-year income bonds. Present bonds are to be surrendered for 50 per cent of their face value in income bonds, and a part of the preferred stock will be allotted to all bondholders participating in the agreement. The first-mortgage bonds are to be issued to provide funds to complete the plant at not less than 80 per cent of their face value. Mr. Buchanan stated that A. O. Brown & Company had advanced in the neighborhood of $1,000,000 in cash to the company, and that his company represented about half of the $5,000,000 Whitney Company bonds. The value of the plant in its present condition is about $2,000,000, and it will take at least $2,000,000 to complete it. The company has large holdings in North Carolina and was organized for the purpose of utilizing the power of the Yadkin River. The present plant which is hoped will be completed by July 6, 1908, has a capacity of 45,000 hp and the construction of a 50,000-hp plant is contemplated later, to supply power to the cotton mills and other industries in that region. The company owns 7534 acres of land.

DECREASE IN CONSTRUCTION BY THE AMERICAN TELEPHONE COMPANY.—Construction work by the operating companies of the American Telephone & Telegraph Company for 1907 will be a great deal less than the $79,366,949 expended in 1906 on new work finished in 1906. During 1905 and 1906 the company went about the work of expansion on a large scale, and in those two years a total of more than $130,000,000 was expended, so that at the beginning of 1907 a large part surplus of primary construction all installed and prepared for last year's expansion was ready. The advancing cost of labor, materials and cost of installation work in 1907 made it necessary to cut down the expansion work contemplated. Reports from 11 of the 30 odd operating companies for the year ended Dec. 31, 1907, give a total of $20,807,972 spent in construction work, a decrease of $10,936,384, or 34 per cent decrease from the amount spent in 1906. The $20,807,972 given above is about 40 per cent of the 1906 total of $79,366,949, and estimating on this basis the construction expenditures of the Bell system for 1907 may be approximated at $50,000,000, which is practically $30,000,000 less than during the previous twelve months.

MASSACHUSETTS ELECTRIC COMPANY PREFERRED STOCK ISSUE.—The stockholders of the Boston & Northern and the Old Colony Street Railway Companies will meet on March 17, when they will be asked to authorize an issue of preferred stock not exceeding $1,250,000 for the Boston & Northern and $750,000 for the Old Colony Company. The stock is to have voting power and will call for 6 per cent cumulative dividends. The issue will be made for the purpose of retiring the floating debt of the two companies, and it is believed that such securities as the dividends are to be at the rate of 6 per cent will find a more ready market than bonds in the present financial situation.

CINCINNATI UNION GAS & ELECTRIC COMPANY REPORT.—Earnings for 16 months of the Union Gas & Electric Company, of Cincinnati, which about two years ago took over the Cincinnati Gas & Electric Company, were $481,697 after paying all charges. A 6 per cent dividend was paid on the $5,000,000 of preferred stock for the 16 months, leaving a net surplus of $81,697. While these earnings are small for the $5,000,000 of common stock, President Kenan anticipates greatly increased earnings during the coming year. The report shows large increases in all lines of business operated by the company.

CAMBRIDGE GAS LIGHT COMPANY STOCK ISSUE.—The Massachusetts Gas Commission on the petition of the Cambridge Gas Light Company to issue sufficient additional stock to yield $427,000, has approved of an issue of 2015 shares to be offered to the stockholders at $200 a share, making a total of $403,000. The proceeds of 125 shares are to cancel promissory notes, 565 shares to cancel an equal amount of obligations and 1325 shares to pay cost of additions to the plant.

COLUMBUS EDISON COMPANY STOCK INCREASE.—At a meeting of the stockholders of the Columbus (Ohio) Edison Company it was voted to increase the capital stock from $1,000,000 to $1,500,000. There is now an equal amount of common and preferred stock, and it is believed that the respective dividends of 5 and 6 per cent will be maintained.

DUQUESNE LIGHT COMPANY.—The Duquesne Light Company, of Pittsburg, Pa., is considering plant improvement involving an expenditure of $4,500,000. Mr. George R. Webb, formerly president of the Maryland Telephone Company, has been elected president of the Duquesne Company, succeeding Mr. R. C. Hall, who becomes vice-president.

PHILADELPHIA ELECTRIC EARNINGS.—It is reported that the coming statement of the earnings of the Philadelphia Electric Company will show, for 1907, an increase of about $500,000 over the preceding year, and a surplus over dividends of the same amount, an increase of $180,000 over 1906.

WEST INDIAN ELECTRIC COMPANY.—Gross earnings of $198,845 for the year ended Dec. 31, 1907, and net profits of $104,040 are reported by the West India Electric Company. Deducting the fixed charges left a surplus of $57,086, equal to 7.13 per cent on the common stock of the company.

DAYTON & XENIA'S RECEIVER.—C. J. Fernending, of Dayton, Ohio, has been appointed receiver for the Dayton & Xenia Transit Company, on an application from the Worcester (Mass.) Trust Company, which holds $300,000 of the second mortgage bonds of the road.

DULUTH EDISON REGULAR PREFERRED DIVIDEND.—The directors of the Duluth Edison Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1, to stockholders of record March 17.

SEATTLE ELECTRIC PREFERRED DIVIDEND.—Directors of the Seattle Electric Company have declared the regular semi-annual dividend of 3 per cent on the preferred stock, payable April 1 to stockholders of record March 12.

FIRST PAMPHLET REPORT ISSUED BY WESTERN ELECTRIC COMPANY.—The first pamphlet report issued by the Western Electric Company has been mailed to the stockholders and covers the fiscal year ended Nov. 30, 1907. Net earnings on 1906 sales were $1,217,000, against which dividends of 8 per cent, or $1,200,000, were declared, leaving a surplus balance of $17,000. The report gives total assets of $51,483,104, the decrease, $10,701,405, since Dec. 31, 1906, coming in the decrease of merchandise and bills and accounts receivable. The total of bills payable was $17,701,793, a decrease from Dec. 1, 1906, of $9,380,759. Secretary H. A. Halligan says in part: "On Dec. 31, 1906, the indebtedness of the company was $27,082,552, including a contingent liability of $4,201,189 for bills receivable discounted. The business of the preceding year had taxed the resources and credit of the company, sales averaging nearly $6,000,000 a month. Although customers had maintained a good standard of promptness in payment, the investment in accounts and bills receivable was $24,555,074. The process of reducing purchases of materials and payrolls began to be in full operation from February, 1907, and since that time the rate of production in the factories has been in fair proportion to the volume of new orders. The success of the efforts in this direction is shown by the fact that indebtedness has decreased $9,380,759, which, with an increase in cash of $1,147,425, comprises an improved financial condition to the extent of $10,528,184. Sales for 1907 were $52,724,168, as compared with $69,245,332 for the previous year, a decrease of 23.9 per cent. When the cutting down began in February and March, 1907, the initiative was taken with a view primarily to the financial condition of the company and to the necessity of reducing indebtedness. Quick assets at the end of the year were $21,025,669, or 18.8 per cent more than all the bills payable. Factory plants and warehouses are carried on the books at 51.9 per cent of their cost. At the close of the 1906 year, capital and surplus were $35,102,000, a book value per share of $234.01. After deducting $1,338,000 of depreciation and extraordinary expenses in 1907, the book value of stock on Dec. 1 last figures out $225.21."

PACIFIC TELEGRAPH AND TELEPHONE COMPANY.—For the fiscal year of 1907 the Pacific Telephone and Telegraph Company reports gross earnings of $9,223,565, an increase of $1,491,950 over 1906, and total expenses of $7,828,415, an increase of $1,561,423 over 1906. Although the net revenue of $1,395,149 was $69,474 less than the net revenue of the previous year, dividends of $1,080,000 were declared as compared with the $704,566 dividends of 1906, thus reducing the surplus from $760,057 to $315,149. During the year the total expenditures on plant and real estate were $6,174,404. The remarkable increase in gross earnings equals 19.3 per cent and the 44,801 new stations, or 17.3 per cent increase, indicate the extent of the recovery from the San Francisco disaster and the growth of telephone development on the Pacific Coast. During the year the company increased its bonded indebtedness by $8,750,000 owing to the necessity of replacing that part of the system destroyed by the San Francisco earthquake. In point of capitalization and subscribers this company is second in size to the New York Telephone Company, among the subsidiaries of the Bell.

SAN FRANCISCO UNITED RAILWAYS COMPANY DEBT ADJUSTMENT.—Pittsburg dispatches state that the Westinghouse Electric & Manufacturing Company has been authorized by the United States District Court to participate in a plan for adjusting the floating debt of the United Railways Company, of San Francisco. The Railways Company's indebtedness is about $3,500,000, of which the Westinghouse claim is $117,539. The United Railways Company will issue $3,500,000, 6 per cent notes, maturing half in August, 1913, and half in February, 1914, secured by $3,500,000 preferred stock of the United Railways Company, to adjust the debt. It is stated in the petition upon which the order was made by Judge Young, that unless some arrangement is made to meet the floating indebtedness of the United Railways Company, it will be forced into the hands of a receiver. The chief creditors of the United Railways Company, among whom are the General Electric Company and the Lorain Steel Company, are said to have agreed to the proposed plan.

NEW ENGLAND TELEPHONE.—For the fiscal year ended Dec. 31, 1907, after the payment of regular 6 per cent dividends, the New England Telephone Company will show a surplus of more than $260,000, which is equal to 0.82 per cent on the $31,697,800 capital stock outstanding. For the 1906 year the company showed a surplus of but $150,793 and surplus after dividends for the four preceding years has averaged less than $140,000. Maintenance expenditures in 1907 were conducted on an unusually liberal scale, so that if the company had handled the maintenance account on the same basis as 1906, 7 per cent could easily have been shown. It is thought that as soon as earnings warrant and a few adjustments of rates, particularly in the Boston district, have been made, the company will begin payment of 7 per cent dividends.

ELECTRIC SECURITIES COMPANY.—Following is a digest of the semi-annual statement of the United Electric Securities for the six months ending Feb. 1, 1908. Total receipts were given as $171,735, a decrease of $8,314 over the same period in 1907. Expenses of $119,276 show an increase of $20,946 over 1907, leaving a net balance of $52,459. The total income was given as $52,459, against $92,500 for 1907 and the total surplus $1,280,950, against $1,228,488 of 1907. A preferred dividend of $35,000 was declared as last year, leaving a balance of $1,245,950 on hand Feb. 1, and a surplus of $2,117,672 as compared with a surplus of $1,195,356 for 1907. The total assets of the company were given as $7,730,358.

WASHINGTON WATER-POWER NOTES.—Moffat & White and Lee, Higginson & Company, of Boston, are putting forth an issue of $3,000,000 Washington Water Power (Spokane) 6 per cent notes at 96, yielding 7½ per cent on the investment. The company owns and operates 93 miles of electric railway and supplies light and power to Spokane and the neighboring towns and to mines and manufacturing plants within a radius of 100 miles. For the year ended Feb. 29 the gross earnings of the company were $2,173,031, an increase of more than 29 per cent over the previous year. The net earnings were $908,802, an increase of 46½ per cent over 1906.

BUTTE ELECTRIC BOND ISSUE.—A special meeting of the stockholders of the Butte Electric & Power Company will be held on March 30 at Newark, N. J., to vote upon the issue of $5,000,000 thirty-year 6 per cent bonds, secured by a second mortgage upon the properties of the Butte Electric & Power Company and its subsidiaries, the Madison River Power Company and the Montana Power Transmission Company. It is proposed by this issue to liquidate the floating debt of the companies and to provide them with an additional working capital.

NEW COMPANY CHARTERS MEXICAN TRAMWAYS.—An important transaction registered during January in Mexico was the chartering of the Mexican electric tramways by a company with a capital of 8,000,000 pesos (about $4,000,000). Other important business operations which were backed by French, Italian and American capital were registered to the amount of 12,000,000 pesos, and included the construction of electric light plants at Juchitan and Oaxaca, and electric plants on the Isthmus of Tehuantepec.

RUTLAND RAILWAY LIGHT & POWER COMPANY.—For the twelve months ended March 1, 1908, the Rutland Railway, Light & Power Company reports earnings for water, power and light of $112,973, against $80,999 for 1907, and expenses of $63,153 against $51,036 for the previous year, leaving a net for 1908 of $49,820 against a net of $29,963 for 1907. The total net in all departments for the twelve months was given as $109,950, an increase of $23,409 over 1907.

RHODE ISLAND LIGHTING MERGER.—The terms of a merger bill introduced in the Rhode Island Legislature on March 11, chartering the Blackstone Valley Gas & Electric Company, give permission to acquire any gas, electric light or power company in Providence County. The capital stock of the new company is not to exceed $3,000,000 in $100 shares except that when three-fourths of the stock vote favorably there may be additional issues of stock.

AMERICAN TELEPHONE & TELEGRAPH DIVIDEND.—The directors of the American Telephone & Telegraph Company declared the regular quarterly dividend of 2 per cent at the quarterly meeting in Boston. The dividend is payable April 15 to stock of record March 19. On account of the annual meeting transfer books will be closed March 20 to March 31, inclusive.

UNION GAS & ELECTRIC COMPANY.—M. E. Moch was elected a director to succeed H. A. Nordeck, and Olaf Ussing was elected in the place of M. F. Plant at the annual meeting of the Union Gas & Electric Company, held in Cincinnati last week. The other directors were re-elected.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

CENTREVILLE, ALA.—The Centreville Light Company has made arrangements to operate the electric light plant at this place by water power, and will hereafter furnish an all-night lighting service instead of until 11 o'clock.

NORTH BIRMINGHAM, ALA.—The City Council has decided to call an election to vote on the proposition of issuing $5,000,000 in bonds, the proceeds to be used for the construction of a water-works system and electric-light plant. If the election carries, the Council purposes to carry out the plans of Thomas H. Friel, which calls for the construction of a dam across the Warrior River near Phillips Ferry, 28 miles from North Birmingham.

SLOCOMB, ALA.—Plans are being considered for the construction of an electric light plant in the town. A. C. Kelly is interested in the project.

JEROME, ARIZ.—The Two Republics Mining Company is making arrangements to install an electric plant in the early summer to provide electricity to operate the machinery for its mines. There is a water power on the property which will be utilized to generate electricity. Paul Smyly is secretary and treasurer of the company.

PINE BLUFF, ARK.—Plans for the buildings of the Pine Bluff Light & Water Company have been completed by Ford, Bacon & Davis, of New York, N. Y., and contracts for the construction of the buildings will soon be let. A contract will also be let for the construction of a 3,000,000-gal. reservoir.

GRIDLEY, CAL.—A. C. Musselman and D. A. Matheson, of Chico, have bonded the Richardson Springs property, and propose to install a small power plant using the water from the second falls at that place.

HUNTINGTON PARK, CAL.—Work will soon commence on the construction of plant of the Huntington Park Gas & Electric Company. Machinery has been purchased for the plant and contracts awarded for the work. The company was recently incorporated by E. M. De La Matyr, J. J. Curran and H. T. Leukfeld.

LOS ANGELES, CAL.—The Board of Public Works has awarded contracts for the lighting of Hill Street and Broadway during the next year. Electricity for the lamps on Broadway will be supplied by the Los Angeles Gas & Electric Company at 4¾ cents per kw-hour. The Pacific Light & Power Company will supply electricity for lighting Hill Street at the same price.

MONTEREY, CAL.—A new turbo-generator set of 500 horse-power has been installed in the power house of the Monterey County Gas & Electric Company to provide electrical energy for the street railway system of the company.

NAPA, CAL.—Plans are being made by the San Francisco, Vallejo & Napa Valley Railway Company to increase its service. It is proposed to purchase new cars and install new equipment in its power house, which will double the output of the plant.

NAPA, CAL.—The Pacific States Telegraph & Telephone Company has leased its local and rural lines at Calistoga to the Northwestern Electric Company, reserving the long-distance business. The latter company recently purchased the lines of the Calistoga & Clear Lake Telephone Company, which takes in all of the spring resorts in Lake County. The Pacific States company is making arrangements to improve its system in this city and has ordered a new $30,000 switchboard for the local exchange.

PLACERVILLE, CAL.—The Board of Trustees of this city has taken further steps toward the installation of a municipal electric lighting plant. Two propositions are being considered, one on River Hill and the other from Smith's Flat. The board will proceed at once to procure the services of an engineer and obtain estimates relative to the matter.

SAN BERNARDINO, CAL.—Work will soon begin on the construction of the new exchange building of the Pacific States Telephone & Telegraph Company, the cost of which is estimated at $12,000. The company has nearly completed the installation of its underground system, which will be put into service as soon as the new building is completed.

BUENA VISTA, COL.—The Town Board has granted a 20-year franchise to Buena Vista Smelting & Refining Company to construct and maintain an electric light and power plant in the town.

HARTFORD, CONN.—Bids for installing the lighting equipment for the Stone Bridge across the Connecticut River, at Hartford, will be received until March 17 by the Board of Commissioners of the Connecticut River Bridge and Higbway District at its office, Aetna Life Insurance Building, Hartford, Conn. The contract will cover the complete installation of the lighting system for the four-light fixtures surrounding the trolley poles on the bridge. The fixtures, globes and lamps are not included in this proposal.

HOLLY OAK, DEL.—Plans are being made by the Holly Oak Public Service Association for lighting the streets of the town by electricity. There is no electric-light company in the town, but it is thought that some arrangement for a supply of electricity for lamps can be made.

WASHINGTON, D. C.—Bids will be received March 30 at the office of the Commissioners of District of Columbia, Washington, D. C., for furnishing metal cabinet work, electric lighting fixtures, electrical clock system and furniture and equipment for use in the new municipal building, Washington, D. C. Specifications, blank forms of proposals and all necessary information can be obtained at the office of the property clerk, District Columbia, District Building. Henry B. F. McFarland, Henry L. West and Jay J. Morrow are the commissioners.

WASHINGTON, D. C.—Bids will be received until March 25 at the office of the Superintendent of the U. S. Capitol Building and Grounds, Washington, D. C., for weather-proof and rubber-covered electric wire, switches, conduits, etc., for the office building, U. S. Senate, Washington, D. C. Material to be delivered at building; erection of the same not to be included. Specifications and schedule can be had upon application to the above office. Elliott Woods is Superintendent of U. S. Capitol Building and Grounds.

ALACHUA, FLA.—The city is contemplating the construction of an electric light plant and water works system.

SYLVESTER, GA.—An election will soon be held to vote on the proposition of issuing $10,000 electric light and water works bonds.

TENNILLE, GA.—Plans are being made to rebuild the municipal electric light plant at once, which was destroyed by fire on March 3.

NEZ PERCE, IDAHO.—The Nez Perce Co-operative Telephone Company has taken over the system of the Sunset Telephone Company, operating a line seven miles east of Nez Perce. The line will be extended this spring.

BELVIDERE, ILL.—The capital stock of the Boone County Rural Telephone Company has been increased from $2,500 to $20,000.

GALENA, ILL.—The City Council has instructed City Attorney Majors to draft an ordinance relative to the construction of an electric light plant to be owned by the city.

CHICAGO, ILL.—Plans have been prepared by C. B. Bride, of Spokane, Wash., for the development of 100,000 horse power on the St. Joe River in northern Idaho for the Chicago, Milwaukee & St. Paul Railway Company. The railway company is contemplating the installation of an electrical plant to furnish energy to operate its trains across the Bitter Root divide and to operate several sawmills and other manufacturing plants in St. Joe and St. Maries counties. It is said that the work can be completed in about three years, and will cost $3,000,000. A. J. Barling, of Chicago, is president.

PEORIA, ILL.—The City Council has passed an ordinance requiring the Peoria Street Railway to place its feed and transmission wires underground in the downtown district, the work to be completed by March 1, 1909.

PRAIRIETOWN, ILL.—A stock company has been formed by a number of farmers to build and operate a telephone system. Lines will be erected from Prairietown to Bunker Hill.

SPRING VALLEY, ILL.—The contract for lighting the streets of the city has been awarded to the Spring Valley Electric Light Company. The contract is for a term of 10 years.

TREMONT, ILL.—The Union Independent Telephone Company, of Augusta, Me., has purchased the plant and holdings of the Tazewell County Telephone Company, the consideration being $38,400. The first-named company had previously purchased the Tremont Independent Telephone Company, and it is understood that the two exchanges will be consolidated, and improvements and extensions made to the system.

GARRETT, IND.—The Garrett Telephone Company has filed an amendment to its articles of incorporation increasing its capital stock by $15,000. The company has taken over the exchange of the Central Union Telephone Company and will operate the local system. The Central Union company will retain the long-distance station.

MUNCIE, IND.—The Delaware & Madison Counties Telephone Company has decided to erect a new building in this city at a cost of about $25,000.

VINCENNES, IND.—It is reported that a deal has been closed by which the Vincennes Light & Power Company has become owner of the local interests of the Black Hawk Light, Heat & Power Company, which a few months ago brought natural gas to Vincennes from the Illinois field, a distance of 25 miles. This taking over will put an end to the rate war between the two companies.

FAYETTE, IA.—The Interstate State Telephone Company contemplates making extensions and improvements to the local exchange

HAMPTON, IA.—The Central Telephone Company is planning to make improvements to the local exchange and also at Iowa Falls

BARBOURSVILLE, KY.—The East Tennessee Telephone Company is making arrangements to extend its lines from Middlesboro to Barboursville, and contemplates installing exchanges at Pineville and Barboursville.

LEXINGTON, KY.—The East Tennessee Telephone Company is making a number of improvements to its system in this city and is contemplating the extension of its lines into the rural districts, which have not been previously entered. W. T. Haff is local manager.

WILLIAMSTOWN, KY.—The question of installing an electric light plant in the new roller mills is being considered. J. M. Riley is interested in the project.

HOUMA, LA.—The City Council is considering the question of establishing a municipal electric light plant and has appropriated $6,000 for the same.

MANSFIELD, LA.—It is reported that the municipal electric light plant will be taken over by a local company, which is being organized to purchase and operate the plant. L. G. Sample is interested in the project.

OPELOUSAS, LA.—The citizens are considering the question of enlarging the municipal electric light plant. A. C. Jones is superintendent.

GRAFTON, MASS.—The Grafton Electric Company has notified the town of Grafton that it can no longer furnish electric incandescent lamps to the town at $12 each per year. The company has submitted a proposition to the town offering to furnish incandescent lamps of 32 cp for a term of five years at $13.50 each per year, or at $14 per lamp per year on a one-year contract. There are 219 lamps now in use.

LENOXDALE, MASS.—Plans are being perfected for the organization of a local electric-lighting company to furnish electricity for commercial and street lighting. It is probable that electrical energy for operating will be secured from some other company.

NEW BEDFORD, MASS.—A number of merchants occupying stores on the square bounded by Union, William, Pleasant and Purchase Streets are interested in a project to establish an independent lighting plant to supply electricity for lighting their stores. Charles W. Clifford, Masonic Building, is interested in the enterprise.

NEW BEDFORD, MASS.—A special committee has been appointed by the City Council to investigate the question of municpal lighting. The committee consists of Aldermen Winspur and Washburn, Councilmen Livesey, Mahoney and McClure. W. H. Remington is clerk of the committee.

PALMER, MASS.—At the town meeting to be held March 23 the citizens will vote on the proposition as to whether or not the town shall acquire the franchise and property of the Central Massachusetts Electric Light Company. The company at present furnishes electricity for lighting in the towns of Palmer, Warren and Monson, and also energy for operating the Springfield & Eastern Street Railway Company.

ROCKPORT, MASS.—Robert Herne, chairman of the special committee appointed to investigate the question of municipal lighting on March 5, presented a supplementary report in which it was stated that to build and equip a municipal lighting plant for the town would cost $40,000, provided it could secure the overhead system of the Gloucester Electric Company at a reasonable price. Mr. Herne states that the value of the system is placed at $27,800 by the company, which he considers excessive. He presented figures tending to show that the plant would be a good investment for the town.

WESTMINSTER, MASS.—A committee has been chosen to confer with the Connecticut River Power Company in regard to its proposition to erect its transmission lines through the town to furnish electricity for lamps, motors, etc., and report at the next town meeting. The members of the committee are: J. C. Goodrich, Frank H. Battles, Dr. A. E. Mossman, Phillip H. Loughlin and D. W. Barnes.

CLINTON, MICH.—It is reported that improvements are to be made to the municipal electric light plant, including the installation of a new generator.

BAUDETTE, MINN.—A franchise has been granted to Stoner & Jewett, of Bemidji, granting them permission to erect and maintain an electric light plant in this town.

RICHVILLE, MINN.—A local telephone company has been formed and will install an exchange at once.

MOSS POINT, MISS.—It is reported that the L. A. Dantzler Lumber Company is contemplating the installation of an electric light plant.

PHILADELPHIA, MISS.—Plans are being prepared by the Philadelphia Compress Company for the erection of an electric-light plant.

ARCADIA, MO.—The construction of a concrete dam, 400 ft. long and 50 ft. wide, is being contemplated by Louis Miller and associates. It is proposed to develop 500 electrical horse-power. No machinery has yet been purchased.

CASSVILLE, MO.—The Cassville & Western Railway Company is contemplating the construction of an electric power plant. S. M. Mitchell is president and manager.

BILLINGS, MONT.—Arrangements are being made to extend the service of the Billings Mutual Telephone Company to all the farms and towns in the Stillwater and Rosebud valleys.

BUTTE, MONT.—A special meeting of the stockholders of the Butte Electric & Power Company will be held March 30 to vote upon the issue of $5,000,000 in bonds to be secured by the properties of the Butte Electric & Power Company and its subsidiaries, the Madison River Power Company and the Montana Power Transmission Company, the proceeds of which issue will be used to take up the floating debt of the companies and to provide them with additional working capital.

GLASGOW, MONT.—The city of Glasgow is contemplating the installation of water works, electric lighting system and making other improvements. H. C. Allen is city engineer.

HELENA, MONT.—We are informed that work will commence early this spring by the Capital City Power Company on the construction of a concrete-steel dam across the Missouri River near Helena, having a head of 120 ft. and 1500 ft. in length, which will develop 30,000 electrical hp, for transmission at 70,000 volts, three-phase to Helena, Butte and Anaconda. The contract for the construction of the dam has been awarded to the Capital City Improvement Company, of Helena, and includes the erection of a 70,000-volt transmission line, 40 miles in length. M. H. Gerry, Jr., is chief engineer and W. L. Miller engineer in charge.

WAHOO, NEB.—The City Council is considering the question of installing an electric-light plant and new water works for the city. An election will probably be held to vote on the proposition.

RENO, NEV.—It is stated that the Home Telephone Company is planning to enter this city, and that the company will operate in this state under the name of the Home Telephone Company of Nevada. The material for the construction of the lines has been ordered from the Sterling Electric Company, of Lafayette, Ind. The company proposes to connect all larger towns of Nevada, and also will connect with a line to Los Angeles. William La Shelles is interested in the enterprise.

TONOPAH, NEV.—The transmission line of the Nevada Power Company from Bishop to Millers is completed and the company will now furnish electricity direct for the Desert mill of the Tonopah Mining Company, as well as for the Belmont mill. It is expected that the transmission line will be extended to Manhattan and Round Mountain during the present year.

WINNEMUCCA, NEV.—The Utah-Nevada-Idaho Telephone Company has closed negotiations for the purchase of the Home Telephone Company, which is operating telephone systems in Winnemucca, Goldbanks, Paradise and Golconda. By this deal the company has secured telephone connection from Salt Lake City into all the important towns in eastern and southern Nevada. The company will begin construction of a number of lines which will eventually connect Winnemucca with San Francisco.

HAMPTON, N. H.—The Exeter, Hampton & Amesbury Street Railway Company was sold at public auction March 10 to Charles H. Penny, of Hartford, Conn., who represented a committee of bondholders of the company. The price paid for the road was $250,000.

PATERSON, N. J.—The Board of Freeholders of Passaic County has authorized County Counselor De Yoe to draft a bill to be introduced in the Legislature giving counties of this class the right to build their own lighting plants. The present contract between the county and the Public Service Corporation will expire in August, 1911. Under its terms the county pays at the rate of $140 per lamp per year, regardless of whether they are placed in outlying districts or in the heart of Paterson or Passaic.

ALAMAGORDA, N. M.—Plans are being prepared by Merrill H. Fisher for the construction of an electric power station.

ALBUQUERQUE, N. M.—The Colorado Telephone Company is making arrangements for the construction of a long-distance telephone line from Albuquerque to Estancia, where it will connect with the local and rural independent systems.

ALBANY, N. Y.—The City Council has passed an ordinance providing for 100 additional lamps for the city street-lighting system.

ALBION, N. Y.—Plans are being made by the Buffalo, Lockport & Rochester Railway Company to open the Rochester-Albion section on May 1. Electricity for operating the new road will be furnished by the Niagara, Lockport & Ontario Power Company from its transmission line running through Lockport. One connection will be made at Lockport and the other at South Greece.

BINGHAMTON, N. Y.—The Binghamton Electric Light, Heat & Power Company has nearly completed the installation of an additional 1000-hp equipment in its plant on Court Street, which will give a total output of 3000 horse-power.

CANISTEO, N. Y.—Plans are being considered by the business men of the town to purchase the telephone system of either the Century Telephone Company or the Bell Telephone Company, to be operated on the co-operative plan.

COEYMANS, N. Y.—The power house of the Atlantic Light & Power Company is rapidly nearing completion, the equipment of which consists of two 120-hp engines direct connected to alternating-current generators. The streets will be lighted with incandescent 40-cp lamps. There are 90 street lamps in Ravena, 55 in Coeymans and 40 in New Baltimore. The West Shore Railroad has contracted for 30 arc lamps for its yards in Ravena.

EAST WORCESTER, N. Y.—The Great Bear Light & Power Company has applied to the Public Service Commission for permission to exercise its franchises in East Worcester and Richmondville; also for permission to issue $20,000 in capital stock and $20,000 in bonds. The company has a water power plant in East Worcester, and proposes to furnish electricity in this town and in Richmondville for lamps, heat and motors.

ROCHESTER, N. Y.—Plans for the new telephone exchange building of the Bell Telephone Company have been filed, the cost of which is estimated at $16,000.

SPENCERPORT, N. Y.—The Ogden Telephone Company has decided to build its own system. The company has been negotiating with the Bell Telephone Company, with a view of buying its plant, but the two companies could not come to terms.

MINOT, N. D.—Arrangements are being made to erect a new power plant that will meet the needs of the entire city. It is proposed to organize a stock company to build the plant. J. A. Brunner is interested in the enterprise.

WILLISTON, N. D.—Arrangements are being made by the Muddy Valley Telephone Company to erect 22 miles of new line. G. W. Atterbury is secretary.

CEDARVILLE, OHIO.—Owing to the closing down of the electric light plant of the Cedarville Electric Light & Power Company, the City Council is considering the question of installing a new lighting system. The citizens recently voted in favor of issuing bonds for the construction of a municipal electric light plant.

CLEVELAND, OHIO.—The contract for constructing and equipping the railway of the Massillon, Wooster & Mansfield Traction Company has been awarded to the Mohawk Construction Company.

CLEVELAND, OHIO.—The City Council has transferred $37,000 from the general contingent fund of the city to the lighting fund, which will be used to purchase a 1000-kw unit, to be used in addition to the 500-kw machine now in operation in the municipal plant on the West Side. This additional equipment will give the plant sufficient output to light the streets in the territory west of the river, and, it is believed, will furnish sufficient energy to supply private service where desired.

CLEVELAND, OHIO.—Announcement has been made that arrangements have been completed for financing the construction of the Cleveland, Brooklyn & Elyria Railway Company and that work on the construction of that portion of the road between South Brooklyn and Orrville will be done this year. Next year the railway will be extended to Zanesville, with a branch from Strongville to Elyria. It is expected that the Westinghouse single-phase, alternating-current system will be used. According to the persent plans, the company will be absorbed by a new company, to be known as the Cleveland, Orrville, Coshocton, Zanesville & Elyria Railway Company, which will be capitalized at $4,800,000. The officers of the company are: W. E. Brooks, of Elyria, president; J. J. Breitlinger, of Cleveland, vice-president; J. H. Knisely, Jr., secretary, and B. E. Ottman, of Cleveland, treasurer.

COLUMBUS, OHIO.—The Board of Public Service has notified the finance committee of the City Council that it will submit an ordinance authorizing an issue of another $40,000 in bonds, the proceeds to be used to provide for additional equipment for the municipal electric-light plant, including additional lamps, coal-crusher outfit, rearrangement of the coal conveyor, installation of necessary meters and other apparatus.

CUYAHOGA FALLS, OHIO.—The question of increasing the equipment of the municipal lighting plant is under consideration by the City Council, and estimates of the cost of the new machinery have been submitted by the Arbuckle-Ryan Company. The plan is to double the output of the plant at once and, in the contract to be let, provide for the growth of the village for the next 15 years, which will probably require an expenditure of $10,000 at once and twice that amount within the period specified.

EAST PALESTINE, OHIO.—The capital stock of the Unity Township Telephone Company has been increased from $8,000 to $15,000. J. W. Hoon is secretary.

GALLIPOLIS, OHIO.—The directors of the Gallipolis Home Telephone Company contemplate enlarging the plant here. The capital stock of the company was recently increased from $50,000 to $100,000.

GIRARD, OHIO.—The question of establishing a municipal electric light plant and water works system is being considered by the citizens of this village. L. R. Bingham is interested in the project and would be glad to receive information pertaining to the construction of such a plant.

MOOREFIELD, OHIO.—The Moorefield & Cassville Telephone Company has filed an amendment to its charter increasing the capital stock of the company from $2,000 to $5,000.

PORT CLINTON, OHIO.—The capital stock of the Port Clinton Electric Light & Power Company has been increased from $15,000 to $25,000.

MANGUM, OKLA.—J. T. Patterson and J. W. Chambers, of Ada, have purchased the plant and holdings of the Mangum Electric Light & Power Company for $60,000.

PENDLETON, ORE.—The Eastern Oregon Independent Telephone Company has purchased the plant and holdings of the Butter Creek Telephone Company and is planning to make many improvements and extensions to the system. The capital stock of the company has been increased from $5,000 to $50,000, and the following named officers elected: O. F. Thomson, president; Asa B. Thompson, secretary and treasurer; W. W. Pankey, general manager.

PORTLAND, ORE.—The City Council has passed an ordinance directing the executive board to enter into a five-year contract with the Portland Railway & Light Company to furnish electricity for lighting the city.

TILLAMOOK, ORE.—Plans are being made for the construction of an electric light plant in this place. The cost of the plant is estimated at $15,000.

LEMOYNE, PA.—The system of the Valley Traction will soon be operated by electrical energy supplied by the York Haven Power Company. The power station at Lemoyne will be held in reserve for emergency purposes.

PITTSBURG, PA.—At the annual meeting of the Duquesne Light Company, held March 7, it was decided to proceed at once with the extension of its system, plans for which were adopted some time ago, but were delayed owing to the financial situation. The plans include the construction of a large power station to be located on the water front, and the present plant in East Liberty will be used as a substation. The cost of the new system is estimated at $4,000,000. George R. Webb, of Baltimore, Md., is president of the company.

NEWPORT, R. I.—The Board of Aldermen has instructed the city clerk to advertise for bids for lighting the streets of the city for periods of three and five years with electric, gas and vapor lamps. The present contracts have two months yet to run.

GREENVILLE, S. C.—Plans are being made by the Southern Power Company, of Charlotte, N. C., to extend its transmission lines into this city. Work will soon begin on the construction of the line and is to be completed by Sept. 1. Dr. W. Gill Wylie is president of the company.

KNOXVILLE, TENN.—The capital stock of the Acme Electric Company has been increased from $5,000 to $20,000.

NASHVILLE, TENN.—The City Council has granted the French Broad River Power Company a 45-year franchise to furnish electricity within the corporate limits of the city. The company proposes to erect a dam and hydro-electric plant at Pickle Island in the French Broad River for the purpose of generating electricity to be transmitted to Knoxville. Under the terms of the franchise, the plant must be in operation by March, 1912, and, upon the completion of the plant, pay the city $4,000 per annum for the first four years, and then $6,000 per annum until 1 per cent of the gross earnings in the city amount to $6,000 per year, when the company is to pay the city 1 per cent of its gross earnings in the city.

CHILDRESS, TEX.—A company has been organized in Childress to establish a light and power plant in this place. For further information, address C. W. Mitchell.

FORT WORTH, TEX.—It is reported that J. B. Wilbur, president of the Royal Trust Company, of Chicago, Ill., is interested in the construction of an electric light plant in Fort Worth.

GALVESTON, TEX.—Arrangements have been made for lighting the County Boulevard, by which it is understood that the county will erect the posts and wires and the city is to supply the lamps and maintain the system. The cost of the posts is estimated at $55 each.

HILLSBORO, TEX.—It is stated that plans have been completed by the Independent Telephone Company for the construction of a toll line from Amarillo to Fort Worth, and from Fort Worth to Hillsboro, with a branch line from Eagan to Cleburne. The lines will be built during the coming summer.

MEMPHIS, TEX.—Plans are being made by the Memphis Ice & Electric Company to install an electric light plant.

TAYLOR, TEX.—Owing to the dissatisfaction of the present rates charged for electric service, plans are being made for the construction of another electric light plant in Taylor. Local capitalists are interested, and it is said that the new company will fix the price of the service at 10 cents per kw-hour. The present rate is 20 cents per kw-hour.

DANVILLE, VA.—The Dan River Power & Manufacturing Company has increased its capital stock from $2,500,000 to $3,000,000. It is said that this action will not be followed by any further enlargements of the company's plant. The company's manufacturing plant is driven by electricity generated at a hydro-electric station.

PORTSMOUTH, VA.—The Southern Bell Telephone & Telegraph Company has purchased a site on Queen Street, on which it will build a new exchange building, the contract for which will be let in the near future. The building is to cost not less than $100,000.

NEWPORT, WASH.—R. S. Anderson, who was recently granted a franchise for a telephone system, has accepted the terms of the Council and will commence the construction of the system as soon as the weather will permit.

TACOMA, WASH.—Application has been made to the Commissioners of King County by Donald Fletcher, of Tacoma, for a franchise to erect transmission lines on the public road leading to Green River, Hot Springs. It is proposed to construct a large hydro-electric plant on the Cle Elum River about seven miles above the head of Lake Cle Elum. Applications have already been made for franchises in Pierce County.

ADAMSTOWN, W. VA.—The power plant of the Fairmont & Clarksburg Traction Company was damaged by fire recently, causing a loss of about $50,000. The plant will be rebuilt at once. The main office of the company is located at Fairmont.

KAUKAUNA, WIS.—Plans are being considered by the Fox River Valley Telephone & Telegraph Company to install a local exchange in this city, and also at Menasha and Neenah.

RANDOLPH, WIS.—A telephone company has been organized by the citizens living in and around Randolph for the purpose of erecting a telephone system to connect with the Wood County Telephone Company.

CHEYENNE, WYO.—The Northern Colorado Power Company has stopped work on improvements to its system in this city, owing to the

City Council having prohibited the company from carrying on further work in the city streets. The order resulted from the refusal of the company to accede to a demand from the Council, that it enter into an agreement to reduce the price of electricity for incandescent lamps from 20 cents to 12 cents per kw-hour, and the price for street arc lamps from $120 to $80 per year, and for electricity for motors 50 per cent, and also to reduce the price of gas 33⅓ per cent. The company offered to reduce the price to 15 cents per kw-hour for incandescent lamps, and for arc lamps to $100, but refused to make the reductions demanded by the Council.

LADYSMITH, B. C., CAN.—The Town Council has decided to make the necessary arrangements for the installation of an electric lighting system.

NEW WESTMINSTER, B. C., CAN.—On behalf of the Sunset Power Company, S. S. McDiarmid, of Vancouver, B. C., has made application in the Recorder's office here for 15,000 cubic inches of water from the Quanli River.

MINNEDOSA, MAN., CAN.—The citizens are considering the question of establishing an electric light plant in connection with the proposed municipal water works system.

ANCASTER, ONT., CAN.—The citizens of this town are interested in the organization of an independent telephone company. Henry Pim is one of the promoters.

BRACEBRIDGE, ONT., CAN.—Messrs. Hutchison, Smith and Thomson, of this town, are interested in the construction of a telephone line from Bracebridge to Port Carling and Minette.

GALT, ONT.—Chairman Fryer, of the Union of Western Municipalities, on the Niagara power question, states that the following municipalities have applied for power to the Hydro-Electric Commission: Galt, for 1200 horse-power; Guelph, for 2500 horse-power; Hamilton, municipal purposes only, 1500 horse-power; Woodstock, municipal purposes only, 900 horse-power; Preston, municipal purposes only, 600 horse-power; New Hamburg, municipal purposes only, 200 horse-power. Applications are now wanted from other municipalities as follows: London, Brantford, Stratford, St. Thomas, Waterloo and Hespeler. When these places have applied there will be a meeting of the executive union, at which contracts will be prepared and submitted to the municipal councils.

STEVENVILLE, ONT., CAN.—The Welland County Telephone Company is planning to remove its headquarters from Stevenville to Bridgeburg and will improve its system in that place, at a cost of $10,000.

MONTREAL, QUE., CAN.—The City Council is considering the question of establishing a municipal electric light plant, to cost $182,000. John R. Barlow is city engineer.

AMECA, MEX.—James P. Harvey, of Ameca, and associates are preparing to install a hydroelectric plant in that district to furnish electricity to operate the machinery of the mines and mills.

AMECAMECA, MEX.—The waterfalls of two branches of the Ayoloco River, near Amecameca, are to be utilized for a hydroelectric plant which Juan Falera and associates are preparing to install there. The electrical energy will be used for industrial purposes.

AUTLAN, MEX.—Thomas Kelly, of Chicago, Ill., and associates have planned to erect a hydroelectric plant on the Ojo Verde River, near Autlan, for the purpose of supplying the mines of that district with electricity.

GUADALUPE, MEX.—The Guadalupe de los Reyes Mining Company has installed a large electric plant in the Guadalupe de los Reyes camp, State of Sinaloa. The energy will be used to operate the mills and machinery for its mines.

GUANAJUATO, MEX.—A company, headed by Bernard MacDonald, of Guanajuato, one of the principal owners of the Guanajuato Consolidated Mining & Milling Company, has been formed and taken over the concession held by the Monterey Hydro-Electric Company for the installation of a large hydro-electric plant to supply Monterey with electricity. It is announced that 12,000 hp will be conveyed to that city by means of transmission lines from the plant that is to be erected on a river 50 miles distant from the town. The survey for the proposed plant has been made and all preliminary details for its erection arranged.

GUAYMAS, MEX.—Eugenio H. Gayon, of Guaymas, and associates have taken steps to erect a hydroelectric plant on the Guaymas Bay. Transmission lines will be built to Guaymas and other places where the electrical energy can be used.

HOSTOTIPAQUILLO, MEX.—C. H. Brooks, vice-president of the Santo Domingo Mining Company, of this place, is at the head of a syndicate of American and British capitalists who have taken steps to erect a hydroelectric plant on the San Diego River, in the State of Jalisco. The proposed plant will cost about $500,000 and will supply electrical energy to operate the mines of that district and adjacent territory. It is stated that the work of constructing the plant will soon begin.

MAZATLAN, MEX.—The city of Mazatlan is to be supplied with electricity for lamps and motors from a hydroelectric plant which Miguel Cordero and associates are arranging to install on the Presidio River.

MEXICO CITY, MEX.—Manuel Sanchez Navarro is constructing a large dam across the Lerma River in the State of Michoacan for the purpose of forming a storage reservoir, which will have a capacity of 100,000,000 cubic meters of water. The water will be used to operate a hydroelectric plant which he will install to supply mines and other industrial concerns with electricity.

MEXICO CITY, MEX.—Manuel Gomez Pezuela is preparing to fulfil the terms of a concession which be obtained recently from the Federal Government for the installation of a hydroelectric plant on the Amacusac River, State of Morelos.

ROSARIO, MEX.—The Tajo Mines Company is installing a large amount of electrical machinery and equipment at its mines in the Rosario district, State of Sinaloa.

TEMOSACHIC, MEX.—The Pinos Altos Mines Company has placed an order for machinery for an electric power plant and equipment for its mines and mill. Electricity will be transmitted about six miles to a substation, where a motor generator will be installed to change the energy from alternating current to a direct current for the operation of a 10-ton mining locomotive. Two 50-hp motors will be installed to operate the stamp mill, ore crushers, pumps and other machinery.

TEQUILA, MEX.—The Lerma Mines Development & Power Company is preparing to erect a large hydroelectric plant near the town of Tequila, State of Jalisco. The company will obtain its initial power from the Santiago River. According to the terms of the concession granted by the government, the company will transmit electricity to a number of mining camps in the State of Jalisco for the operation of mines and mills. The company has a capital stock of $1,000,000. Gill S. Peyton is president.

New Industrial Companies.

THE ELECTRIC-THERMO ALARM COMPANY, of Seattle, Wash., has been incorporated, with a capital stock of $250,000, by Watson James Hill and Frederick E. Kreatz.

THE SWEDISH ELECTRIC VIBRATOR COMPANY, of Chicago, Ill., has been incorporated by Foree Bain, George T. May, Jr., and C. A. Criswell. The company proposes to manufacture electrical apparatus.

THE ELECTRIC BELL & LOCK MAINTENANCE COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $5,000, by Alvin Fuesslein, Henry Bonawitz and Frederick W. Barwick, all of Brooklyn.

THE MUTUAL TAXICAB COMPANY, of Hoboken, N. J., has been incorporated, with a capital stock of $125,000, to conduct a general electric cab service. The incorporators are: A. V. Jones, H. M. Browne and F. W. Mills, all of New York, N. Y.

THE FORT PITT MOTOR MANUFACTURING COMPANY, of Pittsburg, Pa., has been chartered, with a capital stock of $50,000, by Henry M. Schmitt, of Pittsburg, treasurer; Julius Sturtevant and George V. Rothweiler, of New Kensington.

THE EASTERN ELECTRIC COMPANY, of New Bedford, Mass., has filed a certificate of incorporation, with a capital stock of $15,000. The company proposes to manufacture and deal in electrical appliances. Edward H. Jennings is president and treasurer.

THE ELECTRIC RAILWAY TRAINING COMPANY ASSOCIATION, of Kansas City, Mo., has filed articles of Incorporation, with a capital stock of $12,000. The incorporators are Frank M. Robinson, Albert F. Drake, Arthur P. Keel, Herman F. Cook and Norman E. Newman.

THE SOVEREIGN ELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $150,000. The company proposes to manufacture lighting appliances and fixtures. The incorporators are L. O. Hall, E. E. Hall and L. P. Smith, of New York City.

THE STERLING ALTERNATING IGNITION COMPANY, of Binghamton, N. Y., has been incorporated, with a capital stock of $25,000, to manufacture machinery and its appliances. The incorporators are: Howard L. Loper, of Richmond Hill; A. R. Kelly and Fred Knowlton, of New York, N. Y.

THE ELECTRO-WELD COMPANY, of Marlboro, Mass., has been incorporated, with a capital stock of $30,000. The directors are: Frank Billings, president; Hector E. Moineau, treasurer, and Daniel F. Hayward. The company proposes to manufacture and deal in articles of steel and iron, etc.

FEDERAL TAXICAB COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $200,000, to manufacture motors, engines, machines and cars for the transportation of passengers, goods, etc. The incorporators are: Edward McM. Mills, Richard F. Tully and Cornelius A. Cole.

THE HACHENBERG TURBINE COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $250,000. The incorporators are: L. Sandford, of Yonkers; L. Hachenberg, of New York City. The company proposes to manufacture engines, boilers, machinery, motors, etc.

THE JUST-RIGHT-LIGHT COMPANY, of Wakarusa, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is placed at $10,000. The object of the corporation is to manufacture light, heat and electrical apparatus. R. E. Myers, Jacob Helmkee and W. O. Yarian are the directors.

THE NATIONAL TELEPHONE RECORDER COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $10,000. The incorporators are Jacques Ricser, Herman M. Braun and Lawrence Goldman, all of New York. The company proposes to manufacture the Gamble telephone recorder.

THE ELECTRO MAGNETIC APPLIANCE COMPANY, of Hammond, Ind., has been incorporated, with a capital stock of $25,000, for the purpose of manufacturing an electric riveting hammer invented by John Rathburn, of Hammond. The officers of the new company are: C. G. Kingwell, president; C. E. Bauer, vice-president and treasurer, and J. B. Rathburn, secretary and electrical engineer.

Company Elections.

COLUSA, CAL.—At the annual meeting of the Glenn County Telephone Company H. J. Barceloux was elected president and George Barceloux secretary and treasurer.

SAUNEMIN, ILL.—At the annual meeting of the Saunemin Mutual Telephone Company the following named officers were elected: Dr. C. F. Ross, president; W. F. Shepherd, secretary, and H. G. Norman, treasurer.

JESUP, IA.—At the annual meeting of the Farmers' Mutual Telephone Company the following named officers were elected: J. T. Burrell, president; W. C. Kenney, vice-president; C. L. Bright, secretary, and James Tracy, treasurer.

LE CLAIRE, IA.—At the annual meeting of the Le Claire Independent Telephone Company the following named officers were elected: Henderson Graham, president; J. P. Suiter, vice-president; Arthur Dawley, secretary, and William Henry, treasurer.

JEFFERSONVILLE, KY.—At the annual meeting of the Laurel Telephone Company the following-named officers were elected: Perry Spurgeon, president; R. M. Martin, vice-president, and John Hallett, secretary and treasurer.

BENDON, MICH.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: William Dexter, president; J. W. Jarrett, vice-president; S. D. Burke, secretary; A. Allen, treasurer, and Hector McLean, manager.

REDWOOD FALLS, MINN.—At the annual meeting of the Redwood County Telephone Company A. O. Gimmestad, of Bellview, was re-elected director, and also was elected president of the company. A. G. Weldon, of Wabasso, and R. A. Maahs, of Echo, and L. Lindeman, of Renville, were also elected directors.

LACONIA, N. H.—At the annual meeting of the Laconia Electric Lighting Company the following named officers were elected: W. L. Maurin, of Providence, R. I., president; J. P. Maurin, of Providence, R. I., vice-president; Thomas E. Stere, of Providence, R. I., treasurer; F. M. Beckwith, of Laconia, clerk, and F. L. Thomas, of Laconia, manager.

OBERON, N. D.—At the annual meeting of the local telephone company the following named officers were elected: Charles Schaffner, president; E. A. Hatch, vice-president; A. Baldwin, secretary and treasurer.

MARTINSBURG, OHIO.—At the annual meeting of the Knox-Licking Telephone Company the following-named officers were elected: A. O. McKee, president; Solon Ackley, vice-president; F. E. Elliot, secretary and manager, and J. N. Frees, treasurer.

PHILLIPSBURG, PA.—At the annual meeting of the United Home Telephone Company the following-named officers were elected: S. A. Blessing, of West Milton, president; N. W. Rinehart, vice-president; T. B. Mills, of Brookville, secretary; H. B. Marshall, of Brookville, treasurer, and S. A. Mosby, of Phillipsburg, manager.

PITTSBURG, PA.—At the annual meeting of the Duquesne Light Company the following-named officers were elected: George R. Webb, of Baltimore, Md., president; D. P. Reighard, vice-president; S. P. Austin, secretary, and Robert C. Hall, treasurer.

FORT WORTH, TEX.—At the annual meeting of the Northern Texas Traction Company the following-named officers were elected: Guy E. Tripp, president; John T. Hallowell, first vice-president; H. T. Edgar, second vice-president and manager; Alvah K. Todd, secretary; Henry B. Sawyer, treasurer, and Charles E. Aldrich, assistant secretary.

ARKANSAW, WIS.—At the annual meeting of the Farmers' Telephone Company the following-named officers were elected: B. M. Catura, president; James Black, vice-president; Peter Taylor, treasurer, and Fred Pitman, secretary.

GILMANTON, WIS.—At the annual meeting of the Gilmanton & Dovers Farmers' Telephone Company the following-named officers were elected: E. F. Turner, president; S. Glatzmann, vice-president; C. J. Sund, secretary, and A. B. Hutchinson, treasurer.

New Incorporations.

PETALUMA, CAL.—Articles of incorporation have been filed for the Central Telephone & Telegraph Company. The incorporators are: John H. Dickinson, E. A. Nordyke and J. H. Stone.

SANTA ROSA, CAL.—The Central Telephone & Telegraph Company has been incorporated by J. H. Dickinson, E. A. Nordyke and J. H. Stone.

SANTA ROSA, CAL.—The Chilens Valley Telephone Company has been incorporated, with a capital stock of $5,000, by M. de Martin, Charles Martin, A. Bloom, H. Juhl and J. Schobeda.

HASTY, COL.—The Union Telephone Company has been incorporated, with a capital stock of $10,000, by W. A. Hasty, George A. Johnson, C. E. Liggets, A. B. Ham and B. A. Wilson, all of Hasty.

DALTON, GA.—The Dogwood Telephone Company has applied for a charter. The capital stock of the company is placed at $1,000 with the privilege to increase it to $10,000. The incorporators are G. W. Head and J. C. Keown.

EVANSVILLE, IND.—The Evansville Terminal Railway Company has been incorporated, with a capital stock of $200,000, by Albert F. Karges, Marcus Sontag, William H. McCurdy, James V. Rush and others. The purpose of the company is to promote, construct and operate street and interurban railways and to operate plants for the distribution of electricity for lamps and motors, etc.

OLIO, IND.—Articles of incorporation have been filed for the Olio Telephone Company with the Secretary of State by B. R. Smith, S. R. Williams and F. F. Johnson. The company proposes to build and operate a telephone system in this town and in the eastern portion of Hamilton County.

JEFFERSON, IA.—The Jefferson Township Telephone Company has been incorporated and will erect 40 miles of wire by early spring.

LAKIN, KAN.—The organization of the Kearny County Mutual Telephone Company has been perfected and the following named officers elected: W. S. Prather, president, A. R. Hetzer, vice president; Thomas Prather, secretary, and Mrs. A. J. Smith, treasurer. Work on the construction of the system will begin about April 1

TOPEKA, KAN.—The Kansas City & Kansas Southwestern Railroad Company has been organized, with a capital stock of $10,000,000, by E. M. Lambkin, of Kansas City; C. S. Dudley, Minneapolis, Minn., S. W. Brewster, Chanute; H. E. Hopper, of Indianapolis, Ind.; J. E. Martin, of Minneapolis, Minn., and W. L. Moyer, of New York, N. Y.

BALTIMORE, MD.—Application has been made to the State Legislature for the incorporation of the Baltimore Light, Heat & Power Company. The capital stock of the company is placed at $100,000, with the privilege of increasing it to $2,500,000. The company proposes to furnish electricty for lighting, in conjunction with the steam heating, refrigerating and cold storage business. It is also understood that the company proposes to secure electricity from the plant of the Patapsco Electric Manufacturing Company on the Patapsco River. The incorporators are: Richard B. Fentress, president of the Baltimore Refrigerating & Heating Company; John W. Van Dyke, of Pennsylvania, Arthur Montell, John A. Tompkins and George E. Taylor, of Maryland.

LAKELAND, MINN.—The St. Croix Rural Telephone Company has been organized and the following named officers elected: Andrew Anderson, president; Samuel McKean, vice-president; John M. Oliver, secretary and treasurer.

PURDY, MO.—The Purdy Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The incorporators are R. C. Overton, James M. Bayless, A. C. Garrison and others.

ST. JAMES, MO.—Articles of incorporation have been filed with the Secretary of State for the St. James Ice & Power Company. The company is capitalized at $25,000, and the incorporators are Chris. Koeln, of St. Clair, Louis Becker, L. B. Carroll and Edward W. Floristel, all of St. Louis. The company proposes to produce electricity and gas for light, heat and power, and to manufacture ice and do a cold storage business, etc.

JERSEY CITY, N. J.—The Mutual Benefit Electric Light & Power Company has been incorporated, with a capital stock of $2,500,000, for the purpose of producing and distributing electricity for lamps, heat and motors. The incorporators are: J. R. Blinck, R. S. Carrick, J. F. Nagle, of Jersey City, and J. M. Seymour, Jr., of Newark.

REMSEN, N. Y.—A rural telephone company has been organized in East Remsen to construct a line from Lake Julia to Remsen. The officers of the company are: R. R. Pritchard, president; William H. Thomas, vice-president; N. C. Phelps, secretary, and David R. Jones, general manager.

BRINSMADE, N. D.—The Brinsmade Telephone Company has filed articles of incorporation, with a capital stock of $[illegible]. The incorporators are S. M. Gibbs, Alexander Link and C. M. Muri, all of Brinsmade.

CARPIO, N. D.—The Carpio Telephone Company has been incorporated, with a capital stock of $10,000, by George A. Dahle, G. K. Christianson, Bisgard Kappel and others, all of Carpio.

OKARCHE, OKLA.—The Straight West Telephone Company has been incorporated, with a capital stock of $500, by George Halfhazel, H. [illegible], all of Okarche.

SENTINEL, OKLA.—Articles of incorporation have been filed for the Sentinel Long-Distance Rural Telephone Company. The company is capitalized at $10,000, and the incorporators are [illegible] M. Wright, F. Wingham, of Sentinel; W. H. Davis and C. C. Allen, of Rocky.

JACKSONVILLE, ORE.—The Oregon Rapid Transit & Power Company has filed articles of incorporation, with a capital stock of $3,000,00 The purpose of the company is to construct and operate an electric railway throughout Rogue Valley. The present plans contemplate the construction of a railway from Ashland to Grants Pass. The incorporators are J. E. Watt, F. E. Metrick, F. E. Page, A. S. Bliton, S. A. Nye and F. L. Evans.

TILLAMOOK, ORE.—The Tillamook Electric Light & Fuel Company has been incorporated, with a capital stock of $15,000, by Charles I. Clough, A. K. Case and Henry Crenshaw.

McADOO, PA.—The McAdoo Electric Company has been incorporated, with a capital stock of $10,000. A. W. Drake, of Lattimer Mines, is treasurer, and the directors are: John S. Wise, of Lattimer Mines; L. O. Emmerick, Nicholas Kuech, of Hazleton; Thomas L. Kearns and Peter McCarron, of McAdoo.

PITTSBURG, PA.—The Pennsylvania Electric Company has been incorporated, with a capital stock of $10,000, by L. L. Banks, James Bradley, J. L. Merrill, J. W. Boileau and S. Sellers, all of Pittsburg.

PITTSBURG, PA.—The Central Light, Heat & Power Company has been chartered with a capital stock of $10,000. J. T. Crump is treasurer, and the directors are T. J. Crump, H. F. Steele, H. Tucker, all of Pittsburg.

REIGELSVILLE, PA.—The Clymer Power Company has been incorporated, with a capital stock of $60,000, by Lee S. Clymer, of Reigelsville, treasurer; Benjamin F. Fackenstal, Jr., of Reigelsville, and John S. Fackenstal, of Easton.

SWISSVALE, PA.—A charter has been granted to the Empire Machine & Electric Company, with a capital stock of $10,000. E. Ernest Rose, of Swissvale, is treasurer, and the directors are James R. Bell and Benjamin H. Thompson, of Pittsburg.

BATSON, TEX.—The Independence Telephone Company, of Batson, has been organized for the purpose of constructing a telephone line from Batson to Hardin.

TAYLOR, TEX.—The Citizens' Light & Power Company has been incorporated, with a capital stock of $10,000, by Howard Bland, E. A. Robertson, T. W. Marse, H. D. Mendell and C. B. Challeber.

MANGOHICK, VA.—The King William Telephone Company has been granted a charter, with a capital stock of $3,000. The officers of the company are: W. T. Mooklar, president; H. B. Smith, Jr., vice-president; J. T. Mitchell, secretary, and C. J. Powell, treasurer.

ELKINS, W. VA.—The Roaring Creek Power Company has been chartered, with a capital stock of $25,000, by P. B. Bloomfield, C. W. Maxwell, of Elkins; W. S. Walker, of Ligonier, Pa.; M. J. Brown, of Frostburg, Md., and J. E. Morgan, of Elkins.

BENTON, WASH.—The Benton Independent Telephone Company has been chartered, with a capital stock of $4,800, by Clark E. DeBow, James M. Hobland, Frank P. Jackson and others.

WASHOUGAL, WASH.—The Home Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000; the incorporators are G. M. Keep, Morris Webber and A. J. Henrickson.

YAKIMA, WASH.—Articles of incorporation have been filed with the Secretary of State for the Sunnyside Telephone Company, with a capital stock of $15,000, by J. I. Brown, Emery Thompson, George E. Rodman, F. J. Taylor and S. T. Woodlin.

SHEBOYGAN FALLS, WIS.—The Sheboygan Falls Light & Power Company has been incorporated, with a capital stock of $25,000, by Otto B. Weisse, Emil Weisse and others.

SPOONER, WIS.—Articles of incorporation have been filed for the Burnett & Washburn County Telephone Company, with a capital stock of $4,000, by C. L. Klinzman, and others.

FORT WILLIAM, ONT., CAN.—The Iron Range Railroad & Development Company will apply to the Provincial Legislature for incorporation and other things, ask for power to build and maintain telephone and telegraph lines, also electric power plants. For further information address J. F. Swinburn, Fort William, Ont.

LOWVILLE, ONT., CAN.—The Nelson Telephone Company has been incorporated, with a capital stock of $10,000, by James Jardin, J. H. Hilliken, J. W. Cust and George Ramshaw.

PILOT BUTTE, SASK., CAN.—The Canadian-American Telephone Company has been organized, with the following officers: E. Raffenberg, president; B. Holden, vice-president; G. Moore, secretary; George Anderson, treasurer, and W. Keay, general manager.

MEXICO CITY, MEX.—A British company, capitalized at $1,000,000, is being formed here to establish an extensive system of long-distance and local telephone lines in southern Mexico. It is stated that the company will operate under a concession which Manuel S. de Corbera and J. Sitzenstatter, of this city, obtained from the federal government for a long-distance line between this city and Vera Cruz. The company will establish exchanges in the cities of Vera Cruz, Cordova, Orizaba and other places. The concession also gives the right to establish wireless telephone stations throughout the territory in which they are to operate. Messrs. Corbera and Sitzenstatter are now constructing an underground system in Vera Cruz, and more than three miles of conduits have been laid.

MORELIA, MEX.—A local telephone company has been formed in this place with the following officers: Jose Oseguera, president; Manuel D. Bonilla, vice-president; Rafael Elizarraras, secretary, and Manuel Garcia Gomez, treasurer. The company will establish a telephone in this city and adjoining towns.

Legal.

CRAWFORDSVILLE, IND.—By virtue of a decree of the Federal Court, in the interest of the Knickerbocker Trust Company, of New York, Edward Daniels, of Indianapolis, Master in Chancery, will conduct the sale of the plant of the Crawfordsville Water & Light Company. No bid will be accepted for less than $75,000.

BATTLE CREEK POWER COMPANY.—The suit of the Battle Creek Power Company, of Redding, Cal., against the Pacific Power Company and others to condemn 12 acres of land on Battle Creek for a reservoir site has been ended, the jury giving the Battle Creek company the land sought, but requiring $32,500 as damages. The land is worthless except for the water rights going with it. The Battle Creek company's right to 18,000 in. of water was confirmed.

SANTA CRUZ ELECTRIC COMPANY.—The jury in a $20,000 damage suit brought by R. C. Muburtis against the Santa Cruz Electric Light Company, of Santa Cruz, Cal., has brought in a verdict for the defendant. Mr. Muburtis claimed that he had been knocked from the top of a Southern Pacific Company's box car by a wire that was allowed to sag over the railroad company's track, and that, in addition to the injuries sustained by the fall, he received an electric shock and burns that have impaired his health. The defence claimed that Muburtis should have brought his suit against the railroad company, as the track at that point had been changed from a narrow to a wide-gauge track, thereby allowing the passage of taller cars, which was the real cause of the trouble.

INJURY TO LINEMAN BY CONTACT WITH ELECTRIC LIGHT WIRES.—In the recent case of Grimm vs. Omaha Electric Light & Power Company, Supreme Court of Nebraska, 114 N. W. Rep., 769, it is held that the instinct of self-preservation and the disposition of men to avoid personal harm may, in the absence of contrary evidence, raise the presumption that a lineman, killed or injured while engaged in locating and remedying trouble on the lines, was in the exercise of ordinary care. It was further held that the burden of establishing that the lineman had assumed the risk of the dangers connected with his employment was upon the electric light company. In the case of Bell Telephone Company vs Detharding, 148 Fed., 371; 78 C. C. A., 185, plaintiff's intestate was employed by defendant telephone company as a "trouble finder" and was sent by his superior in the line of his duty to ascertain the cause of the failure of a telephone to work properly, which was unknown. In climbing a cable pole his hand came in contact with a guy wire, from which he received an electric shock, which caused him to fall, and he was killed. From the effects of a storm of the previous night, or from some other cause not shown, the telephone wires leading to the pole had sagged across electric light wires and had also charged the guy wire. Held, that the risk from such danger was one known to and assumed by plaintiff's intestate as one necessarily incidental to his employment, and that there could be no recovery from defendant for his death.

CONSUMER NOT BOUND TO PAY FOR ELECTRIC CURRENT AS REGISTERED BY DEFECTIVE METER.—The defendant, a manufacturing company engaged in repair work, entered into a contract with the plaintiff, a quasi-public corporation engaged in selling electric current for light and power, in which contract the defendant agreed to pay for the electric current furnished by the plaintiff "at the rate of ten (10) cents for each horse-power hour, as measured at and by the meter provided by the (plaintiff) company." The defendant used the current and paid the monthly bills rendered therefor for a period of three years, when, on Aug. 20, 1904, the plaintiff discovered that an error had been made in each of the previous monthly readings by the various inspectors of the plaintiff, who, having omitted a cipher in the reading of the units, had during this entire period been rendering bills which, it is claimed, gave only about one-tenth of the current used by the defendant in this time. The plaintiff, relying on the words of the contract, presented an additional charge for $3,828.36, or for $1,650 a year, as against the annual charge of $350, which the plaintiff had paid. The defendant for several months paid the bills made in accordance with this new reading of the meter, but he refused to pay the amount claimed by the plaintiff as due before the discovery of the error. Though the court admitted the evidence of the defendant, which showed that the plaintiff's meter was inaccurate and that the new reading of the current was altogether disproportionate to the horse-power employed; and though the plaintff's witnesses testified that they had been accustomed to read the meter improperly, and that such meter had never during the period in controversy been properly tested, and that when finally tested it was found to be 13 per cent fast, yet a verdict was directed for the plaintiff for the full amount, with interest. On appeal it was held that the defendant was not liable for the amount registered in the meter, but only for the current actually used. To enforce the contract literally would have worked a manifest injustice, for if the consumer were liable absolutely according to the amount of electricity registered by the meter, there would be no redress if an inaccurate meter should register a consumption calling for an impossible payment.—(New York & Queens Electric Light & Power Co. vs. Long Island Machine & Marine Construction Company, New York Appellate Division, 100 N. Y. Supp., 176.)

Personal.

MR. F. C. FINKLE, consulting engineer of Los Angeles, Cal., announces the removal of his office from the Edison Building to Rooms 230-231, I. W. Hellman Building, of that city.

MR. JOSEPH B. McCALL, president of the Philadelphia Electric Company, has been put forward as a candidate for delegate from Philadelphia to the coming national Republican convention.

MR. WILLIAM E. FOSS, of Boston, has been retained by the Newark (N. J.) Board of Public Works to make an investigation of the electrolytic effect of trolley currents on the water mains of that city.

MR. GEORGE R. WEBB, formerly president of the Maryland Telephone Company, of Baltimore, Md., has been appointed president of the Duquesne Light Company, Pittsburg, Pa., to succeed Mr. Robert C. Hall.

MR. ARTHUR L. MUDGE, who for the past four years has been associated with the Allis-Chalmers Company and with Allis-Chalmers-Bullock, Limited, has recently joined the staff of the Canadian Crocker-Wheeler Company, Limited, Montreal.

MR. H. L. DOHERTY, who is president of the holding company that controls the Rockford, Ill., Edison Company, is to address the members of the Rockford Manufacturers & Shippers' Association at their annual business meeting to be held March 21.

PROF. J. J. GREEN, formerly in charge of the electrical engineering department of Notre Dame University, has gone abroad to make a tour of the more notable electrical plants of Europe, and for attendance at the Marseilles International Electrical Exposition.

MR. THOMAS B. PECK, JR., sales manager for some time past for the Electro-Dynamic Company, of Bayonne, N. J., manufacturers of interpole motors, etc., has resigned that position, and is now taking a vacation in the South. His successor has not been announced.

MR. JOHN W. BRASHEARS, who for many years has been first assistant to W. A. Converse, chemical director of the Dearborn Drug & Chemical Works, in charge of the Analytical Laboratories, has been appointed assistant superintendent of the manufacturing department.

MR. R. S. STANGLAND has assumed charge of Muralt & Company's construction office at New Fort Lyon, Col., and will superintend the erection of the complete lighting, heating and power plant which his firm is building for the United States Government at the Naval Hospital at that place.

MR. FRANK F. FOWLE has taken offices in Marquette Building, Chicago, for practice as a consulting engineer. Mr. Fowle will make a specialty of work connected with the design and construction of telephone systems, including railway telephone systems, and also of alternating-current engineering.

MR. T. A. EDISON has so far recovered from the recent operation for mastoiditis and aural abscesses that he was able to leave on Saturday last for his Florida place at Fort Myers. He was accompanied by Mrs Edison, and they traveled in a private car. Mr. Edison will remain in Florida for several weeks.

MR. ARTHUR L. LINN has been appointed general auditor of the Schenectady Railway Company, which places him in charge of the accounting of all of the railway and lighting companies in which the Mohawk Valley Company is interested. In addition, he is either the secretary or assistant secretary of fifteen of the nineteen companies. Mr. Linn's office is located in the Night & Day Bank Building, New York City, where he makes his headquarters.

MR. W. A. LAYMAN, general manager of the Wagner Electric Manufacturing Company, of St. Louis, has recently been elected a vice-president of that company. Mr. Layman has risen very rapidly through various positions in this company, and under his management a large factory has been erected. His election to the vice-presidency is an evidence of the appreciation of his business and engineering judgment and ability, which his friends are glad to see thus recognized.

MR. HAROLD BUTTENHEIM has resigned as business manager of the *Street Railway Journal* and as secretary of the McGraw Publishing Company, in order to devote himself to the conduct of *Hardware*, the semi-monthly representative of the hardware trade, in which he has purchased a controlling interest. Mr. Buttenheim became connected with the *Street Railway Journal* in 1893, and since then merit and hard work had won for him successive and rapid promotions. He takes with him the hearty good will and best wishes of his former associates. The headquarters of Mr. Buttenheim's new company, incorporated this week under the name of The Hardware Press, will be at 114 Liberty Street, New York.

MR. E. N. SAWTELLE, who has for some years been the London district manager of the British Westinghouse Electric & Manufacturing Company, with headquarters in the Westinghouse Building, Norfolk Street, Strand, London, has been recently promoted to the position of territorial sales manager. Mr. Sawtelle, who is as well known in the United States as he is in England, having for many years been connected with the Westinghouse interests, both in Cleveland and New York, now makes his headquarters at the company's works in Trafford Park, Manchester, where he will co-operate with the district office managers in the further development of their territories, and will, in addition, take personal charge of such more important negotiations as he may be directly interested in. Mr. O. H. Baldwin, who is also well known in the United States but better known in England for the past ten or fifteen years, has been appointed the manager of the London district.

Obituary.

MR. FRED BRYSON MAZE, an electrical engineer connected with the General Electric Company at Schenectady, N. Y., died March 8, aged 30 years.

MR. ADDISON F. HUNTIE, secretary and treasurer of the United Illuminating Company of Connecticut, New Haven, Conn., died suddenly March 13 at his home in New Haven. He was 40 years of age. A widow and three children survive him.

MR. JOHN BURRY, electrical engineer of the Stock Quotation Telegraph Company and inventor of the Burry printing telegraph system, died suddenly last week at the age of 47 years. Mr. Burry was born in Fribourg, Switzerland, and came to this country when 19 years old. As noted in a recent issue, the Burry printing telegraph is now being tried for use in communicating the course of proceedings on the floor of the House of Representatives in Washington, to committee rooms and the offices of members.

MR. ALBERT ANDERSON.—We regret to announce the death of Mr. Albert Anderson, president of the Albert & J. M. Anderson Manufacturing Company, of Boston, which occurred on Wednesday, March 11. Mr. Anderson was born near Christiania, Norway, June 26, 1850. At the age of 16 he left home, and after following the sea for about five years settled in Boston, in 1871. In 1877 he started a small machine shop in Washington Street, and the business grew so rapidly that not long after a second shop on Hamilton Street was opened. The present factory site was occupied in 1888, about which time Mr. Anderson began to devote his attention to the electrical field, starting the manufacture of trolley line and station material. He constantly added improvements to his line of manufactures, some of which were covered with patents. In the summer of 1906 Mr. Anderson received a severe shock from coming in contact with a 6900-volt circuit, and his health never recovered from the effects. Mr. Anderson is survived by his brother, Mr John M. Anderson, a daughter and two sons—Mr. Albert B. Anderson and Mr. Andreas Anderson—who will become partners in the company succeeding their father.

Unclassified Items.

COLUMBUS, NEB.—The Columbus Light, Heat & Power Company has been incorporated with a capital stock of $150,000, by William C. Rose, John L. Burke and John W. Parrish.

NEWARK, DEL.—The Elk River Heat, Light & Power Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are S. M. Donnell, of Newark; E. W. Maloney, of Avondale, Pa., and B. F. Groff, of Lancaster, Pa.

MR. GEORGE A. CAMPBELL, for the past two years manager of the Reno Power, Light & Power Company, of Reno, Nev., has resigned to accept a position as general superintendent of the Truckee River General Electric Company, operating plants at Carson, Virginia, Yerington, Gardinerville, Reno and other places in Nevada.

MR. E. W. CLARK has been appointed superintendent of the municipal electric light plant at Ellensburg, Wash., to succeed Mr. W. L. Leverich, resigned.

ELMIRA, N. Y.—The Public Service Commission, second district, has authorized the Elmira Water, Light & Railroad Company to issue its bonds to the amount of $372,000, to be sold at not less than 80 per cent of their par value, the issue of the capital stock to be secured by such issue being required for the refunding of certain of its obligations and for the completion, extension and improvement of its plant.

LEESBURG, GA.—Preparations are being made by the citizens to erect a complete telephone system for the town, which is to be in operation within 60 days.

COVINGTON, KY.—At the annual meeting of the Cincinnati, Newport & Covington Light & Traction Company the following directors were elected: C. M. Thurnauer, J. C. Ernst, Julius Fleischmann, J. M. Hutton, J. S. Trevor, Randolph Rodman, R W. Neff, C. P Garney and T. S. Hamilton.

NEWARK, N. J.—At the annual meeting of the United Electric Company the following-named directors were elected: John J Burleigh, Walton Clark, Mark T. Cox, Anthony R. Kuser, Lewis Lillie, Thomas N. McCarter, U. H. McCarter and George J Roberts

PRINCETON, ONT., CAN.—At the annual meeting of the Princeton-Drumbo Telephone Company the following-named officers were elected F. J. Daniel, of Princeton, president; T Convay, vice-president, and Thomas Starr, secretary and treasurer.

NAPOLEON, OHIO.—At the annual meeting of the Okolona Telephone Company the following-named officers were elected Fred Gunn, president; D. Panning, vice-president, J A. B[illegible]en, secretary, and G. H. Freytag, treasurer.

RUSHFORD, MINN—The City Council has granted the City & Farmers' Telephone Company a franchise to erect a telephone exchange in this city.

WILDWOOD, PA.—The City Council has granted the Eastern Telephone & Telegraph Company a franchise to install complete telephone and telegraph systems in the city.

NEWPORT, KY.—The Water Works Commissioners have instructed Superintendent Glazier to prepare plans and specifications for the construction of an electric light plant to be installed at the pumping station.

CHILTON, WIS.—Application has been made to the City Council for a franchise for an electric light plant in this city.

HARTFORD CITY, IND.—The Hartford City Electric Light Company contemplates making improvements to its plant and will install additional machinery.

TRENTON, MO.—The Board of Public Works is considering the question of establishing a municipal electric light plant. For further information address C. A. Foster.

HOLYOKE, MASS.—The Walsh Holyoke Steam Boiler Works has been awarded the contract for furnishing and installing the new steel penstock, with its branches for the electrical power station of the Newfoundland Development Company, at Grand Falls, N. F. The contracts amount to $210,000.

MYRTLE POINT, ORE.—Plans have been completed by the Coquille Valley Power Company for the construction of a power plant at the head of Brewster Valley, which will have a minimum output of 4000 horsepower. The water will be flumed for a distance of 5000 feet and will have a fall of 300 feet through a pipe line to the power house. Electricity will be transmitted to Myrtle Point, Coquille, Marshfield, North Bend and Bandon. Two hydro-electric units and two steam-driven units will be installed. J. S. N. Smith, of Ashland, consulting engineer, has charge of construction of the plant.

OLYMPIA, WASH.—J. H. Swift has filed a notice of a water right in the Box Canon in the Nisqually River with the county auditor, laying claim to 35,000 cubic inches of water per second. The claim is located about three miles up the river, and in the notice filed declares the right to use the water by flume or tunnel for power or irrigation purposes.

PROSSER, WASH.—Messrs. Smith and Olsen, who some time ago purchased 950 acres of land under the canal extension within two miles of Prosser, for the purpose of establishing a colony, are negotiating with the Prosser Falls Land & Power Company to secure electricity for lamps and motors for the residents of the colony.

PIEDMONT, W. VA.—The Piedmont Railway Company has applied for a street railway franchise on Fairview Street, in connection with the proposed electric railway connecting Piedmont and West Virginia Junction, W. Va., and Luke and Bloomington, Md., a distance of about two miles.

JEWETT CITY, CONN.—A new gasoline engine is being installed in the municipal electric light plant. The transmission lines of the municipal electric plant are being extended from this borough into Sylvandale, where lamps will be installed in the residence of James O. Sweet. Franklin G. Waters is superintendent.

RENO, NEV.—The Virginia & Truckee Railway Company is planning to equip its road, to be operated by electricity between Reno and Carson. It is understood that the overhead system will be used to the city limits and the third-rail system the remainder of the route. It is said that work will commence soon on the project so as to be prepared for the summer traffic to the resorts between the two cities.

ESCONDIO, CAL.—At a mass meeting held recently the citizens voted to instruct the City Trustees to secure an approximate cost of establishing a municipal electric light plant, and it is expected that a special election will soon be held to vote on the proposition.

ARCATA, CAL.—The California Barrell Company has installed a 40-hp motor in its plant to operate the machinery, and if satisfactory, will install more and larger motors to take the place of its steam plant. Electricity for operating the plant is furnished by the North Mountain Power Company, of Eureka, through A. B. Brizard & Company, of Arcata, the local agency.

OSAKIS, MINN.—Frank H. Cannada has been granted a franchise to erect a telephone exchange in this town.

COVINGTON, KY.—The property of the Independent Telephone Company, owned by S. P. Kineon, was sold at public auction March 11 to Attorney U. J. Howard for $2,400, who represented a number of the creditors. The property consists of telephone lines in Kenton, Campbell and Pendleton counties, with exchanges at Butler, Falmouth and Grant's Lick.

COLUMBUS, OHIO.—The new 1000-kw turbine at the municipal electric light plant will soon be placed in operation. Two new 300-hp boilers are also being installed. The new equipment will be sufficient to provide for the present needs of the plant. The Service Board is now planning to install 200 more lamps on the various circuits, which will require an expenditure of from $8,000 to $10,000.

GENEVA, N. Y.—The Board of Public Works has granted the Economic Power & Construction Company permission to enter the city conduits, and a contract has been entered into whereby the company rents two ducts for a term of 20 years at the annual rental of five cents per duct foot. The contract calls for 5515 feet, starting April 1, and as many more from time to time as the company may need. B. L. Jones, of Buffalo, is president of the company.

NASHVILLE, TENN.—The City Council has passed an ordinance appropriating $100,000 for enlarging and improvements to the municipal electric light plant, for which plans and specifications are now being prepared. J. W. Dashiell is secretary of Board of Public Works.

JESUP, GA.—A charter has been issued by the Secretary of State to the Goose Creek Railway & Power Company. The company is capitalized at $250,000, and proposes to construct an electric railway from Jesup to Docktown, a distance of about 24 miles, and to equip and operate an electric light and power plant. The incorporators are H. W. Whaley, F. E. Breen, S. E. Cohen, W. M. Boberson, of Jesup, and D. G. Zeigler, of Columbia, S. C. D. G. Zeigler is chief engineer.

CHIHUAHUA, MEX.—The Compania Electrica y de Ferrocarriles de Chihuahua has been organized with a capital stock of $2,200,000. The company will take over the Mineral Railroad Company, the street railway company and the plant of the Industrial Electric Company. The company proposes to convert the Mineral Railroad from steam to an electric line, and also to operate the street railway lines by electricity. An electric power plant with sufficient output to furnish electricity for operating the railways and for lighting the city will be erected by the company. Enrique C. Creel is president of the company, and A. C. Nash is general manager.

SASKATOON, SASK.—The Saskatchewan Power Company has applied for articles of incorporation with a capital stock of $1,000,000 to construct a power plant on the Saskatchewan River at this place. J. F. Cairns, of Saskatoon, is interested in the project.

PINE BLUFF, ARK.—At the annual meeting of the Citizens' Light & Transit Company the following-named officers were elected: J. F. Rutherford, president; D. C. Bell, first vice-president; R. L. Rutherford, second vice-president; W. T. Young, secretary, and F. E. Cherot, treasurer. Plans are now being made to double track the Sixth Avenue line.

FINDLAY, OHIO.—At the annual meeting of the Home Telephone Company the following-named officers were elected: J. C. Bright, president; T. J. Collingwood, vice-president, and H. W. Stoker, secretary and treasurer.

FITZGERALD, GA.—The organization of the Fitzgerald & Ocilla Electric & Power Company has been completed and the following-named officers elected: S. Tilden Holtzendorf, president; B. F. Holtzendorf, first vice-president; W. T. Whitley, second vice-president; A. Holtzendorf, secretary and treasurer. The capital stock of the company is placed at $50,000.

TORONTO, ONT., CAN.—At the annual meeting of the Electrical Development Company the following-named officers were elected: Sir Henry Pellatt, president; Frederic Nicholls, first vice-president, and William R. Mackenzie, second vice-president.

HARTFORD, CONN.—The Connecticut Home Telephone Company, recently incorporated, has been organized by the election of the following-named officers: Lewis Sperry, of Hartford, president; Frank H. Wheeler, of New Haven, vice-president; Harrison B. Freeman, Jr., of Hartford, secretary; R. P. Lyon, of Hartford, assistant secretary, and J. H. Hale, of Glastonbury, treasurer.

Business Notes.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., has opened a district sales office at 907 Andrews Building, Cincinnati, Ohio. Mr. Geo. W. Euker, who has had a varied experience in electrical and power plant work, is in charge as manager.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, has doubled the capacity of its winding and repair department in order to handle its increasing business in these lines. New quarters have been leased in the Bindley Hardware Company Building, at Shadyside Station, where direct railroad and express facilities are available. By the addition of more lathes, punching presses and milling machines, the company is in a position to turn out armatures complete if necessary.

THE BULLOCK ELECTRIC WORKS, of Cincinnati, Ohio, drafting and correspondence departments, it is said, will be moved to the plant of the Allis-Chalmers Company at Milwaukee, Wis., sometime in April, so that all special construction work may be done from there. All stock motors and appliances heretofore built in these shops will, however, continue to be built in Cincinnati. The object in removing this department is to concentrate the special work in one plant. There will be no reduction in the working force at the Cincinnati plant.

GOULD STORAGE BATTERY INSTALLATION.—The Gould Storage Battery Company, 341 Fifth Avenue, New York City, has been given a contract to install for William W. Harrison, of Glenside, Montgomery County, Pa., a large storage battery, consisting of sixty cells, Type S-623, in lead-lined tanks. The capacity of this new battery is 220 amperes for eight hours. A battery about equal to this was installed a few years ago, which, with the new one, will make a total of 120 cells. The current from these batteries is used for not only lighting purposes, but also for power.

THE UNITED GAS MACHINERY COMPANY has taken offices in the Engineering Building, 114 Liberty Street, New York City. It has taken over the business formerly conducted by Thos. F. Fitzsimmons at 100 Broadway, and will manufacture a complete line of gas generators for making producer gas for gas engines and heating, and water gas for high temperature furnaces, forges, annealing, etc. Thos. F. Ftzsimmons remains with the company as its president and general manager, and his long experience in the application of producer gas to gas engines and water gas to furnaces, insure to the purchaser the best possible results.

THE ROESSLER & HASSLACHER CHEMICAL COMPANY, 100 William Street, New York, has recently appointed F. A. Croselmire, formerly president of the Croselmire & Ackor Company, manager of its platinum department. Mr. Croselmire is well known in the platinum trade, having been identified with it, both in this country and Europe, for many years past. It will be the company's endeavor to obtain and develop the friendship and patronage of all who may solicit its services in any way pertaining to platinum, gold and silver refining.

CROSELMIRE & ACKOR COMPANY.—The plant of this company has been purchased, as mentioned in the issue of last March, by Franz Eisenbach & Company, the home address of which firm is Offenbach, Germany, not Berlin, as stated. Messrs. Eisenbach & Company have heen connected with the Croselmire & Ackor Company for the past three and one-half years, and during that period have been represented by Mr. Conrad Eisenbach as one of the managers of the business. Mr. Eisenbach, who is now a partner and president and treasurer of the new company, will personally conduct the business on the same basis as heretofore.

GAS ENGINES FOR STEEL FOUNDRY.—During January the Duquesne Steel Foundry, which operates a large plant in the Pittsburg district, decided to adopt the gas power system to operate the works formerly driven by steam. The initial equipment will consist of a 400-hp (max.) Westinghouse gas engine of the three-cylinder, vertical, enclosed type, direct connected to a 240-kw generator which will serve the various motor drives around the plant. The plant will operate on natural gas, which is available in large quantities in the Pittsburg district, for power as well as lighting, at such low rates as to render gas power the cheapest form of power available in this section of the country.

RONEY MECHANICAL STOKERS.—The Westinghouse Machine Company, builders of the Roney Mechanical Stoker, reports for the first two months of this year a good demand for stoker equipments. Perhaps the most interesting orders have come from cold storage companies. The Merchants' Ice & Cold Storage Company, of Cincinnati, are installing three equipments; the Montgomery Ice & Cold Storage Company, Jenkintown, Pa., two equipments, and the Holt Ice & Cold Storage Company, Indianapolis, Ind., the same number. Another municipal lighting station at Troy, Ohio, operated by the Board of Public Service, has adopted Roney stokers, and the Pennsylvania Light, Heat & Power Company, of Allegheny, Pa., operating a large central station at that place, increases its present equipment with two stokers of large capacity. The Mutual Union Brewing Company, Alliquippa, Pa., is installing three equipments, and the Alpha Portland Cement Company, operating a number of plants in the country, one of the largest size.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 10, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

881,108. APPARATUS FOR ELECTROLYSIS OF BRINE; C. F. Carrier, Jr., Elmira, N. Y. App. filed April 25, 1907. An electrolytic cell having decomposing and oxidizing compartments, means for circulating mercury therethrough, and a distributing slot for mercury substantially centrally disposed in the decomposing department.

881,114. ELECTRIC VIBRATOR; J. M. Dinkins, Indianapolis, Ind. App. filed July 21, 1906. A form of vibrator bell for large gongs in which the clapper strikes on the interior surface, rather than on the periphery of the gong.

881,138. ELECTRIC BLOCK-SIGNAL; E. P. Matter, Alexandria, Va. App. filed May 13, 1907. Patentee has a brush depending from the locomotive cab which engages a contact plate to establish an alarm signal in the cab in case the semaphore is set at danger.

881,181. BATTERY HOLDER; E. S. Egge, Montgomery, Ala. App. filed Aug. 14, 1907. Has a socket to receive a dry cell with spring-impelled contact buttons, which automatically connect the batteries in series when they are inserted in inverted relation in the sockets.

881,235. GAS IGNITER; C. T. Giorgi, Florence, Italy. App. filed Oct. 5, 1904. Renewed Feb. 1, 1908. A complete construction of gas lighter making use of a magnet coaxial with the tube of the burner and which attracts a laterally movable armature, which operates a turn cock, and heats a platinum filament to ignite the gas.

881,247. ELECTRIC PUMP REGULATOR; A. Koesche, Chicago, Ill. App. filed Sept. 13, 1907. A pump regulator for air compressor systems having a switch element which is abruptly displaced by toggle levers when a predetermined pressure against a piston is exceeded.

881,264. ELECTRIC SIGNAL DEVICE; E. Schermerhorn, Amsterdam, N. Y. App. filed Sept. 1, 1906. A pocket device, including dry cells, and a miniature electric lamp, and also having a telegraph sounder. The light may be flashed with the telegraph signals.

881,284. WALL BRACKET FOR ELECTRIC LIGHTS; W. R. Atkinson, New York, N. Y. App. filed April 23, 1907. A porcelain housing having a lamp receiving portion or socket at right angles to the plane of the surface on which it is received.

881,297. SOCKET FOR ELECTRIC LAMPS; C. G. Burton, Peru, Ind. App. filed March 14, 1907. A socket having a switch element of the ordinary turn button type, and including special features for locking the parts of the casing together.

881,300. ELECTRIC SWITCH; E. M. Coffin, Oakland, Cal. App. filed March 7, 1906. Two-button snap switch having a spring-impelled switch element retained from movement by a detent which is displaced by the button at the end of a predetermined inward movement.

881,306. ELECTRIC SWITCH; G. Cutter, South Bend, Ind. App. filed June 13, 1906. A rotary snap switch making use of knife blade switch elements movable in the plane of rotation of the handle and abruptly moved to complete their throw by a spring-impelled roller engaging a cam surface.

881,344. ELECTRICAL SIGN RECEPTACLE; F. J. Russell, New York, N. Y. App. filed April 5, 1907. A receptacle for use in electric signs and similar relations where the socket is secured in a perforation of the sheet metal support. Makes use of a pair of porcelain cups which nest together from opposite sides of the sheet metal support. The inner cup receives the threaded shell.

881,359. TROLLEY POLE CONTROLLER; C. R. Traxler et al., Winston Salem, N. C. App. filed April 16, 1907. A trolley pole controller comprising a weight for attachment to a trolley pole cord, and a tubular guide for the weight in its vertical movements.

881,360. TELEPHONE-RELAY; C. W. Underwood, Crowley, La. App. filed July 6, 1907. In a telephone-relay, a telephone receiver magnet and coils, a telephonic transmitter, an armature in operative relation to the telephone receiver magnet and mechanically connected to the transmitter element, and a wire support for the armature having a localized central connection thereto, said wire being under longitudinal strain or stress.

881,371. ELECTRICAL PLUG AND RECEPTACLE; P. C. Brown, Boston, Mass. App. filed Oct. 20, 1906. A screw socket plug connection having a detachable construction, whereby the jack position can be inserted by a direct movement, whenever desired.

881,387. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; A. C. Eastwood, Cleveland, Ohio. App. filed March 6, 1907. A complete multiple control system for trains designed to make use of direct current at low voltage for individual motors, and establish a complete control by which their voltage is low at starting without the use of resistances.

881,404. ELECTRIC ESCAPEMENT FOR TIME MOVEMENTS, C. F. Hollister, Waterbury, Conn. App. filed March 25, 1907. A secondary clock, including a magnet displaced escapement.

881,410. VALVE STEM AND TIRE DEFLATION ALARM; A. E. Kay, Chicago, Ill. App. filed Aug. 3, 1906. Patentee has a specially constructed valve for automobile tires with a plunger which is depressed to establish an alarm circuit in case the tire flattens.

881,453. APPARATUS FOR PROTECTING GRAIN STACKS; J. P. A. Anderson, Madrid, Ia. App. filed Feb. 25, 1907. A canvass covering for a grain stack with flexible lightning conductors embodied therein from which circuits are established to the ground.

881,456. DYNAMO ELECTRIC MACHINE; Henry Berg, Orange, N. J. A ventilated construction for armatures of dynamo electric machines making use of propeller blades at the ends of the armature which maintain a continuous current of air therethrough.

881,464. EXPRESSION DEVICE FOR KEYBOARD MUSICAL INSTRUMENTS; J. W. Darley, Jr., Baltimore, Md. App. filed Dec. 13, 1905. A switch controller adapted to put different sound devices in circuit with a keyboard by the operation of suitable stops on the instrument.

881,470. TROLLEY; C. Harkness, Providence, R. I. App. filed Nov. 28, 1906. The harp carries a table swiveled on a vertical axis and from which there projects upward a pair of trolley wheels.

881,517. ELECTRIC FURNACE; C. E. Wilson, Ferris, W. Va. App. filed Sept. 16, 1906. In an electric furnace, the combination of a melting receptacle provided with main electrodes, and an exciting electrode movable between the main electrodes, toward one and away from the other, for the purpose set forth.

881,518. ELECTRIC FURNACE; C. E. Wilson, Ferris, W. Va. App. filed Sept. 15, 1906. Modifications of the above

881,519. ELECTRODE-HOLDER FOR ELECTRIC SMELTING FURNACES; C. E. Wilson, Ferris, W. Va. App. filed Sept. 15, 1906. An electric-furnace, current-distributing holder for a plurality of pencil electrodes, comprising, in combination, a head having pencil receiving openings through it, electric current conducting means connected with the head, and a pencil-support comprising current-conducting pencil engaging and releasing clamping means on the head at each of said openings.

881,520. SECTIONAL ELECTRODE FOR ELECTRIC FURNACES; C. E. Wilson, Ferris, W. Va. App. filed Sept 15, 1906. A pencil-electrode section for electric furnaces, formed of separate longitudinally extending members, fitting closely together at adjacent sides and provided at opposite ends with means for clamping the members together, and for securing the sections endwise to other sections.

881,527. PROCESS FOR TREATING COMPLEX COBALT ORES AND FOR REFINING COBALT FROM NICKEL, ARSENICAL AND SILVER BEARING ORES; E. E. Armstrong, Niagara Falls, N. Y. App. filed May 1, 1906. The process of separating cobalt which consists in electro-chemically precipitating the cobalt as oxid by treating a solution of the same to electrolysis in the presence of a halogen salt of a metal.

881,531. CURRENT COLLECTOR FOR THE THIRD RAIL OF ELECTRIC RAILWAYS; J. G Baukat, White Plains, N. Y. App. filed Aug. 24, 1907. A contact shoe or trolley for electric trains which can be reversed on its clamping devices so as to engage the third rail on its upper or underneath surface

881,533. STERILIZING; E. P Beckwith, Cazenovia, N. Y. App. filed Nov. 9, 1905 Means for purifying or sterilizing water with ozone and for treating air to produce ozone for use in sick rooms and similar places. Makes use of a nest of perforated tubes through which the current of air flows and in which it is exposed to an electric discharge

881,539. ELECTRIC BELL; D. M Bliss, New York, N. Y. App filed March 1, 1906. All of the windings and contacts are hermetically sealed in a brass casing through the wall of which the magnet poles project to act upon the clapper armature. The device has a supplemental vibrator within the casing to avoid the usual vibrator contact on the clapper armature.

881,565. SAFETY LIMIT SWITCH; H. A. Everett et al., Barrington, N. J. App. filed July 23, 1907. A means for preventing the chain plug on an electric hoist from assuming a jamming position to the structural work of said hoist, and thereby preventing the breaking of the chain or wire rope, or [illegible] injury to the electric motor or motors or wiring connected thereto

881,580. METHOD OF RECOVERING COPPER FROM ORE OR MATTE BY ELECTROLYSIS; Henry K. Hess, Philadelphia, Pa. App. filed Jan. 31, 1907 The herein-described process of recovering copper from natural ore or matte consisting in immersing porous briquets containing particles of comminuted ore in an electrolyte together with a lead electrode in permanent contact with the briquets and subjecting the same to the action of an electric current for the liberation of the copper.

881,585. ELECTRIC-MOTOR; E. Hopkinson et al., Manchester, England. App. filed Dec. 29, 1905. An electric motor of the induction type having a plurality of rotors mounted to revolve about the separate axis, and a magnetic system common to and arranged to extend symmetrically around said rotors in a direction transverse to their axis and to act equally and simultaneously upon diametrically opposite parts of such rotor.

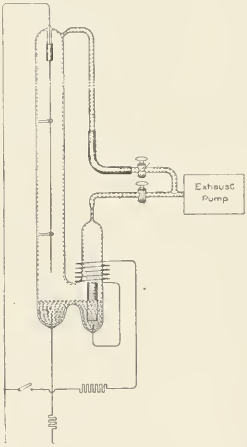
881,587. TROLLEY WHEEL PLACING DEVICE; H. G. Husted, Oberlin, Ohio. App. filed July 29, 1907. Makes use of a small supplemental roller with spiral grooves running from each end toward its center and which is designed to reposition the trolley wheel beneath the wire so that it may be easily engaged while the car is running.

881,588. METHOD OF EXHAUSTING VAPOR-CONDUCTORS; A. M. Jackson, Schenectady, N. Y. App. filed Aug. 4, 1903. The method of exhausting a vapor electric apparatus, which consists in conducting the exhaustion from a pair of communicating chambers simultaneously, and maintaining an arc while the exhaustion is in progress.

881,596. ELECTRIC CARRIER; S. H. Libby, East Orange, N. J. App. filed May 18, 1906. An electric crane having a plurality of electric carriers to run upon the same track. Includes means for preventing a collision between the carriers.

881,628. TELEPHONE CUT-OUT; E. W. Smith, New York, N. Y. App. filed July 12, 1907. In a telephone system, the combination with a plurality of lines and a main line, of a plurality of magnets one for each party line connected with the main line, an armature normally in circuit with the main line and the party lines, and means whereby the armature may be made to break the circuit with any of the party lines.

881,635. CAR SIGNAL SYSTEM; D. P. Thomson, Schenectady, N. Y. App. filed Aug. 2, 1907. The track rails are made continuous throughout their entire length so as to serve their return current carrying function. At intervals sources of alternate current of different periodicity are alternately connected. The locomotive carries a sensitive coil in inductive relation to the track and which is in a telephone circuit within the cab. The engineer can tell by listening to the character of the hum in his receiver whether he is getting current from one or two blocks away, depending on where the track rails ahead are short-circuited by the preceding train.



881,588.—Method of Exhausting Vapor-Conductors.

881,636. BALANCES SET; L. E. Underwood et al., Lynn, Mass. App. filed Oct. 1, 1904. Electric distribution of the three-wire type in which compensating machines are used to balance the load between two main conductors and the neutral wire of the three-wire circuit.

881,642. ELECTRIC RELAY; E. Weston, Newark, N. J. App. filed June 21, 1904. An electric relay in which the movable contacts carried by the relay armature close local circuits on stationary front and back contact stops, the armature being actuated by magnets on opposite sides.

881,647. SELF-EXCITED ALTERNATOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 19, 1906. In a self exciting alternator, a main armature winding, an auxiliary winding, a field magnet, a field winding carried thereby provided with a rectifying commutator, brushes bearing on said commutator and connected to said auxiliary winding, and short-circuited conductors surrounding each pole and the spaces between poles.

881,663. FIRE ALARM; G. H. Carroll, Vacaville, Cal. App. filed Nov. 9, 1907. Patentee makes use of a cord connected at one end to a circuit-closing device and at the other end to a coil spring whereby its stretch and slack are taken up under ordinary circumstances. In case of a fire, the cord is burned and the circuit-closing device actuated.

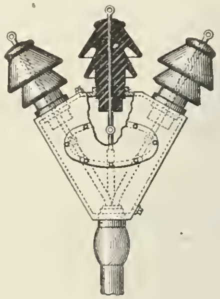
881,682. SHIELD FOR THE USE OF LINEMEN; G. E. Harrison et al., Detroit, Mich. App. filed Aug. 1, 1907. A device adapted to be placed over potential wires of a transmission system when the lineman is on the pole to protect him from the high voltages.

881,683. ELECTRICAL SOCKET SEAL; L. T. Hatfield, Sacramento, Cal. App. filed Aug. 3, 1906. A small paper device adapted to be inserted in a lamp socket, and constitutes a seal to prevent the insertion of a lamp without first destroying the seal.

881,686. ELECTRIC SWITCH; S. Hoadley, Gosport, Ind. App. filed Aug. 12, 1907. Means whereby a telephone may be switched into and out of connection with either one of two exchanges, and in which an extension or separate bell is used for the subscriber, so that he may not be called from one exchange until he has finished communication with the other.

881,712. TELEPHONE-RECEIVER; H. G. Pape, New York, N. Y. App. filed June 16, 1904. Renewed Jan. 25, 1908. In a receiver, the combination with a casing divided to form front and rear compartments, of an armature in one compartment, a diaphragm in the other compartment, a magnet having an inclosing shell screwed into the dividing wall of the casing, and a connection passed through the magnet between the armature and the diaphragm.

881,765. STARTING DEVICE FOR MERCURY VAPOR ELECTRIC LAMPS; L. A. Audibert, Lodeve, France. App. filed Sept. 14, 1906. A means for starting mercury vapor lamps by preliminary contact. Makes use of a magnet displaced filament which dips into the mercury at starting.



881,777.—Terminal for Electric Cables.

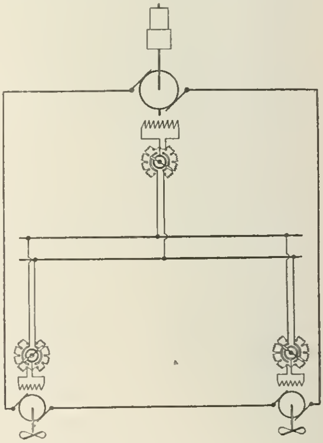
881,777. TERMINAL FOR ELECTRIC CABLES; C. W. Davis, Edgeworth, Pa. App. filed March 31, 1906. A conduit connection for three-wire, high-voltage transmission systems making use of a housing from which there project three petticoated insulators through which the circuit wires are received from the conduit.

881,810. ELECTROPLATING APPARATUS; G. A. Lutz, New York, N. Y. App. filed April 8, 1907. An electroplating apparatus comprising a tank for an electrolyte, a series of anodes suspended within said tank, a post within said tank located within said series of anodes, anodes suspended from said post, means for connecting all of said anodes in a circuit, and a cathode plate provided with means to support articles to be plated and arranged to suspend said articles in the space between said series of anodes.

881,811. ELECTROPLATING APPARATUS; G. A. Lutz, New York, N. Y. App. filed April 8, 1907. The combination of a tank for an electrolyte, means for suspending an article to be plated therefrom, means for suspending an anode from said cathode, and means for insulating the anode from said cathode.

881,840. INSOLE FOR BOOTS AND SHOES; J. Askins, Lima, Ohio. App. filed Sept. 23, 1907. Makes use of electrolytic action to cause the absorption of moisture from the foot in use.

881,847. THERMOSTAT; F. P. Butman, Holbrook, Mass. App. filed March 27, 1903. A small metallic housing adapted to be secured in the wall at points to be protected and having a spring-impelled plunger, movement of which is resisted by a fusible substance.



881,864.—Means for Transmitting Power Electrically.

881,864. MEANS FOR TRANSMITTTING POWER ELECTRICITY; G. Lewin, Schoenberg, Germany. Covers the synchronous operation of two twin-screw propellers of a boat by the use of a third generator controlling the field excitation of each propelling generator.

881,878. TELEPHONE-SWITCH; A. N. Wright, Jackson Center, Ohio. App. filed July 8, 1907. Plug switch analogous in construction to plugs of a resistance box.

881,880. GALVANOMETER; S. G. Brown, London, England. App. filed April 7, 1903. Provides means for indicating whether a circuit in which the galvanometer is included possesses self-induction or capacity.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, MARCH 28, 1908. No. 13.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office....590 Old Colony Building
Cleveland Office....1015 Schofield Building
Philadelphia Office....Real Estate Trust Building
European Office....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....per year, $3.00
Dominion of Canada....4.50
Other Foreign Countries within the Postal Union....6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, MARCH 28, 1908.

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Proposed International Candle.

We learn that a joint committee of the Gas Institute, of the Institution of Electrical Engineers, and of the Illuminating Engineering Society has recently drawn up resolutions urging the National Bureau of Standards at Washington to take steps toward bringing about, if possible, an international candle corresponding, say, to a readjusted *bougie decimale,* which should be acceptable to Belgium, Denmark, England, France, Holland, Italy, Norway, Sweden and the United States. Such an international candle might well be established through the medium of interchanged standardized incandescent lamps, on the basis of mean values of, say, the British pentane candle, the French carcel and the older British sperm candle as previously evaluated in terms of the hefner and hitherto employed in this country. The compromise would involve not more than 3 per cent change in any of the standards now existing, and would abolish the senseless multiplication of primary national photometric units. According to the views of the joint committee above referred to, which views we cordially endorse, the illuminating engineering industries are ready to change their existing United States standards of candle-power if the countries named, or the majority of them, will agree upon a common compromise international candle. We hope that the United States Bureau of Standards will lose no time in soliciting the aid of all the other countries in bringing about this much-to-be-desired result. It would be very desirable to include Germany in the plan, but the hefner unit used in Germany is some 10 per cent off the mean candle of other countries, and no one can be expected to make so great a change as that unit would involve industrially if universally accepted. However, the agreement of the countries not using the hefner upon an international candle, would at least reduce six existing standards to two. Each country would then have its own national standard, the pentane, carcel, hefner, etc., and also one international candle, maintained by lamp interchange and in known relation to the national lamp. At present, with six national standards, we have to keep a sort of cross-reference table with 36 entries in order to compare results. In time, the international candle might make reference to each special national standard unnecessary.

The Bell Telephone Report.

Some very interesting statistics are given in President Vail's annual report for the American Telephone & Telegraph Company's system. A total capitalization for the system is shown of $554,939,000, with an appraisal value for the plants of $488,206,000. This leaves barely $75,000,000 for good-will franchises, contracts, etc, so that a physical valuation would have no terrors. A great deal of nonsense has been uttered and written about Bell over capitalization, but such figures are one of the best evidences that could be adduced as to the inherent financial soundness of the enterprise. This great system brought in last year $120,753,200 in net earnings. An estimate at the beginning of the year was $200,000,000 for the Bell and Independent networks together, and would appear to be quite exact. Incidentally we may note that President Lindemuth, of the International Association, places the Independent capitalization at $350,000,000, which, for the whole industry, would make a splendid total of $900,000,000. This is very near the amount estimated for the central-station industry, namely, $1,000,000,000, and shows how rapidly the telephone art is coming up to the levels of lighting and traction as a field of investment.

An interesting item in the report is the statement that the Bell system now has 3,035,533 stations. The Independents claim 4,000,000. But the Bell system has connected with it 755,316 Independent stations and private lines, making a total of 3,839,000, so that the two systems on this basis of computation are fairly equal. There being no reason to question Mr. Vail's figures, it would seem that actually not far short of 20 per cent of the Independent instruments are on working terms with the Bell system, in spite of the anathemas and bulls of excommunication directed against those who indulge in this unholy practice. On the other hand, the virtues of competition are clearly brought out by these figures of growth, although Mr. Vail addresses himself very earnestly to an argument on the proposition that the old theory "the telephone is a natural monopoly" is still tenable. If it be true that existing competitive local systems overlap only to the extent of about 15 per cent, the theory needs restating in some other form. When the actual point of saturation has been reached in telephonic development, the theory may quite likely validate itself, but meantime it does look as though the public were benefiting by the existing struggle and that even the Bell system was none the worse for having had to justify its existence by dealing with a strong adversary in a field in which it once reigned supreme.

THE KENNELLY DIAGRAM.

The new method of determining mean spherical or zonal intensities from the polar curve of a luminous source, described by Dr. Kennelly this week, is of great interest and practical convenience. It is less obvious but more elegant than the familiar Rousseau diagram, and more useful in that in the final result it substitutes a linear measurement for the determination of an irregular area. This of itself is an important improvement, since the summation of the area under a curve is no small bother by whatever method accomplished. Even getting out and working a planimeter is a nuisance unless a number of results are to be evaluated at the same time. When the Kennelly diagram is drawn the work is practically over, while when the Rousseau diagram is drawn the trouble is just fairly under way. Both diagrams are methods of approximate graphical integration and their accuracy depends upon the number of zones taken for the summation. From the figures given by Dr. Kennelly the use of 10 deg. zones is beyond the necessities of ordinary commercial photometry, 15 deg. or 20 deg. zones being quite sufficient for most cases. Zonal values can be scaled off with great readiness just as they can be determined by the planimeter from the Rousseau diagram. Dr. Kennelly's discovery of this new and beautiful method comes at a most opportune time before the Rousseau method has rooted itself in American practice. It is used, of course, and appreciated, but the only diagram familiar to the average student or engineer is the usual polar one. This, convenient as it is, has serious limitations, and often conveys at a glance information that a little study shows to be entirely incorrect For instance, a really considerable equatorial distribution of light may be represented by a mere inconsequential hump on the polar curve of a concentrating shade, while on the other hand an immense polar extension may really represent a very modest flux of light. The Kennelly diagram makes no false representations of this kind, and while it is less easily read by the untrained eye than the areas of the Rousseau curve, it is much more easily constructed by the student or the engineer, and quite as serviceable for technical purposes. It is certainly a most valuable addition to the armory of the engineer and we shall hope to see it come into immediate and extensive use. We congratulate Dr. Kennelly on the development of a method so novel and so beautifully facile.

THE TUNGSTEN LAMP SITUATION.

From the standpoint of the electrical supply company the evolution of the new incandescents is at an embarrassingly rapid rate, not by any serious lessening of output, but by the incidental questions of policy and the demand for things which are not obtainable. Broadly, every improvement in efficiency is desirable and in the long run will increase earnings, and central station men realize this fully. Yet when a lamp comes along that is actually able to reduce by two-thirds the consumption of energy per candle-power, it is a little difficult to tell what had best be done with it in view of a limited supply and a high price. In particular the latter feature of the new lamps is troublesome to the companies that have been furnishing free lamp renewals. While on account of the long effective life of the tungsten lamps and their high efficiency, the actual cost of renewals per cp-hour is little more than in the case of carbon lamps even at present prices for the former, the fact is that per kilowatt sold through them the renewals are equivalent to a substantial cut in price, say 10 per cent or more. In other words, a company that furnishes free renewals of tungsten lamps not only cuts its immediate sales, but its price as well

On the other hand, it has been the quite uniform experience that a cut in price of current made spontaneously and not forced by cut-throat competition, has been followed by a positive increase of business and profits. The world is yearly getting more nocturnal in its habits and is needing and using more and more light. And its use of electricity for lighting seems to have steadily increased faster than the price has decreased. The final result therefore of the new high-efficiency lamps will be increased earnings. Yet at present the situation is such that free renewal of such lamps is a difficult matter. The lamp factories cannot now or in the immediate future turn out tungsten lamps fast enough to meet even a fraction of the demand; and when a company cannot get enough lamps to supply its customers how shall it square itself with disappointed customers if it undertakes free renewals? It cannot give each customer his proportionate share of the obtainable lamps, for a mixture of carbon and tungsten lamps is not only of objectionable appearance, but would be productive of unlimited kicking. It cannot properly distribute tungsten lamps by a lottery system nor can it fairly discriminate between customers. The logical procedure seems to be that adopted by most supply companies, of charging enough for renewals to put it fairly up to the consumer as to changing his installation. Enterprising men who realize the economics of the situation will then change over to the new lamps as fast as they can be had, while the obtuse or over-conservative will pay, as always happens, for their lack of enterprise. Then the question of free renewals, i. e., cutting price, can be left to take care of itself in due season.

The early crop of lamps in this country has been mainly in the 100-watt size; that is, of a size well adapted to replace arcs and clusters. But it has fortunately turned out that the smaller sizes are easier to make than seemed possible at first. The slender filaments are somewhat fragile, it is true, but yet less so than was at first to be feared. As a result 60 and 40-watt lamps are on the market in small quantities and a 25-watt lamp is being imported and must be reckoned with later. These smaller lamps touch a vastly greater number of consumers than the larger size, and will be for the present more difficult to supply in quantity. Their renewal costs are materially greater at present prices than those of the larger lamps, and free renewals imply a still larger cut in price. In fact, it is the cost of renewals in these smaller lamps that make the free-renewal problem so troublesome. No one knows, of course, what will be the ultimate cost of the modern high-efficiency lamps. The tendency of price will be assuredly downward, but toward what limit it is difficult to say. Their construction is much more intricate and troublesome than that of carbon lamps, and only experience can show how cheaply it can be carried out. It is, of course, possible that a new material for filaments may turn up of higher specific resistance than tungsten and hence lead to a cheaper and simpler construction. But until such a material is found costs will be relatively high. Tungsten filament is expensive and tantalum, whether for filaments or for supports for the tungsten, is by considerable the most costly commercial metal. Until the situation is relieved and tungsten lamps are available in the enormous quantities required to supply the general demands, central stations have a good many difficulties to face. They cannot fairly be asked virtually to cut the price just because a lamp can be had that will cut their bills in two. Meanwhile the tungsten lamp is being cried for, not only on account of its saving in energy, but by reason of its excellent color, a much closer approximation to white than most arcs, and immeasurably superior to the commoner illuminants.

ARCHITECTURE AND ILLUMINATION.

A recent paper on the relation between the principles of architecture and illuminating engineering brings very forcibly to mind the radical difference in point of view between the artist and the man of affairs—between those whose first demand is æsthetic effect and those who hold to the Socratic doctrine that beauty is adaptability to use. Each represents a somewhat extreme point of view, and reconciliation can be effected only through some measures of compromise. Canons of beauty are the result not of philosophical evolution, but of fashion and environment. The mediæval architect spurned the Greek and Roman ideals in the West and followed them in the East. The modern is glad to copy from any of his forerunners that do not chance at the moment to be out of fashion. As a copyist he is generally fairly successful, and his only really dismal failures come when there are no suitable ancient precedents and he has to strike out for himself. Now and then he scores a notable success, but it is notorious that no group of architects could be found to give unanimous approval to any structure that breaks away from tradition, and on which judgment has to be passed upon its merits rather than its resemblances.

The fundamental conditions between the conditions of ancient and modern architecture lie in the differences of purpose. The great buildings of olden times were, for the most part, of religious significance, or, in later times, colossal compromises between fortresses and buildings. In either case they stood apart in reverence or menace, and their claims to beauty lie in part in their suitable environment. One could hardly appreciate the Parthenon sandwiched between department stores on West Twenty-Third Street, or Notre Dame jammed among the apartment houses of upper Broadway. The great building devoted to strictly utilitarian purposes is distinctively modern, and if it fails of the purposes of its use, no decorative features can redeem it. And illumination, too, is strictly modern. The ancient city was dark after nightfall, and the hours of human labor were adjusted to daylight. At present cities are becoming nocturnal in their ways, and require light not only for purposes of utility, but as part of their natural life. A city building must be judged artistically not only by day, but by night, and designed accordingly. It may be true that this condition of things is all wrong, that men would be better, and be happier, if they worked only in daylight hours, and in the evening left the cliff dwellings of the city for the simpler life, but we cannot escape our environment in this work-a-day world and must face life as we find it. Proper illumination of buildings to be used at night is not primarily a question of æsthetics, but of grim necessity. The building must be suitably lighted by night, and in parts by day, through the use of artificial illuminants. And the architect must never forget that the lighting is essentially not decorative, but utilitarian.

Granted, however, that the illumination is good for the purposes of its use, every one will rejoice if it can be made æsthetically good as well. Just here is the point of contact between the architect and the illuminating engineer. The training of the architect has not yet covered the technique of modern methods of illumination, which is almost daily becoming more intricate, and in the growing tendency to specialization he is never likely to cover it. The illuminating engineer, on the other hand, is not likely to become a specialist in architecture. Working hand in hand, the two can get good and harmonious results even under the difficulties imposed by modern conditions. The common mistake is in calling in the engineer, not to work with the architect from the start, but to rectify his blunders later. A large building is erected under the full supervision of an architect. After it is occupied, it is found that the lighting is in amount or kind totally unsuitable, and the illuminating engineer is called in. He works then on things as they are, without the advantage of co-operation, and if he commits æsthetic sins they are at least sins no worse than those which prompted his opportunity. The lighting and the scheme of decoration should be worked up simultaneously; but proper lighting, from the standpoint of illuminating engineering, should be considered as much a fixed requirement as suitable heating or proper structural strength. Adequate lights are like adequate radiators, necessities, with the advantage that they can more readily be modified in accordance with æsthetic considerations. Good lighting can be made artistic more easily than artistic lighting can be made good: hence the desirability of early co-operation in design between architect and engineer Both have much to learn, and intimate association will go far toward mutual teaching and appreciation.

Marseilles International Electrical Congress.

An electrical congress will be held at Marseilles, France, from Sept. 14 to 21, in connection with the International Electrical Exhibition of Marseilles. The congress will have as honorary presidents, M. Mascart, Member of the Institute, president of the permanent committee of electricity; M. D'Arsonval, Member of the Institute, professor at the Collège de France; M. Marcel Deprez, Member of the Institute; M. Hippolyte Fontaine, electrical engineer. The active president will be M. Maurice Levy, Member of the Institute, inspector-general of bridges and ways, professor at the Collège de France and the Ecole Centrale, vice-president of the permanent committee of electricity. M. Paul Janet, professor at the Sorbonne and at the Ecole Supérieure d'Electricité, director of the Central Laboratory at Paris, will be first vice-president.

This congress will hold general meetings and section meetings, and visits will be made to industrial establishments. Members of the congress will have the advantage of reduced rates at several hotels in Marseilles, as well as reduced rates when traveling on any of the French railroads.

Manuscripts of papers for presentation before the congress may be sent to the General Secretary of the Exposition, 63 Boulevard Haussmann, Paris, France, before July 15. The admission fee to the Congress will be 20 francs. Checks or money-orders may be made payable to Monsieur le Trésorier du Congres, 63 Boulevard Haussmann, Paris, France.

The congress will be divided into nine sections, as follows: Section I. Governmental regulation and control, in which subjects relating to legislation, prevention of accidents, taxes and franchise will be considered. Section II. Construction and protection of electrical systems, comprising the subjects of insulation, overhead and underground distribution. Section III. Technical and commercial operation. Section IV. Lighting and domestic applications; photometry will be included in this section. Section V. Applications to the industries, including mines, traction and agriculture. Section VI. Electrochemistry and electrometallurgy. Section VII. Telephony and telegraphy. Section VIII. Electrotechnical education. Section IX. Applications to hygiene and medicine.

Over-capitalization and Issue of New Public Utility Securities.

In authorizing an issue of bonds and stocks by the Watertown (N. Y.) Light & Power Company, the New York State Public Service Commission of the Second District has laid down its policy with regard to permitting the issuance of new securities by corporations with existing capitalization, and with regard to expenditures by public service corporations for purposes other than public service. The Watertown municipal authorities had contended the company was over-capitalized and had urged that before granting the application a careful valuation of the corporation's property be made. In the opinion, written by Commissioner Osborne, it is decided that:

"The existing capitalization of a public service corporation need not necessarily be examined into before authorization of securities, under section 69 of the Public Service Commissions law. The material question on such application is whether the desired issue of securities is necessary for one of the purposes specified in that section.

"Public service corporations may be authorized to make expenditures incidentally for purposes other than public service, if such expenditures are on property to be used ultimately and properly for such public service.

"The purchasers of securities authorized by this commission are not exempt from the business risks involved in the possibility of the corporation issuing the securities being over-capitalized."

The commission authorized the issue of bonds and stock by the company, for the discharge of its lawful obligations, to the amount of $200,000 5 per cent gold bonds to be sold at not less than 80 per cent of their par value, and $102,500 stock at par.

It is provided in the order that "any excess in the proceeds of this issue of bonds which may be realized from the sale of them at a price above 80 per cent of the par value thereof shall operate to reduce to the extent of such excess the amount of capital stock authorized to be issued."

The applicant company took over the property of the Remington & Sons Pulp & Paper Company, which owned valuable water-power facilities, and this the commission approves as a proper business undertaking, looking toward the future development of the Watertown Light & Power Company in its public service capacity of furnishing to Watertown and its vicinity light and power.

The commission in its order disallowed the amount set down for improvements made upon the Remington property prior to June 4, 1906, which was $14,134.78.

"These improvements were made before the date of the filing of the original application herein referred to," says the order, "and in our opinion these amounts are properly regarded as included in the capitalization allowed by the former Commission of Gas and Electricity." Also there is disallowed $175 for rent of contractor's office, $784.15 for improvements to buildings not used for the light or power purposes, $7,425 for salaries and $3,725 representing excess rental of contractor's plant. In addition to the above amounts $919.29 was withdrawn by the applicant in the proceedings upon the application, making a total of $27,163.22.

The city of Watertown, as represented by its Mayor and Attorney, had insisted that the company, under the order of the former Commission of Gas and Electricity allowing a capitalization of $700,000, was greatly over-capitalized.

Wire Inspection Bureau.

At a meeting of 26 wire manufacturers, representing practically all the important rubber-covered wire interests in the country, at the Hotel Manhattan, New York City, on Friday, March 20, it was decided that the control of the Wire Inspection Bureau should be placed, as far as the manufacturers were concerned, in the hands of the Rubber-Covered Wire Engineers' Association. This step followed the action of the Underwriters' Laboratories in withdrawing from the Wire Inspection Bureau. The manufacturers decided that they themselves could supervise the inspection and labeling of wire, and that the Rubber-Covered Wire Engineers' Association, to which all manufacturers of approved wire are eligible, was well fitted to have charge of the Wire Inspection Bureau in order to maintain its high standards. The engineers will select the governing board of the bureau, and will represent the manufacturers in all bureau matters. Every manufacturer of rubber-covered wire whose name is on the approved list of the National Board of Fire Underwriters has been invited to join the Engineers' Association, and nearly all have become members, so that it is possible for every manufacturer of approved wire to be represented on the Wire Inspection Bureau as a member of the Engineers' Association.

Following the circular letter issued Feb. 15 by the Underwriters' Laboratories, of Chicago, which has been printed in these columns, and in which a statement was made that the Underwriters' Laboratories could no longer indorse the label service of the Wire Inspection Bureau, the committee appointed by the wire manufacturers attended a conference at which were present the chairman and several members of the executive committee of the National Board of Fire Underwriters, the secretary and other representatives of the Underwriters' National Electric Association, the president and other representatives of the Underwriters' Laboratories, and all the gentlemen heretofore composing the committee on finance and specifications of the Wire Inspection Bureau. The representatives of the insurance companies made it plain that they had no desire to injure in any way the interests of the manufacturers, but, on the contrary, were extremely anxious to work harmoniously with them in a joint effort to establish a high standard of manufactured product and insure that all product sold should be kept up to such a standard. The manufacturers explained that it would not be satisfactory to them to admit into their works inspectors exclusively under the employ of the Underwriters' Laboratories, or any other organization in the management or control of which they had no voice. The underwriters stated that they did not desire to force on the manufacturers a stamp or label device, and that they would go no farther than to offer such service, if it was desired by the manufacturers. After due consideration, the manufacturers decided to take into their own hands the matter of supervising the inspection and labeling of wire and that their united indorsement of any system would answer all purposes.

The Wire Inspection Bureau under the control of the Engineers' Association will continue the work which it has carried on in the past, with only such improvements as may be suggested from time to time by the Underwriters' Laboratories, the manufacturers themselves or any other parties interested. The Wire Inspection Bureau will give label service only to manufacturers who are producing an approved wire. The labels or stamps used will be a certification by the united manufacturers that any wire bearing such stamp is fully up to the Underwriters' Laboratories standards. The Wire Inspection Bureau was formed on May 22, 1905, by the rubber-covered wire manufacturers and the National Board of Fire Underwriters, and was organized to protect reliable manufacturers against unfair competition and to prevent practically the use of wire with defective rubber insulation. A joint committee of six was chosen to decide on wire tests, and three inspectors were appointed to visit the testing laboratories of factories making rubber-covered wire and to supervise and verify tests specified by the bureau. The expenses were paid by fees collected from the manufacturers whose product was tested, each company paying its share in proportion to the amount of wire manufactured.

N. E. L. A. Chicago Convention Exhibition.

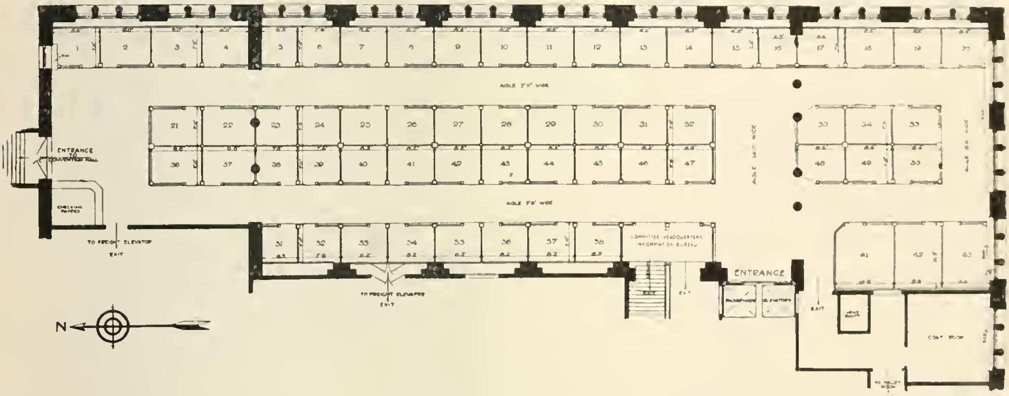
The accompanying illustration is a plan of the space available for exhibits at the Chicago convention of the National Electric Light Association. As previously announced, the convention will be held in the Auditorium and Annex, May 19-22. The exhibits will be located in the large hall on the top floor of the Auditorium Hotel, which adjoins and connects with the meeting-room. The elevators leading to this floor are so located that members attending the sessions will pass through the exhibition hall to gain entrance to the meeting-room. The well-known architects, Messrs. D. H. Burnham & Company, will have charge of the designing booths and decorative treatment.

There are 63 booths in all, ranging in size from 44 sq. ft. to 124 sq. ft. The prices to exhibitors include the erection of a platform, posts, railings, painting, a sign bearing the name of the exhibiting member, furniture consisting of a table or desk and two chairs, and current and lamps for lighting the booth. Direct current at 110 volts (two-wire system) for operating exhibits and other special purposes will be available at 5 cents per kw-hour.

For the convenience of exhibitors, arrangements have been made with the Joseph Stockton Company, of Chicago, for the handling of exhibits. All packages should be addressed to the exhibitor in care of the Joseph Stockton Company, to whom should be sent the bill of lading direct. The boxes will be stored in this company's freight barns and delivered into the Auditorium on Saturday, May 16, and Monday, May 18. In order to avoid delays it is suggested that all shipments be made so that they will reach Chicago a few days before Saturday, May 16.

The exhibitor must be a commercial member of the association. Exhibitors must have their booths ready Monday evening, May 18, at 7 o'clock. During the convention a "Convention Daily" will be published by the association on each of the four days of the exhibition, under the management of Mr. C. W. Lee. Secretary Neumuller, of the Exhibition Committee, reports that by the second day after the circular was issued giving details of the exhibition, applications for more than a third of the exhibition space were received, and the committee believes that by the end of this week the entire space will be sold.

The tungsten lamp will play a prominent part in the illumination of the exhibition hall. The color-scheme is receiving a great deal of attention, and it is the desire to make the exhibition attractive not only from a commercial standpoint, but also from the artistic standpoint.



PLAN OF BOOTH LAY-OUT.

Electric Club in Chicago.

The Electric Club organized in Chicago several weeks ago in an informal way for the purpose of getting electrical men together at luncheon once a week has now been formally incorporated under the laws of the State, and at the meeting March 18 the election of the following officers was ratified: President, Mr. C. A. S. Howlett, of the Western Electric Company; vice-president, Mr. A. L. Millard, Westinghouse Electric & Manufacturing Company; secretary, Mr. S. M. McFedries, J. L. Schureman & Company; treasurer, Mr. W. P. Crockett. The club meets together at lunch in the German Room of the

Grand Pacific Hotel every Wednesday at 12:30 p. m. At each meeting a few minutes' informal talk is given by some member on some practical electrical subject. The club is composed of manufacturers, salesmen, jobbers, consulting engineers, and in fact men from all branches of the electrical business. It is proposed to have a smoker and entertainment April 3.

International Candle-Power Unit.

At the general meeting last June in Boston of the Illuminating Engineering Society, a sub-committee of the Committee of the Society on Nomenclature and Standards was appointed to study the question of a unit of luminous intensity. Later committees were appointed by the American Institute of Electrical Engineers and American Gas Institute to co-operate in the work, and in February a final joint report was made. This report has been approved by the two last-mentioned bodies, and will shortly come up for action before the Illuminating Engineering Society, with no doubt as to its acceptance by that body.

The report recommends the adoption of a common national unit of candle-power, which will be maintained by the National Bureau of Standards, from which will be issued secondary standards for practical photometric work. The committee recommends that steps be taken to secure an international agreement as to a candle unit; to this end no definite value is assigned to the unit, which is left to be fixed by international agreement with the condition that it shall represent approximately the average of the candle units at present in the national laboratories of the United States, England and France. Pending such agreement it is recommended that a common candle unit be used in this country which shall be 2 per cent less than that now maintained at the Bureau of Standards, since there can be no doubt that such a candle unit would differ by less than 1 per cent from the international standard that would probably be fixed.

Public Utilities Accounting.

At the public hearing on the subject of gas and electric accounting, which will be held by Public Service Commissioner Maltbie, March 26, at 10:30 a. m., there will be present, besides the Commissioners of the First and Second Districts, the accounting committees of the American Gas Institute, the National Electric Light Association and the Empire State Gas and Electric Association. An invitation has been extended to the representatives of the Massachusetts and Wisconsin Public Service Commissions to be present, and representatives of other gas and electric companies, accountants and others interested in the subject of accounting will be welcomed. The subject of the hearing will be the tentative classification recently submitted in pamphlet form by the Commission of the First District. Everyone will be given a chance to be heard, and it is hoped that some basis for a universal system of accounting may be reached. As matters now stand, it is not likely that the present tentative system will be adopted as a whole; in fact, it was stated by one in close touch with affairs that the Wisconsin Commission would positively refuse to accept the classification in its present form. It has been criticised because the item "working capital" has been left out, characterized as "crude" and objected to on the grounds that it is not easily understood except by experts, and represents the ideas of the New York companies without regard to outside interests. "The basic question," said one who has been following the matter closely, "is whether the classification shall show everything or as little as possible. The New York companies seem to be working to make the classification show as little as possible, while the other interests are anxious to make it a full and public record which will not require an expert accountant and a week of time to decipher."

Annual Meeting of the New England Electric Lighting Engineers.

The annual meeting of the New England Association of Electric Lighting Engineers was held at the American House, Boston, on March 18. President W. L. Mulligan was in the chair. During the business meeting Mr. S. Fred Smith, general manager of the Salem Electric Lighting Company, was elected president for the ensuing year, and Mr. Cole, of the Waltham Gas Light Company, was elected secretary.

THE TUNGSTEN LAMP.

Mr. J. S. Whitaker, of the Rockingham County Light & Power Company, Portsmouth, N. H., read a paper on the "Introduction of the Tungsten Lamp." Mr. Whitaker discussed the appeal to the customer of the tungsten lamp, especially in relation to the unprogressive merchant in need of more and better light. Citing a life test made upon an 80-cp, 115-volt lamp, the speaker stated that it burned 864 hours continuously, with no perceptible change in color or diminution of light, though no photometer test was made. He cited a small dry-goods store, which originally had an installation of incandescent lamps and gas arcs combined. Tungsten lamps were installed in the show windows, and one wing on free trial, with the result that an order was placed for a complete tungsten installation. The lighting cost to this merchant last December was 20 per cent less than a year ago. During the last seven months Mr. Whitaker purchased 850 tungsten lamps; of these 27 were broken in transit, 418 were installed and 143 burned out. It was found that 75 per cent of the early burn-outs occurred in the first 100 hours. Later lamps are better and more uniform. A charge of $1.75 each for 100-watt lamps is made to the consumer. This allows for transportation and breakage. The company replaces all lamps not burning 100 hours.

Mr. Whitaker has found the "Meridian" fixture neat and economical for tungsten installations. For store lighting, the bowl-frosted lamp with bowl reflector he had found satisfactory, and for window work a clear lamp with a concentrating reflector located high in the window near the front.

In the brief discussion, Mr. Wilcox, of Lowell, stated that a rental basis of 25 cents per month had been found satisfactory in meeting the gas-arc competition. Mr. Sands, of Haverhill, loans the shade and reflector in store installations of tungsten lamps; if one is broken or lost the customer pays for it. Mr. Cowles, of the Boston Edison Company, said that his company has put out about 1200 80-cp tungstens, charging an excess of $1.10, the lamp remaining the property of the company. Breakage does not seem to be a bugbear. The life appears to be very good—so far at least 700 hours. The company places the lamps in the sockets itself, pendent sockets being used. Mr. Hale, of the Boston company, pointed out that most customers appear to prefer the lamp installed with a clear shade, even though the company advises the use of a sand-blasted globe and etched shade.

In Peabody, 100-watt lamps are installed to meet gas-arc competition at a charge of $1.50, with a guarantee that the annual cost of renewals shall not exceed $3. The gas people charge a yearly rental of $3 per lamp. In this town the tungsten lamp replaced a gas-arc installation in a bowling alley. Formerly there was one gas lamp between each pair of alleys; the tungstens were placed one over each alley with reflectors keeping the light out of the eyes of the patrons, and directing it to the pins, the result being a great improvement.

THE BOILER PLANT.

The next paper was by Mr. F. S. Allen, of the Hartford Steam Boiler Inspection & Insurance Company. The subject was the diseases of boilers. Mr. Allen first discussed the failure of the lap seam. In the years when iron plate was exclusively used in the construction of boilers, there were but few failures from this defect. Steel seams resent treatment that iron withstood, and in cases of seam distortion from true circular form, fracture at the longitudinal joints is probable. Proper bending in the rolls is of great importance. Often the plates are not bent so as to conform to each other, and when the rivets are closed and brought together, a reverse strain is caused in the material, developing incipient fracture from the beginning.

Another defect is improper pressure in closing the rivets. Ruptures of plates due to this cause have been no respectors of factors of safety or age of boilers. Crystallization is another source of trouble. This is found in boiler tubes made of inferior material, as well as in plates. Not infrequently there is some unusual color or sound that will attract the attention of the examiner, in the line of crystallation evidence. A case of this kind occurred in a large battery of boilers in which there was no evidence of thinning or overheating, distortion or of sediment found in the tubes. They gaged to their full standard thickness for their diameter, but there was a peculiar, unusual color when rubbed clean of soot and ash to the original skin of the metal, but not showing under file any change except bright metal. Two tubes were removed for test, and as a result, all the tubes in the boiler had to be replaced. In the same plant were boilers operated 23 years at 125 lb., but these others that were defective were operated at 160 lb. The trouble was assigned to the higher temperature and pressure of the latter.

Of late there have been many defects found in the bolts that hold the tube caps on the manifolds on some types of water-tube boilers. This is a dangerous defect, as most of these boilers are operated under high pressure and the caps are upon the outside, so that the giving of the bolts releases the entire contents of the boiler into the fireroom. This has become of such seriousness as to be taken up with one of the largest electric-road operators, and chemical tests have been made of the bolts. It is thought that the use of commercial steel bolts is responsible for the trouble, and the remedy seems to be the use of the best quality of Norway iron. These bolts are not subjected to expansion strain or vibration, and the trouble is probably due to the constitution of the material, which seems to lend itself to crystallization.

Mr. Allen then discussed the subject of scale. Water-tube boilers are particularly sensitive to this trouble. The failure of tubes is also sometimes due to improper welding. With the temperature due to higher pressure there are some new developments in scale formation, especially in the fire-box type of upright boilers. There is too little space for scale deposit on the tube sheets, and the large amount of heating surface and the normal evaporation with brackish water show rapid scale formation on the tube sheets directly over the fire. Judicious use of solvents is essential in such cases. It has been found that the difference in temperature between steam at 125 lb. and at 160 lb. is probably sufficient to precipitate out of the ordinary sediment a small amount of sulphate of lime. Feed water containing nitrates is very bad for boilers, as a nitrate compound is a deadly enemy to iron and steel plates.

Trouble with lubricating oils continues to be one great cause of boiler failures. Separators are put up without reference to the volume of steam that is to pass through them. Separators have capacity as well as other machinery. Oil can be readily removed from some types of boilers by swabbing the sheets and tubes with a mop dipped in kerosene oil, with no open lights around the boiler. Boilers inaccessible for mopping can be boiled out with a large amount of caustic soda and kerosene oil pumped into the boilers, and a pressure of two-thirds the normal being maintained for 12 to 20 hours, when the sediment can be readily washed out.

Corrosion is still found in some types of boilers. Where the water is pure and the boilers are operated intermittently, corrosion is frequently found in the form of pitting. Banking the fires for a number of days and keeping the water in a nearly torpid condition, sometimes causes pitting. Once started, corrosion provides its own fuel unless checked. With pure water one of the best treatments is to keep the water alkaline with soda ash. It is important frequently to ream and keep free the openings in bolts drilled as a source of protection, for a solid residue often becomes baked in the bolt center.

Many of the minor diseases of boilers, as rapid loss of ductility and development of incipient fractures at different parts, as in the plain tubular boiler, at the girth seams, may be due to imperfect operation, varying water levels, and the introduction of cold water. The burning out of one fire in a battery, leaving the drafts full on, and the boiler connected with the rest of the battery under full pressure, is a severe strain on boilers, often causing leakage at stay bolts and seams and around the tubes of fire-box boilers.

Mr. Allen closed by a brief discussion of the superheated-steam question. The burden of his remarks was that cast-iron is not a suitable material to use in connection with superheated steam in boiler construction. He had seen some of the best makes of extra heavy valves with cast-iron bodies on superheated steam at high temperatures, that in a few months had become badly checked and marked, affecting the whole body of the valve. Soft-steel castings were substituted, with good results so far. Fittings or manifolds of cast-iron connecting superheaters with generators at over 100 deg. superheat should not be endorsed.

Mr. A. J. Campbell, manager of the New London Gas & Electric Company, read a paper entitled "Comments." He discussed his experience with a CO_2 recorder, which showed that when the instrument was properly and intelligently handled it would give accurate results. The stack draft in the plant is controlled by an automatic damper regulator, operated by steam pressure. After a series of tests, it was found that by leaving the furnace doors open and trying to produce poor conditions, the CO_2 average could only be reduced to about 8 per cent, while, on the other hand, the best results obtained averaged 10 and 11 per cent CO_2, indicating a loss up the stack of about 20 per cent. It is very possible that where the boiler conditions are very poor, the use of a CO_2 recorder will effect a great saving. If the CO_2 does not average over 5 per cent, the loss up the stack will be 40 per cent and over, and with a recording instrument for a guide, the CO_2 average should easily be brought up to 9 or 10 per cent, reducing the average loss to about 20 per cent. If the CO_2 average is already around 9 or 10 per cent, it is doubtful how much practical gain comes from the use of such an instrument.

METERS.

Mr. Campbell concluded by emphasizing the importance of keeping up meter records. It is essential to know how many meters have been purchased, where all meters are in use, stock lost, if any, repaired, etc. Mr. Sands, of Haverhill, described his system of keeping track of all meters by issuing orders for sets and removes in quadruplicate, and by making up a monthly meter statement covering the subject completely. Of the quadruplicate orders, a copy goes to the superintendent, cashier, meter department and meter setter. The orders are filed numerically, and by keeping an exact record in this way no meter is lost or allowed inadvertently to be loaned to a customer without the company's knowledge.

Meeting of A. I. E. E. Ithaca Section.

At the "education meeting" held Feb. 21, Dr. Steinmetz's paper on "Electrical Engineering Education" was read, and in the discussion students gave the results of their own experience in class work Following the formal part of the meeting, an informal smoker was held in the offices of the electrical engineering department, and an opportunity was thus afforded for the local members to become better acquainted, and to take up individual points, which could not be discussed in the meeting.

On March 6 a very profitable discussion followed the presentation of the following papers: "The Non-Synchronous Generator in Central-Station and Other Work," by Mr. W. K. Waters, abstracted by Mr. H. W Smith: "Some Developments in Synchronous Converters," by Mr Charles W. Stone abstracted by Mr. H L. Sharp: "Some Features of Railway

Converter Design and Operation," by Mr. J. E. Woodbridge, abstracted by Mr. E. J. McIlraith. These papers are being used as reference text in connection with the senior lectures in electrical engineering.

Alternators in Parallel.

A meeting of the Electrical Section of the Western Society of Engineers occurred Wednesday evening, March 11, at which a paper entitled "Alternators in Parallel" was read by Prof. Morgan Brooks, of the University of Illinois. Prof. Brooks opened his paper by stating that motor-generator operation and parallel operation of alternators are theoretically one and the same. When two synchronous machines are running in parallel and one machine falls the smallest fraction of a cycle behind the other in vector position, it necessarily receives power from the other machine in the same sense that a motor receives power from its generator. A normal vector difference for motor operation as compared with generators would be, perhaps, 10 electrical degrees. Alternators in parallel will oscillate through vector positions of perhaps 2 or 3 deg. or more when what is commonly known as hunting occurs.

Prof. Brooks showed a pair of bicycle wheels arranged on a stand to illustrate this hunting action. The wheels were mounted side by side and had weighted rims. An elastic band connected the two wheels in parallel so that they always maintained a nearly equivalent position. This illustrated the fact that two alternators are forced toward equality of phase position no matter which one leads the other, and also that such compulsory action exists actually to hold machines in stop.

Several charts were shown arranged with movable pointers by which readings of e.m.f. and current could be made from the chart. These charts illustrated the essential differences between parallel operation in the same station and in connection with long-distance transmission, and showed why a motor connected through transmission will fall out of step more easily than one connected to its generator in the same station.

The interesting feature of the evening was a demonstration of ordinary synchronization and Prof. Brooks's self-synchronization method. Through the courtesy of the Commonwealth Edison Company a synchronizer and ammeter at the lecture hall in the Monadnock Building were connected to the switchboard gallery at the Harrison Street station so that all the usual switchboard indications of phase difference and current could be read direct by the audience in the lecture room.

A 200-kw rotary converter was motor-driven and thrown in parallel with the station busbar. The first experiment was done as accurately as possible with no noticeable ammeter deflection. In the second experiment the motor-generator was switched in at perhaps 15 deg. out of phase, when a rush of current amounting to 2000 amperes was observed, representing a momentary overload of about 50 per cent. Then a reactance coil was connected between the 200-kw machine and the busbars, and synchronizing was done 30 deg., 90 deg. and 180 deg. out of phase, the maximum current being about 600 amperes at 180 deg. As a final exhibit, the motor was speeded up until a considerable difference in speed was attained, the synchronizer revolving too rapidly for proper switch closing. A paralleling switch was then thrown, and speed adjusted until the machine was running steadily. The coil actually used for this work consisted of 120 lb. of No. 0 copper wire wound on a reel just as it came from the storeroom.

In discussing the paper, several speakers spoke of the reduction of synchronizing difficulties to-day as compared with conditions of 10 years ago before the introduction of the synchronizing instruments. Mr. E. F. Smith, of the Commonwealth Edison Company, stated that damage due to synchronism was a negligible factor in their operation to-day, and that no trouble had arisen for many years. He suggested, however, that this method would doubtless serve for quicker synchronizing of frequency changers. In such a use reactance coils would be connected both in the motor and generator circuits, and both motor and generator switches closed at once. Mr. Abbott, also of the Commonwealth Edison Company, stated that a smaller size of wire could be used for synchronizing than in this case, and he believed that under favorable conditions ½ lb. of copper per kilowatt would be sufficient for such a coil.

Prof. Brooks closed the discussion by calling attention to the rather unexpected reactance of such small coils in this work, such a coil probably being cheaper than a reactance with an iron core. A considerable current overload might safely be carried, since the coil was in use for such a very short time. When the inductance depends on the magnetization of an iron core a large momentary rush of current may occur and the very purpose of the coil be thereby destroyed.

CURRENT NEWS AND NOTES.

MULTIPLE UNIT MOTOR CARS FOR N. Y., N. H. & H. R. R.—The New York, New Haven & Hartford R. R. has ordered from the Westinghouse company four multiple-unit, direct-alternating, single-phase motor cars to supplement its electric locomotive equipment.

AMERICAN ELECTROCHEMICAL SOCIETY.—A meeting of the New York section of the American Electrochemical Society will be held at the Chemists' Club on Friday evening, March 27, at which Dr. Clayton H. Sharp will deliver a lecture on "Electric Illumination with the New Arc and Incandescent Lamps." The annual meeting of the society will be held at Albany, N. Y., on April 30, May 1 and 2. One of the days of the meeting will be spent in Schenectady and another in Troy.

N. Y. ALUMNI ASSOCIATION OF GEORGIA INSTITUTE OF TECHNOLOGY.—A permanent organization has been effected with headquarters in New York City of the New York Alumni Association of the Georgia Institute of Technology. It is composed of those graduates of the above institution who live in or near New York City. During the last 12 years this institution has grown so rapidly in size and importance that the number of buildings occupied and amount of ground covered equal that of much older technical institutes elsewhere. This association will undoubtedly result in much good both to the alumni and to the college. The secretary of the New York Association is Mr. J. H. Williams, of 299 Broadway. The executive committee is composed of Messrs. C. E. Fairbanks, H. F. Jeter, F. C. Furlow, C. J. Merritt, H. L. Snowden, F. C. Morton and F. V. Stephens.

NEW YORK PUBLIC SERVICE LAW.—Messrs. Page and Wainwright have introduced in the New York Legislature a bill amending the Public Service Commissions law and adding thereto a new article relating to the regulation of telegraph and telephone companies. There are a large number of important changes in the bill. In article 4, relating to gas and electric corporations, a new section is inserted entitled "safe and adequate service; just and reasonable charges; unjust discrimination; unreasonable preference." Paragraph three of section 66 is changed, giving the commission power to prescribe by order, "the nature, class, kind, character and efficiency of the electric supply system, of the current supplied and of the lamps furnished," etc. In the portion in reference to gas, the word "distributed" is added so that in all cases the section reads "gas . . . manufactured, *distributed* or sold." In paragraph four, in regard to uniform accounting, the following is added: "Where the commission has prescribed the forms of accounts, records or memoranda to be kept by such persons, corporations and municipalities, it shall be unlawful for them to keep any other accounts, records or memoranda than those prescribed." Section 67, in regard to inspection of gas and electric meters, is changed by making the present law apply to gas meters only and adding paragraph three in regard to inspection of electric meters. A large number of corrections are made in the present bill and the duties of the commission are more clearly defined. The powers of the commission by the amendments proposed are considerably increased.

PUBLIC SERVICE HEARINGS MUST BE PUBLIC.—The Up-State New York Public Service Commission has denied an application made by a railway for a private hearing and has ruled that all hearings must be public.

PROF. ERNEST RUTHERFORD, formerly of McGill University and now professor of physics at Victoria University, Manchester, has been awarded a prize of 9,600 lire by the Turin Academy of Sciences for his researches in radioactivity.

KELVIN LECTURESHIP.—The first Kelvin lecturer in the foundation of the British Institution of Electrical Engineers will be Prof. S. P. Thompson, whose opening subject will be "Lord Kelvin: His Life and Works." The lecture will be delivered April 30 at the Institution of Civil Engineers, London.

MUNICIPAL PLANT FOR SALE OR LEASE.—The municipal electric-lighting plant of Spirit Lake, Iowa, is offered for sale or lease. The plant was presented to the town by the Stevens Steam & Electric Company, and began operation in 1900. The equipment consists of a 20-light arc machine and two 120-kw. 60-cycle alternators.

B. A. A. S.—Prof. J. J. Thomson has been nominated as president of the next meeting of the British Association for the Advancement of Science, which will be held at Winnipeg next year, Aug. 25 to Sept. 1. The Canadian Parliament will make an appropriation of $25,000 toward the expenses of the meeting, and the city of Winnepeg will contribute $5,000.

THE UNIVERSITY OF ILLINOIS ELECTRICAL SHOW.—The students in electrical engineering at the University of Illinois, Urbana, which last year held such a successful electrical show, have planned a similar undertaking for this year, March 26 to 28. The show is considered of value by the authorities because of the practical training it affords in organization, handling of men and producing results.

BONAPARTE SCIENCE FUND.—Prince Roland Bonaparte has donated a fund of $20,000 to the French Academy of Sciences, the annual proceeds of which are to be used to assist scientific investigators in researches. The deed of gift states that the allotments are not to be regarded as awards of merit, but as donations to assist in defraying the expenses of investigators who have already made their mark in original research.

ELECTRIC SHOCK RESTORES SIGHT.—According to a newspaper dispatch from Phillipsburg, N. J., a man named John Miller had the sight restored to one eye, blind for 30 years, by a shock from an electric wire. According to the account, when Miller recovered from the shock he saw a woman wearing a blue dress walking in the street. "By gracious, Schooley!" exclaimed Miller to his employer, "I see her with my bad eye."

STREET LIGHTING IN SCRANTON, PA.—During a recent visit to Scranton, Pa., Mr. Leslie M. Shaw, former Secretary of the Treasury, expressed the opinion that Scranton is the best lighted city in the United States. A local journal in commenting on this statement said that the new management of the American Gas & Electric Company has made it an object for merchants and manufacturers to use more electricity, and is doing a great deal to advertise Scranton.

TELEPHONES AND ORCHESTRA PITCH.—At a concert last week in New York given by the Boston Symphony Company, the telephone was utilized to maintain harmony in pitch and rhythm between the orchestra and trumpeters behind the stage. There was placed near the wall, so that the trumpets could catch through it every strain of the orchestral music, a telephone. Over the transmitter was fitted a large megaphone. By this means the trumpets were enabled to keep perfect pitch and rhythm with the orchestra.

VIOLATION OF THE METRIC SYSTEM.—The French Academy of Sciences has, according to a despatch from Paris, condemned the nickel five-sou piece, introduced five years ago, because it does not conform to the metric system. This coin won popular favor by slow degrees, chiefly because it is the price of a first-class fare on the Metropolitan Underground Railway. The Academy wishes to have it replaced by a four sou piece; that is, one of 20 centimes.

OHIO EXAMINATION OF ELECTRICIANS.—The bill introduced in the Ohio Legislature some time ago to provide for an examination of electricians has been amended in such a way as to substitute a chief electrical examiner, with district deputies, instead of a state commission, as was at first proposed. The salary of the chief is to be $3,000 a year, and that of the deputies $1,200. Annual licenses will cost $5, while the fee for renewals will be $3 for all wiremen, helpers, moving-picture operators, operators of theater switchboards and similar occupations. This bill has been recommended by the house committee on manufactures and commerce.

SWISS CENTRAL STATIONS.—A recent report gives the number of Swiss central stations on Jan. 1, 1907, as 559, an increase of 61 over the previous year. Of these 240 generate all of their current, 50 generate only a part, and 249 buy their current. The cost of installation was $212 per kilowatt for stations under 1000 kilowatts, $157 for stations between 1000 and 2000 kilowatts, and $136 for the largest station, which has a capacity of 15,900 kilowatts. Direct-current is supplied by 61 stations (25 per cent), alternating current by 155 stations (65 per cent), and both direct and alternating current by 24 stations (10 per cent). Ten stations supply current at voltages higher than 10,000, the voltage of four being 25,000. One station supplies direct-current at 25,000 volts.

ELECTRIC CARS AT GERMAN AUTOMOBILE EXPOSITION.—At the Berlin automobile and electric motor-boat exposition, Consul-General A. M. Thackara reports, electric cars were on exhibition for almost every purpose, from the luxuriously fitted touring car to the lightest delivery wagon. The new Edison storage battery was exhibited by a German company, and among the varied types of electric vehicles was one of the mixed system, that is, an electrically-driven car with a four-cylinder benzine motor to furnish the power for a dynamo generating the current. There were also several new types of electric sparking attachments. Many of the larger cars had the two ignitions, in which case magneto jump sparks and battery ignition, which can be worked independently, were used. Electric cars were exhibited which were guaranteed to run, at a moderate speed, a distance of 100 kilometers (62 miles) with a single charging of the batteries.

PAY-AS-YOU-ENTER CARS IN NEW YORK.—On Sunday, March 22, 155 new cars, of the pay-as you enter type, were put into service on the Madison and Lenox Avenue lines of the New York City Railway Company. Each car is 48 ft. long and has a capacity of 75 passengers—38 seated and 37 standing, no more than 75 being taken on. When a car is full a "Full Car" sign is displayed. The cars are equipped with four motors each, and the total cost of the new equipment is about $1,100,000. In addition to this $400,000 was expended in changes at curves and in the car house to accommodate these extra long cars. If the experiment meets with approval, other lines will be similarly equipped. General Manager Oren Root states that, so soon as the public has accustomed itself to entering and leaving the new cars, machines for collecting fares will be attached to the rails of the entering passageway. "This will leave the conductor," said Mr. Root, "entirely to the important task of starting and stopping the car, which means the elimination of many accidents. He will also make change."

NEW N. E. L. A. MEMBERS.—At the February monthly meeting of the N. E. L. A., 30 company and 24 individual members were elected.

FARMERS DEMAND LIGHT.—Action has been brought against the Peterson Heat, Light & Water Company, a Des Moines, Iowa, company, doing business in that city and Alden, to force it to furnish electric light to two or three farmers living along the 11,000-volt line between the two places.

PUBLIC POLICY COMMITTEE MEETING OF THE N. E. L. A.—On Tuesday, March 17, the Public Policy Committee of the National Electric Light Association held a meeting in the rooms at the association's headquarters in the Engineering Building, New York City. A report was formulated by the committee which will be submitted at the forthcoming convention in May.

"SOCIETY DAY" AT THE ELECTRICAL SHOW.—At a recent meeting of the directors of the Electrical Show, which will take place next October at the Madison Square Garden, Mr. Arthur Williams, of the New York Edison Company, was unanimously elected president, succeeding Mr. George F. Parker. It is planned to set aside a certain day during the show week, which will be called "Society Day." The admission charge on that day will be $1, and the receipts will be donated to some worthy charity.

SURGES AND OSCILLATIONS.—At a meeting of the New York Electrical Society, to be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, on Friday evening, March 27, Mr. Ernst J. Berg will present a paper entitled "Oscillations and Surges Affecting the Design of Systems for the Transmission of Electrical Energy." Among the points discussed will be the instantaneous abnormal voltages and currents due to energy stored electromagnetically and electrostatically; surges caused by grounds in transmission systems; surges due to arcing grounds; statics caused by grounds; abnormal voltages caused by triple frequency e.m.f. in transformers; corona effects.

A. S. M. E. APRIL MEETING.—The next monthly meeting of the American Society of Mechanical Engineers will be held in the auditorium of the Engineering Societies Building, New York, on the evening of April 14. The subject to be presented will be "The Conservation of Our Natural Resources," and the meeting will be addressed by four speakers who will consider forest preservation in its relation to water power, economy in the utilization of fuels, and the attitude of the engineer in regard to these. Dr. Henry S. Pritchett, president of the Carnegie Foundation, for the advancement of teaching, will be one of the speakers and will discuss the "Relation of the Engineer to the Body Politic."

TUNGSTEN LAMP IN TOPEKA.—In a current issue of the *N. E. L. A. Bulletin*, Mr. John T. Huntington states that the Topeka Edison company has taken up the large candle-power tungsten units to compete with the mantle gas lamp, and to replace enclosed arc lamps where their use produces bills beyond the means of the customer. He considers that the ideal method under which to furnish high candle-power tungsten lamps for the illumination of stores or large rooms is on a lamp-hour basis in connection with a timing device, which need be nothing more than a common clock mechanism arranged to start and stop by a magnet which is energized from the lamp circuit; this would be much cheaper and far simpler than any of the present forms of meters, and suitable for circuits in stores where all lamps are operated at the same time, and also adapted for use in residences as well, in which case a separate mechanism would be required in each lamp. His company is about to try the experiment of furnishing 100-watt tungsten lamps at a rental charge of 2 cents per day.

EFFECT OF NEW BRITISH PATENT LAW.—According to a consular report, German manufacturers are taking steps to establish plants in Great Britain in order to meet the commercial situation which the new British patent law has created. A large concern near Frankfort-on-the-Main, one of the greatest manufacturers of coal-tar colors and other chemicals (all of which are protected by patent rights) has already taken steps to procure a large tract of land near Ellesmere Point, England, on which it will forthwith have a branch factory built for the manufacture of the principal articles which it sells in Great Britain under protection of patents secured in that country. It is also reported that the great chemical color works at Elberfeld purpose to buy a tract of land in England and erect branch factories upon it so as to be able to hold in future the valuable trade in Great Britain.

ELECTRICAL DEVELOPMENTS IN ITALY.—Consul James E. Dunning, of Milan, Italy, reports that the Municipal Council of Milan has accepted the report of a commission in favor of the construction of a hydro-electric installation in the Alpine hills north of the city, which provides for a generating station of sufficient power to meet the probable demands for current, and has authorized the requisite outlay for the work. $2,546,640, to be raised by a loan guaranteed by the Council. A syndicate has been formed in Rome to provide a hydro-electric generating station at Treni, in Apulia, to produce current to work three railways, viz., from Treni to Corato, from Treni to Andria, from Fernandino to Trinitanople. The station will also supply current to surrounding towns. Steps have been taken for the building in North Italy of the Lake Garda line, to run from Riva di Trento, along Lake Garda, to Verona, 48¼ miles, electricity to be the motive power.

FIRST ELECTRIC ROAD FOR COLOMBIA.—On the steamer *Prince Eitel Frederich*, which sailed last Saturday from New York, was shipped the equipment of the first electric street-car road to be built in the republic of Colombia, S. A. The road will be constructed in Bogota, the capital, and will replace the mule-car lines now in use. The steamer will discharge at the port of Cartagena, and from there the railroad will transport the equipment for 15 miles, when the journey will be continued by water for 400 miles. A trip of 100 miles on mule-back, followed by a water trip and another mule-back journey, will finally bring the equipment to its destination. The cars used will be run by two 25-hp motors each and current will be generated in a power house belonging to the city. The road is not more than six miles in length and eight or nine cars will be used, but eventually the system will be much enlarged. The electrical part of the equipment was furnished by the Westinghouse Company.

LECTURES ON RAILROAD ELECTRIFICATION AT UNIVERSITY OF MICHIGAN.—Prof. C. L. de Muralt, professor of electrical engineering at the University of Michigan, is giving a course of lectures to the senior electrical engineering students at Ann Arbor on the "Electrification of Steam Railroads." Professor Muralt, who has been lecturing during the last semester on the underlying phases of this subject, such as the power-station equipment, transmission and working conductors, motor characteristics, etc., intends to supplement these by a discussion of the technical and commercial features of the following subjects: (1) The general electrification problem. (2) The reasons for electrification. (3) The operating characteristics of steam and electric locomotives. (4) The choice of electric systems. (5) An analysis of the cost of operation. (6) The field of railroad electrification: the congested terminal, the mountain grade and the trunk line. (7) Preparation of an electrification project for a particular road, special attention being directed to such problems as the design of locomotives, the calculation of run sheets, the choice of speeds, study of the peak load, the location of substations, the economics of transmission and other collateral topics.

Electrical Developments in Porto Rico.

SINCE the termination of Spanish rule on the island of Porto Rico, 10 years ago, the value of the exports has tripled, the area planted with tobacco has been more than quadrupled and everything has materially prospered under American administration. Among the important developments of recent date is the construction of an interurban railway for freight and passenger traffic between Caguas and San Juan and a water-power plant to generate electricity for operating the road and for supplying lamps and motors with energy in San Juan and vicinity. Caguas has not heretofore had railway connection with the seaboard, and all transportation of tobacco and other produce has been by means of native ox carts. The San Juan-Caguas railway is the first to penetrate the interior of the island and will be a part of the modern electric street railway system now serving San Juan and its suburbs.

The electrical development mentioned began with the organization, in 1906, of the Porto Rico Railways Company, Ltd., a corporation of Canadian interests with which Messrs. J. G. White & Co., of New York, are associated as engineers and constructors. In the Porto Rico Railways Company, Ltd., were merged the San Juan Light & Transit Company and the Porto Rico Power & Light Company. At the same time two subsidiary companies were formed; namely, the Comerio Water Power Company and the Caguas Tramway Company, the former to carry through the water-power project and the latter to build the railway. All of the electricity used in San Juan and vicinity for railway, light and power purposes was generated by the San Juan Light & Transit Company and by the Porto Rico Power & Light Company. Each of these companies operated a steam-driven power station, and the Porto Rico Railways Company, Ltd., will continue to operate one of these plants in conjunction with the hydro-electric station at Comerio Falls. The minimum flow of La Plata River is sufficient to permit the station to generate 1000 kilowatts and the average load that can be carried throughout the year is 1600 kilowatts.

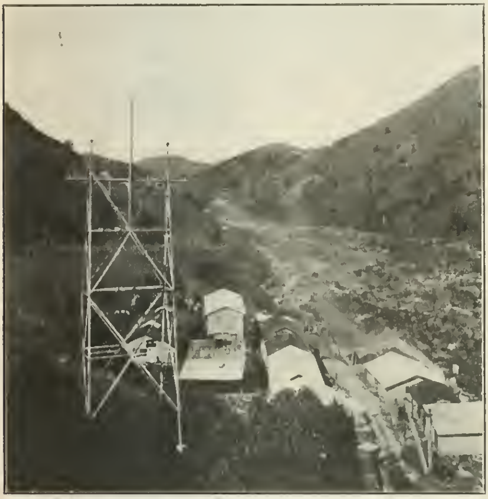


FIG. 1.—TRANSMISSION LINE, COMERIO FALLS AND SAN JUAN.

The power plant of the San Juan Light & Transit Company is located on a lagoon at San Turce on the road to Rio Piedras. The equipment comprises 1100 horse-power of Cahall and Babcock & Wilcox boilers; two simple automatic engines connected to two 225-kw. 2200-volt, two-phase, 60-cycle Westinghouse alternators, and another engine connected to a 250-kw. 550-volt, Bullock railway generator. There was until recently also a 200-kw railway unit; but this has been replaced by a 500-kw, 2200-volt, two phase, Westinghouse steam turbine unit. The condensing apparatus consists of a Wheeler surface condenser for the older engines and a Worthington barometric condenser for the turbine. Bituminous West Virginia coal costing about $5.50 per ton is unloaded from boats at San Juan and hauled in the company's own cars to the power plant at San Turce. Sea water is used for condensing purposes; the simple engines operating on a vacuum of about 10 in. to 12 in. and the turbine operating with a vacuum of 27 in. In a substation adjoining the power house are installed two 300-kw. synchronous-motor generator sets and eight 200-kw water cooled transformers for stepping down the voltage from 20,000 volts, three phase to 2300 volts, two-phase. The high-tension current is brought from the hydro-electric station at Comerio Falls. The motor-generators supply the energy for the railway lines. The power plant furnishes part of the energy used for lighting and power in San Juan and vicinity, the remainder being generated in the plant of the Porto Rico Power & Light Company.

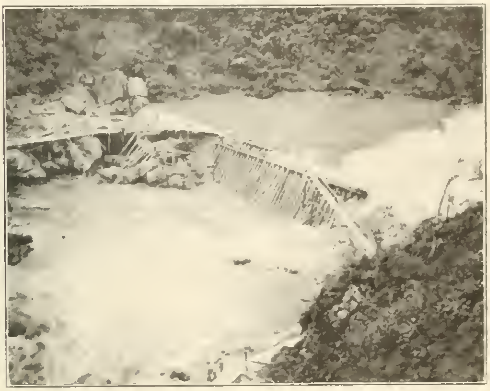


FIG. 2.—COMERIO DAM, TWO SLUICES RUNNING FULL.

The power plant of the Porto Rico Power & Light Company supplies the 2200 volt, single phase current in San Juan and also energy for a three-wire, direct-current system. This company has the contract for the street lighting of San Juan, the lighting equipment consisting of direct-current, multiple arc lamps. The power-plant equipment comprises 470 horse-power of tubular and water-tube boilers, two tandem-compound and one simple automatic engine from which are belt-driven a total

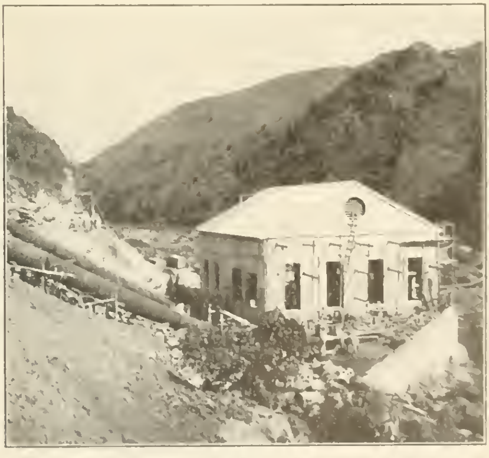


FIG. 3.—PENSTOCK AND POWER HOUSE AT COMERIO FALLS

of 400 kilowatts of direct-current apparatus and one 75-kw, single-phase alternator. The station is near the water front in the central part of the city and supplies most of the energy for commercial circuits and the greater part of the lighting in the central part of San Juan.

The hydro-electric plant of the Comerio Power Company, which will supply the bulk of the energy for railway and lighting purposes in the remodeled system, is situated at Comerio Falls on La Plata River, one of the largest streams on the island. The station is about 20 miles from San Juan and 12 miles from Caguas. The rating of the water-wheels installed is 3000 horse-power and the available head of water is 180 ft. A dam located at the head of the falls deflects the water through a long tunnel and two penstocks to the power house proper located in the gorge below. The dam, which is of concrete, is approximately 40 ft. high and 300 ft. long. The entrance to the tunnel is through steel head gates set in concrete at the west end of the dam. The tunnel is horseshoe shaped, concrete lined, has a sectional area of 30 sq. ft. and is 2600 ft. long. A reservoir, formed by a concrete dam 28 ft. high, receives the water as it emerges from the tunnel. The penstocks pass from the base of the reservoir to the power house, the slope being one in two. The penstocks are 54 in. in diameter and 500 ft. long. They are constructed of tank steel varying in thickness from ¼ in. to ⅜ in. supported and anchored in concrete piers. The main gates at the upper ends of the penstocks are 60 in. in diameter and are provided with bronze facings and seatings with ball-bearing stands.

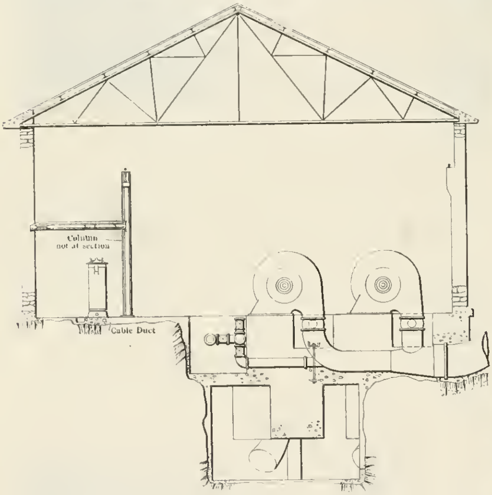


FIG. 4.—CROSS-SECTION OF POWER HOUSE AT COMERIO FALLS.

The power house is constructed of cement-coated rubble masonry, and its sub-structure is built into solid rock. The hydraulic equipment consists of four horizontal wheels of the Francis inflow type built by the I. P. Morris Company, of Philadelphia. Each wheel is rated at 750 horse-power and has a speed of 450 r.p.m. under a 175-ft. head. Two turbines are arranged on each penstock and they discharge vertically into the tail pit through conical draft tubes. The turbines are equipped with Lombard governors.

The main electrical equipment consists of four 400-kw units direct-connected to the water-wheels. The size of the units was selected with reference to the varying demand for energy for operating the railway and commercial load during the day and the full lighting and railway load at night. Three-phase, 60-cycle current is generated at a potential of 2300 volts, the potential being stepped up to 20,000 volts by six 300-kw, oil-insulated, water-cooled transformers. There are also two 40-kw exciter generators driven by Pelton water-wheels rated at 64 horse-power and running at a speed of 450 r.p.m. The plant was erected under difficulties. The nearest government road being 4 miles from the station, machinery, etc., had to be hauled by carts over the steep grades and through streams.

The transmission line to the substation at San Turce is one of the most interesting features of the system. Duplicate lines of No. 4 copper wire are carried on structural steel transmission towers at a height of 40 ft. The wires are spaced 60 in. apart and a wire is carried above the transmission circuits as shown and grounded at every fourth tower as a protection against lightning. A private telephone circuit is also installed on the towers. The latter are very heavily galvanized and are spaced 12 to the mile. The transmission line follows the river part of the way, branching thence in a direct line across country to San Juan.

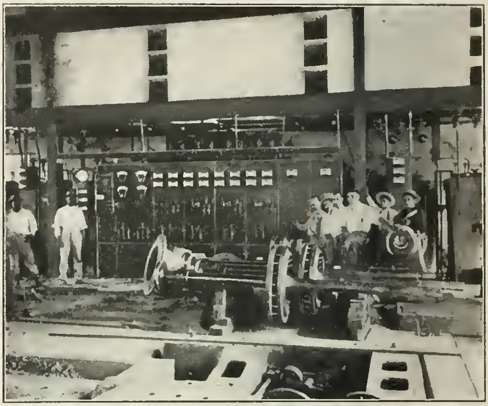


FIG. 5.—INTERIOR OF POWER HOUSE.

The distribution system in San Juan is unlike that found in the average American city owing to the peculiar lay-out of the city. Like those in many Spanish cities, the streets are extremely narrow so that the lines are of necessity run over the house tops. A 60-cycle, 2200-volt, single-phase line is carried on the poles of the street railway from San Turce to the city and in the city proper runs over the house tops on bracket construction. Consumers have been grouped on secondaries so that the transformers connected to the lines are fairly large and the core losses therefore moderate. A circuit is also run from San Turce to Rio Piedras.

FIG. 6.—LOWER FACE OF DAM, LOOKING EAST.

The direct-current lines of the Porto Rico Power & Light Company are always alive, and there is a single-phase circuit sively used. When the dimension a of the core, and the outside dimension B, of a square-core electromagnet, are fixed, its economy may be considerably increased by rounding the corners of the core, as in Fig. 3.

It will be seen that by increasing the value of r from 0 to 0.5a, the square core, by gradual transition, becomes perfectly round, a remaining constant. It is, therefore, obvious that for various ratios of T and a, the core and winding for maximum economy will fall somewhere between the square core and the round core.

In Fig. 6 is shown the ratios of $\frac{A}{P_a}$ for flux density, and $\frac{A^2}{P_a}$ for the total flux, when $\frac{T}{a} = 0$. Fig. 7 shows the relations when $\frac{T}{a} = 2$. The maximum values for $\mathcal{B}$ and ϕ are shown in Fig. 8. The values of μ, E, l and ρ, as before stated, are assumed to be constant. The dimension a is also assumed to remain constant, while the values of r and T are variable. This shows the ratios of the various average perimeters and core areas, taking the cross-sectional area of the square core as unity for the core areas, and the average perimeter of the square-core winding as unity for the average perimeters.

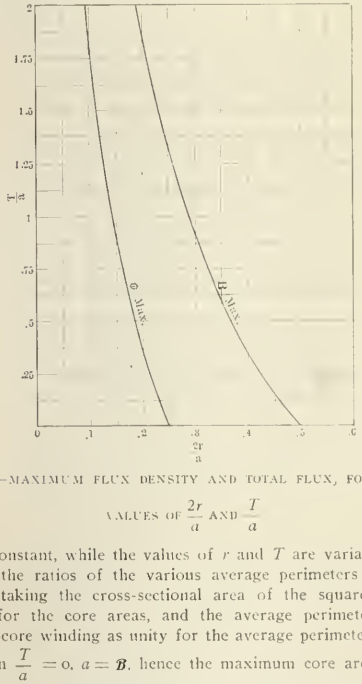


FIG. 9.—MAXIMUM FLUX DENSITY AND TOTAL FLUX, FOR VARIOUS VALUES OF $\frac{2r}{a}$ AND $\frac{T}{a}$

When $\frac{T}{a} = 0$, $a = \mathcal{B}$, hence the maximum core area will be obtained with the square core. The round-core winding, however, has the minimum average perimeter; and as the ratio between core area and average perimeter is the same, the value of $\frac{2r}{a}$ which will produce the maximum flux density will be found to be 0.5. The condition which shall produce the maximum flux is met when $\frac{2r}{a} = 0.25$.

The proper value of $\frac{2r}{a}$ to produce maximum results for practical windings will be found at the points where the flux density, or the total flux curves, intersect with the average perimeter curves. This relation is shown more clearly in Fig. 9.

The usual insulation between the core and the winding has not been considered. However, the average perimeter of the winding may be compared with the total cross-sectional area of the core, plus the insulating medium, and corrections made for the difference between the actual and assumed core areas. In any case, it is important that the average perimeter shall be calculated for the actual winding only.

Minneapolis Light and Power Rates.

During the recent controversy over the question of electric light and power rates to be charged by the Minneapolis General Electric Company under its new franchise, a report was made by Mr. Charles L. Pillsbury, a consulting engineer of that city, in behalf of citizens who were anxious to get at the true status of the matter before rates were agreed upon. Mr. Pillsbury's report, entitled "Rates and Methods of Charge for Electric Light and Power as Applying to the Minneapolis General Electric Company," has been printed and forms a very comprehensive document on the subject of equitable rates, and in view of the increasing interest being shown in electric lighting rates the country over, it is of timely value, through clearly setting forth sound theories on the rate question and exploding some of the popular misconceptions which, as was the case at Minneapolis, have given rise to very ill-advised legislation. The original franchise offered to the Minneapolis General Electric Company required a uniform rate of 8 cents per kw-hour to all consumers, with discounts according to quantity only. The unfairness of this system both to consumers and public is well brought out in the report. Incidentally it may be said that Mr. Pillsbury's report is in accordance with the findings of probably every board of experts which has passed upon the rate question for the past 10 years.

The report first takes up the elements entering into the costs of production and distribution of electricity and brings out the large plant capacity required and the small number of hours per year that this is in use. The excessive plant capacity required is illustrated by the published statement of the Edison Electric Illuminating Company of Boston to the Massachusetts Board of Electric Light Commissioners, to the effect that during the year 1906 one half of the plant did approximately 97 per cent of the work; the other half being required to do the 3 per cent of business which came at the time when the greatest number of lights are called for during the winter season. Now since the fixed charges constitute a large percentage of the total cost of production and distribution, it is evident that the total costs per unit of output will decrease rapidly as the output of any given plant is increased by longer hours of average use of electricity. To illustrate this principle, the report presents an example of a small high-grade steam-driven plant of a capacity of 400 kilowatts located in a small city and provided with a fully equipped overhead distribution system. The cost of the plant is assumed to be $100,000 or $250 per kilowatt of plant capacity. This report then gives the fixed expenses not proportional to the output as follows:

Depreciation, 5 per cent	$5,000
Taxes and fire and liability insurance 2 per cent	2,000
Salaries, legal expenses and fixed labor	8,000
Other fixed expenses	1,000
Total fixed expenses	$16,000

The plant, if worked at full load every hour in the year, would generate 3,504,000 kw-hours. Dividing this into the fixed expenses of $16,000 would make the fixed charge 0.456 cent per kw-hour. Assuming that the variable expenses proportional to output, such as fuel, variable labor, variable maintenance, etc., are 2 cents per kw-hour, the expense of output generated 24 hours per day would be 2.456 cents per kw hour. If, on the other hand, the total yearly output should only be equivalent to one hour's average daily use of the plant and corresponding to a yearly load factor of 4.17 per cent, the fixed expenses, not including interest or dividends on investment, would be 10.958 cents per kw-hour, and the total expenses 12.958 cents. If only one half hour's use is made of the station per day, the fixed expenses are 21.84 cents per kw hour. He then shows the great difference between the cost of production and distribution to different consumers as figured on this basis and the uniform rate per kw-hour to all consumers without regard to hours' use per year, which was proposed by the first ordinance. The argument is frequently put forth that in a plant having many customers, their demands do not coincide. It is evident that as regards lighting many do coincide Statistics show that the station-lighting demand represents about one-third of the sum of the customers' lighting demands. These facts indicate clearly that so far as cost to the company is concerned, the load factor (or the ratio of the average to the maximum load) is of tremendous importance; and if customers are to be billed in proportion to the costs of the service rendered, the customers' load factor must be taken into account in fixing the rates.

The report then takes up the question of whether rates closely following the costs to the central-station company would enable the company to meet competition with private plants. Obviously, no rates should be adopted which would tend to prevent a company from taking on all such business as it can at a profit. Such business tends to swell the total volume and to decrease the average costs, and therefore the average rates to all consumers. A system of rates which would prevent the company from taking on any of such profitable business or which would compel the company to give secret special rates differing from the schedule in order to obtain it, would be pernicious in the extreme. After analysis Mr. Pillsbury finds that the rates properly based on the customer's demand or load factor not only follow the line of cost to the company, but also the line of costs of competitive isolated plant service.

He then shows that power rates can justly be made lower than lighting rates. The difference between the station power demand and the sum of the consumers' power demands is much greater than in the case of lighting. Further, there are lamp renewals and the necessity of high-grade voltage regulation. An equitable system of rates should take into account the load factors of the customers, the lower cost of service for power, and the slightly lower cost of service for large quantities.

The report presents a synopsis of the rates charged in 33 American cities. A careful analysis shows that fundamentally but five systems are represented, namely:

1. Uniform meter rate per kw-hour.
2. Uniform meter rate with step system of discounts varying with quantity used.
3. Uniform meter rate with block system of discounts varying with quantity used.
4. Readiness-to-serve method.
5. Maximum-demand system.

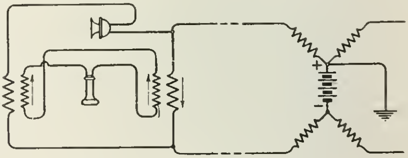
The first he considers so utterly impracticable as to be unworthy of any consideration. The second is not based on scientific analysis of cost of production, cannot result in a uniform percentage of profit and represents only arbitrary sale values. This system is rapidly going out of use. The block system of discounts, where reduced rates apply to certain consumption in excess of that used at the higher rate, is commercially more desirable than the step system, but unduly discriminates in favor of large consumers. The readiness-to-serve system is probably scientifically correct, but imposes a rather heavy minimum charge and high rate to very short-hour users of current. The maximum-demand system is used in 14 of the cities listed. It usually consists of two meter rates, a higher or primary rate, applying to all consumption up to an amount equivalent to certain stated average daily hours' use of the maximum current, and a lower rate applying to all excess consumption. The consumer does not get the benefit of the lower rate until he has taken sufficient current at the higher rate to reimburse the company for the use of that proportion of its total capacity reserved for him. Mr. Pillsbury favors this system. Practically the only valid objections to the demand system are difficulty in getting the public to understand the rate and method of computation, and chance for error in determining the demand for which the rate is to apply.

The report then takes up the plants of the Minneapolis General Electric Company. The 10,000-kw water-power station at Taylor's Falls is not yet on a paying basis. Mr. Pillsbury estimates that for the coming year the expenses independent of output will amount to 60 per cent of the total, those proportional to output being 40 per cent. He recommended that the lighting rates proposed by the company for the first year of its new franchise be adopted, these being 10 cents for the first 52 hours' use of the equivalent of the customer's maximum demand, and 6 cents for current used in excess of that. As noted in these columns in the issue of March 7, the committee of the Council and the company came to an agreement Feb. 25 on the rates to be charged for the first year of the company's franchise. These rates, with the prompt payment discounts taken off, are as follows: Residence lighting, 9 cents per kw-hour for the first 52 hours' use per month of 40 per cent of the installation, and 6⅔ cents per kw-hour for all current in excess. Commercial lighting, 9 cents per kw-hour for the first 52 hours' use per month of the customer's maximum demand, and 6⅔ cents for all current used in excess. The customer's demand is to be determined by monthly demand meter readings. Retail power, 7½ cents per kw-hour for the first 52 hours' use per month of the customer's maximum demand, and 2½ cents per kw-hour for all current used in excess, the customer's demand in all cases to be determined by meter readings. The minimum rates are $1 per month per meter for lighting customers and $1 per horse-power per month on the rated capacity of a customer's installation for power. The above rates do not include lamp renewals or maintenance. There are quantity discounts of from 5 to 25 per cent on bills ranging from $50 to $250 per month.

New Telephone Patents.

"AUTO-SIDE TONE" CIRCUIT.

The telephone is now so familiar to all that many of the peculiarities of its operation for a long time known only to the telephone fraternity are now recognized generally. In this category may well be included "side tone" or that excitation of a receiver coincident with the use of its own associated transmitter. This side tone has long been of use to telephone troublemen, its volume affording a fair indication of the condition of the telephone set or even, under certain circumstances, of the condition of the line and the distance to its faults. On the other hand, as the service demands in long-distance work have gradually grown, this side tone has proved detrimental. The reason lies in the comparatively great volume of the side tone as compared to the volume received from the distant end. For a considerable time there have been in service side-tone reduction sets of more or less efficiency. A new arrangement has now been patented by Professor Morgan Brooks, of Champaign, Ill. He has devised several plans for different systems, but for illustration that shown below will suffice. This is a common-battery system. It will be noted that two induction coils are required. These are so poled that when currents are generated due to the action of the transmitter, these currents will neutralize each other in the local receiver circuit. For example, suppose current flowing in the primaries as indicated by the arrows, and assume the transmitter resistance increased suddenly. There will at once be a diminution in the current in one primary and there will be an increase in that in the other. These changes must produce approximately neutralizing currents in the secondaries. For incoming currents the primaries, of course, work together, as they are in parallel.



BROOKS "AUTO-SIDE TONE" CIRCUIT.

STATION CIRCUIT.

When two coils are wound together, the wires lying in close proximity for a considerable part of their length, the result is a very fair condenser, the two windings serving as the plates. When these windings are those of a telephone, this telephone will respond to currents from a circuit connected to the two windings, provided that the charges flowing into windings have a cumulative inductive effect in the coils. Messrs. C. M. Jacobs, of Reading, England, and W. J. Thorrowgood, of Wimbledon

Park, England, have recently patented circuits employing such instruments. In these circuits the receiver is in parallel with the induction coil secondary, which latter is included in the single-wire line, such as a telegraph line. The receiver may have a condenser in series with it with a leg to ground connected between this condenser and the receiver. It is found by the inventors that telegraph currents normally passing in the line are most inefficient in their effects upon a phonophore receiver, and therefore the telegraph currents can be tolerated while the telephones are in use.

Letters to the Editors.

Looping vs. Cutting Theories of Electromagnetic Induction.

To the Editors of Electrical World:

Sirs:—Concerning your comments on page 543 in your issue of March 14, 1908, under the heading "Looping Versus Cutting Theories of Electromagnetic Induction" you seem to cast some doubt upon the sufficiency of the cutting conception when it is applied to "closed or nearly closed magnetic circuits." In reality, there is no trouble with the conception, even in this case, if properly applied. Of course, the conception itself is merely a symbol or representation of something which occurs and which conception or symbol involves the idea of Faraday of magnetic lines cut by conductors; lines which tend to shorten themselves, and which are mutually repellant laterally. It was for the purpose of showing the sufficiency of the line-cutting conception that I wrote a paper on "Magnetism in Its Relation to Induced E.M.F and Current," which was read before the American Institute of Electrical Engineers at the meeting of May 22, 1889, and which, of course, appeared in the *Transactions later.* It was also published in the Electrical World dated July 1, 1889. To this paper I would refer anyone who has felt that the line-cutting idea is insufficient for all cases of magneto-electric induction.

West Lynn, Mass. Elihu Thomson.

To the Editors of Electrical World:

Sirs:—As I understand Mr. Hering's drawing and statements in his article in your issue of March 14, he considers that the current flows from brush to brush in a confined direct line, and that the magnetic flux is projected perpendicularly through the copper strip *C* at a point directly in line with the two brushes *B B* across the proposed line of current. Now, if I am right as to this understanding, I wish to state my views in the matter.

When the two brushes contact, as shown, at the two opposite edges of the strip and midway of the strip's length, the current from brush to brush would *not* confine itself to the assumed path, but would, instead, travel the entire length of the strip for the width of its path; it could, so to speak, be likened unto a multitude of filaments of divided current branching at the brushes, spreading and coupling across the strip. When the strip is moved endwise these spread-out paths of current still exist, notwithstanding that the contact-position of the brushes are shifting along the strip. Now, in view of the width of current-path being greater than the width of the flux-path, there is effected a changing of current interlinkage with the flux as the strip is moved along between the brushes and across the position of the magnet.

As to preference for the cutting or the interlinking-stress hypothesis, I prefer the latter as affording the better concept as to what happens mechanically, because, if we will consider a number of loosely bunched conductors carrying one-way current, there is developed around this bunch a magnetic girth that draws these current-bearing wires together into a more compact mass, apparently in consequence of the tendency for this encompassing magnetic path to shorten by its pronounced tension.

I would suggest considering this contractile feature also in connection with Mr. Hering's "pinch" phenomena announced in your pages some time ago.

In an old number of *Blackwood's Magazine* the corelation of current to magnetism was expressed in the following terms:

Around the magnet, Faraday
Is sure that Volta's lightnings play;
  But how to draw them from the wire?
He took a lesson from the heart—
'Tis when we meet, 'tis when we part,
  Breaks forth the electric fire.

This verse would indicate Faraday as advocating the linkage-stress idea. It does really seem as though current and flux mutually avoid tenanting the same place, although each endeavored to embrace the other.

Philadelphia, Pa. H. C. Heckendorn.

To the Editors of Electrical World:

Sirs:—In the article by Mr. Carl Hering, in your issue of March 14, Maxwell is quoted as follows:

On page 559 at the bottom of the first column: "The whole of these phenomena may be summed up in one law. When the number of lines of magnetic induction which pass through the secondary circuit in the positive direction is altered, an e.m.f. acts round the circuit, which is measured by the rate of decrease of the magnetic induction through the circuit": and in order that Maxwell may not have to bear the brunt of the attack alone J. J. Thomson is also quoted in words to the same effect.

Now I think I am right in maintaining not only that this rule, *precisely as it is stated* by these two authorities, is exactly correct, but also that it is universally applicable to problems involving induced e.m.f. The argument of Mr. Hering to the contrary falls to the ground for the following reasons: First, he uses the word "circuit" in a way different from that in which it is used in the looping rule, for he considers that a portion of a loop (his term "open circuit" must surely, in its simplest form, mean a portion of a loop) may be called a circuit. Now the law he is discussing speaks of tubes of induction "which pass through the circuit," and unless the word circuit be taken to mean a complete loop, the expression "passing through the circuit" has no definite meaning. The term "open circuit" is a term commonly used, but I think that strictly speaking we have no experience of any such thing as an "open circuit." In the way in which it is commonly used the term "open circuit" means a circuit one section of which possesses a very high resistance and (usually) a very small capacity. When applied to such a circuit as this the looping rule is quite satisfactory. The rule is, as is obvious from the form of its statement, only applicable to complete circuits and not to portions of circuits. A little thought always enables it to be applied to some circuit the e.m.f. induced in which will be due entirely to any particular portion it may be necessary to consider, and in this way the e.m.f. due to that "portion" may be determined.

Mr. Hering next considers that a circuit, one section of which is being constantly replaced by a new section, can be looked upon as always one and the same circuit. In the figure on page 559 the section represented by the dotted line is, during movement of the strip, continually being renewed. Had he taken account of this fact, I think Mr. Hering would have seen that there is indeed a *rate of change of the flux passing through each instantaneous circuit.*

The experiment spoken of in the middle paragraph of the second column of page 550 consists essentially in taking a C-shaped conductor, a copper plate and a round bar-magnet. The copper plate is glued on to the flat end of the magnet and this copper-plated bar-magnet is then passed between the horns of the C-shaped conductor. It "may not be generally known," says the author, "that there will not be any induction whatsoever." And yet to some of us it would seem to require a very wild imagination to think that there possibly could be any induction; for both the looping and the cutting rules at once show that there is none.

In closing Mr. Hering says: "It cannot be disputed that the loop or linking law *does not* instruct us what the result in that experiment will be." To my mind, however, it most certainly can be disputed, for the linking law predicts the result of the experiment in precisely as clear a way as does the cutting law.

In the editorial commenting on Mr. Hering's article, when speaking of the e.m.f. induced in the bars of a direct-current machine with slotted armature core, doubt is cast upon the possibility of arriving at a result by the cutting rule. Now when a conductor sweeps over a pole face it is obvious that it must cut through all the lines of force that emanate from that pole face. And that this must be so no matter what antics the lines of force may go through in attempting to avoid being cut. It is, of course, true that the density of the lines within the slots is much less than that in the teeth. The fact, however, has been neglected that the speed of cutting of the flux is greater in a slotted than in a smooth-cored armature. In the case of a smooth-cored armature the flux may be regarded as stationary while the bars move, but in the case of a slotted core *both flux and bars are in motion.* Underneath any given point on the pole face there exists at one moment a tooth and at the next moment a slot. The tooth demands a high density, while the slot demands a low density. Hence the density at the point of the pole face considered is changing. The lines must therefore be regarded as in motion relatively to the pole face.

In the last paragraph of the editorial on page 543 it seems to be implied that the cutting conception of induced e.m.f. applies only to conductors. Now it is easily shown that the magnitude of the e.m.f. produced when a conductor cuts lines of force is independent of the resistance of that conductor, and there seems to me to be no reason to think that the e.m.f. would not still be the same even if the thing cutting the lines of force had an infinitely high resistance and were therefore what is called a non-conductor.

As regards the e.m.f. induced in the coils of a transformer, I personally have always found that the cutting rule serves to give to a student an excellent physical conception of what takes place, and I am a loss to know how the method can be held to fail.

In conclusion I should like to say that I quite agree with Mr. Hering in considering that it is generally better to emphasize the cutting rather than the looping rule, although the one is the precise equivalent of the other. The first involves a "rate of cutting," the conception of which seems to be easy to a student, while the other involves a "rate of change," and this seems to be a conception that is by no means so easy. Especially does it seem difficult for a student to realize that a quantity whose value is *naught* may nevertheless have a rate of change whose value is not naught.

Pittsburg, Pa. Frank M. Denton.

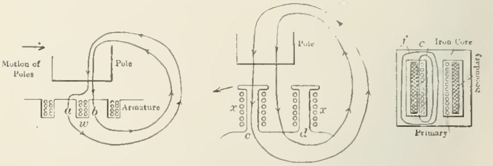
To the Editors of Electrical World:

Sirs:—In the editorial comments on the article by Mr. Carl Hering in the issue of March 14, the statement is made that in machines in which the conductors are embedded in the iron, such as tooth armatures and transformers, the "cutting theory" does not hold, and we are forced to the "link" hypothesis.

It seems to me that the cutting theory holds absolutely for these cases, as well as it does for the cases mentioned by Mr. Hering, provided one keeps in mind the fundamental conception of a "line of force" as expressed by Faraday, namely, that it is always a *closed circuit* or *loop*.

With this exception in mind, and referring to Fig. 1, one can readily see that in order for a line of force to get from the position *a* to the position *b*, it must cut the embedded wires *w* if the loop continues intact. Referring to Fig. 2, which shows a pole-type of armature, in order for the pole *d* to take the place of the pole *c*, it is necessary for the wires *x* to cut into and out of the line of force. The same argument holds for transformers. It is clearly evident in Fig. 3 that in order for a line of force to move from position *c* to position *f*, it must cut the conductors if the line of force remains a closed loop.

With this conception of a line of force in mind, it may be stated that it makes no difference where the conductors are located, whether in free space on the surface of some magnetic material or totally embedded in magnetic material, provided that in our calculations we take the actual number of lines of force which *cut* the conductors.



FIGS. 1, 2 AND 3.—LOOPING VS. CUTTING THEORIES OF ELECTROMAGNETIC INDUCTION.

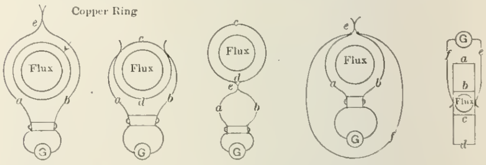
Wilkinsburg, Pa. A. B. Reynders.

To the Editors of Electrical World:

Sirs:—While I do not feel myself qualified to enter with Mr. Hering into a discussion as to whether Maxwell's or Faraday's interpretation of the law of magnetic induction is the more general, I do wish to question what Mr. Hering has proved by means of his "crucial" experiment, described in the March number of the *Proceedings* of the A. I. E. E. and to which he refers in his article in your issue dated March 14. I have tried to analyze what the experiment accomplishes; whether or not, by such means as he describes, we can actually link or unlink a circuit with some magnetic lines, and yet have no e.m.f. induced in that circuit.

I consider that phase of his experiment wherein he has a circuit made up of two springs, some wire and a galvanometer, already linked in the field of an excited solenoid, around which solenoid is placed a copper ring. From Fig. 1 we see that the circuit which is going to be manipulated. consists of two springs, *a* and *b*, their point of contact *e*, and the wire connecting the springs to the galvanometer, together with the galvanometer itself. We will see what happens when this circuit is unlinked from the magnetic field.

Suppose that the operation has been partially completed, and we have the circuit as shown in Fig. 2. The original circuit has now had introduced into it another part, the copper ring, which part consists of two paths in parallel; one path *c*, combined with the original circuit, still encloses the flux, but that circuit consisting of the original one and the path *d*, through the ring, *does not* enclose any flux; and here is where the fallacy of Mr. Hering's argument appears to lie. By means of the path *d* we have short-circuited that part of the original circuit which encloses the flux.



FIGS. 1, 2, 3, 4 AND 5.—LOOPING VS. CUTTING THEORIES OF ELECTROMAGNETIC INDUCTION.

Following the operation still further, we see that the last step gives us three paths in parallel, as shown in Fig. 3. Two paths, *d* and *c*, exist through the ring and a third through the point *e*, where the two springs come in contact. When the springs are further removed, that path *c*, which is necessary to form a circuit still enclosing the flux, is cut off altogether from our original circuit. That no current would be forced through the galvanometer during this operation could have been safely predicted, and the labor of performing the experiment saved.

The writer wishes to suggest to Mr. Hering that if he wishes to perform the experiment again, a simple way of doing it would be to attach a wire, *f*, to the springs as indicated, then open the springs, draw them over the solenoid, let them come together again, and remove the wire. This accomplishes exactly the same thing as his experiment, and proves the same thing with regard to the question he is considering—nothing.

Referring to the figure given in connection with his article, we see that the same fallacy exists here as in the experiment just considered. The copper plate used, forming part of the circuit of the galvanometer, might be made up, for simplicity, of four wires, *a*, *b*, *c* and *d*, connected together at their ends. We can now readily see that it is impossible to say that the flux is linked with the galvanometer circuit or the reverse. The word circuit now is ambiguous; does the galvanometer circuit now consist of *e*, *d*, *f*, or *c*, *a*, *f*? In the former case, the flux is already linking the circuit, while in the latter, it does not. If we should now increase the number of wires, *a*, *b*, *c*, *d*, indefinitely, we would have the equivalent of the copper plate. We can only say that the flux is linked with the galvanometer circuit when it is included in the circuit *G*, *e*, *a*, *f*, and that the flux does not link the galvanometer circuit when it is outside the circuit *G e d f*.

Pratt Institute, Brooklyn. J. H. Morecroft.

To the Editors of Electrical World:

Sirs:—In your issue of March 14 you refer to the method of expressing Faraday's law of induction, and show that as applied to Hering's experiment, Faraday's statement is correct. This is undoubtedly the true statement of the law, and the method of counting the number of lines of induction enclosed by the coil at the beginning and end of the time is simply a convenient but not very illuminating method, for finding the number of lines that have cut the circuit. When anyone can devise a method, as Mr. Hering has done, for getting the lines out from the circuit without cutting the conductor, the method fails. It is well to emphasize the fact that it is the cutting that produces the e.m.f. as Mr. Hering has done.

As to the iron-clad armature, there is no serious difficulty. The wires are in a weak field, and, therefore, do not feel a great pull, but in the motion of the armature, all the lines that are surrounded by the wire are pulled out of that connection, collapsing quickly by virtue of their own elasticity as soon as they leave the iron. It will be evident that they must all cut the wires when it is remembered that they never have any free ends and cannot get out of their surrounding coil without cutting it—unless one should use some device similar to that of Mr. Hering.

Again as to the disturbances in the air, the same e.m.f. is set up in a string as in a copper wire, and as much e.m.f. is exerted on the air surrounding lines of induction as in one turn of copper wire. In the air, however, only a convection current is produced, unless, as in the upper atmosphere, the air itself is a conductor. But in the displacement currents, which constitute light waves, there seems to be no reason why the currents and lines of induction should not be linked together just as they are in the armature of a dynamo. Maxwell's theory assumes such linking, though the mental conceptions may not be as easy to form in this case as in that of the dynamo.

University of Tennessee. Chas. A. Perkins.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Direct-Current Turbo-Generators.—W. Hoult.—The usual methods for obtaining a fixed brush position in direct-current turbo-generators are either by means of compensating windings, or by commutation poles, or by a combination of both these methods. With compensating windings alone, sparking due to distortion is prevented, but that due to the current reversal in the short-circuited coil is left, to overcome which either the brushes are given a lead or the machine is overcompensated. By using commutation poles, a magnetic field is obtained so as to produce in the coil undergoing short-circuit by the brush, an e.m.f. acting in opposition to its reactance voltage. The main drawbacks of machines fitted with commutation poles alone is that the main field is distorted by the armature reaction, so that the maximum voltage per segment is considerably increased on approaching full load, thus giving a greater tendency for "flashing over" with dust on the commutator. Absolutely sparkless commutation can be obtained from no-load to large overloads without any movement of the brushes. Such machines can be built about 10 to 15 per cent cheaper than those fitted with compensating windings, and for machines in which the maximum voltage per segment can be kept below about 30, and in some cases below 45, they are perfectly satisfactory. It is necessary that the iron of the commutation pole should be worked on the straight part of the *BH* curve, and consequently at a very low density, so that the reversing field increases in the same proportion as the armature current increases. In machines using both compensating windings and commutation poles, no distortion is given to the main field and a reversing field is obtained to overcome the e.m.f. in the coil undergoing short-circuit by the brush. Carbon seems to be the best material for the brushes.—Lond. *Elec.*, Feb. 21.

Induction-Motor-Generators.—An illustrated description of two induction-motor-generators for the London County Council tramways which are said to be the largest built in England. Each machine has an output of 1500 kilowatts at 500 to 550 volts at a speed of 135 r.p.m., and can carry 25 per cent overload continuously for one hour. The induction motors are of the wound-rotor type with slip rings for inserting the starting resistance, the stator being wound for the full normal pressure of 6600 volts between the three phases and a frequency of 25 cycles per second.—Lond. *Elec. Rev.*, Feb. 28.

Heating of Armatures.—G. Schmaltz.—An article illustrated by diagrams in which the author shows that it is incorrect to base the calculation of the conduction of heat in a laminated armature when magnetized on tests made in the unmagnetic condition. The reason is that the thermal conductivity of iron when being magnetized decreases in the direction of the flux. The author calculates the reduction of the thermal conductivity of the armature due to this cause and gives two numerical examples.—*Elek. Zeit.*, Feb. 27.

Commutation.—C. L. R. E. Manges.—A letter in which the writer attacks the usual commutation theory and points out that several experimentally established facts cannot be explained on the basis of the old commutation theory.—Lond. *Elec.*, Feb. 21.

Carbon Brushes.—A long illustrated translation in abstract of the French article, noticed before in the Digest, on standardization tests with carbon brushes for dynamos and motors.—Lond. *Elec.*, Feb. 28.

Tests of Electric Machines.—F. Loppe.—A long article giving general considerations on tests of electric machines and a comparison of the regulations of the American Institute of Electrical Engineers, the Association of German Electrical Engineers and the French Association of Steam Engine Owners.—*L'Ind. Elec.*, Feb. 25.

Lamps and Lighting.

Enclosed Flame-Arc Lamps.—In the Digest of March 14 the new Jandus "regenerative" enclosed flame-arc lamp was already noticed. Recent London journals now contain more detailed illustrated descriptions. If an ordinary flame-arc lamp would be enclosed, the fumes evolved from the chemically-impregnated carbons would soon form a deposit on the globe.

obscuring the arc. The new lamp has two special features. In the first place, special means are provided for obtaining a circulation of the gases past the arc, and, secondly, the light is mainly produced by raising certain gases to the temperature of incandescence, and not by the combustion of chemicals in the arc. The spectrum of the light from the arc is a band-and-line spectrum, showing that the gases are incandescing. Fig. 1 shows the mechanism of the lamp, which is the same as is used in the ordinary Jandus single enclosed-arc lamp. The lower carbon, which is the positive, is held in a fixed support. Surrounding the arc is a clear glass cylinder, and outside this again is a translucent globe. The inner glass cylinder is in communication with two metal tubes, one on either side of the globe. There is a circulation of the hot gases up the central cylinder and down the other tubes, and the incandescent gases are carried round and subjected to the high temperature of the arc several times before finally condensing and settling in the outer tubes. The inner glass cylinder is kept perfectly clear of deposit for the greater part of its length, chiefly as a result of the high temperature which prevents the gases condensing, and also probably on account of the direct and strong draught past the arc. The upper negative carbon is an ordinary high-grade carbon. The lower carbon is also of high-grade carbon, but is star-shaped in section. The grooves between the eight rays of the star are filled with a chemical composition which is laid in in the form of a paste. The rods are then baked, and the paste expands into the pores of the carbon and fixes itself firmly into the grooves. The carbons themselves are not impregnated. About 15 grains of the composition are volatilized every hour, the gases rising up from the positive crater through the arc. The arrangement of the carbons and enclosed globes gives a favorable distribution of light, as can be seen from the curve of Fig. 2. The life of a single pair of carbons is over 70 hours. The light is of yellow-white color, but modifications can be obtained by varying the nature of the composition on the positive carbon. The 550-watt size taking 5.5 amperes at 100 volts, gives a mean hemispherical candle-power of 2200. This lamp is the invention of A. Denman Jones. The following comparative working costs of the new lamp and other works are given:

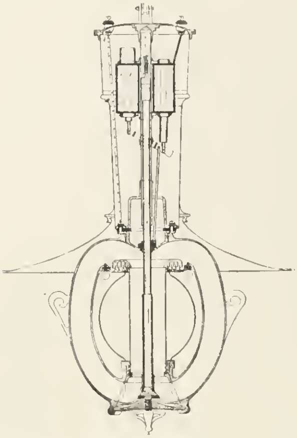


FIG. I.—SECTIONAL ELEVATION OF LAMP.

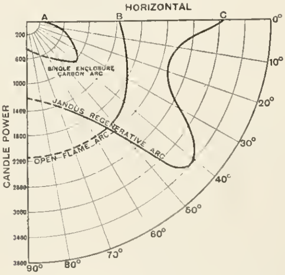


FIG. 2.—LIGHT DISTRIBUTION CURVES.

	Jandus regenerative flame lamp.	Inclined carbon flame lamp. metal cored carbons.	Multi-carbon or magazine flame lamps, cheap carbons.	Single enclosure pure carbon lamp.
Current	5.5 amps.	11 amps	9 amps.	5.5 amps.
Voltage	100 volts	50 volts	44 volts	100 volts
Watts	550	550	400	550
Mean hemispherical candle power	2,200	1,900	1,050	670
Life of carbons	70	10	40	80
List price of carbons per hour	0.32 cent	0.86 cent	0.56 cent	0.03 cent
Cost of current and carbons per 1,000 cp-hours at 4 cents per kw-hour	0.14 cent	1.60 cent	2.56 cent	3.32 cent

The lamp is mainly intended for street, open space and workshop lighting.—Lond. *Elec. Eng'ing,* Feb. 27, and Lond. *Elec.*, Feb. 28.

Filament Support.—A note on a recent English patent of the British Thomson-Houston Company (Allgem. Elek. Ges.) for holders or supports for lamp filaments, incandescent at high temperatures, composed wholly of or having a surface coating only of pure thorium or magnesium oxide. The holder is molded, heated to a temperature of at least 2000 deg. C., and then dipped in a mixture of hydrofluoric and sulphuric acid. The melting point of the final product is very high, so that there should be no danger of the filament becoming fused to the holder.—Lond. *Elec. Eng'ing,* Feb. 27.

Train Lighting.—A long and fully illustrated description of the new train-lighting dynamo of the Felten & Guilleaume-Lahmeyer Company, which has already been noticed in the Digest.—Lond. *Elec. Rev.,* Feb. 21.

Power.

Electrically-Driven Rolling Mill.—An illustrated description of a new 15-in. Merchant rolling mill at a British steel works, driven by a 500-hp, three-phase motor. The motor runs at 245 to 250 r.p.m. Between the motor and the mill is a 28-ton fly-wheel, 19 ft. 6 in. in diameter. By means of a slip regulator the speed can be reduced momentarily to 110 r.p.m. if necessary, to allow the fly-wheel to give off extra energy to the mill during the short periods of very heavy load. The motor has a bar-wound rotor and current is supplied to the stator at 2000 volts. The windings of the rotor are connected to a liquid resistance, and this resistance is made to increase automatically as the load on the motor increases. The insertion of resistance in the rotor naturally causes it to lag behind the stator in phase, and, as the speed decreases, the fly-wheel supplies energy to the system. The same piece of apparatus includes both the starter and the regulator. The upper part of the vessel contains a number of horizontal pipes, through which water is circulated to keep the liquid cool, and below these are large horizontal plates which can be lowered into the liquid to decrease the resistance between them and fixed electrodes at the bottom of the tank. As the liquid is heated it rises and is cooled by the cold-water pipes, so that there is a continuous circulation. The moving plates are actuated by a hand-wheel, and are also independently attached to a lever carried on a projecting spindle by a small brake motor. The other end of this lever carries counterbalance weights. To start the mill motor, the plates are lowered by means of the hand-wheel after the main stator switch has been put on. After they have been lowered a certain distance, the lever engages with the lever attached to the brake motor. In the stator circuit of the rolling-mill motor there is a small three-phase series transformer, the secondary circuits of which are connected to the stator winding of the brake motor; the rotor of the brake motor is an ordinary short-circuited rotor. As the current supplied to the rolling-mill motor increases, the potential across the primary of this series transformer also increases, and the potential of the secondary rises sufficiently high to start the brake motor, the speed of which will, of course, depend on the amount of extra load on the main motor. As the brake motor turns, it lifts the plates which are in the liquid and thus increases the resistance of the rotor carried in the main motor, and the speed of the main motor drops. When the load diminishes again, the brake motor no longer exerts sufficient torque to counterbalance the difference in weight between the moving plates and the counter weights, and the former again fall, decreasing the resistance of the stator circuit in the main motor, and allowing it to speed up again, thus restoring to the fly-wheel the energy that it has given up to the mill during the heavy-load period.—Lond. *Elec. Eng'ing*, Feb. 27.

Austrian Transmission Plant.—A long and very fully illustrated description of the Lebring power plant in Steiermark, which transmits energy to Graz and the neighborhood. The plant was erected in 1903, and was the first one in Austria to employ a transmission voltage of 20,000. There are four turbines, each of 500 to 600 horse-power. The 430-kilovolt-ampere alternators generate current at 1500 volts, which is raised to 20,000 for transmission. There are 11 substations. The power plant, the transmission line and the substations are described in considerable detail.—*Elek. u. Masch.* (Vienna), Feb. 9, 16, 23.

Traction.

San Diego.—An illustrated description of the street railway system of San Diego, Cal., which is the furthest southwestern line in the United States, and the traffic of which has more than doubled during the last four years. The company has at present more than 35 miles of track. In the power house three turbo-generators, each of 500 kilowatts, have recently been installed.—*St. R'y Jour.*, March 14.

Electric Traction.—P. Dawson.—A continuation of his long illustrated serial on electric traction on railways. In the present installment the author considers the suitability of the three-phase motor for electric traction, and discusses more particularly the Ganz system of control.—Lond. *Elec.*, Feb. 28.

Block Signals.—An illustrated description of the system of automatic block signals used on the Chicago South Side Elevated. The system as installed is a simple normal clear block signal system without distant protection or overlaps, but it differs in several respects from the methods used on other roads. The interval between trains has been reduced to one minute, or even less.—*St. R'y Jour.*, March 14.

Installations, Systems and Appliances.

Automatic Current Regulator.—An illustrated description of an electrolytic automatic regulator due to O. Sackur for obtaining constant current with varying voltage. It is shown in Fig. 3. In the cell *A* water is decomposed between two large nickel electrodes, and the oxygen and hydrogen gas mixture escapes through the capillary tube *B*. Inside the cell *A* a pressure is produced which is proportional to the speed with which the gas escapes from *B*, and, therefore, also proportional to the current. The terminals *a* and *b* of cell *A* are connected with the terminals a_1 and b_1. In the sketch *S* is the source of current, *X* is the apparatus in which the current is to be kept constant, *G* an ammeter, and W_1, W_2 adjustable rheostats. By regulating W_1 the current through *G* and *X* is first adjusted to the desired value. Then the tube *F* is raised or lowered until the mercury is just below the platinum point *C*, but does not actually make contact with it. Further, the screw *E* is so adjusted that it is just above the mercury surface without actually making contact. If now the voltage of *S* should fall and the current in *X* and in the cell *A* will decrease, the gas pressure in *A* will decrease and the mercury in the monometer tube will rise and will make contact with *C*, so that the branch circuit W_2CD in parallel with W_1 is closed. The current through *AGX* will, therefore, increase, contact *C* is broken, etc. On the other hand, if the e.m.f. should rise, the mercury will make contact with the screw *E*, and the branch circuit DEW_2 is closed, so that the current in *AGX* decreases. Then the contact *E* is broken, etc.—*Electrochem. and Met. Ind.*, March.

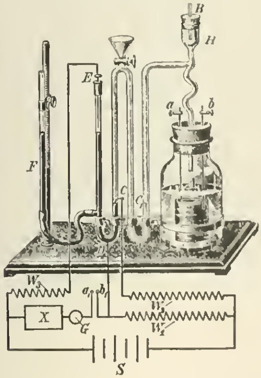


FIG. 3.—AUTOMATIC CURRENT REGULATOR.

Starter for Induction Motors.—An illustrated description of a starter for induction motors which is essentially a transformer in the main circuit to reduce the primary pressure for starting. The apparatus combines in itself starter, main switch and fuses. The transformer is of the autotransformer type, there being only one cell per phase, the reduced voltage being obtained by connecting the motor leads to intermediate points on the main coil. In the standard primary transformer starter three types are provided, thus giving three different transformation ratios.—Lond. *Elec. Rev.*, *Electrician*, *Elec. Eng.*, Feb. 14.

British Refuse-Destructor Power Station.—An illustrated description of the new municipal power station of Greenock, in which a refuse destructor has been included. There are two 750-kw generating sets and the main supply from the station is for power and lighting at 500 volts and 250 volts.—Lond. *Elec. Eng.*, Feb. 14.

Wires, Wiring and Conduits.

High-Voltage Fuses.—E. B. Merriam.—An illustrated article pointing out that recent developments on high-voltage fuses and tests on 60,000-volt transmission lines indicate that many desirable combinations of a non-automatic switch and fuses are possible, the switch serving to open or close the normal load of the line, and the fuses taking care of heavy overloads and short-circuits. This provides a very economical arrangement where there is a moderate amount of power to be tapped from a transmission line. To be satisfactory on high-voltage circuits a fuse must be quick-acting and it is now an established fact that a fuse blown in a confined space, such as a non-conducting tube of suitable dimensions, has the property of opening the circuit quickly, the arc being projected from both ends of the tube. This action can be improved if the tube is closed at one end and provided with a proper expansion chamber. A General Electric fuse of this type is described and illustrated.—*Gen. Elec. Rev.*, March.

Fuses.—W. Fellenberg.—The conclusion of his illustrated paper on new enclosed high-tension fuses of the Allg. Elek. Ges.—*Elek. Zeit.*, Jan. 23.

High-Tension Insulators.—An illustrated article on high-tension insulators. While porcelain fulfils all the other requirements, it is opaque, so that it is impossible to detect by the eye a small fault within the mass. Glass is transparent, and any fault in it may be at once detected, but it is very fragile. While many engineers think that in the competition between porcelain and glass for high-tension insulators, glass is doomed, the author of this article thinks that this competition is not yet definitely settled. He describes some high-tension insulators of glass made by a French company, and gives also illustrated descriptions of several other high-tension insulators.—*L'Ind. Elec.*, Feb. 25.

Electrophysics and Magnetism.

Variation of Young's Modulus Under the Influence of the Electric Current.—H. Walker.—A paper giving an account of an experimental investigation. The behavior of steel, soft iron, copper, and platinum was examined when a current was passed through the wires. In the case of iron wire, the modulus in c.g.s. units at a room temperature of 20.4 deg. C. was 18.51×10^{11}; this fell to 17.30×10^{11} when the current had raised the temperature to 23.9 deg. C.; it then steadily increased to 20.19×10^{11} at a temperature of 50.6 deg. C., after which it decreased as the temperature was raised. In the case of steel, similar changes took place; the maximum value, however, was reached at 34 deg. After the temperature had been increased to 108 deg. it was reduced, and the maximum value of the modulus was then found at 57 deg. Copper behaved in exactly the same manner. Platinum behaved entirely differently, there being no initial fall in the modulus, which increased at a slower rate than in the above metals up to a temperature of 110 deg.—*Proc. Royal Soc. of Edinburgh,* for 1906-7, No. 4; Lond. *Elec.*, Feb. 21.

Magnetic Hysteresis in Rotating Fields.—T. Weiss and V. Planer.—According to Baily, there is no hysteresis in a rotating magnetic field, when that field is very strong. This important result has been confirmed in a more elaborate manner by the present authors. They used the method adopted by Blondel and Carpentier, but substituted for the permanent magnet an electromagnet, and operated upon a thin iron or nickel disk, suspended parallel or at right-angles to the axis of rotation of the field. Thus they were enabled to measure both the rotational and the alternating hysteresis. The hysteresis torque was found to be independent of the speed. The field was as intense as 10,000 gauss. In iron and nickel, the rotational hysteresis passes through a maximum and then decreases to zero as the field increased. At the maximum, the rotational hysteresis is just half the maximum alternating hysteresis. In feeble fields. on the other hand, the rotational surpasses the alternating hysteresis. It is not simply twice the latter, as alleged, but varies from four times down to zero. A field of 7300 gauss suffices to annul the rotational hysteresis in pyrrhotine. This field is also the "chief demagnetizing field."—From *Bulletin* 271 of the French Phys. Soc'y; abstracted in Lond. *Elec. Eng'ing,* Feb. 13.

Canal Rays.—An article on the Doppler principle and canal rays. From observations of Stark and others of the Doppler effect in canal rays it would seem that in this case the luminous particle which gives rise to the Doppler effect is not the molecule, but the atom at rest; that is, the atom deprived of its negative electron. While this would be very important, the question cannot yet be regarded as settled.—Lond. *Eng'ing,* Feb. 28.

Canal Rays.—E. Goldstein.—An English translation of a former German paper of the author in which he gives a condensed summary of many years' observations made by him since 1886 concerning canal rays, with additional notes.—*Phil. Mag.*, March.

Phosphorescence.—A. Stephenson.—The usual explanations of the phenomena of phosphorescence is that the energy communicated by the incident light is stored as potential energy of the molecules, and that on the removal of the light the change of configuration ceases to be stable and the system gradually returns to its initial state, the potential energy setting up vibratory motion and thereby becoming dissipated as emitted light. The author shows in this mathematical paper that a simple type of mechanical system exhibits the chief phenomena of phosphorescence, and, furthermore, that the agreement between the properties of the phosphorescing substances and those of his system is of a quantitative nature. From his point of view, energy stored by the system under the incident disturbance is kinetic.—*Phil. Mag.,* March.

Movement of Insulators in Magnetic Fields.—S. J. Barnett.—An abstract giving an account of an investigation of the electric displacement and intensities produced in insulators by their motion in a magnetic field, and its bearing on the question of the relative motion of ether and matter.—*Phys. Rev.*, February.

Mutual Inductance.—D. N. Mallik.—A highly mathematical paper giving formulas for the mutual inductance for the following cases: Two circular wires in any relative position to each other, carrying currents; mutual induction between two parallel rectangular wires symmetrically situated and carrying unit currents, and mutual inductance between two concentric and coplanar elliptic wires.—*Phil. Mag.,* March.

Units, Measurements and Instruments.

Measurements of Weak Alternating Currents.—H. Abraham.—For the measurement of weak alternating currents, such as telephone currents, and for the determination of the phase difference, a galvanometer with a moving coil and laminated electromagnet is specially useful since it allows great sensitiveness to be obtained, and this remains the same both in the measurement of continuous and alternating current of high frequency (500 and above). With an internal resistance of 100 ohms a thousandth of a milliampere can be detected. For the majority of applications, therefore, only a fraction of the working current need be used. The field of the electromagnet being $H \sin \omega t$, if a current $I \sin (\omega t - \phi)$ is passed through the moving coil, the permanent deflection will be proportional to $HI \cos \phi$. If this current is replaced by another with the same amplitude, but which is exactly in quadrature with the first, the deflection will be $HI \sin \phi$ and from these two readings the amplitude and phase of the current I can be found. A simple method of obtaining equal currents in quadrature is the following: Several turns of wire are wound on the electromagnet. The e.m.f. induced in this winding is in quadrature with the flux of the electromagnet. Or, a tapping is taking off to a non-inductive resistance connected in the exciting circuit of the electromagnet. The e.m.f. obtained is in phase with the flux in the magnet, and it is quite easy to make the second e.m.f. equal to the first. Concerning the application of this instrument to telephone lines, see abstract below.—Lond. *Elec.*, Feb. 28.

Maximum-Demand Indicator.—H. S. Hatfield.—An article on the Merz demand indicator which depends on the principle of allowing the motor meter, which is measuring the consumption on the installation, to turn for a certain definite period a counting train. At the end of this definite period the meter is disconnected from the gear through which the counting train has been turned, and the former is reset to its initial position. The meter is then reconnected, and the process repeated over again and again for the same time interval. The counting train acts as a non-return hand, and its indication shows the maximum consumption which has taken place during the resetting period. This principle has now been worked out and modified, and in the latest design the periods of resetting can be made anything from a quarter of an hour to two hours, according to the nature of the load, or by agreement with the consumer. The special feature of the new design is the use of an electrically-wound clock.—Lond. *Elec.*, Feb. 28.

Capacity of Paper Condensers and Telephone Cables.—A. Zeleny and A. P. Andrews.—A note on an American Physical Society paper. The free charge capacities of various condensers and of a telephone cable were compared with their capacities as obtained by the ordinary method where the galvanometer remains connected during the whole period of its throw. In most cases the free charge determinations can be made to within one-tenth of 1 per cent, and the capacities as obtained by the ordinary method are shown to be from 2 to 300 per cent greater than the free charge capacities, the amount of difference depending on the condenser. Errors are shown to exist in the present methods of determining the specific inductive capacities of dielectrics and in the resistance of dielectrics as obtained by the loss of charge method.—*Phys. Rev.*, February.

Current Balance.—W. E. Ayrton, T. Mather and F. E. Smith.—An illustrated Royal Society paper in which the authors describe a new "current weigher" specially designed and made by them for the absolute measurement of current. Very consistent results were obtained, and as the result of numerous determinations, the authors find the e.m.f. of the cadmium cell at 17 deg. C. to be 1.0187_1 volts, and that of the Clark cell to be 1.432_9 at 15 deg. C.—Lond. *Elec.*, Feb. 28.

Telegraphy, Telephony and Signals.

Propagation of Telephone Currents and Telephone Apparatus—H. Abraham and Deveaux-Charbonnel.—A full translation of their French paper, which has been noticed in the Digest, on the propagation of telephone currents through underground conductors. The authors experimented with frequencies from 250 to 500 on experimental lines of the type of the Paris underground network and found that the results experimentally obtained are in quite close agreement with the theory. In a second paper the authors discuss the most efficient working conditions for telephone apparatus. The chief requirements deduced by them are as follows: For all types of receiver where the inductance of the coils is given, the diameter of the wires should be such that resistance of each receiver is slightly more than a quarter of the apparent ohmic resistance *R* of the line, including the fine wire winding on the transformer. This rule necessitates the use of receivers whose resistance is between 100 and 200 ohms. If *R* is the apparent ohmic resistance of the line and *M* the internal resistance of the microphone, the most favorable value for the ratio of transformation is slightly greater than $\sqrt{R/2M}$, which works out between 6 and 7. To obtain the maximum efficiency, the impedance of the secondary winding should be considerably greater than the apparent resistance of the line. These three conditions seem to be fulfilled in all good commercial apparatus that the authors examined. The efficiency of the telephonic transformers was obtained by measuring the amplitude and phase of the currents and primary and secondary e.m.f. of the apparatus in circuit, and was found to be less than 60 in all the telephones examined. This low value seems to show that telephonic transformers are, in general, too small. Nothing is more easy than to obtain transformers whose efficiency is 90 per cent, and which correspondingly increase the transmitting power. Too much importance must not, however, be attributed to this improvement. Nearly half the energy is saved, but the ear is so little sensible to variations in the intensity of sounds that the hearing scarcely seems to be improved. To ensure a regular transmission to very great distances, inventors should concentrate their efforts on the microphone, for this apparatus is capable of great improvements.—Lond. *Elec.*, Feb. 28.

Factory.—Some illustrated notes on an English factory for making switches and rheostats.—Lond. *Elec. Rev.*, Feb. 28.

Labor Cost Distribution.—G. F. Stratton.—An article describing the method of labor cost distribution which is employed at the shops of the General Electric Company.—*Eng'ing Mag.*, March.

Production System.—H. M. Wharton.—An article on the organization of the "production system" of the Westinghouse Electric & Manufacturing Company.—*Eng'ing Mag.*, March.

Electric Signals.—An illustrated description of the system of electric signaling used in the Simplon Tunnel.—Lond. *Elec.*, Feb. 28.

BOOK REVIEWS.

Gleichstromerzeuger und Motoren; Ihre Wirkungsweise, Berechnung und Konstruction. By W. Winkelmann. Hannover: Max Jaenecke. 124 pages; 40 illustrations. Price, 3.4 marks.

Although some little information is given concerning the performance of direct-current generators and motors, the major portion of this book is devoted to an outline of the methods of calculating the electric and magnetic circuits of these machines. The purely mechanical details have not been mentioned. A few suggestions are given with reference to commutation along familiar lines in accordance with practice which was considered standard five years ago, but the use of commutating poles is not discussed. The value of the book lies in the fact that the various formulas and design constants have been collected from the most reliable sources and are presented in convenient shape for immediate application.

Magnétisme et de L'Electricité By A. Nouguier Paris: Librairie Polytechnique. 396 pages, 193 illustrations. Price, 12.5 francs.

This book aims to give an accurate theory of magnetism and electricity and the relation between the two. The author explains in detail those "laws" of electrophysics that are presented without explanation in elementary texts on physics, and are expressed in the form of mathematical equations in electrical engineering literature, such as the relation between the ampere turn and the flux produced thereby, cyclic variation in the permeability and the hysteresis loss which it causes, flux variation and its effect upon the time-phase relation of the current and the e.m.f. The treatment is that of a mathematical physicist and possesses little that will appeal directly to the practicing electrical engineer. At the same time, however, the presentation is characterized by clearness, and the book can be read with advantage by engineers who are not wholly adverse to the use of mathematics.

Die Gleichstrommaschine. By E. Arnold. Berlin: Julius Springer. 600 pages, 13 tables, 502 illustrations. Price, 20 marks.

This is the second volume of Professor Arnold's most excellent treatise on direct-current machinery. Volume I dealt with the theory and test, while Vol. II is devoted to the design, construction and operation of direct-current motors and generators. As may be judged from the number of pages and illustrations, the book contains a large amount of material; when it is known that there is no padding and that the descriptive matter relates to well-designed, modern machines, discussed by one who thoroughly understands the various design features, it will be appreciated that the book is of more than ordinary interest and value. After comparing the various insulating materials and the methods for applying the materials to the armature coils, the author describes the electrical and mechanical details of armatures, commutators, brushes, field coils and cores, and explains methods for testing the insulation of the machine and for insuring that the rotor is properly balanced. Dimensional drawings are given of 43 direct-current machines in rating from 2.6 horse-power to 1720 kilowatts. The latter machine is designed for 230 volts and provided with commutating poles and two commutators. Although the merits of the commutating pole machine are not fully discussed, the method of calculating the proportions of such a machine is explained. The various special machines, such as constant-current generators, variable-speed generators, variable-voltage generators, three wire generators and constant-current motors, are described. The book is not of a nature to render it well suited for the use of students. It can be accurately characterized as a most excellent reference book for designers of direct-current machinery.

Experimental Electrical Engineering. By V. Karapetoff New York: John Wiley & Sons. 790 pages, 538 illustrations. Price, $6, net.

This manual for electrical testing is characterized by thoroughness and completeness. There are 35 chapters, covering the whole series of tests conducted by junior and senior students in engineering laboratories. It differs somewhat from the usual laboratory manual in that considerable space is devoted to descriptions of the performance of various types of electrical machinery. The descriptive matter is presented in such a manner as to assist the student in understanding the phenomena in the machine being tested, and its presence allows him to perform the actual manual labor connected with the test in the most effective way; it does not relieve the student from the task of verifying the theory, but merely prevents him from wasting time in searching for things that are not to be found.

In addition to the usual tests of generators, motors and transformers, descriptions are given of tests of measuring instruments, transmission circuits, storage batteries, electric heaters and welders, arc and incandescent lamps. Great care has evidently been exercised in rendering the treatment accurate and in agreement with modern practice. It is to be regretted that, after carefully distinguishing between power and energy, and the units watt and watt-hour, the author did not see fit to discard the term "wattmeter" when describing energy meters that are calibrated in watt-hours. Just why the manufacturers of electrical energy meters should assume that the word "integrating" when added to the word "wattmeter" introduces the idea of time the reviewer is unable to appreciate. What the instrument actually integrates is watt-hours and not watts. Undoubtedly the word "integrating" is properly used when applied to a type of photometer which indicates an addition of the light from a lamp in various directions. The text is largely free from the minor errors in expressions that convey the proper idea from the writer, while leaving the wrong impression upon the reader. However, the reviewer questions the advisability of attributing to "electric resonance" the compounding of synchronous converters by the use of inductive reactance in the supply circuits.

The material contained in the book has been well selected, logically arranged and presented in convenient form for laboratory use. The book is one that will be liked by both the student and the instructor.

Direct-Current Starting Rheostats.

The Westinghouse Electric & Manufacturing Company has developed a line of face-plate starting rheostats, which have been designed to meet fully the specifications and conditions laid down by the National Board of Fire Underwriters and the American Institute of Electrical Engineers. The starters for motors on 110 volts up to 22 horse-power, or 220 volts up to 35 horse-power, use the bar type of resistance, which consists of a resistance wire wound on iron bars which are first covered with a fireproof material. The ends of the bars are held in place by porcelain pieces, clearly shown in the illustrations. The construction is strong and rigid, so that adjacent turns on the same bar cannot short-circuit, nor can turns on one bar come in contact with turns on another bar. The whole construction, resistance, iron frame, slate front, contact arm, etc., is fireproof.

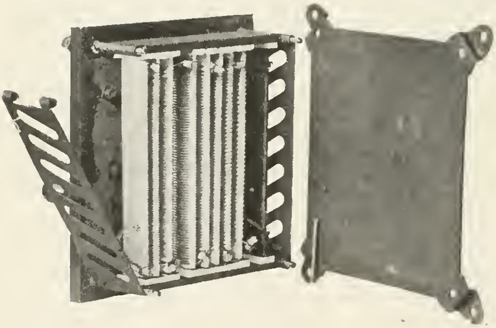


FIG. 1.—BAR-TYPE STARTING RESISTANCE OPEN FOR INSPECTION.

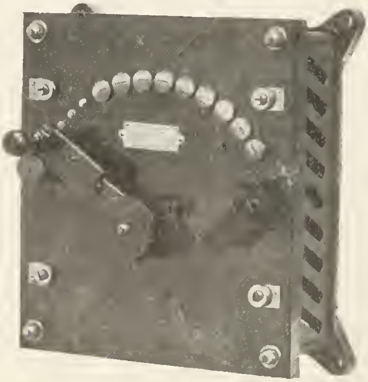


FIG. 2.—FACE-PLATE STARTER, 80-AMP. CAPACITY.

Another feature embodied in these starters is the low-voltage release. The contact arm will positively fly back to the off position if the current is shut off from the line, or if the voltage falls below a fixed limit. This prevents damage to the motor should the current again be thrown on or the voltage rise suddenly to its full value. The method of connecting the magnet of the release coil is of special benefit where the field of the motor is to be regulated. The magnet is connected across the line independently of the shunt field and is unaffected by variations in the field current.

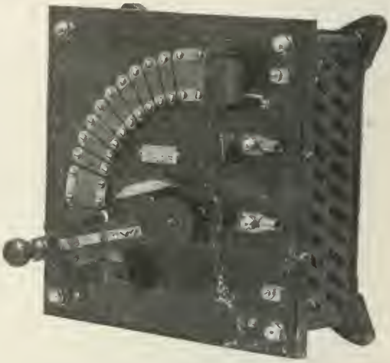


FIG. 3.—FACE-PLATE STARTER, 160-AMP. CAPACITY.

The small, button type of rheostat shown in the illustration is used on the smaller types of motors and is capable of carrying 80 amperes. For the larger motors, larger contacts are required; this requirement is met by furnishing renewable contacts, as shown in the illustration of the 160-amp. rheostat. In this larger type of starter a special short-circuiting brush is provided which cuts out the last contact, insuring the lowest resistance possible.

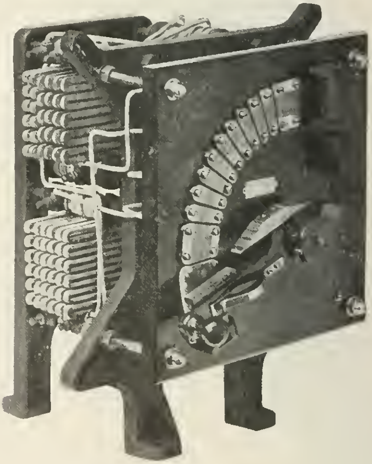


FIG. 4.—GRID-TYPE STARTER, 240-AMP. FACE-PLATE.

For starting motors on 110 volts of 25 horse-power, or 220 volts 45 horse-power and larger, the grid type of resistance is used, which is fully ventilated and will stand the heavy duty required in starting large motors. All contacts, brushes, fingers and springs may be removed from the front with ease. This line of starters is adapted for 110-, 220- and 500-volt motors.

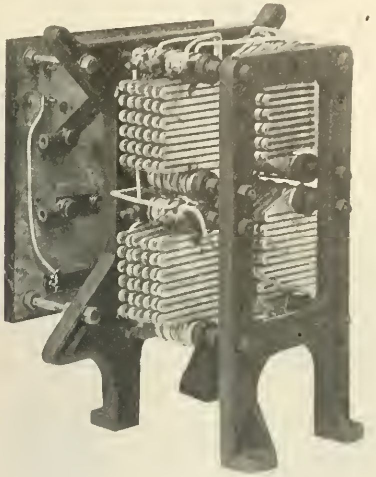


FIG. 5.—GRID-TYPE STARTER, 240-AMP. FACE PLATE, REAR VIEW.

As these rheostats are used only in starting, the handle will not remain on any point except the last, unless held. They are intended to bring the motor up to speed in 15 to 30 seconds, according to size, and are made for full-load conditions.

Universal Family Sewing Machine Motor.

To meet the demand for a sewing-machine motor that will reduce the selling effort upon the part of the dealer to the minimum and enable him to get prompt returns, the Westinghouse Electric & Manufacturing Company has placed upon the market a machine with all the necessary attachments for fitting any one of the standard types of sewing machines. This motor

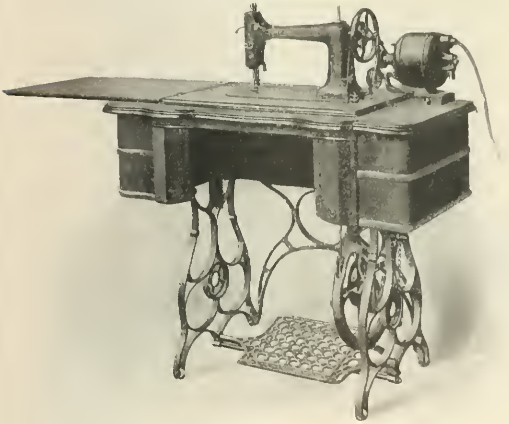


FIG. 1.—MOTOR FITTED TO SEWING MACHINE.

is equally satisfactory on drop head and stationary head machines, and may be fitted to new or old machines. Full instructions for mounting and operating the motor are supplied to purchasers.

The motor is mounted on the top of the table and runs at a constant speed. The speed of the needle is regulated by increasing or decreasing the belt tension. A special brake and belt tightener arm is attached by chain to the foot pedal, which should be disconnected from the large balance wheel. Pressure on the pedal releases the brake, tightens the belt and starts the machine. Perfect regulation of the speed is obtained after a few minutes' practice. In fact the needle may be stopped with greater promptness than when running from the foot pedal, and the usual control over the speed is readily learned.

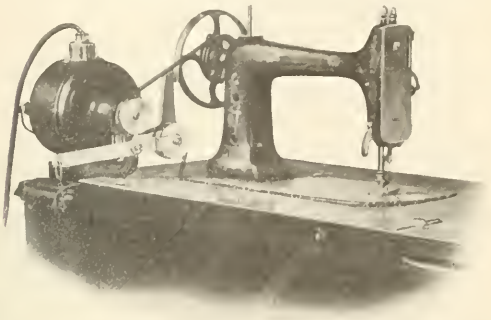


FIG. 2.—VIEW OF BRAKE AND BELT TIGHTENER.

The entire outfit presents a neat appearance, being well finished in black japan with nickel trimmings. The motor and its attachments are especially well made and will require a minimum of care and of attention in operation. These machines are made for 100-110 volt alternating current, 60 cycles, and for 100-110 direct current circuits.

Electric Glue Pot.

An electric glue pot recently placed on the market by the General Electric Company, embodies a new and interesting feature of design, namely, the elimination of the water jacket. The water jacket is a necessary feature of the ordinary glue pot, inasmuch as this water serves not only to distribute the heat evenly to all parts of the glue, but also prevents it from becoming overheated. While necessary, it is also the cause of so much trouble as to render the ordinary and the earlier types of electric glue pots practically inoperative, when viewed from the standpoint of economy and satisfaction.

The elimination of the water jacket has been made possible by the adoption of a casting of pure aluminum which forms the glue pot proper. The high conductivity for heat, together with the proper design of the heating unit and proportioning of the radiating surface, combine to keep the glue at the proper temperature, although the maximum temperature of the exterior and bottom of the pot is said never to exceed 180 deg. Fahr.

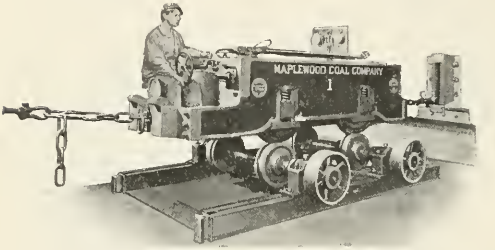
ELECTRIC GLUE POT.

The heating element is of the well-known cartridge type, and possesses the characteristic features of simplicity, renewability and long life. It has been found that a saving in electricity has resulted by the omission of the water jacket, the energy consumption of the smaller sizes being reduced as much as 50 per cent. The practical efficiency of the glue pot and the superiority for result-producing work claimed for it over the ordinary water jacket type, render it particularly valuable to carpenters, pattern makers, book-binders, etc. To the central-station manager it affords possibilities for building up a profitable day load and should prove as successful in this respect as the more popular electric flat-iron.

Electric Locomotive-Testing Plant in the Baldwin Locomotive Works.

In order to determine the actual performance of Baldwin-Westinghouse mine and industrial locomotives under service conditions before they leave the works, the Baldwin Locomotive Works have erected a testing plant similar to the locomotive testing plant that was used at the St. Louis Exposition. This plant, as shown in the accompanying illustration, consists of a pair of adjustable rolls upon which are placed wheels that may be moved to accommodate locomotives built for any gage. Provision for varying wheel base is made by movement of the rolls toward or away from each other.

The locomotive to be tested is anchored in position by chains attached to the ends. Suitable Prony brakes are used to measure the power developed by the motors, and a switchboard provided with the necessary electrical instruments enables a complete record to be made of the performance of every locomotive. Although a thorough test of the electrical equipment is always made before it leaves the Westinghouse works, at East Pittsburg, this test of the assembled locomotive is found to be of great advantage in that it insures the ability of the locomotive to operate continuously under service conditions.



ELECTRIC LOCOMOTIVE TESTING PLANT.

Frink Adjustable Reflectors.

I. P. Frink, of 551 Pearl Street, New York, has brought out a line of adjustable reflectors especially suited for show-windows and other similar uses. These reflectors have been given the name of "Frinklet," and are made with a strong metal frame lined with the usual Frink special silver-plated corrugated glass in sections. The paneled end reflector is shown in Fig. 1. This is fitted with a nickel-plated twin socket for lamps of 8, 16 and 32 candle-power. With ordinary 16-cp lamps, the reflector is said to throw 125 candle-power on the floor of a window 10 ft. high. The twin socket, plain, open-end reflector is illustrated in Fig. 2, and the round reflector, which is 12 in. in diameter and is suitable for tungsten, tantalum and other high-efficiency lamps, is shown in Fig. 3. In all of the reflectors the silvering is protected against scratching by the metal covering, and the corrugated glass being inserted in sections, breakage due to expansion and contraction is eliminated, and any section broken by accident can be easily replaced. A feature of the "Frinklet" is the ease with which it can be adjusted to any size of window. By means of adjustable fittings, the reflector can be attached to the window frame or ceiling and be directly connected to molding, conduit or condulet so that no wires are exposed. The special adjustable fitting shown in Fig. 4 is intended for conduit, condulet or junction-box connection. The fitting shown in Fig. 5 is intended for molding connection and may also be used on window frames and ceilings with flexible cord feed. Fig. 6 illustrates an adjustable fitting for stems. The engravings show the fittings half size. It is evident that by means of the attachments shown the reflectors, with lamps, may be attached to any length of stem and used for ordinary illumination purposes or for illuminating paintings, statues, etc., the adjustable fitting making it possible to train the light at any desired angle.

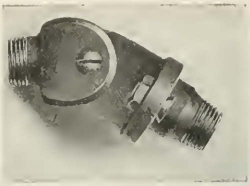


FIG. 4.—FITTING FOR CONDUIT, CONDULET OR JUNCTION-BOX CONNECTION.

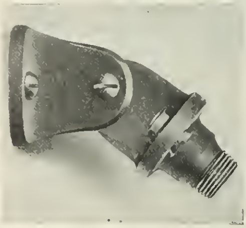


FIG. 5.—FITTING FOR MOLDING CONNECTION.

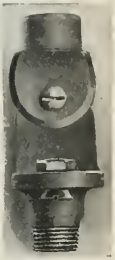


FIG. 6.—ADJUSTABLE FITTINGS FOR STEMS.

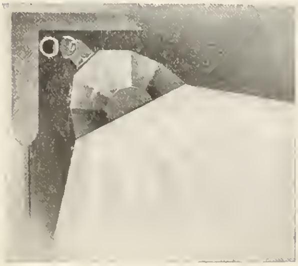


FIG. 1.—PANEL END REFLECTOR.

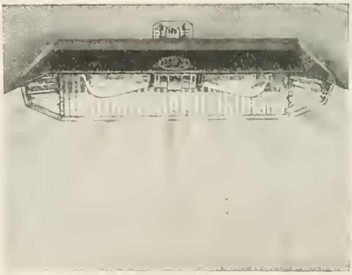


FIG. 2.—OPEN END REFLECTOR.

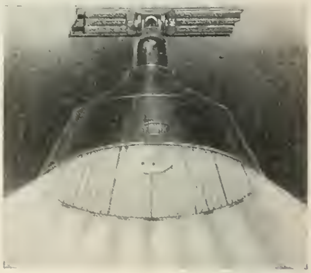


FIG. 3.—ROUND REFLECTOR.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade during the last week showed as much improvement as can be expected under existing conditions. Buying this year has been marked by extreme conservatism. The spring buying has passed its point of greatest activity, and although sales are much less than a year ago, as a whole the spring buying was much better than was anticipated several months ago. Industrial lines exhibit a great deal of irregularity. While steel and iron prices have been maintained pig iron shows weakness in spite of more inquiry. Coincident with the improvement in general conditions, the percentage of idle machinery decreases, but reductions in wages and dividends show that the forces of readjustment are still operating and will continue to operate for some time. Although dividends have shrunk, no general weakness has followed the decrease, the previous decline in prices offsetting the smaller returns on securities. No disturbances as yet have followed wage reductions and it is thought that the process of readjustment along this line will be completed without serious opposition on the part of employees. Railroad reports show that the number of idle cars has materially decreased. The winter wheat crop is in excellent condition and the prospects for spring farming are excellent. Money continues to grow easier gradually, and the reduction of the Bank of England rate to 3 per cent is the lowest point in rates touched by that institution since 1905. Many hopeful features developed in the electric field during the week, and in general the situation showed improvement over a week ago, both in increased orders and more inquiries. The General Electric Company received an order from the New York Central Railroad for 12 electric locomotives which will be of the "6000" type now in use. The bodies will be built by the American Locomotive Company. Another order received by the General Electric Company was for the electrical equipment of 125 cars for the Interborough Rapid Transit Company, and it reports a $1,000,000 order from the Chicago Railways Company, the largest electric order placed since the depression in October. It includes 400 four-motor car equipments. An order has been received by the General Electric Company for a complete substation equipment which will cost about $180,000, for the Companquia Pocas de Santos, Brazil, and smaller orders have been received from the Manchurian Railway, Corea, and the Sao Paulo Light & Power Company, of Brazil. As indicative of returning confidence, an order for 50,000 incandescent lamps for Rio Janeiro has been placed in New York. This is said to be the largest order for that class of electrical goods ever sent from South America.

MEXICAN TELEPHONE ENTERPRISE.—With the purpose of developing long-distance and wireless telephony between Mexico City and the port of Vera Cruz, a Mexican company with a capital of $500,000 is being formed. The organization of the company is being carried out by Francisco Alfaro, representing a group of London capitalists who are backing the enterprise. The concession for the establishment of long-distance, as well as wireless stations in the section of the Republic between Mexico City and Vera Cruz, was obtained by Manuel S. de Corbera and J. Sitzenstatter, an engineer, covers a period of 50 years, and allows the building of lines in and between various towns, such as Vera Cruz, Cordoba and Orizaba. Underground cables and lines will be laid in these towns. More than 5 kilometers of underground work has already been laid in Vera Cruz. The development of the wireless part of the concession will be left until a later time, the concessionnaires now devoting their attention to the stringing of wires between towns and the laying of underground cables in Vera Cruz. It is intended ultimately to spread a network of wires throughout the state of Vera Cruz, with the purpose of connecting it with the large rubber, coffee, sugar and other plantations. Governor Teodoro A. Dehesa and his secretary of state, Eliezer Espinosa, are greatly interested in the construction of adequate telephone service as planned by the concessionnaires, and General Porfirio Diaz, President of Mexico, it is reported, is assisting the enterprise with many suggestions.

STEAM TURBINE DEVELOPMENT.—As an evidence of the extent to which the steam turbine has been introduced as a power producer in large steam plants, the following data have been obtained from the Westinghouse Machine Company, of Pittsburg: The steam turbine business began in this country about 10 years ago. From that time until the close of the year 1907 the Westinghouse Company has manufactured and installed 493 machines distributed among 282 different plants, aggregating a total of 930,000 hp, or an average of 1886 hp per machine. But in addition to this output the shops at East Pittsburg had orders on hand at that time for 149 turbines, aggregating 323,000 hp more, so that up to the beginning of this year that company alone had taken orders for steam turbines aggregating a total of over 1,250,000 hp. When the steam turbine was first placed upon the market it was believed that its most fruitful field would be in the power houses of electric railway and lighting plants; it is interesting, therefore, to find that the company has installed turbines in 21 railroad power houses, 22 textile mills, 12 machinery power houses, 19 mining power houses and about 60 other manufacturing plants in the United States.

GENERAL ELECTRIC COMPANY OPERATING ON FULL TIME.—It is reported from Schenectady that 10,000 employees of the General Electric Company, who have been working four days a week for two months, will shortly go on full time as a result of large orders recently received by the company from the New York Central Railroad, the Chicago Railway Company and the Interborough Rapid Transit Company of New York. Other large orders for equipments in foreign countries have been received by the General Electric Company. It is stated that the volume of new business booked by the company at present is at the rate of $40,000,000 per annum, against a low point in December not exceeding $30,000,000 per annum. February was rather a poor month and did not show the comparative improvement over January's business which January showed over December. There is no question about the intention of the directors to pay the regular dividend of 8 per cent during the coming year.

THE ELECTRICAL JOBBERS' ASSOCIATION held a meeting at Niagara Falls March 17, 18 and 19, which was well attended by supply dealers from all parts of the country. Many representatives of the manufacturing interests were also present. The subject of most interest during the meeting was the reported intention of the Manhattan Electrical Supply Company to withdraw from the association. The Manhattan Company is about to open a large branch house on Forty-second Street, New York, where a full stock will be carried in addition to its present store at Park Place. It is understood that the same company may further extend its business by opening branches in other large cities throughout the country on the lines of its present Chicago store.

AMERICAN GOODS.—An American consul in Europe reports that a society recently organized in his district, whose members are expert technical men of all branches of trade, has opened a special bureau of information with a view to promoting the importation of goods of foreign manufacture. This bureau desires to be furnished with catalogues and price lists of all kinds of goods of foreign make so as to be able to put the local consumer in direct connection with manufacturers. Among the list of goods for which catalogues are requested are: motors, cables and electrical machinery. The name and address of the consul mentioned can be obtained by writing to the Bureau of Manufactures, Washington, D. C.

NEW PLANT FOR DUQUESNE LIGHT & ELECTRIC COMPANY.—It is reported that the Duquesne Light & Electric Company, of Duquesne, Pa., contemplates spending $4,500,000 in improvements, which will include a new central power plant. The company is capitalized at $500,000 and has authority to issue bonds to the extent of $10,000,000. Mr. George R. Webb, of Baltimore, was elected president of the company at a recent meeting of the directors, succeeding Mr. R. C. Hall, who becomes vice president.

STATUS OF THE COPPER MARKET.—During the week the copper market showed considerable signs of strength. Domestic consumption since March 1 has undeniably increased. But local consumers have not rushed into the market, nor has the buying been in any considerable quantities. Genuine sales of several million pounds have been made, but they were strictly in accord with existing trade conditions and in line with the current policy of consumers to buy only such amounts as are required by immediate needs. The advance in price for Lake from 13c of a week ago to 13⅛c is to some extent justified by improved conditions among electric companies, notably the General Electric Company, which, it is announced, will operate shortly on full time, having received several large equipment orders. The Phelps Dodge Company, which in normal times is selling agent for 8,000,000 pounds of copper a month, is out of the market, it is reported, having sold ahead for the next two months. The wire companies which have been buyers of copper to some extent of late are expected to come into the market shortly for large blocks of the metal, and the brass companies, which report an increased demand for their goods, will be in the market within the next month on a larger scale. Although the rumors of large sales, ranging from 1,000,000 to 3,000,000-pound lots, are ridiculed by the trade, yet the dealers are optimistic over the outlook and 15c copper by the first of May is freely predicted. The London market is slowly responding to the improved tone in the American market. Stocks in the warehouses are being steadily reduced and the market rests on a good demand and supply basis. The exports from the port of New York since the first of March reached a total on Tuesday of 15,160 tons. The stock of Standard held in England is said now to consist practically of American electrolytic. American producers have shipped their accumulated supplies to foreign buyers, and with the sign of relaxation of pressure to sell, an improvement has set in both in America and Europe.

Prices on the Metal Exchange closed Monday as follows:

Lake	12⅞@13⅛c.
Electrolytic	12¾@13c.
Castings	12⅝@12⅞c.

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	5	0	59	10	0
Standard copper, futures	50	12	6	59	17	6
Market	Firm.			Firm.		
Sales of spot				200 tons		
Sales of futures				700 tons		

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 10 0
London, futures	64 10 0	61 17 6
London, best selected	67 10 0	61 0 0

The Utah Copper Company is now producing at the rate of 40,000,000 pounds of copper yearly, and it is expected that the production will be increased to 60,000,000 yearly. The last annual statement showed that the company was producing at a cost of below 8 cents a pound. The initial dividend will be declared in July of this year. The Consolidated Copper Company, organized a year ago by interests connected with the chief stockholders in the Cumberland-Ely, Nevada Consolidated and Utah Copper Company, is to have its capital increased from $50,000,000 as one of the preliminary steps to taking over the three properties mentioned. At the same time the name is to be changed to the Copper Mines Company. By August the Cumberland-Ely and the Nevada Consolidated will each be producing at the rate of 30,000,000 pounds of copper a year. All the properties of the Amalgamated Copper Company in Montana are again in operation, one of the Anaconda and one of the Parrot companies being the last to start up. The cost of copper production in Butte during the last few years has ranged from 9 to 12½ cents a pound, but this year it is considered certain that the cost will be kept much lower.

Financial Intelligence.

THE WEEK IN WALL STREET.—Early last week the reaction on the rising market which had been expected for several days took place and the market slumped, but at no time during the fluctuations which followed did it reach former low levels. The general improvement in trade conditions was reflected in the buoyancy of the market, which rose easily on occasions and at the close of the week was at practically its highest level and holding there strongly. The week was marked by a number of disturbing elements, among which was the reduction of the dividend rate from 6 to 5 per cent by the New York Central Railroad. A freer market for securities was indicated by the many announcements of new issues made during the week and in reflection of this condition the local banks once again added substantially to their reserves. The excellent report of the United States Steel Corporation for the previous year, with gross receipts of $757,000,000, or three-fourths of the entire amount of the original capitalization of the company, was one of the most encouraging features that has appeared for a long time. The report stated that orders received in January were 25 per cent better than orders booked in December, while February's orders exceeded those booked in January by about the same percentage, and the gain in March, up to the time of issuance of the report, over corresponding days in February, was at the same rate. On Monday of this week the market closed bullish with business on a broad scale. Stock prices ended not much below the highest of a session during which United States Steel issues, recognized leaders of the market, had reached the best figures of the year. Speculative sentiment was stimulated by a series of developments helpful to securities and the market closed strong and tending upward. Closing prices on Monday were as follows:

NEW YORK.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
All-Ch.	6⅝	7	2,800	Int.-Met., com.	7½	7¼	2,775
All-Ch. pfd.	17⅜	20½*	2,250	Int.-Met., pfd.	19¾	18¾	1,850
Amal. Cop.	55¼	58½	257,170	Mackay Cos.	56½	55¾	500
Am. D. T.	39*	39*	——	Mackay Cos. pfd.	62*	61*	——
Am. Loc.	37	41½	9,910	Met. St. Ry.	16	17*	100
Am. Loc. pfd.	91½	92⅞	320	N. Y. & N.J. Tel.	98*	100	154
Am. Tel. & C'bl.	50*	50*	——	Steel, com.	33	35	397,725
Am. T. & T.	108¼*	108⅜	800	Steel, pfd.	97¼	98⅝	38,725
B. R. T.	43¾	46⅝	114,410	W. U. T.	49	49	1,320
Gen. Elec.	120¼	123½	3,279	West'h, com.	40	40¼	725
Hud. R. Tel.	—	44*	——	West'h, pfd.	59½*	40*	——

BOSTON.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
Am. Tel. & Tel.	109⅜	108¾	——	Mass. E. R. pfd.	47½	45	——
Cumb'lnd Tel.	106¼	106½	——	Mex. Tel. pfd.	5	—	——
Edison El. Ill.	202	203	——	New Eng. Tel'p.	110	109	——
Gen. Elec.	122½	123	——	W'st Tel & Tel.	7¼	6¾	——
Mass. Elec. Ry.	10½	10	——	W. T. & T. pfd.	64½	62½	——

PHILADELPHIA.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
Am. Rys.	42¾	42¾	——	Phila. Elec.	7¾	7¾	——
Elec. Co. of Am.	9⅛	9	——	Phila. R. T.	16⅝	18⅝	——
Elec. Stor. B'ty.	28	26	——	Phila. Traction.	—	86	——
E. S. B'ty pfd.	—	—	——				

CHICAGO.

	Mar. 16.	Mar. 23.	Shares sold.		Mar. 16.	Mar. 23.	Shares sold.
Chicago City Ry.	150	155	——	Met. Elec. com.	17	17	——
Com.-Edison	90	91	——	National Carbon.	52	54	——
Chicago Subw'y.	—	—	——	Nat. Carbon pfd.	103	102	——
Chicago Tel. Co.	112	120⅛	——				

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*Last price quoted.

Shares sold are for week March 16-21.

TRI-CITY RAILWAY & LIGHT COMPANY.—The regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1 to stock of record March 27, has been declared by the directors of the Tri-City Railway & Light Company, of Davenport, Iowa.

HAVANA ELECTRIC REGULAR DIVIDEND.—The regular quarterly dividend of the Havana Electric Railway Company of 1½ per cent on the preferred stock, payable April 15, has been declared by the directors of the company.

HAVANA ELECTRIC REGULAR QUARTERLY DIVIDEND.—The directors of the Havana Electric Railway Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 15.

WASHINGTON WATER POWER COMPANY DIVIDEND.—The directors of the Washington Water Power Company, of Spokane, Wash., have declared the regular quarterly dividend of 1¾ per cent, payable April 1.

UNITED RAILWAYS OF ST. LOUIS DIVIDEND.—The regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 10, has been declared by the directors of the United Railways of St. Louis.

NATIONAL CARBON REGULAR QUARTERLY DIVIDEND.—The directors of the National Carbon Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable April 15.

MANCHESTER TRACTION REGULAR DIVIDEND.—The directors of the Manchester Traction Light & Power Company have declared a regular quarterly dividend of 2 per cent, payable April 15.

COLORADO TELEPHONE REGULAR DIVIDEND.—Directors of the Colorado Telephone Company have declared the regular quarterly dividend of 1¾ per cent, payable April 15.

NEW DIRECTORS FOR THE WESTINGHOUSE MACHINE COMPANY.—At a meeting of the directors of the Westinghouse Machine Company, held in Pittsburg on Wednesday, March 18, the number of directors was increased from five to nine, the last seven of the list which follows being the new directors. Those elected were: George Westinghouse, president; H. H. Westinghouse; James C. Chaplin, vice-president of the Colonial Trust Company, Pittsburg; William McConway, president of the McConway-Torley Company, Pittsburg; W. H. Donner, Pittsburg; Wilson A. Shaw, president of the Bank of Pittsburg; Robert Wardrop, president of the People's National Bank, Pittsburg; Horace E. Smith, of the Philadelphia banking firm of Chas. Smith & Sons, and John F. Wallace, of New York, formerly the head of the Panama Canal Commission. The retiring members of the board were George C. Smith, Walter C. Herr and E. E. Keller. Mr. H. H. Westinghouse stated, while in New York, that the machine company would be taken from the receivers' hands on April 1, that being the end of the company's fiscal year. Necessary steps to this end have been taken, there remaining only minor details, such as the accounting by the receivers, receivers' fees, etc. Speaking of business conditions, Mr. Westinghouse said: "The Electric & Manufacturing Company has fared much better during the recent stress than many other lines of business and electrical prospects are much brighter. But the railroads, the largest single field of commercial enterprise in the country, have been dealt a staggering blow. Railroad men view the outlook gloomily. None of them are going ahead with improvements as in past years, and even in the case of repairs the parts are being taken from idle equipment to supply the worn-out parts on active equipment, a condition of affairs almost unparalleled. It seems that there is not much chance for an immediate change, though I am an optimist and believe always in looking on the best side of things. Railroads have cut down their operating expenses to the minimum and I believe that in order to enable them to continue there must be some radical step taken, such as an advance in rates. The question of wage reduction has come up, but at best that is an unpopular move and one that railroad men dislike very much to take. An increase in rates would not arouse much opposition on the part of shippers, I believe, for they will see that it will help things along and they will be glad, moreover, to get business on which to pay the higher rates."

ILLINOIS TUNNEL AND CHICAGO SUBWAY MERGER.—It is reported that plans are completed for merging the capitalization of the Illinois Tunnel Company and the Chicago Subway Company. An official announcement of the plan is expected shortly. Already $30,000,000 capital stock of the tunnel company has been acquired by the Chicago Subway Company, which owns the stock of the Illinois Telephone Construction Company and the Chicago Warehouse & Terminal Company. There are $17,000,000 in 5 per cent bonds of the Illinois Tunnel Company outstanding, which are secured by a first mortgage on the property, bear 5 per cent interest and mature December, 1928. The plan proposes to take up these bonds, giving in exchange a 4 per cent collateral trust bond of the Chicago Subway Company. The basis of exchange, it is reported, will be 105 for the tunnel bonds and 85 for the subway bonds. The forthcoming issue of the latter is to be about $21,000,000, secured by a deposit of the tunnel bonds and stock and other valuable securities owned by the subway company. The assent of about 90 per cent of the tunnel holders of the bonds to the proposed change has been obtained, and those holders who do not wish to take any securities in exchange will have their bonds redeemed. E. H. Harriman and J. Ogden Armour are the controlling interests in the Chicago Subway Company, and have both been opposed to the plan of merger until the earnings of the subway company were enough to take care of the fixed charges on an issue of bonds such as is now proposed.

WESTINGHOUSE READJUSTMENT PLAN PROGRESSING.—Published reports which appeared in certain New York papers to the effect that the plan of reorganization for the Westinghouse Electric & Manufacturing Company was not progressing as favorably as was expected are emphatically denied by officers of the company, and the rumor that the plan might fail is declared to be entirely unfounded. The reports stated that the creditors of the company, who are scattered all over the country, have not responded in the manner expected and said that the matter of raising $7,000,000 working capital by the sale of an equal amount of assenting stock at par, or $50, was a matter of concern over which there were many misgivings. "There is no truth whatever in those statements," said one close in touch with the company's affairs; "such rumors are being constantly circulated among the newspapers by irresponsible persons and have absolutely no foundation in fact."

MARCONI COMPANY REPORT.—The annual report of the Marconi Wireless Telegraph Company, which will be mailed to the stockholders on March 30, will show a considerable improvement over the report of last year. The gross receipts received for messages sent during the year will be $8,250 more than for similar receipts in 1906-7, and profit and loss will also show an improvement for operations during the last 12 months. Gross profits will show an increase from $8,157.01 in 1906-7 to $13,822.55 in 1907-8, a gain of $5,665.54, or nearly 70 per cent. A saving of about $6,500 will be shown in administrative and general expenses, and a net decrease of more than $12,000. The report will call attention to a number of vessels equipped with the Marconi apparatus during the last year, and to the extension of the series of land stations which is planned. Certain valuable patents have been acquired and the rights to others are in the process of completion.

A $36,000,000 POWER CORPORATION FOR MACON, GA.—Announcement is made of the formation of the Central Georgia Power Company, a company capitalized at $36,000,000, which will develop the water powers of Middle Georgia. The new company, following conferences with the Governor and the Railroad Commission at Atlanta, was authorized by the latter to issue $20,000,000 in bonds and $16,000,000 in stock. At the conclusion of the conferences President W. J. Massee, of Macon, left for New York in company with James G. Campbell, partner in the banking house of A. B. Leach & Company, of New York, Boston and Chicago, which is said to have taken the bonds. Contracts will be entered at once for the expenditure of $25,000,000. The headquarters of the company will be at Macon.

ELECTRIC STORAGE BATTERY COMPANY REPORT.—For the fiscal year ended Dec. 31, 1907, the Electric Storage Battery reports gross earnings of $1,075,226, as compared with gross earnings of $1,331,799 for 1906, and a total net income of $821,274, as compared with $1,059,372 for the previous year. Dividends of $812,450 were declared, leaving a net surplus of $8,824, as compared with the net surplus for 1906 of $246,922. The total surplus was $3,669,327, a decrease of $85,124 from the previous year. Francis E. Bond, A. C. Humphries and William D. Winsor were elected directors to succeed Harry Payne Whitney, Thomas Dolan and H. H. Vreeland, who resigned Otherwise no changes were made in the directorate.

CENTRAL UNION TELEPHONE COMPANY.—The Central Union Telephone Company, of Chicago, is negotiating for the control of the Indianapolis Independent Telephone Company. At present the Central Union Company has 400,000 stations in Illinois, Indiana and Ohio. Frederick P. Hanson and Ernest M. Kimball, of Chicago, have been elected directors.

PASADENA, CAL., MUNICIPAL BONDS.—The city of Pasadena, Cal., is inviting proposals for $100,000 in 4½ per cent municipal improvement bonds, part of the proceeds to be devoted to a municipal lighting plant. At an election held Feb. 20 the vote on such a plant was 1318 in favor and 454 against. Bids will be opened March 31.

AUTOMATIC TELEPHONE MERGER RUMORED.—Dispatches from Chicago state that Ogden Armour, of that city, is holding conferences with interests connected with the Chicago automatic telephone systems, with a view to combining the automatic telephone systems of the country.

AMERICAN CITIES RAILWAY & LIGHT DIVIDEND.—The directors of the American Cities Railway & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1.

ROCHESTER RAILWAY COMPANY.—The regular quarterly dividend of 1¼ per cent on the preferred stock has been declared by the directors of the Rochester Railway Company. The dividend will be payable April 1

CINCINNATI STREET RAILWAY DIVIDEND.—The directors of the Cincinnati Street Railway Company have declared the regular quarterly dividend of 1½ per cent. payable April 1.

ELECTRIC BOAT REGULAR DIVIDEND.—The regular dividend of 2 per cent on the preferred stock, payable April 1, has been declared by the directors of the Electric Boat Co.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

RUSSELLVILLE, ALA.—The citizens are considering the question of establishing an electric light plant and water works system.

SLOCOMB, ALA.—We are informed that A. C. Kelley and M. E. Dougherty are interested in the construction of an electric light plant, the cost of which is estimated at $5,000, and for which bids are now being received.

EUREKA SPRINGS, ARK.—M. B. Baird, of Tulsa, Okla., has purchased the famous Blue Spring and properties surrounding the Walden Switch on the north side of the White River, and proposes to install an electric plant, which will secure its power from the source of the spring. The company will be known as the Eureka-Blue Spring Water Company and intends to establish a pleasure resort.

LODI, CAL.—An election will soon be held to vote on the proposition to issue bonds to establish water, light and sewer systems.

PASADENA, CAL.—The Pacific Electric Railway has decided to double-track all of its lines in Pasadena. H. E. Huntington is president of the company.

REDDING, CAL.—Harry L. Shannon, of San Francisco, has appropriated 2000 cu. in. of water of the Bear Creek, 15 miles southeast of Redding, the water to be diverted through a canal to a power house, where electricity will be generated. Mr. Shannon was the organizer of the Northern California Power Company, and also of the Shasta Power Company. He is not now connected with either company, but states that he will soon have another company in the field.

RIVERSIDE, CAL.—Plans are being made by the Riverside & Arlington Railway Company to build a new electric railway to Crestmore, where the large cement works of the Southern California Cement Company are in course of construction. Right of way for the railway has already been secured.

SANTA ANA, CAL.—A proposition recently submitted by N. A. Ulm to build an electric railway from Tustin through this city across the Santa Ana River to Huntington Beach has been endorsed by the Merchants and Manufacturers' Association. A committee has been appointed to secure subscriptions to the stock. The road will be built by local capital and will be operated independently. The cost of the road is estimated at $150,000.

WOODLAND, CAL.—The Pacific States Telephone Company is reported to be contemplating extensive improvements in its service in central and northern California, principally on the west side of the river.

NEW HAVEN, CONN.—The United Illuminating Company is preparing to install turbines at its power plant between the Mill River bridges in Grand Avenue.

WESTPORT, CONN.—The Westport Electric Company has made arrangements to extend its transmission lines on Compo Street to the Beach and expects to be able to furnish electricity for lamps by May 1.

SMYRNA, DEL.—The Diamond State Rapid Transit Company, recently incorporated for the purpose of constructing an electric railway from Delaware City to Lewes, is making arrangements to commence the construction of the road. The railway will be 98 miles in length. The power station will be located at St. Georges. John D. Thompson, of Wilmington, architect, has been engaged to prepare plans for the power house. It is expected that construction will commence within 60 days. J. W. Endean is general manager.

WILMINGTON, DEL.—A syndicate, with a capital stock of $1,000,000, has been formed to construct an electric railway from Lewes to Rehoboth, and Ocean City, Md. The promoters are said to be Philadelphia and Wilmington men.

WASHINGTON, D. C.—Bids will be received at the Government Printing Office, Washington, D. C., until April 15 for furnishing electrical supplies, etc., during the fiscal year ending June, 1909. Blank proposal forms and other information may be obtained by addressing the above office. Henry T. Brain, acting Public Printer.

WASHINGTON, D. C.—Bids will be received until March 31, at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yard, New Orleans, La., a portable electric grinder, as per schedule 907. Applications for proposals should designate the schedule desired by number. E. B. Rogers is paymaster-general.

WASHINGTON, D. C.—Bids will be received until April 15 at the Department of the Interior, Washington, D. C., for furnishing electrical supplies, etc., during the fiscal year ending June 30, 1909. Forms of proposals, etc., will be furnished on application; requests for blanks must designate the classes of supplies upon which it is proposed to bid. James Rudolph Garfield is secretary.

WASHINGTON, D. C.—Bids will be received at the office of the Secretary of Department of Agriculture, Washington, D. C., until April 15 for furnishing electrical supplies, etc., during the fiscal year ending June 30, 1909. Full information will be furnished on application to the disbursing clerk. James Wilson is secretary.

WASHINGTON, D. C.—The Senate has passed the bill authorizing the construction of a dam and bridge across the Missouri River near Great Falls. The bill as passed confers authority on the Secretary of War to permit the Missouri River Improvement Company of Montana to construct a dam across the Missouri River, with canal and appurtenances for water-power and other purposes.

MACON, GA.—The Central Georgia Power Company has received permission from the State Railroad Commission to issue $16,000,000 in capital stock and $20,000,000 in bonds. The company is planning to develop various water power properties on the Oconee, Ocmulgee and Flint rivers owned by the company. The first plant will be erected on the Ocmulgee River, eight miles from Jackson, which is capable of developing 18,000 horse power, the cost of which, including the entire equipment and transmission lines, is estimated at $1,850,000. Lockwood, Greene & Company, of Boston, Mass., have charge of the construction of the plant. Contracts will soon be awarded for the work. W. J. Massee, of Macon, is president of the company.

MADISON, GA.—The new municipal electric light plant has been completed and was put into operation March 10.

HAILEY, IDAHO.—Arrangements are being made to operate the Crœsus mine and new mill by electricity. The Cramer Electric Company will furnish electrical energy and is now extending its transmission line to the mine.

PARIS, IDAHO.—Extensive improvements are contemplated by the Bear Lake Electric Light & Power Company to its plant, which will involve an expenditure of about $12,000. The company contemplates putting in a pipe line from the spring, which forms the head waters of Paris Creek, to the site of the present power house, and the erection of a new power house. The plant will have an output of about 1000 hp, which will be sufficient to light the whole valley and to operate an electric railway from Montpelier to the lake.

CHICAGO, ILL.—The Chicago City Railway Company has purchased a site at Brighton Park on which it proposes to erect a power station and car barns.

CHICAGO, ILL.—Work will commence on April 1 by the Chicago & Northwestern Railway Company and the Chicago, Burlington & Quincy Railroad Company on the installation of the electrical equipment for the Wood Street freight yards, which will involve an expenditure of $2,000,000.

DECATUR, ILL.—The City Council has granted a franchise to the Decatur, Sullivan & Mattoon Interurban Railroad Company. The company has secured the entire right of way, and it is expected that work on the construction of the road will begin soon. The power plant will be located in Decatur. R. B. Starbuck, of Mattoon, is president of the company.

GALATIA, ILL.—The Galatia Independent Telephone Company has increased its capital stock from $1,056 to $2,480.

LEMONT, ILL.—The Village Board is considering the question of installing electrical apparatus in the pumping station to replace the present steam plant. The contract for street lighting does not expire for another year. It is expected that provision will be made for an all-night service and additional lamps.

MATTOON, ILL.—The Mattoon-Hillsboro Interurban Railroad Company has secured all of the right of way for its interurban line with the exception of Mattoon. It is expected that the franchise will be acted on favorably soon. The power plant will be located in Mattoon. W. R. Patton, of Charleston, is president of the company.

NOBLESVILLE, IND.—We are informed that the Noblesville Heat, Light & Power Company has extended its transmission line to Federal Hill, a suburb of Noblesville, and has also taken a contract to supply electricity for lamps and motors in Cicero, and is planning to extend its transmission lines to other near-by towns. C. E. Layton is manager.

PLYMOUTH, IND.—The capital stock of the Winona Telephone Company has been increased to $100,000, and arrangements made to complete to farmers' lines, several of which were commenced last fall, but owing to the early winter were not completed.

UNIONDALE, IND.—The directors of the rural telephone lines of Uniondale and Poe have decided to unite and construct a commercial line from Poe to Ossian, thereby extending the services of both companies. The officers of the Uniondale line were elected as follows: Frank Hoopengardner, manager, and Wells Newhard, secretary and treasurer.

ATLANTIC, IA.—The Atlantic Gas & Fuel Company, which has recently been organized under a new management, proposes to furnish electricity and gas for lighting.

CLEAR LAKE, IA.—The local telephone company is contemplating a number of changes and improvements to its system, including the installation of a new switchboard, new cables and extension of lines.

DAVENPORT, IA.—The Independent Light & Power Company has given to the German Trust Company a trust deed covering all its property rights, franchises, etc., to secure an issue of $600,000 in bonds.

TOPEKA, KAN.—William C. Stewart, superintendent of the municipal electric light plant at St. Joseph, Mo., has been engaged to investigate the Topeka municipal electric light plant and street lighting system to make an estimate of the cost of rebuilding and extension of the municipal electric lighting system, with a view of asking for a vote April 7 on the proposition of issuing bonds to enlarge the same.

LOUISVILLE, KY.—The Board of Aldermen has passed an ordinance granting a franchise to the George G. Fetter Company, which will enable the company to sell electricity within a limited district in the city, for which he is to pay the city $5,000.

NEW ORLEANS, LA.—The City Council has granted to D. O. Hewitt, of McCook, a 20-year franchise to construct and operate an electric light and power plant. A. R. Scott, of McCook, is consulting engineer.

SHREVEPORT, LA.—The City Council has passed an ordinance granting a franchise to John Lorenz to construct and operate an electric railway in this city.

SANFORD, MAINE.—The citizens have voted to accept the proposal of the Sanford Light & Power Company to enter into a contract for street lighting for a period of 10 years. Under the terms of the contract the company is to furnish incandescent street lamps at $10 per lamp per year, which is $2 less than the town is paying under the present contract.

ANNAPOLIS, MD.—The Maryland Senate has passed the bill incorporating the Wicomico Electric & Power Company.

CLINTON, MASS.—The committee of the Board of Trade appointed last summer to investigate the matter of procuring for Clinton the electricity to be generated at the Wachusett dam by the Metropolitan Water and Sewerage Board, has submitted its report, in which it states that electrical energy to the amount of 2500 hp hours for 3000 hours per year will be generated at the dam, which the Metropolitan Water and Sewerage Board is willing to dispose of at $15 per horse power under certain conditions. The committee recommends that steps be taken toward making a contract with the board for the entire amount, to be bought in bulk and distributed to the smaller industries.

HOLYOKE, MASS.—Proposals will be received until March 28 by W. H. Snow, manager of the Gas and Electric Department, for enlarging and altering the municipal electric light station of the city of Holyoke, plans and specifications for which can be obtained from the superintendent of the station.

PETERBORO, MASS.—The citizens have voted to appropriate $3,800 for repairs and improvements to the municipal electric light plant; also to extend the commercial and street lighting service in the town, providing those desiring commercial lighting will pay for the wiring from the present terminus at the Carter corner to their residences.

SALEM, MASS.—The County Commissioners are planning to construct a new boiler house at the county jail, and when completed it is probable that an electric lighting plant will be installed to furnish electricity for lamps for the county buildings.

SOUTH FRAMINGHAM, MASS.—At the annual town meeting the citizens voted to award the contract for street lighting to the Edison Electric Lighting Company for a term of one year and to increase the appropriation to $9,000 for a one-year contract. The company submitted the same proposal as in previous years, offering a 5 per cent reduction on a five-year contract, with provision that the town may revoke the contract at any time on 90 days' notice if it should decide to enter into municipal lighting, and to change the street lamps from 32 to 40 cp.

WAKEFIELD, MASS.—The question of abandoning the municipal lighting plant and purchasing electricity and gas for the town from some private corporation, or the expenditure of $72,000 to put the plant in first-class condition, is being seriously considered by the town. It is claimed that the plant has been run at a loss for the last few years. A committee of nine has been appointed to investigate the matter and was also authorized to secure the services of an expert at a cost not to exceed $800, and to report not later than the November town meeting. The estimated cost of putting the electrical branch of the plant in up-to-date condition is $52,000, and an expenditure of $20,000 will be required for the gas plant.

WEST MEDWAY, MASS.—A proposition has been submitted by the Edison Electric Illuminating Company to furnish the town with electricity for street lamps at a reduced rate for a long period. If a contract is made for 10 years a discount of 10 per cent will be given, which will make the rate $15 per lamp per year, or a discount of 20 per cent for a 20-year contract, making the price for each lamp $12 per year.

ANN ARBOR, MICH.—The new power plant of the Washtenaw Power Company at Lowell has been completed. The plant is equipped with all the appliances for the thorough scientific testing of the flow of water and securing data concerning turbine power under all conditions. The plant is to be placed at the disposal of the engineering department of the university as an experimental station for the use of the students in that department.

HASTINGS, MICH.—Bids will be received by the Thornapple Gas & Electric Company for the construction of its proposed substation.

MENOMINEE, MICH.—The Menominee Light & Traction Company is planning to develop the water-power of the Menominee River at Chappee Rapids, four miles from this city, and will erect a large power plant at that place at a cost of $400,000. The company will transmit electricity to Menominee and Marinette, Wis., for lamps and motors. The interurban railway between Menominee and Escanaba will be built as soon as the right of way can be secured.

UTICA, MICH.—The capital stock of the Utica Electric & Water Company has been increased from $22,000 to $30,000.

WAYNE, MICH.—The Village Council has entered into a contract with the Washtenaw Light & Power Company to furnish electricity to light the streets of the village. The company is to install a plant and have it in operation by Oct. 1. The streets are now lighted by an acetylene gas plant, owned by the village, which will be abandoned.

BEMIDJI, MINN.—The Beltrami Electric Light & Power Company has resumed work on its dam at the rapids in the Mississippi River. The plant will be in operation in August.

CROOKSTON, MINN.—Arrangements are being made to build a co-operative farmers' telephone line, with 40 miles of pole line between Haug and Greenbush and Badger.

LAKE CRYSTAL, MINN.—The property of the Lake Crystal Milling Company, which includes the city electric light plant, was sold at auction March 12 to C. S. Christenson, of Madelia, for $12,500.

MINNEAPOLIS, MINN.—An ordinance granting a franchise to the Northern Heating & Electric Company has been introduced in the City Council. Thomas McDermott, of St. Paul, is attorney for the company.

MINNEAPOLIS, MINN.—H. L. Burdick, superintendent of the Rocky Mountain Bell Telephone Company, has announced that an eastern extension of the lines through Montana has been planned for this year.

THIEF RIVER FALLS, MINN.—The Thief River Falls Electric Railway Company has decided to purchase a site for a dam at some point along the Red Lake River. It is proposed to develop the water power to furnish electricity to operate the proposed electric road.

GULFPORT, MISS.—Plans are being made by the Gulfport & Mississippi Traction Company to increase the output of its power plant by 1500 kilowatts. The new equipment will include the installation of a turbo-generator set. The cost of the improvements is estimated at $120,000.

HATTIESBURG, MISS.—Arrangements have been made by the Hattiesburg Traction Company for the sale of $300,000 in bonds, the proceeds of which will be used for the erection of a new electric light and power plant, and the completion and equipment of the street railway system, for which seven miles of track have already been laid. Work on the construction of the power plant will begin early in April, and it is expected to have the street railway system in operation during the summer.

AURORA, MO.—The Cassville & Western Railroad has been purchased by a syndicate of Eureka Springs, Ark., capitalists. The road will be equipped to be operated by electricity and will be extended to Roaring River.

KANSAS CITY, MO.—J. C. Herring, chief engineer of the Kansas City & Southeastern Railroad Company, writes that surveys have been completed and the right of way secured for a railway, about 30 miles in length, which will extend from Kansas City through various towns. The present plans contemplate operating the line with gasoline electric cars. An issue of $600,000 in bonds will be floated to build the road. The officers of the company are: Charles A. S. Sims, president; H. W. Gibson, vice-president; B. F. Shouse, treasurer, and George P. Norton, general attorney, all of Kansas City, Mo.

OMAHA, NEB.—It is reported that the owners of the Boyd Opera House have decided to install a private lighting plant.

HENNIKER, N. H.—The citizens have voted to extend the electric lighting service to the Wilkins Mill.

NEW MARKET, N. H.—At a town meeting held recently the citizens voted to postpone indefinitely the proposition to install a municipal electric light plant. The Selectmen were authorized to enter into a contract with the New Market Electric Light, Power & Heat Company to furnish electricity to light the street and public buildings for a term of five years at a cost of $2,000 per year. In case they cannot make a contract at the above price, they are authorized to make a contract for one year at $2,400, the price paid last year.

ROCHESTER, N. H.—The local telephone exchange was destroyed by fire recently, entailing a loss of about $15,000.

RUMNEY, N. H.—Arrangements are being made to organize a stock company for the purpose of establishing an electric light plant in the town. The citizens have voted to enter into a contract with the company, should it become incorporated, to light the streets of the town at a rate of $500 per year, using 65 incandescent lamps.

TILTON, N. H.—The Town Board is considering the question of securing an improved electric lighting service.

EGG HARBOR CITY, N. J.—Steps are being taken by the Egg Harbor City Telephone Company to construct a telephone line from Green Bank to Lowe Bank.

MORRISTOWN, N. J.—The Morris County Traction Company is making plans to resume work on the construction of its railway between Union and Elizabeth.

PATERSON, N. J.—Announcement has been made by Thomas N. McCarter, president of the Public Service Corporation, that the cost of lighting for the County of Passaic would be reduced from $140 to $100 per lamp per year. Although the present contract will not expire for three and one-half years, the change in price will go into effect immediately. The county will also be able to light the county thoroughfares and bridges within the city limits at the same rate as paid by the city, which is $78 per lamp per year, making a saving of $62 on each lamp.

VINCENTOWN, N. J.—Plans are being made by the citizens of this town to incorporate a telephone company to construct a telephone line from Vincentown to Tabernacle.

VINELAND, N. J.—The Governor has signed the bill appropriating $20,000 for a new lighting and heating plant for the Vineland Soldiers' Home.

MELROSE, N. M.—Contracts have been let by the Roosevelt County Telephone Company for the construction of an extension to its toll line west of Melrose, which will be 40 miles in length; also for the construction of an exchange building for both the toll and local systems, to replace the building which was recently destroyed by fire.

ARCADE, N. Y.—The citizens on March 17 voted to establish a municipal electric light plant to cost $35,000.

BROOKLYN, N. Y.—Extensive improvements are being made by the Coney Island & Brooklyn Railroad Company, which include the installation of a high-tension transmission system, the replacing much of the rolling stock and the overhauling of its roadbed. The cost of the work is estimated at $1,500,000. S. W. Huff is president of the company.

EAST WORCESTER, N. Y.—The Public Service Commission, second district, has granted the petition of the Great Bear Light & Power Company to construct its plant and exercise its franchises within the villages of Worcester, West Richmondville and Richmondville; also for permission to issue $20,000 in capital stock, a first mortgage for $20,000, and $20,000 in bonds to be secured by said mortgage.

NEW YORK, N. Y.—Bids will be received by the Board of Health, Department of Health, corner of Fifty-fifth Street and Sixth Avenue, Borough of Manhattan, until April 1, for furnishing materials and installing electric and gas lighting fixtures in the Measles Pavilion of the Kingston Avenue Hospital, Kingston Avenue and Fenimore Street, Borough of Brooklyn. Thomas Darlington, M. D., is president of Board of Health.

NEW YORK, N. Y.—Bids will be received until March 30 by C. B. J. Snyder, superintendent school buildings, for electrical equipment for public schools as follows: No. 153, Borough of Manhattan; No. 17, Borough of Brooklyn; No. 90, Borough of Queens.

RANDOLPH, N. Y.—The plant and holdings of the East Randolph Telephone Company, with exchanges at Randolph, Conewango, Steamburg and Kennedy, has been purchased by John H. Wright, of Jamestown. The company has a capital stock of $10,000, with a bond issue of $10,000.

GREENSBORO, N. C.—The new Proximity mill now under construction will be operated by electricity generated at the power plant of the White Oak Mill, the equipment of which is now being increased by the installation of two additional steam engines of the Corliss type of 2000 hp each, direct connected to two 1500-kw generators.

SILER CITY, N. C.—Arrangements are being made by the Matthews Telephone Company for the construction of a telephone line from this place to Ramseur.

BRYAN, OHIO.—The City Council has passed an ordinance providing for an issue of $10,000 in bonds for improving the electric light and water plant.

MONTPELIER, OHIO.—The citizens have voted to issue $30,000 in bonds for rebuilding the municipal electric light plant and water works system.

NORWALK, OHIO.—The capital stock of the Local Telephone Company has been increased from $400,000 to $600,000, the proceeds to be used for improving and developing the system and to take care of its rapidly increasing business.

WEST TOLEDO, OHIO.—A bill has been presented in the State Legislature to authorize townships trustees to make contracts for lighting the streets of unincorporated villages upon petition of the owners of the majority of the foot frontage of the streets to be lighted. The bill is general, but was drafted upon request of West Toledo citizens.

YOUNGSTOWN, OHIO.—Preparations are being made by the Central Union Telephone Company for the construction of an underground conduit system.

CLINTON, OKLA.—The Clinton Light & Power Company is reported to have closed a contract for the construction of a power house.

ALBANY, ORE.—Announcement has been made that the present horse-car street railway will be equipped to be operated by electricity at once and will be in operation within 60 days. The Willamette Valley Company will supply electricity for the system. Additional machinery will be installed in the plant, which has already arrived. J. E. Ross is local manager of the railway system.

KLAMATH FALLS, ORE.—Application has been made to the City Council by W. H. Mason, representing the Inland Electric Company, for a franchise to construct and operate an electric railway from the eastern limits of the city to the terminus of the line of the Klamath Falls Land & Transportation Company. The Inland Electric Company proposes to construct and operate an electric railway between Klamath Falls and Merrill, a distance of 25 miles.

GLENDALE, ORE.—The officers of the local telephone company have decided to extend a rural telephone line from this city to Fernvale.

MEDFORD, ORE.—Plans are being made by the Oregon Rapid Transit Company for the construction of a network of electric railways to cover the Rogue River Valley from Grant's Pass to Ashland. The company has located water rights for the development of 30,000 horse-power, but is now negotiating with the Condor Water & Power Company for electrical energy. The officers of the company are: F. C. Page, president; S. E. Nye, secretary; F. E. Herrick, treasurer, and F. L. Evans, general manager.

PORTLAND, ORE.—The City Council has granted a franchise to the United Railways Company for the construction of its lines to Mount Calvary Cemetery and Hillsboro.

HANOVER, PA.—Plans have been completed for the extension of the Hanover Street Railway to Littlestown, by the way of McSherrystown, a distance of seven miles. The contract for the work has been awarded to John Dobbling, of York. Another extension five miles in length is contemplated from McSherrystown to New Oxford. The projected line will then be extended to Berlin Junction, where the East Berlin Branch Railway, a steam railway, will be equipped to be operated by electricity, and the road continued through Abbottstown to East Berlin. When the railway is completed to Littlestown it is proposed to extend the electric railway to Gettysburg, 10 miles distant.

JOHNSTOWN, PA.—The application of the Johnstown Passenger Railway Company for permission to extend its railway system from East Conemaugh to the substation now under construction for the company, a distance of four and one-half miles, has been approved by Governor Stuart.

LANCASTER, PA.—The application of the Rohrerstown, Landisville & Mount Joy Railway Company for permission to extend its railway system in the town of Mount Joy has been approved by Governor Stuart.

MONONGAHELA, PA.—The Monongahela & Carroll Street Railway Company has been granted a franchise over Park Avenue to the city limits by the City Council. George Hosack is president of the company.

SHAMOKIN, PA.—Plans are being made by the Shamokin-Mt. Carmel Transit Company to enlarge its power station and install a 750-hp Corliss-Cooper engine and a 500-kw General Electric generator.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has awarded contracts for the erection of the transmission line between Greencastle and Chambersburg, and for the substation at Marion to J. G. Schaff Electrical Company, of Chambersburg, and the Westinghouse Electric & Manufacturing Company. Additional machinery for the power house will be purchased in the near future.

YORK, PA.—Surveys are being made for the proposed York, Glen Rock & Shrewsbury Electric Railway. S. M. Manifold is engineer for the company.

INTERIOR, S. D.—Arrangements are being made by the Interior Telephone Company for the extension of its lines from Interior to Rapid City, and from Chamberlain into Pukwana, and from there to Brule. J. W. Sanford is president of the company.

MILLINGTON, TENN.—The electric light plant and water works system have been purchased by J. W. Page, of this place.

PIOCHE, NEV.—A local telephone system will soon be established in the place.

BROWNSVILLE, TEX.—A street railway franchise has been granted by the City Council to John G. Fernandez, A. C. Brokaw, F. W. Kidde and others of Brownsville.

CHILDRESS, TEX.—The City Council closed a contract for a 24-hour electric light system, which is to be in operation by June 1. The Council has also granted a franchise for an electric street railway system, two miles of which is to be in operation within the next year.

ELSINORE, UTAH. The citizens are considering the question of installing an electric light plant in this place. It is proposed to install a dynamo and other necessary machinery in the Elsinore Mill to generate electricity by water power from the river at that point. J. M. Parry, Joseph Bland and others are interested in the project.

LOGAN, UTAH.—The High Creek Electric Light & Power Company is installing an additional 350-kw generator and 500-hp turbine to the present equipment of its plant. The company now furnishes electricity for lamps and motors in Smithfield, Richmond, Lewiston and Trenton, Utah, and Franklin and Preston, Idaho. J. I. Shepard, of Richmond, is general manager.

SALT LAKE CITY, UTAH. The contract for the erection of the transmission line of the Strawberry Valley irrigation project has been awarded to Henry Gardiner, of Spanish Fork, Utah. This transmission line will be about 30 miles in length and will extend from the power plant of the U. S. Reclamation Service, near the mouth of the Spanish Fork Canyon, to the west portal of the Strawberry tunnel, where the electrical power will be used for the completion of the tunnel.

CHRISTIANSBURG, VA.—The Montgomery Electrical Company, recently incorporated, has been organized and the following officers elected: J. L. Vaughn, of Roanoke, president; E. S. Hagan, vice-president; T. W. Simpson, chief engineer, and E. J. Jones, consulting engineer. The company has acquired the property of the Greyson Electric Company and the municipal plant at Christiansburg.

ROANOKE, VA.—Bids will be received until March 31 by W. E. Thomas, city clerk, for lighting the streets, alleys and public parks of the city with 250 or more electric arc lamps for a term of five years from Nov. 1, 1908, until Nov. 1, 1913. Bids will also be received for furnishing electrical energy for 250 or more arc lamps; also for constructing and equipping an overhead lighting system to be owned by the city, consisting of all the necessary fixtures, wires, poles, lamps, etc. W. B. Bates is city engineer.

CHEHALIS, WASH.—Application has been made to the City Council by Eugene A. Marsh, representing the Seattle Electric Company and the Northwestern Long-Distance Telephone Company, for a franchise for the construction of an electric railway, light and power plant and telephone and telegraph system in Chehalis and Centralia.

ROSALIA, WASH.—Extensive improvements are contemplated for the town, including the installation of an electric lighting and water works system. The Inland Empire Electric Railroad Company has a franchise for an electric lighting system, and promises to have the system in operation by July.

MEDICAL LAKE, WASH.—The Washington Water Power Company has commenced work on the erection of its transmission line from this place into the Big Bend country. The company will furnish electricity for lamps and motors in Reardan, Davenport, Harrington, Sprague and other places.

NORTH YAKIMA, WASH.—Plans are being made by the Northwest Light & Power Company to extend its transmission lines to Wapato and Toppenish. It is stated that the line will cost about $1,600 per mile, but if enough business can be secured to pay the interest on the investment the extension will be made. It is also planned to erect substations in the towns.

APPLETON, WIS.—The Fox River Valley Telephone & Telegraph Company is installing a new switchboard in the local exchange and also in its exchange in Wrightstown. The company will also build exchanges in Kaukauna, Neenah and Menasha.

JUNEAU, WIS.—Plans are being prepared by W. G. Kirchoffer, Madison, Wis., for a two-story power house for the city.

KEWAUNEE, WIS.—At an election to be held May 18 the citizens will vote on the proposition to issue $20,000 for an electric light plant.

MILWAUKEE, WIS.—An estimate of the cost of a municipal electric light plant prepared by R. W. Hunt & Company, of Chicago, Ill., has been submitted to the Common Council. Estimates were made upon the basis of 2000 and 3000 arc lamps, with one extra unit for commercial purposes in each instance. Separate reports were also given for plants run by gas and by steam. A plant operated by gas with an output for 3000 lamps will cost $1,245,449, while for 2000 arc lamps the plant would cost $920,000. A steam plant for 2000 arc lamps will cost $823,492, and for 3000 lamps $1,079,607. The above estimates were furnished to the Board of Public Works in compliance with a resolution adopted by the Common Council in February for the purpose of letting the people know the cost of the plant when they vote on the question of municipal lighting at the April election.

MONROE, WIS.—The Monroe Electric Light & Power Company has submitted a proposition to the City Council for a renewal of the street lighting contract, whereby the company agrees to install new magnetic lamps at the same price that is now paid by the city for the lamps now in use, which is $65 per month, and if the city decides to change the schedule from 12:30 o'clock until 1 o'clock the cost will be $69 per month. The contract is to be for a term of 10 years.

MUSCODA, WIS.—The Village Council has awarded the contract for the construction of the dam at Balmoral, about three miles north of the village, to Salmon & Rasqua, for $2,850. The dam, which furnishes power for operating the municipal electric light plant, was washed out about six weeks ago, leaving the village in darkness. The cost of the work when completed will cost about $15,000.

CHEYENNE, WYO.—Bids will be received until April 15 at the office of the constructing quartermaster, Cheyenne, Wyo., for steam heating, plumbing, electric wiring and furnishing and installing electric light fixtures in the various buildings at Fort D. A. Russell. Specifications and blank form of proposal may be obtained at this office. Plans and specifications for the work specified above, for the inspection of bidders, will be placed as follows: In office of depot quartermaster, Omaha, Neb.; chief quartermaster, Chicago, Ill.; depot quartermaster, St. Louis, Mo.; depot quartermaster, New York, N. Y.; chief quartermaster, Denver, Col. Captain V. K. Hart, acting quartermaster, U. S. Army, has charge of construction.

SHERIDAN, WYO.—It is reported that S. A. Broadwell, representing Eastern capitalists, is negotiating with the City Council for an electric railway franchise. It is proposed to connect the large coal camps with the city.

EDMONTON, ALB., CAN.—Plans have been prepared by City Engineer Keeley for the proposed electric light plant, the cost of which is estimated at $149,000.

LADYSMITH, B. C., CAN.—Mayor Nicholson has promised the Citizens' League that he will endeavor to arrange for the construction of a civic electric lighting plant.

REGINA, SASK., CAN.—W. W. Hilton, architect, has a proposal for the development of electrical power at the Government dam now being constructed.

MISSION, B. C., CAN.—J. Wintemute, of this town, has been granted permission to use 300 cu. in. of water from Silver Creek, and proposes to install an electric plant to furnish electricity for this town.

NEW WESTMINSTER, B. C., CAN.—S. S. McDiarmid, of Vancouver, representing the Sunset Power Company, has made application for 15,000 cu. in. of water from the Quanli River.

PHOENIX, B. C., CAN.—The Granby Consolidated Copper Company is making arrangements to improve and enlarge its smelting works near Grand Forks. Orders have been placed for machinery and additional electrical equipment, which will increase the output of the smelters to 4500 tons per day. An engine of 500 horse-power will be installed. The converter plant will be enlarged, and the new converters will be operated by electricity. Two new blowers will be operated by four 150-hp electric motors. The cost of the improvements is estimated at $200,000. A. B. W. Hodges is local manager.

CRYSTAL CITY, MAN., CAN.—At the annual meeting of the Louise Telephone Company it was decided to endeavor to purchase all the government telephone lines within the municipality of Minto. For further information address W. J. Mutch, Crystal City, Man.

RUSSELL, MAN., CAN.—The United Telephone Company has been formed, with a capital of $20,000, to take over the business of the Russell Telephone Company. It will build a number of extensions and generally improve the system. Goodbun Brothers, of Russell, are managers.

WINNIPEG, MAN., CAN.—The City Council has decided to proceed with the water-power development at Point du Bois Falls as soon as possible and the Board of Control has taken steps toward the construction of the tramway from Lac du Bonnet to Pointe du Bois.

WINNIPEG, MAN., CAN.—A by-law is now in preparation ordering all the wires of the Winnipeg Electric Company underground. F. I. Cambridge is city electrician.

WINNIPEG, MAN., CAN.—The Municipal Power League has presented a petition to the City Council which calls for the immediate construction of the civic power plant at Lac du Bonnet at an estimated cost of $3,250,000. Cecil B. Smith is consulting engineer.

NEW SARUM, ONT., CAN.—A new telephone company has been organized with the following directors: G. L. Sommers, David Caughell, W. Rockie, Bruce Griffin, L. R. Cloes, S. Penhale. David Caughell is chairman and B. Griffin secretary.

OTTAWA, ONT., CAN.—A bill is before Parliament giving entire control of telegraph and telephone systems in the Dominion to the Railroad Commission. The commission will have power to fix rates and enforce the carrying out of agreements between companies and municipalities or individuals.

PORT ARTHUR, ONT., CAN.—An agreement has been reached regarding the purchase of the portion of the municipal street railway system which runs in Fort William. The price will be agreed upon by arbitration, but in the meantime this city will continue to run the system as before by supplying electrical energy, etc. An agreement is now being drawn up which provides that the city of Port Arthur is to supply the electrical energy unless it can be obtained cheaper elsewhere. Address Mayor Carrick, of Port Arthur, or Mayor Murphy, of Fort William.

ST. CATHERINE'S, ONT., CAN.—The city has granted an extension of time till Aug. 1 next to the Falls Power Company for supplying electricity to the city. The price to be paid is $39.50 per arc lamp per year. J. Albert Pay is Mayor.

TORONTO, ONT., CAN.—The city has stopped all negotiations with the Toronto Electric Light Company and will make application at once to the Hydro-Electric Power Commission for a supply of electrical energy to the amount of 7500 kw.

WELLAND, ONT., CAN.—It is reported that the British Canadian Smelters, Ltd., are preparing to erect a large plant on the Niagara River, in the township of Willoughby, and are now negotiating with the Hydro Electric Power Company for electrical energy to operate the plant.

GANANOQUE, QUE., CAN.—A by-law providing $10,000 for the completion of the electric lighting plant was passed by the ratepayers. Address R. H. Williams.

MOOSEJAW, SASK., CAN.—J. D. Murphy is authority for the information that the Saskatchewan Telephone Company will build a long-distance line from Estevan to the Manitoba boundary, having recently completed the system between Moosejaw and Estevan.

MOOSEJAW, SASK., CAN.—Sealed tenders will be received by John D. Simpson, secretary and treasurer, until April 6 for the following machinery and equipment in connection with the municipal electrical plant: One turbo-alternator and exciters; condensers and pipework; main switchboard and connections. Plans and specifications will be sent upon application and deposit of $25, which will be refunded on receipt of a bona fide tender.

PRINCE ALBERT, SASK., CAN.—Estimates for the cost of developing the water power of the Saskatchewan River at Steep Creek for the city have been prepared by Charles H. Mitchell, Toronto. He reports that 10,000 hp can be developed at an approximate cost of $350,000 and 100,000 hp for $1,000,000. It is stated that the city has decided to erect a plant on the river. C. O. Davidson is city clerk.

New Industrial Companies.

THE HEAT, LIGHT & REFRIGERATOR COMPANY, of Portland, Me., has been incorporated, with a capital stock of $5,000,000. H. P. Sweetser is president and L. L. Hight, of Portland, Me., treasurer.

THE RADIO BATTERY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000. The incorporators are Roland B. Respess, Harry I. Robinson and John W. Kinne, of New York. The company proposes to manufacture and install storage batteries, etc.

THE CUMMINGS PATENT FURNACE CONSTRUCTION COMPANY, of Jersey City, N. J., has filed articles of incorporation, with a capital stock of $150,000. The incorporators are H. O. Coughlan, L. H. Gunther and J. R. Turner, of Jersey City. The objects of the company are to manufacture boilers, furnaces, fire boxes, etc.; also to carry on a business of mechanical and electrical engineering.

THE KENT MILL COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $2,000, by Frank H. Hall, Charles D. Thompson and David Edwards. The purpose of the company is to deal in electrical appliances.

THE JOVE MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $5,000, to manufacture mechanical and electrical apparatus. The incorporators are Perry Saylor, C. R. Forster, Allan H. Pratt.

THE SWITCHBOARD SECURITIES CORPORATION, of Wilmington, Del., has been incorporated, with a capital stock of $1,000,000, by T. Conyngton, Upper Montclair, N. J.; O. Jacobs, of Riverhead, N. Y., and P. L. Garrett, of Hockessin, Del.

Personal.

MR. ALEX. HENDERSON, who has been away from New York for some six months, and has visited a large part of the South and West in that period, besides making a trip to the Sandwich Islands, has just returned, and is in his old familiar haunts at the Engineers' Club, much to the pleasure of a host of friends. He is very sanguine as to the general electrical outlook.

MR. CLARENCE E. DELAFIELD has resigned as the head of the high-tension division of the Ohio Brass Company and has accepted a position as sales manager for the Ideal Electric & Manufacturing Company, of Mansfield, Ohio. For many years Mr. Delafield was connected with the Wagner Electric Company as its St. Louis district manager, and hence is familiar with the commercial side of the industry.

MR. DUDLEY D. PENDLETON, who for 15 years has been connected with the Westinghouse Companies, has resigned from that organization and will go in business for himself in Pittsburg as a consulting and contracting engineer. For the last four years Mr. Pendleton has been handling a large part of the Westinghouse steam railroad work in the East, and previous to that time had managed numerous important operations in western Pennsylvania, and is probably one of the best-known electrical men in that section of the country. Besides engineering, he has had a broad experience in the mining field.

MR. F. W. SANFORD and Mr. S. O. Ochs, both formerly connected with the Stanley Instrument Company, of Great Barrington, Mass., expect to sail on March 28 for Russia. They go in the interest of prominent American manufacturers for whom they will establish Russian agencies. Mr. Ochs, who was more recently associated with the Boston office of the Fort Wayne Company, has had wide experience in Russian business methods, and this, combined with his knowledge of the languages, will afford these gentlemen exceptional opportunities to carry through their enterprise. Their address in Russia will be in care of the Gebhard & Hoy Company, Ltd., Moscow, Russia.

MR. LESTER G. FRENCH has been engaged by the American Society of Mechanical Engineers to direct its editorial department. Among the immediate improvements to be undertaken is the establishing of departments in the monthly *Proceedings*, thus providing a greater variety of technical articles of interest. Mr. French received his degree in mechanical engineering from the Massachusetts Institute of Technology in 1891. After four years' apprenticeship, drafting room and shop experience, and a year and a half as a text book writer, Mr. French was engaged on the editorial staff of *Machinery*, and for nine years was editor-in-chief. Recently Mr. French re-engaged in the publishing of text books on algebra, applied mechanics and of a treatise on steam turbines.

Unclassified Items.

HILTON, N. Y.—The citizens have voted to issue $5,000 in bonds to establish a lighting plant.

HOLLAND, MICH.—Plans are being contemplated for extensions to the municipal electric light plant, which will double the output of the plant. It is expected that the work will be taken up this year.

LIBERTY, IND.—The Board of Trustees are considering the question of granting a franchise to Clinton Egbert and Paul C. Morey, of Hamilton, Ohio, for the installation of an electric light plant in the town. The streets of the town are now lighted with gas.

HARTLEY, IA.—The citizens have voted in favor of issuing $12,000 in bonds for an electric light plant.

BUCYRUS, OHIO.—It is reported that the proposition to issue $90,000 in bonds for a municipal electric light plant will be submitted to a vote of the people.

PROVIDENCE, R. I.—A bill to incorporate the Blackstone Valley Gas & Electric Company has been introduced in the House of Representatives by W. D. Bullock, of Pawtucket. The measure allows the incorporators to acquire and dispose of the rights and franchises and property of gas and electric companies in Providence County and to deal in the stocks and securities and calls for a capitalization of $3,000,000. The act is practically for the purpose of allowing the Pawtucket and Woonsocket companies to consolidate or merge. The incorporators are John A. Arnold, Charles E. Ballou, George Barchelor, Stedman Butterick, Jonathan Chace, Frank A. Sayles, Charles A. Stone, Edwin W. Webster and others. The above companies are now controlled by the Stone & Webster interests, of Boston, Mass.

BARNESVILLE, GA.—An election will soon be held to vote on the proposition to issue $25,000 in bonds for constructing an electric light plant, water works, etc. T. W. Cockran is Mayor.

EDINBURG, VA.—Bids will be received until April 11 for an electric light franchise. J. D. Lennon is Mayor.

MINNEAPOLIS, MINN.—All bids received March 16 for furnishing a lighting plant at the county farm were rejected. Hugh R. Scott is county auditor.

HIGGINSVILLE, MO.—The light and power plant of the Higginsville Milling Company was destroyed by fire recently, entailing a loss of about $4,000.

ATCHISON, KAN.—The Atchison Railway, Light & Power Company contemplate rebuilding its plant during the coming season, which will involve an expenditure of between $60,000 and $80,000.

AINSWORTH, NEB.—The Ainsworth Electric Lighting Company is planning to start work on the construction of its dam, and expects to have its plant in operation by next October.

DALLAS, TEX.—The citizens will vote April 7 on the proposition to issue $50,000 in bonds to install a municipal electric light plant.

COLUMBUS, OHIO.—The municipal ownership bill, introduced by Senator Howe, of Cleveland, provides that cities shall have the right to purchase electric light and water plants now owned by private companies and bonds may be issued to pay for such properties, but whenever the amount issued for this purpose exceeds one per cent of the total value of the property in such corporation listed for taxation, then the issue must first be authorized by a vote of the people in the village or city.

SEDAN, KAN.—N. B. Wall has purchased an electric generator, which will be installed in his plant for the purpose of furnishing electricity for lamps and fans in this town.

DOWNS, KAN.—A company of local capitalists, including H. H. Welty, F. M. Wells, Harrison Brothers and others, have purchased the electric light plant here, owned by B. M. Stephenson, for $15,000. A company will be incorporated with a capital stock of $25,000. It is said that the new owners contemplate making improvements to the plant.

BLUFF CITY, TENN.—Matthew Miller, of Bristol, recently purchased the electric light plant and water power of the Holston Electric Company of this city.

AMITE CITY, LA.—J. M. Ritson, of New Orleans, has assumed charge of the electric lighting system here and will give the plant a thorough overhauling. Several thousand dollars will be expended in making improvements.

LOGAN, UTAH.—At the annual meeting of the High Creek Electric Light & Power Company the following-named officers were elected: David Eccles, of Ogden, president; Joseph Monson, of Logan, vice-president; Joseph Quincy, of Logan, secretary; D. C. Budge, of Logan, treasurer, and J. I. Shepard, of Richmond, general manager.

COLUMBUS, OHIO.—At the annual meeting of the Columbus, Delaware & Marion Railway Company the following-named officers were elected: John G. Webb, president; O. M. Gottschall, vice-president; H. B. Hane, secretary; N. J. Catrew, treasurer, and George W. Whysall, general manager.

MILFORD, N. J.—At the annual meeting of the Delaware Telephone Company the following-named officers were elected: Alton C. Rapp, president; Mahlon W. Angell, vice-president; William H. Farrand, secretary, and Elmer E. Culver, treasurer.

CHARLESTON, S. C.—At the annual meeting of the Charleston Consolidated Railway, Gas & Electric Company the following-named officers were elected: Philip H. Gadsden, president; Samuel H. Wilson, managing director, and P. J. Balaguer, secretary.

FREDERICKSBURG, VA.—At the annual meeting of the Fredericksburg Power Company the following-named officers were elected: William C. Whitner, president; A. P. Rowe, vice-president, and A. T. Embrey, secretary and treasurer. The company will resume in the spring the work of the development which was suspended for the winter.

MR. P. H. ALEXANDER.—A very large circle of friends and acquaintances will regret deeply to learn the news of the death of Mr. P. H. Alexander, at South Nyack, N. Y., last week. The funeral took place on Monday. Mr. Alexander had had a long connection with electrical development. He was at first associated with the old Thomson-Houston Company, and then joined the Westinghouse forces, becoming general manager of the old Sawyer-Man Company. He then went into the electrical supply business, founding the firm of Alexander, Barney & Chapin. In more recent years he was connected with the Southern Electric Company, with headquarters at Baltimore, and was engaged in development work in the South. So wide an area of contact had made him extensively known throughout the field, and his death at the age of 60 removes one who was very prominent in the early, exciting times of electric light introduction and growth in this country. The cause of death was diabetes, complicated with grippe.

Business Notes.

MR. E. J. COYLE has resigned as manager of the Southern Electric Company, of Baltimore, and associated himself with the Baltimore Electrical Supply Company as sales manager.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has moved into its newly erected factory at Kelley Avenue and Thirty-eighth Street. The floor space available in the new plant is three times greater than that of the former location.

MR. F. M. SHEPARD has taken charge of the Philadelphia office of the Northern Electrical Manufacturing Company, Land Title Building. Mr. Shepard has been in the sales department of the company at Madison for several years and renews his Eastern connections fortified by extensive experience in work details, as well as sales department matters.

WIRELESS CONNECTORS.—Dossert & Company, 242 West Forty-first Street, New York, have received an order for 400 solderless cable connectors from the San Francisco Gas & Electric Company. F. A. Lawson & Company, Pacific Coast agents, write that Dossert solderless connectors have been specified in the plans for the wiring of the new Palace Hotel in San Francisco.

BOOKS ON TRACTION.—The McGraw Publishing Company, 239 West Thirty-ninth Street, New York City, has just issued an envelope-size, 8-page circular or catalogue of books devoted to the subject of electric railways. Some 56 items are included, and in each case not only are details given as to price, pages, etc., but the nature of the book is outlined. It constitutes an excellent little guide to the growing literature of the subject.

LOCKE INSULATOR COMPANY.—Mr. W. T. Goddard, electrical engineer of the Locke Insulator Company, is making an extensive trip through the Western States and through the Pacific Coast States investigating high-voltage insulator applications and transmission line and power-house design. Mr. Goddard is making a special study of the influence of various climatic conditions upon the design of insulators for various localities, especially in view of designs for 100,000 volts and higher.

THE LOCKE INSULATOR MANUFACTURING COMPANY has appointed as its agents for eastern Canada the Engineer Equipment & Supply Company, Lindsay Bldg., Montreal, Canada, which will be ready to place in the hands of engineers interested information concerning Locke product. Mr. S. W. Smith, of the above company, has long been associated with the lighting interests of Montreal, and for a considerable time was connected with the Canadian Westinghouse Company as [illegible] engineer.

THE WEBER COMPANY.—The Weber Steel Concrete Chimney Company, of Chicago, announces that, owing to an increase of scope through taking on other kinds of plain and reinforced concrete construction work in addition to chimneys, it has been decided to change the name of the company to the Weber Company. The general offices will continue to be in the Marquette Building, Chicago. The company is now prepared to carry out contracts for all kinds of concrete and reinforced work, including foundations, walls, buildings, sewers, chimneys, etc., and already has some large contracts in these different lines under construction. The Weber Company now has branch offices in New York, Atlanta, Cincinnati, St. Louis, Houston, Memphis, Minneapolis, Denver, Salt Lake City, Los Angeles, San Francisco and Seattle, and foreign offices in London, Paris and Halle, Germany.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 17, 1908

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

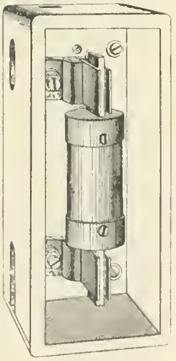
881,934. PROCESS OF PRODUCING ALUMINUM-MAGNESIUM ALLOYS; Franz von Kugelgen, et al., Holcombs Rock, Va. App. filed April 27, 1905. The process of producing aluminum-magnesium alloys, which consists in electrolyzing a combined fused bath of a magnesium compound and an aluminum compound.

881,938. BLOCK-SIGNAL; Don D. Miles, Jr., of Aurora, Ill. App. filed November 10, 1906. Block-signal for surface roads having an overhead trolley. Includes a special form of contact shoe suspended above the trolley wire between a pair of adjacent hangers and which closes a plurality of circuits in predetermined order.

881,943. ELECTRIC LIGHT SIGN; Mortimer Norden, of New York, N. Y. App. filed August 21, 1906. Has a box in which the lamps are received in receptacles of the ordinary sort. The lamps project through funnel-shaped openings in the cover plate, said openings flaring into the outline of the letter to be represented.

881,963. DISTRIBUTION FIXTURE; William D. Scott, of Buffalo, N. Y. App. filed October 7, 1907 (renewal). Has a plurality of adjustable collars with supporting strips carried thereby and projecting above and below the same, and insulators carried by the projecting parts of said strips.

881,965. FUSE AND FUSE BOX; Frank L. Sessions, of Columbus, Ohio. App. filed October 20, 1905. Makes use of a refractory box with an open side, in which are spring contacts analogous to those of a knife blade switch, between which the fuse is received.



881,965.—Fuse and Fuse Box.

881,967. ELECTRIC INSULATOR; Charles R. Slusser, of Montpelier, Idaho. App. filed January 30, 1907. A glass or porcelain insulator of substantially the usual form; has a V-shaped groove or slot extending diagonally inward from its upper surface and in which the conductor is received and held.

881,968. ELECTRIC KETTLE; David C. Smith, of Western Australia, Australia. App. filed July 8, 1907. Construction of tea kettle having an inner chamber communicating with one side wall of the tea kettle and in which is received a plurality of resistance elements.

881,985. PLUG SEAT SWITCH; Bernard O. Wells, of Charleston, Ill. App. filed Dec. 8, 1904. Relates to details of construction of a plug seat switch wherein the circuit connections may be made or broken by the plug of a cord circuit.

881,986. AUTOMATIC GAS ANALYZER; Henry J. Westover, of New York, N. Y. App. filed March 21, 1907. Relates to an improved form of circuit controller for use with either of a plurality of kinds of gas analysis apparatus. Includes an outer and an inner float designed to engage contact points in a predetermined sequence.

882,013. ELECTRIC SIGN OR ILLUMINATING DEVICE; William N. McComb, of New York, N. Y. App. filed Oct. 5, 1904. The lamps are received in a box, being supported by rectangular metallic strips which establish the circuit connections thereto. The strips in turn extend between bushings on longitudinally extending cross bars. In this way each lamp is movable into different relations, depending on the outline of the sign.

882,026. MEANS FOR TRANSMITTING ELECTRIC CURRENTS WITH INCREASED ENERGY; Julian A. Stratton, of Chicago, Ill. App. filed July 13, 1906. A [illegible] for transmitting [illegible] waves or undulations and giving them increased energy [illegible] propagation. It is particularly adapted for the "dynamo" [illegible] of Telephone Repeaters.

882,048. INDUCTION COIL; M. S. [illegible], of Detroit, Mich. App. filed Aug. 19, 1907. A construction of coil box with magnetic shields interposed between the separate coil units to prevent cross induction.

882,055. GAS LIGHTING DEVICE; William K. Elliott, of Payson, Ill. App. filed Aug. 16, 1907. A gas burner of the inverted mantle type having circuit wires extending in proximity to the mantle and adapted to cause a jump spark through the action of a small induction coil. Includes a pneumatic apparatus for turning on the gas.

882,075. PROCESS FOR SEPARATING THE METALS CONTAINED IN COPPER-NICKEL MATTE; James M. Neil, Toronto, Ontario, Can. App. filed June 3, 1907. In a process of refining nickel [illegible] copper-nickel matte, the electrolysis of a solution of [illegible] sulfate with a copper-nickel anode and copper cathode to deposit the copper in the metallic form, and the treatment of the [illegible] nickel sulfate solution with a solution of a chloride of an alkaline earth resulting in the formation of a solution of nickel chloride and a precipitate of the alkaline earth.

882,089. ELECTRIC SIGNALING APPARATUS; Benjamin [illegible], of Denver, Colorado. App. filed Jan. 4, 1907. An apparatus for signaling between trains when the latter have approached [illegible] given distance or have reached the same block, contacts [illegible] provided for establishing an alarm circuit by special [illegible] on the trains.

882,095. WIRE TIE FOR INSULATORS; Waldo E. [illegible], of Flora, Indiana. App. filed Nov. [illegible], 1906. A wire [illegible] adapted to be secured to an ordinary glass insulator [illegible] tie the conductor thereon.

882,096. LIGHTNING ARRESTER; Franklin P. Cauble, of Lincolnton, N. C. App. filed May 3, 1906. Construction of lightning arrester having a choke coil connected [illegible] in the line and an insulated grounded conductor arranged within the coil [illegible] plicity of points extending [illegible] therefrom.

882,110. ANODE; A. M. Hill, of New Haven, Conn. App. filed April 15, 1907. Particular form and [illegible] of [illegible] anode.

882,118. ANNUNCIATOR; John I. [illegible], of [illegible]. App. filed May 27, 1907. Provides an annunciator [illegible] indicating device that shall be effective from both sides of a [illegible] board. Combines with such indicator [illegible] tions so arranged that the insertion [illegible] the board or partition shall restore [illegible] condition.

[illegible]130. RESTORING ATTACHMENT TO TROLLEY WHEELS AND ELECTRIC SIGNAL FOR THE SAME; G. H. Brooks, of Louisville, Ky. App. filed June [illegible], 1907. The trolley [illegible] supplemental swinging harp connected thereto [illegible] naled on elongated spool [illegible] trolley [illegible] the usual trolley on the wire.

[illegible]141. CABLE INSULATING AND TESTING SYSTEM; [illegible] Cope, of New Waterford, Ohio. App. filed June 3, [illegible]. Has means for passing air into telephone conduits so that [illegible] can tell where there is a leak by the [illegible] air.

882,143. BLOCK SIGNAL SYSTEM; William D. [illegible], Ill. App. filed Dec. 23, 1907. Has [illegible] magnetic lock and an actuating circuit, together with means associated with the lock for completing a maintaining circuit [illegible].

882,144. STORAGE BATTERY ELECTRODE; Thomas A. Edison, of Llewellyn Park, Orange, N. J. App. filed M[illegible] 30, [illegible]. A [illegible] for the active material of an alkaline battery, comprising [illegible] of conducting metallic flakes welded together to form a [illegible] integral structure, substantially as set forth.

882,153. TROLLEY HEAD; James Lennox, of Brackenridge, Penna. App. filed July 24, 1907. The trolley wheel is made with the flange portions separable from the tread portion, so that the latter is removable when worn.

882,157. SAFETY APPLIANCE FOR RAILWAY TRAINS; Robley C. Millard, of Atlanta, Ga. App. filed July 17, 1907. Has a valve for venting the main pipe line controlling the brake mechanism; electric trolleys for said valve, one for opening the same to vent the main pipe line to effect a setting of the brakes, and the other to close said valve to release the brakes.

882,158. MAGNETIC ORE SEPARATOR; R. R. Moffatt, New York, N. Y. App. filed May 6, 1905. Includes a large field magnet with consequent poles between which travels a flexible belt carrying the ore which is subjected to the action of a screw while passing through the densest portion of the field so as to displace the magnetic particles.

882,169. ELECTRODE; M. Ruthenburg, of Philadelphia, Pa. App. filed Sept. 20, 1901. An electrode of the class specified, consisting of a solid mass of uniform non-ferruginous compositon, comprising silicon and carbon, capable of resisting the action of free chlorin, chlorous acid and nitric acid; said electrode being characterized by its capacity to conduct electricity through its mass, substantially as set forth.

882,186. SECONDARY ELECTRIC CLOCK; G. B. Bowell, of Westminster, London, England. App. filed Dec. 14, 1905. Has a rotary step by step operating device comprising an electromagnet with a double cam-shaped disc mounted to rotate the field thereof and actuated by the magnet when energized.

882,198. INDUCTION COIL; J. O. Heinze, Jr., of Lowell, Mass. App. filed Sept. 13, 1907. Makes use of iron plates and bodies which are disposed around the outside of a coil unit and coil box for the purpose of improving the action of the vibrator.

882,218 ELECTRIC DISCHARGE APPARATUS; P. H. Thomas, of Pittsburg, Pa. App. filed Feb. 6, 1903. An apparatus for diverting static charges of electricity from conductors of dynamic electricity to ground without disturbing the normal operation of such conductors and the machinery and apparatus connected thereto.

882,225. FLUSH RECEPTACLE; F. T. Wheeler, of Plainville, Conn. App. filed Jan. 29, 1907. A wall receptacle having a porcelain block in which is received a threaded shell, and which is attached to the rear face of a plate which fits over the opening in the wall and has a door which can be removed to expose the socket.

882,242. CROSS CONNECTION FOR DYNAMO ELECTRIC MACHINES; W. H. Foot, of Wilkinsburg, Pa. App. filed April 28, 1906. Provides an improved means for interconnecting equipotential points in the windings of dynamo electric machines that are subjected to high speeds in operation, the connections being designed to occupy a small amount of space and be protected from injury.

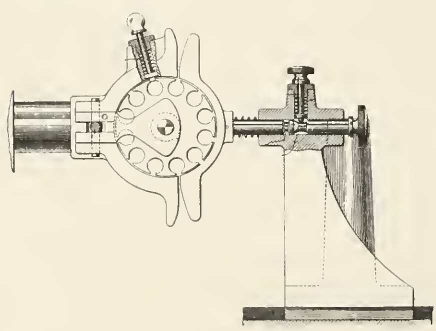
882,250. FIRE ALARM BOX; M. W. Hamblin, of Milwaukee, Wis. App. filed Feb. 27, 1902. Fire alarm box of the type designed to be placed in buildings, and from which an alarm is sent to a main receiving station. Comprises a box adapted to serve both as an alarm box and as a watchman's receiving box.

882,253. COIL WINDING MACHINE; F. R. Kunkel, of Wilkinsburg, Pa. App. filed June 12, 1905. A rotatable spindle carries a form of chuck with a circular opening in which the armature core may be inserted. The chuck has guiding ears which serve to direct the wire into the grooves of the armature when the latter is being wound.

882,257. INCANDESCENT LAMP; M. M. Merritt, of Middleton, Mass. App. filed Feb. 11, 1907. The base of an incandescent lamp is initially made with the usual threaded shell and center contact integral. These parts are spun or stamped in one piece, and are afterwards cut apart, so that they are electrically separated.

882,258. PROCESS FOR THE MANUFACTURE OF INCANDESCENT LAMP BASES; M. M. Merritt, of Middleton, Mass. App. filed May 27, 1907. The method of making the article set forth in the above patent.

882,260. SPARK PLUG CLIP; C. A. Mezger, of New York, N. Y. App filed Sept. 6, 1906. Patentee makes use of a device having a pair of spring blades which engage the upper and lower sides of the thumb-nut of the spark plug.



882,253.—Coil-Winding Machine.

882,265. LIGHTNING ARRESTER; N. J. Neall, of Pittsburg, Pa. App. filed Jan. 24, 1906. A lightning arrester comprising a discharge block having conducting plates secured to the faces thereof, and an apertured sheet of insulating material secured to one of the conducting plates.

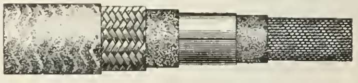
882,275. RAILWAY SIGNALING APPARATUS; J. D. Taylor, of Edgewood Park, Penn. App. filed Jan. 4, 1908. Signal system for trolley roads making use of alternating-current propulsion and using one of the track rails for the purpose of carrying the signaling current, while the other track rail carries both the power current and the signaling current. Provides means for generating a counter e.m.f. which opposes the fall of potential in the power rail which has hitherto tended to cause an element of error.

882,276 ELECTRIC SIGNALING SYSTEM; J. D. Taylor, of Edgewood Park, Penn. App. filed Jan. 30, 1908. Relates to modifications of the above.

882,292. FLEXIBLE CONDUIT; W. S. Brown, of New York, N. Y. App. filed Aug. 21, 1907. A flexible conduit adapted to lead circuit wires through the walls and ceilings of a building and protect the same from grounds and injury. Patentee makes use of a construction which has no metal in its composition, and which is very flexible laterally, and strong in a longitudinal direction. For this purpose, there are provided canvas or similar strips running longitudinally of the conduit between layers of plastic material.

882,337. JUNCTION BOX FOR ELECTRICAL CONDUITS; A. McMurtrie, of New York, N. Y. App. filed Aug. 29, 1901. A form of outlet or junction box for interior work having a square main portion with a round entering neck or channel which can be telescoped into the wall so as to suit different building constructions.

882,340. ELECTRICALLY CONTROLLED SWITCH MECHANISM; G. E. Palmer, of Boston, Mass. App. filed May 5, 1908. An electrically controlled switch mechanism for power circuits, and particularly mechanism controlled from a remote point. Has an armature or solenoid which locks the switch firmly closed and automatically breaks the energizing circuit for the switch control.



882,292. Flexible Conduit.

882,347. COMPOSITE SIGNALS AND TELEPHONE SYSTEM; Harry O. Rugh, of Sandwich, Ill. App. filed June 14, 1906. Details of circuits and connections.

882,378. DRINKING VESSEL; E. Friendlich, of New York, N. Y. App. filed Jan. 23, 1907. A drinking cup having a push button in the handle which completes a circuit through the body of the fluid contained in the cup.

882,388. ELECTRIC OIL SWITCH; J. D. Hilliard, et al., of Glens Falls, N. Y. App. filed Jan. 29, 1906. Oil bath switch having one contact plate supported by an insulator in submerged relation, and another swinging knife-blade element which is abruptly moved by mechanism on the outside of the box.

882,394. CONTACT APPARATUS FOR ELECTRIC IGNITERS; J. Krannichfeldt, of Cologne, Germany. App. filed Dec. 16, 1905. Has a multiplying gear and a centrifugal device for closing the circuit when the speed of the generator has attained a predetermined value.

882,417. PROCESS OF PRODUCING FERROSILICON; Edgar F. Price, of Niagara Falls, N. Y. App. filed Nov. 14, 1905. The continuous process of producing ferrosilicon, which consists in smelting a charge containing a silicon compound, carbon and a source of iron, by means of an electrically-heated resistance conductor, with drawing the molten product from the furnace, and supplying the charge-mixture as required, as set forth.

882,418. PROCESS OF PRODUCING SILICO-SPIEGEL; Edgar F. Price, of Niagara Falls, N. Y. App. filed Nov. 14, 1905. The continuous process of producing silico-spiegel, which consists in smelting a charge containing compounds and manganese and silicon, carbon and a source of iron, by means of an electrically-heated resistance conductor, withdrawing the molten product from the furnace, and supplying the charge-mixture as required, as set forth.

882,424. INSULATOR PIN; W. Scharfhausen, of Payette, Idaho. App. filed June 10, 1907. A device for securing an insulator pin within the cross arm of a telegraph pole, comprising a groove which receives a nail and deflects the latter outwardly into the wood of the cross arm. The nail is afterwards bent over to hold the pin in place.

882,450. TROLLEY; F. E. Brazeal, of Monson, Mass. App. filed June 15, 1907. A form of trolley wheel having a pair of annular chambers, with oil rings therein, for lubricating purposes.

882,495. TROLLEY CAR POLE ATTACHMENT; G. R. Dunn, San Diego, Cal. App. filed Aug. 30, 1906. The trolley harp is pivoted to the pole on an inclined axis in the plane of the trolley wheel. The wheel is held in comparatively rigid relation by a chain connection, but is capable of slight lateral movement through the resiliency of the chain.

882,498. PROTECTIVE APPLIANCE FOR ELECTRIC CIRCUITS AND APPARATUS; H. H. Hornsey, et al., Chicago, Ill. App. filed Dec. 19, 1901. Relates to protective appliances for electric circuits employing tubular or other coverings for fuse wire, together with signaling means to indicate the condition of the fuse wires or links within the tubes or sheaths.

882,508. STATIC INFLUENCE ELECTRIC MACHINE; H. Wommelsdorf, Charlottenburg, Germany. App. filed April 27, 1906. A construction of the sectors of a Wimshurst static machine, in which the sectors are embedded in layers of insulating material so as to be separated from one another, but each has a stud projecting out for engagement with the brushes.

882,509. APPARATUS FOR PRODUCING OZONE; A. C. Wood, Philadelphia, Pa. App. filed Oct. 1, 1904. Has a pair of concentric tubes, between which the air current flows, being subjected to a brush discharge between the tubes at different points along their lengths.

882,510. APPARATUS FOR PRODUCING OZONE; A. C. Wood, Philadelphia, Pa. App. filed May 12, 1906. Relates to modifications of the above.

882,514. CONNECTION FOR ELECTRIC CONDUCTORS; F. O. Ball, Plainfield, N. J. App. filed Jan. 31, 1906. A spring clip having a pair of holes which can be made to register and engage over the usual threaded terminal studs of a dry battery. The resiliency of the springs throws them out of register and clamps the studs.

882,523. BLOCK SIGNAL SYSTEM; F. E. Kinsman, Plainfield, N. J. App. filed Nov. 29, 1904. The track rails are made sectional throughout their length for signaling circuit purposes, and the power conductors are arranged in a special way so as to be separated by a considerable distance, whereby the danger to persons walking on the track is minimized.

882,531. ROTARY CONVERTER; J. L. Murdock, Bound Brook, N. J. App. filed March 28, 1906. A rotary converter for three-phase alternating currents, accumulating predetermined portions of such currents in such a manner as to accumulate the effects of the portions thus selected, and thus build up a virtually direct current which is practically constant.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, APRIL 4, 1908. No. 14.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office....590 Old Colony Building
Cleveland Office....1015 Schofield Building
Philadelphia Office....Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....per year,	$3.00
Dominion of Canada....	4.50
Other Foreign Countries within the Postal Union....	6.00
25 shillings · 25 marks · 31 francs	

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 23,000 copies are printed.*

NEW YORK, SATURDAY, APRIL 4, 1908.

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THE BRIGHTER OUTLOOK.

One of the revival hymns of the last generation contained two lines to the effect that "Skies are clearing, and we're hearing joy-bells everywhere." This might easily be applied to the present industrial and financial situation in the United States, but it is well to take a quiet and sober view of the various unmistakable signs of recovery from the panic of the autumn and the distress of the winter. Even now, there are losses as well as gains, and many fields of production are still suffering from restricted output and an inadequate demand. But at such times as this, it is the state of mind and the tendency that really count, and here we find full warrant for hopefulness, and for a tempered optimism.

We note among the electrical companies several bright symptoms. The General Electric and Westinghouse interests report good orders, and a fuller tide of activity in their shops. Large contracts for traction cars are being given out, and others impend. The New York Edison Company reports that its February business was equal to that of the same month in 1907. The Bell telephone system is resuming construction work that will run to $50,000,000 this year, and last week 49 new Independent telephone companies reported, 26 of which had a capitalization of $720,000. The purchases of copper on electrical account are growing again, and resumption of transmission enterprises is noticeable. It is apparent that the general tone is very much improved in the electrical field, and that there are good reasons for an increase of cheerfulness.

Outside of the electrical field, the symptoms are mainly of an encouraging character. President Gary, of the U. S. Steel Corporation, has reported orders to be increasing at a rate of even 25 per cent gain over the preceding month. Railroad earnings are better in several systems, and the number of idle cars is still dwindling. The building trade is more active, and the mildness of the opening of spring has greatly stimulated retail trade. In New York, bank and trust company resumption has had a markedly good effect, and the barometrical indications from Wall Street are all those of a rising glass. There is nothing in national political actions to arouse anxiety, but, on the contrary, there is a distinct betterment in the public and legislative attitude on corporations and railway affairs. Hence we do not think it is amiss to suggest to our friends that the day for pessimistic doubt and inertia is behind them and not ahead. All the situation now requires is a little courage and some confidence in the shape of renewed vigor in attacking opportunity and in creating new capital.

It is fortunate that two recent decisions in the United States Supreme Court should have come at this time to show that the railroads have a resort from which to obtain relief from both fines that are too large and fares that are too low. Their property rights under the Constitution are to be respected, and the Minnesota and North Carolina decisions emphasize this in a manner cheering to all who are desirous of seeing the railroads regulated, but not willing that they should be made the subject of confiscatory laws. Another point helpful at this time in general betterment is the readiness of the corporations to let investors know where they stand. The issuance of monthly net earnings statements by the New York Central and the appearance of the first American Sugar Refining report are both evidences that the demand for fuller publicity is to be met voluntarily, and that legislation to this end is along the right line. It is in this manner again that solid foundation is being laid for the new prosperity of the near future.

POWER IN THE APPALACHIANS.

A recent circular of the U. S. Department of Agriculture (No. 144) gives a large amount of interesting and valuable information regarding the water powers of the Southern Appalachian region and the steps necessary to their conservation. In some measure this is involved with the question of forestry and the proposed reserves about the headwaters of the Appalachian streams. As we have heretofore intimated, the amount of precise information about the effect of deforestation on water power is very meager owing to the short length of time covered by the investigations. In those regions of the country in which water powers have been longest under measurement, partial deforestation had occurred prior to such measurement, the first growth having been cleared away and the land converted to farming and grazing for many years. For instance, in the case of the Merrimac, or any other of the well-developed New England streams, the amount of woodland on the watershed has not changed greatly in half a century save for the devastation wrought about the headwaters in the last decade or so. The country had been well cleared early in the last century as regards the lower portions of the watersheds. Hence, while there is clear evidence of a tendency to lower minima, this evidence cannot be made useful as regards the amount of damage for some years to come.

The nature of such damage is clear when one considers the state of flow in the rivers of a really denuded country like some parts of the West. The ultimate amount of damage depends in part on the geological formation and the nature of the soil, but in the judgment of the forestry experts, the danger in the Southern Appalachians is especially great. That region is practically devoid of natural lakes, which in New England are of great value in steadying the flow; and one of the most interesting and valuable portions of the report before us relates to the possibilities of artificial storage. A lake is a far more useful conservator of water power than any amount of forest, since it is under complete control, and the rate of run-off into it becomes a matter of no consequence provided the total amount is well maintained. The chief thing is to secure storage capacity enough to make full use of the total rainfall, and the main difficulty is to get so complete and immediate control of the upper watersheds as to make their utilization possible. In our country as at present constituted it is wellnigh impossible to hold any man's attention to a project that looks to the future—he is ready only for a chance to grab profits and run. The general government is really our only hope in a case like this, for the States have generally proved their impotence in large affairs of a nature bound to bring protests from local looters. Now and then a State rises to the occasion, but in large affairs, where prompt and effective co-operation in several States is necessary, present experience is discouraging; and when it comes to national action there is a not unnatural jealousy of centralized power that makes action exceedingly difficult to secure. To tell the truth, the situation is not exactly encouraging.

If, however, such action were possible the results to be obtained are of a most important character. Discounting as one must the figures of the report on account of the low gradient which holds over much of the stream-slopes, there still remains a prodigious amount of water power that can economically be utilized. The figures before us indicate a total based on low water conditions of something like 1,500,000 effective horse-power. This amount can be easily doubled by the use of a moderate amount of auxiliary steam power. The amount to be obtained with fairly complete storage is, of course, very indefinite as yet, but perhaps a total of 10,000,000 horse-power would not be wide of the mark. The trouble is that this prodigious gain can be secured only by very drastic action, which would amount practically to governmental control of the hydraulic resources. No form of State or private control is adequate unless more than equally dangerous. The time has come in the world's history when people cannot safely trust to the casual and thoughtless development of national resources. Up to a certain point these are not extensive enough to work evil, but to-day the wholesale waste that goes on in many directions is a public menace against which the most elementary principles of self-preservation call for action. In the case before us, the industrial possibilities of seven or eight million horse-power available through large storage works are tremendous, especially in view of the depletion of the cheap coal supply. The concrete problem is, granting the great desirability of the result, whether it can by any now practicable means be accomplished. The larger project certainly looks dubious in view of the general trend of present public sentiment; but there certainly is no reason why the first reserve proposition could not be carried out, thereby holding at least part of the necessary territory and protecting the natural watersheds until such time as more effective action with respect to storage could be secured.

BRITISH STANDARD SPECIFICATIONS FOR CONSUMERS' SUPPLY METERS.

It is only a few months since the Engineering Standards committee in London issued a schedule of standard specifications for customers' meters. This schedule possesses interest for all central station men, as indicating the relative conditions of service, installation, testing and maintenance among the English-speaking electric supply systems on the two sides of the Atlantic Ocean. In regard to standard meter capacities, the schedule only recognizes seven, namely, for 3, 5, 10, 25, 50, 75 and 100 amperes. The standard pressure of supply for these meters is not stated, but is probably 200 volts, adapted to 400-volt 3-wire systems. In America, there are 15 standard ampere-capacities of meters, between 3 and 100 amperes inclusive, and each is constructed in four different types, namely, for 2-wire 110-volts, 2-wire 220-volts, 3-wire 220-volts and 2-wire 500-volts. The schedule calls for at least two sealing places on the case, one for the manufacturer and the other for a testing authority. In addition to this, the cover of the terminal compartment has to be provided with a sealing place for the purchaser—that is, the central station. In America there is usually only one seal on a meter. The name-plate is required to indicate, in addition to the usual electric data, either the speed of the rotor at full load, or the number of rotor revolutions for registering one kw-hour. It is specified that the full-load rotor speed shall not exceed 150 r.p.m. The waste of power in the main circuit path through the meter is not to exceed 15 watts at rated load, and the drop of pressure in this path must not exceed 2 volts at rated load. This would represent 1 per cent drop, a somewhat generous limit. The waste of power in the pressure circuit is specified not to exceed 4 watts for each 100 volts of pressure. This is consistent with good American practice in commutator meters. In meters of the induction type, which take less excitation, our potential losses per hectovolt are usually from 2 to 3 watts. The schedule requires that, in meters of 10 or more amperes capacity, the starting current shall not be more than 1 per cent of the rated load current applied during a steady test of five minutes. In other words, a meter must start and run steadily during a five-minute test, with 1 per cent of its rated load, under normal terminal voltage.

The error of a meter when tested under standard conditions of voltage, current, frequency and temperature is required not to exceed 2½ per cent between rated load and one-tenth of rated load. At any load between one-tenth and one-twentieth of rated load, say 1/N of rated load, the percentage error is not to exceed N/4. This is not a severe requirement on non-inductive loads when meters are new; but it is somewhat severe on meters which have been in extended service without readjustment. The overload requirements of a meter are that it shall not be injured by 25 per cent overload current at normal pressure for one hour, but that no greater margin of protracted overload than this should be called for. Also, that the meter shall not be injured by 15 per cent overload pressure for one hour. Moreover, the meter should stand, for not more than half a second, the application of 30 times rated load current, under rated voltage, without injury or impairment of calibration. This amounts to a definite short-circuit test applied through a circuit-breaker. In regard to underload tests, the meter must not creep with no current in the main circuit path when the voltage on the potential circuit is 10 per cent above rated voltage. In regard to variations of condition, alternating-current meters must not exceed 1 per cent of error due to change in frequency, when the frequency varies 5 per cent above or below its normal rated value. Meters with potential circuits must not exceed 1 per cent of error due to change in potential, when the potential varies 10 per cent above or below its normal rated value. Alternating-current meters must not exceed 2 per cent in error due to change in power-factor, when the power-factor of the load is varied from 100 per cent to 50 per cent. The last requirement is rather severe.

The manufacturer of the meter is made responsible for defects either in material or in workmanship that may become apparent within three years after the date of delivery. Moreover, if the meter is found to be registering with an error in excess of the limits specified, and shall not have been subjected to unreasonable usage, the manufacturer is made responsible for the readjustment of the meter at his own expense. It would be interesting to learn how far this schedule is actually applied in Great Britain, and how it works out. It would seem that there is a broad opportunity for disputes between the manufacturer and the electric supply company or purchaser, on the question of what constitutes unreasonable usage or as to defective material. In England, a number of manufacturers supply meters and it is perhaps a matter of practical necessity to specify rigidly the requirements of meters from the standpoints of the consumer and of the central-station operator. In the United States, the manufacture of meters is limited by patent considerations to a few firms, so that rigid specifications of the manufacturer's liabilities are not so important.

The Use of High Voltages.

Recent steps indicate that there is likely soon to be a material increase in the voltages used for power transmission. Practice hung for a long time in the neighborhood of 50,000 volts, but now 70,000 have been successfully passed and considerably higher pressures are in sight. True, most of the ordinary cases of power transmission do not require higher pressures than are now commonly used, but as time goes on the scope of the transmission problem widens. A considerable number of important powers all the world over are at so great distance from profitable markets that they require extreme voltage for successful utilization. Besides, there are groups of lesser powers which could be very advantageously joined into great transmission networks if voltages were available to keep down the cost of conductors. For the former class of powers the working pressure should be at least 100,000 volts, and preferably double that figure in many cases. For the latter class 100,000 volts would often be desirable. Now, as we have many times remarked, the problem of high-voltage transmission is essentially one of line insulation. Transformers can now be built, and in large capacities at a reasonable cost, for pressures much greater than anyone has cared to adopt for a commercial line.

So far as insulators are concerned, the trouble comes not from inability to get a suitable quality of porcelain, but from the extreme precautions required to prevent arcing under severe weather conditions. Up to 60,000 or 70,000 volts the insulators are quite manageable, but when one talks about 100,000 or 150,000 volts, with any reasonable factor of safety, the situation changes. The suspension types of insulator are as yet untried on any considerable scale. They are of considerable promise, yet it is not clear that they meet sufficiently well the requirement of preserving adequate dry surface in a drizzling rain. The modern insulators with deep petticoats stand up well under the wet test, but whether it will be practicable to secure mechanically good suspension insulators with equally good protection is quite another matter. If all the surfaces are wet, increase in their number or dimensions is not very efficacious. On account of the importance of lessening the number of insulation points very high-tension lines will necessarily be of long-span construction, with towers giving proper support for probably rather elaborate insulating structures. In fact, the available length of span will be a very important consideration in the design of such lines. This necessity may lend a new interest to composite cables and wires to gain the utmost tensile strength, and especially the highest practicable elastic limit. It is this latter that especially counts in line design.

Incidentally, in such long-span work the towers will have to be designed as engineering structures, not merely put together anyhow. Another feature of design which must be carefully studied is the stability and strength required to withstand wind and ice stresses. We are under the impression that engineers are generally more scared than hurt on this account. The lines which go down in storms are very rarely power transmission lines, but telephone and telegraph lines, with from a dozen to fifty rusty wires carried on each venerable pole. In laying out a long-span line, study should be made of the actual meteorological conditions in the region where it is to be erected, and the line figured accordingly. One does not have ice storms in the South, nor are actual wind pressures at all as high as they are commonly taken in line calculations. With the points of support reduced to the minimum number, leaving a reasonable factor of safety, the insulators can be made adequate without extraordinary expense. One can use insulators in tandem without difficulty in a tower construction with plenty of vertical space, and it should be entirely feasible with material even now available to go at least to 100,000 volts while retaining at least as good factors of safety as are now common at 50,000 or 60,000 volts. Before going higher these factors of safety should be considerably stiffened. A factor of 3 is none too high for reasonable security. It seems not unlikely that the suspension type of insulator can be developed for proper protection against rain, and with this available there seems no reason why 150,000 volts should not be tackled in the near future. He would be a rash prophet who would venture to set an upper limit for the future, but with a working voltage of 150,000, most if not all of the big transmission projects could be worked out commercially. The remainder could well await the next upward step.

The Commercial Importance of Meter Accuracy.

Some station managers do not realize the importance of accuracy in the registration of customers' meters, and are content, provided that the meters do not creep, or make false registration under no load, even if the average registration is several per cent low. Nevertheless, 1 per cent of average defective-meter registration means not only 1 per cent less revenue, but would offset several per cent of economy in fuel or other operating expenses. A meter which failed to record the supply to one last lamp in an installation, the last 50-watt lamp that might burn alone for 20 hours in 24, would lose one kilowatt-hour a day, or a revenue in one year of $36.50, at 10 cents per kilowatt-hour. It is not only well worth while paying a good fair price for accuracy in the first cost of a meter, but it is also well worth while employing skilled and well-paid labor for meter inspection and attendance. A good meter inspector will amply justify his expense to the central station and no man is qualified to read and inspect meters who is not capable of testing, adjusting and repairing them. Some managers think that anyone can read a meter dial. It is true that very little training is needed for reading the figures on a meter-dial and writing them down correctly in a book, but meter inspection includes an examination into the condition of meters and a test of their registration at intervals of from one month for the most important meters to 12 months for the least important meters. It has not yet been realized, because the conditions have not yet had time to reveal themselves, that the advent of the new metallic-filament lamp in general, and of the tungsten-filament lamp in particular, will throw greater demands upon the meters and meter department of electric lighting systems. The smaller the power consumed by each individual lamp, the greater must be the precision in meter registration in order to attain the same ratio between kilowatt-hours sold and kilowatt-hours generated. It is true that the first effect of the change in lamps will be to increase the light per lamp turned on, rather than to diminish the power consumed per lamp, but sooner or later we must expect that the economy inherent in the use of the new filaments will develop in both directions.

Combination Gas and Steam Engine Plants.

The gas engine and the crude oil engine are finding an increasing use among small central stations. However, in spite of the recognized economy of these engines in fuel costs per kw-hour, their introduction has not been as rapid as some of their advocates predicted some 10 or 15 years ago. It is now well established that, except where coal is very cheap, a small engine operating on producer gas or an efficient crude oil engine can produce a kw-hour at much lower fuel cost than the ordinary small steam plant. Where cheap natural gas is available, there is no question about the economy of the gas engine. It may, therefore, seem rather remarkable that gas engines are not to be found in a larger number of small central stations. In looking for the causes of their slow introduction, one naturally inquires first as to the reliability and maintenance cost of the gas engine. As to this, the gas engine seems to have about as good a record as the steam engine in plants where it has been in service the past five years. An answer to the question is then hardly to be found in the unreliability of the gas engine in its smaller sizes. The fact that gas engines are not as well understood as steam engines has undoubtedly had an effect on their adoption. When we come to the question of first cost, the gas engine plant is so much more expensive than the average small steam plant that this furnishes a powerful reason for its slow introduction. In some small central stations the owners are averse to spending a cent more than is necessary in apparatus to give increased capacity. In some cases this aversion is fully justified. It can be laid down as a general proposition that for carrying purely peak load, low first cost and reliability are first considerations and fuel cost per kw-hour secondary, for the reason that the fixed charges on the investment far outweigh any possible difference in operating economy for the few hours the peak-load machinery is operated. For such machinery as operates 24 hours per day, the case is entirely different. It has been suggested, and in fact put in practice by a number of companies, to combine steam and gas engines in one plant, using the gas engines with high-fuel economy for carrying the all-day load and using steam engines and boilers for the peak load only. The large fixed losses which occur when operating a steam plant greatly underloaded 24 hours a day are thus obviated, and the investment is much lower than it would be to carry the entire peak load with gas engines. The objection to this plan is, of course, that it necessitates two different kinds of engines in the same plant, and perhaps not a very large plant at that. Uniformity of apparatus, which is in general desirable, is thus not obtained. These reasons may, however, be largely sentimental, and it should be carefully figured out in every case which method will give the lowest total operating expenses.

Diffusing Light from High Candle-Power Lamps.

The increasing use of lamps of very high intrinsic brilliancy and high candle-power for interior lighting, and the increasing consideration that is being given to the comfort of those who occupy rooms so lighted, makes the desirability for diffusing the light from these high candle-power sources a matter of serious consideration. This problem has always been before those engaged in illuminating work, but it is being more clearly recognized as an important problem now than ever before. It will be generally admitted that for eye comfort during continued work, nothing in the way of artificial lighting can equal daylight as it is ordinarily received through windows. In the case of daylight, the light in a room is received by reflection from the sky and clouds. It is, therefore, so well diffused that no definite sources of light are recognized, as is the case with artificial illuminants. In artificial lighting, on the other hand, we depend upon more or less concentrated sources of light. This at once gives rise to two difficulties. The first, and most important of these, is that in writing with the highly glazed papers now common, or in working on polished metal surfaces which are fairly good reflectors, there is a considerable amount of regular reflection from the surface under the eye. This glare or glisten of regular reflection is so pronounced that when the eye is in some positions it makes reading impossible, as nothing but the glare can be seen on the paper, while in many other positions it is annoying. This may seem like a rather fine-spun theoretical point, but, as a matter of fact, it is the unrecognized source of a great deal of the trouble which is experienced in working by artificial light.

To be sure, this trouble can to a large extent be overcome by proper placing of the lamps, so that the regular reflection does not strike in the eye; but this is not by any means as easy as it sounds. For example, with any form of desk lamp placed anywhere in front of the worker, he will many times an hour be annoyed (very likely without knowing it) by this glare. It is much more pronounced with the common arrangement of a desk lamp squarely in front than it is when the lamp is placed either to the right or the left; but practically the only position in which a desk lamp can be placed so that the worker will never be annoyed by reflection from the paper and at the same time will not have annoying shadows, is at the left and slightly behind the worker. Now this is a position which is in a great many cases impractical. In fact, about the only place where it is feasible is where the lamp can be placed high on a chandelier or pendant at the position spoken of, unless the worker is willing to put a portable stand lamp at his left elbow. Now much of the trouble which is constantly experienced with artificial light could be considerably reduced if we could employ larger light-giving surfaces instead of the intense light sources of small area we now use. In the lighting of stores and public places the difficulties which have just been enumerated, due to reflection from the surfaces being worked upon, is not so serious as in offices, factories and homes; but it is equally objectionable for another reason, namely, the bad effect the intense light sources themselves have on the eye. In the lighting of stores and public places the eye cannot avoid the light sources by shading of the lamps or by the shading of the eyes by the eyebrows. It is, therefore, also desirable in these places to greatly increase the area of the visible sources of light.

The common method of increasing the visible light-giving surface of a lamp is, of course, to use small globes of frosted, opal or prismatic diffusing glass, or to resort to frosted lamps. This improves matters considerably, but leaves much to be desired, especially with the higher candle-power incandescent lamps now common. The inverted bowl shape of reflector, which is justly becoming more popular day by day, besides giving a very efficient light distribution at all angles below 70 degrees from the vertical, also covers the lamp in a way to reduce considerably the intrinsic brilliancy meeting the eye if a lamp with frosted tip bulb is used. It is, however, desirable to increase the area of light-giving surface even further than this. The use of very large enclosing globes of diffusing glass with the lamp and the proper reflector mounted inside the globe increases the expense of each lighting unit considerably, but also makes for decidedly better results by a great increase in the area and decrease of intensity of the light-giving surface. Another plan which is just beginning to gain foothold is the use of recesses and false skylights, behind which lamps are concealed, the skylight consisting of diffusing glass. When properly designed so that the light sources spread their illumination evenly over the skylight, this plan gives results which begin to approach daylight in effect. Undoubtedly the nearest approach to daylight diffusion can be obtained, however, with properly designed indirect lighting. The qualification, "properly designed," is important, because it has been very thoroughly demonstrated that some indirect lighting schemes are both inefficient and trying to the eyes. If indirect lighting from concealed lamps is to be successfully accomplished, it must be by means of reflecting surfaces of proper shape to direct the light down where it is needed without excessive loss through a number of reflections. These reflecting surfaces must also be in such a position as to be easily avoidable by the eye of the ordinary occupant of the room. For example, if the indirect lighting scheme is such that there is a large amount of highly illuminated sidewall, which the eye cannot very well avoid, it has been well demonstrated that the eye demands a higher illumination on a reading page for comfortable reading than if this brightly lighted surface were not present. In other words, a large, brightly lighted surface of this kind is almost as effective in causing the iris to automatically close and shut light out of the eye as would be a row of bare lamps in a similar position. The art of indirect lighting can well be cultivated more thoroughly, as can also the art of placing light sources behind diffusing glass screens without undue expense for fixtures and glassware and without undue loss of efficiency.

Annual Report of American Bell Telephone System.

The annual report of the American Telephone & Telegraph Company, signed by President T. N. Vail, presents a highly interesting and impressive aggregation of statistics relative to one part of the telephone industry in the United States. It is much fuller of data than usual, and discusses most of the vital problems of the existing situation with notable frankness and fulness.

At the close of the year a valuation based on the replacement cost of the existing plant, without any allowance for franchises or for unearned increment, showed $488,296,000. Against this there were outstanding obligations of the American Telephone & Telegraph Company and its associated companies, including capital stock at par in the hands of the public, of $554,939,000. These companies also had cash on hand, quick assets and investments of $101,074,000, so that the obligations against the plant were only $453,865,000, or $34,431,000 less than its appraised value The book value of the exchange construction is $114 per exchange station, and the book value of all the property, including the long-distance lines, is $162 per station. The American Company holds $273,404,797 in stocks and bonds of its associated or sub-companies, and has $41,621,174 in its long-distance plant. Its capital stock is $179,595,255, and its bonds and convertible notes amount to $178,495,000.

For the first time a statement of the operating companies (that is, those companies which directly furnish Bell telephone service) is given, with gross earnings for the whole country of $120,753,200, operating and general expenses of $53,242,300, and maintenance of plant $34,665,700. The balance available for dividends was $25,819,700, out of which dividends amounting to $19,206,100 were declared, which seems reasonable when the value of the plant is considered. The American dividends paid were $10,943,644.

At the present time there are outstanding 1,525,280 shares of stock of the company, 1,312,502 of which are held by 23,453 stockholders, an average of less than 56 shares each, the balance, 212,778 shares, being held by 16 shareholders, each with 5000 shares or over. Mr. Vail states that more than three-quarters of the entire share capital is still held in the New England States.

The business has shown a constant gain during the year, and at the close there were 3,839,000 stations connected to the system, with a total of 8,610,592 miles of wire. The total number of exchange and toll calls for the year was about 5,997,000,000. During the year $52,921,000 was added to construction, and in the past eight years $351,835,655 has been so added. Of the stations connected 755,316 belong to other systems than the Bell. There was a total gain during the year of 768,340 stations. The number of exchanges and branch offices is 5108, an increase of 219, with a total of 88,274 employees.

Mr. Vail directs attention to the new Western Electric policy of selling telephonic apparatus to all comers instead of to licensees exclusively. He favors placing telephone companies under public service commissions and argues strongly in favor of the "natural monopoly" one exchange idea. "Duplication of plant is a waste to the investor. Duplication of charges is a waste to the user. The advantages claimed for competition are lower rates and improved service. Exhaustive competition may temporarily produce either or both of these results, but, as before stated, this temporary gain is purchased by an excessive waste. Duplication of plant and operation cannot produce either result without exhaustive competition. Given the same management, the public must pay double rates for service, to meet double charges, on double capital, double operating expenses and double maintenance.

"In most cases of proposed competition an examination of the prospectus will show that, by the same process, it is expected to make good a capitalization equal to at least two or three times the actual cost of the construction. The only benefits are to the promoter."

Chicago Commonwealth Edison Ordinance Passed.

The ordinance fixing the maximum rates to be charged by the Commonwealth Edison Company, of Chicago, until 1912, was passed by the Chicago City Council March 23. The ordinance also recognizes the consolidations which led up to the Commonwealth Edison Company organization. The company is to pay 3 per cent of its gross receipts to the city. This is in accordance with the franchise previously owned by the Commonwealth Electric Company. The rates are as follows: Up to July 31, 1908, 15 cents per kw-hour as a primary rate for energy used up to the equivalent of 30 hours' use of the consumer's maximum demand, and 9 cents per kw-hour as a secondary rate for all energy in excess of the foregoing amount. After July 31, 1908, the maximum rate is to be 13 cents, and secondary 9 cents. From Aug. 1, 1909, to July 31, 1912, the primary rate is to be 13 cents and the secondary rate 7 cents. A discount of 1 cent per kw-hour from the foregoing rates is to be allowed on all bills paid within 10 days.

New British Patent Law.

Dr. Alfred Müller, of New York, has addressed to the Secretary of State, Washington, a letter making certain recommendations in relation to the revised British patent law which went into effect Jan. 1, 1908. A discussion of this law appeared in our issue dated Feb. 15.

Dr. Müller calls attention to that section which provides that at any time not less than four years after the date of a patent any person may apply to the Government for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. Should it be found after inquiry that the allegations are correct, then, unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or give satisfactory reasons why the article or process is not so manufactured or carried on, the patent may be revoked forthwith or after such interval as may be specified, unless, in the meantime, it is shown that the patented article or process is manufactured or carried on within the United Kingdom to an adequate extent. If within the time limited the patented article or process is not manufactured or carried on within the United Kingdom to an adequate extent, but the patentee gives satisfactory reasons why it is not so manufactured or carried on, the period above mentioned may be extended for such period not exceeding 12 months. Any decision under this section is subject to appeal to the court.

Dr. Müller asks that in view of the fact that the patent laws of the United States do not require British, or any other foreign inventors who have obtained patents in this country, to put their invention into practice in the United States, subject to the penalty of having their patents revoked for failure to comply with such a requirement, steps should be taken on the part of the government of the United States to induce the British Government to make the above section of the British law inapplicable as regards the United States of America, with the understanding that the putting into practice of an invention in the United States shall be equivalent to its execution in England.

Reference is made to a similar understanding recently arrived at between the government of this country and that of Switzerland, and it is stated that action similar to that suggested has already been taken on the part of Germany.

Dr. Muller informs us that in reply to his letter he has been informed that the State Department has set on foot negotiations looking to a conventional arrangement with Great Britain by which the lapse of a patent for non-working may be reciprocally waived. The American ambassador in London has reported that he has brought the subject to the attention of the British Government.

Lower Telephone Toll Rates Recommended in the Boston District.

In connection with the investigation of the telephone rates in Boston and suburban districts, and following out the lines of the report of Prof. D. C. Jackson, recently summarized in these columns, the Massachusetts Highway Commission has made recommendations as follows:

Provided, that the Legislature appropriates the money needed for the work, an inventory of the property of the New England Telephone & Telegraph Company shall be made as soon as possible, said appraisal to include the property of the company in Massachusetts in detail, and to extend over the remainder of the territory covered by the company's operations in accordance with a plan to be stated by the commission.

2. That careful studies of the traffic over the company's lines be made by the company during the period when the inventory and appraisal is in progress, following a plan to be submitted by the commission to the company at an early date.

3. That a preliminary adjustment of the toll rates now in force in the Boston and Suburban Division be made by a reduction in said rates between subscribers' telephones in all exchanges within a radius of five miles from the center of gravity of the metropolitan telephone service from 10 cents to 5 cents for each conversation of five minutes' length; it being understood that the following 16 suburban exchanges will be affected thereby: Charlestown, East Boston, South Boston, Cambridge, Chelsea, Roxbury, Somerville, Brookline, Everett, Dorchester, Revere, Winthrop, Jamaica Plain, Brighton, Malden and Medford exchanges.

Revision of the Electrical Code.

The sixteenth annual meeting of the Underwriters' National Electric Association was held in New York City, March 25 and 26. The reports of the various committees appointed last year were brought before the general meeting for final action and the numerous suggestions for changes in the rules received during the year were also given consideration. The changes and reports as finally approved will appear in the October "List of Electrical Fittings."

New rules were adopted governing the construction and installation of Cooper Hewitt lamps and Moore electric light tubes. The former must have a cut-out for each lamp or series of lamps, except when contained in a single frame and lighted by a single operation, in which case not more than five lamps shall be dependent on a single cut-out. The resistances or regulators must be enclosed in non-combustible cases, and where the resistances or regulators are subject to flyings of lint or combustible material, all openings through the casings must be protected by a fine wire gauze. Moore tubes must be installed so as to be free from liability to mechanical injury or of contact with inflammable material. The high-potential coils and regulating apparatus must be installed in an approved steel cabinet which shall be ventilated in such a manner as to prevent the escape of flame or sparks in case of burn-out. The apparatus in this box must be mounted on slate, and the enclosing case positively grounded. The supply conductors must comply with the rules governing low-potential systems where such wires do not carry current having a potential of over 300 volts.

The fine print note under rule 8, section *d*, was amended so as to make this apply to auto-starters only, and a new section was added to rule 60 governing the details of rheostat construction. New rules were approved governing the installation of transformers under low-potential systems, as follows: Oil transformers must not be placed inside of any building except central stations and substations, unless by special permission of the inspection department having jurisdiction. Air-cooled transformers must not be placed inside of any building excepting central stations and substations, unless the highest voltage of either primary or secondary does not exceed 550 volts, and must be so mounted that the case shall be at a distance of 1 ft. from combustible material or separated therefrom by non-combustible, non-absorptive insulating material, such as slate or marble. Where transformers are placed at a lesser distance, a slab of slate or marble somewhat larger than the transformer must be used, and where the transformer is mounted on a side wall, the slate or marble must be secured independent of the transformer supports, the transformer being supported by bolts countersunk at least 1/8 in. below the surface of the back of the slab and filled.

The committee on wiring of electric cranes reported the following rules, which were adopted:

All wires except bare collector wires, those between resistances and contact plates of rheostats and those subjected to severe external heat, must be approved, rubber-covered and not smaller in size than No. 12 B. & S. Wires between resistances and contact plates of rheostats must conform to No. 4-*c*, unless the wires are exposed to moisture, in which case the insulation must also be rubber. Wires subjected to severe external heat must have approved slow-burning insulation. All wires excepting collector wires and those run in metal conduit or armored cable must be supported by knobs or cleats which separate them at least 1 in. from the surface wired over, but in dry places where space is limited and the distance between wires as required by Rule 24-*h* cannot be obtained, each wire must be separately encased in approved flexible tubing securely fastened in place. Collector wires must be supported by approved insulators so mounted that even with the extreme movement permitted the wires will be separated at all times at least 1½ in. from the surface wired over. Collector wires must be held at the ends by approved strain insulators.

Where the wires are arranged in a horizontal plane above the crane, they must be supported at least every 20 ft. if practicable and separated at least 6 in., but if longer spans are necessary, the distance between wires must be increased proportionately, the span in no case to exceed 40 ft. If not arranged in a horizontal plane they must be carried along the runways and must be rigidly and securely attached to their insulating supports at least every 20 ft., and if not arranged in a vertical plane, must be separated at least 8 in.

Where bridge collector wires are over 80 ft. long, insulating supports on which the wires may loosely lie must be provided at least every 50 ft. Bridge collector wires must be kept at least 2½ in. apart, but a greater spacing should be used whenever it may be obtained. Collector wires must not be smaller in size than specified in the following table for the various spans:

Distance between rigid supports. Feet.	Size wire required. B. & S.
0 to 30	6
31 to 60	4
Over 60	2

Collectors must be so designed that sparking will be reduced to a minimum between them and collector wires. The main collector wires must be protected by a cut-out and the circuit controlled by a switch, cut-out and switch to be so located as to be easy of access from the floor. Cranes operated from cabs must have a cut-out and switch connected into the leads from the main collector wires and so located in the cab as to be readily accessible to the operator. Where there is more than one motor on a single crane, each motor lead must be protected by a cut-out located in the cab if there is one.

Controllers must be installed according to No. 4, except that if the crane is located outdoors the wires between resistances and contact plates of rheostats may be rubber-covered or bare or slow-burning if properly supported. If the crane operates over readily combustible material, the resistances must be placed in a fire-resisting enclosure, or if located in a cab, the cab must be constructed of non-combustible material and sides provided which enclose the cab from its floor to a height at least 6 in. above the top of the resistance.

The motor frames, the entire frame of the crane and the tracks must be permanently and effectively grounded.

A number of recommendations were made calling for conductive coatings on cables, outlet boxes and fittings in order to secure better electrical contact at all points throughout systems in which they are used.

The committee on the recodification of the Code was continued. It is the purpose of the committee to separate the specifications for fittings, materials and details of construction from the Code and print these in a separate pamphlet. Cross references will be omitted where it is feasible, and the requirements themselves inserted. All fine print notes which are intended to be mandatory will be made rules, and those which are not mandatory will either be eliminated or else be printed as explanations. The committee also recommended that hereafter only reports of regularly appointed committees and definite suggestions for changes or additions be printed in the advance bulletins.

Slight changes were made in the rules governing the construction of circuit-breakers, panel boards and the marking of variable-speed motors. The committee on outline lighting presented a report quite different from that appearing in the advance bulletin, the latter not being the report of the committee, and the new report was adopted with slight amendments, as was also the report of the committee on street railways.

The report of the committee on outline lighting included general specifications of the class of construction required. Rubber-covered wire and moisture-proof receptacles are necessary and no circuit can contain more than 66 sockets nor carry more than 1320 watts.

The report of the committee of rule 13A, grounding of low-potential circuits, was referred back to the committee for further consideration. Since the publication of the report in the advance bulletin some of the interests in the conference have reconsidered their action so that much diversity of opinion existed as to what is a proper ground, what is the proper voltage at which to make the grounding mandatory, etc. On motion of Mr. W. H. Blood, Jr., the sense of the meeting with reference to the matter of making the grounding of circuits mandatory was taken, for the guidance of the committee when the other details, such as proper grounds, voltage, etc., were agreed on. The opinion as expressed in the vote was that grounding should be made mandatory. The National Electrical Inspectors' Association were not in favor of making the grounding mandatory, and it was the wish of the Underwriters' committee that the other bodies represented in the conference should also report to it the sense of their organizations with reference to the matter for its guidance.

The following suggested changes in the rules were adopted: The fine print note under rule 2, section *a*, was amended to read as follows: "Wires from generator to switchboard may, however, be placed in conduit, provided that proper precautions are taken to protect them against moisture and mechanical injury. If lead-covered cable is used no further protection against moisture will be required, etc." Section *c* of the same rule was amended by inserting the words "where not in conduit" after the first word. The last sentence of the fine print note in rule 12, section *g*, was amended to read: "The outer or weather end of conduit is to be provided with approved devices having wires separated and bushed through porcelain."

A number of changes were made in rule 24. Section *a*, with fine-print note, was stricken from the Code; section *o* was amended by making the first recommendation "a turn of 90 deg., etc."; section *p* was amended so as to restrict the number of different circuits in the same conduit to four two-wire or three three-wire; section *x* was changed by substituting the word *or* after the word *fastenings* for *of*. Rule 24A was also changed somewhat. Section *d* was amended so as not to prohibit the installation of armored cable without the lead covering in buildings of fireproof construction in locations free from moisture; the word "underground" was omitted from the first line of the fine-print note under section "a." A new section was added as follows: "All bends must be so made that the armor of the cable will not be injured. The radius of the curve of the inner edge of any bend not to be less than 1½ in."

Rule 28, section *c*, was amended so as to exclude flexible cord from show cases as well as show windows; the fine-print note under section *g* was omitted. A number of minor changes were made in the rules governing the wiring of theaters, principally in inserting the words "or armored cable" so as to permit the use of the latter as an alternative to rigid conduit. The other changes have to do with the details of construction, fitting, etc. Among the miscellaneous suggestions adopted were the following: All self-fastening knobs, cleats and supports must be secured by suitable screws; wires in molding must be in continuous lengths from outlet to outlet or from fitting to fitting; sockets or rosettes cannot be used to dead-end a circuit; soapstone can be used as an alternative for slate or marble; and ends of flexible wire need not be soldered before insertion under binding posts, as called for in rule 14, section *c*.

Surges and Oscillations on Transmission Systems.

In a paper read before the New York Electrical Society last Friday evening, Mr. Ernest J. Berg discussed the various phenomena in the nature of surges and oscillations met with in high-tension transmission systems. He discussed the subject under the heads of instantaneous abnormal voltages and currents due to energy stored electromagnetically and electrostatically; surges caused by grounds; surges due to arcing grounds; statics caused by grounds; abnormal voltages caused by triple frequency e.m.f. in transformers, and corona effects. The electromagnetic and the static energy stored in a circuit were compared to the mechanical energy stored in a moving body. It is no more possible to change the current or voltage of an electric system than it is to change the speed of a fly-wheel without supplying or consuming energy. If the current in an inductive circuit could be interrupted instantaneously, the voltage would rise to infinity, and if capacity is present there will be a corresponding current flow. On the interruption of the current the electromagnetic energy is converted into electrostatic energy, and this in turn is reconverted into electromagnetic energy, causing current flow. Where there is no resistance in the circuit the current would flow indefinitely, but since there is always resistance present the energy is dissipated in heat and the oscillations finally cease.

The phenomena associated with grounds on one of the transmission wires or with temporary emergency transformer connections were explained by the aid of blackboard diagrams. When one transmission line is grounded, "static" appears at the switchboard, at the generator and in general in the secondary network, and the instruments, transformers, motors and generators are liable to be damaged thereby. A ground on a high-potential line usually causes considerable disturbance on telephone lines.

Mr. Berg pointed out that with certain transformer connections a triple-frequency e.m.f. is induced in the transformer which, although not affecting the voltage between the lines, affects the potential stresses of the windings against ground. These e.m.fs., however, are not incidental to high voltages, but are of much more importance in high-voltage systems due to the usually lesser margin in insulation.

Arcing grounds, Mr. Berg pointed out, are always more destructive than positive grounds since they involve a train of oscillations, the circuit being made and interrupted with great frequency. The stresses caused by such grounds depend much upon the transformer connections.

Experiments have proved that with parallel conductors air insulation breakdowns and corona effects appear at a potential gradient of 100,000 volts per inch at atmospheric pressure. With rubber or varnished fabric corona takes place at higher voltages than in air. It was shown to be practically impossible to insulate a wire of small gage for very high voltages. Corona manifests itself in a glow, and among other effects it turns small wires black, while larger ones remain bright. It is thought that the formation of nitric acid is an accompaniment of the corona.

Marseilles International Exposition.

Arrangements have been completed whereby the international exposition at Marseilles will be supplied with electrical energy from the power houses of the two companies which supply the city of Marseilles. Each of these will supply from 1000 to 1200 kilowatts of three-phase currents at 5000 volts. About 25 transformers will be installed in small kiosks scattered through the park, which will supply secondary circuits for lighting the grounds. A 600-hp Rateau-Brown-Boveri electric pump will furnish the water for a large electrical fountain. The general lighting of the grounds will be by means of 350 arc lamps and about 40,000 incandescent lamps. The accompanying illustration shows an allegorical representation of electricity which will be one of the decorations of the Palais de l'Energie.

ALLEGORICAL REPRESENTATION OF ELECTRICITY.

Tests of Internal Combustion Engines.

Data bearing upon the fuel consumption of small internal engines are always of interest. Below are given the results of tests upon pumping plants at Westford, Wrentham and Wareham, Mass., by Mr. E. M. Blake, of Boston:

At Westford a 50-hp Olds horizontal gas engine, a 40 to 60 hp suction gas producer and an 8 x 12 in. Smith-Vaile vertical triplex pump installed by the Westford Water Company were tested. The results of a 24 hour continuous pumping test, the producer being fed with anthracite pea coal and the fires operated under exactly normal conditions, were most satisfactory. The equipment ran without a hitch. At 80 per cent of full load, the conditions prevailing during the run, with an average delivery of 282.8 gal. per minute, against an average total head of 416.21 ft., including friction and suction, the duty, based on 100 lb. of coal actually burned in the producer, and allowing 1 per cent slip on the foot-pounds of work actually done by the pump end, was approximately 146,000,000 ft. lb.

In the Wrentham test, a single 25-hp Mietz & Weiss fuel oil engine, direct-connected to an 8 in. x 10 in. Smith-Vaile vertical triplex pump was tested. At three-quarters load, the condition prevailing during the test, with a delivery of 262.3 U. S. gal. per minute against an average total head of 197.88 ft., including friction and suction, the fuel oil consumption averaged 1.95 lb. per hp-hour, based on the horse-power developed at the pump end.

At Wareham, the engines tested were two 25-hp Mietz & Weiss fuel oil engines, direct-connected to two 8 x 10 Smith-Vaile vertical triplex pumps. At approximately three-quarters load, with a combined delivery of 525 U. S. gal. per minute, against an average total head of 201.14 ft., including friction, etc., the fuel oil consumption averaged 1.93 lb. per hp-hour.

Power Station in Indiana Coal Fields.

Frank Fauvre, Paul White and other capitalists of Indianapolis, who are preparing to build and equip a large central power plant in the bituminous coal fields of Indiana, southeast of Terre Haute, in order to have a ready market for the sale of energy developed at the new plant, have acquired the property of the People's Light & Heat Company, of Indianapolis. This company has a franchise covering the entire northern portion of the city, and runs for a period of 25 years.

By building this power station at the coal mines it is claimed that there will be a saving of at least $41,300 per year in freight rates and taxes incidental to such a plant built and maintained in Indianapolis. The officials estimate that an 8000-hp plant would consume about 82,600 tons of coal a year, which would cost, freight rates included, $41,300 per annum put down in Indianapolis, against $6,000 at the mouth of the mine, making possible a saving of $35,300 per annum. There will be a small loss in transmission to Indianapolis, requiring about 10 per cent more coal to be burned in order to equal the output of a plant of the same size at Indianapolis.

It is stated that the railroads at times are unable to deliver coal shipments promptly, thus entailing considerable loss to the industries depending upon the electric plants for energy. The new central-power plant will be able, therefore, to produce electrical energy at a low rate for a large territory.

The officials say that many factories came to Indiana during the natural-gas days, and more will come and old ones started when electric power is furnished at a reasonable price, and that is what their organization proposes to supply. The company's principal business will be with the mills and factories. It claims to have already received orders for over 3000 horsepower without any solicitation whatever.

The transmission line from the plant at the coal mine to Indianapolis will be about 100 miles in length. It will pass through a thickly settled district, having a number of towns and cities to be supplied. When this territory, including Indianapolis, is taken care of, the plan is to turn toward Vincennes, Evansville, Louisville and eastern Illinois.

The company is capitalized at $1,000,000. In addition to the acquisition of the People's Light & Heat Company, the organization has taken an option on 500 acres of coal land. Arrangements are now being made for an early construction and equipment of the central station.

New Edison Contract for City of Boston.

The Edison Electric Illuminating Company, of Boston, has succeeded in securing a contract with the city for the lighting of its municipal buildings on the company's regular schedule of rates. The cancellation of the old contract was made on March 28 by Counsel Babson for the city, and this will save Boston about $1,000 a month, beginning with the April bills. For about four years the company has been endeavoring to bring the city authorities to appreciate the advantages of taking current at the standard rates. Mr. E. W. Burdett represented the company in its negotiations. The new schedule is the one given by the company in every city in its territory for the lighting of municipal buildings. The conditions of use govern the rates in every case.

Under the new arrangement some of the departments will be obliged to pay somewhat more than others, but the average for all will be a saving, as indicated. It is expected that by rearrangement of lamps and the substitution of more economical lamps, the cost of lighting will be materially reduced in some cases. The old street lighting contract, which provides for a maximum return of 6 per cent on the investment, is still in force, although the arbitration provided for under the terms of the street-lighting contract every 2.5 years saved the city over $10,000 per year recently. It is hoped by the company still further to reduce the cost of lighting or else to provide more light at the same cost through the use of improved lamps.

"Breakdown" Consumers Express Views.

Public Service Commissioner Maltbie, who is conducting the gas and electric companies investigation in New York, held an informal conference on Wednesday, March 25, with the users of "breakdown" electric service. The points brought out in the previous hearings with the electric companies were discussed and various plans with regard to the supply and price of "breakdown" service were considered. Commissioner Maltbie said afterward that no final conclusions in regard to "breakdown" service had been reached as yet by the commission.

New York City "Break-Down" Service.

A hearing was held before Commissioner Maltbie, of the New York City Public Service Commission, last Friday on the subject of "break-down" service. The New York Edison Company made a proposal by which it modified its previous break-down rates as set forth in a letter to the commission on Jan. 16, so that the basis of charge should be for the maximum demand of the break-down consumer rather than on the basis of the entire installation as formerly. Mr. W. W. Freeman of the Brooklyn Edison Company was called to the stand and handed the commissioner a memorandum of the present number of break-down customers supplied by the Brooklyn Company. The memorandum showed that there are six consumers under special contract at rates of 6, 5 and 4 cents, using 503,248 kw-hours, with total charges of $24,158.40, averaging 4.8 cents per kw-hour. The Brooklyn Edison Company supplies four retail consumers using 8,958 kw-hours, with total charges of $1,048.40, an average of 11.8 cents per kw-hour, making a total of 10 consumers using 512,206 kw-hours, with total charges of $25,206.80, averaging 4.92 cents per kw-hour.

A summary of break-down connections for 1907 of the New York Edison Company showed that there were 105 retail customers with installations of 3778 kilowatts and a consumption in kw-hours of 728,447, which was billed for $69,959.54, an average return per kw-hour of 9.62 cents, or an average return per kilowatt connected of $18.52. For 1907 there were 40 retail power consumers, nine of which used power exclusively, consuming 240,805 kw-hours, and billed for $18,896.31, an average return per kw-hour in cents of 7.85 and an average return per kilowatt of connected installation of $19.34. For the eight wholesale power users the installation was 2041 kilowatts, with a consumption in kw-hours of 2,416,973.1, billed for $100,337.76, an average return per kw-hour of 4.15 cents, and average return per kilowatt of connected installation of $49.16, making a grand total of 153 consumers, with 6796 kilowatts of installation, consuming 3,386,256 kw-hours, paying $189.193, an average return per kw-hour of 5.58 cents, and an average return per kilowatt of connected installation of $27.84.

Mr. J. W. Lieb, Jr., vice-president of the Edison Company, said that there was no record of the load curve of break-down consumers, nor data to show what amount of generating or distributing plant was required for this class of consumers. He handed to the commissioner a modification of the memorandum of break-down service rates which were contained in a letter to the commissioner dated Jan. 16. Mr. Lieb's memorandum stated that break-down service would be furnished to any applicant operating a private plant under the following conditions: (a) A service charge of $30, including the supply of current at the best rate of the class for each kilowatt of maximum demand. (b) The maximum demand to be controlled by a special "limit service" switch which will be adjusted so as to allow the customer to use up the capacity for which he specifically contracts. (c) The load for which the customer contracts will be a "balanced load"—that is, a load which will be taken up in approximately equal quantities from each side of the 3-wire system. (d) For each installation of break-down or reserve service of capacity less than 10 kilowatts of maximum demand, the company will charge $75 for introducing the "special limit" switch and protecting device. (e) The customer is to provide the incandescent lamps for original installation and renewals, carbons and trimmings, and for the maintenance of arc lamps, the company to assume no responsibility for installation; an allowance to be made offsetting the supply of incandescent lamps under each of the wholesale forms of contract, and where the service is taken under retail contract, a special reduction of 1 cent per kw-hour will be made in view of the customer's relieving the company of the supply and care of the incandescent lamps or arc lamps. (f) The above conditions do not refer to any installation or part of an installation permanently segregated from the private plant and connecting directly and permanently with the service of the company. Such installation may be supplied under direct contract, at the best rates obtainable by any other consumer under like conditions, using an equal amount of current. The memorandum stated that this rate was experimental and might be revoked at the end of the year.

The conspicuous feature of the modification suggested by Mr. Lieb is that a consumer may specify the maximum demand of current required instead of contracting for the whole installation as formerly, and the rate is based on that demand; including the expense of lamp, renewals, trimmings, etc., the charge for current would be 9 cents per kw-hour. The service charge of $30 contained in the former offer, including the current, would be maintained, Mr. Lieb said, but if after a year of experimentation with ammeters it was found that this rate was too high, the company would be willing to consider a modification. "In making this radical change," Mr. Lieb said, "we have given the greatest consideration to the suggestions that have been made to us, and any information which we could obtain to throw light on the subject, with the result that the modification made accords to what we consider to be the very lowest rate for that class of service and makes it possible for the customer to obtain every advantage from it." He said that the company would accept payment at the rate of $2.50 a month on the $30 a year charge, and that the consumer was privileged to use up to the maximum demand at any time during the year without extra charge. The company was willing to make break-down connection under this new rate as soon as it learned that the modification would be acceptable to the consumer. Mr. Maltbie pointed out that the commission could not formally approve of a rate, and that it had taken up the matter merely with the intention of bringing the company and the consumer together.

The Tungsten Lamp.

In an address before the New York section of the American Electrochemical Society, delivered by Dr. Clayton H. Sharp, March 27, the following considerations relating to the tungsten lamp were presented:

There are certain main difficulties in producing a filament from a material like tungsten due to the fact that the tungsten is not ductile and unites readily with oxygen or carbon. Hence it is the practice to produce filaments from tungsten in the form of a very fine powder which is held together by some sort of binder which can be removed after the filament has been squirted; this removal must leave the filament free from oxygen and carbon. A number of processes have been described. The first to appear was that of Kuzel, in which a collodial solution of tungsten is formed by making an arc between tungsten terminals under water. This solution when of the proper consistency is squirted into filaments which consist entirely of pure tungsten and water. When the water has been driven out, the tungsten particles can be sintered together by heating the filament by means of the electric current in an atmosphere containing no oxygen. In Welsbach's process, an organic binder is used to make a paste which can be squirted through a die. The binder is removed by heating in an atmosphere which will oxidize the carbon and which contains at the same time sufficient hydrogen to reduce any tungsten which may have been oxydized. For the Just-Hanaman process, a very fine filament of carbon is heated in an atmosphere of chloride of tungsten and hydrogen. This results in a deposit of tungsten upon the filament or a substitution of tungsten for carbon. The carbon must afterward be removed by some such process as indicated above. In the "Z" process, a binder of collodion is used which can be made to burn itself out entirely. It has been found possible also to use binders of paraffine, which material can be removed simply by heat; or a slow melting metallic alloy may be used as a binder, the foreign metals being driven off by heat. An account was given of the results of a manufacturer's test on 15 series tungsten lamps in which the average candle-power did not change during 2135 hours of burning. Of these lamps, five survived at the end of the test and only three had actually burned out.

New York Lighting Investigation.

At the hearing on Monday, March 30, of the New York City Public Service Commission, the general subject of light and power was considered, with special reference to the number of contracts and rates charged by the various New York City companies. Messrs. Arthur Williams, H. M. Edwards and J. W. Lieb appeared for the New York Edison Company; Mr. Frank W. Smith for the United Electric Company; Mr. W. W. Freeman for the Brooklyn Edison Company; Mr. Henry E. McGowan for the Flatbush Gas Company; Mr. J. T. Cowling for the Westchester Lighting Company; Mr. E. H. Rosenquest for the Bronx Gas & Electric Company; Mr. C. G. M. Thomas for the New York & Queens County Company; Mr. Carleton Macy for the Queens Borough Company, and Mr. W. J. Norton for the Richmond Light & Railroad Company. All those who appeared handed to Commissioner Maltbie memoranda showing the number of current contracts on the books of their respective companies, and were questioned in respect to the details. The hearing was adjourned until Thursday, April 2.

Proposed Illumination for Denver Plaza.

A large central plaza or civic center is proposed for Denver by those interested in civic improvement. The plan calls for the occupancy of about six city blocks immediately west of the state capitol, upon which about $15,000,000 is to be expended for grounds and buildings. A plan for the illumination of this plaza has been prepared by Mr. R. Garland Gentry, illuminating engineer of the Denver Gas & Electric Company. In the plans which he outlines, which have appeared with large illustrations in Denver papers, a certain amount of outline lighting is provided on the principal public buildings, such as the stadium, mint, public library and state capitol. For the lighting of walks and drives he recommends a post of moderate proportions and conventional design equipped with incandescent lamps of some modern type, such as Gem, tantalum or tungsten, spacing these poles about 100 ft. apart diagonally across streets and driveways. This he strongly recommends in preference to arc lamps. A park or plaza is a resting place, and a soft, well diffused illumination should be provided. This could be accomplished with incandescent units equipped with translucent globes of some familiar type of glassware. Colored lighting effects could be obtained in the fountain and sunken gardens.

Sign Business in Shreveport, La.

Shreveport, La., is one of the few cities where the policy is pursued of pushing flat-rate sign business to come on after the peak. With a total of 24 signs containing 2743 2-cp lamps, 12 signs containing 1739 lamps, are on flat rate, and burn from 7 to 11 o'clock during the winter months. By this means a load of 22 kilowatts is kept off the peak. No great difficulty was experienced in doing this, and the objections of a few consumers were met with the argument that the company was willing to make a lower rate for off-peak business.

On flat-rate signs the company makes a rate of 15 cents for each 2-cp lamp. The 24 signs bring a gross yearly revenue of $2,787, and $2,238 of this is obtained from the 12 flat-rate signs.

Public Utilities Accounting.

A hearing was held before Commissioner Maltbie, of the New York City Public Service Commission, on March 26, on the subject of uniform accounts for gas and electric companies. Those who appeared formally before the commissioner were Mr. A. F. Weber, statistician to the Commission of the First District; Mr. Forrest E. Barker, of the Massachusetts Board of Gas and Electric Light Commissioners; Mr. William J. Meyers, statistician for the Second District Public Service Commission; Mr. W. J. Hagenah, statistician for the Wisconsin commission; Mr. H. M. Brundage, for the Astoria Light, Heat & Power Company; Mr. F. S. Dame, representing the Des Moines Electric Light Company, and member of the National Electric Light Association; Mr. A. F. Stanford, representing the Brooklyn Union Gas Company, Jamaica Gas Company, Richmond Hill & Queens County Gas Company, Woodhaven Gas Company, Newton Gas Company, and the Flushing Gas Company; Mr. James Gillman, assistant auditor of the Brooklyn Union Gas Company; Mr. John L. Bailey, of the Baltimore Consolidated Gas, Electric Light & Power Company; Messrs. E. J. Allegaert and P. S. Young, of the National Electric Light Association; Messrs. A. S. Knight and L. M. Wallace, of the Boston Edison Electric Illuminating Company; Mr. G. W. Curran, of the American Gas Institute; Mr. J. W. Fernley, of the New York & Richmond Gas Company; Mr. J. J. Humphreys, of the Brooklyn Borough Gas Company and member on the commission of public accounting of the New England Association of Gas Engineers; Mr. M. M. Graham, of the New Amsterdam Gas Company; Mr. G. G. M. Thomas, of the New York & Queens Gas Company; Mr. J. E. Sanborn, of the New York Mutual Gas Light Company; Messrs. M. M. Flook and M. E. Johnson, of the Kings County Lighting Company; Mr. H. M. Edwards, auditor of the New York Edison Company, and chairman of the committee on the uniform system of accounts of the National Electric Light Association; Mr. W. W. Freeman, vice-president, and Mr. P. R. Atkinson, treasurer, of the Brooklyn Edison Company, and Mr. W. H. Gardiner, chairman of the committee on uniform accounts of the New England Association of Gas Engineers. In addition there were others present from various parts of the country interested in the subject of uniform accounting.

The tentative system of accounts, issued by the Public Service Commission, was taken up and each item carefully discussed. Every one who desired had a chance to make whatever suggestions he deemed appropriate. The commissioner noted the suggestions made, and at the close of the hearing it was announced that a conference would be held soon between the statisticians of the First and Second Districts of the New York Public Service Commission and the various other persons representing the other commissions and those interested in the subject of uniform accounting, to discuss further the suggestions and the proposed amendments made at the public hearing.

CURRENT NEWS AND NOTES.

NEW YORK CITY MUNICIPAL LIGHTING PLANT SHUT DOWN.—The refuse destructor electric lighting plant erected several years ago under the Manhattan end of the Williamsburg bridge has been abandoned. It was found that the cost of coal necessary to burn with the garbage to keep up steam was so great that, together with other expenses, the cost to generate current greatly exceeded the rate at which it could be purchased from the New York Edison Company.

GASOLENE-ELECTRIC MOTOR CAR TRIAL.—A trip from New York to Philadelphia was made March 29 by a Strang motor car, the time being two hours and five minutes. During part of the trip a speed of 50 miles per hour was maintained. The equipment consists of a six-cylinder gasolene engine direct connected to a direct-current generator, which latter supplies current to motors on the axles of the cars.

APPLICATION OF ELECTRICAL HEATING TO TEXTILE WORK.—A patent was issued March 24 to C. T. Kaisser and Lew Francis on an electric heating device for singeing or burning off the down or nap of fabrics, which work has hitherto been done by a naked gas flame.

THE OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION will hold its second annual convention in Guthrie, Okla., on May 25, 26 and 27. An exhibit of electric and gas appliances will be one of the features of the meeting. There will be no charge for electric current or gas for exhibiting purposes. Mr. Galen Crow, of Guthrie, is secretary.

PIONEER THEATER ELECTRIC LIGHTING.—The celebration last week of the forty-third anniversary of the beginning of the managerial career of Tony Pastor, the dean of American vaudeville, recalls that his Fourteenth Street house was one of the first theaters of the world to be lighted by electricity and the first to use the electric sign for advertising purposes. The same sign, "Pastor's," still hangs at right angles to the street before the Fourteenth Street Theater.

SMALL CANDLE-POWER TUNGSTEN LAMPS.—In reference to a statement in an editorial in the issue dated March 28, to the effect that in this country tungsten lamps have been mainly made in the 100-watt size, we are informed that the tungsten lamp factory of the National Electric Lamp Association in Cleveland has made nothing but 110 and 60-watt lamps since it was started, and that there are probably more 40 and 60-watt tungsten lamps in the United States to-day than 100-watt tungstens.

ELECTRIC SIGNALS LESSEN ACCIDENTS.—The report for January of the Union Pacific Railroad shows that for the 1,500,000 engine-miles of the road the total cost for train accidents was only $1.088 per mile. This excellent showing is attributed to the use of block signals, hand power and pneumatic systems having been displaced by electricity. The railroad had expended $2,000,000 for the installation of safety appliances and under the improved system it is practically impossible for the operator to give two trains the right of way at the same time.

ELECTRIC BALL OF FIRE.—A despatch to the *Cleveland Leader* from Bellefontaine, Ohio, stated that a meteor having the appearance of a ball of fire, fell in that place on March 18 and exploded with a terrific report. Further inquiry developed that on the date given an electric storm of unusual severity passed over the town, and from a responsible source we are informed that a "ball of fire about the size of a quart cup descended from the insulator of a telephone pole to within three feet of the sidewalk, where it exploded with a loud noise, but without doing any damage."

NATIONAL CONFERENCE ON STANDARD ELECTRICAL RULES.—The annual meeting of the National Conference on Standard Electrical Rules was held at the Edison Auditorium on Friday afternoon, March 27. Delegates from the various associations composing the conference were in attendance, and in accordance with the request of the National Board of Fire Underwriters the sense of the meeting was taken with reference to making the grounding of low potential circuits mandatory. The consensus of opinion was that if a good, reliable ground could be procured, grounding should be required; but if not, grounding should not be insisted on. Mr. W. H. Blood, Jr., was re-elected president and Mr. C. J. H. Woodbury secretary of the conference.

MERCURY VAPOR APPARATUS.—Two patents were issued March 24 to O. O. Kruh, of Schenectady, N. Y., on mercury vapor electric apparatus which involve new dispositions of the electrodes. In one patent the device described has a pair of anodes, each located in separate and opposite chambers in the walls of the main tube, while a tube extending past the anode openings contains the cathode. In this manner the discharge or arc blast from the cathode is extended beyond the anodes, thus preventing any tendency toward arcing between electrodes. In the second patent the anode and cathode are parallel and each contained within a double shield; one of these two shields is an open cylinder and within it is another cylinder enclosing the electrode, and having an opening on the side farthest from the opposite electrode.

PRESIDENT CASTRO CONFISCATES TELEPHONE COMPANY.—It is reported that President Castro, of Venezuela, has made another raid upon foreign rights, this time the victim being the telephone company of Carupano, which supplies telephone service for the districts of Bermudez, Arismendi and Benitez. The official reason given for the seizure of this property by government representatives was, that the telephone company was a menace to the government and to the public peace. The company had a contract with the government which gave it the privilege of exclusive operation in the districts mentioned and free service was given to the municipalities. It is said that the seizure resulted from the refusal on the part of the company to give service to certain officers of the government. The militia took forcible possession of the property, imprisoning the manager and the employees.

SOUTHERN APPALACHIAN WATER POWERS.—The United States Department of Agriculture has issued a pamphlet (circular 144, Forest Service) by Messrs. M. O. Leighton, M. R. Hall and R. H. Bolster, which discusses the relation of the Southern Appalachian Mountains to the development of water power. The various larger rivers having their sources in the Appalachians are taken up in turn, and estimates given of the amount of horse-power available for development. The aggregate or minimum horse-power is no less than 2,829,900, and it is estimated that at least 50 per cent and probably more of this power is available for economic development. This figure represents merely the minimum horse-power, and if auxiliary power were provided to supply short seasons of water deficiency, it would be profitable to develop two and one-half times this amount, and the full development of storage facilities would increase the minimum from to 3 to 30 times. While some of this power has already been developed, the proportion is so small as to make no showing when the enormous resources are taken into account. It is pointed out that the rental of 1,400,000 horse-power at $20 per hp-year is equal to a gross income of 3 per cent on a capital of $933,000,000.

DEAN BOVEY.—In commenting on the appointment of Professor Bovey, F.R.S., Dean of the Faculty of Applied Science in the McGill University, Montreal, to the responsible position of Rector of the Imperial College of Science and Technology, the London *Times* says that the governors of that institution have taken a bold step, but one for which there is ample justification. McGill University, it says, stands in the front rank of the institutions of higher education in the Empire, and this position is largely due to the organization and equipment of the Faculty of Applied Science, the credit for which belongs, principally, to the Professor of Civil Engineering, who has been Dean of the Faculty since its separate establishment in 1888. "Professor Bovey has shown not only that he can impress influential and wealthy citizens and corporations with the advantages of advanced scientific training, but that he can also successfully organize the extensive resources provided by the liberality of such donors. Moreover, Professor Bovey's appointment to the newly-established Rectorship has a wide and Imperial significance, which alone is commendable. This appointment may, therefore, be welcomed both from the practical and from the sentimental point of view, and the governors may be congratulated on having taken a step which should advance the Imperial College a stage further along the difficult path toward the realization of the high ideal which its well-wishers have imagined for it."

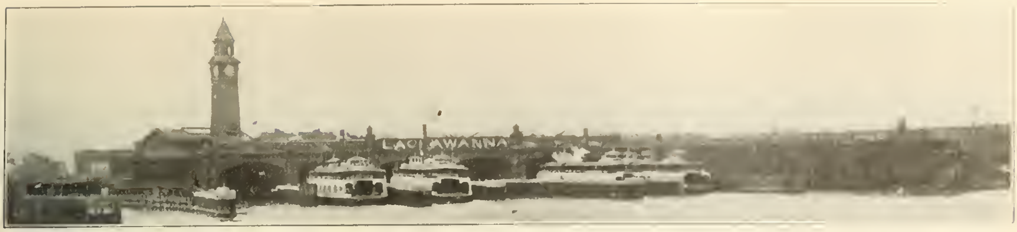


FIG. 1.—TERMINAL STATION AND FERRY HOUSE OF THE LACKAWANNA RAILROAD AT HOBOKEN, N. J.

Electrical Equipment of the Hoboken Terminal of the Lackawanna Railroad.

THE new terminal station and ferry house of the Delaware, Lackawanna & Western Railroad at Hoboken, N. J., is a steel frame structure with reinforced cinder concrete walls and floor slabs and a slag roof. The terminal is practically fireproof and is a part of the extensive improvements made at the eastern terminus of the railroad. The railroad company operates ferry lines between the terminal and Barclay, Christopher and Twenty-third Streets, New York; the ferry passenger traffic approximating 100,000 passengers daily. A large part of this traffic is between New York City and suburban towns in New Jersey reached by the Lackawanna Railroad. The terminal is a model of neatness and cleanliness and has a river frontage of 600 ft. and a width of 400 ft. to the outer ends of the ferry racks.

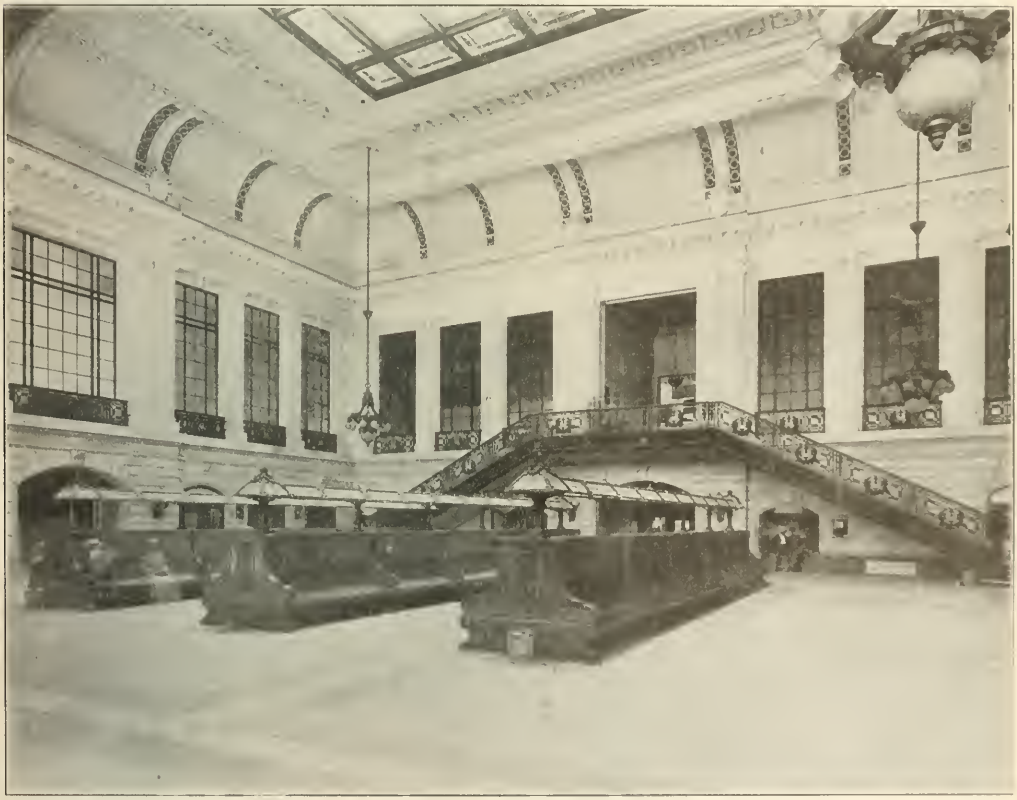


FIG. 2.—MAIN WAITING ROOM, HOBOKEN TERMINAL LACKAWANNA RAILROAD.

The general design of the structure is shown in the accompanying engravings. The ferry house is long and narrow, built parallel to the river, with the station building at one end. It is two stories high, and the ferry boats being double deckers, passengers may use either floor in embarking and disembarking. The second floor entrances to the boats connect with a 72 ft. x 450 ft. concourse ending in the station building proper. A concourse also connects with the first floor entrances and is provided with convenient exits to the station and to the street.

The concourse on the second floor is so arranged at the station end that suburban passengers may proceed directly from the boats down a flight of stairs 40 ft. wide to the trains. An entrance to the waiting room is also provided, while passengers to Hoboken have a separate exit. Similar exit arrangements are provided on the ground floor. Passengers coming to Hoboken from New York by way of the Hudson tunnels are landed just outside the train shed. East bound passengers desiring to enter the boats may pass through the first-floor concourse directly from the trains, waiting rooms or the street to the lower deck of the boats. Those desiring to reach the upper deck of the boats ascend to the second-floor concourse on an inclined plane of slight grade, or by elevators and stairways.

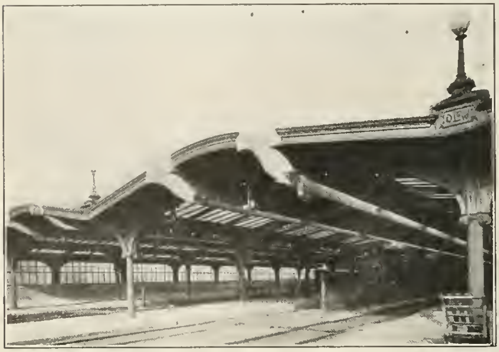


FIG. 3.—FRONT OF TRAIN SHED, SHOWING METHOD OF ILLUMINATING.

The main waiting room is 100 ft. square and 54 ft. high with abundant window space on the sides and skylight in the roof. A large dining room is located on the second floor at one corner of the building and is provided with a balcony which is used as an open-air restaurant in summer extending out over the dock. The terminal has been carefully designed as regards natural light, so that only in a few places is artificial illumination necessary during the day. The 225-ft. clock tower shown is added purely for architectural effect. It is a copper shell on a steel frame and contains besides the four clocks, a large ventilating fan.

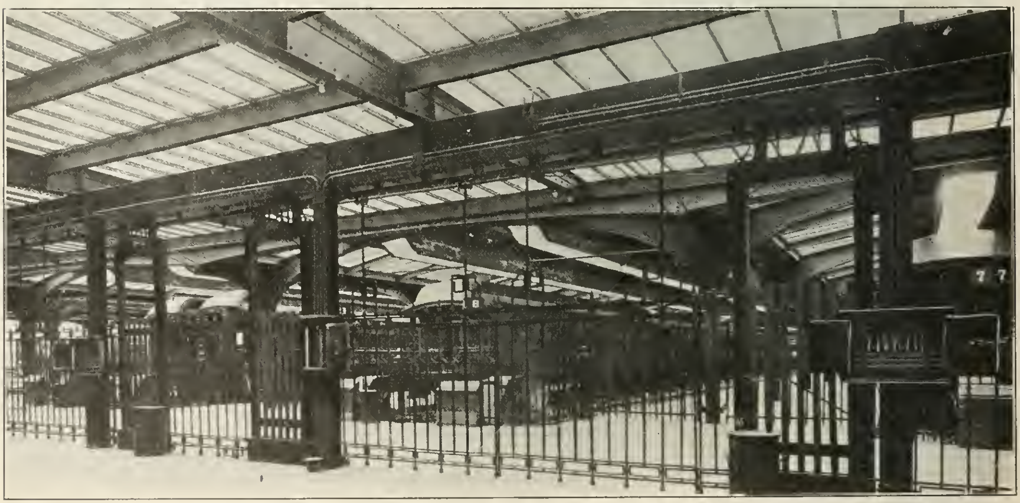


FIG. 4.—ENTRANCE TO TRAIN PLATFORMS, SHOWING DISTRIBUTION PANELS AND LAMPS.

The train shed differs greatly from the usual type of train sheds in use. The shed consists of a number of low short-span, longitudinal sections built up of structural steel, reinforced concrete and wire-glass with the steel protected from locomotive gases by concrete and with copper in all places where exposed metal is required. There are 14 tracks in pairs under the train shed with concrete platforms 20 ft. wide between each pair. A longitudinal section of the shed covers each pair of tracks and half of the platform on both sides of them. The roofs are high enough to clear the highest locomotives in use on the road. The adjacent sections are supported by longitudinal rows of columns placed 27 ft. on centers down the middle of the platforms, with a transverse built-up roof girder at each transverse column row. Resting on the transverse roof girders are longitudinal purlins which support the reinforced concrete roof slab and the skylights in it. That part of the transverse girders directly over the locomotive stacks and the longitudinal purlins on both sides of the longitudinal openings in the roof over the locomotive stacks are entirely encased in concrete.

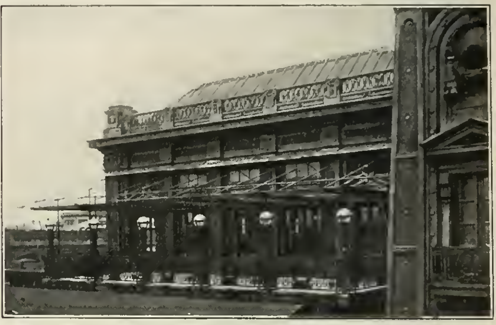


FIG. 5.—BALCONY OUTSIDE OF RESTAURANT.

The longitudinal openings over the locomotive stacks extend the entire length of the train shed and with the exception of the crossing of the roof girders is entirely open, so the locomotives exhaust directly into the open air. A built-up section encased in a concrete slab is placed on edge on either side of the opening to direct the gases in their passage from the stacks, to protect the longitudinal purlins and to keep rain and snow from blowing in on the platforms. The tops of the locomotive stacks are so near the openings that practically no smoke or gases discharged from them finds its way below the shed. Three continuous skylights of wire-glass, 6 ft. wide, are placed longitudinally in the roof of each section. One of these is at the peak of the roof and admits light directly to the inside windows of the cars on the tracks below The remaining two rows are placed over the platforms, one on each side of the tracks so as to admit light to the outside windows of the cars. The proximity of the skylights to the car windows avoids the poor light usual in most train sheds. One of the illustrations shows the excellency of this illumination.

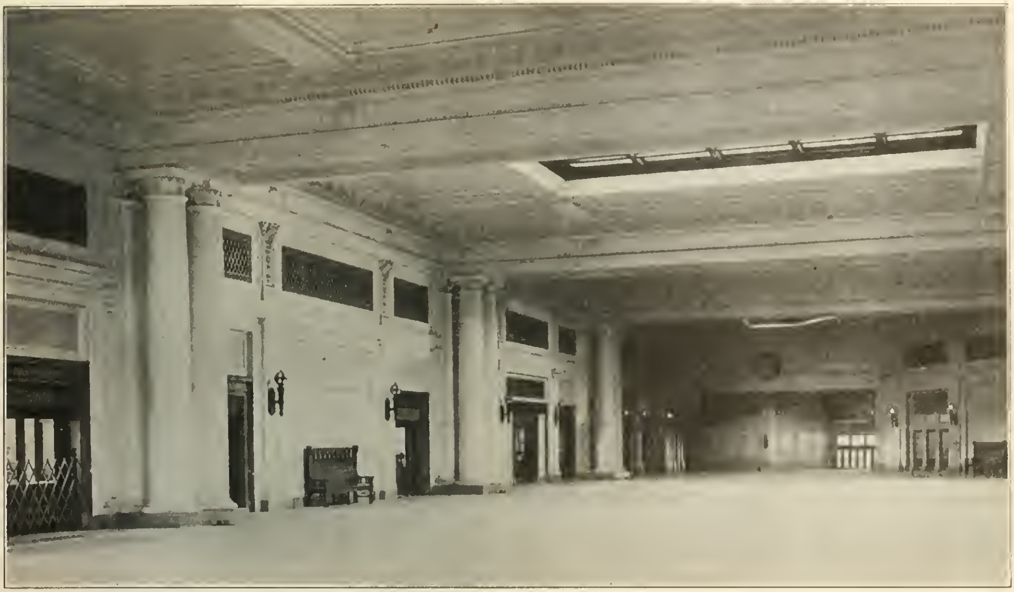


FIG. 6.—PARTIAL VIEW OF UPPER CONCOURSE IN LACKAWANNA TERMINAL.

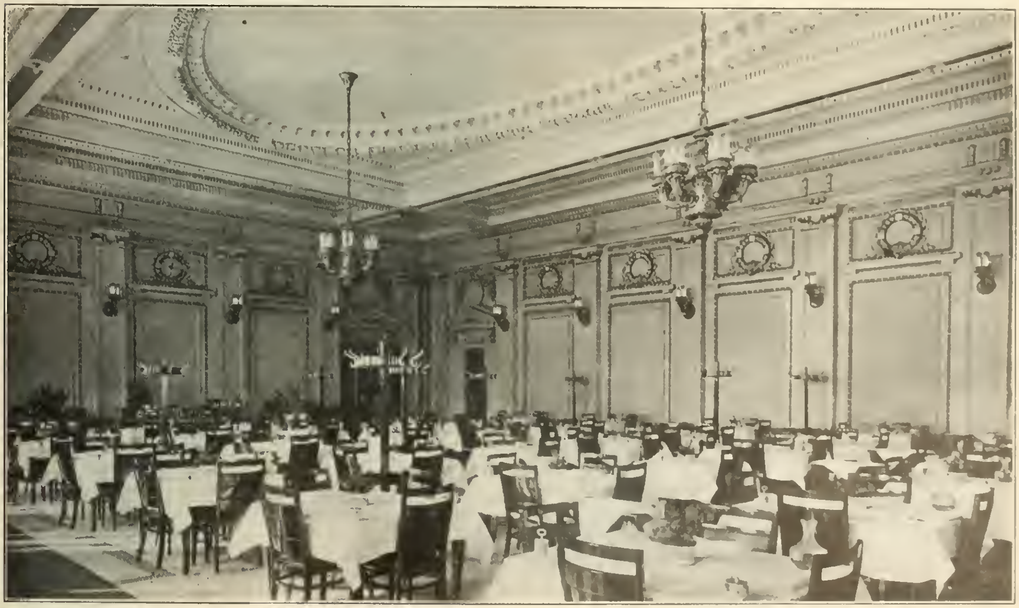


FIG. 7.—VIEW OF MAIN DINING ROOM IN LACKAWANNA TERMINAL.

To the left of the train sheds, and some little distance beyond, is the power house, which supplies the electrical energy for the lamps and motors in use at the terminal and the hot water for heating the various buildings, as well as the compressed air for operating the signaling and switching system

The equipment at present installed consists of eight 300-hp Atlas water-tube boilers fitted with superheaters and with the Parsons system for burning the finest sizes of anthracite coal; two 500-kw Westinghouse-Parsons turbo-generators; three air compressors and auxiliary apparatus. Expansion bends connect the boilers to a main header passing through the boiler room and around the engine room in a loop, so that steam can be taken from the boilers in either direction. A feature of the header is that it is equipped with separating tees so that no separators are placed at the engine throttles. The turbines exhaust either to Worthington surface condensers or through an exhaust hot-water heater, from which the hot water for heating the depot and surrounding buildings is obtained.

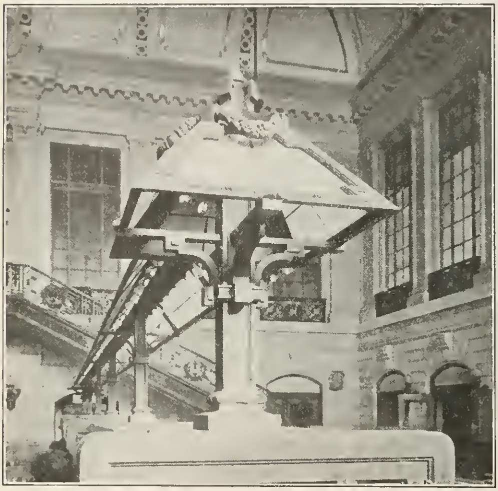


FIG. 8.—METHOD OF ILLUMINATING SETTEES.

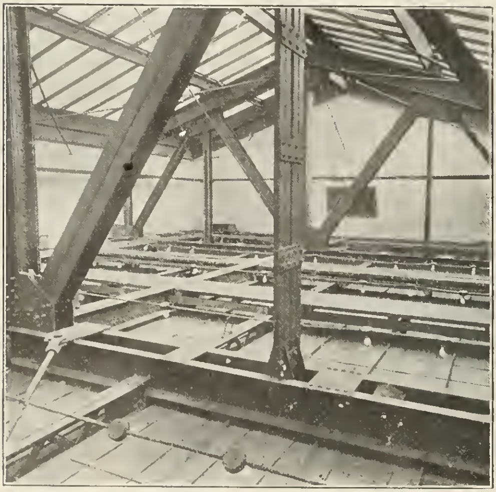


FIG. 9.—LAMPS ABOVE ART-GLASS CEILING OF MAIN WAITING ROOM

The air compressors can also be operated condensing or the exhaust can be passed through the hot-water heater. All of the auxiliary apparatus is operated non-condensing; the exhaust passing through the boiler feed-water heater. Two exciter units are provided, one steam-driven and the other motor-driven. Each unit has a rating of 50 kilowatts. Feed water is purchased from the city, and salt water for circulating through the condenser is taken from the river through concrete ducts.

The turbines are placed on a gallery in the power house, as is also the switchboard. The turbo-generators are 2300-volt, 60-cycle, three-phase machines. The switchboard is made up of 15 standard panels of General Electric make, and is equipped with oil switches. Seven feeder panels are provided for controlling the various circuits outside the power house and two arc lamp panels for controlling the arc-lamp circuits in the yards. Three-phase current, at a potential of 2200 volts, is brought in underground conduits to two distribution points in the terminal. Here high-tension switching apparatus and step-down transformers are provided, the local distribution being on the three-wire system at 220 volts. At the terminal is also provided a 100-kw motor-generator set for supplying direct

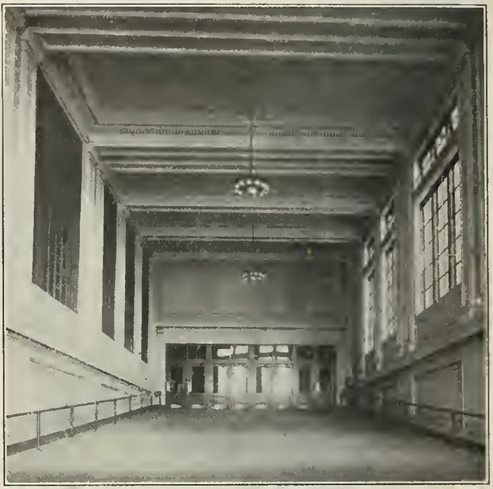


FIG. 10.—PASSAGEWAY LEADING FROM TRAIN SHED TO UPPER CONCOURSE.

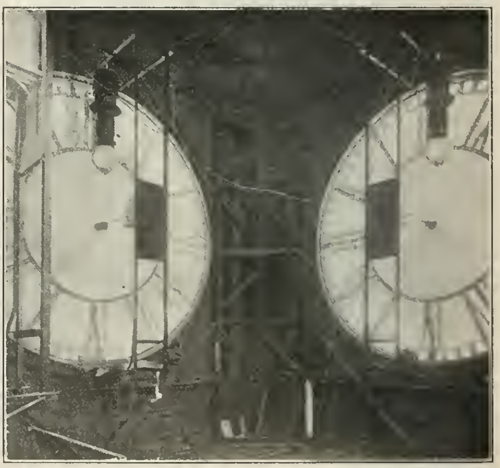


FIG. 11.—FLAMING-ARC LAMPS BEHIND CLOCKS IN TOWER.

current for the motors driving the two elevators in the station and for four ventilating fans. The large fans used in the hot-air system are driven by low-tension three-phase motors. The arrangements of circuits is such that each panel board is controlled by a separate switch on the switchboard at the distribution center, so that all lamps may be controlled from this point. The panels are arranged so that the board controls a certain defined district needing illumination at certain times, so that late at night, when only a few lighted lamps are required, these circuits may be controlled from the switchboard.

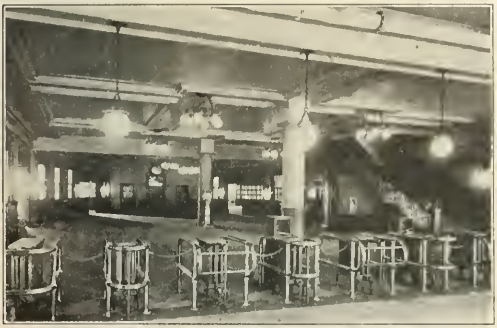


FIG. 12.—VIEW OF MAIN FERRY WAITING ROOM.

All told, there are approximately 6500 16-cp lamps in use in the terminal, besides 65 arc lamps, 60 bracket fans and 10 ceiling fans. The arc lamps are used on the ferry bridges and in the team concourses. The main waiting room, shown in Fig. 2, is lighted by four chandeliers, each holding 48 16-cp lamps. In addition there are 70 lamps above the art-glass skylight; 40 lamps in the rosettes on the ceiling; 120 clear-bulb lamps concealed in the cove, and 18 brackets containing 120 lamps. Under the art-glass shades running over the tops of the settees are 336 4-cp lamps. A view of the lamps above the settees is given in Fig. 8. The arrangement of lamps above the glass ceiling, as shown in Fig. 9, results in a spotted effect on the glass and a different scheme is under contemplation for illuminating the ceiling.

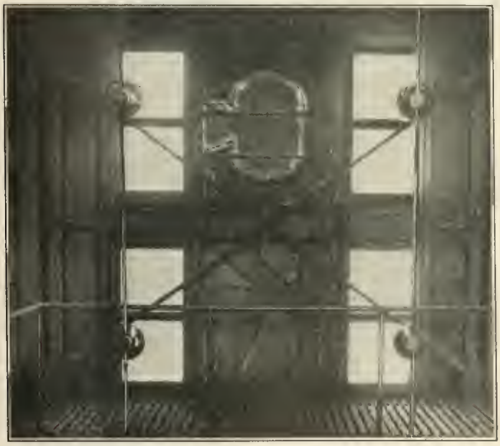


FIG. 13.—METHOD OF LIGHTING WINDOWS IN TOWER.

The upper concourse is lighted by means of 40 brackets containing 120 lamps and by means of 13 rows of incandescent lamps stretched across the ceiling on the girders. There are 903 lamps in all on this concourse. The incline leading from the train sheds to the upper concourse is lighted by three chandeliers, as shown in Fig. 10, each of which holds 17 lamps. For the illumination of the train concourse and sheds 1063 lamps are used. The lamps on the train concourse are placed beneath the steel work, and the lamps on the platforms are frosted and are spaced five to the arch, as shown in Fig. 3. At night the effect is very pretty, indeed.

In the dining room, a view of which is shown in Fig. 7, 164 frosted lamps are used, and the balcony outside, shown in Fig. 5, is lighted by 60 lamps in six pedestals and by 20 lamps in the lattice work overhead. The lamps in the restaurant are for the most part on brackets and in the chandeliers. There are 24 brackets, each holding four lamps, and two chandeliers each holding 24 lamps. There are also four six-lamp clusters on the ceiling, and 16 lamps in the square, at whose corners the clusters are placed. The chandelier shown in Fig. 6, just outside the restaurant, contains 24 lamps.

In the Lackawanna sign across the front of the ferry house are 485 4-cp lamps, and in the archway over the ferry slips 460 4-cp lamps are arranged, while along the edge of the roof 405 16-cp lamps are disposed. The tower is lighted at night by 72 lamps placed as shown in Fig. 13. Each 16-cp lamp is mounted 3 ft. back of the window and fitted with a cone reflector. The clocks in the tower are lighted by means of flaming-arc lamps, as shown in Fig. 11. At first, incandescent lamps were tried, but the face of the clock being made of such heavy glass, the results were very disappointing. It is also intended to place 16 flaming-arc lamps in series across the 2200-volt circuit and suspend them in a circle from the top of the tower on the river side. The small ferry waiting room is lighted by 10 four-lamp brackets and three 12-lamp chandeliers. The main ferry waiting room, a view of which is given in Fig. 12, has two 12-lamp chandeliers just inside the entrance, five three-lamp chandeliers over the ticket booths, 11 6-lamp brackets along the walls, and six six-lamp chandeliers suspended from the ceiling. This is the only room requiring artificial illumination at all times.

Taken altogether the illumination is very satisfactory. The arrangement of the enclosed-arc lamps in the lower concourse is not all that could be desired, and the engineers contemplate installing high-efficiency incandescent lamps instead and arranging them so as to obtain a better distribution of the light. The train sheds are well lighted, and owing to the design, are very clean. Conduit is used throughout in the wiring of the buildings and train sheds. Mr. K. M. Murchison was the architect of the terminal, and Messrs. Peet & Powers, of New York, were the electrical contractors. Mr. H. M. Warren, of Scranton, Pa., is the electrical engineer of the railroad company having direct supervision of the electrical work, and to him and to Mr. Van Patten, engineer at the terminal, we are indebted for many courtesies extended in the preparation of this article.

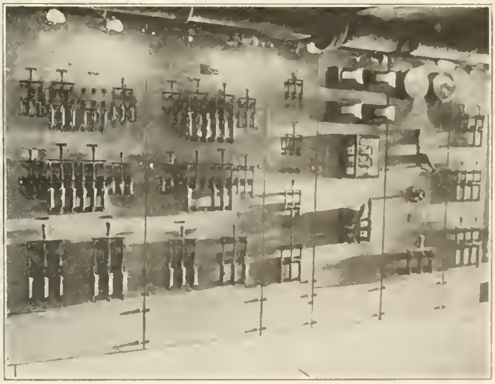


FIG. 14.—DISTRIBUTION BOARD IN TERMINAL.

Economical and Efficient Plans for Lighting Small Houses.

By J. R. Cravath and V. R. Lansingh.

Many central-station companies are now wisely directing special effort to secure as customers the many small houses and cottages which are to be found in every city. It is coming to be more commonly recognized than formerly by central-station men that a number of such small houses per block will yield a better revenue for a given amount of investment in lines and transformers than will a few large houses. The reason for this is that the maximum demand of the large house is much larger in proportion to the number of kw-hours consumed per month than in the case of a collection of small houses. There was a time when the cost of electric light kept it out of small houses, but this reason should no longer hold. Reduction in rates, together with the introduction of fairly efficient lamps of less than 16 candle-power, puts electric light within the reach of all but the very poorest class of people, provided it is installed in a way which will give good lighting results with small kw-hour consumption.

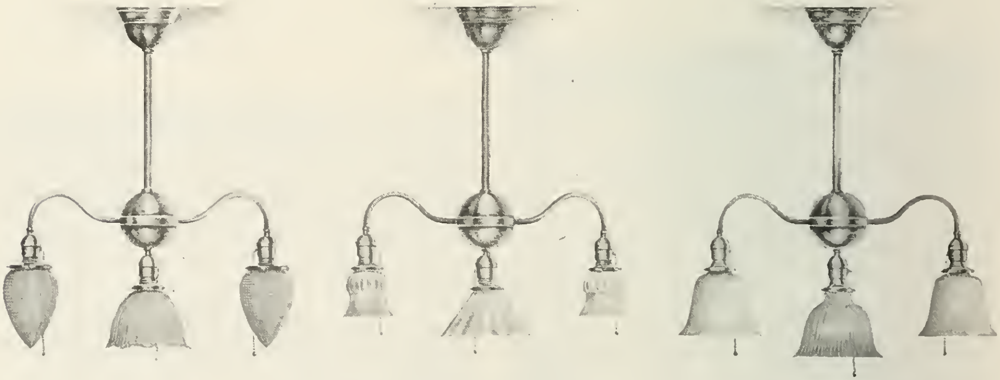
It is much more important to use good illuminating engineering in planning the lighting of small houses than it is in large houses, because the owners of the latter can usually afford to waste more current than can the occupant of a small house. This article has been written to help the central-station company or contractor to install cheap and efficient electric-lighting arrangements in small houses. In some cases central-station companies themselves, or through special arrangements with contractors, are making special offers to wire small houses for a certain price per outlet or for a certain price for a given number of outlets, supplying fixtures, glassware and everything complete at a very low figure. In such cases it is, therefore, of great importance to the future welfare of the company that such standard lighting equipments be efficient as well as cheap, in order that the economy of electric light may cause its use to be extended, and in order that complaints may be reduced to a minimum. The designs here suggested offer several alternative plans for all of the common rooms in a small house.

LIVING ROOM.

For the living room the kind of fixture shown in Figs. 1, 2 and 3 is recommended. Such a fixture is simple and cheap, and answers all the practical requirements of a much more elaborate fixture. The central stem of this chandelier is ¾ in., and the arms ⅜ in. outside diameter. Its cost in large quantities unwired in common lacquered brass finish is about $2.60 to $3.10, including sockets and shade holders, but not including glassware or lamps. It differs from the ordinary three-light chandelier in that all sockets are pendant (that is, pointed straight down), and one socket is placed on the bottom tip. This socket (sometimes called by fixture men a bottom tap) is an important feature for two reasons: It allows a reflector for reading purposes to be used on the center socket, while glassware suited to the general lighting of the room can be used on the arms without destroying the symmetrical appearance of the chandelier. It also permits a portable table lamp to be attached to the middle socket in a much more sightly manner than if it had to be plugged into one of the chandelier arms. The reason for making sockets pendant is partly to avoid the sagging of shades and pulling apart of sockets which are so common when sockets are placed at an angle, but it is mainly to afford better light distribution, and to make it possible to equip economically the chandelier with glassware which will prevent glare in the eyes. Space does not permit going fully into the reasons for the superiority of having pendant lamps on a chandelier of this kind, but they are sufficient to justify the complete elimination of chandeliers with lamps at an angle in houses where economy in first cost and in operation is a great object. The chandelier is equipped with pull sockets and the lower edge of the socket should be 6 ft. 8 in. above the floor. For a 9-ft. ceiling the chandelier should be 28 in. from the top of the canopy to the bottom of the center socket. This will place the socket chain within easy reach, and make it easy to turn off and on various lamps on the fixture as needed. This in itself has an important bearing on economy, especially in cheap work where switches cannot be afforded.

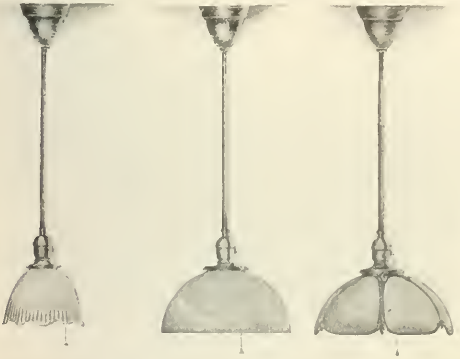
Another detail which should receive attention is the much-neglected matter of shade holders. A large number of the shade holders sold to-day are entirely inadequate to hold a shade or reflector in proper position. The commonest form of shade holder is made of very light, flimsy brass, with only two supports or prongs between the outer and inner portions. They are almost sure to be bent before the chandelier has been up long, and give a slipshod appearance, besides interfering with the proper distribution of light. Shade holders should be of heavy brass, and should have at least three prongs supporting the outer rim. Among the improved patented holders recently brought out, which are considerably stiffer than the ordinary varieties, are the "Hubbell" and the "J-E-M," the latter being a wire holder of considerable stiffness.

Fig. 1 shows the living-room chandelier equipped with glassware according to a plan which we shall designate as Plan A. This is probably the most efficient arrangement of those shown, and is also the most expensive as regards cost of glassware. The center socket has a Holophane reflector, and the arms are fitted with enclosing globes. The center lamp is intended for ordinary reading purposes, and with the reflector shown, with a 16-cp lamp, will give an even illumination ample for reading over an area large enough to accommodate any ordinary family. An 8-cp lamp would be sufficient with a more concentrating reflector, but the area lighted sufficiently for reading



FIGS. 1, 2 AND 3.—FIXTURES FOR LIVING ROOMS.

purposes with a concentrating reflector would be very much smaller; so that in putting out a chandelier for general use where conditions are not known, it is wise to provide one which will cover a large enough area to meet all possible conditions, even though maximum economy is not attained. The reflector shown on the center socket will light up any ordinary small living room fairly well in addition to the area in the center of the room, and is, therefore, sufficient for reading purposes. To supplement this, the two lamps on the arms of the chandelier are provided with enclosing globes, which are intended to throw light into the far corners of the room when this is necessary, as, for example, to furnish a light on a piano. The enclosing globe shown in this plan is to give a general distribution of light below the horizontal. A white asbestos or mica washer should be used in the 3¼-in. shade holder to prevent dust from falling inside the globe. Such asbestos washers can be bought with the globes at less than a cent apiece. All the globes on this chandelier (Fig. 1) so cover the lamps that when persons are sitting around the sides of the room facing the chandelier, no light can fall in the eyes except the diffused light coming through the globes and reflector. The arrangement, therefore, combines efficiency with absence of glare. The total cost of the chandelier, as shown in Fig. 1, complete with sockets, shade holders and glassware, not wired and excluding lamps, is about $3.80 to $4.30 when purchased in wholesale quantities by dealers and central-station companies.



FIGS. 4, 5 AND 6.—DINING-ROOM FIXTURES.

Fig. 2 shows the same form of living-room chandelier equipped with glassware according to Plan B. The central socket has an 8-in. fluted opal cone, which has been a staple trade article for many years. The arms are equipped with a sand-blasted (roughed inside), bell-shaped shade which covers the lamp sufficiently so that the glare of the bare lamp filament is not received in the eyes. Any frosted or roughened shade of this general shape will answer the purpose here. The light distribution, with the chandelier equipped according to this Plan B (Fig. 2) is very similar to that obtained in Plan A. The glassware costs less than half as much. It might be considered by some rather old-fashioned in appearance on account of the fluted opal cone, but the lighting results with this equipment are excellent. The total cost of a chandelier equipped according to Plan B, complete with sockets, holders and glassware, not wired, excluding lamps, in large quantities is about $3.08 to $3.58.

Fig. 3 shows the same style of living-room chandelier equipped with glassware according to Plan C. The central socket has a white enameled Zalinski reflector, and the arms a bell-shaped shade roughed inside, either of the particular design shown or something similar. This glassware costs about the same as that in Plan A. The amount of light obtained in the center of the room for reading purposes will not be quite as much as in Plans A and B. The enameled reflector on the center socket, however, is a beautiful diffuser and softener of light to make up for its slightly lower reflecting efficiency. The arrangement will, therefore, be preferred by some on account of general appearances.

In Figs. 1, 2 and 3 attention is called to the fact that the center socket is equipped with a standard 2¼-in. shade holder, and not with a 3¼-in. spun holder attached above the socket, as fixtures are frequently made. The spun holder, as usually placed, is too high, costs more and is not suited to any of the requirements specified.

Plan D is suggested for the very cheapest class of work in a living room, and consists simply of a drop cord with a 6-in. fluted opal cone reflector, like that shown on the center socket in Fig. 2, but of smaller diameter, in order that the lamp will not be so completely covered by the reflector. This permits more light to be thrown around the edges of the room, which is desirable, inasmuch as only one lamp is provided.

DINING ROOM.

Fig. 4 shows Plan A suggested for the dining room. It is customary to provide a more elaborate arrangement than this for dining-room lighting, but it is entirely unnecessary for illumination purposes and money can well be saved here and put in other places to better advantage. This fixture consists of a plain, one-light pendant, ⅜ in. outside diameter, equipped with a pull socket, the lower edge of which is 6 ft. above the floor, and a substantial three- or four-prong shade holder, as suggested under the head of "Living Rooms." The Holophane reflector shown gives such a distribution of light as to illuminate with almost perfect uniformity any ordinary size of table and, at the same time, if an 8-cp lamp is used, the lamp filament is almost invisible to those sitting around the table. An 8-cp lamp is ample for any of the dining-room table lighting arrangements suggested in this article. If the top of the table is properly and evenly lighted, the illumination of the rest of the room will usually take care of itself. The cost of a fixture equipped, as shown in Fig. 4, Plan A, including socket, shade holder and glassware, is about $1.50 in wholesale quantities, not wired and not including lamps.

Fig. 5 shows a similar one-light pendant for dining-room lighting equipped according to Plan B, with a staple 10-in. opal dome reflector with 3¼-in. shade holder. The other equipment is the same as Plan A. The opal dome gives a somewhat similar distribution to the reflector shown under Plan A, except that a small area in the center of the table is more brightly lighted at the expense of the edges, and this central area will have some light and dark streaks, due to the reflection of the lamp filament from the smooth opal reflecting surface of the dome. The total cost of a chandelier, unwired, equipped as in Plan B (Fig. 5) is about $1.48 in wholesale quantities, without lamp. It is, of course, possible to light the dining room with a drop-cord equipped with either of the reflectors mentioned under Plans A and B.

Fig. 6, Plan C, for dining-room lighting, shows a somewhat costlier arrangement, in which an inexpensive art glass dome with 3¼-in. holder is used instead of an opal or prismatic reflector. It is also evidently possible to substitute a chain for the rod pendant. The cost of the unwired fixture, as shown in Fig. 6, Plan C, is about $5.65 in wholesale quantities, including everything but the lamp.

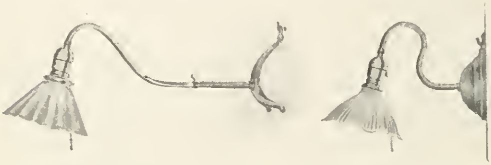
KITCHEN.

Plan A suggested for the kitchen is to place one light at the ceiling in the center, equipping with a pull socket to which a string can be attached for turning the lamp on and off. This does away with the necessity of a switch, and, at the same time, puts the lamp up where it will be most useful for general lighting of the kitchen. Of course, if cost permits, it is desirable to have a switch near the door for this lamp, as the kitchen lamp is usually turned on and off a number of times in the course of an evening. Under Plan A the lamp in the center of the ceiling could be equipped either with a 6-in. fluted opal cone or with a prismatic reflector like that shown under Plan A for the dining room. The fluted opal cone is a few cents cheaper, but will not give quite as much light at sink and range around the sides of a kitchen 10 ft. square as will the prismatic reflector mentioned. At the same time, it will give more in the center of the kitchen than this particular prismatic reflector.

Plan B for the kitchen consists in putting in a pull socket at the ceiling over that portion of the kitchen in which most of the work is done. In some kitchens it may be possible to locate the lamp at the ceiling in one corner of the room where most of the work is done, so that it would be, of course, unwise to put it in the center. In such a case, a concentrating form of reflector should be used.

BEDROOMS.

Plan A suggested for the bedrooms is to place a pull-socket at the center of the ceiling. This then gives the occupant the choice of a number of different arrangements which can easily be changed from time to time. He can place a fluted opal cone at the ceiling, attach a string to the chain of the socket and use this ceiling lamp for the general lighting of the room. If light is wanted for reading or sewing in the center of the room, a short-length drop cord can be used to bring the lamp down, utilizing the same reflector. Plans B and C, which follow, can also be used where a center socket or receptacle is available.



FIGS. 7 AND 8.—BRACKET FIXTURES.

Plan B consists in attaching to the central receptacle a length of portable cord, to which is attached an adjustable, portable wall bracket of the type shown in Fig. 7. This bracket can be hung on a neat brass hook at any point in the room where it is wanted, and easily changed at a moment's notice. Thus, much of the time it may be wanted directly over the dresser. At other times it may be needed at some other point for sewing, or over the bed, where it can be turned on easily in the night. This bracket, which is shown equipped with a common 6-in. fluted opal cone reflector, has a rotating adjustable stem, so that it can be turned up or at an angle. Its cost, without wire, including reflector, holder and socket, is about $1.32.

Fig. 8, Plan C, shows another neat type of portable wall bracket which has been used to no great extent, but which can be made up easily by any fixture manufacturer. In appearance it is like any simple wall bracket, except that for the ordinary canopy is substituted a solid portable stand base, to which an eye is attached for hooking over a wall hook at any point in the room. The cost of such brackets made up in quantities should not exceed $1.35 to $1.50, complete with glassware. Any concentrating prismatic reflector of light weight is suitable for use on such a bracket, as is also the fluted opal cone shown under Plan B.

BATHROOM.

For the average bathroom, the cheapest arrangement is probably a drop cord with the bottom of the socket 6 ft. 8 in. from the floor, equipped with a pull-socket, a 6-in. fluted opal cone reflector, and a turn-down type of lamp giving 8 candle-power when turned up and ½ candle-power when turned down.

HALL.

For the hall a plain pendant, like Fig. 4, with a roughed bell-shaped shade, like those on the arms in Fig. 3, is recommended. This gives good diffusion, and about the kind of light distribution needed in a hall, especially where stairs are to be lighted. The turn-down type of lamp can also be used here to advantage.

PORCH.

A cheap and efficient porch arrangement is to place a socket at the ceiling with a 7-in. opal dome reflector. This will have to be controlled by a wall switch either inside or outside—preferably the former. A 4-cp lamp will be ample for ordinary purposes. The opal dome reflector recommended is similar to that shown on the fixture, Fig. 5.

In what has been said in this article, the authors do not wish to be understood as recommending some of the arrangements specified where the owner can afford something better. It is intended to cover only the cheapest class of work. Where it can be afforded, switches should be added in as many rooms as possible. The previous articles by the authors have taken up many of the problems met in a better-class of residence work.

Improvements on Ellis Island, New York Harbor.

The finest dining room for immigrants in any part of the world was formally opened on Ellis Island, New York harbor, on Wednesday, March 18. When the new dining room was thrown open, the old system, which caused immigrants considerable annoyance, inconvenience and often was responsible for long delays, was abolished. That is to say, the six dining rooms which were in use since the opening of the busiest immigration station in the world and which were scattered over the island, are used for other purposes, and the new arrivals can take their meals while detained there in the new dining hall on the second floor of the main building.

The new dining hall can accommodate 1400 immigrants at a sitting, while under the old system eight sittings were necessary. The new dining room is well lighted by electricity and the sanitary kitchen is equipped with modern appliances and utensils for preparing food for the table. A 2-hp, 220-volt motor belted to a shaft drives a potato peeler, a food chopper and an ice-cream freezer. In addition there are two motor-driven dish-washing machines. Electricity is used exclusively on the island for illuminating and power purposes and the model isolated electric plant installed about six years ago will soon be held in reserve and a new turbine-driven electric plant installed. Ellis Island is within 10 minutes of New York City and within about three minutes of Communipaw, N. J., although boats only ply between the island and New York. The exhaust steam from the engines is used for a number of purposes throughout the numerous buildings, so that an isolated plant is necessary. Governor's Island, close by, is supplied on the other hand with electrical energy for lighting the streets, houses and fortifications by the Edison Electric Illuminating Company of Brooklyn through a cable crossing Buttermilk Channel to a rotary-converter substation on the island.

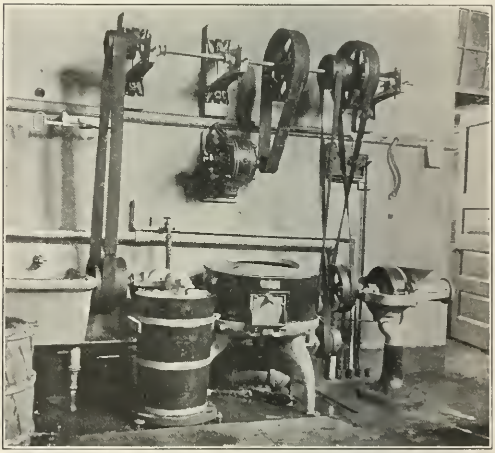


FIG. 1.—MOTOR-DRIVEN DEVICES IN KITCHEN.

Among the recent changes on Ellis Island is the substitution of flaming arc lamps for ordinary arc lamps for general illumination at night. Fig. 2 shows two of these lamps, which are all of the Excello type, on the wharf near the steamboat landing. The lamps are suspended from ornamental posts and there are at present in use 29 flaming arc lamps. Flaming arc lamps are also used for illuminating the immense baggage room in one of the buildings and arrangements are being made for installing quite a few more lamps of this type around the island, which it should be mentioned is not a very large place, being used exclusively as an immigrant station.

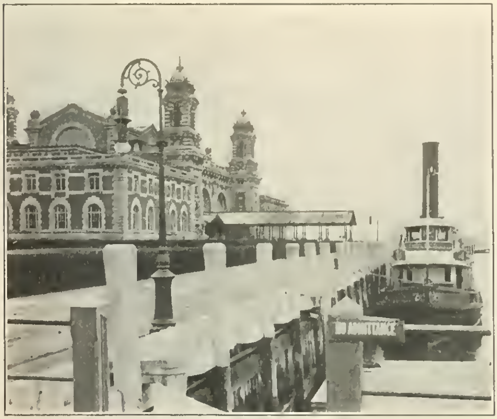


FIG. 2.—FLAMING-ARC LAMPS ON ELLIS ISLAND.

The National Bureau of Standards; the Service That It May Render to Electrical Engineers and Central-Station Companies.

By Joseph B. Baker.

It is estimated that of the approximately 5000 central stations in this country only about 250 are large enough to have their own general testing department. That is to say, only 5 per cent of all the central stations are well enough equipped for the work of testing their own instruments and apparatus to be independent of outside testing laboratories.

In some of these larger and more highly organized companies elaborate testing departments have been developed, with a competent technical and scientific staff, and a complete equipment of apparatus, including primary standard instruments, for all testing, experimental and research work that the company may wish to undertake. The testing department makes periodical and special tests of the switchboard and portable instruments used by the company, including instruments for the meter department, and of its own primary standards; tests the efficiency of the electrical machinery—generators, rotary converters, transformers, etc.—in the company's main and sub-stations; tests conductor and insulator resistance of the lines and cables, and the efficiency of the lightning arresters; takes indicator cards of the engines, makes analyses of the oil, coal and feed water; in short, performs all sorts of tests required to maintain the efficiency of the plant, which, but for the existence of the testing department, would require the calling in of outside engineering services.*

Contrasted with this high degree of organization is the case of the other 95 per cent of the central station companies of the country, too small or too incompletely organized to have any such department. Here, if ever, is a need for the exercise of government paternalism to assist commercial enterprise, and the valuable service that may be rendered this large number of companies by the National Bureau of Standards, by placing the scientific resources of the government at their disposal, at comparatively small cost, is the subject of the present article.

THE INCEPTION OF THE BUREAU OF STANDARDS.

Early in the history of the government provision was made for the adoption of suitable standards of length, mass and capacity. The Treasury Department, which had charge of the work, in providing copies of these standards for the several states, through the Office of Weights and Measures, was obliged to go into the matter of thermometric standards also. But beyond this limited scope of the government's activities, nothing further was done up to a comparatively recent time. During the last years of the Office of Weights and Measures (at the time of the beginning of the electrical industries) the office began to equip itself for the testing of electrical standards, especially of resistance and e. m. f.

The gigantic growth of scientific, manufacturing and commercial interests, requiring the substitution of exact for rule-of-thumb measurements and the introduction of interchangeable methods in manufacturing, revealed the poverty of standardizing facilities that existed in this country. Foreign standardizing bureaus, notably the Physikalisch-Technische Reichsanstalt of Germany, upon which we were dependent for the exact testing of instruments of precision, set a splendid example of the value of a broad scientific institution giving a service independent of commercial considerations. The need of the establishment of a National Bureau of Standards was agitated, and in 1901 the Congress appropriated funds for the construction and equipment of laboratories and the maintenance of a scientific staff.

THE MECHANICAL AND ELECTRICAL EQUIPMENT.

A site was selected, about 7½ acres in extent, in the northwest section of the District of Columbia, about 3½ miles from the White House, and two good-sized laboratory buildings were erected and thoroughly well equipped. Fig. 1 is a view of one of these buildings, the Mechanical Building. On the ground floor is the engine room, shown in Fig. 2, containing the electrical machinery and switchboard for supplying all of the laboratories. Fig. 3 is a view of the Physical Building, in which the more delicate work is done and in which the chemical laboratories and the executive offices are located. A third (smaller) building, for use as a low-temperature laboratory, and equipped with apparatus for the liquification of gases, was added later, and other buildings are projected.

The personnel of the bureau, which numbered 110 at the beginning of the fiscal year, July 1, 1907, is selected by competitive civil service examination, and includes over 60 per cent of scientific and technical men. The above paper states: "With the exception of the leaders in the principal lines of the bureau's work, the policy has been to appoint graduates of first-class scientific and technical colleges to the lower grades of assistantships, advancing them to the higher grades as they become proficient and vacancies occur. At entrance they are allowed to select the line of work in which they desire to specialize, and every opportunity is given them for development. The leaders of several important sections of the bureau are men who entered it as minor assistants, but who were equipped with a thorough scientific training which enabled them to take advantage of the splendid opportunities the bureau offers in certain fields of scientific research."

The special electrical testing facilities of the laboratories of the National Bureau of Standards comprises a complete and modern equipment of instruments, apparatus and machinery, which is being improved and increased constantly, in accordance with the progress of the mechanical and electrical arts.

The Mechanical Building contains the mechanical and electrical plant, the instrument shop, about one-half of the electrical work, photometry and engineering testing. Two 125-hp water-tube boilers, with economizer and forced draft, are now installed, with space reserved for additional boilers, to give an ultimate capacity of 500 horse-power. The engine equipment, shown in Fig. 2, comprises a tandem-compound engine of 120 horse-power, driving two direct-current, 37.5-kw generators, each giving 300 amperes at 120 volts and connected in a three-wire system; and a smaller engine of 40 horse-power capacity, which, like the larger engine, drives two direct-current generators. A third engine and direct-connected 40-kw, 60-cycle alternating-current generator are now being installed. The auxiliaries, installed on and under a platform in the boiler room, include steam and electric-driven high-pressure water pumps, boiler feed pumps, etc., and the filters, feed-water heater, pressure and storage tanks, etc.

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*An example of such a testing department is that of the Malden, Mass., Electric Light Company, which was described in an illustrated article in the issue of Dec. 7, 1907, page 1098.

The electrical machinery includes a double motor-driven booster, for charging storage cells, having a capacity on each side of 200 amperes at 30 volts, or at lower voltage and correspondingly larger current; a three-unit motor-generator set, consisting of a motor driving 60-cycle and 180-cycle, two-phase generators, giving an adjustable e. m. f. of nearly sine wave form, and considerable range in frequency and wave form by connecting the generators separately or in series; a three-unit set with 60-cycle, three-phase generators, the phase relation of which may be varied by mechanically shifting the field of one of the machines, for obtaining any desired power-factor in any instrument having a current and a potential coil; and a smaller set, similar to the preceding, giving two 60-cycle, three-phase currents of adjustable phase relation, and a three-phase 120-cycle alternator, driven by an inverted synchronous converter used as a motor, the latter also giving alternating current at 60 cycles.

There is also a new 10-unit set, consisting of two driving motors and eight alternators, all direct-connected on a common shaft, which may, however, be uncoupled in the middle so that the apparatus may be operated as two independent sets, each with its own motor. One set has three alternators, giving 60, 180 and 300 cycles, sine-wave form, and capable of being joined in series, thereby varying the wave form. The second set has five alternators, giving 420, 540, 660, 780 and 900 cycles, respectively. All the machines may be joined in series, as they have the same current capacity, namely, 35 amperes. The voltages, however, decrease gradually from 200 for the largest to 10 for the smallest. When joined in series all the odd harmonics to the fifteenth will be present in the e. m. f., or may be quickly cut out. The wave form can be varied indefinitely by varying the number of harmonics employed and their relative intensities and phases. This machine is very useful in testing and research, not only for varying wave form, but for obtaining a great variety of frequencies. The switchboard for this set is equipped with hot-wire instruments arranged to show what components enter into the resultant e. m. f. The operating switches give complete and quick control over the various possible combinations.

The main switchboard, which appears in the background at the left in Fig. 2, controls the direct- and alternating-current machinery and a combination set of storage batteries arranged in groups on the three-wire system. The batteries—which are installed in a battery room, equipped with a motor-driven exhaust fan for drawing off the fumes—are employed (a) for operating motors when great steadiness of speed is desired; (b) for lighting and power when the engines are not running, and (c) for general experimental purposes. The switchboard equipment includes also several plug panels, for distributing any of the currents to any part of the laboratories. All pipes and wiring are carried through the sub-basement, under the engine room floor, so that the engine room is free from overhead piping and wiring. This arrangement also gives free travel for the crane. A spacious subway, the concrete top of which appears in Fig. 1, connects the Mechanical Building with the Physical Building. Through this subway are carried all of the piping and wiring necessary to supply the latter building from the plant in the former building. An instrument and machine shop, equipped with individual motor-driven tools and having a force of expert mechanicians, is an important adjunct to the laboratory. Great pains have been taken to equip the laboratory rooms in all of the buildings with the conveniences—such as local switchboards, hot, cold and ice-water piping, cold-brine, gas and compressed-air and vacuum piping, and ample electric wiring—necessary for the most efficient work.

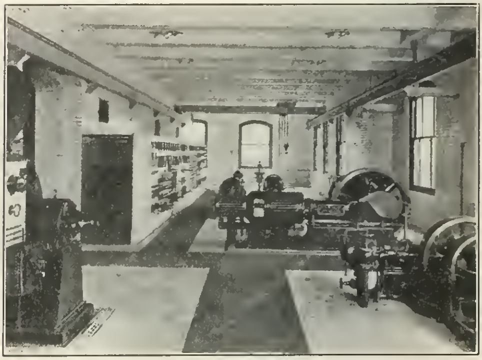
FIG. 2.—ENGINE ROOM, BUREAU OF STANDARDS.

FIG. 1.—MECHANICAL LABORATORY.

FIG. 3.—PHYSICAL LABORATORY.

WORK OF THE ELECTRICAL DIVISION.

The work of the Electrical Division of the bureau is divided into sections, as follows:

Section 1. Resistance and E. M. F.

The work of this section consists in the verification of resistance standards and standards of e. m. f.; the calibration of precision rheostats, Wheatstone bridges, potentiometers and other resistance apparatus; the verification of resistance standards for current measurement; the determination of the electrical properties of materials, and researches on standards of resistance and e. m. f. Without giving space to the details of the routine of this section, or to the instrumental equipment for its work, which are given at some length in the paper already referred to, it may be stated briefly that high-precision methods are employed for the verification of original standards, and the calibration of secondary standards, and that any special researches are made that may be required, and that would be entirely beyond the facilities of any private laboratory, such, for example, as the thorough investigation on standard cells (both Clark and Weston) recently published in the *Bulletin* of the bureau.

Section 2. Inductance and Capacity, and Absolute Measurements.

The work on inductance and capacity includes the investigation of methods of measurement, the construction and testing of the bureau's standards, testing for the public, and the measurement of the inductances and capacities of instruments. The bureau possesses a series of standards of inductance and capacity, the values of which have been fixed with high precision using several different methods of measurement.

The testing of condensers includes not only the measurement of their capacity, but the investigation of the variation of the capacity with frequency or duration of charge, temperature, leakage and power-factor of the charging circuit, whereby their constants are completely ascertained, and they become instruments of precision. The calibrating of well-made inductances to 0.02 per cent is made a special feature of the work. Such standards are exceedingly useful in facilitating the making of accurate inductance measurements, which now play an important part in electrical measurements.

The equipment for measurement of capacity and inductance is very complete, and includes means for determining the residual capacities and inductances in the "non-inductive" coils of resistance boxes so as to permit their use with alternating currents in inductance measurements.

A number of important researches in absolute measurement have been completed and published in the *Bulletin*, including the ratio of the electromagnetic and electrostatic units; determinations of an absolute standard of inductance, the value of which is accurately known by calculation; the design and construction of a new type of chronograph, enabling accurate measurements to be made very quickly of the speed of a driving motor or the frequency of a current; the change in resistance of standard coils and resistance boxes due to atmospheric humidity; a new form of resistance standard; and the calculation of self and mutual inductance of coils of various forms. Other researches now in progress are: A study of the coulometer (volt-ammeter); the absolute measurement of current by means of an electro-dynamometer, and the absolute measurement of resistance by different methods. The results of several of these and other researches upon electrical subjects have already been published in the *Bulletins* of the bureau, and reprinted as "separates," which may be obtained upon written application to the bureau.

Section 3. Electrical Measuring Instruments, and Section 5, Photometry.

The work of Section 3 includes the investigation and testing of instruments of precision for measuring current, voltage and power (both direct and alternating); and the testing of laboratory and commercial instruments designed for such measurements, such as ammeters, voltmeters, wattmeters and watt-hour meters for direct and alternating currents, and special alternating-current instruments, such as frequency meters, phase meters, curve tracers, etc.

The photometric work of the bureau comprises the testing on incandescent-lamp standards for candle-power and distribution of light, the commercial testing of lamps as to life, candle-power and efficiency for various departments of the government, and the study of special problems in photometry. The equipment includes precision and integrating photometers for measuring mean spherical and mean hemispherical candle-powers, a Brace spectro-photometer, a flicker photometer, standard Hefner lamps, etc. A commercial photometer has been designed and constructed for the rapid testing of incandescent lamps. This instrument includes a horizontal and an end-on rotator, Bunsen screen with Leeson disk, and variable sectored disk, by the use of which lamps ranging from 5 to 100 candle-power can be read without readjustment of the standard lamp. An efficiency meter, by means of which efficiencies or watts per candle can be read directly, has recently been designed and built and added to this photometer.

In connection with the photometric work a number of researches have been made and published.

Section 4. Magnetism.

A considerable number of instruments for testing the permeability and hysteresis of specimens of iron have been secured and comparisons made by testing the same sample with different apparatus. Several important investigations have been made in magnetic measurements, and will shortly be published. The bureau is in a position not only to measure with commercial accuracy the permeability and hysteresis of specimens of iron and steel of various forms and under working conditions, but also to test specimens to a higher precision to be used by others in their own instruments as standards of comparison.

WHAT THE BUREAU CAN DO FOR THE ELECTRICAL ENGINEERING PUBLIC.

Having touched briefly on the resources of the bureau, we come to the services that it is in a position to render to the electrical engineer. Among the functions prescribed by the Act of Congress by which the office of Standards, Weights and Measures of the Treasury Department was, on July 1, 1901, superseded by the Bureau of Standards, were several which are stated briefly in *Bureau Circular No. 6*, dated Feb. 20, 1906, as follows: "The bureau will furnish such information concerning standards, methods of measurement, physical constants, and the properties of materials, as may be at its disposal, and is authorized to exercise its functions for the Government of the United States, for state or municipal governments within the United States, for scientific societies, educational institutions, firms, corporations, or individuals engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments. For all comparisons, calibrations, tests or investigations, except for those performed for the Government of the United States or state governments, a reasonable fee will be charged."

The range of tests made by the bureau—including verification of standards, determination of constants of apparatus and of electrical properties of materials and general testing work—and the fees charged for the same, are covered in detail in the circular to which reference has just been made. This circular also contains regulations covering the proper form of the application for tests, shipping directions, remittances, etc.

The above references cover some of the specified activities of the bureau, but some of the special ways in which the bureau stands ready to carry out its functions are, however, not so well known as they should be to engineers and the managements of central-station companies. The following brief account is intended to set forth these special services, in accordance with the desire of the director of the bureau and his official staff for a better and more general understanding of them. The wider usefulness of the bureau consists in the placing of the valuable scientific and technical resources of the government virtually at the disposal of the commercial and engineering public, as follows:

1. The bureau stands ready to test portable instruments, such as voltmeters, ammeters and wattmeters, used by the central station in checking other instruments. This testing ought to be done, not only at the time of purchase, as a check on the maker's calibration, but at intervals later, say, every six months,

to detect changes with time. The fees are nominal, and in many cases do not amount to the cost of doing the work.

2. When instruments or apparatus are sent in for calibration the bureau gives an impartial test, unaffected by any commercial considerations, or by the "personal equation" that comes in where the instrument is sent to its manufacturer for such calibration, or where an instrument made by one manufacturer is sent to the testing laboratory of another manufacturer for recalibration. Further, the bureau will point out any defects that may exist in the instrument for the work in hand, if requested to do so. Sometimes defective and inaccurate instruments are put out by manufacturers. If a customer returns such an instrument to the manufacturer for test and recalibration, it would ordinarily be returned to him without comment, whereas the bureau not only reports the observed accuracy of the instrument, but stands ready to advise in regard to its suitability or unsuitability to the work in hand.

3. If a central station company is contemplating the purchase of a number of instruments of a new or untried type, it can send in a sample, submitted by the manufacturer, for the government test before buying. Having bought the instruments, if the company has any reason to imagine that any of the shipments are not "up to standard," it can send in additional samples from each shipment, from time to time, which will be tested and reported upon. Of course, this applies particularly to electric service meters, of which a central station company purchases a considerable number. The same thing applies to indicating instruments and test meters for testing service meters at the consumers' installation, and to samples of service meters of different makes, to determine their comparative value and to provide standard meters to be used in checking others.

In the case of transformers, although the same plan might be followed, the bureau would encourage central station companies to make their own tests, especially as the expense of shipping transformers is comparatively heavy. The large electrical manufacturing companies issue instruction books which facilitate the testing of service transformers even by small central station companies that are not thoroughly well equipped with testing instruments. Central station companies are rarely equipped to test the current and potential transformers of instruments, however, and the bureau stands ready to perform this work for them.

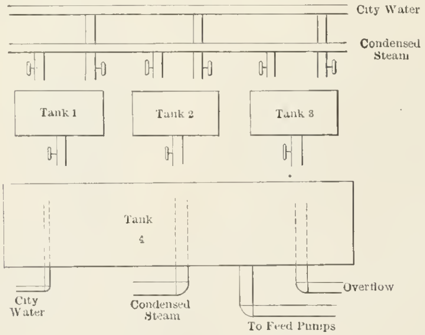

FIG. 1.—METHOD OF MEASURING FEED WATER.

4. The bureau is useful to central station companies in an indirect way by serving as a sort of court of appeal in disputes with customers over meter charges. The mere statement of the fact that the company "has its instruments and meters tested by the government" may often avail to terminate an otherwise vexatious dispute.

5. The bureau invites the representatives of companies' managements contemplating the organization of a new equipment or changes in old equipment, to call at the bureau and consult with the experts. This applies especially to the organization of a testing department or meter department, where none already exists. The bureau is especially ready to give information and suggestions to stations contemplating the testing of incandescent lamps or transformers, as to the best methods and apparatus for such work, and to test incandescent lamps to be used as standards of candle-power. Such consultations are well worth while and will often save many times over the time and expense involved by the saving of unwise or unnecessary outlay and by suggestions for the general improvement of the plant that are brought out by the consultation.

In addition to the regular lines of work referred to above, the bureau is prepared to undertake a certain amount of research work along special lines that is beyond the facilities of even the very large central station companies.

Test of Medium Capacity Central Station.

By Howard S. Knowlton.

In the following paragraphs are given the results of a test recently made upon a central station of about 2500 kilowatts normal capacity. As the test was of a semi-private nature, the name of the plant is omitted, but it is thought that the methods employed and the results obtained may be suggestive to companies interested in testing stations of about this size. The objects of the tests were to investigate the operation of the plant as a whole when running under ordinary commercial loads, and to determine the steam consumption and thermal efficiency of a 1000-kw Westinghouse turbo-alternator.

The plant is located in New England near the shore of a large river which supplies condensing water and permits the handling of coal by water. Coal is received in barges, from which it is unloaded by an elevator and stored in a yard, whence it is conveyed by tracks to a crusher. The latter is driven by a 15-hp Westinghouse induction motor. The coal is then lifted to a pocket in the top of the boiler room by an endless chain elevator, also driven by this motor. It is then distributed in the bunker by an 18-in. belt conveyor. In the bottom of the bunker are three gates operated from the floor, through which the coal falls into a weighing car. This car is provided with weighing scales and a chute, which delivers directly into the stoker receivers. The stokers are three Roney units driven by a 5-hp induction motor. The ashes are dumped in the yards from wheelbarrows.

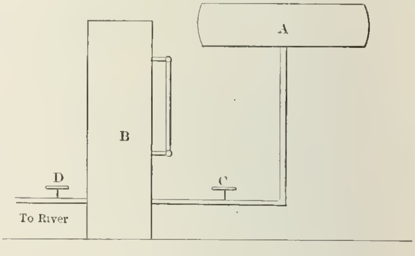

FIG. 2.—METHOD OF MEASURING DRIPS.

Three 650-hp Cahall boilers and a Sturtevant economizer are installed in the plant, the tube scraper being driven by a 3-hp motor. At the time of the tests a forced draft system was in operation, but this was to be changed to an induced draft outfit expected to give better results with the stokers. Feed water is supplied by one of the two Blake pumps, which draw from a main-feed water tank and discharge through a primary heater and the economizer into the boilers. The primary heater is located in the pump room and is furnished with the exhaust steam from the turbine and reciprocating engine auxiliaries. Wet vacuum pumps, situated beneath the turbine condensers, deliver the condensed steam to the feed-water tank, and the make-up water is supplied automatically from the city mains. Two steam mains, with cross-connections, run from the boilers to the prime movers. One main is connected to the boiler superheaters and leads to the turbines above, while the other is used for saturated steam and is tapped by both reciprocating engines and turbines. The latter may be driven by either superheated or saturated steam.

The main generating units consist of two 1000-kw three-phase turbo-alternators. The reciprocating engines supply from 435 kilowatts to 935 kilowatts in 500-volt direct-current power, there being two engines of the compound condensing type for this work. The station outfit is used for incandescent and lighting, railway and power service. The maximum alternating-current load is about 1000 kilowatts, so that one machine easily handles it. During the past winter the peak load was about 1200 kilowatts. Two 50-kw exciters are provided. The turbine exhaust is handled by Worthington surface condensers of 4500 sq. ft. cooling surface. Cooling water comes from the river. A carbon-dioxide recorder is used in the plant, and the station is equipped with two Tirrill regulators.

The scope of the tests covered the following points: 1. A seven-hour test on the plant as a whole under ordinary working conditions, covering both maximum and minimum loads. 2. Special tests under specified loads on one turbo-alternator, with loads varied in 25 per cent stages from 25 per cent to 150 per cent of the rated output. The power generated in these tests was consumed in water rheostats. 3. Individual tests on auxiliary apparatus to determine their steam consumption and its relation to the total.

The position of observers, their apparatus and duties for the 72-hour test were as follows:

Station 1.—Coal. One man was required at this station, which was located on a platform above the boilers. His duties were to weigh and record the amount of coal used, and the time of feeding to the stokers. Coal was weighed on calibrated scales provided before it was dumped into the stokers by the firemen. The man at Station 1 also recorded boiler-room temperatures from thermometer readings. Samples of coal were taken hourly and mixed in a box for subsequent analysis.

Station 2.—Feed-Water. The measuring tanks provided were lined with galvanized iron to prevent leakage, and calibrated previous to the test. A small barrel and platform scales were carried up to the tank platform. Each tank was filled to a certain reference mark and the amount of water weighed. During the test the tanks were filled to their reference marks and the number of fillings recorded, and also the time of feeding to the boilers. The drip, which is usually returned to the boilers by a Holly loop, was piped to a measuring tank, and quantities and temperatures recorded. The temperature of the feed-water was taken by a thermometer in the large tank into which the measuring tanks discharge. One man was required at this station. His duties were to record the number of tanks of water used, the time of emptying and the temperature of the water. The test was started with the water at a marked level in the feed-water tank, and one of the measuring tanks full. The level of the water in the boilers was marked on the water gages and measured. At the end of the test the water in the feed tank and in the boilers was brought as nearly as possible to the previous levels. The apparatus for this station consisted of thermometer, tank and scales for calibrating the measuring tanks.

Station 3.—Ashes. One man was required below the boiler platform to weigh the ashes as they were delivered from the boilers. Ashes were taken out in a wheelbarrow and weighed on platform scales. The man at this station also recorded the outside temperature. The test was started with the ashes all removed. The apparatus consisted of thermometer and platform scales.

Station 4.—Calorimeter. A Peabody throttling calorimeter was placed at the entrance of the delivery pipe to the turbine. The man at this station took readings every hour and determined the quality of steam after each reading. The apparatus was a calorimeter, two gages, high-scale thermometer and aneroid barometer. The records of this station gave boiler and atmospheric pressure, as well as steam quality.

Station 5.—Flue-Gas Analysis. One man was located at the point where the up-take enters the stack. He took and analyzed samples of flue gas every hour, and recorded the reading of the draft gage and stack thermometer. The apparatus consisted of an Orsat gas equipment with gas receptacle for drawing a continuous sample, chemicals, and high-scale thermometer. The draft gage was already installed.

Station 6.—Switchboard. One man at the switchboard read all instruments. These were direct-current wattmeter output, alternating-current wattmeter output, alternating-current wattmeter input to three auxiliary motors, and alternating-current wattmeter input to exciter. Readings were taken every 15 minutes. Alternating-current and direct-current main wattmeters were also read for total output every quarter hour.

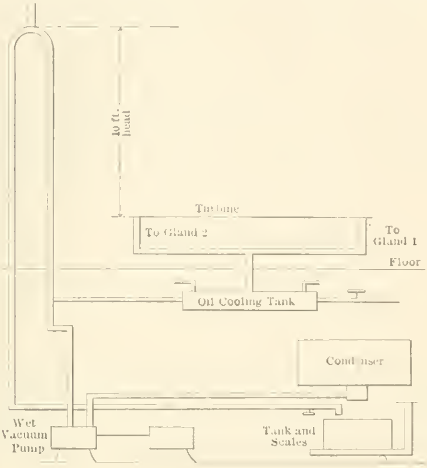

FIG. 3.—METHOD OF MAINTAINING WATER IN GLAND.

The individual turbine test was made with saturated steam. One man took calorimeter readings at the turbine. At the turbine one man recorded steam pressure, vacuum and speed by counter attached to the governor shaft, reading every 15 minutes. He also recorded temperatures by the thermometer at different parts of the generator and read the output of the machine and the input to the motor-driven exciter. Condensed steam was piped to two weighing tanks. The man at this station recorded the temperature of the cooling water before entering and after leaving the condenser, and the temperature of the condensed steam. The apparatus consisted of two tanks, two platform scales and three thermometers. Three men were required behind the switchboard. One attended to the water supply for the rheostats and the other two kept the load balanced and adjusted. A man at the switchboard recorded the readings of three ammeters, two wattmeters (one for each of the two phases) and one voltmeter. Two-hour runs were made at each point of fractional load.

The test for steam consumption of auxiliaries was run for 12 hours. The exhaust from all of these was piped to one condenser and the condensation weighed in three tanks. The station output was read on the two main wattmeters.

The water rheostats were two in number, of approximately 1800-kw capacity, placed in the power station yard just outside the transformer room and connected with the station by standard cables led out from the busbars through holes bored above the windows in the wall at that end of the room. The six terminals were supported by scaffolding erected above the rheostats, and the height of the plates was regulated by ropes and pulleys. Six faucets were also provided to supply cooling water as needed. In the station transformer room, on a platform, were three 120 to 1 ratio current transformers, and 20 to 1 potential transformers, through which the cables passed before going to the rheostats. The secondaries were grounded as a precaution in case the insulation should break down. On a temporary table lower down were the ammeters, wattmeters and voltmeter, together with a speaking tube connecting with the rheostat man. The power consumption of the alternator field was measured, and speeds and steam quality taken. Some little difficulty was experienced in keeping the water rheostats cool at 25 and 50 per cent overload, but these temporary variations did not affect the results as the first hour of each test was spent in regulating the load and letting it attain a stable condition, and instrument readings were taken every five minutes of the second hour.

In the turbine test, calorimeter readings were taken every 10 minutes. The water of condensation was allowed to flow into one tank for a set interval of time and then into the other for a like interval. In the meantime the first tank was weighed and emptied. At the higher loads this time interval was about 1.5 minutes. The test for 50 per cent overload had to be discontinued after a run of one and three-quarter hours, as the two boilers, even when running with forced draft, could not maintain the pressure, which dropped as low as 110 lb. per inch. Readings were obtained for a full hour, however, because the recording of data was begun half an hour sooner than in the other tests.

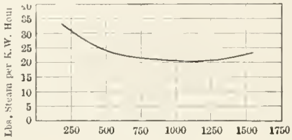

FIG. 4.—TEST CURVE.

A test on the mechanical stokers was made to investigate the operation of the stokers and of the entire boiler equipment at higher loads on the station than are customary. This was done during the turbine test when the load on the turbine was at normal, 25 and 50 per cent overload. The plan was to reproduce the starting conditions as nearly as possible at the end of each hour with reference to the height of water in the gage glasses and the amount of coal on the fires. The hopper was kept ever full throughout the tests. To do away with measurements of siftings throughout the grates, the ash pits and floor were cleaned just before the end of each hour. One man weighed the coal and measured the furnace drafts. A second man measured the feed-water, and a third the station output. Another kept the conditions constant and took the feed-water temperatures, boiler pressure and draft in the stack.

One turbine is always in operation at the plant, and with the present load both are not required at the same time. One of the reciprocating engines, with its corresponding belted generator, takes care of the direct-current motor load from 6 a. m. to 6:15 p. m. on week days, after which time a motor-generator set handles it. On Saturdays this set is started at 4 p. m. and run through until Monday morning, because of the light power demand on Sundays. Two motor-driven Brush arc generators are started about dusk and run until daybreak. The total power generated is thus exclusively alternating current at night.

The method of measuring the amount of feed-water supplied to the boilers is illustrated in Fig. 1. In this scheme, the tanks 1, 2 and 3 fed into a fourth tank, from which the feed pumps drew their supply of water. Above tanks 1, 2 and 3 ran two parallel pipes, one leading to the condensing systems and the other to the city water mains, so that each tank could be filled from either source of supply independently of the other tanks. When the plant is running under ordinary conditions, all of the condensed steam is pumped directly into tank 4. For the make-up supply, water from the city mains is admitted to tank 4 by means of an automatic valve and float arrangement which keeps the water-level constant. During the test, it was necessary for the operator to use his judgment about the amount of make-up water needed, as the feed-water was deflected through tanks 1, 2 and 3.

Fig. 2 shows the method of measuring the drip. The Holly return system collects the condensation from all the steam piping and automatically returns it to the boiler at boiler pressure. To determine the amount of this drip during the test, it was necessary to devise some method of measuring the water under high pressure. This was accomplished as in Fig. 2. The pipe leading from the collecting tank, *A*, of the Holly system to the boiler was closed by a valve (not shown in diagram), thereby preventing the condensed steam from returning to the boiler. On the bottom of the collecting tank, *A*, was inserted a 1-in. pipe, and to this was joined a plate-iron drip can, *B*, with a valve, *C*, in the connecting pipe. A 2-in. pipe containing valve *D* was inserted into tank *B* near the bottom to afford a passage for the drip to be blown into the river. Tank *B* was located below the level of *A* in order to allow the condensation to collect when valve *C* was opened and *D* closed, A 3-ft. gage glass on tank *B* permitted the operator to see the exact height of the water. The drip was allowed to collect until a certain level was reached, as indicated by a reference mark near the top of the gage glass. Valve *C* was then closed and *D* opened, thus allowing the drip to be blown into the river by its own pressure. When the level of the water had reached a certain reference mark on the lower portion of the glass tube, valve *B* was again closed and *C* opened. The time of each drainage was recorded and tank *B* was subsequently calibrated between the two reference marks. Hence, the total amount of drip, as well as the rate of collecting the same, could be determined.

For flue gas analysis a siphon arrangement was connected with the flue between the economizer and stack, so as to collect continuous samples of gas for hour periods. For a considerable portion of the test this method indicated very poor combustion in the furnaces, and upon examination it was observed that a large number of crevices in the economizer and backs of the furnaces admitted so much outside air as to completely vitiate the results of the flue gas analyses previously made. To overcome this difficulty samples were after this taken directly as the gas left the furnaces, and this method gave better results.

In a Westinghouse-Parsons turbine steam leakage through the seamings is prevented by means of water glands. To efficiently maintain the water in the gland it is necessary to apply a certain head on the gland water. Usually under normal running conditions this is accomplished by means of a small steam pump which supplies filtered river water to a standpipe. Some of the water may either leak through the gland and find its way to the condenser, or the steam may condense in trying to pass through the gland. In either case an error results in determining the steam used by the turbine. To eliminate this source of error in the turbine tests, the following course was pursued. Referring to Fig. 3, the oil-cooling tank through which the gland water ordinarily passes was cut off from the pump by means of the valve shown in the diagram. A 10-ft. head was placed on the gland so as to act through the cooling tank. The standpipe giving the 10-ft. head was in the shape of an inverted U, and was opened to the air at the top. One end of the standpipe was connected with the wet vacuum pump, and the other emptied into the tank arranged for weighing condensed steam. The receiver was emptied as usual by the wet vacuum pump. This enabled the gland system to be kept filled with water throughout a test, so that all water passing into the tanks was supplied by the condensed steam, and any leakage through the gland into the condenser simply circulated through the gland system and oil tank without affecting the amount of condensed steam.

The coal determination showed a calorific power of 12,995 thermal units (British) per pound in one sample, and 13,830 units in the second sample (stoker test).

The flue gas analysis showed the following average for gases taken from the stack and boiler setting in the 72-hour plant test:

Temperature	CO_2	CO	O_2	N	
237.5° F.	5.51	1.09	13.75	80.65	Chimney
	8.03	.23	11.22	80.52	Boiler setting

The difference in the percentage of CO_2 shows the effect of leakage in the boiler setting, the gas passing up the chimney being diluted with air. The heat loss in the chimney was 10.9 per cent. The total drip in 72 hours was 15.700 lb. The thermal efficiency of the plant was as follows, in the 72-hour run:

Total coal burned	132,567 lb.
Total power generated	33,940 kw-hrs.
Average coal per hour	1,841 lb.
Average power generated	471.4 kw
Average coal per kw-hr	3.91 lb.
B.T.U. per kw per minute (by analysis)	846
B.T.U. per hp per minute	631.2
1 hp theoretically equals per minute in B.T.U	42.42
Efficiency of plant (42.42 ÷ 631,2) x 100	6.72 per cent
Maximum load in kw	1,157.3
Load factor	40.8 per cent
Average station lighting load in 72 hrs	9.43 kw
Average exciter input in 72 hrs	10.84 kw
Average auxiliary motor input in 72 hrs	3.02 kw
Total direct-current output in 72 hrs	7,330 kw-hr.
Average direct-current load	101.8 kw
Total alternating-current power generated, Turbine 1	19,600 kw-hr.
Total alternating-current power generated, Turbine 2	7,610 kw-hr.
Average alternating-current turbine load in kw	378
Total water fed	1.579,773 lb.
Test of Turbine Auxiliaries, 4-hour run:	
Steam consumption per hour	1,752 lbs.
Average power in kw	225

This includes the following pumps: One dry vacuum, one wet vacuum, one circulating and one gland water pump.

The results of the turbine test at various loads are given in the following tables:

	Load in kw					
	264	513	748	987	1275	1500
Steam per hour in lbs.	7,878	12,476	16,200	20,525	26,755	33,383
Steam per kw-hr. in lbs.	29.8	24.3	21.65	20.8	20.95	22.2
Vacuum in ins.	28.28	28.29	28.19	28.39	28.39	27.63
Field input in kw	3.07	3.29	3.55	3.92	4.35	4.80
Boiler pressure, lbs. absolute.	170.7	165.5	165.8	167.3	167.4	167.1
Temp. of cond. steam deg. F	52	54	56	63	81	81
Thermal efficy. in per cent.	9.83	12.05	13.57	14.25	13.77	13.51

The thermal efficiency, assuming dry coal, was:

B.T.U. input per pound of coal	13,830 B.T.U.
Water evaporated per pound of coal from and at 212 deg.	9.25 lb.
Heat taken in primary heater per lb. coal	1,056 B.T.U.
Heat taken in economizer per lb. coal	470 B.T.U.
Heat taken in boiler per lb. coal	8,705 B.T.U.
Thermal efficiency of boiler	62.9 per cent
Thermal efficiency of boiler with economizer	66.4 per cent

The generator showed a voltage regulation of 12.28 per cent when 1000 kilowatts non-inductive load were thrown off the machine. During this operation the frequency rose from 58 to 61.1 and the speed from 1765 r. p. m. to 1872 r. p. m.

In the stoker test, the average draft in the chimney was 0.74 in.; under grates, .43 in., and in furnace, .19 in. The average temperature of the feed water entering the boiler was 101.3 deg. C., and the average boiler pressure, 146.8 lb.

* * *

Direct-Current Motors, Their Action and Control—VI.

By F. B. Crocker and M. Arendt.

In the preceding article it was explained that speed control by variation of field flux is applied in practice to three types of motor, as follows: (a) magnetic circuit unsaturated, in which the flux is nearly proportional to the ampere-turns and the armature winding, as well as commutator, has many sections to diminish self-induction; (b) specially designed field magnets, in which the flux density at the pole-tips is always high; (c) a commutation field is maintained by a compensating winding or is established by auxiliary poles, commonly called "interpoles."

Bullock Motor.

Machines of Class (*a*) are built by many manufacturers, and while in successful operation they are larger than constant-speed motors, as already shown. The following data apply to a 5-hp, 3-to-1 variable-speed Bullock motor, and Figs. 1, 2, 3 and 4 are respectively magnetization, speed load, flux distribution and efficiency curves at various field strengths, showing clearly the operation of this motor.

Data of Bullock variable-speed motor.

Rated capacity, 5 horse-power.

Rated pressure, 220 volts.

Speed, 350 to 1050 r.p.m.

Armature current at rated load 22.2 to 24.6 amperes (depending upon the speed).

Field current, 1.3 to .23 amperes.

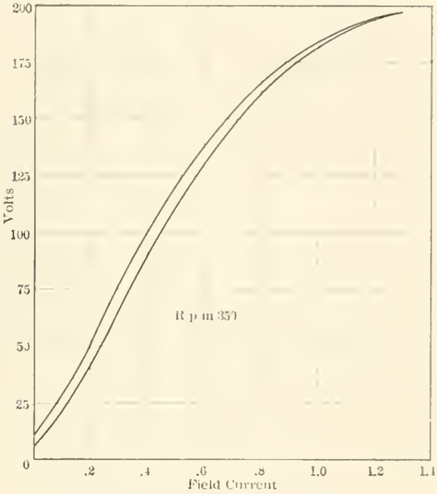

FIG. 1.—MAGNETIZATION CURVE OF MOTOR.

No-load armature current, 2.1 to 3.6 amperes (depending upon field strength and speed).

Armature resistance, hot, 1.12 ohms.

Field resistance, hot, 195 ohms.

Weight of motor complete, 1100 lb.

Storey Motor.

Machines of Class (*b*) were formerly manufactured by the Magneto Electric Company, and called Storey motors after their designer. The concentration and holding of the flux at the pole tips were obtained by recessing the pole pieces as shown in Fig. 5. In addition the steel of the frame was soft and flux density high, without reaching the bend of the magnetiza-

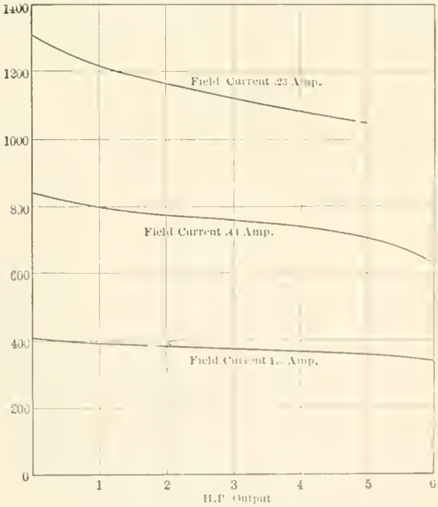

FIG. 2.—SPEED-LOAD CURVES OF MOTOR.

tion curve; the pole pieces are relatively short and the armature has many sections. A magnetization curve of a 3-hp, 3-to-1 speed motor of this type is shown in Fig. 6. Flux distribution curves at various loads and speeds are shown in Fig. 7. Speed and load curves are given in Fig. 8, and efficiency curves at various field strengths in Fig. 9. The data of one of these motors are as follows:

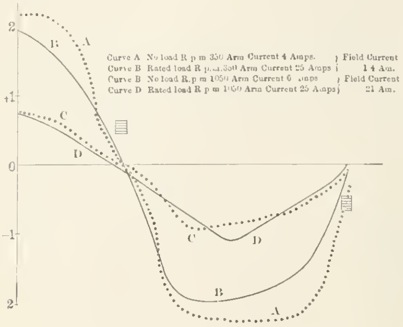

FIG. 3.—FLUX DISTRIBUTION OF BULLOCK MOTOR.

3-hp adjustable-speed (3-to-1 ratio) Storey motor.

Rated pressure, 115 volts.

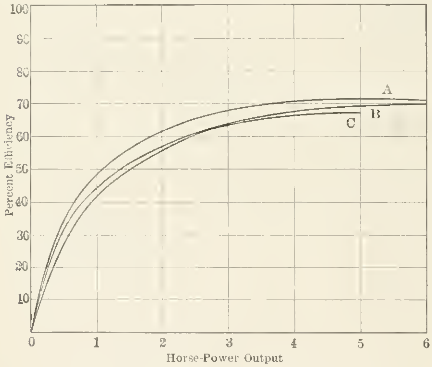

FIG. 4.—EFFICIENCY CURVES OF BULLOCK MOTOR.

Armature current at rated load, 25 to 28 amperes, depending upon the speed.

Field current, .5 min., 1.7 max.

No-load armature current, 1.1 to 4 amperes, depending upon the speed.

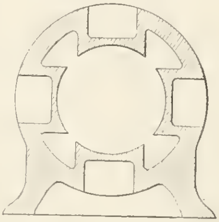

FIG. 5.—FIELD FRAME CONSTRUCTION OF STOREY MOTOR.

Armature resistance, .31 ohm.

Field resistance, 67.5 ohms.

Speed, 430 to 1290 r.p.m.

Weight, 800 lbs.

Interpole Motor.

A prominent type of adjustable-speed, direct-current motor embodying auxiliary commutation fields is that of the Electro-Dynamic Company.* It employs auxiliary poles located directly over the armature coils undergoing commutation, which poles are excited by a winding in series with the armature. Thus a flux for reversal is obtained where needed, and at the same time it is one which increases with the load. The flux of these interpoles is in direct opposition to and slightly in excess of that produced by the armature ampere-turns, the exact amount depending upon the length of the air-gap and quality of the iron employed; while the proper position for the brushes is such that no torque is produced by the auxiliary flux. The connec-

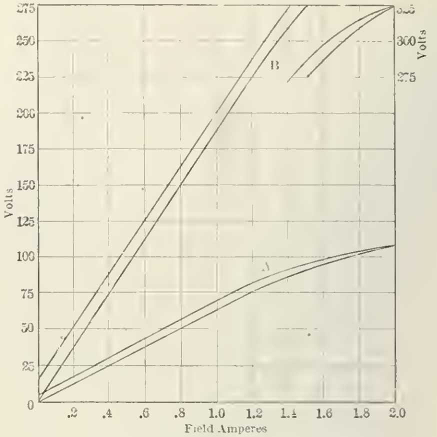

FIG. 6.—MAGNETIZATION CURVE OF STOREY MOTOR.

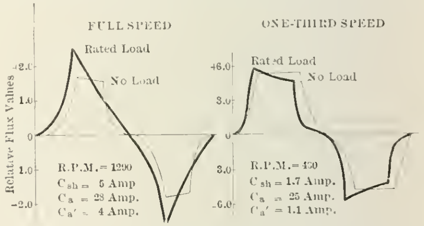

FIG. 7.—FLUX DISTRIBUTION CURVES OF STOREY MOTOR.

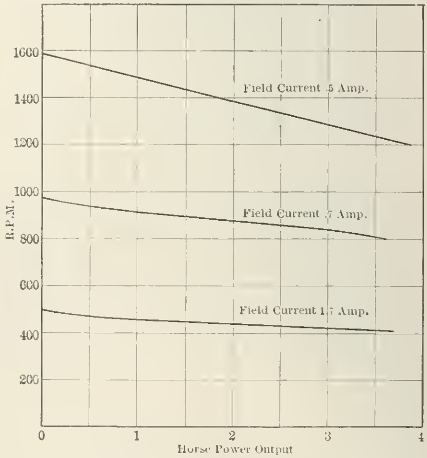

FIG. 8.—SPEED LOAD CURVES OF STOREY MOTOR.

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*U. S. Patent No. 775,310, Nov. 22, 1904.

tions of this interpolar motor are shown in Fig. 10, and data of a 5-hp, 6-to-1 variable-speed machine are as follows:

Armature current, 24 amperes max., 22.2 amperes min.
Field current, .16 ampere min., 1.27 amperes max.
No-load armature current, 1.7 max., .7 min.
Resistance of armature winding, 1.16 ohms.

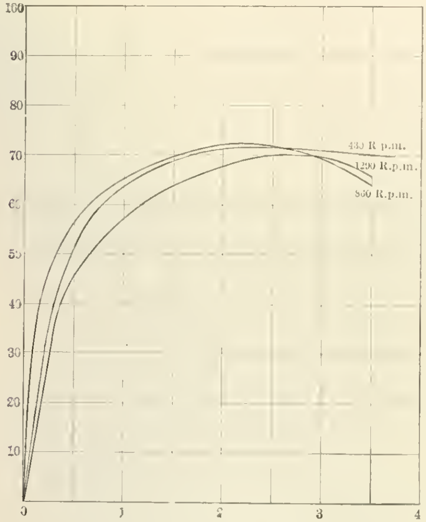

Fig. 9.—Efficiency Curves of Storey Motor.

Resistance of interpolar windings, .2 ohm.
Resistance of shunt field, 176 ohms.
R. P. M., 210-1260.
Weight, 1200 lb.
Speed, 210 to 1260 r.p.m.

The various working curves, such as magnetization, speed and load, flux distribution and efficiency are shown in Figs. 11, 12, 13, 14 and 15, respectively. The peculiar shape of the flux curves is due to the field of the interpoles producing a flux for reversal directly at the brushes. If the brushes be displaced so that the short-circuited armature coils are not directly under the center of the interpoles, the motor characteristics are considerably altered. The machine speed falls off considerably when the brushes are advanced, and increases when shifted back, thus resembling compound and differential motors under load changes. Hence to be equally operative in both directions of rotation, the coil which is being commutated must be directly under the center of the interpole; this adjustment is shown in Figs. 13 and 14.

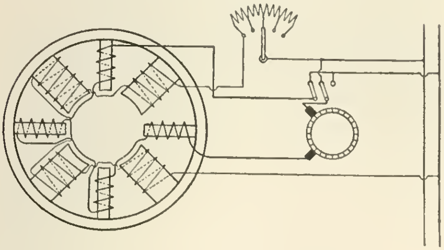

Fig. 10.—Connections of Interpole Motor.

A study of these various curves brings out the difference in operation of the variable-speed motors of types A, B and C, respectively.

Dunn Method.

Another type of motor, the speed of which is adjustable by varying field flux, was invented by Mr. Gano S. Dunn.* The armature is supplied with constant current and the field winding separately excited from a constant-potential circuit through a rheostat. The armature current being constant, the torque varies directly with field flux. By means of the field rheostat this flux may be regulated from a very low value up to full strength with corresponding increase of torque. This large range of control is obtained by regulating the field current, which is small, the heavy armature current being kept constant by an automatically regulated generator, as in constant-current arc lighting. The advantage is similar to that secured by the "field-weakening" method already described, but gives any torque or speed from zero to full value, while the latter is practically limited (unless special

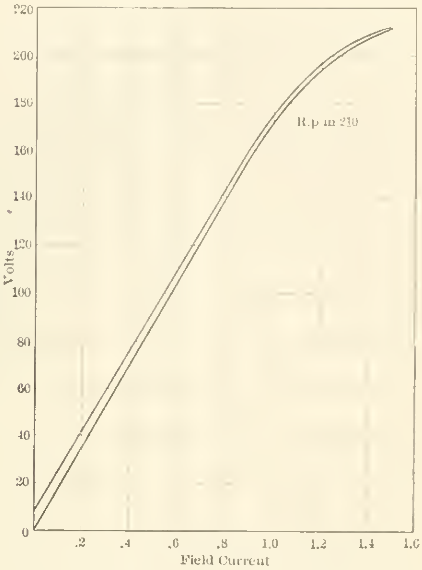

Fig. 11.—Magnetization Curve of Interpole Motor.

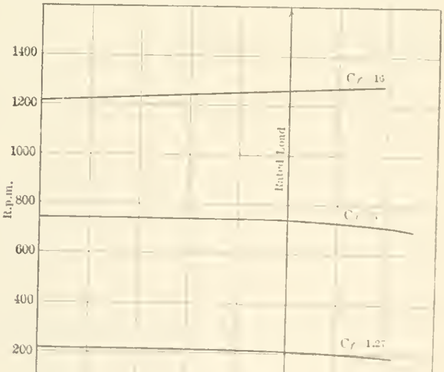

Fig. 12.—Speed-Load Curves of Interpole Motor.

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*U. S. Patents No. 549,061, Oct. 29, 1895, and No. 591,345, Oct. 5, 1897.

designs are employed) to a certain ratio of speeds, usually 3 or 4 to 1. This method possesses an additional advantage over field-weakening control in having maximum field strength with maximum speed and torque. In these respects it would be adapted to adjustable speed work in machine shops. On the other hand, the necessity for constant-current as well as constant-potential supply and the high voltage required to give any considerable power, are serious objections to this system. It is hardly practicable to operate motors below 20 horse-power with more than 100 amperes, at which current it would require about 1000 volts to supply 100 horse-power on one circuit—a dangerous voltage in a shop. To multiply circuits is objectionable because each would demand its separate constant-current generator. Furthermore, the latter has not been developed commercially above 10 amperes. For these reasons, the field-weakening and multiple-voltage methods are preferred for machine shop or similar service.

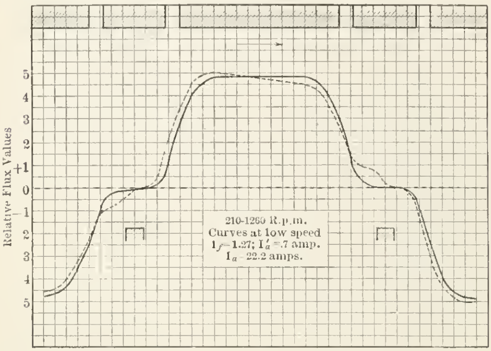


FIG. 13.—FLUX DISTRIBUTION OF INTERPOLE MOTOR.

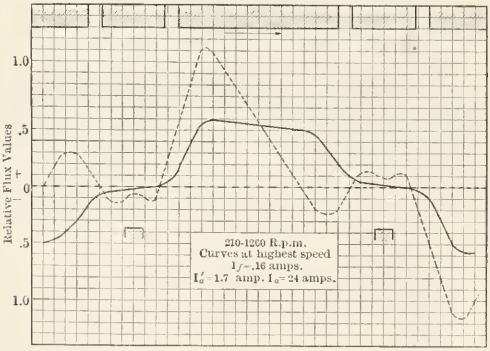


FIG. 14.—FLUX DISTRIBUTION OF INTERPOLE MOTOR.

Combined Steam- and Gas-Engine Plant at Mankato, Minn.

The Mankato Gas & Electric Light Company has an interesting central station in which part of the units are driven by gas engines and part by steam engines. Originally the electrical end of the plant, which adjoins the gas works, consisted entirely of gas engines driving single-phase and monocyclic alternating-current generators. For the recent additions to the plant steam engines have been used.

It is interesting to note that apparently no trouble is experienced in throwing any of the generators in this plant in parallel, the generators driven by different gas engines and steam engines being run in parallel in regular operation without unusual precautions. These generators range in size from 50 kilowatts to 300 kilowatts. This experience is interesting in view of the fact that it is sometimes considered uncertain whether small single-phase generators driven by different engines can be operated in parallel without trouble in the ordinary small central station. The gas engines are Westinghouse three-cylinder, upright. Of the three gas engines now in the plant, one of 85 horse-power has not cost over $75 for maintenance in five years. Two engines of 125 horse-power, which have been in service five and three years, respectively, also have had a low maintenance expense, with the exception of one accident not to be charged to the engine. This accident was the knocking off of a cylinder head by accumulation of water in the cylinder while the engine was standing. The water leaked in from the water-jacket and the engineer failed to be sure that the cylinder was drained before attempting to start.

The gas required in actual daily operation averages 24 to 25 cu. ft. per kw-hour. The ordinary coal illuminating gas is used. This makes a tolerably expensive fuel. The economy could, of course, be considerably improved by installing a producer gas plant. The first cost and consequent investment charges on such a plant have been found considerably higher than for steam.

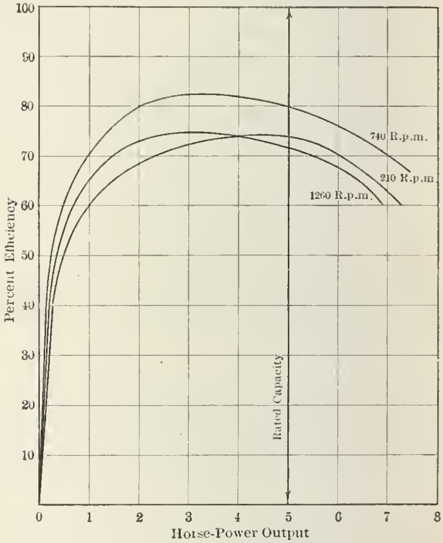


FIG. 15.—EFFICIENCY CURVES OF INTERPOLE MOTOR.

At the time the last addition to the lighting plant was being considered, the question came up of whether to continue the station as a gas-engine plant or whether to install steam engines and boilers. As far as operating economy was concerned, the gas engine operating on illuminating gas and the steam engine operated with cheap Illinois and Iowa coals were about on a par. The cost of a 280-hp gas engine alone would have been about $12,000, or $57 per kilowatt. Besides this, it would have been necessary to enlarge the gas plant at an additional cost of about $10,000. Otherwise the gas plant would be sufficient for the gas service of the city for some time to come. The complete steam engine and boiler plant to operate a 300-kw generator were installed for $30 per kilowatt. The engines and boilers were then operated during the peak load, and the remainder of the 24 hours the gas engine carried the load. In this way the investment was kept down on the purely peak load apparatus, and the wastefulness of a steam plant operated at very light loads many hours per day was avoided.

Recently the situation has been still further changed by the building of a street railway in Mankato, for which the Mankato

Gas & Electric Light Company has a contract to supply power, and a Twin-City Corliss engine has been installed for driving the railway generator. It is an 18-in. x 36-in. simple engine running 120 r.p.m., direct-connected to a 200-kw, 500-volt, direct-current railway generator and belted to a 150-kw. monocyclic alternator. This unit is to be run continuously during the day for railway and lighting loads, and the other gas and steam engines run on the peak. The last half of the night, when the cars are not running, the load will be carried by a gas engine. The connected motor load is about 200 horsepower. The day load on the station has been ordinarily handled heretofore by one 125-hp gas engine. The company is under the management of its secretary and treasurer, Mr. R. E. Brown.

Electric Light and Power at Greenfield, Mass.

GREENFIELD, Mass., the county seat of Franklin County, is a clean, thriving city of 11,000 inhabitants, the center of a truck-farming and tobacco-growing district, and has the largest tap and die manufactories in the world within its borders, the majority of the inhabitants being employed in these shops.

The first electric-light company was started in 1887 and was known as the Greenfield Electric Light & Power Company, with a capital of $5,000. The equipment consisted of a 50-light Thomson-Houston arc generator. A proposition was made to the gas company to run their generator in the gas company's plant to operate an incandescent lighting machine. This the gas company refused to do. Then a bargain was made with the owners of a large shoe shop by which the engine of the shoe shop ran the dynamo at night. In a year's time an engine was bought, and also two 200-light constant-potential generators, and inside lighting in Greenfield became an established fact. Business was done with the townspeople on the basis of a flat contract. The company was in active and open competition with the gas company. A representative of the electric-light company went through the city and asked the people what the amount of their gas bills were. Upon learning the amount, a proposition was made to furnish them electric lighting at the same price that they paid for gas, on a flat rate. This gave the electric light service a big start. Matters went along in this shape until 1894, when the capital of the company was increased to $30,000 and bonds were issued to the amount of $25,000. With this money a new station was built containing up-to-date machinery and meters were placed in service for the first time. The office of the company was then moved to the business center of the city, where larger quarters were obtained. The capital of the company has since been increased to $100,000, then to $130,000, and finally to $200,000. In 1902 the company bought a water-power site at Shelburne Falls, about nine miles above Greenfield, close to Buckland, Mass., where a large dam was built. The entire cost of the plant was $150,000.

The steam-plant equipment consists of three Hazelton upright boilers of 250 horse-power each. There is also one 600-hp Stirling boiler. The engines consist of one Russell 500 horse-power, one Buckeye 250 horse-power, and one Harris-Corliss 600 horse-power. The generators are four General Electric 400-kw, 2300-220-110-volt machines. There are also two 50-light luminous-arc outfits. The switchboard consists of eight panels. The coal for the station is brought by wagon and then wheeled to the boilers. The machines in the station are all belted. The ashes are used for filling in a swamp near the station. The peak load in winter registers 950 kilowatts and occurs between 5 and 6 p. m. In summer the peak occurs between 7 and 8 p. m. and registers 800 kilowatts.

The force required to operate the station is as follows: Superintendent, line foreman, six linemen, one foreman for inside wiring, an average of six inside wiremen, one chief engineer, three engineers, four firemen, two switchboard men and one laborer.

The lines are all overhead. The transformers are used individually on the lighting circuits, and grouped for power circuits where the load is heavy. The primary circuits have permanent ground detectors.

The power load is composed of 134 motors aggregating 810 horse-power. The largest single motor is a 60-hp machine driving a brick press. The power is furnished at 220 volts, three-phase, alternating. The total length of wire strung on the poles is 600,193 ft. The number of poles is 962. The total amount of energy generated last year was 1,877,916 kw-hours. The total number of incandescent lamps connected of all sizes of candle-power is 10,046. The company furnishes to the city 69 arc lamps at $87.50 per lamp per year. There are also 61 incandescent lamps of 40 candle-power supplied at $29 per lamp per year.

The meters are tested at the office of the company, where ample room has been given for their care. When the meters are received from the makers they are placed in stock without testing. All meters are tested regularly once a year, also cleaned and adjusted if found to be off standard. Upon complaints of high bills and requests made to have meters examined, the meters are tested in circuit, a portable testing set being used. The meters are read on regular days each month. There are about 600 meters on the circuits. It takes two men about four days to read them. The index books are of the loose-leaf type. When a new consumer is connected up and his meter is set, a card is made out and placed on file as the consumer's record of meter and installation. The information on the card calls for address and name of consumer, occupied as, service started, suspended, meter number, date removed, cause, amperes, volts, constant, size and whether direct current or alternating current, whether two or three wire, location, installation consists of, sockets wired and size of lamps, make of motors, horse-power, volts, phase, arcs, make, amperes, circuit, number type and make of fans, and a space for remarks. This card record is kept as accurately as possible.

The equipment of the water-power station at Shelburne Falls consists of two Stillwell-Bierce & Smith-Vaile wheels of a total horse-power of 1200. They drive two General Electric 400-kw, three-phase machines. The current is sent down nine miles to the steam station at 10,000 volts, transformed for distribution to 2300 volts and finally reduced to 220 and 110 volts. This plant operates about six months of the year, being shut down the other half of the year by ice in the winter and in the summer by low water. The plant is operated by two engineers and two assistants.

The office of the company is very attractive and up-to-date. It is located in the heart of the city just off the main street. There are two very large show windows in which is very neatly arranged an electrical display. All appliances are placed in the windows in season. For night display, the windows are well lighted. The show room occupies the largest space in the office. On one side is a large table on which are placed various electrical heating and cooking appliances, and so connected that quick demonstrations can be made when requested. The rest of the show room contains electrical fixtures and lamps. A person doing business with the company passes through the show space whether to pay a bill or lodge a complaint, and the display is so arranged that a person is bound to notice it. Prompt attention is paid to any one requesting information concerning any portion of the exhibit. The rear portion of the office contains the meter room and stock room. The power bill is on buff-colored paper and the incandescent bill on blue. The consumers' ledger is of the loose-leaf type.

The new business is taken care of by one man, who spends all his time at it. He is paid a straight salary and takes care of both power and light. The results from his work are very satisfactory to the company. The entire field has been gone over thoroughly and all prospects kept track of. The solicitor was started on a flat-iron campaign with the result that in one year and a half of work, in conjunction with his other business, 156 flat irons were put out and are in daily use. The solicitor in this work carried a sample iron with him. It was found that when he was sent out to canvass for the installation of residence service that the electric flat-iron did good work as an entering wedge. The solicitor also sold Gem lamps and electric fixtures, although the greatest amount of sales are made at the office show room. The company furnishes free lamp renewals, the consumer purchasing the first installation. The solicitor has been for a short time at work building up a heating load. Already quite a few hair-curling irons and hot-water appliances have been placed. The electric sign, or, in fact, any sign extending out over the sidewalk, is not permitted by the authorities in Greenfield. There are one or two electric signs, but these are small affairs, both in size and electric equipment. The stores are closed every evening in the week with the exception of Monday and Saturday evenings, when they are kept open until 10 p. m.

The company does considerable advertising and has followed this up consistently. This is usually in the form of small circulars, on the back of the monthly bills and in the newspapers. Every month there is sent out with each bill some small descriptive circular on some one appliance or attention is called to some phase of the electric service as supplied by the company. These have from time to time brought back requests for further information. The company runs an advertisement in each of the two weekly papers, changing them each week. No follow-up letters or circular letters have ever been sent out. The back of the incandescent and power bills each month contain under the heading of "Facts and Suggestions" statements and notes concerning the service, of which the following are examples:

"Electric power is cheaper, cleaner and quieter than any other power.—It is well to have a duplicate set of bearings on hand. —Purchase the new automatic oil switch, which will take care of the overload without fuses or injury to the motor.—A motor attached to ceiling or side of building utilizes no floor space.—Make your starting load as light as possible.—Thoroughly clean your motor once a week.—Electric light creates no odor of any kind, no smudge, dust or sediment to settle on the surroundings. —Try the electric-heating pad. It maintains a uniform and constant heat. It is superior to and is rapidly replacing the hot-water bag.—You can iron in any room of the house with an electric flat-iron. It saves you many a weary step from stove to board. You need but one iron to do your entire ironing. We should be pleased to furnish you one on 30 days' trial.—Ask our meter man to teach you how to read your meter and figure your bill. He will gladly do this."

The results from the advertising done have warranted the company in paying more attention to it. The company has not as yet been interfered with politically or otherwise in the pursuit of its business and has enjoyed since its commencement the confidence of the public.

The company has been progressive in the matter of rates for both power and light. When the meters were first installed a rate of 16 cents per kw-hour was made, with a 10 per cent discount if the bill was paid promptly. As the business of the company increased and in its efforts to get some of the larger of the gas consumers, all sorts of special rates were made. These were, after some difficulty, all abolished and the present rate put into operation. This rate footed up a reduction of 23 per cent over the old schedule and a saving of that amount to the consumers. The present lighting rate ranges from 15 cents to 8 cents per kw-hour according to the amount used. The incandescent rates are as follows:

Between	0	and	75	kw-hours	monthly	15	cents
"	75	"	100	"	"	14	"
"	100	"	200	"	"	13	"
"	200	"	300	"	"	12	"
"	300	"	400	"	"	11	"
"	400	"	500	"	"	10	"
"	500	"	600	"	"	9	"
	600 kw-hours and over at					8	"

A discount of 10 per cent is allowed if the bill is paid within 10 days of delivery of bill, on all bills in excess of $1.50 per month. There is a service or minimum charge of 41 cents per month on all lighting bills whose amount does not reach $1.50 per month. For example, if a consumer's bill was 50 cents for a month, 41 cents would be added, making the total bill 91 cents for that month.

The power rates are based on consumption, the basic rate being 6 cents per kw-hour. There is a minimum or service charge on all power bills for service up to and including three horse-power, of $1.50 per month. On an installation of more than 3 horse-power, the service charge is based at the rate of 50 cents per horse-power connected. There is no discount allowed for prompt payment as on the lighting rates. The power rates are as follows:

Between	0	and	100	kw-hours	per	month	6	cents
"	100	"	200	"		"	5.5	"
"	200	"	400	"		"	5	"
"	400	"	600	"		"	4.5	"
"	600	"	800	"		"	4	"
"	800	"	1,000	"		"	3.8	"
"	1,000	"	1,200	"		"	3.5	"
"	1,200	"	1,500	"		"	3.2	"
"	1,500	"	2,000	"		"	3	"
"	2,000	"	2,500	"		"	2.7	"
"	2,500	"	3,000	"		"	2.5	"
"	3,000	"	4,000	"		"	2.3	"
"	4,000	"	5,000	"		"	2.2	"
"	5,000	"	6,000	"		"	2.1	"
"	6,000	"	8,000	"		"	2	"
"	8,000	"	10,000	"		"	1.9	"
"	10,000	"	over	"		"	1.8	"

Mr. J. W. Stevens, the president of the company, stated in regard to the work that had been accomplished: "We were very fortunate in having in Greenfield a city that is clean, politically and otherwise, so that our start in the electric light and power business was a favorable one, not being hampered by various obstacles placed for personal or political gain. We did our level best to interest the gas company, as did a great many of the private citizens, in the production of electric current, but to no avail, so that our only alternative was to go ahead and produce current the best way we could. The changing over from a straight flat rate to one of metered charges brought us a great deal of trouble, which was amicably settled. Perhaps it is safe to say that the meter rates when first put in operation increased the monthly bills of many customers. But, on the other hand, among the arguments presented to our customers was the fact that the new and up-to-date machinery installed was giving them a service much above the old and also that they were paying at a fairer rate, both for themselves and also for the company. We, like every other electric company, began from that time on to reduce continually our rates, owing to the increase of business and the lessening of the production costs by the new machinery. These reductions at our present schedule amount to about 23 per cent on our first schedule.

"Our new-business work we have found to be worth keeping up. The result of our solicitor's work in this field we have found to be entirely satisfactory. As he not only keeps visiting the old consumers, but the prospective ones as well, we are kept in close and active touch with our customers and the solicitor has become an interesting source of knowledge to the company in personally learning the needs and wants of the consumers and for the consumers in learning of the aims of the company. Our advertising is another method of getting in closer touch with the consumers, as we have frequently found to our advantage. We have and are now adding a great amount of additional machinery, mostly generators. An up-to-date switchboard will be installed with all the latest appliances and instruments.

"We supply the street-railway system with current, and arrangements are now being made by which we expect to get a large share, if not all, of its business. We have a great many shops here in Greenfield, and we expect to get their power business. It will be a question of rates more than anything else, but we believe that we can arrange matters so that we can quote a low enough rate to get the business and make some money on the proposition. In the matter of signs, we have experienced some trouble in getting them installed owing to the ordinance prohibiting signs over the sidewalk. We have never made any effort to have the ordinance repealed. There are some places that have under consideration the matter of having electric signs placed against the building, but as the stores are only opened two evenings in the week, the storekeepers are rather skeptical of their utility.

We realize that Greenfield has only just tasted electric service and we are on the move to have it swallowed whole."

The officials of the Greenfield Electric Light & Power Company are: Mr. J. W. Stevens, president; Mr. Charles R. Keith, secretary; Mr. G. W. Lawrence, treasurer and superintendent; Mr. C. F. Mosher, chief engineer; Mr. H. D. Seavey, chief electrician.

Motor Ratings, Old and New.

By F. J. Chisholm.

The complaint is sometimes heard from motor buyers, "Motors are not as good to-day as they used to be," meaning that the overload capacity of the present motor is not as great as that of its predecessor. A word of explanation may be useful for a clear understanding of what changes have actually taken place.

Until a few years ago, when the fundamental patents covering induction-motor design expired, motors were generally guaranteed to carry 25 per cent overload for 24 hours, 50 per cent overload for two hours, and 100 per cent overload for half an hour without injury of any kind. The reason for these great overload capacities were several, of which the chief one was a lack of knowledge as to the horse-power required by machine tools.

Before the introduction of the electric motor, tool manufacturers could only test for power required by long and costly methods based upon steam indicator card readings. The fact that all shops were operated on the large-group-drive principle gave little necessity for knowing the individual rating of each tool. When, therefore, the electric motor came into use and a large group of machines was to be cut up into smaller groups, motor-driven, it was discovered that often no two groups gave the same result. A motor of a given rating would drive one group easily, and run very hot on a second group of apparently similar make-up as to number and type of tools and methods of working. Motor manufacturers were consequently driven to very liberal ratings, so that, if a motor did have an overload, the margin would be ample to carry it with safety. Purchasers were not long in learning that an electric motor was a machine which would stand much abuse as to overloads and grew to consider this as an inherent feature.

With the continued success of the motor as a driving machine, both tool manufacturers and makers of motors realized the necessity of knowing just what power each tool and appliance required. The electric motors themselves, with suitable measuring instruments, readily furnished the data hitherto almost unobtainable. When this information became known there was no longer any need for the extra liberal rating of motors. Accordingly the leading makers of motors offered to the buying public machines 25 per cent lower in cost than the older types of the same rating and lighter in weight for the same horse-power capacity.

Buyers were first attracted to the lowered prices of motors, but soon became confused in some cases when reports came back that "any old load" the attendant cared to put onto the machines could no longer be imposed without disastrous results. Competitive conditions prevented the manufacturing companies from starting a campaign of education before this change of ratings went into effect, and even to-day there is more or less confusion as to what changes were actually made.

Now the application of a given horse-power rating to a motor is a somewhat arbitrary affair, for the reason that a given amount of iron and copper worked up into a motor may be made to carry any load up to a point where the motor will go up in smoke. A mass of metal which would carry 20 horse-power for one minute before burning out, could not be offered to the public as a 20-hp motor, of course. Evidently the horse-power rating on the name-plate would have to be a safe fraction of this load. If, for instance, it were labeled 7½ horse-power, then a 25 per cent overload could be carried indefinitely and a 100 per cent overload for half an hour without injury. Assuming a weight of 1000 lb. for this mass of finished metal, and a cost of 50 cents per pound to manufacture, then the motor would sell for $500.

Suppose, however, this same mass of metal was called a 10-hp motor; we would now safely carry 25 per cent overload for only about two hours, 50 per cent for half an hour and 100 per cent overload momentarily. This new motor still weighing the same as before would be sold at $500. Of course, the buyer who had paid $750 for a 10-hp motor made from 1500 lb. of metal would now pay $500 for a motor rated at 10 horse-power.

Some buyers at first seemed to think the reduction in price should have been allowed for machines of the old ratings. But how they could reasonably expect manufacturers to use the same quality of material and labor and sell for 25 per cent less than before, in a rising market, is not clear. As a matter of fact, equivalent value was still offered. The change in ratings was somewhat modified by new designs which enabled manufacturers to obtain more horse-power from a given mass of metal.

The change in alternating-current motor ratings was soon followed by a like change in direct-current motors, and more conservative ratings are gradually coming out for generators, both alternating current and direct current. No mention has been made of heating as affecting ratings, because design affects this very much. Ventilating openings, fan blades, etc., all tend to make arbitrary the rating of a given weight of metal when manufactured into the finished machine.

Electric Light Lines Above Trees at Winchester, Ind.

Two years ago, at the suggestion of the Citizens' Water & Light Company, of Winchester, Ind., the City Council of that town passed an ordinance regulating the height of trees to 35 ft. The company promised to rebuild its lines complete if such an ordinance was passed. This was done, and Figs. 1, 2 and 3 show the general appearance of the shade trees and lines in winter as a result of this move. The company used 50-ft. poles. As can be seen from the engravings, the appearance of the street has been improved on the whole by this move, and the very serious difficulties encountered when trying to run

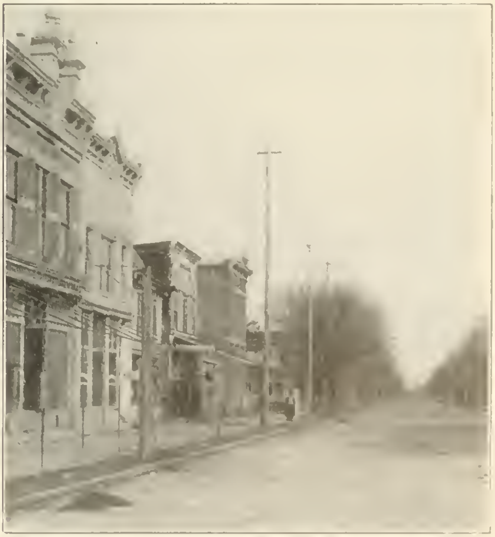


FIG. 1.—45 FT. TREES IN WINCHESTER STREET

electric-light lines along heavily-shaded streets without objectionable trimming, are largely eliminated. The trees were trimmed by property owners before the lines were rebuilt in accordance with the order of the City Council. The company has not had to trim the trees as yet, though presumably it could easily be done, as in some other cities, by the use of a cable stretched between poles, on which a lineman could be sent out on a traveler. Mr. Carl R. Semans is manager of the company.

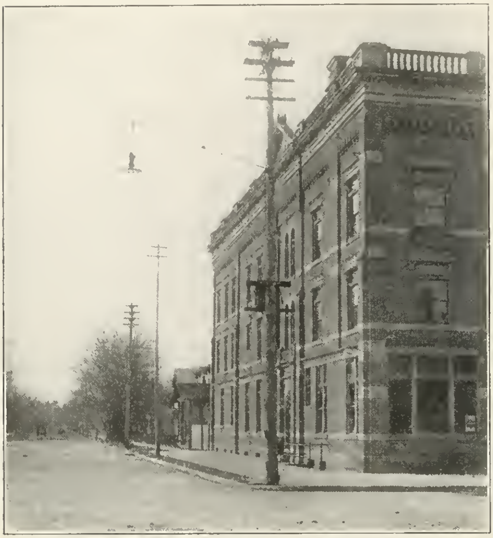


FIG. 2.—LINES ABOVE TREES, WINCHESTER, IND.

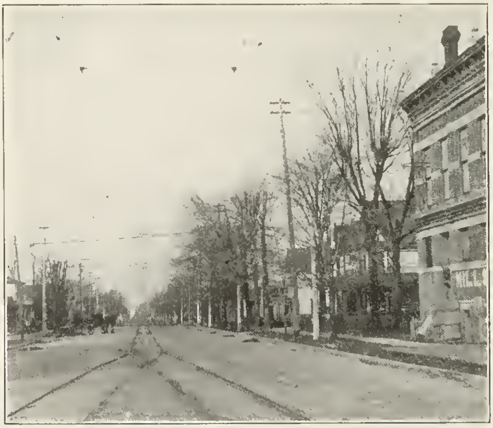


FIG. 3.—WINCHESTER STREET WITH HIGH LINES.

Development at Albert Lea, Minn.

The Albert Lea (Minn.) Light & Power Company is a notable example of a company which makes the most of its opportunities. This town is a railroad center in southern Minnesota, with a population of about 5600. The company has a direct-current plant operating at 110 and 220 volts, three-wire, with Corliss engines and also supplies an Evans-Almirall hot-water heating system giving service in the business district. The company also has a water-gas plant.

The electric earnings per capita for 1907 were $5.65. The hot-water heating earnings were $1.31, and the gas earnings $1.70. Of the electric earnings, $1.40 per capita was received for electric power and 55 cents for street lighting. From this it will be seen that the town is not liberal in its street lighting. The company has nearly all the power load in the town, except a 30-hp engine in a laundry; it has, however, 24 electric irons in that same laundry.

The electric customers number 650, divided as follows: Residence customers, 500; power, 75; store and office lighting, 75. The connected motor load is 400 horse-power, the largest motor being of 90 horse-power. One of the largest customers is a flour mill which operates 24 hours per day part of the year. The company also drives the factory of the American Gas Machine Company, a rapidly-growing gasoline lighting plant manufacturing works. This being the home town of this prosperous manufacturing company, a number of stores have gasoline lighting, since the company keeps its gasoline plants in first-class condition on account of the out-of-town prospective gasoline-plant purchasers, who naturally come to Albert Lea.

The rates for electric light are 12 cents per kw-hour net, with quantity discounts down to 8.5 cents. The power rates are 7.65 cents per kw-hour for small users. For large users they are 7.65 cents for the first 30 hours' use of the connected load and 5 cents for all above that. A solicitor is employed part of the year. As a part of the advertising and soliciting campaign, an office has been fitted up near the main street for which a rental of $25 per month is paid. Heretofore solicitors from out of town have been brought in, but this year a solicitor trained in the company's ranks will be used. The plan for the immediate future is to push for the kind of business which calls for no extension of lines. In the electric end, this will include electric heating, electric signs at flat rate, outline lighting and show-window lighting at flat rate. By taking show-window lighting at a flat rate, to be under control of the company, it is hoped to liven up the down-town district. The company's exhibit room is well illuminated with Gem lamps in bowl reflectors placed near the ceiling, thus furnishing a practical example of efficient and effective store lighting. Free renewals are furnished on both Gem and common carbon-filament lamps. The Gem lamp, with its accompanying reflectors, has proved very effective in meeting competition. These lamps have been placed in 12 saloons formerly using gasoline plants. These are on a flat rate and are turned off by the owners at 11:30, a check being kept on this by the company. This flat rate is the equivalent of about 8.5 cents per kw-hour. Last summer 60 electric irons were put out. There are now about 75 altogether in use.

POWER-STATION NOTES.

The power plant has direct-current generators driven by Corliss engines. The largest unit has a compound Corliss engine. The hot-water heating system connected is more than enough to take all the exhaust steam during the day. In the summer the engines are run condensing. They are also run partially condensing during peak load in the winter. This is done by passing the exhaust first through the hot-water heater and then to the condenser. The evening the writer visited the plant an 18-in. vacuum was being maintained. The heat needed over and above that supplied by the engines was supplied by live steam from the boilers. The object of running the engines condensing, even though live steam had to be supplied to make up the deficiency, is to get sufficient capacity out of the engine to carry the load. The output in 1906 was 750,000 kw-hours, which in 1907 increased to 825,543. The coal per kw-hour for all purposes in 1906 was 9.75 and in 1907, 8.9, including coal used in the hot-water heating system. The coal used in summer, when the heating system is not in operation, is 7.2 lb. per kw-hour.

The total coal used in 1907 cost only 1.5 per cent over 1906, although the output in kw-hours increased 10 per cent. This is a record of which the manager justly feels proud. The reduction has been made by constant vigilance, both in purchasing and using coal. Southern Illinois steam coal is used, as this is found to cost less per kw-hour than the La Salle lump formerly used. The coal is purchased on the b.t.u. basis, a contract being made with the Fuel Engineering Company, of Chicago, for sampling and testing the coal purchased. A small portable Orsat flue-gas testing apparatus has also been used frequently to help show the firemen what constitutes good firing. This has been a great help. A close watch is kept on power-station reports by the manager, and any unusual increase in fuel or water is immediately taken up with the power-plant men. Each 12-hour shift makes a report of coal burned, and ash taken out. Bristol gages record the steam pressure, incoming water temperature and voltage. The ash of the coal as determined by analysis, is 11.2 per cent. As determined by weight at the plant it is 12½ per cent, showing that the firemen get very good combustion. The cost of coal per kw-hour, including heating, is 1.5 cents. Four and one-half men are charged against the power station. From two to three outside men are employed in the electric end of the business. Recently a man has been placed in the store-room to keep track of stores—an experiment which was considered a doubtful economy for such a small plant at the time it was started. It seems to be paying well, however, as considerable waste of material has been stopped. The peak load for 1907 was 384 kilowatts, the load factor for the year being 24.5 per cent. The management of the company is under Mr. Ludwig Kemper.

Central Station Publicity.

By Andrew J. Haire, Jr.

Central-station publicity must necessarily be of an educational character. Few people realize how far the development of electricity has been carried. They cannot comprehend its mysterious mode of operation, and there is naturally, therefore, at least a negative attitude toward its installation in their homes. Then, again, there is the antagonistic spirit with which all public service corporations are now regarded. The publicity department of every central station has, therefore, certain definite handicaps to overcome before it can hope to extend the field of operation of its plant.

The commercial or business-getting activities of the average central station are carried on through two different methods; through personal solicitation and through advertising, which will be taken up in turn.

PERSONAL SOLICITATION.

The first qualification of the central-station solicitor is a thorough technical knowledge of electricity in its application to the particular class of business upon which he is working.

Salesmen generally are too apt to conclude that if they have met with success in one line, their chances of succeeding in another are practically assured. They forget that while every salesman, or business-getter, must possess certain general qualifications, such as good appearance, pleasing address, tact and perseverance, these are of little avail unless backed up by the specific qualifications required in every line. Since technical knowledge is so important a condition to the solicitor's success, a problem which the commercial department of every large power plant has to deal with is, how can this condition be best met? To employ graduate electrical and mechanical engineers as business solicitors is often impracticable. The solution of the problem seems, in fact, to lie in getting good raw salesmen material and in training and educating that material up to a promising degree of efficiency.

Different companies follow different methods of educating their solicitors, and it may be instructive to consider the systems of some of the larger manufacturers of illuminants as well as central stations. Many of these conduct courses in the study of electricity. These courses are open to the sales department as well as to the engineering departments, and it is probable that there is no more effective way of initiating the inexperienced salesman into the elementary mysteries of electricity. These study courses are generally supported, financially and otherwise, by the management of the plant. Probably every central station is provided with a more or less complete library of authoritative text books and technical magazines. These the solicitors are encouraged to study. In fact, it should be firmly impressed upon the selling staff that the more thoroughly the principles of electricity are understood, the greater are the chances of bringing in new business and consequently of drawing larger salaries.

Some electrical companies use, as the basis of the agent's initiation into the solicitation of electrical business, what is called the "agent's hand book." The Boston Edison Company, notably, has found this an excellent means of instructing its salesmen. Regarding this aid, Mr. R. S. Hale, general agent of the company, has to say:

"This hand book is, to my mind, the most important help to new-business-getting we have. We use the ordinary loose-leaf book of pocket size, either National Simplex No. 4241 or Unimatic No. 7752, and put in it all the hints, suggestions and orders touching the interest of the general agents' department. The general advice as to the qualifications and aims of the agent and the specific information about the company's business, which varies little from year to year, are printed in the regular way. Other details, regulations and explanations of particular points are got out on a multigraph machine and distributed as occasion serves. The ordinary hints are given numbers, from 1 to 100; the special advertising hints are of less importance and are numbered from 100 to 200, while a third series, giving prices and data in regard to current-consuming devices, is numbered from 200 to 300. This division is for the purpose of making it easier to find hints on special subjects."

Every qualification which goes to make up a good salesman in any line is essential to the central-station solicitor, and in this respect I cannot do better than quote in part the words of one of the speakers at the convention last year of the National Electric Light Association:

"Give me a man who is training himself systematically along the lines of endurance, ability, reliability and action, and I will show you a man who, all things considered, will outdistance his competitors. This man will realize that beyond the training of these faculties and qualities—which is the educative or first part of education—that he must also fill in with useful knowledge, which is the second part of education. Thus this man will make a scientific study of human nature his business. He will study types, temperaments, motives, habits of people. He will realize that it is a great mistake to handle everybody alike. While we all belong to certain types, yet no two people are constructed exactly alike. An ability to read his fellow man correctly is one of the greatest assets of the business man. While it is true that we pick up much knowledge from contact with our fellow men, it is also true that some of the greatest scientists in the world have spent their lifetime in a masterful study of this problem, and as a result of their study have been able to give us information that will remove our knowledge from the plane of guesswork to that of practical certainty. Once knowing how to read people through, the study of the types, temperaments, and so forth, as evidenced not only by their general shape of head, facial expression, but through the voice, through the gesture, through habit as evidenced by many things, we shall be able to obtain a mastery of the situation."

Solicitors for electric power companies are paid generally a straight salary supplemented by a commission based upon the net returns of the business secured. The commission should be limited so as not to exceed in any case the salary of the solicitor.

The work of the solicitor should be followed up by the company, both by good service and prompt correction of all complaints, on the part of the engineering department and by forceful newspaper advertising and mailing literature on the part of the advertising department. Much devolves upon the advertising manager in making the solicitor's work successful.

Are Issues of Capital Stock, Which Do Not Represent Cash Invested, Justifiable?

By W. H. Winslow.

Ask the average man whether or not, in his opinion, issues of capital stock in excess of physical assets are right or wrong, and he will probably, with "watered" stock in mind, promptly reply in the affirmative. Those who have given the subject some thought, however, know that whether or not such issues are wrong, depends on circumstances. The last report of the Interstate Commerce Commission contains these significant words: "We are aware that in the construction of new lines of railway, developing new territory, it has been necessary in many instances to sell railway securities at large discount, and to sell bonds with stock bonuses, and, even in such cases, it has many times been difficult to raise the necessary capital."

It is not clear to many, however, why this should be the case. What difference is there, they say, between subscribing cash to the capital of a concern and building the plant with such capital, or buying the bonds of the concern and getting a bonus of stock issued against franchise or other non-physical assets? Let us take a concrete example. Suppose that it is proposed to start some public utility in a small but growing community, and that the promoters decide not to issue any bonds, but to float stock at par, for the purpose of building the plant. Why should a man, with capital to invest, fight shy of such a proposition, when he is willing to invest in the bonds of the company, with a bonus of stock, as in either case he is assured of his share of the entire net earnings?

Let us suppose that the plant is built with cash received from sales of stock only, and that in a few years it becomes necessary to raise more capital for necessary extensions, and that it is found impossible to sell additional stock. The natural result is that the plant is mortgaged to raise the needed money, which mortgage becomes a first lien on the property, and one which, in a period of depression, or owing to adverse conditions, may be foreclosed and the stockholders left without anything to show for their money. In this connection it must be remembered that, unlike ordinary strictly private enterprises, public service corporations have frequently to raise additional capital, even when the return on that already invested is insufficient to make their securities attractive. The owners of a factory, for example, cannot be compelled to increase its capacity or even to keep running, unless they choose, but a public service corporation must not only keep running, but must increase its capacity to meet the needs of the public.

Suppose, on the other hand, that the plant is built with the proceeds of an issue of bonds secured by a first mortgage on the plant (sold with a stock bonus), which mortgage is made for a sum much in excess of the original issue of bonds, so that additional first mortgage bonds may be issued for extensions. Suppose, further, as in the other case, that the company falls on evil days, and the mortgage is foreclosed; our investor in this case may have his stock wiped out, but he is assured of his share of the proceeds of the sale of the property.

The giving of stock bonuses in untried enterprises to secure capital necessary for their development is, however, a very different thing from issuing such stock in concerns which have reached a position of assured permanency and earning power. It is this latter practice which has made the term "watered stock" anathema to the public. It would appear, then, that so-called "watered" stock is necessary and advantageous to the public under some conditions, and unnecessary and harmful to the public under others. Stated in another way, when enterprises are still in an untried and speculative state it is necessary to offer capital the inducement of a possible return much greater than can be secured in investments largely devoid of risk, while when the enterprises have demonstrated their earning power, no such inducement is required. In Great Britain this is recognized in dealing with gas companies, they being allowed to earn 10 or 12 per cent on the sums invested up to the point where they are firmly established, while on additional capital the return is limited to 5 or 6 per cent. It is, perhaps, only natural that when people see public utilities whose business has passed the earlier, uncertain stage paying good dividends on stock representing no cash investment, they should consider such a situation wrong; and, further, that they should consider the giving away of franchises which have proved so profitable as unwise and unnecessary. Let us, however, consider the situation at the time the grants were made. The writer has in mind a town where the usual franchises were granted about 20 years ago. At that time, the town was growing rapidly, and all of the credit of the municipality was needed to finance street improvements, sewers, schoolhouses and the like. Also the individuals of the community needed all their capital in developing their own business and, as a result, welcomed the coming of outside capital to works. This outside capital was willing to risk large sums of money on the ultimate growth of the town making them a handsome return for their investments on the usual basis of bonding the plants for their cost and issuing stock against the grants, charters and franchises owned. As a matter of fact, no such return has yet been made, and it has even been necessary to refund the bonds on a lower interest basis; thus, in this case, at least, the risks assumed were far from imaginary. There is still hope, however, that in the future dividends on the stock will, in part at least, compensate for the very slim return so far received. It is folly to suppose that at the time the plants referred to were built, any capital could have been secured on a less attractive basis, and, even should the stock ultimately pay dividends of 10 per cent, it would be a long time before the average return on the capital invested would reach 8 per cent. Is there anything here for the inhabitants of the town to condemn?

The public utilities of this country doubtless have much to answer for, but are the communities they serve so utterly without sin that an attitude of pious horror becomes them? Assuming that it is wrong for a public utility to earn more than a fair return on its securities, is it any less reprehensible for a community to let a utility struggle along for years, building up its business, and then when at last it begins to pay a fair return to try to acquire it for the value of its physical assets, or to force it to reduce its rates to a point where it will yield a return no greater than might have been secured in other ways, without any of the struggle and worry of those earlier years? In short, is it right that the merchants and land owners and all the others whose efforts have built up the town should reap to the full the profits of final success, while those alone who have invested in public utilities, and who, in many cases, have done as much as anyone to develop the town, should be forced to be content with a return on the money invested no greater than they would have received from investments entailing no work and very little risk?

The Law of Electric Light Companies.

By J. E. Brady.

In general, it may be said that electric-light companies are liable to persons injured through their negligence to the same extent as are individuals and other classes of corporations. There is nothing inherently different in the nature of electric-light companies which requires the application of different or unusual rules of law in actions for negligence where they are involved. The cases, however, very often present novel combinations of facts.

LIABILITY TO EMPLOYEES.

There are general rules of law applying especially to the relation of employer and employee which govern the duties of electric-light companies to their employees in the same manner as they regulate the obligations of any other employer; and, likewise, rules which prescribe the rights and obligations of the employees of such companies. Under these rules, it is presumed that every person of ordinary intelligence has knowledge of the destructive forces of nature. If the work he performs exposes him to danger from these forces, he assumes the risk of the injury. Every man of experience in handling live wires will be taken to understand that he must use great prudence. The authorities generally announce that if the servant has full and equal knowledge with the master that the appliances used are defective, and each is equally indifferent to the danger, they will stand on a footing of equality as to damages. In the first place, however, it is the master's duty to be careful that his workman be not induced to work under the notion that the appliances are safe, when he knows or has reasonable ground to believe that they are dangerous. On the other hand, it is the duty of every workman to execute the work assigned to him with required care, and not to expose himself to the liability of injury. In other words, the general rules which determine the liability of a master to his servant for injuries to the servant apply as between the electric-light company and its employees. Smart vs. Electric Light Company, 47 La. Ann., 869.

In Colorado Electric Company vs. Lubbers, 11 Colo., 505, the defendant company, acting through one of its superintendents, sent out a carpenter in the employ of the company with instructions to remove a lamp in one of the electric light towers, connect the wires with the circuit, and return with the lamp to the works. At that season of the year the usual time for turning on the current was 4:45 p. m. on clear days and 4:30 p. m. on cloudy days. It was about 4:15 when the carpenter commenced work, and, while he was engaged in detaching the lamp, the current was turned on, causing him to fall to the pavement, sustaining permanent injuries. The carpenter was inexperienced in the work he was ordered to do, and it was outside the duties of his regular employment. He knew that it was dangerous to handle live wires, but, on the trial of his action against the company for damages, he testified that he did not know what a "jumper" was and had no knowledge of its functions or use. It was shown that, subsequent to the accident, the defendant company posted notices at its works warning all employees engaged at work on its lines to quit such work at 4 o'clock each day, and not to resume without first notifying the officers at the works. A judgment was given for the plaintiff on the theory that he had a right to rely upon the assumption that the current would not be turned on earlier than usual, and that by not waiting until the usual time the company was guilty of negligence. It was found necessary, however, to reverse the judgment because of the admission of the evidence as to the posting of notices after the accident. The liability of the company was to be determined on what took place before and at the time of the accident. What it did afterward, in the way of precaution, to avoid future accidents should not have been construed into an admission of a previous neglect of duty and should not have been submitted to the consideration of the jury.

In another case, the insulation having been burned off a portion of an electric-light wire by lightning, a night lineman was sent out to investigate. He found the fault, returned to the station and had the current shut off from the circuit. He then returned to the pole near which the trouble was located and, by pushing the handle of a cut-off box on the pole, made it impossible for the current to reach that pole. Current was again turned on, lighting all the lamps on the circuit but the one in question. Shortly afterward, a night patrolman, not having knowledge of the facts related, climbed the pole, turned on the current by means of the cut-off box, as it is his duty to do when trimmers had left it turned off, and received a shock which threw him to the ground and caused his death. It was here held that the defendant electric-light company was liable for damages under the Massachusetts employers' liability act. Willey vs. Boston Electric Light Company, 168 Mass., 40.

It is well settled law that the master must furnish the servant with reasonable safe appliances for the performance of his work. And if the master fails to do this, or fails to repair a defective apparatus, after reasonable time, then he will be responsible for the resulting damages thereby occasioned to the servant, provided, of course, the servant has himself exercised ordinary care for his own protection. If the servant engages in a hazardous employment, or attempts a service necessarily attended with danger, he will be held to assume all the risks ordinarily incident to the work. In other words, the employer is not an insurer of the safety of his employee. More than this, even where there are defects in the machinery or appliances given into the hands of the servants, still if the peril attending their use "is such as to be perfectly obvious to the sense of any man, whether master or servant, then the servant assumes the risk." Wray vs. Electric Light & Water Power Company, 68 Mo. App., 380, announces the above proposition of law, the facts therein showing that a lamp trimmer was injured as a result of a defect in a lamp, which was obvious to the most casual observer, and had existed for 18 days before the accident without any report or complaint from the lamp trimmer, whose duty it was to report to the lineman any defects on the circuit which he was unable to repair.

In the case of Smart vs. Electric Light Company, 47 La. Ann., 869, it appeared that one of two linemen working at the top of a pole was killed by a current received from the wires on which he was at work. The foreman in charge of the work sent gloves up to the men for their use. The one of the two who was not injured did not put on the gloves, but worked with his bare hands. The other donned the gloves, but being old and defective, they failed to serve the end for which they were intended and their wearer received a fatal shock. The evidence showed that the deceased lineman was competent and experienced and that it was the duty of the linemen to inspect their gloves and turn them in for new ones when they became unfit for use. The claim made by the plaintiff in the action against the company was that the wires upon which the accident occurred should have been made "dead" before the work was commenced. But under the rules of law as set forth above, it was held that the lineman had assumed the risk of injury resulting from the defective condition of the gloves and that the company was, therefore, not liable.

In Junior vs. Electric Light & Power Company, 127 Mo., 79, where a lineman, who had been supplied with rubber gloves with which to work, was killed while working without the gloves, it was held that there could be no recovery against the company, as the lineman had been guilty of contributory negligence. In that case the court held that the lineman by his own neglect of the means furnished him by his employer, brought his hands in contact with the wires and lost his life, and the master is not liable.

It was said in Electric Company vs. Kelly, 57 N. J. L., 100: "The better view of a master's duty to a servant is that which, taking into consideration the well-settled doctrine that a servant, by accepting employment, consents to take the risk of all dangers obviously or naturally incident to such employment, imposes on the master a positive duty to take reasonable care and precaution not to subject the servant to other or greater dangers. The rule thus formulated is of wide application, but with reference to such cases as that now under consideration (where a lineman was injured through the breaking of a pole on which he was at work) may be thus stated: The master must take reasonable care to have the tools and appliances with which, and the places on or about which, the servant is to be employed, reasonably safe for the work the latter is employed to do."

It is the duty of the master to inform the servant of peculiar dangers. The following is quoted from the case of Chicago Edison Company vs. Hudson, 66 Ill. App., 639: "The master is bound to inform his servant of all dangers incident to the service of which he, the master, is cognizant, or of which, in the exercise of ordinary care on his part, he would be informed; he is bound to warn the servant of all latent or extraneous dangers of which he himself has knowledge, or of which, in the exercise of ordinary care, he would be informed; and if he fail in this respect, he is liable to the servant for all the consequences resulting to him from lack of such warning. This rule applies to dangers of which the master himself is aware, or ought to know, and which are unknown to the servant, and would not be readily ascertained except by a person possessed of peculiar knowledge, which the master has no reason to suppose the servant possesses. Dangers which are the result of common knowledge, which can be readily seen by common observation, the servant assumes the risk of, but when the danger to be avoided requires a knowledge of scientific facts, an ordinary servant is not presumed to have knowledge of them, and it is the duty of the master, knowing of them, to inform the servant in respect thereto."

As to the master's duty to supply his servant with proper appliances, the following statement is taken from the case of Harroun vs. Brush Electric Light Company, 12 N. Y. App. Div., 126, 152 N. Y., 212, where it was held that the quoted instructions were correct: "The law requires not that degree of diligence and foresight which is required of an insurer, or which the law might require of a corporation towards the public, but simply reasonable care and prudence in the selection of safe and suitable appliances for the use of employees. * * * * While, in a general way, the law requires simply reasonable care and foresight by the employer in the selection and provision of appliances for the use of the employee, that care and prudence must be proportioned to what may properly be expected of him under the circumstances, and increases in a corresponding ratio with the danger and hazard necessarily connected with the use of appliances."

Electricity in Horticulture.

Weak electric currents have been applied to moistened earth in order to determine their effect on plant life, and all the experiments made tend to show that under certain conditions rapid growth results from such applications of electricity. A new use of electricity for obtaining somewhat similar results has been made by Mr. G. Hartman, of Turbine, Ontario, Canada, who converts the electrical energy into heat and applies the heat under a hotbed for vegetables and flowers. In the comparatively cold climate of Northern Ontario, a current of from 15 to 20 amperes at a potential of 110 volts has been found to be sufficient for a hotbed for a family garden. Figs. 1 and 2 show the arrangement of the heater, which has been successfully used for two seasons. The heater consists of about 260 ft. of No. 12 B. & S. gage iron wire wound in coils 2 in. in diameter. A piece of 1½-in. pipe was used in winding the coil, which was afterward cut into seven parts and mounted on porcelain knobs on a piece of asbestos board, the coils being connected in series.

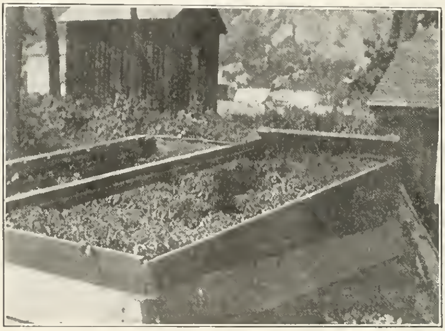


FIG. 1.—HOTBED HEATED BY ELECTRICITY.

The heater was placed under a rough board frame about 6 ft. by 8 ft., the floor of which above the heater was covered with about 5 in. of earth, two hotbed sashes being used to cover the top of the frame. Electrical energy was taken from a 110-volt circuit, and owing to the line losses, the actual current received at the hotbed last year was 15 amperes at 80 volts. The previous year, a current of 18 amperes at [illegible] volts was obtained, and good results were obtained in both cases. The heat was found to be sufficient to keep the earth always noticeably warm, and in the cold early spring weather, tender flowers and vegetables grew rapidly. In some cases the growth was so rapid that the plants were large enough to be set out to advantage, were it not for the danger of frost.

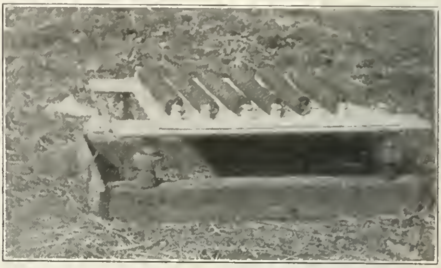


FIG. 2.—DETAILS OF HEATER.

Testing Electric Machinery.

By W. M. Hollis.

To many persons the testing of electric machinery appears be very complicated, to require many and expensive instruments, and to involve very technical formulas and operations. Such is undoubtedly the case in very many tests where extreme accuracy is required; but the tests given herewith are of very general application and do not require many measuring instruments or intricate calculations. Methods are also given for testing machinery of considerable size under practically full-load conditions, although the amount of power required is only a fraction of the power required at full load.

In testing dynamos and motors for efficiency it is usual to determine the losses, the output being equal to the input minus the losses. The losses may be divided into the electrical and mechanical losses, or may be divided into the heating losses, core losses and friction losses. The latter two losses are oftentimes combined and designated as the stray-power losses.

The measurements should be reduced to a minimum, and as few instruments as possible used in making them. In some cases the output and losses are measured, and in other cases the input and losses, while in still other cases the input and output are determined. With large machines, the last test is not easily made, and if made, is expensive. The other two tests are more easily made. The commercial efficiency in the cases mentioned is equal to the (input — losses) ÷ input or output ÷ (output + losses). The stray-power loss is, of course, equal to the difference between the total losses and the I^2R, or heat losses. Where the input and output are measured electrically, and also the I^2R losses, the stray-power loss may be readily obtained.

In the stray-power method of testing machines, the dynamo is adjusted to run at normal speed and under conditions such that the stray power is the same as when the dynamo is operated normally at the load desired. The efficiency at this load may thus be determined without the dynamo carrying the actual load. For instance, with a shunt-wound machine, values of the following would be required: field-coil resistance and armature resistance, hot; field current and armature current at no load. In addition, the normal voltage at the terminals would be required, the armature e.m.f., the full-load armature current, and the terminal voltage used in the tests.

In a dynamo the terminal voltage is equal to the normal voltage at the terminals plus the product of the armature resistance times the full-load armature current; or, in other words, the armature should be subjected to a voltage equal to the operating voltage at the terminals of the machine plus the voltage drop in the armature when operating under full load.

The usual method is to run the dynamo as a motor without load at normal speed by adjusting the field current. Under these conditions the back e.m.f. would be equal to the applied, very little current flowing into the armature, and this is the voltage generated by the machine when operating as a dynamo under full load. Since the machine is operating at normal speed, the flux must be the same as when the machine is operating as a dynamo, so that the hysteresis loss is the same. The current taken, times the operating voltage plus the full load voltage drop, is equal to all losses. Subtracting from this value the small amount of loss created by the "running light" current, which is a very small percentage of the full-load armature current, leaves the hysteresis and friction losses. The same method of obtaining efficiency can be applied to a motor, but in this case the voltage applied at the commutator should be the operating voltage minus the voltage drop in the armature.

The principle of the stray-power method for determining efficiency is as follows: When a dynamo is operating under full load and at normal speed and voltage, a certain amount of mechanical power is required to rotate the armature. The electrical power output is less than the mechanical power input because of the losses in the machine consisting, as before mentioned, of the heat losses and the stray-power losses. When the machine is driven at no load under normal conditions, the stray power is substantially the same as before. There is, of course, a small armature current due to the amount required to excite the fields, but by separately exciting the field magnets this factor may be neglected. These armature heat losses are thus eliminated and the stray power is the amount of mechanical power required to drive the machine.

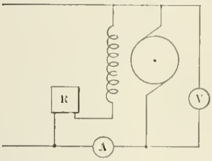


FIG. 1.—TESTING SHUNT-WOUND MOTOR.

Ordinarily the measurements of mechanical power are very difficult to make, and they are, moreover, less accurate than electrical power measurements. Therefore, if electrical power measurements are substituted for mechanical power measurements; that is, electrical power is used to drive the machine as a motor under normal operating conditions with the field magnets separately excited, the stray-power losses will be equal to the electrical power input. Adding to this stray-power loss the value of the I^2R losses at full load, the total losses are obtained. The output is expressed in electrical terms, the measurements are electrical, and the calculations are thus very much simplified.

Another method of determining the efficiency is to use a motor to drive the dynamo under normal no-load conditions for the latter, and to measure the electrical power required to drive the motor. The driving motor is then disconnected from the dynamo and the power required to drive the motor is ascertained when it is operating under the same running conditions as before. The difference between the two values represents the stray-power loss of the dynamo.

A method of testing two similar machines at one time under full-load running conditions with the use of but a fraction of the full-load power of either machine is shown in Fig. 2. Here *M* and *G* are the machines to be tested, and are preferably rigidly connected. *D* is an additional dynamo used to supply the total losses of both machines. Machine *M* is used as a motor to drive machine *G* as a dynamo, and as the two are electrically connected, when full-load conditions are obtained, the dynamo *D* has to supply to the mains merely the total losses of the two machines. The conditions are substantially that of the dynamo *G* furnishing power to drive the motor *M*. The latter then drives the dynamo *G* through the mechanical connections shown. As there are electrical and mechanical losses, these are supplied by dynamo *D*.

An ammeter is used in the lines between the machines and the terminal voltages of the machines is obtained by means of the instruments shown. The field magnets are separately excited for normal full-load conditions. The current supplied by the dynamo *D* is measured also. There are several modifications of the method outlined above, whereby a less number of measuring instruments are required and wherein the losses only are measured. Fig. 3 shows such a modification.

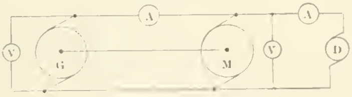


FIG. 2.—TESTING MACHINES UNDER FULL-LOAD CONDITIONS.

The stray-power method is of value in obtaining efficiencies, but does not give full-load running conditions or show up faults, such as sparking or overheating, which might develop under full load. For a long heat run, large amounts of power are required, and this is expensive. The method shown here is adapted for two similar machines mechanically connected, one being used as a dynamo and the other as a motor. The losses only, or a very small part of the total energy, is supplied from the mains or from an additional machine. The field magnets are separately excited in any suitable manner from a source of supply. A voltmeter is used to ascertain the voltage at the motor terminals, and an ammeter is placed in the leads between the two machines, and another ammeter is placed in the supply leads in order that the current used in supplying the losses may be found. The field magnets are separately excited for normal full-load conditions for each machine, and the motor is adjusted for normal speed and voltage. If I_1, I_2, and I_3 represent the current in dynamo *D*, motor *M* and the supply mains, respectively; V_1 and V_2 the voltage at the dynamo and motor terminals, respectively; R_1 and R_2 the resistance of the armatures of the dynamo and motor when warm, and L_1 and L_2 the stray power loss of the dynamo and motor, then $I_2 = (I_1 + I_3)$. The electrical input to the motor is $V_2 I_2 = (V_2 I_1 + V_2 I_3) = V_2 (I_1 + I_3)$. The dynamo output is equal to $V_1 I_1$. The motor output is equal to the input at full load minus the losses, and the dynamo input, neglecting for the present the transmission losses, is equal to the motor output. The dynamo output is, therefore, equal to the input minus the losses. Now, the total losses are equal to $(V_2 I_2 - V_1 I_1)$ and as $V_1 = V_2$ the losses equal $V_2 (I_2 - I_1)$ or $V_2 I_3$. The watts supplied to the motor are equal to $V_2 I_2$, and the watts output from the dynamo are $V_1 I_1$ so that the combined efficiency is equal to $V_1 I_1 \div V_2 I_2$, and since $V_1 = V_2$, the efficiency in per cent may be expressed as $I_1 \div I_2$. If similar machines are used, the efficiencies are substantially the same. The efficiency of either machine is equal to the square root of the efficiency of both.

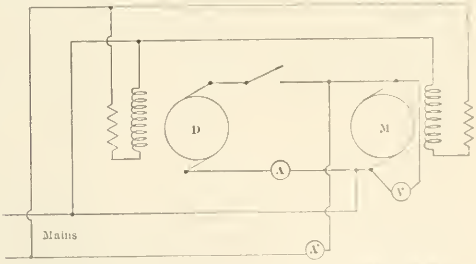


FIG. 3.—TESTING MACHINES UNDER FULL-LOAD CONDITIONS

It is, of course, understood that any great differences would be brought out by the measurements made at first. It is also well to reverse the arrangement and use the motor first as a dynamo in order to note any extreme variation. This method necessitates the use of an ammeter in the leads between the motor and dynamo, which, in the case of large machines, involves heavy currents, the measurements being at full-load values. Sometimes the above method is used simply to test a machine under full-load running conditions for a time sufficient to ascertain the maximum temperature of the parts and for noting any tendency to sparking or other possible defects, the efficiency having been previously obtained by the stray-power method. In such a case, the full-load current would not have to be used, and some appropriate form of current measuring device might answer. The machine used as a dynamo need not be similar to the one to be tested, but merely large enough to supply the amount of current required.

Since the losses in the motor and dynamo consist only of the I_2R armature losses and the stray power losses in each case, the armature resistances may be readily measured and thus the I^2R losses calculated and subtracted from the total losses. The total stray power losses will equal the product of the voltage at the motor terminals times the current in the supply leads (representing the losses) minus the sum of both I^2R losses of the machines. Having the stray power losses, the efficiency may be readily calculated as before.

To make a complete test, the efficiency may be obtained by the stray power method, and then with a pair of machines a heat run made at full load, when the machine may be observed for sparking or overheating. A machine of larger rating may be used with the machine to be tested, and if a heat run with full-load current only is desired, the voltage of the machine used as a dynamo need not necessarily be the same as the voltage of the machine to be tested. If a number of tests are to be made using the same machine as a dynamo each time, it may be advisable to test the machine for stray power losses at a number of different speeds and voltages, the values being kept for reference when testing other machines as motors.

An adjustable resistance should be inserted in the field circuits of each machine, and the one used as a motor should have a starting resistance in the armature circuit for use in starting. A switch should also be provided in the leads between the dynamo and motor. In starting, the motor should have its field magnets fully excited and the switch between it and the dynamo should be open, the motor being supplied at no load from the small additional dynamo or the supply mains, as the case may be. When the dynamo voltage and the line voltages are alike, the switch in the lead may be closed. The dynamo current and motor speed may then be adjusted and regulated by varying the field strengths of the dynamo and motor. It is of course understood that these adjustments shall be made slowly, since any sudden change may disturb the balance of the system and cause heavy currents to be drawn from the supply circuit.

Solving Some Power-House Problems.

By Geo. W. Martin.

As in every other line of work, the things that go to make up the daily routine of a power-house are not altogether the great problems, but rather the small details which occupy a considerable part of an engineer's time. One of the questions which are always of interest in a plant that is run condensing, is how to remove the oil from the condensed steam if it is desired to return the latter to the boiler. Some engineers shun an oil separator as they would the smallpox, and are content to allow the condensed steam to go to waste rather than run what to them is the risk of the oil getting into the boilers and causing considerable damage.

On the other hand, the experience of others has been that oil may be removed from condensed steam in an entirely satisfactory manner, and one quite often reads letters in the technical press from engineers who themselves have constructed oil separators which served the purpose in every respect. It is with some of these "home-made" devices that a part of this article will concern itself.

One arrangement which the writer has met with consists of two oil barrels joined together with a nipple at the bottom of the sides, as shown in Fig. 1, in this case the pipe being 4-in. To one side of the second barrel, as shown, a "goose neck" is fixed. Both barrels are two-thirds full of straw. The action of this oil separator is as follows: The water from the condenser empties into the first barrel, both barrels filling up to the level of the top of the goose neck. The oil will, of course, rise to the top of the water, but the straw is used as an additional safeguard to catch the oil and prevent it flowing with the water from one barrel to the other, and out of the goose neck.

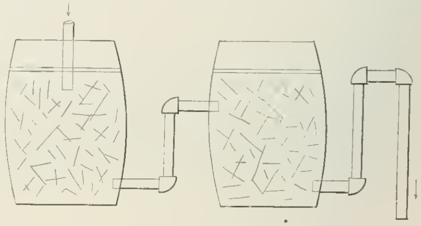


FIG. 1.—OIL SEPARATOR.

The object of the goose neck, as will be seen, is to keep the oil up as far as possible from the outlets of both barrels. As the oil accumulates it is skimmed off the top of the water. The straw may be renewed every month, or as often as experience proves it necessary. Adding another barrel, with the goose neck on the third barrel, will, of course, make a longer path for the oil to travel, and also give it another place to rise to the surface of the water. This may be necessary in certain-sized plants, but the two barrels will be found to be ample to take care of the water from a 1,000,000-gal. Worthington pump.

Should additional barrels be used, the arrangement would closely resemble another design of oil separator which has proved itself reliable. This is shown in Fig. 2, and consists of a tank divided into a number of compartments, one being connected to another by a goose neck. Here, as in Fig. 1, the water rises in each compartment to the level of the goose neck, the oil rising to the top and being either drained or skimmed off. The effect of the several compartments is to give the oil a greater chance to rise through the water to the level in each compartment.

Another design, which employs the same principle involved in Figs. 1 and 2, is shown in Fig. 3. A tank is divided into three compartments, the partition between the first two ending a short distance—3 in. or so—above the bottom, thus connecting the two compartments. The third compartment is connected with the second by a goose neck, as shown. The water enters the first compartment, the oil rising to the level of the goose neck, and the water in the second compartment also floats whatever oil may have come over from the first compartment. The upward turn of the goose neck at the bottom is to prevent any of the water from the first compartment flowing directly into the goose neck. In all the separators described, one of the chief points to be considered in their con-

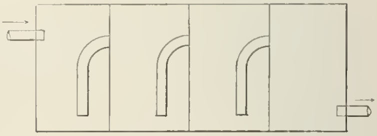


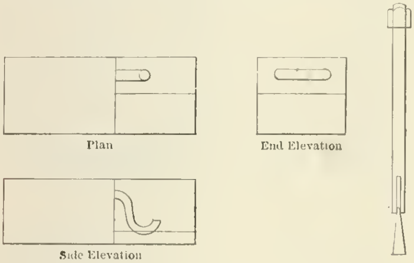
FIG. 2.—ARRANGEMENT OF OIL SEPARATOR.

struction is to prevent a direct flow of water from one compartment into another. The path of the water must be as broken and indirect as possible to give the oil ample opportunity to separate from the water.

Another matter of interest to an engineer is how to prevent water-hammer in a pump. More than one experienced man has had reason to remember the time and energy spent in trying to stop this trouble, yet the remedy is a very simple one. The difficulty is overcome merely by placing a pet-cock in the suction of the pump, leaving it open enough to admit a sufficient amount of air to cushion the strokes of the piston. If the size of the suction is below 8 in., a ⅛-in. cock may be found large enough. For larger sizes a ¼-in. cock may be necessary. In some cases a ⅛-in. pet-cock wide open has quieted a pump which before defied all efforts to remedy the trouble.

Still another "kink" is the use of wire screening, commonly known as "mosquito wire," to reinforce gaskets and prevent their blowing out of flanged steam joints. The screen is for use with any of the several varieties of packing similar to "Rainbow," and is placed in the joint on both sides of the gasket, holes being cut in it similar to those in the gasket. When the bolts are tightened up, the screen is pressed into the packing and serves to hold it together. With this arrangement the blowing out of a gasket is practically impossible with any of the pressures in common use.

A "home-made" expansion bolt is another item which has served its purpose well. It consists merely of a piece of round steel of the desired diameter and length, threaded at one end, a slit being cut in the other end for a distance of about 2 in. A wedge is also provided, made of machine steel, about the same length as the slit in the bolt, the wide end being about ½ in., or just enough to spread the end of the bolt to make it hold.



FIGS. 3 AND 4.—OIL SEPARATOR AND EXPANSION BOLT.

To set the bolt, it is placed in the hole in the wall, foundation or other masonry, the wedge being first driven in just enough to hold it, and a piece of lead is placed on the top of the bolt to receive the blows of a hammer. The bolt is then driven down, the wedge being forced into the slit, thus spreading the bottom apart and binding the bolt in the hole. This kind of expansion bolt could not, of course, be used above ⅝ or ½ in. in diameter, or in cases when the shock of driving it would injure the foundation or wall.

Regulation of the Draft of Steam-Boiler Furnaces.

By W. H. Wakeman.

THE term draft as applied to steam-boiler practice means the difference between the weight of the column of hot gases inside the chimney and the weight of a column of air of the same size outside of the chimney. As the density of air and other gases varies with their absolute temperature, it is practicable to determine by calculation the difference in weight, or, in other words, the force of the draft in inches of water, and compare it with the readings of a draft gage.

The difference in weight may be determined by the following formula:

$$H \times (D - d) = P$$

in which H = height of the chimney in feet; D = density of the outside air; d = density of the hot gases, and P = pounds per cubic foot.

When the value of P is multiplied by 0.192 the product is the force of the draft in inches of water.

The value of D is determined by the following formula:

$$(493 \times .0807) \div A = D$$

in which A = the absolute temperature of the external air, or the temperature Fahrenheit + 461.

The value of d is determined by the following formula:

$$(493 \times .084) \div G = d$$

in which G = the absolute temperature of the hot air or gases.

As an illustration, take the case of a chimney 100 ft. high in which the gases are at a temperature of 440 deg., while the temperature of the external air is 70 deg. Fahr.

$$100 \times \left(\frac{493}{531} \times .0807\right) - \left(\frac{493}{901} \times .084\right) \times .192 = 0.556 \text{ in. o}$$

water. (See Fig. 1.)

A simple but correct draft gage can be made by heating a glass tube at the center and bending it into the form of the letter U. Fill it about one-half full of water and connect one side of it with the chimney flue, leaving the other side open to the atmosphere. It is not possible to read such a gage to thousandths, or even hundredths of an inch, but if it is applied to a chimney that is operated under conditions mentioned for the formula, it should show a full ½ in. Failure to do so may be caused by cooling of the gases as they ascend, therefore while the temperature is 440 deg. where the pyrometer is inserted, or 901 absolute, it may be much less near the top of the chimney, which would make the gases heavier and the draft is reduced accordingly.

In this example the chimney is assumed to be 100 ft. high, and as the draft varies directly as the height of the chimney, it may easily be calculated for any other height where the temperatures are the same. For illustration, suppose that the draft of a chimney 80 ft. high is required. For a chimney 100 ft. high the draft is 0.556 and for a chimney 80 ft. high it is $.556 \times .8 = 0.444$ in. of water. A chimney 135 ft. high would have a draft of $.556 \times 1.35 = 0.75$ in. of water. Analysis of rules and formulas for determining the force of chimney draft show that much depends on the temperature of the ascending gases, but it is not safe to carry this too far because what may be termed the limit of buoyancy is reached at about 600 deg. Fahr. For this reason it is a good idea to treat all temperatures above this point as if they were 600 deg., as the density of gases at higher temperatures decreases more than their velocity increases when moving through a chimney. Practically the same amount of air is forced through a furnace when the chimney gases escape at 600 deg. that when the chimney gases escape at a temperature of 800 deg. or more, so that this excess temperature represents a loss of heat.

When a draft measurement is taken at the base of a chimney the result is the "gross draft," because it is the highest that can be secured with that chimney. If the measurement is taken at the ash pit of a boiler furnace the result is the "net draft," because it is the draft actually available for the combustion of fuel. (See Fig. 2.) The difference between these two measurements is caused by friction of the air and hot gases as they are forced through the grates. Friction is also caused by the coal used, and it increases as the size of the coal decreases. The condition of the fire also affects the draft, as it is evident that air will pass through a clean fire more rapidly than it will through one containing a layer of ashes and clinkers several inches thick. Sharp turns in the combustion chamber and breeching of a boiler, also in the smoke pipe, add to the friction, and in some cases a large per cent of the total draft is used in this way. Where several boilers are connected to one chimney, the net draft of each may vary, and the variations may not always be the same.

Difference in the draft of chimneys indicates a difference in the rate at which coal can be burned in the furnaces connected to these chimneys. Although the difference in draft varies directly with the height of the chimney, the rate of combustion which can be secured per square foot of grate surface per hour is equal to twice the square root of the height of the chimney minus one, according to Prof. Thurston's formula:

$$2\sqrt{H} - I = R$$

in which H = height of chimney in feet, and R = pounds of coal per hour per square foot of grate surface; so that with a chimney 50 ft. high 13 lb. of coal could be burned per square foot of grate and 19 lb. per square foot of grate could be burned with a chimney 100 ft. high. It is not difficult to find cases where more than 19 lb. of coal is burned per square foot of grate with a chimney 100 ft. high, while in others it is impossible to secure this rate, and in still others the rate of combustion can be secured for a short time, but it cannot be maintained. These differences do not prove the formula useless, as it forms a basis for results that can be secured under good conditions, and where the conditions are not good, due allowance must be made.

Prof. Kent gives the following formula for the horse-power of a chimney, or in other words, the horse-power of boilers for which it will give sufficient draft:

$$\text{Horse-power} = 3.33 \times E \times \sqrt{H}$$

in which E = effective area of the chimney in square feet, and H = height of the chimney in feet.

In order to cover all emergencies an allowance of 5 lb. of coal per horse-power per hour should be made. The effective area is nearly the same for square as for round chimneys, as the corners of a square chimney are not very effective, therefore if a chimney is 4 ft. sq. it should be taken as if it were round and 4 ft. in diameter. The formula is based on the assumption that the rate of combustion varies directly with the square root of the height of the chimney. When these formulas are used it is assumed that the size of the grate is properly proportioned for the area of the chimney. Firemen sometimes regulate the draft for their furnaces by the ash-pit doors, as illustrated in Fig. 3. These doors are shown closed, but the full draft power of the chimney is still in operation, hence cool air is drawn in through every crack and crevice, as indicated by the arrows. Of course, some settings provide more places for air to enter than others, but it is not practicable even with the best settings to prevent air leakage, hence there is always some loss on this account. The steam pressure ceases to rise, although the coal continues to burn slowly, because the heat thus produced is diluted with cold air and a direct loss is the result.

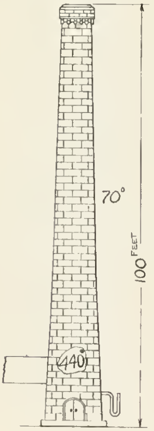


FIG. 1.—MEASURING DRAFT IN CHIMNEY.

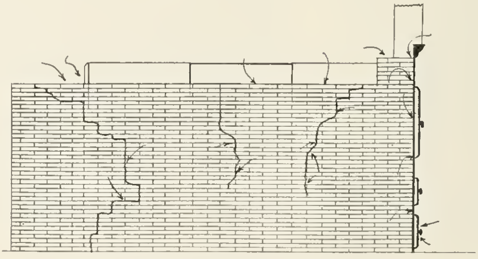


FIG. 3.—LEAKY BOILER SETTING.

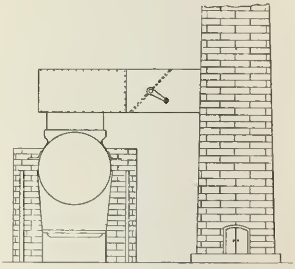


FIG. 4.—DAMPER IN FLUE.

On the other hand, when the damper is closed, as shown in Fig. 4, the force of the chimney draft is shut off, because there is only space enough around the damper to allow smoke to escape to the chimney. Boiler makers frequently make dampers such loose fits that combustion continues after the damper is shut as tight as it can be, hence the steam pressure continues to rise until the safety valve opens, thus allowing much valuable heat to be wasted. This refers to times when but little steam is used, and the only thing that the fireman can do is to close the ash-pit doors until an opportunity is found to close some of the open space around the damper, either by riveting on strips of sheet iron or by making a new damper.

Another plan which is often adopted by careless firemen is to simply open the furnace door when they desire to check the formation of steam. The coal continues to burn, but the large volume of cold air which is thus drawn in cools the furnace. This practice cannot be too strongly condemned.

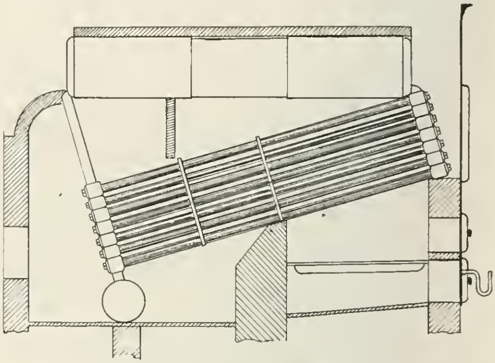


FIG. 2.—MEASURING DRAFT AT ASH PIT.

In the first plant in which the writer was employed as engineer, the damper was operated solely by hand, as an automatic appliance for this purpose was a luxury far beyond his ideas at that time. The engine was heavily loaded, making it necessary to carry as high a pressure as the inspector allowed, hence if the steam gage was not closely watched and the damper promptly shut, the safety valve opened and wasted steam at a rapid rate. The damper was then quickly closed, also the ash-pit door, in order to save heat, and when the pressure was lowered enough to let the safety valve close, they were opened and the performance was repeated.

Under such conditions it is plain that a good automatic damper regulator properly installed will save enough fuel to pay for itself in a few months; nevertheless, it is not safe to claim that even a superior regulator will save a given per cent of the steam used, without knowing the extent to which steam is wasted under present conditions, for it is possible to regulate a damper so closely by hand that it is not practicable to show a very great improvement by any other method. Such a plan calls for very close attention, hence the time thus spent will soon cost enough to pay for a good regulator that will last for many years and always be on guard. Automatic damper regulators will form the subject of a subsequent article.

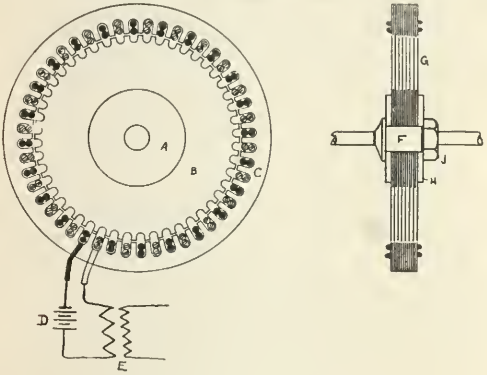
LETTERS ON PRACTICAL SUBJECTS

HIGH-FREQUENCY ALTERNATOR.

It has frequently been stated that a generator giving a frequency of 100,000 cycles or more would be a great aid in syntonic wireless telegraphy. The following is a description of a machine designed to be safely run to generate 240,000 cycles, and which could be made for large power requirements at relatively small cost.

The stator C is made of a very thin laminated iron wound with a single wire going down where marked black and coming up where cross-hatched. If for any particular case this does not give great enough flux, the winding could be arranged so as to form poles embracing several instead of only one tooth; but this, while giving greater flux, would also give greater self-induction, which would be objectionable. Low flux also means low hysteresis.

The rotor, AB, is made up of thin laminated iron, every other plate being small like A. If when the plates are mounted on the shaft, they are moistened with a sal ammoniac water, a slight coating of rust will be formed, and this when clamped by nut J and washers H will produce a structure capable of running at very high speeds. The idea of employing friction as a means of reinforcing the plates at the center seems ridiculous at first thought, but if the sheets are .002-in. thick or less, and the radius of the plate A is 2 in., and coefficient of friction 1/10, a pressure produced by the nut of only 500 lb. per square inch of A will make it easier to pull B apart than to pull it out from between the plates A.



HIGH-FREQUENCY ALTERNATOR.

A storage battery D produces the exciting current, which flows in the same wire as the alternating current induced. When the teeth of B match those of C, the direct current flowing in the wire will produce a magnetic flux. When the teeth are pulled away, the diminishing flux will increase this current; when they approach the increasing flux will diminish this current. These variations will set up in the secondary of the transformer E an alternating current which, by properly proportioning the windings of E, can be given any desired voltage.

The absence of wire on the rotor, the high tensile strength of thin plates (which only need be annealed in the teeth and a short distance inside them), and the reinforcement provided by the plates A, make it safe to run the machine at something like 1000 ft. per second surface speed, giving a stress of somewhere between 20,000 and 30,000 lb. per square inch. If the slots are the width of an ordinary hack-saw cut or 1/32 in., 20 slots per inch can be used and wound with No. 24 wire. The frequency would then be 1000 ft. × 12 in. × 20 = 240,000 cycles per second.

It would, of course, require very careful workmanship and close clearance, say 1/100 in., and it would be wise no doubt to enclose the machine in a stout steel case, but there is no insurmountable difficulty involved in the design.

East Pittsburg, Pa. A. T. Kasley.

PECULIAR BEHAVIOR OF COMPOUND-WOUND MOTOR.

A communication in the March issue regarding the wiring of a compound-wound motor calls to mind a peculiar occurrence which came under the writer's notice two years ago. A 220-volt, 50-hp compound-wound motor was used to drive a haulage cable for shifting cars. The motor was differentially compounded to maintain an even speed at all loads. As the writer passed near the house containing the motor, the operator ran out and said the motor was acting badly and would run backward once in a while. As the man was excited and not well informed, I said nothing, but guessed he was wrong in one sense at least. If the breaker flew out the counterweights (six tons) would overhaul the motor eight or ten turns, but he maintained it did not throw the breaker until after reversing. There was considerable solder thrown out and the brush holders were pitted and spattered with melted brass. The motor ran all right for a short time, and then the ammeter showed some overload, and the motor slowed down a little and then with a roar started backward, throwing fire and solder. I knocked out the circuit-breaker, or reached for it, rather, as it flew out. I had to think out a cause for the occurrence and found the following to be the only reasons I could give:

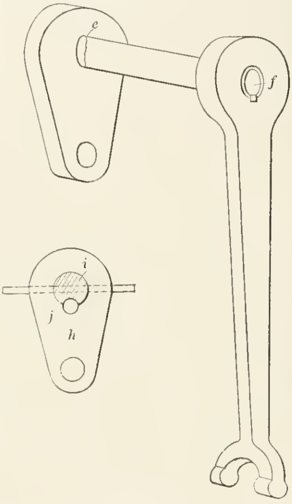
The heavy load caused a strong armature current, which displaced the line of commutation somewhat and weakened the shunt field enough to nullify it. The heavy current in the series coils helped the armature and killed the effect of the shunt field, and finally changed the polarity of the poles, and then reversed the direction of rotation of the armature. The sparking was caused by the heavy current and also by the line of communication being shifted away from the brushes. When this motor was installed there was trouble of a peculiar nature. The wires from the pole line entered the house at the eaves and passed down inside to the switchboard. From the starting-box the wires passed through and under the floor, and through the foundation to the motor base. The motor not being intended to reverse, had three wires run to it, the positive lead to armature wire at the terminal block, the negative to the series-field coils. A small wire, also positive, went to $(+F)$ the shunt-field coils. The leads marked A-2 and S-1 were jumpered together, and the negative shunt-field wire was tapped onto the negative series coils. This gave a straight job of wiring and no chance for mistakes; besides a print came with the machine. But the men in the dark under the floor crossed the heavy wires and did not see it, and when the wires were shoved up through the foundation they said their positions were the same as those of the wires which went through the floor at the board. The south wire was positive, the middle negative, and the north wire was the shunt wire. In the hurry of getting the machine started, no tests were made with the voltmeter, as everyone was sure the wires were right. The motor started all right and certainly tried to do its best. It ran at a speed of 1800 r.p.m. instead of 1000 before anyone got near the circuit-breaker. It also ran in a reverse direction to that intended. Six or seven men looked at the motor at once and found nothing the matter. Later on a test for voltage and polarity was made, and we found that the wires were crossed and this threw the shunt-field connections on the same side of the armature and short-circuited it. All voltage it got was dropped over resistance grids. Being differentially compounded, the motor ran reversed as a series machine, and these fields were small and weak (just a slight governing effect was all that was wanted). When the motor leads were straightened out and the connections tested and known to be correct, the motor started at regular speed and in the right direction, and gave no trouble until it began to run backward occasionally as described in the first part of this letter

Conneaut, Ohio. Chas. M. Green

DOUBTFUL PUMP REPAIRS.

Your correspondent was recently inside an electric-light station just as the valve-moving lever broke on a duplex feed pump supplying water to a steam boiler. The broken part looked something like the illustration below, the break occurring at *e*, the piece *h* coming loose. Inspection revealed the fact that the arms and shaft were nothing but cast-iron, and the wonder was it did the work so long without breaking.

Repairs had to be made in a hurry, and the engineer proceeded to belie his claim to that title. Never for a minute did he stop to consider the strain likely to be placed upon the lever and shaft when the pump was working, nor did he think what the parts would have to do should the pump commence short-stroking. Instead, the broken parts were rushed to the nearest repair shop and instructions given to drill a hole entirely through shaft and all, as shown at *f*, and to put a ½-in. bolt through the whole, the shaft itself being only ⅞ in. in diameter.



PUMP REPAIRS.

The result can be imagined, and three strokes of the pump sufficed to cripple the outfit again. Then the part was started town-ward again, and the shaft, which was solid with the crank *h*, was drilled out and a new steel shaft put in place. as shown in the detail sketch, at *i*. To hold the new shaft a pin *g* was put through the crank and shaft, and the levers put in place in the pump again. Near midnight the crank and shaft developed the characteristics of a wire cutter, and the engineer was kept mighty busy the rest of the night, putting new pins in the pump rock-shaft. The trouble was finally overcome by putting in a pin, as shown at *j*. The experience of the engineer should serve as an incentive for engineers to do a little thinking for themselves, thereby saving much useless work.

Scranton, Pa. John Scott.

DRYING OUT ARMATURES AND FIELD COILS.

Among the many points necessary for the proper care and maintenance of electrical machinery, the matter of freedom from grounds and proper insulation resistance is an important one. Sometimes parts of a machine, in shipment, such as the armature or fields, become wet and, of course, must be dried before installing or operating, or a large dynamo or motor may accidentally be wet while in position. Now the ordinary installation or power station is not provided with a drying oven, so other means must be found.

Such moist condition would ordinarily be discovered by inspection or after a test of insulation resistance or for grounds. Suppose first that the machine is installed, and tests show simply a lowering of the insulation resistance and the presence of moisture. If the field coils are damp such coils should be connected to the supply mains, and a current at a greatly reduced voltage sent through them, such current being gradually increased and the coil dried until the moisture is completely driven out.

If necessary some sort of a drying oven may be improvised for the coils, care being taken not to have the temperature too high. With a damp armature, and especially for a good-sized machine, the method of sending a current of electricity through it is usually more practicable.

Usually the best way is to operate the machine as a motor, sending heavy currents through the armature, but at a voltage at first very much less than the normal voltage. Such voltage could be readily obtained by placing a temporary resistance in series with the armature circuit, or using some low-voltage mains or machines, if such are available. Such current should be kept on until the armature is throughly dried, preferably for several hours. The armature temperature should not be allowed to become very greatly in excess of the full-load temperature after a run of several hours.

If the armature is not in place in the machine, some sort of a clamping device may be improvised for holding brushes in contact with the commutator. The armature resistance is, of course, very low, and connection might be made in series to a circuit carrying a current equal to the full-load current. In such case great care should be taken to have a good, substantial contact surface. There should preferably be a resistance shunted round it at the start, and the armature current gradually increased by increasing the shunt resistance. Any possibility of burning the commutator is thus prevented due to insufficient contact by suddenly throwing on the full current.

Various modifications will, of course, readily suggest themselves for open-coil armature and alternators, a lower voltage than normal being used at first and the full-load current not being greatly exceeded in any case.

The great difference in the case of the voltage applied to the armature when in place with the fields excited, and of the voltage when the armature is not in the machine, is due to the counter e.m.f. set up in a rotating armature, which so greatly reduces the current flowing; consequently, with the armature not in place, it should be treated as a very low resistance and should not, of course be attached directly to the mains ordinarily used for the machine without some considerable resistance, as a water rheostat, in series.

A convenient form of water rheostat can be easily made out of a heavy cask or barrel, a pair of iron plates suspended therein, and wires attached to the same, the barrel containing water in which salt or soda has been dissolved. Preferably at first clear water should be used and the salt gradually added until the resistance is approximately correct. Or a heavy iron plate could be placed in the bottom, with a wire attached, and another plate suspended near the top of the liquid, which may be raised or lowered, thus varying the resistance.

Brooklyn, N. Y. James L. Longworth.

WIRING OF BURGLAR CIRCUITS.

I note in last month's issue a description by Mr. George H. Jones of a scheme for wiring lamps for emergency use so that these may be lighted from the owner's chamber. It would appear from the description that this was an entirely new scheme. Such, however, is not the case. Schemes of this kind have been in use for a number of years, and a very simple diagram of connections is shown in the Standard Handbook for Electrical Engineers. In that book a burglar circuit is described as an arrangement whereby a number of lamps throughout a house may be lighted by a switch, usually placed in the owner's chamber, irrespective of other switch control, except, of course, any switch at a lamp socket. The circuit is installed by means of three-way switches with one terminal connected to the lamps, one other point to the main and the other point to an extra wire running to the special switch. All three-way switches must be cut in on the same main.

Philadelphia, Pa. Frederic Kendron.

PECULIAR ELECTRICAL PHENOMENON.

In the March number Mr. Frank W. Merrill described a peculiar electrical phenomenon observed by him and asked for a theory to account for the peculiar occurrence. I should judge that the trouble is due to a ground which occurs on opposite sides of a live electrical system and is equivalent to a short circuit. It would appear that two or three of the incandescent lamp circuits were grounded on one side and that the arc lamp circuit was grounded on the frame of the first lamp or somewhere in the lead connected to the bus having a polarity opposite to that of the grounded lead on the incandescent lamp circuit. When both switches were closed the circuit was from one bus to one blade of the main switch, through the grounds on the several incandescent lamp circuits to the grounded lamp or arc lead to one side of the arc lamp switch to the opposite bus. This would account for the fuses blowing on one side of each of the grounded incandescent lamp circuits and of the arc lamp switch and main switch. If the other fuses were blown and the switches burned, it could be accounted for by the arc being formed across the switches by the burning off of the lead or by the blowing of the fuses; the blowing of the fuses not being sufficient to open the circuit carrying the excessive load due to the short circuit. After the leads to the arc lamp circuit were reversed, the ground was thrown on the side of the circuit which was connected to the same bus to which the grounded side of the incandescent lamp circuit was connected, so that the short circuit was cleared. The arc lamp should be equipped with resistance coils for use upon constant-potential circuits and the resistance of the arc lamp circuit would be high enough to prohibit such an excessive amount of current to flow as to cause the damage detailed.

Georgetown, Wash. A. B. Case.

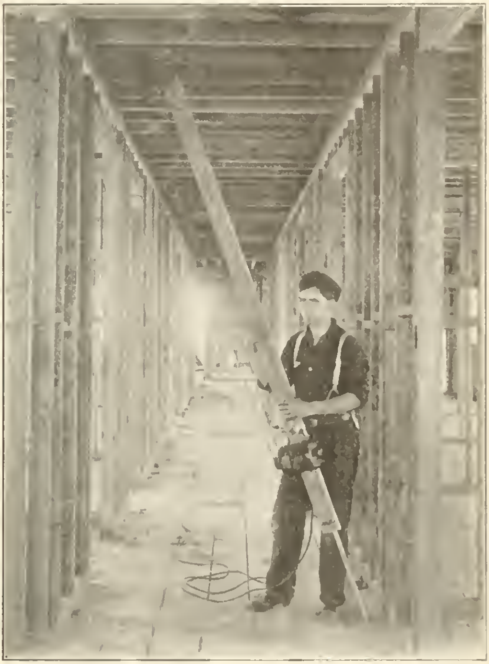
Referring to Mr. Merrill's experience with the 550-volt lighting system, it appears to me that his trouble was due to defective wiring. This would be also indicated by the trouble disappearing when he reversed the arc lamp leads, which was undoubtedly done at the switchboard. I know of no lamp that will refuse to pick up if the current is sent in the wrong direction. The system is probably a railroad system, and there must have been a contact between the arc lamp and incandescent lamp circuits of opposite polarity; and when the arc lamp switch was closed, it probably arced at the contact or contacts, and might have arced to some grounded conductor, and made the main switch carry more current than the arc lamp switch. The main switch probably was twisted out of shape and made poor contact at the blades and at the lead that fused so that the excessive current melted the switch at those points. Reversing the arc lamp leads would throw the contacts together at the same polarity.

The above reminds me of a case in the early days of lighting, where an iron ship was wired in port, but the wiring could not be tested before the ship left port. The electrician tested the circuits as the vessel left port, but almost every fuse blew, so he immediately tested out and connected all the grounded sides together, where only one side of the circuit was grounded, and operated the circuits that way until he could clear the balance of the system. This was in the days when real wiremen were few and far between, and anyone that knew the difference between an insulated and bare wire was an "electrician."

Reno, Nev. F. O. Broili.

HOME-MADE MOTOR-DRIVEN BORING TOOL.

The accompanying illustration shows a home-made boring tool which the writer got up for boring holes in joists for a knob-and-tube wiring job. The device was a success in every respect and paid for itself on this one job. The building to be wired is a three-story structure, 65 ft. x 140 ft., with floor joists spaced 16 in. centers. The system of wiring called for 300 lamps and 110 outlets. A rough estimate showed that the boring of joists necessary to install the wiring was equivalent to boring through 550 ft. of solid timber. To bore the necessary number of holes by hand would be a herculean task even with the improved forms of boring tools, and the time required would also have been great. With the tool shown, the task of boring the holes was finished in 12 hours. In making the device, part of an Anthony boring tool was used, together with a 7-in. V-grooved wooden pulley, a piece of ½-in. gas pipe, two buggy axle clamps, a piece of sash cord for a belt, a board ¼ in. x 4 in x 8 ft. and a 1/6-hp motor. The machine can be adjusted for any height of ceiling between the limits of 8 ft. and 16 ft. It is easily handled, and the motor, which is the heaviest part of the mechanism, is placed on the board about 7 ft. from the ceiling so that ordinarily it will be at about the level of one's waist. The combination is original with the writer, who feels that it may be of use to those who, having similar work to perform, desire to get up a labor-saving device somewhat similar to it. No doubt it can be improved upon, but as a first attempt it certainly was a success. It is operated like the ordinary boring tools with which all wiremen are familiar, the motor doing the work instead.



HOME-MADE MOTOR-DRIVEN BORING TOOL

Hillsboro, Tex. E. D. Kelly

SHUTDOWN CAUSED BY IMPROPER USE OF VALVE AND BY FAULTY PIPING.

A provoking little accident happened through the action of an engineer who made a practice of running engines with the throttle partially open. For some time there had been a rattling and a clicking sound in the throttle valve, and the engineer was intending to take down the valve and investigate matters, but he was prevented from doing so as the valve suddenly refused to be closed, and it was necessary to shut-down the engine by means of the governor in order to stop it at all. The piping was so connected that it was impossible to cut out the engine without closing down another engine, which could not well be spared. As soon as the other engine could be laid off, the balky throttle was investigated, and it was found to be completely out of business. It was a valve of the disk type and the attachment of the spindle to the disk was worn so badly that the disk had fallen from the stem and had become so jammed that the valve could not be closed. It was evident that the undue wear of the disk-spindle mechanism was due solely to the constant movement of the disk, caused in its partially opened condition by the pulsating movement of the steam supply. A little investigation revealed the cause for partially opened throttle valves. It seems that the engineer had previously run engines, upon two separate occasions, which were fitted with defective governing apparatus, and which would sometimes stick and allow the engine speed to run up 10 per cent to 15 per cent before the governor would act. Then, the governor would stick in its new position, allowing the speed to fall 10 per cent to 15 per cent again, before the governor could act and meet the new conditions. This allowed the speed to "see-saw" constantly, to the great detriment of the voltage regulation. Whenever the light commenced to flicker, the engineer would partially close the throttle until the governor lost control, when the "waving" of the light would stop. In this way, after an experience with two engines of similar character, the engineer got into the habit of running engines with the throttle closed down to the point where the governor took control of the engine. Had the governor mechanism been overhauled, as it should have been, at the time the light began to flicker the ruin of half a dozen throttle valves would not have resulted, several tons of coal would not have been needlessly burned to furnish throttled steam to several engines, and it would not have been necessary to shut down two engines for two days. The engineer should not be blamed for the closing down of the second engine, even though he was the primary cause of that action. The man who designed the piping was the man who was to blame for the second engine going out of commission while the valve was repaired, for no good engineer should so arrange two large engines that there is no way of cutting them out individually, except by the throttle valve. Every throttle is liable to get out of order, and to need overhauling at any time; therefore, there should have been another stop-valve in the steam pipe, besides the one at the boilers, by means of which the two engines were cut out while repairs were made to the valve. Two valves should be placed in each large steam pipe to engines.

New York City. James Francis.

THE OPERATION OF A SMALL ELECTRIC PLANT.

In the March issue I notice a contribution from Ralph B. Coleman with which I wish to take issue. He states that Mr. W. H. Wakeman's arrangement of wiring a compound-wound motor is wrong, and then submits a sketch in which the starting-box is drawn wrong. I never saw a starting-box with a no-voltage coil located at the end of the arc swept by the controller. Perhaps such boxes exist, but the main point is this: either he left out part of the wiring or else he taps his no-voltage coil off the last step of the resistance in box. This resistance, if passing field current, would have hardly any effect on the voltage applied to field coils, but with the heavy rush of current into the stationary armature the drop caused by the resistance is large and the shunt field becomes weakened and allows one of two conditions to occur. Either the armature speeds up on a weak field and subjects the machinery to mechanical strains, or else if the motor starts on load the box allows the armature to lag behind its calculated speed at each step and then passes an excess of current through the armature and increases the voltage drop due to the resistance and thus further weakens the shunt field. The series field will hardly be strong enough alone to keep the armature down to a safe speed when running light, or to give a speed high enough when the motor is loaded. If the motor had heavy series-field coils and just enough shunt coils for safety to hold the armature speed down when running light, the starting-box, as shown, would not cause any trouble, but even then it would not be correct. Regarding fuses, I know of enclosed fuse blocks where a 10- or a 35-amp. cartridge will both fit equally well. A still larger size will take fuses of 35 to 60 amperes.

Cincinnati, Ohio. Chas. G. Morrison.

STRAIGHTENING IRON POLES AND ARMATURE SHAFTS.

An electric light and power company operating in a rather large city found itself possessed of a large number of steel poles which had become bent by various fires, in collisions with heavy trucks and by the numberless accidents to which line material is continually being subjected. The curtailment of expenditures during the recent short-money period led the superintendent of construction to look at the pile of bent and twisted poles and he determined to see what could be done toward straightening them.

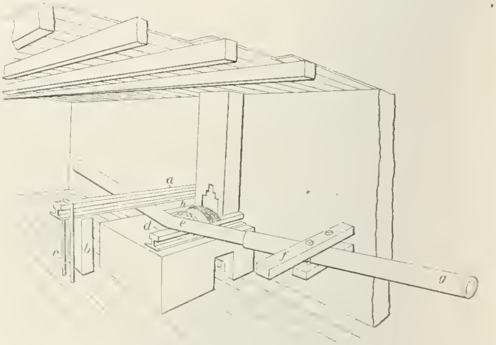


FIG. 1.—STRAIGHTENING IRON POLES.

After some consultation a forge was built in one of the storage sheds where there was plenty of room to handle 60-ft. poles. Wind for the blast was obtained from a blower.

The forge was built up of brick well laid in cement mortar to form a solid bearing for the piece of 110-lb. rail shown at *d*. This rail was loose, and could be shifted to any desired place on top of the forge, which was leveled off and made solid with a coating of rich cement mortar about 1-in. thick spread on top of the brick work. The railroad iron could stand hard usage without destroying the cement base upon which it stood.

Another piece of heavy rail *a* was placed as shown, about 10 in. clear above the cement top of the forge. This piece of rail was held very firmly in place, one end being built into the 17-in. brick wall, while the other end of the rail was supported upon a block *b* and fastened to a heavy "dead-man" by means of the U-bolt *c*. One smith and two helpers handled the poles easily.

The method of straightening the poles was as follows: A bent pole would be placed in the fire *h* and heat applied to the bent portion. The pole would then be pulled out of the fire and placed as shown by Fig. 1, the knee or elbow of the bend *e* resting on the rail *d*. A man at *g* would then pull down on the end of the pole, and if his weight did not prove sufficient, another man would take hold with him. A weight of 400 lb. to 500 lb. applied at *g* seldom failed to bend the pole as desired, but sometimes there were ugly double bends and twists which made it impossible to hold the pole in place to bend it where needed. When this happened, the planks *f* would be placed in position as shown and the bolts tightened. This kept the pole from twisting sidewise when the strain was applied.

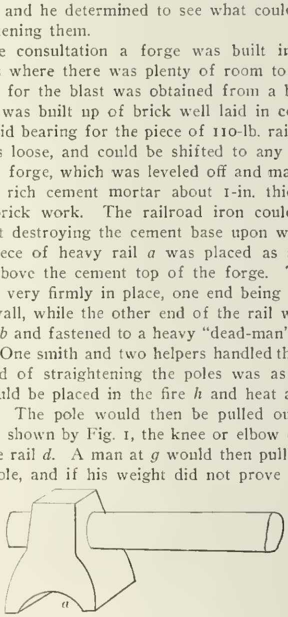


FIG. 2.—TOOL FOR STRAIGHTENING POLES.

When the bend happened to be close to the lower end of the pole, or what would be the lower end of the pole when the pole was erected, the pole was reversed, the large end going into the fire and the small end being used as a lever. Sometimes it was found almost impossible to take out the short kinks and bends which really did little harm except that they spoiled the neat appearance of the pole. A way was finally devised whereby the little, short bends could be taken out as easily as the large ones. For this purpose a tool was made, as shown by Fig. 2, the curve *a* being made a trifle larger than the biggest portion of the pole —just large enough, in fact, so that the corners of the tool would not leave marks on the pole when used under heavy sledge blows.

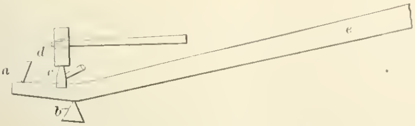


FIG. 3.—STRAIGHTENING BY PEENING.

To use this tool, the pole was placed as indicated in Fig. 3 with the concave portion on top, and directly over the bearing *b*. Strain was put upon the pole at *e*, and while one man was applying strain at *e*, the smith held the hollow-faced tool as shown at *c*, and the third man wielded the sledge, which had the effect of slightly peening or stretching the side of the pole where tool *c* was placed. With a comparatively light strain on the pole at *e*, several smart blows of the sledge at *c* would take out short kinks and make the pole straight. It was frequently necessary to turn the pole about 90 deg. and swage either side a little, so as to round up the cross-section again if it was flattened a little by the sledge blows.

The writer has frequently applied the same method for straighening shafts in machines, particularly armature shafts and motor shafts which had become bent or sprung through accident. A good, stout lathe may be used for straightening armature shafts, as indicated in Fig. 4, though it would be better to rig a special machine for this business if much straightening has to be done, as such work is a trifle too rough for a lathe.

Having located the point where the shaft is bent, mark the hollow of the bend with chalk, place the mark uppermost and pry directly under the shaft, opposite the mark, with a bar or some kind of lever. Have a small hand tool made something like that shown by Fig. 2, only smaller, and with a thickness not over one-quarter the diameter of the shaft, and while a strain is placed upon the armature shaft by means of the bar *b*, Fig. 4, strike the tool *d* several smart blows with the hammer *e*, rotate the shaft again and note the effect of the peening. A convenient way of obtaining a fulcrum is shown at *c*, where the back end of a tool is shown in the tool-post, but turned at right-angles to the usual position of the tool. A few pieces of steel, or two other tools, are placed under the fulcrum tool to make the lever bearing as solid as possible.

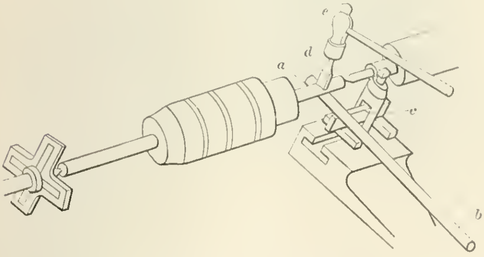


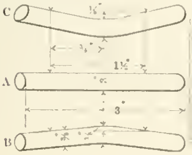
FIG. 4.—PEENING SMALL ARMATURE SHAFT.

This method of straightening shafts enables work to be done right close to an armature or other object which may be on the shaft, and it seems to the writer that the shaft is not as apt to bend again in the same place as when the straightening is done entirely by transverse force. The hammering seems to toughen the shaft where it would otherwise be weakened by the bending.

To determine how much the strength of the shaft or its resistance to bending is increased by bending and straightening, the writer made some tests expressly for use with this letter. A piece of ordinary ⅜-in. bar iron (soft steel) was procured and a piece about 3 in. long was cut off and put into the testing machine upon knife edges 1/16 in. wide and 1½ in. apart. The bending knife-edge was midway between the supporting knife edges and ¾ in. distant from either, as shown by Fig. 5.

Pressure was applied, and 1120 lb. was registered before the bar began to deflect noticeably. To bend the bar ⅛ in. required a pressure of 1400 lb., as shown at *1-a-B*. The bar was then removed from the testing machine and bore the appearance shown by *B*, Fig. 5, being bent ⅛ in., as stated. The bar was then replaced in the machine, but bottom side up, as shown at *C*, and pressure again applied. The bar did not begin to straighten until 1120 lb. was registered—the initial bending strain—and it required 1280 lb. to straighten the bar. The pressure was increased and the bar bent ⅛ in., in the opposite direction, which required 1440 lb. for its accomplishment, 40 lb. more than was required to first bend the bar ⅛ in.

The bar was again reversed, this time being placed in the machine as originally located. The bar commenced to straighten (*2-a-C*) at 1280 lb. as before, but required 40 lb. more to bend it the ⅛ in., although the bar straightened under the same pressure that was originally required to straighten it. In fact, the same pressure was required to straighten, in all cases, up to *3-b-A*, when 1300 lb. was required, after which the pressure the bar would stand when straight constantly decreased until rupture occurred.



	1		2		3		4		5	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	
		1120	1120	1100	1200	1200	1260	1040	560	C
	1120	1280	1280	1280	1280	1300	1260	1120	720	A
	1400	1440	1480	1520	1460	1400	1340	1280 Cracked	720 Broke	B

FIG. 5.—STRAIGHTENING RESISTANCE OF A SHAFT.

The strain necessary to bend the bar ⅛ in. increased in a very constant manner until the fourth bend, or two bendings and two straightenings, and another bending in an opposite direction to the first bend, when the pressure required to bend the bar ⅛ in. was 1520 lb. The increase in power necessary to make the second ⅛ in. bend was 28½ per cent; the increase for the third bend was 27 4/5 per cent, and for the fourth bend, 27 per cent of the power applied in making the preceding bend.

The curious thing about this test is that the power required to straighten the bar, also the strain which the bar would sustain without bending, increased after the power necessary to bend the bar ⅛ in. had fallen by 60-lb. jumps from 1520 lb. to 140 lb. The strain necessary to begin to straighten had increased to 1200 lb. (*3-C*), and the strain which the bar would carry, after it had been straightened, increased 15⅗ per cent to 1300 lb. The bar cracked at the eighth bend (*4-b-B*), and at the last straightening before this crack developed, it will be noted (*4-b-A*) that the bar carried exactly the same strain that it did in the first test (*1-a-A*).

From a study of the data given it is safe to assume that armature shafts will bear repeated bendings and straightenings without apparent loss of strength, until they finally crack during the straighening operation, and that cracks need not be looked for in the kind of material used in this test, at least, until seven or eight bends have been made, back and forth, in one direction or the other. In the case of street-railway motors, where bending is of frequent occurrence, due to a breaking of the gears or of the gear bolts, it would be very interesting to know to what extent the strength of the shaft is affected by the crystallization due to the constant hammering of the axle as the car bumps over rail-joints, mile after mile.

Willoughby, Ohio. James F. Hobart

QUESTIONS AND ANSWERS

Can a covering be placed over a tangential water wheel to deaden the noise made by surplus water? M. B.

A covering of felt can be used for this purpose; but the manufacturers of the waterwheel can better advise you.

In suburban districts, where the streets are covered with trees, at what height above the street are incandescent lamps usually placed? M. L. J.

The practice varies. From 12 ft. to 15 ft. should give satisfactory results.

What effect, if any, will result from the operation of 60-cycle motors, meters, etc., on a circuit fed from a 66-cycle generator? L. C. McL.

Standard 60-cycle motors will operate on 66-cycle circuits with a proportionate increase in speed. Watt-hour meters will register the same on 66-cycle circuits as on 60-cycle circuits.

What solution is used in rectifiers having electrodes of aluminum and iron when connected to a 110-volt alternating-current circuit? S. A. H.

There are various solutions used in aluminum rectifiers. A neutral solution of ammonium phosphate gives good results, or a fused electrolyte of sodium nitrate may be used.

What town or city was the first to be lighted by electricity in the United States? C. C. R.

Series street arc lamps were used in Cleveland, Ohio, in 1879 and shortly afterward a central station was operated in San Francisco for feeding open arc lamps. The first incandescent lamps were supplied with energy from an Edison station in Pearl Street, New York, in September, 1882.

Can I, by placing collector rings on an armature shaft in addition to the commutator of a 110-volt, direct-current motor, obtain a two-phase alternating current while the motor is in operation? R. S. H.

By using four collector rings and tapping the armature at points 90 electrical degrees apart the machine becomes a two-phase rotary converter. The frequency in cycles per second will be equal to the product of the number of poles times the speed in r.p.m. divided by 120.

In rotary converters, what effect would variation in the exciting current have on the behavior of the machine? T. P. V.

When driven from the direct-current side the machine will increase in speed with a decrease in the exciting current. The increase in speed, however, will not produce a corresponding increase in voltage on the alternating-current side, because it is not more than enough to make up for the decrease in the strength of the field in which the armature rotates. When driven from the alternating-current side no change of speed can follow from an alteration in the exciting current since the machine must continue to run synchronously at a speed depending only on the frequency of the supply.

We have a 10-hp, 125-volt, four-pole, series-wound motor which we desire to change for a shunt-wound machine, and would be obliged for information on how to do it. A. E. & M. Co.

Measure the current taken by the field coils when the motor is operating at the required speed and has the normal voltage impressed upon it. By counting the number of turns in the field coils and having measured the amperes, the ampere-turns are readily found by multiplying the value of one by that of the other. It will be necessary for the shunt-field coils to have the same number of ampere-turns, and by allowing 1200 circ. mils per ampere, the proper size of wire may be found from a wire table.

Fan and blower builders are now offering complete lines of motor-driven exhaust fans. The motors are usually of the round or universal types, and I note that both shunt and series-wound motors are offered for this service. Since motors with shunt and series windings have entirely different characteristics, it seems that one or the other must be best adapted for the work. Are there different classes of exhaust service for which one type of motor is preferable to the other? C. W. D.

Motors driving steel plate blowers are usually shunt wound and where the load is fairly constant shunt-wound motors are generally installed. In exhaust fans the motor is usually direct-connected to the fan so that if a series motor is used the load cannot be suddenly lost and the motor speed up. Where the conditions of load are unknown, a series-wound motor is installed because such a motor will slow down if overloaded and speed up if underloaded, the tendency being to carry only a load suited to it; so that troubles from overload are not so liable to damage a series-wound exhaust fan as a shunt-wound exhaust fan.

In making service connections to buildings, what is the proper position for the cut-out and switch? S. J. F.

The proper location of the switch and cut-off will depend on conditions. The fuse must be placed as near as practicable to the place where the service connections enter the building, and the switch may be placed at some readily accessible place as near to the service entrance as possible. Thus, in an underground system, the fuse must be placed where the service entered in the basement or cellar and the switch might be placed on the floor above if that were the nearest readily accessible position. This is the spirit of the Code rules, the intent being that in case of fire, the service can be disconnected as quickly as possible. Where the point of entrance is readily accessible both the switch and cut-out would be placed there; but we can conceive of cases where the fuse would be placed at the service entrance in the attic and the switch, three floors below.

Kindly inform me if it is possible to obtain a three-phase, 220-volt secondary service by the use of two ordinary transformers of the 2200-220-volt type with a three-phase, three-wire primary. Three transformers are now being used to obtain this result. C. W. W.

Two transformers may be employed in three-phase transformation by using what is known as the T-connection. One transformer is connected across two of the line wires, while the other is joined between the third line wire and the middle point of the first transformer. The current in the primary coil of each transformer is the same in value as that in the primary coil of the other, and the secondary currents in the two transformers are likewise equal in value. The voltage impressed across one transformer is only 86.6 per cent of that across the other, so that if each transformer is designed especially for its work, one will have a rating of *EI* and the other a rating of 0.866 *EI;* where *I* is the current in each line wire, and *E* is the e.m.f. between lines. The combined rating will, therefore, be 1.866, as compared with 1.732 *EI* for three single-phase transformers connected in delta or star. It is not essential that one transformer be designed for exactly 86.6 per cent of the voltage of the other; the normal voltage of one can be 90 per cent of the other, without producing detrimental results.

I note that the terms "current," "power" and "energy" are often used for one and the same thing, and I would be obliged if you will kindly state the difference between these terms and also between a "recording wattmeter" and an "integrating wattmeter." I am always more or less confused by these terms and would be glad to have the matter clearly explained to me. T. F. C.

Current is measured in amperes; electromotive force is measured in volts; power is measured in watts, and energy is measured in watt-hours. Unfortunately this distinction is not generally made by central station men and writers who know better. The terms "power" and "energy" have just as definite a significance as the terms "velocity" and "distance." Energy is the product of power and time, while distance is the product of velocity and time, and it is just as improper to use the term "power" where "energy" is intended as it is to use the term "velocity" where "distance" is meant. What is sold by electric light companies at — cents per kw-hour is electrical energy—not current or power, and this is measured by a watt-hour meter and not by a wattmeter of any description whatsoever. Although recording wattmeters (those equipped with charts) can be and have been built, it is physically impossible to construct an integrating (that is, adding) wattmeter to measure energy. The amount of energy used cannot be determined directly by means of a wattmeter; account must be taken of the time, and this fact gives rise to a unit of electrical energy—the watt second or joule. The term "time-meter" is equally as appropriate as the term "wattmeter" for an instrument which measures watt-hours.

Growth of Alternating Current in New York City.

By T. I. Jones.

NOTWITHSTANDING the general business depression that has marked all lines of trade during the past six months, the advance made in the use of alternating current electricity throughout the island of Manhattan has been most marked. The records of The United Electric Light & Power Company, which supplies the alternating current throughout this territory, shows during the past six months an increase in 16-cp equivalents of over 20 per cent.

Perhaps the largest increase which has been made in the general use of alternating current in New York City during the past year has been that of the National Biscuit Company, whose factory covers the entire block bounded by Ninth and Tenth Avenues and Fifteenth and Sixteenth Streets. This factory uses two-phase Westinghouse motors throughout for the operation of all its machinery, a detailed list of the motors in use being as follws:

No. of motors.	Size of motors.	
1	150	hp
1	75	"
2	40	"
3	30	"
9	20	"
14	15	"
7	10	"
35	7½	"
28	5	"
12	3	"
10	2	"
15	1	"
25	½	"
12	⅛	"
Total...174	1,342½	"

In addition to this equipment freight and passenger elevators are in service, all operated by two-phase motors. Besides the motor applications in the National Biscuit Company's factory there are over 5000 incandescent carbon-filament lamps and 1500 Nernst glowers.

When the Parker Building fire occurred at Fourth Avenue and Nineteenth Street, two months ago, it drove the Kny-Scherer Company (one of the largest manufacturers of surgical instruments in the United States) from its showroom and offices at that point to its factory building at the southwest corner of Ninth Avenue and Twenty-seventh Street. The entire two top lofts of the factory were fitted up for general offices and salesrooms, and the manufacturing equipment was remodelled.

Previous to the change in quarters the Kny-Scherer factory was run by a 150-hp Corliss steam engine, which was supplied with steam from three boilers of 75 horse-power each, consuming 3½ tons of coal per day. Connected to the engine by a belt was an old 75-kw Edison generator for the lights. This steam engine has been entirely shut down and the shafting of the factory split up and driven by seven individual-drive, two phase General Electric motors. In addition to these motors a freight elevator driven by a 15-hp, two-phase motor has been installed. This plant has been in operation but 30 days, and during that period an economy of over 20 per cent has been shown over the steam power cost of operation and maintenance. In addition to the alternating-current motors in this building, it is lighted by metallized filament, arc and tungsten lamps. The complete installation consists of about 3000 16-cp equivalents.

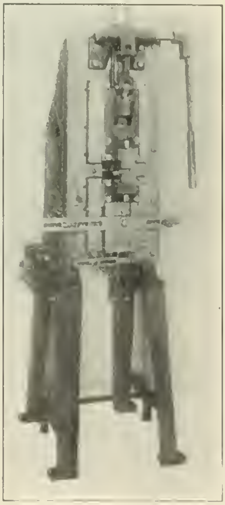


FIG. 1.—HAND SPOT-WELDING MACHINE.

Another installation which is just about to be installed, involving alternating-current power and lighting, is that of the Fleischman Bakery, which has taken the building formerly occupied by the McCreery dry goods store, Broadway and Eleventh Street. In this building the bakery will use two-phase General Electric motors in the dough-mixing and dish washing machines, and in the ventilating apparatus. The firm of Ravitch Brothers, one of the largest structural steel contractors in the city, during the past year has had in constant operation 90 horse-power in motors.

The electric welding industry which was started in New York on a small scale in the latter part of 1906, has during the past six months enjoyed a material growth. The Universal Electric Welding Company has installed a number of new electric welding machines at its plant, 40 West Thirteenth Street, among which is an automatic spot-welding machine, recently shown at the New York Electrical Show, and now being manufactured on a commercial scale. An electric hand-welder is shown in Fig. 1. This machine taking from 5 to 10 kilowatts of current, hand fed, is capable of turning out welded material with from three to 15 times the speed of the old riveting method. The class of work which these machines do is shown in Fig. 2. All of the joints on the spouts, covers and handles of the vessels shown are made by the use of the spot welding machine here shown, alternating current only being available for electric welding.

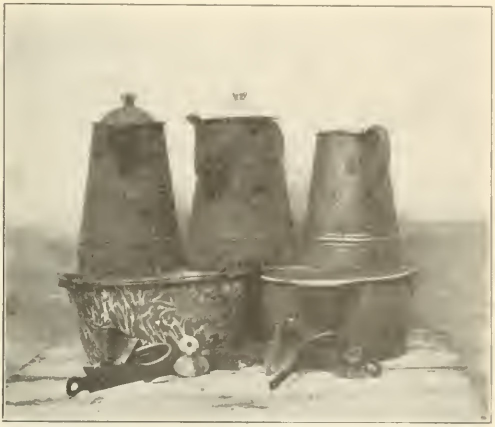


FIG. 2.—SAMPLES OF WELDED GOODS.

The method of razing buildings and structures having iron or steel pillars, by alternating current, which was first introduced in New York City in the demolition of the old Hoffman House (which method is illustrated in Fig. 3) will again be used in the removal of one of the largest structures in New York City during the coming summer. This method has for its object the melting of the base of the pillar by the use of current of great amperage through step-down transformers.

In connection with the building of the new subways with which the average New Yorker is at present interested, alternating current is playing a prominent part. Over 50 horse-power in two-phase alternating-current motors have already been contracted for with the United Company for the operation of concrete mixers to be used in connection with the building of the subway connecting the Williamsburg and Brooklyn Bridges. Electric hoists, of which the following picture shows a type, are also used in such subway work as this in many of the operations for the elevation and lowering of construction material and in dredging. The operation of two-phase motors, both on the concrete mixers and hoists, does away with the stationary boiler and necessary piping in connection with the steam apparatus on the older constructions, and, taking as a basis, 10 lb. of coal per hp-hour, coal at $4 per ton, and current at 8 cents per kw-hour, the use of electric hoists nets a saving of 40 per cent in favor of electricity. The necessary readiness-to-serve on the steam mixers and hoists requires a constant consumption of coal for the operation of the steam engine, involving a cost not incident to electrical service from the street mains.

Perhaps the latest application of alternating-current motors in New York City is in the shoe-shining machinery of the West Moreland Automatic Shoe Cleaning Company, at the corner of Broadway and Thirty-ninth Street. In this place are 14 shoe-shining machines, each operated by a ½-hp single-phase motor. These machines have been in constant operation for the past three months and are giving general satisfaction, with little or no maintenance trouble.

The electric flashing sign which has become to be such a figure along the Great White Way in New York City owes much of its successful operation to the use of alternating current. The following list of signs, all lighted by alternating current and switched by alternating-current motors, bears evidence to this fact: Sparkling-water sign, Broadway, corner Thirty-fifth Street; El Bart gin-rickey sign, Broadway, southwest corner of Forty-second street; Victor talking-machine sign and moving-letter sign, Broadway, corner Thirty-seventh Street; "U-Need-A" biscuit sign, Eleventh Avenue and Sixteenth Street; Levey's waving-feather sign, Broadway and Forty-third Street; Levey "That Spot," 125th Street and Lenox Avenue.

This necessarily brief résumé of some of the applications of alternating current made in New York City during the past six months is meant to give only a general idea of the work that is being done in Manhattan Island alone. A very considerable amount of single- and two-phase motor work is being done in Brooklyn and the Bronx. The installations here cited, however, will, it is hoped, be sufficient to show the general attention which is now being given in New York to the application of electricity for business purposes, and the demand that is being made for alternating current.

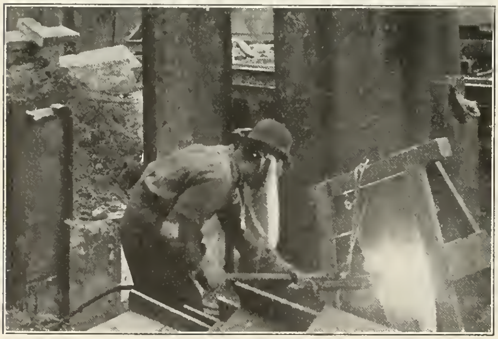


FIG. 3.—METHOD OF RAZING HOFFMAN HOUSE.

Progress in Electric Heating.

By H. W. Hillman.

The installation and continued operation of 27 electric luminous radiators at the Eagle Hotel, Grand Rapids, Mich., has caused many conservative engineers to take an unusual amount of interest in the subject of electric heating. The installation has also caused enthusiastic admirers of electric heating to be proud of the progress which this branch of the industry has exhibited. Both classes of electrical men are naturally interested in the details of the installation, an outline of which is given below.

In the Eagle Hotel the conditions were particularly favorable for electric heating. While the steam-heating system was satisfactory for average conditions of weather, it was overtaxed during severely cold weather, and uneconomical during spring and fall seasons when a small amount of heat would take the chill off the rooms. The electric system, therefore, acts like a storage battery for a station, helping out at the peak of the "severest weather load." It offers excellent flexibility for the spring and fall season requirements for small amounts of heat.

The initial cost of the radiators to the Eagle Hotel was manufacturer's cost plus freight to Grand Rapids, or about $325. When considering an addition to the main steam-heating system, the small sum for the radiators was found satisfactory.

The cost of wiring amounted to about $90. Of course, an entirely new circuit was required, each radiator being properly fused, and the whole system of wiring approved by the local inspector as to size of wire, method of construction, etc. The wiring was done by a local contractor, M. B. Wheeler Company, and the cost of wiring, plus the initial cost of the radiators, was not prohibitive.

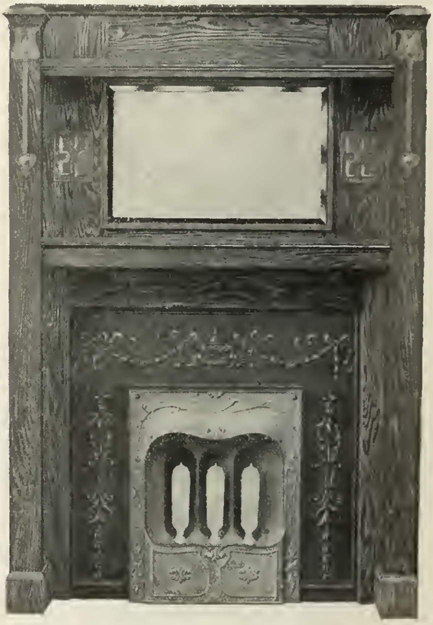


FIG. 1.—ELECTRIC GRATE AND MANTEL.

The Grand Rapids-Muskegon Power Company's rate for less than 25-hp. maximum demand is 3 cents, with a discount, making a net of 2.55 cents per hp-hour. Each radiator consumes one horse-power. The average conditions of the hotel trade indicate that only 10 or 15 of the rooms are occupied at a time, and the occupants would usually require heat for only about two hours in the morning and two hours in the evening. A few days in December were so mild that the radiators were not used either in the morning or evening.

The energy used by the installation is metered. On the basis of an average of 10 radiators operating an average of four hours a day, including Sundays, 1200 hp-hours would be required, and the bill would be $30.60 for the month. The load will be permanent and with good business conditions the bill will vary for six months in the year between $20 and $40 per month, which is satisfactory to the power company.

The question arises as to why such business is satisfactory to the power company. It is understood that the customer purchases the radiators and pays for the wiring. The power company simply furnishes the energy and installs the meter in the same manner as it would handle a motor installation. The average income from such a heating installation will compare very favorably with that from motor installations of similar size. As an answer to the argument opposing electric-heating installations because of the summer season and the absence of income for several months, it may be stated that many motors remain idle during the winter months.

On account of the favorable conditions as to climate, the simplicity of wiring, the reasonable initial cost of the radiators, the encouragement of the Georgia Electric Light & Railway Company, and the operating experience at the Eagle Hotel, an installation will probably be made in a hospital at Atlanta.

Both the conservative and the enthusiastic electrical engineer will be interested to know that the Rathbone & Panigot Mantel Company, of Grand Rapids, has established an electrical department in connection with its mantel business. For years the company has manufactured and sold gas mantels, and is well known in that class of business. Since the last fall season that company has thoroughly investigated electric luminous radiators, and recently begun the manufacture of electric grates.

Fig. 1 shows the general appearance of one of the grates. Its design is particularly artistic. In appearance it harmonizes with other decorations and appointments in the room so that it is easily adapted to installation in residences already erected. As to size and shape, it will fit any mantel, so that a coal grate or gas grate could be readily changed for an electric grate. As to efficiency, it is so designed that no heat passes "up the chimney." The heat is radiated and heated air is circulated in the room, and the grate, therefore, possesses a higher efficiency than any other heating device.

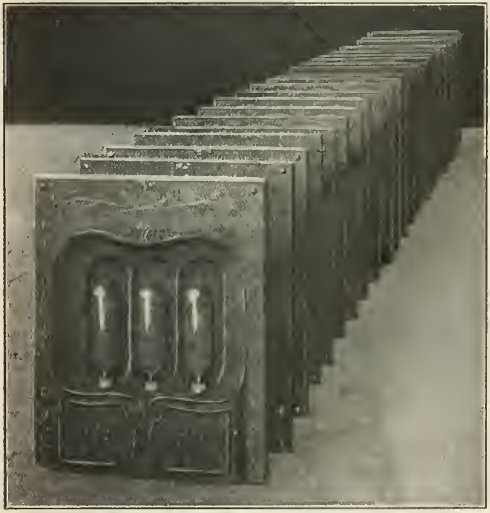


FIG. 2.—ELECTRIC GRATES IN A GRAND RAPIDS MANTEL FACTORY.

The instantaneous heating feature of the electric grate is advantageous. The gas grate likewise responds immediately after lighting, but it possesses the bad feature of vitiating the air in the room. This point gives the electric grate a decided advantage. It was the many advantages of the electric grate which led the Rathbone-Panigot Company to take up its manufacture aggressively. Its long experience in the manufacture and sale of gas grates adds weight to its opinion as to the value of the electric grate.

From the standpoint of the residence customer the electric luminous radiator is becoming a necessity. In a large house recently erected in Grand Rapids five radiators were installed for bath-room use. They were connected to a separate meter circuit.

In the exhibition window of every supply contractor in Grand Rapids electric radiators are in evidence. In the wiring of new and old residences, large and small, plans are made for at least one radiator. The excellent work which has been done by local supply dealers in promoting this electric heating business will be further stimulated when the furniture dealers commence to exhibit electric grates in connection with their various styles of mantels. The Young & Chaffee Furniture Dealer, of Grand Rapids, which is an agent for the Rathbone-Panigot Company, has ordered six electric grates for exhibition in its salesroom with mantels, in the same manner as it has exhibited gas grates in the past. The design of this new grate especially fitted for mantels associates the use of this electric device closely with the furniture dealer, and it extends the field for exhibiting the electrical heating devices. People who visit this large wholesale furniture house will at least see the electric grate in operation.

The most popular grate or radiator is the one rated at 750 watts. At the rate of 3 cents per hp-hour the cost of operation per hour is 3 cents. An owner of an average-size residence who had a bill in January of about $8 for lighting would have objected to a bill of $10 for light, but he gladly paid $2 for the use of a luminous radiator. He considers this device an indispensable fixture in his house.

Central-station managers in general are familiar with the price of luminous radiators and will be glad to know that the price of the electric grate is only slightly higher than the radiator. It is competitive in price with gas grates. There are many reasons why each and every central station should promote the heating business. The progress of electric heating is rapidly advancing, while the approaching spring season will show a greater advancement than any previous year. An additional business, such as intermittent electric heating, will assist in building up of the summer load.

Progressive Central-Station Advertising at Birmingham.

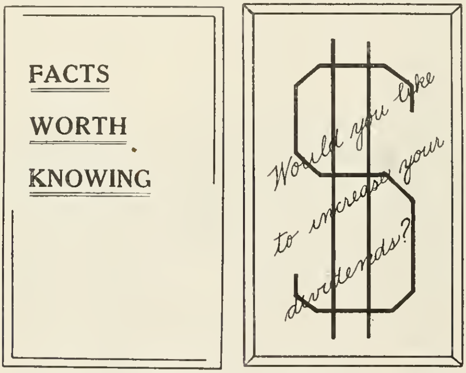
The Birmingham Railway, Light & Power Company publishes a four-page weekly folder called *The Illuminator,* and besides maintaining an attractive exhibit of new electrical appliances at its main office, advertises quite extensively in the newspapers of the city. *The Illuminator* is a 5-in. x 6-in. folder which is distributed free of charge in the cars to the public, and theatrical notices are also included in its make-up. Among the topics which the periodical takes up are places of interest in the city, the opening of new transit facilities, car schedules, transfers, changes in meter-reading periods, new apparatus of special interest, and announcements to consumers. Six volumes of these folders have now been issued, and they are all specially prepared with the local needs of Birmingham in view, rather than being filled up with matter duplicated in many other cities. New industrial opportunities are also touched upon in this folder at times.

In common with many other companies, the Birmingham organization has found it desirable to give space to the subject of meter reading. In a recent newspaper advertisement, 13 in long and 6.5 in. wide, the company illustrated a meter dial and explained with care the way to read meters, pointing out that there is no mystery in the task, although consumers are often of that opinion. The method of figuring monthly bills was also explained. In addition, the company stated that a meter in a house can be tested easily as follows: "A 16-cp incandescent lamp consumes about one-eighteenth of a kilowatt per hour. In the evening let the consumer read his meter, then light 18 16-cp lamps for one hour, or six lamps for three hours, and at the end of the time read his meter again. The electricity consumed, if the meter is recording properly, is then 1 kw-hour, making a difference of one figure on the right-hand dial of the meter." To enable the consumer to get a rough idea of the kw-hour, it was stated that this would keep an arc lamp burning about two hours, would run a 1-hp motor at full load one hour and 20 minutes, would run a fan all day, or a sewing machine all day, and it would also keep a small iron hot for three hours or a large one hot for two hours. In bringing the subject to the attention of its customers in this way, the company endeavors to lessen the chances of friction over meter readings, and thus is constantly strengthening its position.

Central-Station Publicity.

By Norman G. Meade.

A JUDICIOUS distribution by central-station companies of neatly executed literature describing the advantages of motor drive and the convenience of popular applications is very desirable. Small pamphlets, envelope size, are the most convenient, as they may be mailed with monthly statements to customers, making a saving in postage. The class of literature mailed to customers should be descriptive of new devices with a statement of their salient features. These folders are also suitable for the general mailing list, as the installation of some one appliance for a new customer establishes a foothold which generally leads to an extension of business.


FACTS
WORTH
KNOWING
Would you like to increase your dividends?

FIGS. 1 AND 2.—COVER DESIGNS.

If the central station is located in a city where there are numerous large industries operating private plants, a folder setting forth the reasons why electricity should be purchased from light and power companies should be mailed to managers or superintendents. Such folders can be artistically got up and be of a nature to attract attention, or, in other words, be of the "anti-waste basket" type. Figs. 1 and 2 are suggestions for cover designs. The folder should contain an introduction, calling attention to the economy of using purchased electricity and an explanation showing why central stations can sell electrical energy cheaper than it can be generated in private plants. This introduction should be followed by specific reasons for purchasing energy similar to the following arguments: 1. Power is always instantly available, day, night or Sunday. 2 A few machines may be operated, consuming energy only when in use, thereby eliminating operating expenses in boiler and engine room. 3. The expense of removing ashes and refuse from the power plant, with the attendant dirt, is eliminated. 4. Delays and shut-downs incident to accidents in the power plant are eliminated. 5. Power is always available regardless of strikes and labor troubles. 6. Fire hazards are reduced by the elimination of the power plant and high-pressure steam boilers. 7. Space occupied by the power plant is made available for manufacturing or storage purposes. 8. Ground necessary for coal storage is made available for extensions or new buildings. 9. Power for overtime and repair work is always available without the expense of operating a power plant. 10. Noise, smoke and dust incident to the operation of power plants are eliminated. 11. In warm weather the heat arising from the boiler and engine room is eliminated. 12. The cost of ventilating systems is reduced. 13. The accounting department is relieved of numerous entries for fuel, oil and incidental supplies. 14. An estimate of the cost of energy for any ensuing period of time can be made, as a uniform rate is obtained regardless of the market price of fuel. 15. Better regulation is maintained on the distribution system supplied by the central station, insuring a uniformity of speed of the motors, which increases the output. 16. Extensions can be made at any time by simply running a few additional circuits. 17. The responsibility for continuous service and uniform voltage rests with the central station. 18. The superintendent or manager is relieved of the duty of overseeing the operation of the power plant, thus leaving more time for routine work. 19. The difficulty of obtaining competent firemen and engineers is eliminated. 20. The annual expense for energy will be reduced materially.

Another form of advertising literature, mailing cards, is shown in Figs. 3 and 4. In Fig. 3 the card is shown folded for mailing, and in Fig. 4 open for reading. This form of card is very good for follow-up work. It can be sent out at frequent intervals after the folders have been distributed, and should contain pertinent facts and give descriptions of new devices. These cards will necessarily have to be classified the same as the folders, for residence, business and manufacturing distribution.

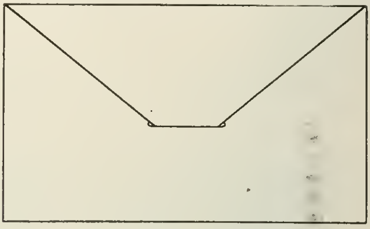


FIG. 3.—MAILING CARD FOLDED.

A house organ is by far the most desirable form of advertising, and if conducted in an interesting manner will be looked for and generally read. It should contain descriptions of new applications, late engineering news of popular interest, arguments in favor of the use of electricity, short descriptions of new installations connected with the company's service and any notes of general interest. An excellent feature of such a house organ is a page devoted to practical suggestions for the care, management and repair of motors, with instructions for locating faults, etc. The success of any advertising medium lies in creating a demand for it. This can be accomplished by catering to the wants of the people and giving them material of practical value.

Fig. 5 is a suggestion for a cover design. The illustration should be changed for each issue, showing some new installation or appliance. If necessary the expense of publishing such a paper can be largely defrayed by the advertisements of local merchants. A well-got up paper, gratuitously distributed, is a good advertising medium for business men in general, and central stations should have no trouble in selling enough space to cover the cost of publishing.

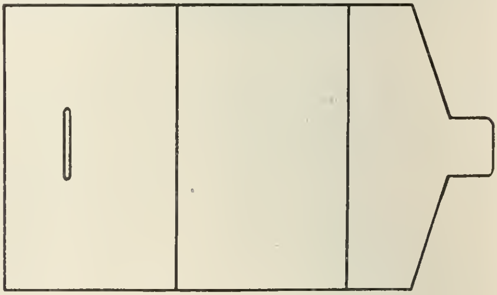


FIG. 4.—MAILING CARD OPEN.

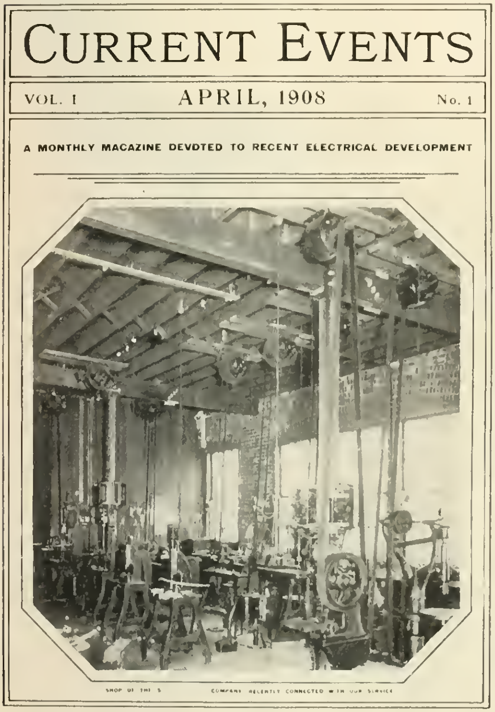
The first page of the initial issue should be devoted to an editorial announcement expressed somewhat as follows:

> TO OUR FRIENDS AND CUSTOMERS.
>
> In presenting this, the initial issue of *Current Events*, we sincerely hope that our efforts will be appreciated. It is our aim to incorporate material

in the columns of each issue that will be of value to the readers and keep them in touch with the latest developments in the electrical field, also to make practical suggestions for the maintenance of motors and appliances of our customers.

The layman does not, as a rule, follow the electrical papers and fails to keep abreast of the many developments in electrical appliances and labor-saving devices for household, business and manufacturing purposes. We intend to tell you all about such applications and show you where you can save money and increase your output by adopting electricity.

There are innumerable devices for use in residences, mercantile establishments, hotels, restaurants, banks, and, in fact, every walk of life that will add to comfort and safety and economy, in addition to saving labor and expense. In the bank, for instance, there are now in general use numerous devices operated by electric motors which automatically perform work formerly done by hand. In this field one of the most important applications is the coin-counting machine, which automatically counts and wraps coins of various denominations. There are other electrically operated devices as well, including addressing machines, letter openers, envelope sealers, etc.


CURRENT EVENTS

VOL. I APRIL, 1908 No. 1

A MONTHLY MAGAZINE DEVOTED TO RECENT ELECTRICAL DEVELOPMENT

SHOP OF THE S COMPANY RECENTLY CONNECTED WITH OUR SERVICE

FIG. 5.—COVER DESIGN.

At the present time the large bakeries are using machinery wherever possible and electric motors are coming into extensive use for its operation. Nowhere is cleanliness more essential than in bakeries, and individual drive by electric motors fulfills every requirement, obviating the use of belting and shafting with the ever-present dust and dripping oil.

Not alone in ordinary business and private pursuits do we find openings for electric power; amusement parks, theaters and concert halls provide many applications. An amusement park where people go for recreation should be free from unsightly objects and anything that mars the general effect of the architecture or scenery. In everyday business life there is much that is disagreeable in the way of dirt and noise, and to secure relaxation it is obvious that places of pleasure should be free from such annoyances, consequently the steam and gas engines that were formerly used for the operation of various devices have given way to the electric motor. What could be more annoying than when listening to a concert or opera than the constant detonations of a gas engine or escaping steam? By using electric motors noise and soot and dirt are eliminated.

To mention all the possible opportunities for the use of electric motors would be beyond the scope of this page. It is sufficient to say in closing that wherever power is required the electric motor offers every inducement for its adoption.

The exact contents of a house organ cannot be laid down, as local conditions will govern its makeup to some extent. The pages are always enlivened by illustrations. Electrotypes of various appliances are readily loaned by manufacturers for the publicity they will receive through its circulation. Small notices of new customers interspersed in the reading columns, something like the following item, are generally interesting:

GAS AGAIN SUCCUMBS TO ELECTRICITY.

The machine shop of , illustrated in Fig. 6, has recently been equipped with motor drive. This is another of the many instances where the gas engine has been superseded by electric motors. This shop is devoted to custom work and the adoption of electric drive is another evidence of the progressiveness of Mr ————, the proprietor.

Various other items calling the attention of manufacturing companies to the advantages of electric drive will be of interest.

A page made up of operating hints should contain practical suggestions based on the company's own experience. Information on the care and maintenance of electric motors may be found in many books devoted to the subject and in the technical press. The regular electrical papers contain abundant items of interest which may be reprinted in full if proper credit be given, or the facts only may be taken and used in connection with some other item bearing on the same subject. In this way it is an easy matter to fill the paper with items of real, live interest and to educate the community in electrical matters. Small central-station companies cannot hope to emulate the example of the very large companies, whose bulletins cost very much to publish. Less elaborate bulletins cost considerably less, and if monthly publication is not considered feasible, quarterly numbers may be issued. It has been found that, as a general rule, with the education of the public in things electrical has come increased load and increased profit.

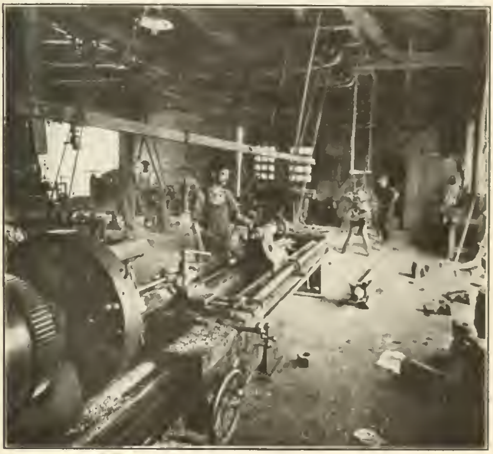


FIG. 6.—EXAMPLE ILLUSTRATION.

A Record on Washing-Machine Motors.

Mr. Adolph Wagner, superintendent of the municipal electric lighting plant at New Ulm, Minn., a town of 5720 population, has made a remarkable record in introducing washing machine motors in his city. He has 50 such motors in service. They are mainly $\frac{1}{8}$ horse-power of Emerson manufacture. Various makes of machines are used. This record is all the more remarkable because municipal plants do not have the reputation of pushing for business and introducing new appliances as do companies. Most companies have as yet introduced very few washing-machine motors. It would be interesting to learn from our readers whether any company or municipal plant has equaled this record of approximately a washing-machine motor for every 114 inhabitants. Most of the washing machines in use in New Ulm are of the less expensive kinds, so that the total cost of motor and machine is under $30.

Broadway's Latest Sign.

The accompanying cut illustrates the latest striking sign along Broadway, New York. The sign is on the southwest corner of Forty-second Street and has been named by the builders, the O. J. Gude Company, the "Largest Petticoat in the World." An appreciation of the size of the sign may be had from the following figures: Length of skirt, 70 ft.; width of "Heatherbloom," 50 ft.; length of shoe, 12 ft.; width of buckles, 3 ft.; height of sign, 55 ft.; electric lamps in sign, 1867.

ELECTRIC SIGN ON BROADWAY, NEW YORK.

It has been remarked that the signs along Broadway heretofore have generally appealed to one's thirst rather than to one's apparel. The forerunners of this sign have alluded to champagne, gin, cognac, Scotch whisky and the like. This sign is the first to make a departure and to advertise clothing. Current to this sign is supplied from the alternating-current mains of the United Electric Light & Power Company.

"New Business" Campaign in Cincinnati.

In a letter to the stockholders, President Kenan, of the Union Gas & Electric Company, of Cincinnati, Ohio, gives the following as the partial result of an aggressive "new business" campaign: During the year 14,984 gas meters were added to the service and 3,069 electric meters were installed in addition to those already in use. Sixteen private gasoline-electric generating plants were closed down, 44 steam and 34 isolated generating plants were supplanted by the service, while 37 hydraulic elevators were changed to electric power. The newspaper and circular part of the work was in charge of Mr. Walter L. Byron.

LETTER TO THE EDITORS.

Noisy Operation of Dynamos.

To the Editors of Electrical World:

SIRS:—In connection with Prof. Nathaniel R. Craighill's article on "Noisy Operation of Dynamos," which appeared in the issue of Feb. 1, it may be of interest to note that a very similar article by Mr. J. Fischer-Hinnen appeared in the *Zeitschrift für Elektrotechnik* (Vienna), June 5, 1904. In that article Mr. Fischer-Hinnen arrives at the same conclusion as Professor Craighill, namely, that for quiet running the ratio of pole-arc to pitch of armature slots should equal an integer + ½, but states that it cannot be considered absolutely accurate since it does not take into consideration the width of the slots. He also states that "in several machines the air-gap was considerably decreased without perceptibly increasing the noise, although the opposite would generally have been expected." The results of 25 tests showed the agreement of the theory with the results obtained in practice except in the case of machines having a large number of armature slots.

The writer has corrected noisy machines in a number of cases by applying the above formula and calculating the length of pole-arc for quiet running, and believes that the probability of noise should be considered when designing direct-current machines.

Since induction motors sometimes prove unaccountably noisy, it seems possible that experiment might lead to a similar formula applicable to that class of machinery.

DENVER, COL. E. N. JENNISON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Transformers.—E. ELM.—An illustrated mathematical article describing the method of calculating the dimensions of a transformer so that its cost of manufacturing is a minimum for a given efficiency and a given temperature limit.—*Elek. Zeit.*, March 5.

Lamps and Lighting.

Small Transformers for Metallic-Filament Lamps.—An illustrated article describing a number of small transformer designs of various British companies for use with low-voltage metallic-filament lamps. The autotransformer design seems to be generally preferred, and it is pointed out that it is advantageous wherever possible to adopt a distributing secondary pressure exactly one-half or one-third of the supply pressure and connect the transformer as a balancer with the equivalent of a three-wire or four-wire distribution system. In installing transformers for this purpose, two different methods of distribution may be adopted: (1) One transformer may be used for each lamp or ground of lamps which are required to burn always together, so that the transformer and the lamps it supplies may be switched on or off together; or, (2) one transformer may be used for a whole installation, the transformer being switched out when no lamps are required. In the first system the initial cost of transformers is greatest; the advantages are, however, that the installation wiring has to carry current corresponding to the normal circuit voltage instead of the reduced lamp voltage, and that no losses occur in the transformer when the lamps it supplies are not in use. Further, the transformer is always operating at full load corresponding to its highest efficiency. The second system has the advantage of lower first cost of transformers; on the other hand, the installation wiring must be suitable for carrying the current corresponding to the reduced voltage, and when only a few lamps are in use, the transformer will not be working at its highest efficiency. In arranging installations, therefore, it may often be found advisable to adopt a combination of these two systems. A special design of transformers for the first of the above systems of distribution is shown in Fig. 1. Concerning a type of transformers for the second of the above systems of distribution, the following figures are given which show the advantage of arranging the transformer as a balancer and grouping the load as evenly as possible on both sides. These figures relate to a 200- to 100-volt transformer for 18 amperes 75 cycles with a constant iron loss of 10 watts connected as a balancer. If 18 amperes are on one side and nothing on the other, the total loss is 41 watts. If 18 amperes are on one side and 9 on the other, the loss is 18 watts. If 10 amperes are on one side and 8 on the other, the loss is 10½ watts. If 18 amperes are on each side, the loss is 10 watts. The voltage on the heavier loaded side is in these four cases 98½, 99¼, 100 and 100 volts, respectively. With regard to the arrangement of existing 200-volt installations for these transformers, where the system of wiring permits of its being divided into two or more bunches, of approximately equal current requirements, as, for instance, when supplied from a distribution board, the method shown in Fig. 2 may be adopted. Where a distribution board is used, this involves only the cutting of one busbar, and the removal of one main from the uncut busbar to the half of the busbar divided from the other main by the cut, in addition to joining in the transformer shown. When this system is used, only the difference between the current taken by the two halves of the busbar passes through the transformer, and when these are balanced the only loss is the extremely small exciting current taken by the transformer. There is a further small loss in the transformer when the currents of the two halves are not equal, but this is only on while the currents are out of balance, and is almost negligible unless the two halves are much out of balance.—Lond. *Elec. Eng'ing*, March 5.

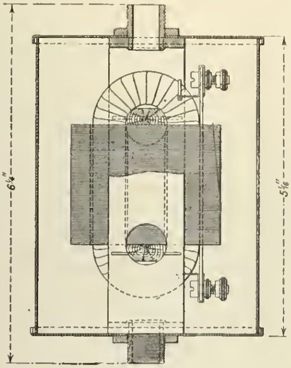


FIG. 1.—SECTION OF SMALL TRANSFORMER.

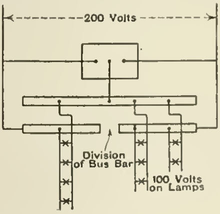


FIG. 2.—ARRANGEMENT OF WIRING OF AUTO-TRANSFORMER FOR BALANCED CIRCUITS.

Metallic-Filament Lamp.—The International Electric Company, of London, advertises the "Orieco" metallic-filament lamp for which the following claims are made: The specific power consumption is 1¼ watts per British candle-power. It can be used on direct or alternating current. "The filament is made by a special process. Its initial cost will be compensated for by a saving of current after 200 hours' burning." The average life is given as 1000 hours, and it is stated that the efficiency does not fall off during the whole life.—Lond. *Elec. Eng'ing*, Feb. 27.

Carbon-Mercury Incandescent Lamp.—An account of a mercury-vapor lamp in which it is claimed the greenish color is corrected by the use of a carbon filament. The filament is enclosed in a U-tube, which also contains a little mercury. This is, however, only visible when the lamp is cold, for when the lamp is heated the mercury vaporizes and takes part in the phenomena. Although the power consumption is not perceptibly increased by the mercury coming into action, the illumination is stated to be considerably augmented. All the mercury is gradually converted into vapor by the heat from the lamp filament. This reduces the temperature of the filament somewhat, hence its resistance increases a little, and, therefore, the consumption decreases as the lamp becomes full of mercury vapor. This then carries a part of the current, and the filament is brought in time to red heat, thus supplying the necessary color correction.—From *L'Elettricita*; abstracted in Lond. *Elec.*, Feb. 28.

Measuring Instrument for Incandescent Lamps.—An illustrated description of a measuring instrument of German make which gives not only the amperes and watts, but also the cost of energy per hour. The instrument, therefore, has three different scales. The scale giving the cost per hour must, of course, be calibrated differently according to the local rate per kw-hour. Also the watt scale must be calibrated according to the local voltage supply. The instrument is intended chiefly for use of laymen, so that they can read directly the cost of using a lamp for an hour and do not need to calculate it from the amperes.—*Zeit, f. Beleucht.*, Feb. 20.

Interior Arc Lighting.—A note on a large number of open inverted arc-lamps recently installed for interior illumination in the premises of a large London drapery establishment. The lamps are fitted with under-reflectors, and in some cases with over-reflectors. The useful intensity of illumination is about 3½ candle-feet.—Lond. *Elec. Eng'ing*, Feb. 27.

Traction.

Italian Power Transmission.—The conclusion of the illustrated description of the power transmission from Caffaro to Brescia. In the present instalment, the transformer station at Brescia and the converter station at the caustic soda factory in Brescia, where direct current is used for electrolysis, are described.—Lond. *Elec.*, Feb. 21.

Power Plant.—An illustrated description of the new electric-power station at the First Garden City. The plant consists of two gas-driven dynamos, each of 100 horse-power, supplied with gas from two suction gas plants, anthracite being the fuel. The dynamo gives direct current at 500 to 550 volts, and a battery and a balancer set are also provided. Supply is given to the factories at either 480 or 240 volts for power, and 240 volts for lighting.—Lond. *Elec. Eng'ing*, Feb. 20.

Cost of Electric Power.—In the discussion of J. F. C. Snell's paper on the cost of power supply for industrial purposes, several figures of the costs of power at private plants were quoted. Stothert stated that the cost of electric power at Babcock & Wilcox's Renfrew works was 0.9 cent per kw-hour, including an allowance for depreciation. Newington gave a case in which the cost of running a suction-gas plant came to 2.26 cents per kw-hour (including all capital charges, but not rent) as against 2.4 cents charged by the corporation previously. J. A. Robertson pointed out that the total cost of electric energy in a shipyard, whether the energy was bought or from a private plant, came to be a small percentage of the wages bill; in a particular case in Greenock the wages came to $675,000 annually and the power only $20,000.—Lond. *Elec. Eng'ing*, Feb. 20. In the discussion of the same paper at Sheffield, further figures were given by various speakers. Felden said that in spite of the price of gas at Sheffield being about half the figure upon which Snell based his comparisons, the Corporation were adding to their power load at the rate of 200 to 300 kilowatts per week. Works that had previously put down their own suction and producer plants had changed over to the Corporation, and the load factor at which they supplied was now from 40 to 45 per cent. Dickinson gave the diversity factor at Leeds as 2.4—Lond. *Elec. Eng'ing*, Feb. 27.

Electric Cranes.—H. H. Broughton.—A continuation of his very long illustrated serial on electric cranes. In the present instalment the author deals with motor-control systems. In order to take full advantage of the properties of an electric motor it is necessary to consider carefully the systems of control to be adopted in any given case. In the first part of the article the several systems in vogue for controlling derricking, slewing, traversing and traveling motors are described. The most suitable arrangements for hoisting-motor controllers are then dealt with, and different methods of control are given. For the heaviest equipments it is necessary to use the remote-control system, and the author describes the elementary principles of this method. The control of single-phase compensated repulsion motors is next dealt with, and two methods of controlling three-phase induction motors are given in conclusion.—Lond. *Elec.*, Feb. 21.

Electric Drive for Wood-Working Machinery.—J. P. Judge.—An illustrated article on the recent equipment of a wood-mantel factory with electric power. Forty-five motors, aggregating 398 horse-power, have been installed, all of them being 230-volt, direct-current machines. A characteristic of many wood-working machines is that the speed of the cutting tool remains constant while the feed should be varied in accordance with the work being done. In such cases the machines are fitted with constant-speed motors for the cutting tools and with variable-speed-motor controllers for the feed.—*Gen. Elec. Rev.*, March.

Electric Power in Docks.—C. E. Taylor.—An illustrated paper read before the (British) Inst. Elec. Eng., in which the author described the many uses to which electric machinery has been put in connection with dock work, such as coal conveyors, hoists, wharf cranes, capstans, etc., and also for driving hydraulic pumping machinery. Parts of the machinery used at several large docks are given.—Lond. *Elec.*, Feb. 21; a full account of the discussion which followed the reading of the paper in Lond. *Elec. Eng'ing*, Feb. 27.

Feed-water Heating.—S. A. Reeve.—An article suggesting a new method for feed-water heating for power plants, with criticisms by R. P. Bolton.—*Eng'ing Mag.*, March.

Installations, Systems and Appliances.

Switzerland.—A continuation of the long article on technical details of hydro-electric installations in Switzerland. The author compares the different methods of electric power transmission and concludes that the three-phase system is preferable to the direct-current series system for transmitting energy from a power house to centers of distribution if the distance is short enough to transmit energy directly at the voltage generated in the power house, so that no step-up transformers are required. This is the case in most installations in cities. If, however, the distance increases and the tension to be adopted becomes very high, the direct-current series system may become preferable, as in the transmission system from Saint Maurice to Lausanne. In a large number of cases both systems are about equivalent and the three-phase systems will then probably be preferred on account of lower first cost. For transmission over very long distances, and especially into rural districts comprising a great number of centers of distribution of smaller importance, the direct-current series system appears to have decided advantages over the three-phase system. For traction on long lines, the single-phase system at 15,000 or 20,000 volts appears to have a promising future.—*L'Ind. Elec.*, March 10.

Electric Equipment of Ships.—W. D. Kirkpatrick.—A paper read before the Liverpool Eng'ing Soc. The chief difficulty of the use of electrical machinery on board ship is the effect on the compasses. To overcome this difficulty, the ironclad dynamo was introduced in 1895 and largely used by the British Admiralty, but the fact that its total weight is 60 per cent higher has led to the adoption of the open-type four- or six-pole machine, which combines a minimum of external leakage with a maximum of accessibility of the brush holders, and is at the same time self-ventilating. The usual insulated two-wire system is now generally used on board ship. In the British navy only vulcanized rubber lead-covered cables are used, run on teak battens fixed to the bulkhead, and secured by brass clips. In some other navies, notably that of Japan, the cables and wires are attached directly to the bulkheads, without teak backing being used. This method the author considers preferable. The standard voltages for ship work are much lower than those in use for shore purposes, and it is only within very recent years that 100 volts has been exceeded or, indeed, become general. Instead of a large number of auxiliary engines scattered all over the ship, the use of electric motors is far more economical. The modern traction motor is very suitable for all requirements on board ship. While electric installation is higher in first cost, the saving in fuel is considerable. A description of the electric plant on the new Cunard steamers *Lusitonia* and *Mauretania* is given.—Lond. *Elec. Eng'ing*, Feb. 27.

Electric Power in Theater.—A description of an electrically-driven scene-shifting equipment recently installed at an English theater. A single motor is employed, which drives a long shaft at a constant speed. The separate winding drums by which the cloths, etc., are raised and lowered, derive their motion from this shaft by an arrangement of clutches and gearing.—Lond. *Elec. Eng'ing*, Feb. 20.

British Refuse Destructor and Electricity Works.—An illustrated description of the new combined refuse destructor and electricity works in Greenock which embodies some new features in destructor design, among which is a device for automatically opening and closing the charging door of the destructor furnace—so that the charging is accomplished without manual labor and with an absence of dust—and a well-designed system for supplying the furnaces with forced draught and ventilating the clinkering floor. The new works contains coal-fed boilers as well as destructor boilers; at present the plant capacity is 1500 kilowatts, and the station, which will eventually supply the greater part of the load at Greenock, is capable of considerable extension.—Lond. *Elec. Eng'ing*, Feb. 20.

London.—Some notes on important progress made last year in electric supply in London. For instance, the St. James & Pall Mall Electric Light Company has obtained a 10 per cent increase in its output and also a 10 per cent increase in its connections. There has been a very marked increase in the use of electric energy for industrial power.—Lond. *Elec.*, Feb. 21.

Slot Meters.—J. B. Clarke.—An article pointing out that frequently consumers when installing only a few electric lamps in a shop or residence do not realize that under existing English conditions their electricity account might be less if registered by a prepayment slot-meter than by an ordinary meter, even if the electricity is charged 1 cent per kw-hour more by the slot meter. The reason is that rent is charged for ordinary meters, but not for slot meters.—Lond. *Elec. Rev.*, Feb. 21.

Protective Devices.—An account of the discussion at the Dublin local section of J. S. Peck's recent paper on protective devices for high-tension circuits. Experience in dealing with voltage surgings in lines of various descriptions were given by central-station, tramway and telephone engineers.—Lond. *Elec. Eng'ing*, Feb. 20.

Circuit-Breakers.—Henry.—An illustrated description of high-tension circuit-breakers built by the Alioth Company.—*L'Ind. Elec.*, March 10.

Direct-Current Time-Limit Relays.—An illustrated description of direct-current relays recently installed on the main switchboards of the steamships *Lusitania* and *Mauretania*. It is pointed out that the only way a reliably inverse-time limit can be attained which can be adjusted independently of the current adjustment is by means of a separate relay.—Lond. *Elec. Eng'ing*, Feb. 28.

Curve Sheets.—J. B. Morgan.—An illustrated article describing a handy curve sheet for use of central-station engineers on which are to be plotted all the costs and output.—Lond. *Elec. Rev.*, Feb. 28.

Wires, Wiring and Conduits.

Steel-Tower Transmission Line.—In a transmission line in the southeast of Sweden a deep inlet of the sea had to be bridged over. Steel towers of special construction are used on either side of the inlet, the span between them being 735 ft.

The towers are 70 ft. high and the minimum height of the cable over the water is 130 ft. The conductors for this portion of the line are of stranded steel wire of 60 sq. mm. (0.093 sq. in.) in section, corresponding to copper wires of 7 sq. mm. section. There are four conductors, three in use, and one as reserve. The mechanical construction of the towers is described. "The tension in the cable at a temperature of — 30 deg. C. amounts to 600 kg (1320 lb.) between the towers, and 750 kg (1650 lb.) between towers and anchors. The maximum tensile stress in the cable is thus 12.5 kg per square millimeter (17,800 lb. per square inch), which provides a safety factor of 5. At + 30 deg. C. the maximum sag is about 30 ft. There is, however, no danger of the cables touching one another, as they are supported at different heights, and 6.5 ft. apart."—Lond. *Elec. Eng'ing*, Feb. 20.

Faults in Multicore Cables.—A discussion of the principal reasons which may cause faults on multi-conductor high-tension cables, especially short-circuits between two phases or interruptions in one or several phases. Methods for locating the faults are described.—*Elek. Anz.*, Feb. 6.

Wiring in Mines.—F. A. Barron.—A continuation of his notes on wiring and wiring supplies for mining service. He deals especially with porcelain or glass insulators, lamp sockets, lamp guards for portable lamps, individual controlling panels for alternating-current motors and trolley construction for mining locomotives. The total cost of 1000 ft. of trolley construction in coal mines, including rail bonds, is estimated at $197.—*Gen. Elec. Rev.*, March.

Wiring.—An article pointing out that if wiring is undertaken in conjunction with a small central station, careful organization and watching are necessary. The work divides up into four main classes, consisting of new wiring, work repairs to existing wiring, wiring extensions to old work, and attention to consumers' complaints. The author deals particularly with the manner in which the work should be booked and the various repairs entered up.—Lond. *Elec. Eng'ing*, Feb. 20.

Fuses.—An illustrated description of several constructions of fuses.—*Elek. u. Masch. Betr.*, Jan. 20.

Electrophysics and Magnetism.

Selenium.—C. Ries.—An account of an extended experimental investigation. The author first discusses the change of resistance of solid crystalline selenium cells due to illumination, and compares different methods of preparing them. He recommends to prepare the selenium first in the amorphous state and then change it by repeated heating into the crystalline modification; it is slowly to be heated up to 195 deg. C., maintained for about half an hour at this temperature, and then quickly cooled. He then discusses the production of an e.m.f. in a photoelectric cell. He finds that the photoelectric current always flows in the direction of the light rays; that is, from the dark selenium electrode through the liquid to the illuminated selenium electrode. If this cell is polarized by impressing an e.m.f. the photoelectric effect may be increased or diminished, or even annihilated. When the illuminated electrode was connected to the positive pole, weak polarization increases the effect considerably, while strong polarization is liable to decrease it. If, however, the illuminated electrode is connected with the negative pole, the photoelectric effect is diminished even by weak polarization and is finally completely annihilated. The polarization, therefore, has an influence not on the direction, but on the intensity of the photoelectric current. This opens up a new way for making selenium cells of high sensitiveness by employing a suitable polarization e.m.f. by a proper choice of the liquid, and by properly selecting the thickness of the selenium.—*Phys. Zeit.*, March 1.

Magneto-Optics.—W. Voith.—Some theoretical notes on recent magneto-optical observations. The author first discusses transverse magnetic double refraction and then deals with the dissymmetry of the normal Zeeman triplet.—*Phys. Zeit.*, March.

Units, Measurements and Instruments.

Resistance Comparator.—W. C. Fisher.—The first part of an article in which the author, after discussing the advantages of the potentiometer method for comparing resistances, describes his design of "resistance comparator." The essential feature of the instrument, as shown in Fig. 3, is the employment of two sliders and a movable slide wire. The slide wire (*S W*), provided with flexible end connections, is carried by, but insulated from, a tubular framework (*FW*) which is free to slide upon the fixed bars *BB*, shown. This framework, the top tubes of which are of square section (upon the top surface of which the scale is engraved), is actuated by the milled nut (*N*) which, since the sliders are friction maintained, gives a micrometer movement to the slide wire. The sliders (*Ss*) have each a free hand-impelled action along their respective tubular frameworks (*F*), which also have individual micrometer movements in the milled nuts (*N*, *n*). Any backlash in the respective frameworks is taken up by strained springs, not shown in the drawings. The sliders carry contacts (*ccQ*) which, as shown in vertical section, can be made to impinge upon opposite sides of the slide wire *S/W*, which is of substantial diameter and hangs in mid-air. A special switch, not shown, but having instantaneous action, is provided for the rapid alteration of connections between the various circuits and for the employment of one galvanometer. The operation of the instrument is as follows: (*a*) Balance standard resistance (which is connected to slider marked "Standard") roughly by hand at any convenient point on the slide wire. (*b*) Flick over switch and roughly obtain by hand the approximate comparison balance with the slider marked "Comparison. (*c*) Check back to (*a*) and adjust more accurately by micrometer. (*d*) Check back to (*b*) and adjust more accurately by micrometer. Repeat these operations if necessary until with consecutive switch reversals no movement of the galvanometer takes place, and hence the two balancing points are definitely obtained." The novel point of a movable slide wire has for its object the fact that, whereas in the ordinary way with a fixed wire any alteration of potential in either "measuring" or "comparison" circuits entails either rheostat adjustment or a readjustment of both slides, in this instrument any alteration of potential can be rectified by adjusting or altering the position of the slide wire itself, so leaving the sliders the same relative distance apart. In this manner two separate adjustments (with readings to be taken and noted at each) are replaced by a single movement simply and quickly performed without the necessity for readings or pencil work—Lond. *Elec*, March 6.

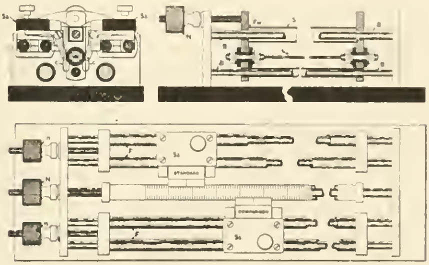


FIG. 3.—ELEVATIONS AND PLAN OF RESISTANCE COMPARATOR.

Electric Clocks.—H. H. Cunynghame.—In the last of a series of Cantor lectures on the theory and practice of clock making the author discussed electric clocks, which he regards as the clocks of the future. The main advantages of electrical clocks are that the wheel train is done away with altogether, and they are much cheaper and simpler. The great obstacle is to get a constant battery, one that will continue in good working order for four or five years. He advocates the use of large-sized Daniell cells of the gravity type Electric clocks may be divided into several groups. The earliest form was to have an electromagnet which attracts a mass of iron placed at the end of the pendulum rod The drawback to this system is that in making and breaking contact, the spark which occurs tends to oxidize the metal and creates an imperfect contact.

One of the first attempts to obviate the difficulty of a constant battery was made by Hipps. This system, known as the Hipps butterfly escapement, consists of a pendulum having an armature at its end moving over contact springs; to the pendulum is attached a flipper which, when the swing of the pendulum becomes too slow, causes the pendulum to make contact with the springs and thus to receive an electrical impulse, which sets the pendulum moving again. This system does away with the difficulty of the want of constancy in the battery to a great extent, because the number of impulses are largely reduced. One clock of this type is still working satisfactorily at a Swiss observatory. In this case very great care has been taken to make the electromagnet of the finest iron. The author referred to a new clock of Fery, which works with a polarized bob, and the inventor believes he has obtained a really constant battery. Another class of clock is that known as train remontoir, or self-winding clocks, the general principle of which is that a falling weight operates a tumbler switch, which closes an electric circuit, and puts into motion a motor which winds the clock up, the circuit being broken when the weight makes another contact at the end of the wind. There are many systems of this nature, including those of Allen, Webber and Hope Jones. Next there is the "Magneta" system, which is based upon the principle adopted by Wheatstone in his early telegraphic experiments, in which he dispenses with the use of a battery and contacts. Against this advantage is the disadvantage that the clocks have to be wound up every day, although, of course, this can be accomplished electrically if necessary. A new system is the Cunynghame-Hope Jones electro-gravity detached escapment, in which a flipper on the pendulum catching in a small arm frees it and allows it to drop upon a finely jeweled roller fixed to the pendulum, and this gives the latter an impulse forward. The arm is only weighted with 1½ grams, but the armature flies forward on to the arm in such a violent way that an excellent contact is secured. Mr. Cunynghame stated that he has had this arrangement under test, and has never known the electrical part to fail. As to electric synchronization, he regards as the most simple arrangement that adopted by the Standard Time Company, in which an electromagnetic plunger drops into a cam on the minute hand and thus corrects it if either slow or fast. Cornu's method is very similar. Another plan, invented by Rudd, involves the use of two pendulums, one for time measuring and the other for the working pendulum. If the working pendulum is working inaccurately, it is corrected each hour by the time pendulum.—Lond. *Elec. Eng'ing*, Feb. 27.

Wehnelt Interrupter.—E. Renz.—An illustrated description of a device for dampening the noise of the Wehnelt interrupter during operation.—*Elek. Zeit.*, Feb. 27.

Miscellaneous.

Electric Monopoly in Germany.—E. H. Geist.—A report made to the Central Association of German Manufacturers on the proposition that the German government should take over the generation and distribution and sale of electrical energy. It is considered to be the domain of the government to carry out anything that serves the general public and from this point of view one should decide theoretically in favor of a government monopoly of electricity. But this could not be done right away without serious trouble, since numerous people would be damaged and the government could not pay fully for the damage it would do. On the other hand, the government would have to take over installations which would not be profitable. The author thinks, however, that it is proper to consider the government monopoly of electricity as an ideal goal to strive for. For the present it should be well to pass laws which would give the government the right of utilizing or buying water powers and coal mines, also electricity stations already existing or in course of erection, and the right to exert its influence on the erection of new electric stations; also the right to buy up electric street railways and to operate them (though it might be advisable that the state would only furnish the current for traction and that the street railway operation would be left to the municipalities). It is believed that when power plants and railways are taken over by the state gradually in course of time, it will be possible for the government to very greatly reduce the cost of energy production so that more and more people who now have their own isolated plants would find it profitable to buy their energy from the government. In this way a natural foundation would be laid for the government monopoly, which then could be created by law without doing damage to anybody.—*Elek. Zeit.*, March 5.

BOOK REVIEWS.

Colorado Springs Lighting Controversy. A Compilation of the Records of the Colorado Springs Lighting Controversy, with an Introduction and Epitome. By Henry Floy. New York: Illuminating Engineering Publishing Company. 327 pages. Price, $4.

One of the most interesting cases of litigation that has arisen in central-station history was that incident to a controversy between the city of Colorado Springs and the Pike's Peak Hydro-Electric Company. The principal issues presented were the meaning of the phrase, "An arc-light of standard 2000 candle-power," and the monetary damage accruing from the substitution of a 6.6-ampere series alternating-current arc lamp for "an arc lamp of standard 2000 candle-power." To determine this and other points involved, arbitration proceedings were finally resorted to, and the present volume gives a record of these proceedings, together with other matter relating to the case. The arbitration committee consisted of Prof. S. G. Carpenter, Mr. E. L. Elliott and Mr. Henry Floy, the author of the present volume. During the proceedings more than a dozen authorities and experts on electric lighting and illumination were examined on the stand, among whom were Dr. Bell, the late Prof. C. P. Matthews, Prof. J. C. Shedd, and Messrs. L. B. Marks, Alton D. Adams, R. F. Schuchardt and W. D'A. Ryan.

In an introductory section, the author gives a historical résumé of the case, together with comments on its main features and conclusions, in which latter excellent advice is given to central stations concerning the form of agreements with municipalities for public lighting. The report of the testimony comprises the greater part of the contents of the book, and in view of the standing of those who were examined and the nature of the subjects considered, this portion forms a contribution of high value to the literature of arc lighting from both the technical and commercial sides. A most interesting part of the testimony relates to the comparative efficiency of enclosed- and open-arc lights, concerning which exact figures from numerous tests were submitted. It was shown, for example, that the candle-power of the maximum ray of the full open arc lamp is not 2000, as is generally believed, but in the neighborhood of 1300; that the consumption of this lamp is about 1 watt per candle, while the consumption of the alternating-current enclosed arc may reach 3 watts per candle.

The book will be of particular value to central stations having municipal contracts for street lighting, as at some future time they may have to confront one or more of the issues of the Colorado Springs case; and all central-station and electric-lighting engineers will find a mine of useful information in the record of the testimony given by the long roll of authorities and experts.

Stationary Steam Engines. By William H. Fowler. Manchester, England: The Scientific Publishing Company. 299 pages; 326 illustrations. Price, 12/6 net.

The title of the book should be "The Design of Stationary Steam Engines," because the treatment is confined almost exclusively to a description of design details, with just enough matter relating to operation to guide the designer in his task of producing a successful engine. The properties of steam and the characteristics of boilers are not dealt with, although some information is given concerning condensers. The matter is a reproduction of articles which have appeared at various times in the columns of the *Mechanical Engineer*. A valuable feature of the book is the numerous working drawings which relate to correctly designed machines. These drawings have evidently been selected with great care, and they cause the book to be well suited for designers and builders.

Suction Gas. By Oswald H. Haenssgen. Cincinnati: The Gas Engine Publishing Company. 88 pages, 4 illustrations. Price, $1.

In view of the increasing importance of gas engines in generating station work, information concerning the production of gas becomes more and more desirable. The present book covers the design, cost of running, development and possible utility of suction gas producers and engines. Descriptions are given of the gas generator, the vaporizer, the cooler, the condenser, the purifier, the regulator and the suction gas engine. Hints are given concerning the operation of the entire plant, and estimates are made of the cost of producing energy. The estimates are based largely on European conditions and probably are not applicable in this country, but this fact does not lessen the value of the technical information contained in the book.

Continuous-Current Engineering. By Alfred Hay. New York: D. Van Nostrand Company. 327 pages, 183 illustrations. Price, $2.50 net.

In this book Dr. Hay has exercised to excellent advantage his ability to describe electromagnetic phenomena in simple terms without sacrifice of accuracy. He has omitted many of the details, a recital of which would have led merely to confusion on the part of the reader, and has laid special emphasis on the features of real importance. In addition to direct-current generators and motors, both the design and operation of which are well covered, the book deals with storage batteries, lamps and photometry. The numerous hints as to constructive details and design constants render the book a convenient manual for reference. The work has been prepared for use as an introductory text on continuous current engineering; it is exceptionally well arranged for this purpose.

Introduction to the Study of Electrical Engineering. By H. H. Morris. New York: John Wiley & Sons. 404 pages; 179 illustrations. Price, $2.50 net.

The author states that the plan of this work is to take the every-day experience of the student as the basis of a general survey of electrical application. The treatment covers fundamental electrical and magnetic quantities, materials of electrical engineering and magnetic circuits, construction and operation of generating station, transformers and motors, and their applications, electric lighting and heating, electrical measurements, and the transmission of intelligence. The method of treatment, which is very unusual, will find many advocates and probably equally as many opponents. The author has used excellent judgment in the selection of material, and extreme care has evidently been exercised to render the treatment accurate in thought and in the expression thereof. In fact, from the standpoint of simplicity in language and correctness in terminology, the book is one of the most satisfactory that has come to the reviewer's notice. The book is lacking in depth (according to the stated desire of the author), but the accuracy of presentation more than compensates for this deficiency. The conscientious use of the book will give to the student a solid foundation for further analytical work.

Practical Physics. By W. S. Franklin, C. M. Crawford and Barry MacNutt. New York: The Macmillan Company. Vol. I, 173 pages, 75 illustrations; price, $1.25 net. Vol. II, 160 pages, 71 illustrations; price, $1.25 net. Vol. III, 80 pages, 49 illustrations; price, 90 cents net.

For the convenience of the students this manual is issued in three small volumes. The first deals with precise measurements and experiments in mechanics and heat; Vol. II treats of elementary and advanced measurements in electricity and magnetism, while Vol. III is devoted to photometry and to experiments in light and sound. In Vol. I excellent suggestions are made as to the procedure in the laboratory and the treatment of data. The method of assigning an experiment to each student at the completion of a laboratory period so that he may prepare in advance for the experimental work is of great importance with reference to the economy of time spent in the laboratory. Carried to its limit, this method might render the student merely a collector of instrument readings for record on his data sheet. A student may sometimes learn more from the mistakes he makes and is forced to correct. When supervised by competent instructors, who carefully examine the reports of the experiments, the method should prove highly advantageous.

The main subject matter of the manual deals with 133 well chosen experiments in physics. With a few exceptions, the experiments do not require expensive equipments, so that the manual can be used in almost any physical laboratory. Moreover, although the statements and the explanations are unusually accurate, they are worded in simple concise terms, the meaning of which can be appreciated by any student. The manual could be rendered more complete and instructive by including more tests on magnetism, magnetomotive force, electromagnetic torque, concerning which the treatment in the usual laboratory text is either confusing or misleading, and Vol. II of the present manual is almost silent. The arrangement of the manual is excellent, and it should prove acceptable to instructors and students in all schools maintaing physical laboratories.

High-Voltage Oil Circuit-Breakers.

An interesting installation of what is said to be the first 75,000-volt automatic, oil circuit-breakers that have been placed in regular service on any transmission system is shown herewith. The circuit-breakers operate without the use of series transformers and the illustrations show the breakers as installed in the Edison Electric Company's substation at Fernando, Cal. In the construction of the mechanism of this switch, the movable contacts, which are of the knife-blade type, constitute part of a simple pantograph, the lower part of which is pivoted to the metal cap of the central insulator and the upper part to the end of a wooden rod, which is attached to a special porcelain insulator secured to the channel iron cross-bar. A vertical movement of the cross-bar imparts a horizontal movement to the ends of the blades as they leave the fixed contacts, these ends being brought together in the center of the tank in the open position of the switch. The cross-bar is carried on two guide rods placed in cast-iron frames between the tanks, as shown in the illustration, the vertical movement being given to it by means of a rocker shaft beneath the central tank, on which are two arms which are connected to the lower ends of the guide rods by means of links. The counterweight is also mounted on the rocker shaft. Coil springs for opening the breaker when tripped are placed in each cast-iron frame between the tanks, where they operate directly on the guide rods. The tanks are of iron, and the covers of marble, made in two pieces, either one or both of these pieces being removable, without disturbing anything else, for the purposes of inspection.

The circuit-breakers shown in the illustration are arranged for hand closing, the handle being carried loosely on the rocker shaft and connected to the closing mechanism by means of a short lever and a dog, the dog being released by the action of the tripping mechanism in the event of an overload or short-circuit. The tripping mechanism, which is very simple in design, is set in motion by any one or any two of the trip coils independently, or by all three acting together, and is automatically reset each time the circuit-breaker opens.

The trip coils, consisting of only a few turns of wire of small diameter, are placed directly in the line, being suspended from the insulators of the disconnecting switches and supported by the connection to the switch terminals. The movable core has a very long creepage surface, approximately 60 in., and a dielectric strength of at least three times the line voltage, thus giving the insulation of the coils a very much higher factor of safety than that of the best series transformers.

These circuit-breakers have been installed in the substations on the Edison Electric Company's 75,000-volt transmission line from Kern River to Los Angeles, and have operated automatically numerous times with success. They are manufactured by J. N. Kelman, 1000 North Main Street, Los Angeles, Cal.

HIGH-VOLTAGE OIL CIRCUIT-BREAKERS.

Fly-Wheel Motor-Generator Sets for Operating Electric Hoists in the Kendall Mines.

An electric-hoist equipment recently installed by the Kendall Gold Mining Company in a mine of the North Moccasin Mountains, Mont., is designed to prevent intermittent load on the hoist from causing fluctuations in the electrical distribution system. The Kendall group of mines is operated by electric power supplied by a hydraulic power-house equipped with one pair of 23-in. turbines direct-connected to a General Electric revolving-field alternator of 400-kw capacity, 6600-volt, 60 cycle, three-phase. The power house is situated about two miles from a never-failing warm spring having a delivery of 8500 cu. ft. of water at 170 deg. F. all the year around.

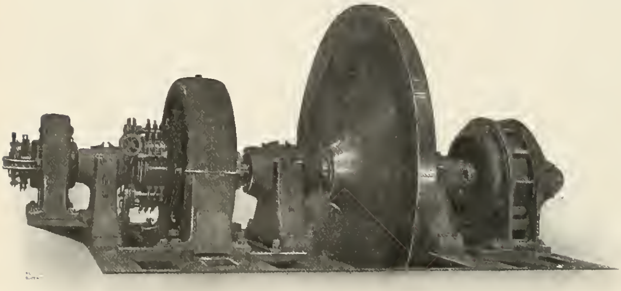


FIG. 1.—FLY-WHEEL MOTOR-GENERATOR SET FOR MINE HOIST.

The transmission line has a total length of seven miles and operates at the generated voltage of 6600 volts. There is a 100-hp General Electric induction motor which drives a Gates crusher, three sets of 15-in. x 26-in. Gates high-grade rolls, one Jeffery jig screen and two large belt elevators. This outfit has a reduction capacity of 500 tons per 24 hours. Besides these, there are installed one 30-hp, one 15-hp, three 10-hp and four smaller General Electric induction motors driving conveyors, centrifugal pumps, exhaust fans, elevators, drill presses, etc. A 75-hp induction motor is used for driving a seven-drill air compressor.

For hoisting the ore from the different levels there is a double drum made by the Denver Engineering Works. The hoisting equipment is designed to raise 2000 lb. of ore from a 1000-ft. level every 103 seconds when operating two drums, and every 170 seconds when a single drum only is in operation.

The mine shaft has two compartments, and extends vertically to a depth of 1000 ft. Two cylindrical drums are used, which are provided with the usual clutches for individual and combined running, each drum operating a compartment in which the weight of the rope is always balanced by an individual tail rope, whether the other compartment is working or not. This rope is 1 in. in diameter and weighs 1.6 lb. per foot. The hoisting speed is 1000 ft. per minute. Each compartment is supplied with one skip weighing 1400 lb., and having a capacity of 2000 lb. or ore.

Theoretical curves of horse-power input to the hoist, when running one compartment (unbalanced operation) and two compartments (balanced operation), both show an unusual demand for power which occurs during the period of acceleration.

The capacity of the generating station being somewhat limited, the large rush of current incident to starting and acceleraing the hoist tends to produce undesirable voltage fluctuation in the system, and the equipment here described was designed to eliminate this trouble and improve the regulation of the line.

To this end an outfit was supplied which permits of the most perfect speed control, allowing the load to be accelerated as rapidly or as gradually as desired. The equipment was also supplied with a means of equalizing the demand upon the power system, so that instead of being intermittent in character it is practically constant.

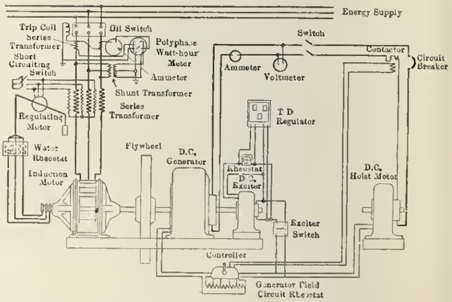


FIG. 2.—DIAGRAM OF CONNECTIONS OF FLY-WHEEL MOTOR-GENERATOR SET.

The system of control has the further great advantage of electrically-braking the load in a manner which not only gives complete control over the retardation of the moving parts of the hoist, but also returns a considerable portion of their kinetic energy to the fly-wheel.

The hoist equipment comprises a shunt-wound direct-current motor, arranged to be geared to the hoisting drums, the motor receiving its power from a motor-generator set driven from the main power system. This set consists of an induction motor and a direct-current generator with a fly wheel swung between them, and a direct-current exciter overhung at one end. The function of this latter machine is to excite the field of the generator and that of the direct-current hoist motor. The direction and speed of rotation of the latter machine is controlled by reversing and varying the strength of the field of the direct-current generator by means of a rheostatic controller, which is conveniently located for the hoist operator.

In this set the induction motor is a three-phase, 60-cycle, variable-speed machine of the collector-ring type, while the direct-current generator is provided with commutating poles and is so designed that it will commutate heavy currents with weak fields.

The fly-wheel is a steel casting, machined all over and perfectly balanced; it weighs about 12,000 lb. and operates at a peripheral speed of about 18,000 ft. per minute. The wheel is used to store energy when the hoist is not in operation, and gives up this energy when the demand on the line is at a maximum.

To obtain this effect on the part of the fly-wheel of alternately storing and surrendering energy the induction motor is arranged for variable-speed operation, changes in speed being automatically controlled by the variation of the main line current, which is led through a small three-phase regulating motor operating a water rheostat in series with the secondary winding of the motor.

The torque which is produced by the full-load value of the main line current in the windings of the regulating motor is exactly balanced by the weight of the moving parts of the water rheostat, so that there is no change in the resistance that is in series with the rotor winding of the motor-generator set so long as the motor is taking full-load current. If, however, it should demand more or less, there is an immediate change in the resistance of the water rheostat, tending to accelerate or retard the speed of the motor-generator set to such a point that the induction motor once more takes full-load current. The voltage of the exciter is maintained at a constant value during the speed variation of the motor generator set by means of a Tirrill regulator.

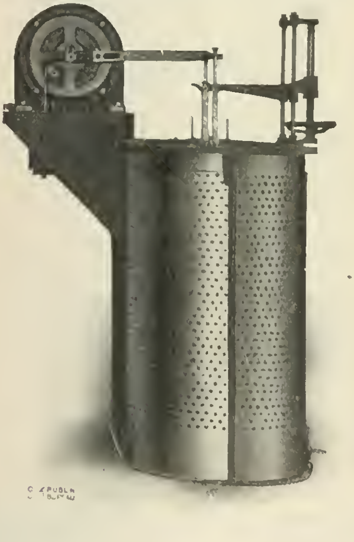


FIG. 3.—AUTOMATIC SLIP REGULATOR

The company's plant has sufficient capacity to furnish the Barnes King Development Company with power for operating an outfit of motors similar to that used at the Kendall Mines, and also power for lighting the town of Kendall. All of the electrical apparatus installed has been furnished by the General Electric Company, Schenectady, N. Y.

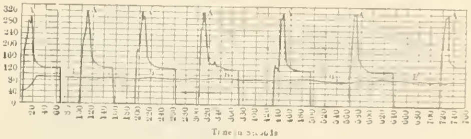
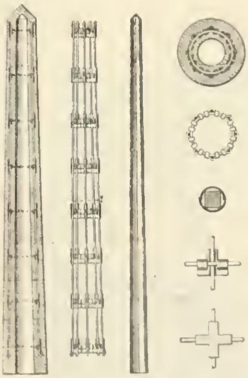


FIG. 4.—CURRENT INPUT TO MOTOR AND CURRENT OUTPUT FROM GENERATOR OF FLY-WHEEL SET.

The operating force is composed of H. H. Lang, superintendent of Kendall Gold Mining Company and general manager of North Moccasin Gold Mining Company; C. A. McLain, mine foreman; E. F. McLean, mill foreman; L. O. Wilson, electrical engineer; A. B. Fox and E. S. Kinney, bookkeepers and Joseph Coyne and Bryan Bradley, assayers.

Hollow Reinforced-Concrete Pole.

The accompanying illustrations show the details of a hollow reinforced concrete pole designed by Mr. F. H. Tidnam, manager of the Oklahoma Gas & Electric Company, of Oklahoma City, Okla. The inventor claims that the cost of these poles is the same as for wooden poles of similar size. The framework or cage for the pole comprises longitudinally-extended wires or rods clamped in place as indicated. A core is inserted within the cage before the concrete is poured, and after the latter has set, the core is withdrawn, thus making a pole light in weight without sacrificing strength. Fig. 2 shows one of these poles close to a wooden pole of the same size. The advantages of concrete poles over wooden poles, aside from strength, are improved appearance and durability.



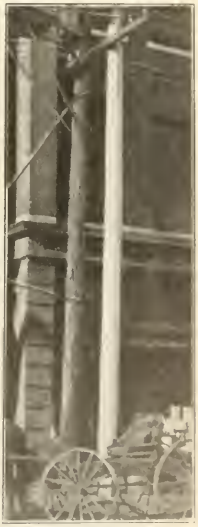


FIG. 1.—DETAILS AND COMPLETE POLE.

Vacuum Electric Massage Vibrator and Shampoo Comb.

The accompanying illustrations show a vacuum massage vibrator and shampoo comb made by Harvey & Hill, Flatiron Building, New York. The outfit consists of a small direct-current electric motor which is direct-connected to a blower and exhauster. The former gives a current of air under pressure and the latter is capable of maintaining a vacuum of about 5 in. The vacuum side is connected to a vibrator, which may be provided with three different sized cups, each of which is suited for particular parts of the body. At the top of the vibrator is a valve for regulating the amount of suction. The motor is provided with a pair of slip rings connected to certain commutator bars so that an alternating current at frequency of about 15 cycles is fed to the solenoid for imparting the necessary motion to the vibrator. A three-step resistance in the top of the vibrator permits of as many distinct pressures or degrees of strength to the vibrating motion. The feature of this type of massage machine is that instead of the usual hammer blow, the flesh is sucked up into the cup so that the peculiar muscle working and pulling effect of hand massage is obtained. The shampooing comb is of hollow metal, and air under pressure passes through it and out of holes in the ends and sides of the teeth. By this means the scalp may be cleaned, the hair dried, or lotions applied to the roots of the hair. The back of the comb is provided with an electric heater so that the air, lotions, etc., may be heated if necessary. In addition a plug connects the comb with the alternating-current circuit from the motor so that electric scalp message is also possible. The outfits are made in three different sizes.

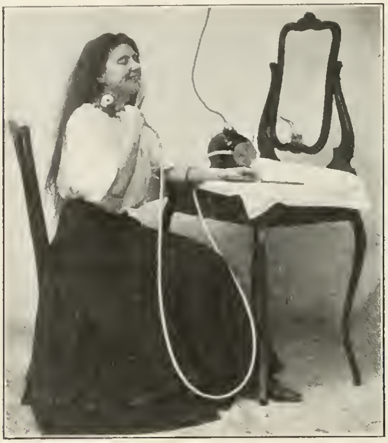


FIG. 1.—VACUUM MASSAGE VIBRATOR.

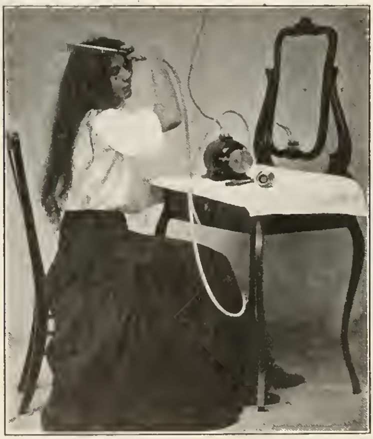
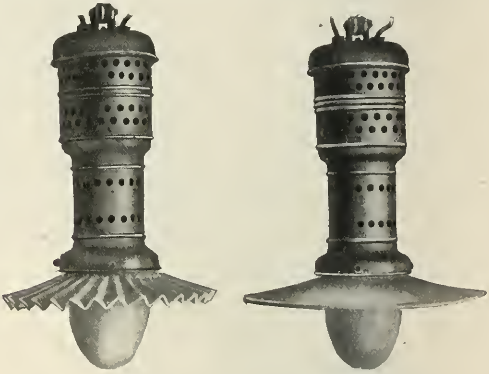


FIG. 2.—SHAMPOO COMB.

Acme Arc Lamp.

Queen & Co., Philadelphia, have placed upon the market the lamp shown in the accompanying illustrations, known as the "Queen Acme Arc," which is claimed to stand alone in current economy and in the quality of its light, resembling daylight, while its freedom from all flickering admits of work being done that would be impossible under the ordinary arc lamp. The decorative appearance of the lamp and its small size, being only 15 in. over all, renders it especially suitable for hotels, shop windows, reading rooms, ball rooms and all other places where strong light is needed, yet where the ordinary heavy and cumbersome arc lamp is impossible. Its short length also allows it to be used in factories with low ceilings, hitherto found so difficult to light. Wherever true color values are to be maintained, as in color-printing plants, textile mills, dry goods stores and art galleries, the Acme arc is claimed to be particularly advantageous.

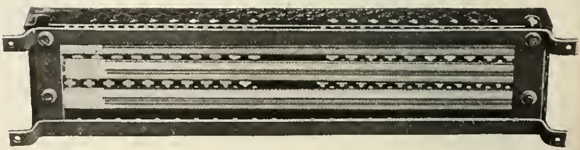


FIGS. 1 AND 2.—ACME ARC LAMP.

The lamp equipped with opal globe and reflector is stated to give 800 candle-power at 2.5 amperes; with clear globe and reflector the candle-power is 1500 at 2.75 amperes, and 1000 candle-power with opal globe at 2.75 amperes. The lamps are differently adjusted, taking from 1.5 to 3.5 amperes and used in 110- and 220-volt direct-current and alternating-current work also. The lamp can be used equally well for indoor and outdoor work.

Automatic Resistor for Arc-Lamp Circuits.

The accompanying illustration shows a rheostat, the resistance of which varies automatically, which has been developed by Heinrich Beck for use in series with arc lamps. The resistor material is iron, which, as is well known, possesses a high temperature-resistivity coefficient. An iron wire, whose



AUTOMATIC RESISTOR.

resistance varies greatly with a change in temperature and therefore with a change in the current, is kept taut by means of springs to prevent sagging when it becomes hot; it is mounted in a glass tube containing hydrogen gas, so that the wire does not oxidize or disintegrate.

The resistor complete, as illustrated, consists of three units connected in series and held within an iron frame provided with suitable binding posts. As indicating the effectiveness of the device, it is stated that when the resistor was connected in series with two flaming arc lamps designed for a normal current of 8.75 amperes at 110 volts, the current increased to 9 amperes when the e.m.f was raised to 120 volts, and it decreased to 8.50 amperes when the e.m.f. was lowered, the total change in current being only 6 per cent for a change in e.m.f. of 20 per cent.

These automatically regulating resistors, known by the trade name "Reglers," are handled by Louis J. Auerbacher, 488 St. Nicholas Avenue, New York, the American representative of the manufacturer.

Electrically-Driven Coffee Grinders.

A number of types of electrically-driven coffee grinders are being placed on the market by the A. J. Deer Company, of Buffalo, N. Y.; those intended to be operated from alternating-current circuits being equipped with Emerson motors of the full-load automatic-start type. One style of grinder widely used is shown in Fig. 1, and a combination coffee grinder and meat chopper is shown in Fig. 2. The coffee grinders are provided with sharp knives which cut the bean without crushing it so that the oil cells are not broken and the caffeine does not evaporate. The coffee mills are made in twenty-two different styles and being widely advertised by the manufacturing company are among the numerous devices for household service often found connected to domestic electric-lighting circuits.

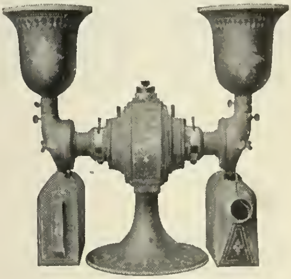


FIG. 1.—COFFEE GRINDER.

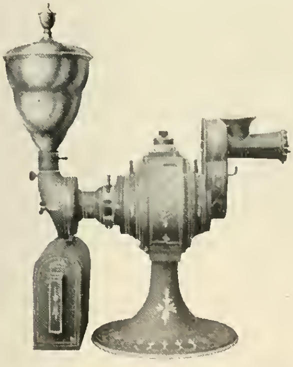


FIG. 2.—COMBINED COFFEE GRINDER AND MEAT CHOPPER.

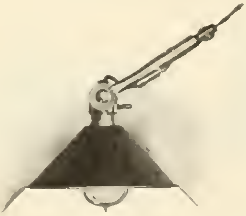
Electrical Equipment for Santos, Brazil.

The Companhia Docas de Santos (Santos Dock Company) through whose docks most of the coffee exported from Brazil passes, has recently placed a large order with the General Electric Company for the complete electrical equipment of its substation and docks at Santos. The order is comprehensive and includes six 3000-kw, water-cooled, three-phase, 60-cycle, 40,000-6600-volt transformers, a 23-panel switchboard and the necessary cables and wiring supplies. The order also includes five 50-light, constant-current transformers, 208 series arc lamps, 420 multiple arc lamps, a large number of induction motors for operating air compressors, hoists, cranes, etc., and a large number of oil-cooled transformers.

Besides furnishing power for the docks, the substation will also supply energy for light and power to various other enterprises thereabout. Power is supplied at a line potential of 40,000 volts by a hydro-electric plant some 35 miles from Santos, the equipment of which was furnished by the General Electric Company some two years ago.

Adjustable Incandescent Lamp Support.

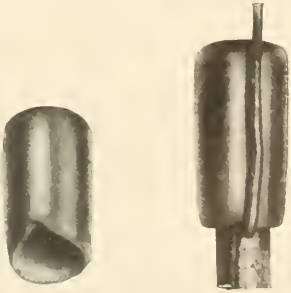
The accompanying illustration shows a simple and rugged support used in connection with drop-cord circuits for directing the light from incandescent lamps to any desired angle. The device is easily attached to a lamp cord, and may be used in connection with any style of shade. It is especially adapted for use in machine shops, factories, draughting rooms, shipping rooms, offices, bank vaults or in any other place where concentrated light is required. The Electric Specialty Company, of Cleveland, Ohio, is the manufacturer of the support, which is made of steel, properly insulated.



LAMP SUPPORT.

Ground Pipe Cap.

A number of central-station companies, of which the Commonwealth Edison Company, of Chicago, is one of the largest examples, ground the secondaries of transformers and lightning arresters by driving a long length of $\frac{5}{8}$-in. galvanized iron pipe into the ground at the base of the pole. The matter of getting a good connection between the top of the pipe and the ground wire leading down the pole has been troublesome. There has also been trouble with battering the end of the pipe by driving



FIGS. 1 AND 2.—GROUND PIPE CAP.

upon it so that the end had to be sawed off before the electrical connection was made to the top. The G. & W. Electrical Specialty Company, of 128 West Jackson Boulevard, Chicago, has just brought out a malleable, cast, galvanized-iron pipe cap shown in Figs. 1 and 2. The wire is doubled inside the cap and is made tight by driving on the cap. The cap also keeps the end of the pipe from being battered during driving. After the pipe is driven, the wire is bent up as shown in Fig. 2. The cap has an interval groove along one side for the wire. The form of the inside of the cap has been made a matter of considerable study in order to get a shape which will hold the wire firmly and make a good electrical contact, and at the same time will not cut the wire when driving on of the cap is first started. The cap is made for a ⅝-in. pipe, and when No. 6 wire is used the wire is doubled to make a good joint. When No. 4 wire is used doubling is not necessary. Joints so made show a voltage across the joint of .0114 with a current of 50 amperes.

Non-Replaceable Fuse Device.

In order to furnish a better protection against fires caused by overloaded electric circuits, Mr. G. E. Painter, of Baltimore, Md., has lately brought out a non-replaceable fuse device. As shown in the illustrations, the general appearance of the device is very similar to the fuse blocks now in use, the only difference being that an extra fuse is connected in series with the fuse terminals for the ordinary type of fuses, and is placed in the bottom of the device. The non-replaceable fuse is intended to have a current-carrying capacity about 10 per cent greater than the fuse block is designed to carry, so that it will not blow as long as the block is properly fused. In case a fuse having a higher rating than the non-replaceable fuse is inserted in the clips, or the terminals bridges with wire, etc., the non-replaceable fuse will blow on an overload, short circuit, etc., and inasmuch as the fuse cannot be renewed, a new fuse block becomes necessary. As at present constructed, cut-outs will take fuses rated as high as 30 amperes, and while at the time of inspection all the different branch circuits are tried out to see that they are not over-fused, it is an easy matter to insert larger fuses so as to permit the circuits to carry heavier loads. In the type of fuse device shown, overloading of the circuits after the work has been inspected is checked. Fig. 1 shows the fuse plug receptacle on the left and at the right the non-replaceable fuse in the bottom. The fuse plug shown alongside of the receptacle reveals the usual way of bridging this type of fuse. Fig. 2 illustrates a straight-line fuse block fitted with the non-replaceable fuse. The terminals for the wires are inside of the porcelain, so that it is not easy to short-circuit at this point.

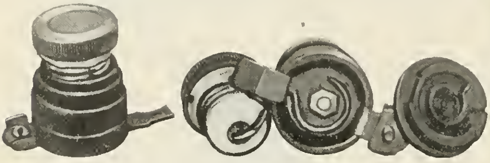


FIG. 1.—DETAILS OF FUSE PLUG RECEPTACLE.

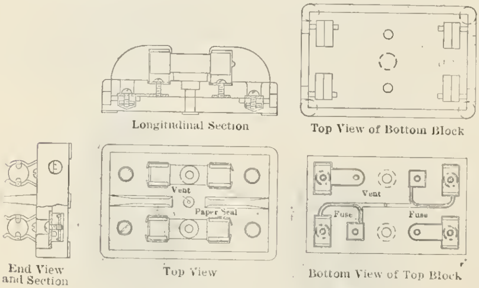
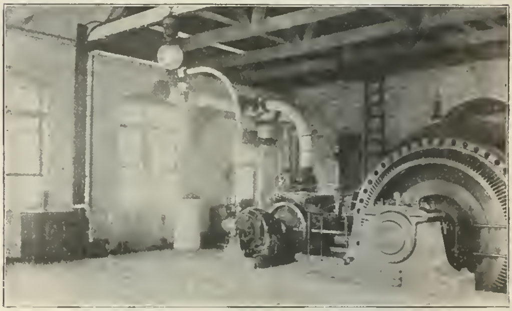


FIG. 2.—NON-REPLACEABLE FUSE BLOCK.

Continuous Lubrication System.

It is generally recognized that oil filters and continuous lubrication systems are conducive to economy in power-station operation. For this reason filters and oiling systems are usually found in all modern stations. The accompanying illustration shows an interior view of the power house of the McKell Coal & Coke Company, of Glen Jean, W. Va. This company operates a number of collieries scattered at convenient points over a tract of several thousand acres. Electricity for operating these numerous mines is supplied from a central power plant, high-tension alternating current being transmitted to scattered substations where it is transformed and converted into low-tension direct current. The illustration shows the first 500-kw unit in the power house, and at the left may be seen a duplex-type oil filter and the circulating pump of a continuous oiling system used for lubricating all the bearings. Overhead, among the roof trusses, a reservoir is placed from which pipes lead to feeds fitted to all the bearings. All oily drips are drained to a tank beneath the engine-room floor from which they are automatically lifted to the filter. After being thoroughly cleaned the oil is pumped back to the overhead reservoir to be used over again. The "White Star" filter and continuous oiling system made by the Pittsburg Gage & Supply Company, of Pittsburg, Pa., are in use.



POWER PLANT OF A WEST VIRGINIA MINE.

Convenient Soldering Fluxes.

For convenience, prepared soldering fluxes are put up in a number of forms—sticks, paste and liquid. The first form is used for general ready soldering where the parts are more or less accessible; the second form satisfies the demand of "out-of-reach" jobs where the stick would be unhandy, and the last form suffices where the flux is to be applied with a brush or squirt can, or the parts soldered are to be dipped in a bath of the flux. The L. B. Allen Company, of Chicago, Ill., manufactures all the forms mentioned, and they are claimed to be non-corrosive. The soldering sticks are 5 in. long and ⅞ in. in diameter. The preparation is rubbed on the heated joint; the solder being applied in the usual fashion. The soldering paste is applied to the joint to be soldered with a rag, splinter or finger and without any preliminary scraping. This form is used chiefly on big joints for electric-light wiring, switchboards, heavy cable work, etc., where this form of flux saves much time. The non-acid fluid flux consists of a solution of soldering salts into which the article soldered is dipped, or which may be applied with a brush or squirt can. This form of soldering flux is used considerably in general commutator and armature work. As is well known in electrical work, the problem is to secure an electrical as well as a mechanical joint. To satisfy this requirement the flux must not destroy or corrode the metal. Tests made with the Allen preparations are claimed to have shown excellent electrical properties and to have given a strong mechanical joint as well.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade in the primary branches was quiet, and operations in industrial lines during the last week was below normal. The opening of spring saw an expansion in retail trade, but fall trade was backward. The weather conditions were favorable to farming activity, and the reports from the winter wheat crop continue excellent. The earnings of the railways continue to grow less, and bank clearings show heavy decreases, not only from last year, but a decrease also from last week of 7 per cent. The stock market continues to advance, collections show a little improvement, but are still far behind, though money is easier. As compared with last year, the lumber manufacturing trade is very quiet, and current production is far below 1907. The iron and steel markets are slightly more dull than two weeks ago, but the general tone is optimistic, although everything depends upon the willingness, or rather the ability, of railroads to purchase supplies, which they do not seem inclined or able to do at present. In ordinary times the railroads consume about 60 per cent of the iron and steel output, but during the last 10 days there has been a halt in the improvement which has been taking place since the beginning of the year. The demand for structural material is light, but a number of large orders have been given out, and there is prospect of a rather heavy tonnage. *Bradstreet's*, for the week ending March 26, reports 286 business failures, against 303 last week, 166 in the corresponding week in 1907, 169 in 1906, 227 in 1905, and 212 in 1904. Inquiries made among the various electrical interests show a healthy and optimistic condition in that line. The General Electric Company during the last month has increased its rate of business from the rate of about $30,000,000 a year to $50,000,000, and the Western Electric Company is experiencing a considerable increase in the demand for telephone apparatus owing to the fact that its customers, the telephone companies, have stocks unusually depleted, while the comparatively new policy of the company in selling to independents is stated to be beginning to assume considerable proportions. The Westinghouse Electric Company is booking orders at the rate of $1,500,000 a month, most of which are small orders. Each month since December the company has shown improvement over the preceding month, and it is expected that the March total of orders will reach $1,800,000. The company has increased the working force about 20 per cent, and the receivers have effected important operating economies which will save between $750,000 and $1,000,000 yearly. The efforts to rehabilitate the various new Westinghouse companies are reaching a satisfactory conclusion. The copper wire business, while much behind the same period of last year, shows considerable improvement, and coincident with the advance in brass prices the manufacturers of copper wire have raised their list of quotations to a basis of 13½c. copper, this advance, as in the case of brass, being the first made by the manufacturing interests in many months. A single sale of 3,000,000 ft. of copper wire was made in Boston last week by one of the large companies dealing in that line of goods. The export demand continues heavy, in many instances being a considerable percentage over the export trade for the same week in 1907.

THE MacGOVERN-ARCHER COMPANY, New York, has been formed to transact the same kind of business, namely, the buying and selling of electrical and steam machinery, as was carried on by the old Rossiter-MacGovern & Company for the past 12 years. Mr. MacGovern entered the electrical field when barely 23 years of age and at once organized the firm of Rossiter-MacGovern & Company. At that time, the buying and selling of electrical machinery of modern design that had seen some service, but by reason of rapidly changing conditions was somewhat out of date, was in its infancy. Mr. MacGovern was quick to see the possibilities offered by reason of the number of consolidations that were being effected in both the street railway and lighting field which was displacing a large amount of first-class apparatus. The result was that he rapidly built up the business to large proportions. Two years ago Rossiter-MacGovern & Company was reorganized and new interests were taken in with a view of extending operations into the contracting and construction field. This branch of the business unfortunately was not successful and it was deemed best for all the parties interested to apply for a receivership for the old company. Mr. Archer, who is associated with Mr. MacGovern, is well known in the street railway and lighting circles, having been with the old concern as sales manager for about six years. The new firm will adhere strictly to the handling of high-grade electrical and steam machinery.

ELECTRICAL PLANT FOR PINOS ALTOS MINES.—The Pinos Altos Mines Company, whose property is situated on the Chihuahua & Pacific Railroad in Mexico, and which has its own water-power, will install two 500-hp water-wheel-type generators in their generating stations, together with exciter, switchboard, lightning and line protection apparatus. The energy from this generating station will be transmitted about six miles at 6600 volts to a substation which will be equipped throughout with lightning protection and line apparatus, also step-down transformers and switchboard. In this receiving substation there will be also installed a motor-generator which will be used to convert the alternating to direct current for use in connection with a 3-ton mining locomotive, used to carry ore between mine and mill. A direct-current switchboard will be provided to control the railway generator and feeder circuits. Two 50-hp motors will be installed at the mill to drive the stamps, crushers, pumps, etc., together with two 20-hp motors, one 40-hp motor and one 30-hp motor and the usual circuit-breakers, switches, etc. In addition to the power equipment there will be a complete lighting installation. The Pinos Altos Mines Company is a Pittsburg corporation, and the sale of the apparatus described was effected by G. & O. Braniff & Company, agents in the Republic of Mexico for the Westinghouse Electric & Manufacturing Company.

GENERAL ELECTRIC ORDERS.—Among the orders recently received by the General Electric Company are the following: 300 four-motor equipments for the Chicago Railways Company; three 1000-kw, 2300-volt, 3-phase alternators for the Manchurian Railway, Corea; 25 600-volt motor equipments, and 40 oil-cooled transformers for the Sao Paulo Light & Power Co., Sao Paulo, Brazil. A shipment of two 50-kw cross-compound marine sets together with switchboards and necessary instruments has been made to Olongapo, P. I. These will be used in the U. S. Government dry-dock Dewey, which recently made the trip around Cape Horn. Another recent order is the electrical equipment for a dock and a sub-station of the Santos, Brazil, Dock Company, which includes six 300-kw transformers, a 23-panel switchboard, five 50-light, constant-current transformers, 628 arc lamps and a large number of induction motors.

CHICAGO MOTOR CONTRACTS.—Roth Bros. & Company, of Chicago, were the successful bidders on the large motor contract for the Federal Company, manufacturers of plumbers' supplies. There were a number of competitors in the field. The contract includes a total of about 40 motors, ranging from 1 horse-power up to 15 horse-power, some of which will be direct connected to machine tools and others will be employed for shaft driving. Roth Bros. & Company were also successful in securing the contract for eight motors and a generator for the Mercantile Steam Laundry's new plant, Chicago.

CHANGE IN GERMAN TELEPHONE RATES.—The German government, which owns and operates the telegraph and telephone systems of the Empire, except in Bavaria and Wurtemburg, proposes to change the present mode of telephone charges, according to a report of Consul-General Richard Guenther, of Frankfort. A certain fee for every call or conversation will be charged instead of a fixed sum per year.

SUSQUEHANNA POWER.—We are informed that the Susquehanna County Electric Power Company, Susquehanna, Pa., has a number of good sites for the location of industries with cheap electrical power available. The land would be given free to desirable parties. J. R. Harris is superintendent.

THE COPPER MARKET.—The boom in copper, heralded for some time, made substantial progress last week, if reported sales count for anything; but Monday's closing prices of 13¼ to 13⅜ were only about ⅛ of a point higher than a week ago. It is reported that a sale of 100,000 pounds of copper was made last week at 13¾c. a pound, and many fairly good-sized purchases at 13¼ were said to have been made, while the General Electric Company was credited with purchases to the extent of 6,000,000 pounds. Inquiries among the leading electrical interests in this city and elsewhere show that there has been no radical change in the general situation, nor have any of the larger concerns gone into the copper market for any great amounts. But the unmistakable improvement in business, and in the prospects of the electrical companies, is of considerable importance to the copper interests. In the last three years the three large electrical companies have consumed about 150,000,000 pounds of copper yearly, and adding the copper consumption of the lesser companies would bring the total to about 200,000,000 pounds per annum. All the three principal companies report more and larger orders, and an increased volume of inquiry which will result in business sooner or later. Many of the customers of the large companies have not been in the market for a long time, and it is practically certain that the next few months will see them again in the field. Reports from Boston state that all the large producing and selling interests are sold out up to date, and have no more spot copper on hand. Phelps Dodge were sold out some time ago, and the Lewisohns closed out their last half-million for New York export at 13¼. It is stated that the United Metals Selling Company cleaned up every pound of spot copper it had on hand, several days ago. During the week the foreign shipment continued much better than was expected. In the week ended March 21, there were exported from the port of New York 8,322,995 pounds of copper, all of which, except a trifle more than 1,000,000 pounds, was consigned to European ports. The week's shipments brought the amount of exports for the year up to about 155,000,000 pounds, and in the 26 weeks ended March 21, the total amount of copper shipped from the port of New York was nearly 365,000,000 pounds, an almost unparalleled amount On Monday there came a halt in the advancing movement of copper, and the fact was more evident that a copper "boom" requires to be backed by substantial buying orders. Quotations on the Metal Exchange closed on Monday as follows:

Lake	13 @13¼
Electrolytic	13 @13⅛
Castings	12¾ @12⅞

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	60	5	0	61	0	0
Standard copper, futures	60	12	6	61	7	6
Market	Easy.			Strong.		
Sales of spot				300 tons		
Sales of futures				1,400 tons		

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 10 0
London, futures	64 10 0	56 17 6
London, best selected	67 10 0	61 0 0

Reports from Michigan state that it is probable that the Lake Superior output of copper for 1908 will be about the same as in 1906, or about 230,000,000 pounds of fine copper, as compared with 210,000,000 pounds for 1907. Calumet & Hecla, which made 100,000,000 pounds of fine copper in 1906, and only 84,000,000 pounds last year, could increase production by about 1,500,000 pounds monthly without any great effort, and the Osceola mine could do better this year than last. The Baltic is the only other mine in that district in shape to increase production during this year. The production of the Baltic during the last half of the year should be about 2,000,000 pounds a month.

ELECTRICITY IN STEEL MILLS.—The new steel mills at Gary, Ind., furnish an indication of the great possibilities existing for the extension of the use of the electric motor. The Indiana Steel Company at that place is installing an electrical generating equipment which will supply current for motors which will run practically all of the machinery of the great plant. Gas engines supplied by waste gases will be directly connected to 2000-kw generators of both the direct-current and the alternating-current types. One of the most interesting features of the equipment is the remote-control, bench-type switchboard, which resembles somewhat the board now used in the generating station of the Electrical Development Company of Ontario, at Niagara, but differs therefrom in many mechanical details. All control switches are effectively interlocked, both electrically and mechanically. The main circuit switches are electrically operated either by motors or by plunger magnets. The direct-current generators will deliver energy to a storage battery, which will then distribute to variable-speed motors throughout the plant. A split-pole rotary converter will allow the alternating-current generators to assist the direct-current machines when necessary, or will cause the battery and direct-current machines to supply energy to the alternating-current system when desired. A commutating-pole booster controlled by means of a carbon regulator serves as a flexible link between the direct-current generators and the storage batteries. All of the apparatus throughout the mill will be motor driven, the largest motor being a 6000-hp machine for running the rail mill. On account of the desire to erect the mill with the least possible delay, the contracts for the apparatus were placed with a large number of companies, who have worked with the greatest possible speed in building the machinery. All of the large electrical manufacturing companies were awarded contracts.

Financial Intelligence.

THE WEEK IN WALL STREET.—Although, as a whole, the stock market during the week showed a gain, the trading was more professional than it has been at any time since the present bulge in prices began, and the speculative element stood out more conspicuously than heretofore. There were many indications that manipulative interests were at work, and the operation of cliques was particularly apparent. Since March 4 there have been only five days when prices on the Exchange have not advanced, and the gain during this period in the standard securities has averaged about 7 points. The decision of the Supreme Court against the legality of the Minnesota and North Carolina rate legislation, the President's message, which cheered by its mildness, and the reopening of the Knickerbocker Trust Company, were all features which gave confidence to operators. There was the usual quota of bear news, but Wall Street, according to its latest tenets, chose to heed only optimistic sounds. As the week progressed, however, the market lost its extremely strong tone and showed a tendency to hesitate, rallying Tuesday and Wednesday on covering by shorts. Among the specialties to which the professionals devoted their attention during the week were such neglected industrials as lead and sugar. Consolidated Gas also showed strength, and among low-priced stocks, Erie and Southern Railway showed a tendency to regain ground. Amalgamated Copper was strong on the improved copper situation. On Tuesday Westinghouse common was lifted from a high of 40¼ of the previous day to 59¼, and on Thursday reached

NEW YORK.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
All-Ch.	7	7¾	2,750	Int-Met., com..	7¼	7½	7,335
All-Ch. pfd....	20½*	18½*	2,600	Int.-Met., pfd..	18¾	20	17,026
Amal. Cop.....	58½	60½	287,575	Mackay Cos...	55¾	57*	1,100
Am. D. T.....	39*	39*	——	Mackay Cos. pfd.	61*	62½	620
Am. Loc.......	41½	45	50,000	Met. St. Ry...	17*	17*	——
Am. Loc. pfd..	92⅞	93¼	2,980	N. Y. & N.J. Tel.	-00	102	14
Am. Tel. & C'bl.	50*	50*	——	Steel, com.....	35	34	487,075
Am. T. & T....	108⅜	108½*	250	Steel, pfd.....	98⅝	98½	50,350
B. R. T.......	46⅝	46	73,890	W. U. T......	49	53	2.181
Gen. Elec......	123½	126	8,700	West'h, com...	40¼	51¾	14.690
Hud. R. Tel...	44*	—	——	West'h, pfd....	40*	80	1,700

BOSTON.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold
Am. Tel. & Tel.	108¾	109	——	Mass E. R. pfd.	45	47	——
Cumb'lnd Tel...	106½	105½	——	Mex. Tel. pfd..	—	—	——
Edison El. Ill...	203	204	——	New Eng. Tel'p.	109	109½	——
Gen. Elec......	123	126¼	——	W'st Tel. & Tel.	6¾	7	——
Mass. Elec. Ry..	10	10	——	W. T. & T. pfd.	62½	62½	——

PHILADELPHIA.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
Am. Rys.......	42¾	42¾	——	Phila. Elec....	7¾	7¾	——
Elec. Co. of Am..	9	9	——	Phila. R. T....	18⅝	17½	——
Elec. Stor. B'ty.	26	28	——	Phila. Traction.	86	86	——
E. S. B'ty pfd..	—	—	——				

CHICAGO.

	Mar. 23.	Mar. 31.	Shares sold.		Mar. 23.	Mar. 31.	Shares sold.
Chicago City Ry.	155	149	——	Met. Elec. com.	17	16	——
Com.-Edison ...	91	92	——	National Carbon.	54	59	——
Chicago Subw'y.	—	18½	——	Nat. Carbon pfd.	102	107	——
Chicago Tel. Co.	120⅛	116¾	——				

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*Last price quoted.
Shares sold are for week March 22-28.

a high point of 58, closing for the week at 58 asked, a gain of nearly 18 points. Shares to the number of 14,690 were traded in as compared with 3279 for the preceding week. On Wednesday Westinghouse preferred felt the uplift, and from 65 touched 73 the next day, and 76 on the following day, closing Saturday at 80 bid, an advance of 15 points. Favorable reports on the adjustment plans of the company's finances was held by some to account for the activity in these two stocks, while by others the movement was labeled as speculative. Bank clearings for the week ended March 26 totaled $2,186,056,000, which was 7 per cent under the previous week, and 27.8 per cent below the similar week in 1907. Repayment to the Treasury of some $14,000,000 of Government deposits, a large part coming from local institutions, led to a heavy cash loss, but money rates were practically unaffected. Foreign money markets were also easy. On Monday the market showed firmness and closed with but slight losses from Saturday's prices, in spite of considerable liquidation. Closing prices for leading electrical securities were as follows:

NIAGARA FALLS POWER COMPANY.—Despite liberal gains in gross and net earnings and total income, the Niagara Falls Power Company was compelled to show in its annual report for 1907, just issued, a falling off in surplus for the year. This resulted from a heavy increase in its fixed charges. Gross earnings amounted to $1,683,223, or $312,915 more than those for the previous year; expenses involved $447,076, or $120,952 more, and net earnings amounted to $1,236,147, or $191,963 more than those for 1906. Other income reached $162,535, or $83,135 more than that for the previous year, making total income $1,398,682, or $275,098 more. Fixed charges, however, amounted to $1,188,009, or $401,112 more than those for 1906, leaving a surplus for the year of $210,673, or $126,014 less than that for the previous year. The combined and condensed balance sheet, as of Dec. 31, 1907, revealed total assets of $25,103,977, or $712,950 more than the $24,391,027 recorded on Dec. 31, 1906. The company stated that it had reserved for improvements, betterments and depreciation $654,429, and that its profit and loss surplus was $469,179. It also reported that it had an excess of capital investment over capital liabilities amounting to $630,334; an excess of current assets over current liabilities amounting to $161,870, and securities of other companies, material, supplies and prepaid insurance valued at $331,404. The Niagara Falls Power Company's subsidiaries, the Cataract Power & Conduit Company, the Tonawanda Power Company, and the Niagara Junction Railway Company, had net earnings of $335,340, $49,874, and $42,953, respectively; and total surpluses of $381,152, $70,063, and $40,313, respectively. The general balance sheets of these subsidiaries showed total assets of $3,821,092, $592,304, and $547,817.

DETROIT UNITED RAILWAY.—The gross earnings of the Detroit United Railway system for February were slightly less than for the preceding month; the total net income was about $6,700 less, while the falling off in the surplus was about $15,000. For the first two months of the year the surplus after charges was $41,832, as against $70,427 for the same period of the preceding year. President Hutchins states that the decrease for the month of February is not due entirely to the prevailing business depression, but in part the climatic conditions; the weather during February was the most severe experienced in several years, resulting in marked interference in traffic and largely increased expenses. New York interests in the Detroit United Railways have characterized as absurd reports from Detroit that the company may be placed in the hands of receivers, which reports, they believe, were circulated for political effect. Since the company stopped the payment of dividends on its stock its financial condition has been improved, and while it still has a floating debt, this has been cut down within the last few months, and the balance can be handled without much difficulty.

WESTINGHOUSE STOCKHOLDERS' MEETING.—The following notice has been issued by Secretary Charles A. Terry of the Westinghouse Electric & Manufacturing Company to the stockholders, calling a special meeting, in Pittsburg, on April 29: "The board of directors of this company has called a special meeting of the stockholders to be held at the chief office of the company in the Borough of East Pittsburg, Pa., on the 29th day of April, A. D. 1908, at 10:30 o'clock a. m., for the purpose of voting for or against the increase of the indebtedness of the company by the issuing of bonds secured by mortgage or otherwise; also for or against the increase of the capital stock of the company, and also for or against the issuing of part or all of such new capital stock as may be authorized, or of stock now authorized but not issued, as preferred stock of the company, with such preferred or deferred provisions and features as the stockholders may authorize and the board of directors shall thereafter prescribe."

MONTREAL STREET RAILWAY EARNINGS.—The gross earnings of the Montreal Street Railway Company for the five months ending Feb. 29, were $1,458,464, an increase of $131,003, or 9.87 per cent over the corresponding period of the previous year. The increase in the expenses was 6.22 per cent, and of the net earnings, 17.25 per cent. The surplus was $294,963, an increase of 17.41 per cent. During the year ending Sept. 30, 1907, the company earned 9.65 per cent on the total $9,000,000 of stock authorized. Since then an additional $1,000,000 in stock and $2,000,000 of 4½ per cent bonds have been authorized. At the present rate of increase the net earnings will probably not justify 10 per cent dividends for the present year.

ITALIAN WESTINGHOUSE RAILWAY.—Through the recently incorporated Italian branch of the Westinghouse Company, the Societe Italiana Westinghouse, a large contract has been obtained by the Westinghouse interests for the electrification of a railroad in the vicinity of Como, the birthplace of Volta. The railroad has heretofore been operated by steam. This contract, together with another contract for the electrification of Italian government steam lines operating in the vicinity of Genoa, will call for the expenditure of more than $5,000,000. In order to manufacture the equipment required by those contracts, a plant costing in the neighborhood of $1,000,000 will be erected at Valdo, near Genoa.

BUTTE ELECTRIC & POWER COMPANY.—At a special meeting of the stockholders of the Butte, Mont., Electric & Power Company, the proposal of the directors to issue $5,000,000 in thirty-year 6 per cent bonds was approved. The bonds will be secured by a second mortgage on properties of the Butte Electric & Power Company and its subsidiaries, the Madison River Power Company and the Montana Power Transmission Company. The proceeds of the sale of the bonds will be applied to liquidate the floating debt of the companies and to provide them with additional working capital.

FIRST DIVIDEND OF NORTH SHORE ELECTRIC COMPANY.—The directors of the North Shore Electric Company have declared an initial dividend of three-quarters of 1 per cent. The company will issue $530,000 new stock at par; each stockholder paying in full by May 1 will receive 20 per cent of his holdings in treasury stock as a bonus. The officers have been re-elected.

WESTINGHOUSE ELECTRIC.—The time set for the consent of the stockholders to the reorganization plan of the Westinghouse Electric & Manufacturing Company expired on Monday, and an extension of sixty days was announced. Amendments to the plan which will greatly facilitate its adoption by all the stockholders, will be agreed upon.

CHICAGO SUBWAY.—All the large holders of tunnel bonds have assented to an exchange for subway bonds. This paves the way both for the lease to the Automatic Telephone Company and also for resumption of the Edison negotiation, which it is expected will shortly be resumed.

CHICAGO TELEPHONE MERGER.—The merger of the Automatic Electric and Strowger Telephone Companies has been ratified by stockholders of both the companies. The combined company is arranging the final terms for the use of the entire subway-tunnel system for its circuits.

NEW YORK & NEW JERSEY TELEPHONE.—The regular quarterly dividend of 1¾ per cent, payable April 15, to stock of record April 4, has been declared by the directors of the New York & New Jersey Telephone Company.

MANILA ELECTRIC REGULAR DIVIDEND.—The regular quarterly dividend of 1 per cent, payable April 1, has been declared by the directors of the Manila Electric Railroad & Lighting Corporation.

COLORADO TELEPHONE REGULAR DIVIDEND.—The regular quarterly dividend of 1¾ per cent, payable April 15, has been declared by the directors of the Colorado Telephone Company.

BELL TELEPHONE OF MISSOURI DIVIDEND.—The directors of the Bell Telephone Company of Missouri have declared the regular quarterly dividend of 2 per cent.

MEXICAN LIGHT & POWER COMPANY PROGRESS.—The report of the Mexican Light & Power Company, recently issued, shows that the investments of that company in Mexico have been more than $40,000,000, and the work of adding to the great plant and extending the business to other parts of the republic is still in progress. During the last year a total of $2,475,331 gold was expended on capital account, of which more than $1,000,000 was spent in the work of completing the hydro-electric plant at Necaxa. About $1,000,000 was spent on distribution lines in Mexico City and the Federal District. The sum of $250,000 was expended during the year on the installation of the second hydro-electric plant, which up to Dec. 31, 1907, had cost $688,000 gold. A provisional dam has been constructed at Los Reyes and a tunnel driven to connect the Laguna reservoir with the Los Reyes reservoir. The Laguna dam has been raised to a height that will provide a storage capacity of 30,000,000 cu. m. of water. The great dam at Necaxa is being built at the rate of about 73,000 cu. m. a month, more than 337,000 cu. m. of material already having been laid, and in all about 1,634.000 cu. m. of material will be used. In addition to the large amount of current which the company is supplying to Mexico City, towns of the Federal District, the city of Puebla and mining concerns in El Oro, the demand is far greater than the supply. The company has tentative contracts for supplying installations amounting to 3000 hore-power, exclusive of the contract which the company has made with the federal government, by the terms of which 3000 horse-power is to be furnished to operate the pumps of the water-works and drainage systems of the city. This contract will probably be begun the latter part of this year. Many transmission lines reach out in all directions from the Necaxa plant, the longest being 175 miles. It is planned to supply all the demand for power within a radius of 200 miles or more from the Necaxa plant.

GENERAL ELECTRIC-WESTINGHOUSE MERGER RUMOR DENIED.—The perennial rumor to the effect that the General Electric and Westinghouse companies are to be merged, duly made its appearance bearing the date of March 29, and has once more been denied by officers of both companies. This time the tale comes from Chicago, and says that if the plans are carried out, which it alleges are afoot, an electrical company will be formed with a capitalization of more than $100,000,000, and goes on to state that negotiations have been going on since the Westinghouse companies went into receivers' hands, although matters were not pushed with vigor until within a few weeks. "Several meetings have been held between the principals of both concerns," so runs the tale, "but from what can be gathered, the largest Westinghouse interests are reluctant to give up the property which they hope to take out of the receivers' hands. But it is said that they have not rejected the offer of the General Electric Company. If their own plans for rescuing the company fail," the romance appropriately concludes, "there will be time enough to accept the offer." A director and officer of the General Electric Company said that there was no foundation for the report, that no conferences looking to consolidation had been held, and that such a merger was neither practical nor contemplated. Officers of the Westinghouse Company smiled when questioned, and said that the report was not worth a denial.

NORTHERN OHIO TRACTION & LIGHT COMPANY.—The report for February of the Northern Ohio Traction & Light Company, shows gross earnings of $119,301, as compared with $116,858 for February, 1907, and expenses of $78,466 as compared with $72,710 for the same month in the preceding year. The net for the month was $40,835, with charges of $42,405, leaving a deficit of $1,570, as compared with a net of $44,148 for February of a year ago, charges of $41,400, and a surplus for the month of $2,748. The two months gross was $246,426, as compared with $242,049, for the same two months in 1907, and the expenses, $160,358 and $152,291 respectively, in the two periods compared, leaving a two months net for 1908 of $85,068, as compared with a two months net in 1907 of $89,758. Deducting charges leaves a two months' surplus of $161 for 1908, as compared with a two months surplus of $7,019 for the same two months in the previous year.

TWIN CITY RAPID TRANSIT REPORT.—The report of the Twin City Rapid Transit Company showed for February gross receipts of $453,944, as compared with $419,802 for February, 1907, and expenses of $253,643, against expenses of $217,468 for the same period of the previous year, leaving a February net of $200,301, as compared with the February net for 1907 of $202,334. Charges, taxes and preferred dividend amounted to $122,789, leaving a surplus for February, $77,512, a decrease from the $87,076 surplus of February, 1907. The gross receipts for the two months was $923,835, compared with $876,639 for the corresponding two months of the previous year, and expenses were $511,844, as against $460,565 of the same two months of the previous year. The two months net were $411,491 and charges, taxes and preferred dividend $244,744, leaving a surplus of $167,247, as compared with $185,557 for the corresponding two months for 1907.

TOLEDO RAILWAY & LIGHT COMPANY'S FEBRUARY REPORT.—The report for February shows an increase in all items except the expense account, which shows a decrease over the same period of the previous year. February's gross is given as $207,878, an increase of $8,177 over February last year. Expenses were $116,301, a decrease of $2,858, leaving a net of $91,577, an increase of $11,035 over February of the previous year. The total income was $92,397, against $81,619 of last year, and the surplus for February, $23,948, or a $5,483 increase over February, 1907. The two months gross was $424,839, and the expenses were $241,389, leaving a net for the two months of $183,450, which represents an increase of $12,046. The total income was $185,048, which after deducting charges and taxes leaves a surplus for the two months of $47,995, against $47,638 of February, 1907, an increase of $357.

HARRIMAN BUYS TROLLEY LINES.—Dispatches from Los Angeles state that the entire electrical interests of Henry E. Huntington have been taken over by E. H. Harriman, and that Mr. Huntington has retired permanently from the electrical field. This means that Mr. Harriman will control the Pacific Electric Company, the Los Angeles-Pacific Company, the Los Angeles Railway Company, the Los Angeles Interurban Railway Company, and the Los Angeles & Redondo Railway Company, one of the largest and most complete trolley systems in the world. Mr. Harriman also controls the Pacific Light & Power Company. The transfer involves a sum in the neighborhood of $50,000,000, and means the control of the trolley lines of Southern California, in addition to a majority of railroad lines which have operated as feeders to the vast Harriman system for many years.——Since the above was put into type, Mr. H. E. Huntington has denied that there is any truth whatever in the report that he has transferred his large interests in electric railways in California to the Southern Pacific or to Mr. Harriman.

PORTLAND ELECTRIC COMPANY.—The report of the Portland (Me.) Electric Company shows a growth in business of 10 per cent during January over the corresponding period of last year. The earnings for January, 1908, were $29,647.87 against $26,988.47 for January, 1907, an increase of $2,659.40. Gross earnings for the year ended Jan. 31, 1908, compared with 1907, as follows: 1908, $300,477.69; 1907, $283,268.65.

KNOXVILLE RAILWAY & LIGHTING REGULAR DIVIDEND.—The regular quarterly dividends of 1 per cent on the common stock and 1½ per cent on the preferred stock, both payable March 31, have been declared by the directors of the Knoxville Railway & Lighting Company.

CITY RAILROAD OF DAYTON REGULAR DIVIDEND.—The directors of the City Railroad of Dayton have declared the regular quarterly dividend of 1¾ per cent on the common stock, and 1½ per cent on the preferred stock, payable April 1.

MEMPHIS STREET RAILWAY REGULAR PREFERRED DIVIDEND.—The directors of the Memphis Street Railway Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable March 31.

CENTRAL & SOUTH AMERICAN TELEGRAPH DIVIDEND.—The directors of the Central & South American Telegraph Company have declared the regular quarterly dividend of 1½ per cent, payable April 9.

PUBLIC SERVICE CORPORATION QUARTERLY DIVIDEND.—The directors of the Public Service Corporation of New Jersey have declared the regular quarterly dividend of 1 per cent, payable March 31.

SYRACUSE RAPID TRANSIT REGULAR DIVIDEND.—The directors of the Syracuse Rapid Transit Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1.

INTER-MET BOND ISSUE.—At a special meeting of the stockholders of the Interborough Rapid Transit Company, held last Saturday, the proposal of the directors to execute a mortgage for $55,000,000 on the company property, against which bonds are to be issued, was approved. The consent of the trustee for the Interborough-Metropolitan bonds, against which $33,912,800 of the Interborough Rapid Transit Company's total $35,000,000 of capital stock is held, has also been obtained for the proposed bond issue. It is the intention of the company, provided the outlined plan is carried on, to issue $18,000,000 of bonds to refund and extend the $15,000,000 of 4 per cent notes which mature on May 1, and to put out $12,000,000 of these new bonds to discharge other outstanding indebtedness of $10,352,726. If it is found difficult to market the proposed bonds the company may issue short time notes with the bonds as security. Action by the Public Service Commission on the application of the Interborough Rapid Transit Company for permission to issue the bonds was postponed until Monday. At the hearing C. H. Venner protested against the proposed Interborough mortgage, but Chairman Willcox of the commission declined to have his objections recorded at that time, and instructed him to submit in writing to the commission any arguments which he might have against the approval of the bond issue. Former Judge Thomas L. Feitner appeared as a representative of security holders of the Interborough-Metropolitan Company, and requested that his appearance be noted. He stated that if this new bond issue should take precedence over the Interborough-Metropolitan securities he would file objections. The $3,000,000 of 60-day notes for which the company is reported to be negotiating were said, in banking circles, to represent merely a shifting of some bank loans to a new form pending the execution of the sale of $20,000,000 bonds or a similar amount of short-termed notes secured by them as collateral, to make up obligations matured about May 1. Whether the bonds will be sold or the financing arranged by short-term notes, based on the bonds as collateral, has not been decided, although it is said the chances are in favor of two-year notes.

BUFFALO INTERNATIONAL TRACTION REPORT.—The annual report of the International Traction Company, of Buffalo, for the fiscal year ended Dec. 31, 1907, gives the gross income as $5,445,070 as compared with $5,024,298 for the preceding year, and expenses of $3,652,602 as compared with $3,146,273 for 1906, leaving a net of $1,792,468 and decrease over the preceding year of $85,557. Deducting charges, there is a surplus of $312,260, a decrease of $152,593. The surplus is equal to 2.1 per cent on the $15,000,000 capital stock. Notwithstanding the financial crisis, said President Henry J. Pierce, the gross earnings of the system for 1907 showed an increase of $420,771 over 1906. The decrease in the surplus was due to higher operating expenses, taxes and interest. During the year the car mileage was increased 1,779,790 miles, equivalent to 9 per cent, and in that time $525,327 was expended for repaving and relaying tracks with heavy rails, etc., and $865,578 for additions to equipment, track and buildings. These expenditures were charged respectively to the fund for depreciation and to capital account.

TO INSPECT NORTH AMERICAN PROPERTIES.—The following announcement was issued last week from the offices of Spencer Trask & Co., the banking firm at Pine and William streets: "About thirty-five representatives and correspondents of the banking firm of Spencer Trask & Co. will leave New York Sunday morning, March 29, to visit the cities of Cleveland, Detroit, Chicago and Milwaukee. Primarily, the object of the trip is to enable the party to familiarize themselves at first hand with the properties of the Detroit Edison Company, the Milwaukee Electric Railway & Light Company, and the Milwaukee Light, Heat & Traction Company, which are among the important public utility corporations under the supervision and management of the North American Company. The party will also go over the properties of the Cleveland Electric Illuminating Company. For many years Spencer Trask & Co. have been identified with the management of these and similar properties, the securities of which are largely held by institutions and individuals both in this country and in Europe."

RUMORED WIRELESS MERGER DENIED.—The reports current of late to the effect that the Marconi Wireless Telegraph Company and the United Wireless Telegraph Company are considering plans of consolidation were denied last week by officers of both companies. Three bills regulating the wireless service are at present pending before Congress, all of which are considered by the wireless companies to be inimical in their present form to wireless interests, and the fact that representatives from both companies have been at Washington looking after their companies' affairs is suggested as the cause of the report that plans of consolidation were on foot.

BELL TELEPHONE COMPANY OF BUFFALO.—The annual report of the Bell Telephone Company of Buffalo, for the year ended Dec. 31, 1907, gives gross earnings of $1,709,679, as compared with $1,573,547 for 1906, and expenses of $1,072,710, against $1,001,924 for the previous year. The net earnings, which are equal to 7.8 per cent on the $8,122,700 capital stock, were $636,969, against net earnings of $571,623 for 1906. Dividends of $474,414 were declared, leaving a balance of $162,555 against a balance of $136,023 for the previous year. The number of stations of the company was given as 54,575, an increase during the year of 1705.

BUTTE ELECTRIC & POWER EARNINGS.—In spite of the fact that work in the Butte copper mines has been practically stopped since October, and all Amalgamated properties shut down with the exception of the Boston & Montana mine, the earnings of the Butte Electric & Power Company for the four months ended Jan. 31, 1908, were $228,394, an increase of $35,927 over the corresponding period of the previous year. The surplus, after deducting interest charges and sinking fund, was $125,605, an increase of $15,023.

ST. LOUIS ELECTRIC & POWER COMPANY REPORT.—For the year ended Dec. 31, 1907, the Union Electric Light & Power Company, of St. Louis, reports gross earnings of $2,855,417, an increase of $612,936 over the previous year. Expenses, including taxes, were $1,116,562, a decrease of $72,241 from 1906, and net earnings were $1,738,855, a gain of $685,177. Interest and miscellaneous expenditures were $981,005, or $466,707 more than for the previous year, leaving a surplus of $757,850, or $218,470 more than for 1906.

UNITED ELECTRICAL OPTIMISM.—T. I. Jones, sales manager of the United Electric & Power Company, is one of the "advance agents" of optimism. He says, "Optimism is the motto of this office. We don't recognize any financial depression here and there are no calamity howlers in our outfit. There has been no month during the last half year wherein we did not write more business than during the corresponding month of the previous year."

ELECTRIC STORAGE BATTERY CUTS DIVIDEND.—The directors of the Electric Storage Battery Company have declared a dividend at the rate of 1 per cent for the quarter on both the preferred and the common stock. This is a reduction of ¼ per cent from the disbursements of last quarter.

UNITED RAILWAYS INVESTMENT COMPANY NOTE ISSUE.—The United Railways Investment Company will issue $3,500,000, 6 per cent, serial notes, maturing from 1909 to 1917. The proceeds of the issue will be used to take up the floating debt of the United Railroads of San Francisco.

PUGET SOUND ELECTRIC RAILWAY COMPANY MEETING.—The annual meeting of the stockholders of the Puget Sound Electric Railway Company will be held on April 21. The books of transfer will be closed April 1 and will reopen April 22.

GENERAL ELECTRIC STOCKHOLDERS MEETING.—The annual meeting of the stockholders of the General Electric company will be held at 12 o'clock, May 12, in Schenectady. The transfer books will close on April 11 and will reopen on May 13.

PENNSYLVANIA BELL TELEPHONE REGULAR DIVIDEND.—The regular quarterly dividend of 1½ per cent, payable April 15, has been declared by the directors of the Bell Telephone Company, of Pennsylvania.

MEXICAN TELEGRAPH COMPANY REGULAR QUARTERLY DIVIDEND.—The regular quarterly dividend of 2½ per cent, payable April 16, has been declared by the directors of the Mexican Telegraph Company.

BANGOR RAILWAY & ELECTRIC COMPANY DIVIDEND.—The directors of the Bangor Railway & Electric Company have declared the regular quarterly dividend of 1¼ per cent.

MASSACHUSETTS LIGHTING REGULAR DIVIDEND.—The trustees of the Massachusetts Lighting Company have declared the regular quarterly dividend of 1½ per cent, payable April 15.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

PINE BLUFF, ARK.—Contracts have been awarded by the Pine Bluff Light & Water Company for the construction of its power plant and reservoir, in connection with the new plant the company is erecting in this city. The Seldon-Beck Construction Company, of St. Louis, Mo., was awarded the contract for the construction of the power plant.

BERKELEY, CAL.—Arrangements are being made by the Bay Counties Power Company to remove its high-tension transmission lines from Grove and Rose Streets in Berkeley. The company is securing the right of way for its pole line on the east side of the Berkeley Hills, to transmit electricity from the main plant in Oakland to the substation in Berkeley. Frank A. Leach, Jr., is manager.

CHICO, CAL.—The City Trustees are contemplating the construction of a municipal electric light plant, and will engage an engineer to make an estimate of the cost of the same.

COLUSA, CAL.—It is reported that the Colusa Irrigation Canal Company is negotiating for a pumping plant to be operated by a 100-hp engine or electrical power. M. J. Biggs is president of the company.

FRESNO, CAL.—The San Joaquin Light & Power Company has made arrangements with Thomas Williams, David Bavo and August Marin to install and maintain for them a 15-hp electric motor on canals occupied by them.

LODI, CAL.—The City Trustees have voted a bond issue of $76,000 for a light and power plant and water works system.

MAGALIA, CAL.—The operation of the new power plant of the P. B. Steifer Mining Company will be started about April 1. The plant will have an output of about 275 kw and will furnish electricity to operate the mines of the company. The California Gas & Electric Company, until recently, furnished electrical energy for operating the mines.

PLACERVILLE, CAL.—Benjamin C. Celio has filed a notice of appropriation of 2000 cu. in. of water of the Cosumnes River, to be used for milling, mining and power purposes.

SAN FRANCISCO, CAL.—The United Railroads of San Francisco have completed arrangements for lighting Market, Valencia and Sutter streets, in accordance with its promise made shortly after the fire. A contract has been awarded for the ornamental poles, which will be erected about June 1. The cost of the work, including the arc lamps, is estimated at $100,000. The company also contemplates the retracking of Market Street from Sansome to Twelfth Streets and that of McAllister Street. Charles N. Black is general manager.

WATSONVILLE, CAL.—The Board of Aldermen has granted the Ocean Shore & Eastern Railway Company a franchise to construct and operate an electric railway through this city.

WOODLAND, CAL.—The Pacific States Telephone Company is erecting a new toll line from Woodland to Colusa Junction. The company will rebuild many portions of its line in the northern part of the state.

EUREKA, COL.—G. H. Scott has appropriated 600 cu. in. of water flowing in the Old Mill Creek for the purpose of supplying water in Trinidad and to generate electricity.

DARIEN, CONN.—The citizens are contemplating establishing a municipal electric light plant. A committee has been appointed to investigate the matter and report at the annual town meeting.

HARTFORD, CONN.—The contract for installing the lighting equipment on the new bridge across the Connecticut River has been awarded by the Board of Commissioners of the Connecticut River Bridge and Highway District to the Rice & Baldwin Electric Company, of Hartford, the work to be completed by May 1. The plans call for 88 tungsten lamps of 100 cp each.

MIDDLETOWN, CONN.—The Southern New England Telephone Company is planning to construct more underground conduits in the business portion of the city. The company is building a new exchange building, which will be completed about Aug. 1. The common battery system will be installed.

WALLINGFORD, CONN.—The Board of Electrical Commissioners has adopted a new schedule of rates for electricity furnished under the meter system, which will take effect from April 1, as follows: Schedule A—Factories, 10 cents per kw-hour; connections made with isolated plants, 10 cents per kw-hour, plus a charge of $5 per year per kilowatt transformer output, same to be owned by the consumer. Schedule B—Places of business, rooms, halls, churches, schools, etc.: First 100 kw-hours, 10 cents per kw-hour; next 200 kw-hours, 8 cents per kw-hour. Schedule C—Residences, heating and small motors up to 1 hp, from 10 cents to 8 cents per kw-hour. Schedule E—Flat rate for sign lighting and yearly contract; 2-cp lamps: 9 cents per month; 4-cp lamps. 16 cents per month; same to burn six nights per week, one hour after sunset until 10 p. m. Special prices for day power service for one-half horse power and over. The minimum charge for all schedules is $1 per month. Prepayment meters will be installed free; the rate charged for energy consumed will be 11 cents per kw-hour. A. L. Pierce is superintendent.

WASHINGTON, D. C.—Bids will be received until April 14 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 918—One 10-hp motor. Puget Sound, Wash.: Schedule 917—2000 ft. single conductor; about 19,000 ft. twin conductor; sockets and interior fittings; 20,000 ft. double conductor silk; 10,000 ft. bell wire, and 5000 ft. signal cable and light fixtures. Schedule 919—11,500 ft. seamless brass voice tubing. Applications for proposals should designate the schedules desired by number. E. B. Rogers, Paymaster General, U. S. N.

ATHENS, GA.—The Athens Electric Railway Company has recently placed orders for additional equipment for its power house, including a 1000-kw Allis-Chalmers turbine, boilers of 290 horse-power, Blake condensers and a 15-ton crane. C. D. Flanigan is manager.

SYLVESTER, GA.—At an election held March 18 the citizens voted to issue $10,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. C. W. Hillhouse is Mayor.

CHICAGO, ILL.—President R. R. McCormick, of the Chicago Drainage Board, has applied to Mayor Busse for permission to use the city's poles and conduits for the transmission of electricity, which the board wishes to furnish to private consumers.

LAWRENCEVILLE, ILL.—The Lawrenceville Water & Light Company is making extensive improvements and changes in its plant, including the installation of a 50-kw, 2200-volt, single-phase alternator and an 85-hp gas engine, for which contracts have been placed. The entire distribution system will be changed from direct to alternating current. The company expects to extend its transmission lines to two neighboring towns, a distance of about 10 miles, and also contemplates installing more generating machinery before the coming winter. C. Gough is manager.

MANITO, ILL.—It is stated that the city has purchased the interest of T. H. Smith in the Manito electric lighting plant. Work on the completion of the system will be pushed as rapidly as possible.

MILLSTADT, ILL.—The capital stock of the West Side Telephone Company has been increased from $2,700 to $4,500.

CANAAN, IND.—The Farmers' Mutual Telephone Company, which purchased the lines of the Green system in Green County, is erecting its lines and will install an exchange in Canaan.

CROWN POINT, IND.—The Crown Point Telephone Company is planning to move its exchange and will install a new switchboard.

FORT WAYNE, IND.—Plans are being made by the Home Telephone & Telegraph Company for making extensive additions to its cable system in Fort Wayne.

LIGONIER, IND.—Sealed proposals will be received by the President and City Council until April 21 for furnishing material and constructing an electric light plant for this city. The work includes a power plant of either steam, with Corliss engine, or a gas engine and producer, or oil engine; one 100-kw alternating-current generator, switchboard, pole line, wiring and 48 street arc lamps. Also furnishing meters and transformers. The power plant will be installed in water works building owned by the city, on foundations to be built by the contractor. Plans and specifications are on file with the city clerk, or may be seen at the office of the engineer, A. J. Hammond, at South Bend, Ind. For further information address R. E. Jeanneret, city clerk.

PACKERTON, IND.—The New Metal Telephone Company is contemplating extending its lines to Packerton, and agrees to install a switchboard if the citizens will agree to guarantee 100 telephones to connect with it.

SOUTH BEND, IND.—The Chicago, South Bend & Northern Railway Company has commenced construction work on its extension between South Bend and La Porte, Mich. Electricity for operating this railway will be furnished by the Indiana & Michigan Electric Company. Substations along the extension west will be built at Lydick, Rolling Prairie and La Porte.

SULLIVAN, IND.—A. S. Courtwright will apply for a franchise for street and residential lighting in this town.

WATERLOO, IA.—The Waterloo, Cedar Falls & Northern Railway Company is contemplating extending its lines to Westfield and other outlying districts of the city. The cost of the work is estimated at about $75,000.

CAWKER CITY, KAN.—A mutual telephone company has been organized in this city, and will either install a new system or purchase the plant of the company now operating in the town. The company already has $7,000 capital pledged.

NATIONAL MILITARY HOME, KAN.—Bids will be received until April 4 at the office of the Treasurer, Western Branch, N. H. D. V. S., National Military Home, Kan., for furnishing and installing one direct-connected engine and generator in the electric light plant. Copies of specifications, together with blank proposals and other information, may be had on application to Major W. W. Martin, Treasurer.

WELLINGTON, KAN.—The new municipal electric light has been completed and placed in operation. The new equipment, consisting of new dynamos, engines, boilers and switchboard was installed by the Allis-Chalmers Company, Milwaukee, Wis. The system has been changed from single-phase to the two-phase system.

JACKSON, KY.—The Jackson Electric Light & Power Company has been reorganized under the name of the Jackson Electric Light & Hydraulic Manufacturing Company by L. P. Gunn, A. D. Moore and J. W. Norwood, all of Lexington. The new company will operate the local electric light plant, which will resume operations at once. The company will also operate water works and manufacture ice. The capital stock of the company is fixed at $20,000.

LA CENTER, KY.—The Ballard County Independent Telephone Company has awarded a contract to the Western Telephone Manufacturing Company for furnishing a switchboard and telephone boxes and supplies for its system. The cost of the system is estimated at $2,500.

OLA, KY.—The Sergesth-Ola Telephone Company contemplates building new lines from Colby to Hilliard, and from Ola to Thornton. J. S. Webb is manager.

PIKEVILLE, KY.—The capital stock of the Eastern Kentucky Home Telephone Company has been increased from $3,000 to $5,000, the proceeds to be used for extending its line to Shelby Creek and other improvements to its system.

TOMPKINSVILLE, KY.—A company has been organized to construct telephone lines in Barren and Monroe counties. The central exchange will be located in Tompkinsville.

NEW ORLEANS, LA.—Preparations are being made by the Cumberland Telephone & Telegraph Company to change its present telephone system in this city to the common battery system.

BUCKSPORT, MAINE.—It is reported that the Penobscot Bay Electric Power Company is planning to construct two more power houses in this section early in the spring. The company owns the Lock & Sluice Company's privileges at the falls and one other location, which may be developed this summer.

DEXTER, MAINE.—The Sebasticook Power Company, of Pittsfield, is contemplating extending its transmission lines to Dexter, the cost of which is estimated at $14,000. The company proposes to make some arrangement with the local company, or any other company that may be organized, to furnish electrical energy for lamps and motors. The town is anxious to secure an all-night lighting service, which the local plant is unable to furnish at present.

DEXTER, MAINE.—The citizens voted to appropriate the sum of $1,075 for street lighting, and authorized the Lighting Commission to make a contract with the Dexter Electric Company at the lowest cost.

HAMPDEN, MAINE.—It is understood that a number of Hampden citizens are interested in the purchase of a water power near the town, where it is proposed to erect an electrical power plant to furnish the town and cottages with electricity for lamps and motors. The summer residents are said to be interested in the project.

TURNER, MAINE.—The Auburn & Turner Railroad Company is about to place contracts for the construction of an extension to its lines, about two miles in length.

CONOWINGO, MD.—The Senate has passed the bill amending the charter of the Susquehanna Power Company to conform to the desires of the Pennsylvania Railway Company, which will enable the former to enlarge the scope of its work when it is ready. By the terms of the agreement between the power company and the railroad, the former, when prepared to go on with the work, will relay the tracks of the railroad company, so that travel will not be interrupted at any time.

FEDERALSBURG, MD.—The Senate has passed the bill incorporating the Idlewild Electric Light & Power Company.

HUDSON, MASS.—The Municipal Light and Power Department is considering the proposition of furnishing electricity for lamps in Stow and Berlin. The department is now furnishing electricity in Gleasondale for lamps and is seriously considering the proposition to extend its lines to Stow, but it is doubtful if the commissioners will take up the Berlin project unless the town erects its own distributing system.

MELROSE, MASS.—A committee has been appointed to investigate the management of the municipal electric light plant and to consider the question of purchasing new equipment or the purchase of electricity for lighting. The members of the committee are George M. Poland (chairman), Edwin C. Miller, F. J. Henkel, Thomas E. Dwyer, John Flanley, Charles N. Winship, G. H. Stowell, S. K. Hamilton and J. T. Cooper.

METHUEN, MASS.—The citizens have voted to appoint a committee to investigate the matter of street lighting and secure prices for the different methods of illumination and make a report not later than May 2.

UPTON, MASS.—At a recent town meeting the citizens voted to appoint a committee to investigate the question of lighting the streets of the town with electricity. The streets are now lighted with kerosene lamps.

WESTFIELD, MASS.—Plans are being made by the managers of the municipal electric light plant to install two new boilers to replace the ones now in use at the plant, in order to comply with the state law. The work will require an appropriation of between $5,000 and $6,000.

DETROIT, MICH.—The City Council has decided to construct an underground conduit system, and has instructed the light, fire and police departments to prepare estimates of the cost of their part of the work. The cost of the work for the three departments is estimated at $113,910.

NILES, MICH.—The large dam erected in the St. Joseph River at Buchanan, which had been weakened by recent floods, was carried away March 21. The dam was 500 ft. long and cost $250,000. It furnished power for operating the electric plants at Niles, Mich., and South Bend, Ind., and was owned by Charles A. Chapin, of Chicago, Ill.

COTTAGE GROVE, MINN.—Plans are being made to build another telephone line from Lake Shore to Cottage Grove.

MINNEAPOLIS, MINN.—The Denel County Telephone Company, of North Dakota, has been granted permission by the Secretary of State to do business in the State of Minnesota.

LOUISVILLE MISS.—The capital stock of the Kirk Telephone Company has been increased from $2,000 to $10,000.

SMITHVILLE, MO.—The citizens have voted to issue bonds for the construction of a municipal electric lighting plant.

ST. LOUIS, MO.—The substation of the Union Electric Light & Power Company was destroyed March 20 by an explosion, causing a loss of $25,000.

WEST PLAINS, MO.—A company has been organized to install a large electric power plant at the Samuel Hammond Mill, on the North Fork River, in Ozark County, about 20 miles from the city. It is proposed to erect a dam at this point and transmit electricity to the city. The company, it is said, will submit a proposition to supply electrical energy to the municipal electric light plant at a much lower cost than the city can operate the plant. C. H. Martin, of Doniphan; Thomas D. Martin, C. K. Martin and Samuel Hammond are interested in the project.

FORSYTH, MONT.—The Forsyth Electric Light & Telephone Company is contemplating extending its telephone line to Miles City.

HELENA, MONT.—Announcement has been made that the patents for the Baker & Burtwell electrical ore treatment have been transferred to the Montana Metallurgical Company, of Helena, a holding company, and that plans have been made for the erection of a plant this summer at Helena or East Helena, with an output of from 100 to 150 tons of ore a day. This is the first commercial plant erected under this process, and it will be built on the unit system, so that it can be enlarged from time to time, as conditions warrant. An option on the process for this district has been given by the Montana Metallurgical Company, and a selection of a site for a plant is now being made.

WINSTON, MONT.—Announcement has been made that a power plant will be constructed on Deep Creek, in Broad Creek, in Broadwater County, in the Big Belt Mountains. It is proposed to supply electricity in the Winston and Radersburg districts and in Townsend for mining and other enterprises, and also for dredging operations on the Missouri River. It is stated that a large number of contracts have been secured

HAVELOCK, NEB.—The Plattsmouth Independent Automatic Telephone Company contemplates the entire rebuilding of its system in this city.

GENOA, NEV.—Adolph Dressler, who lives a few miles below here, has decided to install an electric power plant to furnish electricity for lamps and motors.

GOLDFIELD, NEV.—The County Commissioners have sold the franchise rights for a telephone and telegraph service from Schurz to Rawhide to Attorney George Springmeyer. The Rawhide Light & Power Company has petitioned the County Commissioners for a franchise to operate a light and power plant.

LOVELOCK, NEV.—Negotiations have been closed between the Lovelock Light & Power Company and Stephen R. Young whereby the power company leases for a term of 25 years the entire flow of water in the Humboldt River at the Young Ranch, near Lovelock. The plans of the power company call for the building of a 10,000-volt transmission line to the town limits, where a substation will be built.

CONTOOCOOK, N. H.—The citizens have voted to renew the contract for street lighting with the Contoocook Electric Light Company at the rate of $12.50 per lamp per year.

TILTON, N. H.—The question of substituting the present arc-lamp street lighting system for incandescent lamps is now under consideration. The town now pays $80 per lamp per year for arc lamps of 1200 cp and $15 per year per lamp for 32-cp incandescent lamps.

JERSEY CITY, N. J.—The Mutual Benefit Electric Light & Power Company has filed an application with the city clerk for a general franchise to furnish electricity in this city for lamps and motors. In consideration for a franchise the company offers to furnish electrical energy at a maximum charge of 8 cents per kw-hour, with 5 per cent discount for prompt payment. The company also offers to place all its wires underground and to pay to the city 5 per cent of its gross earnings each year. The officers of the company are: James M. Seymour, Jr., of Newark, president; Richard S. Carrick, secretary, and John F. Nagle, treasurer.

TRENTON, N. J.—A bill has been introduced in the Legislature to permit the boards of freeholders to construct and operate lighting plants and furnish electricity for lighting to any municipality within the county limits. In order to supply funds the board is authorized to issue county bonds to an amount not exceeding $200,000.

ASBURY PARK, N. J.—Harry J. Rockafeller, of Sunset Hall, has petitioned the Council for an electric light and power franchise.

SOUTH ORANGE, N. J.—The Senate has passed the bill authorizing the city of South Orange to construct or acquire an electric light or gas plant.

BABYLON, L. I., N. Y.—The Public Service Commission has authorized the Babylon Electric Light Company to issue capital stock to the amount of $30,000, the proceeds to be used for extensions and improvements.

CANTON, N. Y.—The Northern Power Company has entered into a contract with the Canton Electric Light & Power Company, whereby the Northern Power Company will supply electrical energy from its power plant at Hannawa Falls to operate the local system for a long term of years. A transmission line will be erected from the power plant to the electric light station in Canton.

LOCKPORT, N. Y.—The Niagara County Home Telephone Company is making arrangements to erect a new telephone exchange in this city to cost about $50,000.

NEW YORK, N. Y.—Bids will be received until April 6 by C. B. J. Snyder, superintendent of school buildings, for installing electric equipment in the addition to and alterations in Public School No. 16, on Matilda and Catherine Streets, Borough of Bronx.

NEW YORK, N. Y.—Bids will be received until April 6 by the president of the Board of Trustees of the Bellevue and Allied Hospitals Department, Twenty-sixth Street and First Avenue, Borough of Manhattan, for furnishing and setting lighting fixtures in pavilions A and B of the new Bellevue Hospital, Borough of Manhattan. John W. Brannan is president of Board of Trustees.

FORT ANN, N. Y.—Plans are being made by the Kane's Falls Pulp Company to install an electric light and power plant in the old pulp mill at Kane's Falls. The plant will have an output of 1500 kw and will furnish electricity for lamps and motors in Fort Ann, Glens Falls and other nearby places. The company controls the entire watershed supplying the Kane's Falls power, and proposes to build a larger dam at Kane's Falls in the near future. Eugene L. Ashley is president of the company.

ROUND LAKE, N. Y.—The Village Trustees are considering the question of lighting the streets of the village with electricity. A committee, consisting of Joseph McKay, William H. Mann and E. H. Lisk, has been appointed to investigate and take action on the matter. It is stated that Mr. Warren, of the Clifton Park Company, has submitted a proposition to furnish electricity to operate the system.

WATERTOWN, N. Y.—The Public Service Commission has granted the Watertown Light & Power Company permission to issue bonds to the amount of $200,000, bonds to be sold at not less than 80 per cent of their value, and $102,500 stock at par. It is provided in the order that any excess in the proceeds of this issue of bonds which may be realized from the sale thereof shall operate to reduce to the extent of such excess the amount of capital stock authorized to be issued.

ASHEVILLE, N. C.—Final surveys are being made for the proposed electric railway from Asheville to Hendersonville.

ROUGEMONT, N. C.—C. W. Harris, W. Cochran and H. L. Carver are contemplating the construction of an electric power plant and are organizing a company for that purpose. It is said that they propose to erect a number of manufacturing plants.

STATESVILLE, N. C.—The Turner Mills Company, of East Munho, N. C., is constructing a power plant and cotton mill. The dam, which is 1000 ft. in length, will develop about 350 hp for transmission by electricity to operate the mills. The company is capitalized at $250,000.

BELLE CENTER, OHIO.—The Village Council is contemplating making improvements and additions to the municipal electric light plant, which will involve an expenditure of about $5,000.

COLUMBUS, OHIO.—Plans are being contemplated by the Columbus, Urbana & Western Traction Company for continuing its railway through Plain City, Marysville and Kenton, where it will connect with the Lima & Toledo Traction Company, direct to Toledo. It is also proposed to construct an extension to Urbana.

FREMONT, OHIO.—The City Council has adopted a resolution providing for the removal of all telegraph, telephone and electric light wires within the business district of the city and have them placed in underground conduits.

BARTLESVILLE, OKLA.—Contracts have been awarded by the Bartlesville Interurban Railway Company for the construction of an electric railway from Bartlesville as follows: For overhead construction, tracklaying and installation of machinery in power house, to the Freeborn Engineering & Construction Company, of Kansas City, Mo.; for power house equipment, including generators, engines, pumps and boilers, to the John A. Stewart Electric Company, of Cincinnati, Ohio.

STILLWATER, OKLA.—At an election to be held April 7 the citizens will vote on the proposition to issue $7,000 in bonds for extensions to the electric light plant.

WAURIKA, OKLA.—The city has granted a franchise to M. Griffin O'Neil, of Dallas, Tex., to construct and operate an electric light plant. The cost of the plant is estimtated at $10,000.

LEBANON, ORE.—Plans are being made by the Lebanon Electric Light & Water Company for extensive improvements to both the water and light plants. J. S. Hughes is manager.

HARRISBURG, PA.—The Donora & Eldora Street Railway Company has increased its capital stock from $24,000 to $150,000, and its indebtedness from nothing to $100,000.

HARRISBURG, PA.—The Elizabethtown & Florio Street Railway Company has filed a notice of increase of capital stock from $30,000 to $220,000 with the Secretary of State.

HARRISBURG, PA.—The extension to the Capitol lighting plant has been completed and is now furnishing electricity for the 500 arc lamps in Capitol Park, the State Conservatory and museum building, which will result in the saving of $1,000 per month for the state. The above have been lighted from a private plant in the past.

MILLERSBURG, PA.—A telephone company has been organized to construct a telephone line from Millersburg to Frystown, Mt. Aetna and Myerstown. The directors are James F. Schlasman, D. S. Enminger, of Mt. Aetna; Morris Fisher, Riley Frantz, Harry Miller, A. A. Spannuth and Emmanuel Merkey.

SCRANTON, PA.—Plans have been completed by the American Railways Company, which controls the Scranton Railway Company, for the construction of a large power plant, to be located on the Lackawanna River, near the present power house. The cost of the plant is estimated at $500,000. Frank Caum is manager.

DEADWOOD, S. D.—It is reported that the Continental Copper Company is making arrangements to install complete electrical equipment to operate its mines.

DEADWOOD, S. D.—The Black Hills Traction Company has secured water rights on the Sand Creek, north of here, and will soon commence work on the construction of another large power plant. The output of the new power plant of the company at Belle Fourche, which generates 900 kilowatts, has all been contracted for, and contracts have also been taken for the greater part of the output of the new plant.

NASHVILLE, TENN.—The Nashville Railway & Light Company is planning to extend its lines to the National Cemetery on the Gallatin Turnpike, a distance of about five miles.

EL PASO, TEX.—Captain Thomas A. Davis, president of the El Paso Military Institute, has applied to the government for permission to run an electric railway through Fort Bliss from El Paso to the Military Institute.

OGDEN, UTAH.—The waters of the Willard Canyon, 16 miles from Ogden, are to be developed to generate electricity to operate the Ogden Northwestern Electric Railway and its extension to Brigham City. M. S. Browning, acting for his associates, has acquired all the available water rights in the canyon. It is now proposed to erect a large power house not far from the canyon, to extend the Hot Springs Railway, and to equip the entire system to be operated by electricity, and also to operate cars between Ogden and the terminal of the road. The cost of the plant is estimated at $40,000.

SALT LAKE CITY, UTAH.—H. V. Hart has purchased the property of the Century Gold Mining & Milling Company, and will enlarge the mill and build a large power plant on Raft River.

RICHFORD, VT.—The village of Sutton, Que., Can., has voted to accept the proposition of the Sweat-Comings Company, of this place, to furnish electricity for lighting. It is proposed to transmit electrical energy to the international boundary line, and from there it will be distributed by the village officials, who will also supply Abercorn with electricity for lamps. The new equipment for the plant of Sweat-Comings Company, consisting of new water wheels, steam engine, boilers and dynamo, has arrived and will be installed as soon as possible.

RUTLAND, VT.—The Rutland Street Railway, Lighting & Power Company and the Rutland City Electric Company have been consolidated under the name of the Rutland Street Railway, Lighting & Power Company. By the merger the company takes over all the rights, franchises, plant and equipment of the Rutland City Electric Company, for which it paid $300,000. The new company will operate the street railway and the lighting and power plant separately. The officers of the company are G. T. Rogers, of Binghamton, N. Y., president; Leo W. Wise, of New York, N. Y., vice-president, and Charles H. West, of Rutland, secretary and treasurer.

NORFOLK, VA.—Plans are being made by the Norfolk & Portsmouth Traction Company to erect a substation for its Portsmouth division, in connection with the $1,000,000 power plant just completed.

VIRGINIA BEACH, VA.—The question of installing an electric light plant in this place is under consideration. E. D. Ferebee is interested in the matter.

EDMONDS, WASH.—The Siegfriedt Syndicate has made application to the County Commissioners for a franchise for an electric railway through Edmonds toward Bitter Lake.

NORTH YAKIMA, WASH.—The Yakima Valley Transportation Company has applied to the County Commissioners for a franchise to construct and operate an electric railway along certain public roads in the county.

BARABOO, WIS.—Extensive improvements are contemplated by the Baraboo Telephone Company, which will involve an expenditure of about $5,000. It is proposed to replace the present wires with cables throughout the business district. About 18,000 ft. of cable will be required.

DODGEVILLE, WIS.—Owing to a disagreement between the City Council and the Dodgeville Electric Light Company, the Council has ordered the company to discontinue its service until an agreement is reached. The 10-year franchise of the company expired March 1, and the company has continued lighting the streets since that time, pending an agreement.

EAU CLAIRE, WIS.—The State Railroad Commission has issued an order authorizing the Chippewa Valley Railway, Light, Heat & Power Company to readjust its rates, which it is said means a slight reduction to consumers.

MARINETTE, WIS.—The owners of water power on the Menominee and Peshtigo rivers have combined and contemplate organizing a holding company to take over the rights and holdings of the same. Senator Isaac Stephenson, Perley Lowe, Francis A. Brown, A. F. Hancock, P. A. Martineau and Elmer Grimmer, of this city, and F. H. Johnson, of Oshkosh, Wis., are interested in the enterprise.

PORTAGE LA PRAIRIE, MAN., CAN.—Extensive improvements are contemplated by the Central Electric Company to its plant, which will involve an expenditure of between $25,000 and $40,000. A new building will be erected and other improvements made. John O'Brien is manager.

BRANTFORD, ONT., CAN.—The Grand Valley Railway will construct two new extensions to its system during the spring. One will be built from Brantford, to Port Dover, a distance of 35 miles, and the other from Brantford to Woodstock, 18 miles in length.

BRANTFORD, ONT., CAN.—The hydro-electric plant of the Western Counties Power Company at DeCew Falls was placed in operation March 16, and in future will supply electrical energy in connection with the local plant. The combined output of the two plants is between 50,000 and 60,000 horse-power. The company will supply electricity for industrial purposes at $19.50 per horse-power per year. The company claims that its rates which, under agreement must continue for 25 years, are much lower than can be offered by the Hydro-Electric Commission.

HAMILTON, ONT., CAN.—In the decision handed down by Judge Snider in the street lighting arbitration matter the cost of street lamps will be reduced from $85 to $70 per lamp per year, the reduction to date back to October, 1905, which means a refund of $32,000 to the city from the company. The reduction continues during the balance of the contract, which will expire in July, 1909. It is expected that the company will appeal against the decision.

PRESTON, ONT., CAN.—The Town Council has decided to apply to the Hydro-Electric Power Commission for 600 horse-power of energy. The municipal electric plant will use 200 horse-power, and the other 400 horse-power will be for sale. As soon as the town receives electricity from the Niagara plant an all-night service will be given both for street and residential lighting service.

SHERBROOKE, QUE., CAN.—The Sherbrooke Power, Light & Heat Company contemplates installing another 500-kw, three-phase, 60-cycle generator, to be installed by October next. A. Sangster is superintendent.

New Industrial Companies.

THE U. S. ELECTRICAL MANUFACTURING COMPANY, of Los Angeles, Cal., has been incorporated, with a capital stock of $200,000, by Timothy Mahoney, J. R. Amesty, W. J. Sherriff, G. Russo and Edgar Sharp.

THE ELECTRIC TIMBER CUTTER COMPANY, of San Francisco, Cal., has been incorporated, with a capital stock of $200,000, by M. L. Degnen, M. H. Newman and A. W. Hepburn. W. E. Cashman is attorney.

THE PETTEY ELECTRICAL SIGNAL COMPANY, of Alexandria, Va., has been incorporated with a capital stock of $10,000. The officers are: F. M Hill, president; Zoro Hill, secretary, and G. W. Pettey, manager.

THE AUTOMATIC SWITCH COMPANY, of Mobile, Ala., has been chartered with a capital stock of $10,000. The company proposes to manufacture and sell mechanical and electrical machinery and appliances.

THE C. H. D. BABB & COMPANY, of Bangor, Me., has been incorporated, with a capital stock of $25,000, for the purpose of manufacturing plumbing, heating and lighting apparatus. C. H. Babb is president and R. H. Downing treasurer, both of Bangor.

THE KOZESNIK ELECTRIC THIRD-RAIL SAFETY SYSTEM COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $100,000, by Bernard Hartman, Arthur Hartman and Charles Kozesnik, all of New York, N. Y.

THE OCALA PLUMBING & ELECTRICAL COMPANY, of Ocala, Fla., has filed articles of incorporation, with a capital stock of $5,000. The officers of the company are: David S. Woodrow, president, and George H. Ford, secretary and treasurer.

THE NAGEL MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $15,000, by Theodore Nagel, E. C. Frank Meier and Walter Snyder. The company proposes to manufacture electrical and mechanical specialties.

THE BLACKMAN TALKING MACHINE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $30,000. The directors are: A. L. Blackman, of East Orange, N. J., and George G. Blackman, of New York, N. Y.

THE H. B. DOHERTY COMPANY, of Binghamton, N. Y., has been incorporated, with a capital of $5,000, by Harry B. Doherty, Welcome B. Johnson, Benjamin H. Harris, of Binghamton, N. Y. The company proposes to manufacture motors, engines, carriages, boats, etc.

THE ALMSTEAD MANUFACTURING COMPANY, of Rochester, N. Y., has filed articles of incorporation, with a capital stock of $30,000. The company proposes to manufacture electrical supplies. The directors are Raymond P. Almstead, Morris J. Almstead and John A. Almstead.

THE KLERVIN COMPANY, of Auburn, N. Y., has been incorporated, with a capital stock of $50,000, for the purpose of manufacturing smoke preventives. The directors of the company are Frank H. Messinger, Charles W. Storke, of Auburn, and Ray S. Messinger, of Geoeva, N. Y.

THE E. W. STEVENS COMPANY, of Somerville, N. J., has been incorporated, with a capital stock of $200,000, to manufacture engines, vehicles, etc. The incorporators are: F. Knowlton, of New York, N. Y.; E. D. Cronin, of Brooklyn, N. Y., and R. H. Osgoodby, of Somerville, N. J.

THE ROYAL ELECTRIC COMPANY, of Milford, Ind., has filed articles of incorporation, capitalized at $20,000. The company proposes to establish a plant for the manufacture of electrical and mechanical machinery and appliances. Levi N. Nehr, Asa Le Roy Miller and J. B. Neff are the directors.

THE BALTIMORE LIGHT & EQUIPMENT COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing lighting appliances and fixtures. The incorporators are: G. E. Stickney, Rutherford, N. J.; W. I. Willis, and M. Frank, of Brooklyn, N. Y.

THE INTERNATIONAL PROCESS COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $25,000, for the purpose of carrying on a mechanical, electrical and civil engineering business. The incorporators are: Ernest W. Marshall, George H. Marshall, Henry C. Duter, all of New York, N. Y.

THE MANHATTAN HIGH POWER CAR COMPANY, of Manhattan, New York, N. Y., has been incorporated for the purpose of manufacturing motor cars. The capital stock of the company is placed at $300,000 and the incorporators are: F. W. Barker, J. F. Brandenburg, and F. C. Bonny, New York, N. Y.

THE HOOSIER STORAGE BATTERY COMPANY, of Evansville, Ind., has incorporated to establish a plant for the manufacture of storage batteries and all kinds of electrical and mechanical devices and appliances, and also a plant to furnish motive power to carry on said business. John C. Zutt, W. M. Copeland, A. F. Karges and Ezra Lyon are the directors.

THE UNITED CARBON TRUST COMPANY, of Adams, Mass., has been organized with a capital stock of $5,000,000 and the following officers: Trustees, George N. Hopkins, of Pittsfield; Charles Howes, of Adams, and E. H. Beers, of North Adams; S. H. Fairfield, of North Adams, treasurer. At present the company has a small plant and manufactures carbon brushes, lightning arresters, arc lamps, and moving-picture carbon pencils. The company is planning to secure larger quarters in North Adams and Pittsfield, and will extend its business.

Company Elections.

POMONA, CAL.—At the annual meeting of the Pomona Valley Telephone Company the following-named officers were elected: F. W. Thomas, president; Arthur M. Dole, secretary; C. E. Walker, treasurer, and D. S. Parker, manager.

SAN BERNARDINO, CAL.—At the annual meeting of the San Bernardino Valley Traction Company the following named officers were elected: Howard E. Hunting, president; Mr. Ward, vice-president; Mr. Cook, secretary and treasurer, and A. C. Denman, general manager.

ELIZABETH, IND.—At the annual meeting of the Harrison County Telephone Company the following-named officers were elected: Philip J. Blunk, president; E. L. Smith, secretary; Charles J. Treece, treasurer, and Thomas Evans, superintndnt.

MECHANICSBURG, IND.—At the annual meeting of the Reese Mill Telephone Company the following-named officers were elected: James Pittenger, president; W. H. Wilson, secretary, and George Reagan, treasurer.

PLYMOUTH, IND.—At the annual meeting of the Winona Telephone Company the officers were elected as follows: Samuel Tomilson, president; A. B. Diggs, vice-president, and W. S. Daniels, secretary and treasurer

STENDAL, IND.—At the annual meeting of the Stendal Home Telephone Company the following named officers were elected: Abner McAllister, president; Spencer Barrett, vice-president, and Louis F. Siebe, manager.

WARREN, IND.—At the annual meeting of the Warren Telephone Company the following named officers were elected: John S. Prowl, president; George S. Good, vice-president, J. L. Priddy, secretary and treasurer, and Frank Canaday, manager. About $2,000 has been spent for improving the system, and further improvements will be made during the coming year. The lines will be extended and new ones built.

SPRINGDALE, IA.—At the annual meeting of the West Liberty & Springdale Telephone Company the following-named officers were elected: William Wilkins, president; W. D. Ridenour, vice-president; F. H. Battey, secretary and treasurer, and J. Hinkhouse, trustee. The company has decided to double the entire line.

MARTINSBURG, IA.—At the annual election of the Martinsburg Mutual Telephone Company the following-named officers were elected: Fred Thornburg, president; R. H. Shultz, vice-president; W. G. Lister, secretary, and Earl Ogden, treasurer.

RICHMOND, MASS.—At the annual meeting of the Richmond Co-operative Telephone Company held recently the name of the company was changed to the Richmond Telephone Company and the officers re-elected as follows: Frederick A. Clement, president and general manager; Sidney M. Loveland, vice-president, and John R. Ayer, clerk and treasurer.

GRAWN, MICH.—At the annual meeting of the Grawn Rural Telephone Company the following-named officers were elected: M. A. Brest, president; W. E. Batey, secretary, and F. Van Horn, manager.

CRETE, NEB.—At the annual meeting of the Crete Telephone Company the following-named officers were elected: C. W. Nunemaker, of Tobias, president; B. G. Miller, of Crete, vice-president and manager, and C. E. Bowlby, secretary and treasurer.

BERGEN, N. Y.—At the annual meeting of the Bergen Telephone Company the following-named officers were elected: George R. Fuller, president; George Sands, vice-president; C. M. Beattie, secretary, and C. E. Housel, treasurer.

UTICA, N. Y.—At the annual meeting of the Bossert Electric Construction Company the following directors were elected: D. N. Crouse, B. M. Crouse, F. K. Kernan, W. N. Kernan, Henry Quinn, C. B. Rogers and F. G. Scofield. The present officers were re-elected for the ensuing year.

GALION, OHIO.—At the annual meeting of the Galion Telephone Company the following-named officers were elected: Mark Cook, president; A. A. Whitney, vice-president; S. M. Wolf, secretary; J. W. Cupp, treasurer, and C. R. Callaghan, general manager.

HURON, OHIO.—The Mutual Telephone Company has been organized and the following-named officers elected: Dr. N. E. Woessner, president; Henry Spranker, vice-president, and T. M. Sprowl, treasurer. Work will commence on the construction of the line as soon as the weather will permit.

OKOLONA, OHIO.—At the annual meeting of the Okolona Mutual Telephone Company the following named officers were elected: Fred Gunn, D. Panning, vice-president; J. A. Benien, secretary, and G. H. Freytang, treasurer.

SALEM, S. D.—The West Vermillion Telephone Company has elected the following-named officers: N. E. Carpenter, president; Philip Roche, secretary, and Charles Padgett, treasurer. The company expects to have its line completed and connected with Salem soon.

CHATTANOOGA, TENN.—At the annual meeting of the Chattanooga Railways Company the following named officers were elected: John Graham, president; C. P. King, vice-president; W. H. Lawton, secretary and treasurer.

BOWLING GREEN, VA.—At the annual meeting of the Carolina Telephone Company the following-named officers were elected: C. T. Smith, president; W. E. Ennis, vice-president; Athol Collins, secretary, and L. E. Martin, treasurer. The company is planning to extend its lines at once to various towns in the county.

SPOKANE, WASH.—At the annual meeting of the Washington Water Power Company the following were elected trustees: W. A. White, of New York, N. Y.; H. M. Richards, James M. Glover, L. M. Davenport, A. B. Campbell, J. P. M. Richards, E. F. C. Van Dissell, D. L. Huntington and J. D. Sherwood, of Spokane; H. Parsons and Frank Lyman, of New York, N. Y.

HAGER CITY, WIS.—At the annual meeting of the Hager City Telephone Company the following-named officers were elected: A. F. Andersen, president; J. W. Milton, secretary, and J. H. Gilmore, treasurer.

DAYTON, WYO.—At the annual meeting of the Tongue River Telephone Company the following named officers were elected: R. E. Mills, president; J. Dickson, secretary, and J. O. Kier, treasurer.

HONOLULU, H. I.—At the annual meeting of the stockholders of the Kauai Electric Company, Ltd., the following officers were elected: D. P. R. Isenberg, president; F. M. Swanzy, vice-president; E. H. Wodehouse, treasurer; T. C. Davies, secretary; H. W. M. Mist, auditor.

HONOLULU, H. I.—At the annual meeting of the stockholders of the Hawaiian Electric Company, Ltd., the following officers were elected: J. A. McCandless, president; F. W. Macfarlane, vice-president; F. C. Atherton, treasurer; Godfrey Brown, auditor; W. L. Hopper, secretary.

New Incorporations.

CLARKSVILLE, ARK.—The Johnson County Telephone Company has been granted a charter by the Secretary of State. The company is capitalized at $6,000 and the officers are: W. H. Hunt, president; R. S. Davis, vice-president; J. S. Kolb, secretary, and V. E. Davis, treasurer.

COTTON PLANT, ARK.—The Cotton Plant Light & Power Company has filed articles of incorporation, with a capital stock of $10,000. The incorporators are F. H. Kennedy, D. H. Echols, E. P. Ford and others.

MULBERRY, ARK.—The Mulberry Ice & Light Company has been organized, with a capital stock of $10,000, and proposes to erect a light plant and ice factory.

OAKLAND, CAL.—The San Francisco, Oakland & San José Consolidated Railway Company has been organized for the purpose of consolidating the San Francisco, Oakland & San José Railway and the San Francisco & Bay Counties Railway, which was recently incorporated for the purpose of constructing an electric railway from San Francisco to San José. The present plan of the company is to continue the operation of the three lines operated at present by the San Francisco, Oakland & San José Railway, to construct a railway to San José, to build a branch road to Northbrae and another branch to Claremont, and also to connect the mainland with Yerba Island by means of a tunnel. The company is capitalized at $7,750,000 and the directors are F. M. Smith, F. C. Havens, E. A. Heron, Heron H. Wadsworth and Dennis Searles.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Los Angeles & San Francisco Short Line Railway Company by Captain John Cross, A. P. Cross, Walter F. Haas, M. K. Miller, Charles Wier, M. H. French, W. R. Ireland, C. S. Biernell and J. F. Loomis. The company is capitalized at $2,000,000.

SAN LEANDRO, CAL.—Articles of incorporation have been filed for the Suburban Light & Power Company. The company is capitalized at $1,000,000 and the directors are Charles A. Jeffrey, of Oakland; R. W. Geisenhofer, L. B. Smith, William Lucas, A. J. Lloyd, of San Leandro; Jacob Harner, Jr., and J. W. Burge, of Hayward. The company proposes to furnish light, heat and power to suburban towns on the east side of the bay.

SMYRNA, DEL.—The National Construction Company has been incorporated to build an electric railway from Delaware City to Lewes. J. W. Endean is chief engineer and general manager of the company.

CHICAGO, ILL.—Articles of incorporation have been filed for the Rockford Light & Fuel Company. The capital stock of the company is placed at $2,500, and the incorporators are: John A. Johnson, Anton E. Carlson and William Johnson.

CHICAGO, ILL.—The Calumet & South Chicago Railway Company has filed articles of incorporation, with a capital stock of $1,000. L. A. Busby, H. P. Weber and E. B. Hamilton.

McCALL, ILL.—The McCall Farmers' Telephone Company has been incorporated, with a capital stock of $2,490, by Emile Coeur, Archibald C. Williams and C. M. Benner.

PANA, ILL.—Articles of incorporation have been filed for the Pana, Girard & Jacksonville Railroad Company. The company is capitalized at $50,000, and the incorporators are: B. F. Darnielle, J. N. Anderson, W. F. Bercher, of Springfield; John J. Stowe, of Girard, and Charles E. Sargent, of Greenfield. The principal office of the company is located at Springfield.

JEFFERSON, IA.—The Jefferson Interurban Railway Company has been chartered, with a capital stock of $10,000, to build an interurban railway from Jefferson to Des Moines and to Perry. The officers of the company are: Albert Head, president; Henry Haag, vice-president, and Mahlon Head, treasurer.

TOPEKA, KAN.—The Marlam Construction Company has been chartered, with a capital stock of $250,000, for the purpose of constructing the interurban railway of the Kansas City & Kansas Southwestern Railroad Company from Kansas City to Lawrence, with a branch to Topeka and another to Independence. E. M. Lambkin, of Kansas City, is interested in the enterprise.

FRANKFORT, KY.—The Cairo & Norfolk Railway Company has filed articles of incorporation, with a capital stock of $500,000. The incorporators are: L. W. Goode and E. E. Weston, of New York, N. Y.; M. W. Kelly, of Madison, Wis.; W. A. Usher, R. E. Lockridge, B. A. Neal, F. R. Allen and others.

PORTLAND, ME.—The Consolidated Power & Light Company, of South Dakota, has been incorporated, with a capital stock of $3,000,000. The purpose of the company is to install and operate power plants. G. A. Hutchins is president and C. H. Tolman clerk, of Portland, Me.

PORTLAND, ME.—The Crawfordsville Water & Gas Company has been incorporated, with a capital stock of $375,000. The company proposes to furnish gas and electricity. The officers are: H. L. Cram, president, and B. L. Steward, of Portland, treasurer.

WATERVILLE, ME.—The Kennebec Farm & City Telephone Company has been incorporated, with a capital stock of $10,000, and is practically an extension of the Somerset Farmers' Telephone Company. F. E. Webster is president of the company and Frank L. Ames treasurer and general manager.

ANNAPOLIS, MD.—A bill has been introduced to the State Legislature incorporating the Washington, Patuxtent & Drum Point Railroad Company. The incorporators are: C. A. M. Wells, Joseph R. Owens, Rexford M. Smith, Wallace A. Bartlett and Charles A. Wells, of Prince George's County; Ira J. Baker and Charles C. Mayer, of Washington. The company is capitalized at $250,000, and it proposes to construct a railroad to be operated by steam or electricity from a point on the Chesapeake Beach Railroad in Calvert or Anne Arundel counties, east of the Patuxtent River, to Drum Point and Solomon's Island.

BALTIMORE, MD.—Articles of incorporation have been filed for the Lee Electric Company, with a capital stock of $50,000, by Arthur L. Bosley, Robert L. Gill, both of Baltimore, and Joseph F. Turner, of Philadelphia, Pa.

BLOOMINGDALE, MICH.—The Bloomingdale Telephone Company has been organized with the following officers: Charles Linton, president; Jesse Cone, secretary, and E. J. Marrifield, treasurer. The company will assume control of all the lines owned by the Linton Baker Company.

FERRIS, MICH.—The farmers of East Ferris have organized the East Ferris Telephone Association. The officers are: George Wilson, president; Charles W. Sherman, vice-president, and V. Johnson, secretary.

LANSING, MICH.—Articles of incorporation have been filed with the Secretary of State for the North Burns Telephone Company, with a capital stock of $10,000.

NEW TROY, MICH.—Articles of incorporation have been filed for the New Troy Telephone Company with a capital stock of $10,000.

NEW TROY, MICH.—The Citizens' Telephone Company, of Berrien County, has been organized, with a capital stock of $10,000, by F. H. Morley, William C. Bowers, William A. Keith, Louis N. Tatro and George Ashman.

BAGLEY, MINN.—The Bagley-Omega Telephone Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are E. J. Warren, M. J. Kolb and S. M. Bugge.

ELM CREEK, MINN.—Articles of incorporation have been filed for the Elm Creek Telephone Company, with a capital stock of $2,000, by J. D. Schafer, W. O. Pruitt, J. L. Ridgway, William Grill and A. P. Freitag.

PIPESTONE, MINN.—The Pipestone County Rural Telephone Company has been organized for the purpose of constructing a telephone line to connect with the Northwestern Telephone Company. The officers of the company are: E. S. Butman, president; J. H. Crawford, vice-president; G. S. Sindt, secretary, and Louis Lettow, treasurer.

RICHVILLE, MINN.—The Richville Telephone Company has been chartered, with a capital stock of $5,000, by James Shaw, T. K. Johnson, C. A. Jimner, C. A. Fribery, Jr., J. O. Robb and Frederick Prentice.

CHILLICOTHE, MO.—The Livingston County Mutual Telephone Company has been organized, with a capital stock of $15,000, for the purpose of operating a mutual telephone system in this city and in Livingston County.

BOZEMAN, MONT.—Articles of incorporation have been filed for the Gallatin Valley Electric Railway Company for the purpose of constructing an electric railway, 30 miles in length, through the Gallatin Valley. The company is capitalized at $100,000, and the incorporators are: W. H. Winfree, W. S. Hartman, C. S. Hartman, H. A. Bolinger and H. M. Stewart.

BRISTOW, NEB.—The Boyd County Mutual Telephone Company has been organized at this place for the purpose of installing a telephone system from river to river. An exchange will be established in Bristow and the lines extended to the rural districts.

RENO, NEV.—The Eastern Nevada Power Company has filed articles of incorporation with the county clerk. The company is composed of Utah capitalists, who propose to establish a large reservoir and power plant for irrigation and power purposes in Lincoln County. The capital stock of the company is placed at $500,000. Water will be taken from the Colorado River.

JERSEY CITY, N. J.—The Interstate Traction Company has been incorporated, with a capital stock of $200,000, by G. R. Warner, B. S. Mantz and A. C. Baer, of Jersey City.

JERSEY CITY, N. J.—Articles of incorporation have been filed for the United Railway, with a capital stock of $200,000, by H. O. Coughlan, L. H. Gunther and John R. Turner.

BUFFALO, N. Y.—Articles of incorporation have been filed for the Lima-Honeoye Electric Light & Railroad Company, with a capital stock of $50,000. The directors are: Charlotte E. Georger, Eugene A. Georger, of Buffalo, and Edwin D. Watkins, of Lima. This is a organization of the company after sale.

OX BOW, N. Y.—The Ox Bow Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock of the company is placed at $550, and the directors are D. M. Mills, A. B. Clark and W. G. Lanito, all of Ox Bow.

WARSAW, N. Y.—The Wyoming County Home Telephone Company has filed articles of incorporation, with a capital stock of $50,000. The incorporators are: Howard Hendrickson, William Hendrickson and George H. Rymers, of Albany, N. Y.

HIGH POINT, N. C.—A charter has been granted to the North State Telephone Company, with a capital stock of $50,000, of which $20,000 has been subscribed. The incorporators are W. H. Ragan, V. A. J. Idol, F. M. Armfield, Charles Houser, J. F. Hayden and E. D. Steele.

GRAFTON, N. D.—The Herreatt Telephone Company has been organized to build a telephone line out 10 miles from Grafton to connect with the central office at this place. F. E. Linhart is president of the company and A. C. Jorandberg, secretary.

AMELIA, OHIO.—The Amelia Independent Telephone Company has been incorporated with a capital stock of $10,000, by D. C. Warner, Bennett Behymer, W. C. Coombs, A. A. Eppert and A. N. Coombs.

AVON, OHIO.—The Avon-Sheffield Telephone Company has been incorporated, with a capital stock of $10,000, by J. R. Piper, H. B. Martindale, Andrew Conrad and John Biesneher.

BETHEL, OHIO.—The Bethel Home Telephone Company has been incorporated, with a capital stock of $10,000, by George P. Hibbetz, M. W. Fagaly, T. A. Pinkham, O. B. Davison, P. E. Wilson and O. C. Warner.

GRAFTON, OHIO.—The Grafton Mutual Telephone Company has been incorporated with a capital stock of $10,000 by E. C. Storrs and others.

GUERNSEY, OHIO.—The Sarchet Run Telephone Company was organized at Mantua and the following officers elected: W. L. Simpson, president; Henry Hamilton, vice-president; M. K. Wells, secretary, and John McCullough, treasurer.

NORTH EATON, OHIO.—The North Eaton Telephone Company has been incorporated, with a capital stock of $[illegible],000. The incorporators are Charles W. Langdon, I. N. Haven, Thomas Hales, Aklen Nichols, John Cawley, L. T. Davis and others.

FORT JENNINGS, OHIO.—The Fort Jennings Farmers' Mutual Telephone Company has been formed by Peter Roose, R. J. Cummings, Shelby Harris, Charles Miricle and others.

NEW BAVARIA, OHIO.—The New Bavaria Farmers' Mutual Telephone Company has been chartered by C. E. Young and others.

DUKE, OKLA.—The Duke Telephone Company has been chartered, with a capital stock of $500, by J. L. Williams, W. S. Poole, W. O. Ames and C. Phelps, all of Duke.

BINGER, OKLA.—The Jewell Telephone Company has filed articles of incorporation with a capital stock of $3,000. The incorporators are W. K. Mitchell, N. Godfrey and N. Meadows, all of Binger.

NOBLE, OKLA.—The Farmers' Union Spring Creek Telephone Company has been incorporated, with a capital stock of $15,000, by A. Windrow, E. W. Richardson, Z. Relick and H. B. Richardson, all of Noble.

WOODWARD, OKLA.—Articles of incorporation have been filed for the Farmers' Hub Telephone Company, with a capital stock of $3,000, by Henry Hugerman, L. A. Steat, J. E. Combs and F. S. Beher, all of Woodward.

MAURERTOWN, PA.—A charter has been granted to the Maurertown Mutual Telephone Company, with a capital stock of $5,000. The officers of the company are: C. F. Hockman, president; J. E. Boyer, vice-president; H. C. Rosenger, secretary and treasurer.

WILMORE, PA.—The Wilmore Rural Telephone Company has been organized, with a capital stock of $5,000, for the purpose of building telephone lines into the surrounding country. The officers of the company are: Wallace Sherbine, president, and S. W. Crum, secretary.

JEFFERSON CITY, TENN.—The Citizens' Telephone Company has been incorporated, with a capital stock of $10,000, by B. M. Tittsworth, J. C. Thomas, J. V. Cline, I. M. Tittsworth, I. M. Cate, G. A. Moody and R. M. Bales.

NASHVILLE, TENN.—The Consolidated Electric Company has been incorporated, with a capital stock of $15,000, by George A. Wood, A. G. Rutherford, James A. Singleton and others.

NASHVILLE, TENN.—The Chucky Valley & Cherokee Telephone Company, of Washington County, has been incorporated, with a capital stock of $5,000, by H. C. Jackson, J. J. Brown, F. S. Brown, J. W. Deaderick and John Graham.

McDADE, TEX.—The Knobbs Telephone Company has been organized for the purpose of installing a telephone system to connect McDade with the surrounding towns.

COLFAX, WASH.—The Penawawa Telephone Company, Ltd., has been organized for the purpose of erecting an extensive system of rural telephone lines in Colfax wheat belt. The officers of the company are Silas Smith, president, and Herbert Smith, secretary and treasurer.

EDMONDS, WASH.—Articles of incorporation have been filed for the Edmonds Independent Telephone Company, with a capital stock of $2,500, by A. M. Yost, James Mowat, Zophar Howell and T. A. Siegfrendt.

SEATTLE, WASH.—The N. & S. Electric Company, of Seattle, has been incorporated, with a capital stock of $24,[illegible]00, by Robt. Wilhelm and Wilson Niedergesalss.

SEATTLE, WASH.—The Klickitat Power & Electric Company has been incorporated, with a capital stock of $25,[illegible], by S. Hill, W. G. Collins and N. B. Brooks.

CUSHING, WIS.—The Equity Telephone Company has been organized for the purpose of building a telephone line from Luck to Cushing. The officers of the company are: J. P. Peterson, president; G. E. Johnson, vice-president; E. Wilson, secretary, and Benamin Jergerson, treasurer.

MOSINEE, WIS.—The Mosinee Telephone Company has filed articles of incorporation, with a capital stock of $1,500. The incorporators are Howard Dessert, Arden Paronto, W. von Berg, J. P. Kauter and W. I La Du.

OSCEOLA, WIS.—Articles of incorporation have been filed for the Osceola Electric Company. The capital stock of the company is placed at $4,000 and the incorporators are T. C. Ladd, C. W. Bloom and William Hillskatter.

RUBICORN, WIS.—The Hartford & Saylesville Telephone Company has been incorporated with a capital stock of $1,2[illegible] by A. H. Lambrecht, John Sullivan, Henry Lepien and others.

RUDOLPH, WIS.—Articles of incorporation have been filed with the Secretary of State for the Rudolph Telephone Company by C. O. Hasel, John Granger and Frank Whittman. The company is capitalized at $2,500.

TWO RIVERS, WIS.—The Range Line Telephone Company has been organized and the following officers elected: Peter Becker, president, Anton Hammernik, secretary, and R. Buchelz, treasurer. Work on the construction of the line will begin at once.

VIROQUA, WIS.—Articles of incorporation have been filed with the Secretary of State for the Crawford-Vernon Mutual Telephone Company. The following-named officers have been elected. P. N. Peterson, president; C. Stevlington, vice-president, K. M. Hoeversen, secretary, and A. E. C. Christenson, treasurer.

COBALT, ONT., CAN.—The Cobalt Light, Power & Water Company has been incorporated here, with a capital of $10,000. The incorporators are: J. R. Gordon, of Sudbury, Ont.; C. C. V. Campbell, C. A. Gilmour, of Cobalt, Ont.

LONDON, ONT.—The London Township Telephone Company has been incorporated, with a capital stock of $5,000.

MORRISBURG, ONT.—The Morrisburg Electric Railway Company has applied to the Ontario Legislature for permission to incorporate. The company proposes to construct a system of electric railways from Morrisburg, through Williamshurgh, and thence through Russell to Winchester.

MOUNT FOREST, ONT., CAN.—The Mt. Forest, Wingham & Grey Telephone Company is being organized to operate telephone lines in Mt. Forest and surrounding towns.

Legal.

RECEIVER FOR LIGHT PLANT.—Charles G. Henry has been appointed receiver of the Pond-Decker Manufacturing Company, of Newport, Ky., which owns the electric light plant and the property upon which the Newport Stave Company is operating its plant. The application for a receiver was made by the American National Bank, of Fort Smith.

DUTY OF ELECTRIC COMPANIES TOWARD TRESPASSERS.—In Guinn vs. Delaware & Atlantic Telegraph & Telephone Company, New Jersey, 62 Atl., 412, it was held that a telephone company was liable where a person was injured by coming in contact with one of its wires while he was crossing private property without permission. The guy wire, which caused the injury, was maintained in such a position that it was likely to become crossed with an electric light wire. The theory upon which a recovery was allowed was that, if the injured party was a trespasser at the time of the accident, his wrong was one against the land owner and not a public wrong or one against the public or defendant telephone company.

FORECLOSURE OF PINE BLUFF WATER AND LIGHT PLANT.—Judge Jacob Trieber, of the Federal Court, has appointed C. Philip Waters, of Little Rock, and Frank G. Bridges, of Pine Bluff, receivers of the Pine Bluff Light & Water Company, of Pine Bluff, Ark., which is the result of a suit filed in the United States Circuit Court by the New York Trust Company and Osborn W. Bright to foreclose a mortgage of $250,000 held by the New York company on the property rights and franchises of the company. A contest has been on in Pine Bluff for years between the city and the water company, the city endeavoring to get control of the water works. As the plant is to be sold, it is expected that the city will purchase it.

CONTRACT NOT EXTENDED BY LENGTHENED SERVICE.—Judge John M. Kennedy on March 21 handed down an opinion in the case of the Allegheny County Light Company against the Wabash-Pittsburg Terminal Railroad Company, in which he refuses to sustain the contention of the plaintiff company that the holding or continuation of a light service was an extension of a contract. The light company entered a suit to recover $2,607.28, with interest. The railroad company, in an affidavit of defence, claimed that it was only liable for the amount of the light used, as its contract had expired, while the plaintiff company was charging for a period when no light was used, on the ground that the defendant renewed its contract by holding over. The light company asked for judgment for want of a sufficient affidavit of defence, which Judge Kennedy in his opinion refuses, stating that the railroad company was only bound to pay for the light used and could not be held for a year's service, as the light company contended.

ACTION AGAINST ELECTRIC COMPANY BY EMPLOYEE INJURED WHILE ENGAGED IN CONSTRUCTING MANHOLE.—Whether an electric light company is guilty of negligence in having a manhole lowered into a place made for it without having it braced, with the result that an employee, shoveling sand from beneath it to allow of its being still further lowered, was injured by its breaking and one of the sections falling on him, is a question for the jury to decide, and on such a statement of facts the court should not nonsuit the plaintiff without submitting the question to the jury. Upon the question of the defendant's negligence, evidence on the part of the plaintiff was received which tended to show that it was not safe or proper to lower this structure without its being first braced interiorly and exteriorly. This precaution had not been observed by the defendant, and it therefore became a question of fact for the jury's determination whether the defendant had discharged the duty of ordinary care for the safety of its employees. Ward vs. Edison Electric Illumination Co., of Brooklyn, New York Supreme Court, Appellate Division, 108 N. Y. Supp., 608.

DAMAGES ALLOWED AGAINST ELECTRIC COMPANY FOR INJURIES RESULTING FROM UNINSULATED WIRE.—The plaintiff in a recent case against an electric light company was injured while at work constructing a wall near which one of the company's wires was strung. On the day of the injury the plaintiff was directed by a mason to move certain mortar from a mortar board at one end of the scaffold on which he was standing to a mortar board at the other end of the scaffold. It was raining, and the scaffold, board and tools were wet. In performing this work the plaintiff stepped upon the mortar board and slipped. Apparently he involuntary threw out his hands to save himself or restore his equilibrium, when his left forearm came in contact with the the heavily charged wire. He became at once insensible and fell to the ground upon a pile of rock. The court ruled that, so far as the injuries received by plaintiff from coming in contact with the wire directly are concerned, it is a fair inference from the evidence that the negligence of the defendant was the proximate cause thereof. Birsch vs. Citizens' Electric Co., Supreme Court of Montana, 93 Pac. Rep., 940.

GRANT OF TELEPHONE FRANCHISE BY MUNICIPAL CORPORATION.—A city ordinance extending to a telephone company the right to use the streets, alleys and public grounds of the city in the construction, operation and maintenance of its plant or system, and which does not, in any of its provisions, indicate an attempt to exclude other like corporations or companies from a like privilege, is not the grant of an exclusive right or privilege, and, when a city, by the granting of a such a privilege, has caused the recipient telephone company to incur expense in good faith and in reliance upon it, the city authorities, if the use be a public one, cannot arbitrarily impose by subsequent regulations, without necessity or the demands of public convenience, additional burdens upon the company which are clearly beyond the reasonable exercise of the police power. That a city council may make reasonable regulations relating to the maintenance and repair of defendant's plant is not open to argument; but such regulation is not to be exercised at mere whim and caprice. It must be proportionate to and commensurate with the public necessity for the protection and promotion of the public health, safety, necessity or convenience. The application of the police power cannot be extended by the authority which is intrusted with such application to an arbitrary misuse of private rights. City of Plattsmouth vs. Nebraska Telephone Co., Supreme Court of Nebraska, 114 N. W. Rep., 588.

LIABILITY TO LINEMAN INJURED ON FALLING POLE.—It is held that a telephone company is not liable in damages to a lineman for injuries received through the falling of a pole on which he was working while removing wires preparatory to taking the pole down. It appeared that the pole had rotted at the point where it entered the ground and that the fact was easily discovered by the application of tests known to the lineman had he made proper use of his knowledge. The liability of the company was based on the fact that the foreman had directed the lineman to ascend the pole and cut the wires and that he was negligent in so doing without having first tested the strength of the pole. On the question of the company's negligence, the court said that where a foreman directs an experienced lineman to climb a pole and cut wires, it would be unnecessary to tell him that the appearance of the pole above the ground does not indicate its safety, as the weak point is just below the surface of the ground, and whether the pole is defective there or not can only be ascertained by the usual test, and to inform him of the manner of making the test. Those matters are as much within the knowledge of the lineman as of the foreman, and, as between the lineman who knows all the facts and the foreman, the making of the test, the climbing of the pole and the various acts are details of the work. La Duke vs. Hudson River Telephone Co., New York Supreme Court, Appellate Division, 108 N. Y. Supp., 189.

Personal.

MR. L. L. JOHNSTON, of the Westinghouse Machine Company, delivered a lecture before the Modern Science Club, of Brooklyn, N. Y., on March 31, entitled "Gas Engines."

PROF. FRANK L. TUFTS, of Columbia University, will deliver a series of five lectures at the Hebrew Technical Institute, New York, on the subject of electricity and radioactivity.

PROF. CECIL B. SMITH, of Toronto, Can., delivered the principal address at the twelfth anniversary of the granting of the charter of the Clarkson School of Technology, which was celebrated March 14.

MR. G. MARCONI has been elected manager of the Marconi Wireless Telegraph Company, of London, England, to succeed Mr. H. Cuthbert Hall, who has resigned. Mr. Marconi has assumed his new duties, which may interfere with his projected early trip to this country.

MR. T. J. WEBER has resigned as general superintendent of the Pontiac Light Company, of Grand Rapids, Mich., to become engineer of the properties of Child, Hulswit & Co., bankers, of Grand Rapids. The properties include public utilities in Chattanooga, Tenn.; Laporte, Ind.; Matoon, Ill.; Cadillac and Cheboygan, Mich.; Fort Dodge and Muscatine, Iowa.

NEW YORK ELECTRICAL SOCIETY.—At the last meeting of the New York Electrical Society the following named gentlemen were elected to membership: Clark Potter Read, Jas. W. Owens, J. Allan Worth, Dr. Albert C. Geyser, Joseph W. Lowell, Clarence T. Coley, Bernard Elias, James J. Burnes, Albert C. Triaca, John C. Lotz, Edwin N. Lightfoot, William Leo Culley, Ray M. Telford and A. Schwennesen, of New York City, and Burtis D. Mack, of Jamaica, L. I.

GENERAL A. B. R. SPRAGUE, president of the Worcester Electric Light Company, has returned from a six weeks' trip through the West, in which he visited Colorado, New Mexico, Arizona, California, Oregon and other sections of the trans-Mississippi country. The trip was the first one of such length that General Sprague has had time to take for many years, and the development of the West since his last visit proved of deep interest. He was a guest of the General Electric Company at the annual dinner of the Boston office on March 27.

Obituary.

MR. WALTER L. TYLER, a member of the A. B. See Electric Elevator Company, died at his home in Brooklyn, N. Y., March 22. He was 41 years of age, and was graduated from Columbia in the class of 1887. Mr. Tyler was a member of the Crescent Athletic Club, the Psi Upsilon Fraternity, the Hardware Club and the Hamilton Club, of Brooklyn. He was also a director of the Flatbush Trust Company, and vice-president and director of the Home Title Insurance Company.

MR. BENJAMIN F. WOODWARD, of Denver, Colo., died recently in Mexico. He was born in Newark, Ohio, June 25, 1834, and when 18 years of age was manager of the Pittsburg telepraph office of the Western Atlantic & Ohio Telegraph Company. He built the first telegraph line in Colorado, and for many years was manager for the Western Union Telegraph Company in Denver, and superintendent of the telegraph system for the Denver & Rio Grande Railway.

MR. WILLIAM ORMISTON CALLENDER, the founder of Callender's Cable & Construction Co., Ltd., died at his residence in Bournemouth, on March 14. Mr. Callender was born in Leith in 1827, and was consequently 81 years of age at the time of his death. He settled in London in 1866, and shortly thereafter became connected with the paving industry. In 1879 he patented an insulating material in which Trinidad bitumen formed the chief ingredient, and this material has become widely known as a dielectric for underground mains, under the name of "Vulcanized Bitumen." The Callenders Bitumen Telegraph and Waterproof Co., was founded in 1882, to develop this invention, and the present company, the Callender's Cable & Construction Company, Limited, is its successor. It will be remembered, also, that Mr. Callender organized an American company about 1884, but it had only a short-lived career.

STANISLAUS P. FRANCHOT, Senator of the Forty-seventh District of the State of New York, who established the National Electrolytic Company on the lands of the Niagara Falls Power Company at Niagara Falls, died following an operation in Montreal, Que., Tuesday, March 24. On the morning of Monday, March 16, the Senator suffered a fall at his home in Niagara Falls, and this resulted in a total paralysis of the lower portion of his body. Physicians who were called in to make a diagnosis of the case realized the paralysis was due to pressure on the spine, which might be relieved by an operation. For this reason he was taken to the Western Hospital in Montreal, where he was operated upon on the morning of Sunday, March 22. It was found that the spine was dislocated and fractured. The funeral was held from St. Peter's Church, Niagara Falls, Friday, March 27. It was attended by Governor Hughes, Lieutenant Governor Chanler, Speaker Wadsworth and over 100 Senators and Assemblymen, who traveled to Niagara in a special train to pay the final tribute to the dead Senator. The interment was private and in Riverdale Cemetery, Niagara Falls. Mr. Franchot was born in Morris, Otsego County, New York State. He graduated from Union College, Schenectady, in 1871, and in 1874 married Miss Eells, of West Virginia. In 1884 he went to Buckingham, Que., where he engaged in mining. In 1897 he came to Niagara Falls and established the National Electrolytic Company, of which be was vice-president at the time of his death. He was elected in 1906 to the State Senate as a Republican.

MR. WILLIAM A. KREIDLER, founder and principal proprietor of the *Western Electrician*, died of appoplexy in Augusta, Ga., March 26. Mr. Kreidler was born in South Dansville, N. Y., Aug. 20, 1858. He attended the University of Rochester, class of '84, and was a member of the D K E fraternity. In 1882, after two years in college, he removed to Chicago and entered the employment of the Western Electric Company, and shortly after became an advertising solicitor for the Electrical World and manager of the Western office. In 1887 he founded the *Western Electrician*. As the paper prospered, Mr. Kreidler became also interested in outside non-electrical business ventures, with a large measure of success. He was one of the organizers of the old Chicago Electric Club and its secretary for several years. Of late years Mr. Kreidler had spent much of his time at his country house in Lake Bluff. His city home for many years was at the Belden, 295 Belden avenue. He was a member of the Union League Club, Exmoor Country Club and Lake Bluff Country Club, as well as of the American Institute of Electrical Engineers, the National Geographic Society and the Chicago Academy of Sciences. He was a pewholder in the Church of Our Saviour. Mr. Kreidler was not only a man of fine business ability, but he also possessed marked literary taste and was a collector of fine books. He was interested in the natural sciences, and he also possessed some skill as an inventor, and one or more patents have been taken out in his name. He was a kind-hearted man, of generous impulses, and his death is sincerely regretted by a large number of friends. Mr. Kreidler was married in 1893 to Miss Netta Ophelia Preston and his widow survives him. The other immediate members of his family are his mother, sister and two brothers, living in Olean, N. Y. The funeral took place on Monday, March 30, at 2:30 p. m. from the family residence in Lake Bluff.

Unclassified Items.

EXETER, N. H.—The Exeter, Hampton & Amesbury Street Railway Company, which was recently sold at auction has been reorganized. There will be two companies, one operating an electric lighting system, to be known as the Exeter & Hampton Electric Company, while the street railway will continue under the present name.

SEATTLE, WASH.—Contracts have been awarded by the Board of Public Works in connection with the cluster lamps which are to be placed on Third Avenue as follows: For conduits and underground work, to Meacham & Babcock, for $27,718; transformers and cables to Meacham & Babcock, for $10,070, and to F. T. Crowe & Company for ornamental poles, for $5,202.

FERGUS FALLS, MINN.—Bids will be received until April 15, by G. H. Gard, City Clerk, for furnishing material, including hydraulic and electrical machinery for the municipal electric light plant, and completing the abandoned contract of concrete dam and brick power house.

SPRINGFIELD, ILL.—The Illinois Inland Traction Company has been granted a charter with a capital stock of $100,000. The company proposes to build an electric railway from Chicago to Kankakee. The incorporators are: Carey W. Rhodes, Elmer Schlesinger, Edwin D. Lawlor, of Chocago; Edward Doepp, of Blue Ilsand, and H. C. Bangs, of Glencoe.

SONGO LOCK, ME.—Plans are being made by the Portland & Northern Railway Company to commence work on the construction of an electric railway to run from Portland to Bridgton.

HONOLULU, H. T.—At the annual meeting of the Honolulu Rapid Transit & Land Company the following named officers were elected: L. T. Peck, president; L. A. Thurston, first vice-president; J. B. Castle, second vice-president; William Williamson, secretary, and C. H. Atherton, treasurer.

WALDEN, N. Y.—Articles of incorporation have been filed with the secretary of state for the Wallkill River Company with a capital stock of $250,000 by A. J. Fowler, of Walden; C. B. Fuller, J. E. Fuller, Walter Greer, and G. B. Townsend, of New York, N. Y. The company proposes to construct a power plant on Wallkill River at Walden, and expects to develop about 2000 hp.

RUSTON, LA.—The citizens on March 25 voted to issue $50,000 in bonds, the proceeds of which to be used for extensions and improvements to the municipal electric light plant and water works system.

WILMINGTON, DEL.—The Board of Trustees of the County Hospital, at Farnhurst, is contemplating installing either an electric light plant or an acetylene gas plant, and has appointed a committee to investigate the cost of installing the same. The county is now paying more than $1,200 per year for lighting the hospital.

DENVER, COL.—The Nevada-California Power Company is preparing to make entensive improvements and extensions to its plants in Nevada, which will involve an expenditure of about $500,000. The company plans to enlarge its 7500-hp plant near Goldfield and double the output of the plant.

ELLWOOD CITY, PA.—The Ellwood City & Wurtemburg Electric Railway Company has been incorporated with a capital stock of $18,000 to build an electric railway in Lawrence County, three miles in length. The directors are: J. T. Macklin, Frisco, president; John M. Curry, S. P. Turner, J. N. Kirker, S. C. Van Gorder, and others.

SERGENT, KY.—The Letcher County Home Telephone Company is in the market for a complete telephone equipment for a telephone line from Vilas to Wright, via Tony.

STERLING, ILL.—The government is contemplating the installation of a complete telephone system, which is to extend the entire length of the Hennepin Canal. The central exchange will be located at Feeder Junction, near Sterling, and the lines are to be extended to the Illinois River and down the canal to the Mississippi River.

RICHMOND, IND.—Plans are being made by the Central Union Telephone Company for the construction of a new exchange building in this city.

PRENTICE, WIS.—The citizens have voted to appoint a committee to investigate the question of establishing a municipal water works system and electric light plant, and to secure information concerning the same and estimates of the cost of installing the plant and also the probable expense of operating the same. The streets are now lighted by oil lamps at a cost of nearly $1,600 per year.

BUTTE, MONT.—The stockholders of the Butte Electric & Power Company have approved the directors' proposition to issue $5,000,000, the proceeds to be applied to liquidating the floating debt of the company and its subsidiaries and providing them with additional working capital.

OGDEN, UTAH.—City Engineer Parker has filed with the state engineer two applications for water rights of the South Fork Canyon, a tributary of Ogden River. The first claim is for domestic purposes and the second to develop power for a municipal electric light and power plant; the water to be conducted through a 30-inch pipe line 40,000 feet in length to a point near the mouth of Ogden Canyon, where the proposed power plant will be located.

LOCKPORT, N. Y.—The International Power & Transmission Company, a subsidiary of the Niagara, Lockport & Ontario Power Company, has applied to the City Council for a franchise to furnish electricity in this city for lamps and motors. E. M. Ashley and P. F. King are among the directors.

NOME, ALASKA.—Plans are being made by the Nome Gold Dredging & Power Company for the construction of a hydro-electric plant on the Stewart River, near Nome, at a cost of about $70,000. The company has awarded a contract for a dredge, at a cost of $135,000, which will be electrically driven. George W. Darr, of New York, N. Y., is president.

Business Notes.

THE GORDON BATTERY COMPANY has secured buildings and land at Aldene-Roselle, N. J., where the offices and works of the company will be located on and after April 1, 1908.

THE G. & W. ELECTRIC SPECIALTY COMPANY, 128 West Jackson Boulevard, Chicago, is to furnish a large order of potheads for use in the rear of the switchboard of the Indiana Steel Company's great electrical plant at Gary, Ind. These are to be of the same type as installed by the Sanitary District of Chicago for its 6600 and 12,000-volt lines.

TAUSSIG & BABCOCK.—Messrs. William S. Taussig and Fred R. Babcock announce that they are now located at 1428 Marquette Building, Chicago, under the firm name of Taussig & Babcock. They are the exclusive agents in Chicago territory for the Burke Electric Company, of Erie, Pa.; Patten Manufacturing Company, Chattanooga, Tenn., and James Clark, Jr., Electric Company, Louisville, Ky.

ARC LIGHT EQUIPMENT FOR THE CITY OF CHICAGO.—The Central Electric Company, of Chicago, general Western agents for the Okonite products, is now delivering the first installations of arc-lighting equipment for the city of Chicago. This is one of the largest arc-lighting equipments that has been secured for some time, covering approximately 900 G. I. series alternating current lamps, 16 50-light oil-type arc-light regulators and approximately 800 kilowatts of transformers.

MR. JOSEPH A. SANDFORD, JR., formerly with C. S. Knowles, Boston, Mass., has taken a position as sales manager for the New Lexington High Voltage Porcelain Co., New Lexington, Ohio, manufacturer of porcelain insulators for high-voltage transmission lines. C. S. Knowles, who formerly had the exclusive agency for the above company, will now act as Eastern agent. Mr. Sandford will immediately make agency arrangements in this and other countries for the sale of the company's ware.

THE JACOBSON ENGINE COMPANY, Chester, Pa., has appointed as representatives Mr. F. D. McKercher, 1715 Prospect Avenue, Cleveland, Ohio; Mr. Theo. R. N. Gerdes, M. E., 5 Van Nest Place, New York City, and Mr. E. Kwartz, M. E., in Philadelphia, Pa. The company manufactures horizontal heavy-duty gas engines of the automatic type for producer gas, ranging in size from 20 hp to 500 hp. Business is reported so active that it has been necessary for this company to run 24 hours a day. Among some of the late shipments are two large producer engines for the Pacific Coast, and one large gas engine to operate on gasoline for Salt Lake City.

A NEW SINGLE-PHASE MOTOR.—The Mechanical Appliance Company, of Milwaukee, Wis., announces that it now has on the market a new line of series repulsion single-phase induction motors in sizes of from ⅛ hp up to 5 hp. These motors are self-starting, being started as series repulsion motors by means of a pair of short-circuited brushes bearing on a commutator. When up to speed, a short-circuiting, contact-making device short circuits the commutator segments so that the motor operates as an induction motor. This short-circuiting device acts automatically. The motor can be made to operate at three different speeds, and can also be made reversible. It is especially designed for the individual motor drive of various kinds of machinery.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual meeting Albany, N. Y., April 30, May 1 and 2.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Atlantic City, N. J., June 29-July 2.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting at Toronto, June 10, 11 and 12.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting at Savery Hotel, Des Moines, Ia.; April 22 and 23.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting at Des Moines, Ia., April 23 and 24.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Central Station Men's Association. A. H. Lane, Glencoe, Minn., chairman.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, Kansas City, May 6 and 7.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. Z. Pierson, St. Charles, Mo. Next meeting at Marquette Hotel, St. Louis, April 23, 24 and 25.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York. Next meeting at Chicago, May 19, 20, 21 and 22, 1908.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, May 4 to 9.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio. Next meeting at Columbus, May 15 and 16.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Galen Crow, Guthrie. Next meeting at Guthrie, May 25, 26 and 27.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting at El Paso, Tex., May 7, 8 and 9.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 24, 1908

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

882,553. BLOCK SIGNAL SYSTEM; Fred B. Corey, of Schenectady, N. Y. App. filed March 9, 1905. Block signal system of the type employing alternating currents and wherein the track rails are sectionally energized. Supplies a coil of a track relay from the secondary of the same transformer which supplies the track circuit of the block in advance.

882,554. SIGNAL; Fred B. Corey, of Schenectady, N. Y. App. filed Feb. 17, 1906. A signal system for single-track trolley roads. Makes use of direct-current magnets for shifting the signal and a locking magnet which prevents the signal from going to danger whenever the power circuit is interrupted.

882,564. ELECTRIC HEATER; Edward M. Hewlett, of Schenectady, N. Y. App. filed Aug. 3, 1907. Provides an electric atmospheric heater designed to be operated at a relatively low heat, and which can be brought up to its working temperature in a comparatively short time. Makes use of a sheet metal resistance element stamped in a special zigzag formation of circular outline.

882,569. RHEOSTAT; Charles D. Knight, of Schenectady, N. Y. App. filed July 18, 1907. Combined starting and speed regulating rheostat in which the motor is first brought up to running speed and the speed then varied within certain limits.

882,570. BURGLAR ALARM; Cosino Liaci, of New Haven, Conn. App. filed June 6, 1907. A burglar alarm of the type having a spring-impelled circuit-closing element which is held in circuit-opening relation by a cord. Means are provided whereby the alarm is not operated except by unauthorized persons.

882,573. STORAGE BATTERY; William L. Merrin, Fredericktown, Ohio. App. filed Oct. 5, 1896. A storage battery comprising a container of corrugated sheet iron, an electrode shell therein of corrugated sheet iron, an electrolyte having no chemical effect on said container and electrode shell, and active material in said shell.

882,581. INDUCTION-MOTOR CONTROL; Karl A. Pauly, Schenectady, N. Y. App. filed March 9, 1906. The method of operating an induction motor at varying speeds which consists in establishing two sets of connections adapted to produce tendencies toward operation at two different limiting or synchronous speeds, supplying current to both sets of connections simultaneously, and varying the relative torques produced thereby.

882,582. PROCESS OF PRODUCING MANGANESE SILICID; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. The continuous process of producing manganese silicid, which consists in smelting a charge containing compounds of manganese and silicon and carbon, by means of an electrically heated resistance conductor, withdrawing the molten product from the furnace, and supplying the charge mixture as required, as set forth.

882,587. CABLE REEL; Edmond Rosenberg, of Paris, France. App. filed Aug. 16, 1907. An electric truck for use in coal mining. Has a reel rotatable on a vertical axis and having a sprocket connection with the traction wheels, so as to unwind a cable when the reel is proceeding in passages which do not have a trolley connection.

882,602. CONTROLLING SWITCH; Harold E. White, of Schenectady, N. Y. App. filed Sept. 18, 1906. Controlling switch employing blow-out magnets particularly applicable to motor controllers. Provides individual blow-out coils for each of the fingers and specially arranged insulating means to effectively insulate adjacent blow-out coils from one another.

882,606. INDUCTION MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed March 7, 1906. The method of controlling an induction motor having both primary and secondary members adapted for connection for different pole numbers, which consists in supplying current to both sets of primary connections simultaneously and varying the relative impedances of the circuits formed by the two sets of secondary connections.

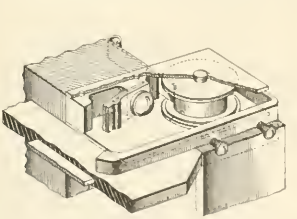
882,607. MAGNETIC CLUTCH; Robert Anderson, of Schenectady, N. Y. App. filed Sept. 18, 1906. Magnetic clutch completely enclosed in a drum-shaped casing and having two driven elements spring-impelled apart and capable of being attracted together by an intermediate iron-clad magnet.

882,609. BONDING-PIN; Frederick H. Ayer, of Chicago Heights, Ill. App. filed Feb. 23, 1907. Bonding-pin having a V-shaped groove on one side, the faces of which are arc-shaped, so as to co-operate with a symmetrical bonding wire having similar arcuate faces throughout.

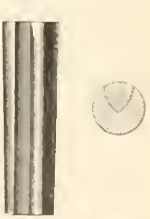
882,610. ADJUSTABLE ELECTRICAL RESISTANCE; Frederick O Ball, of Plainfield, N. J. App. filed Nov. 21, 1907. Makes use of a series of U-shaped resistance elements which are engaged in series between clamping devices. The loops are longitudinally adjustable so as to vary the resistance.

882,639. CONTROLLING SYSTEM FOR ELECTRIC MOTORS; Henry D. James, of Pittsburg, Pa. App. filed April 3, 1905. Provides means for preventing a reversing switch from being moved from either of its closed circuit positions to its off position while the counter electromotive force generated by the motor exceeds a predetermined amount

882,658. CONTROL SYSTEM FOR ELECTRIC MOTORS; Hermon L. Van Valkenburg, of Pittsburg, Pa. App. filed Sept. 2, 1904. System of control for electrical apparatus in which the voltage applied to a translating device is varied by adjusting the circuit connections to a subdivided transformer winding. Also combines a set of voltage varying switches and a set of resistance-governing switches so that they shall operate in the proper sequence and shall be prevented from operating in any other sequence or order.



882,602.—Controlling Switch.



882,609.—Bonding Pin

882,673. LIGHTNING ARRESTER; Walter T. Goddard, of Victor, N. Y. App. filed Aug. 7, 1905. A form of lightning arrester having a spark gap for the passage of lightning, and a magnet to widen the spark gap, so as to interrupt an arc thereacross after the lightning has passed.

882,681. ELECTROMAGNETIC TOY ENGINE; Harry G. Kawekotte and Henry W. Klausmann, of Indianapolis, Ind. App. filed Dec 18, 1907. A U-shaped electromagnet, has depending poles which embrace a wheel having iron pins or armatures at spaced points thereon, and which is rotated by an intermittent energization of the magnet

882,682. COMMUTATOR FOR POLYPHASE CURRENTS; Alexander Heyland, Brussels, Belgium. App. filed Jan. 21, 1903. The combination with a commutator, of brushes bearing thereon, means for causing relative movement of the commutator and brushes, circuits connected to a portion of the segments of the commutator and resistances connecting said circuits to said brushes, when the latter are bearing on segments not connected to said circuits, and intermittently connecting the segments with which said circuits are connected

882,684. SOUND-MUFFLER; John F. Hirsh et al., St. Louis, Mo. App. filed Aug. 5, 1907. A device of the character described, comprising an inner and outer shell of semispherical shape, a layer of felt interposed between said shells and extending slightly beyond the edge thereof, and a flange on the inner shell for clamping said felt in position, substantially as described.

882,687. ELECTRICAL CONTROL SYSTEM; Henry D. James, of Pittsburg Pa. App. filed April 3, 1905. Means for preventing closing of the circuit breaker when the reversing switch is thrown from its forward to its reverse position, or vice versa, unless the counter electromotive force generated by the motor is less than a predetermined amount.

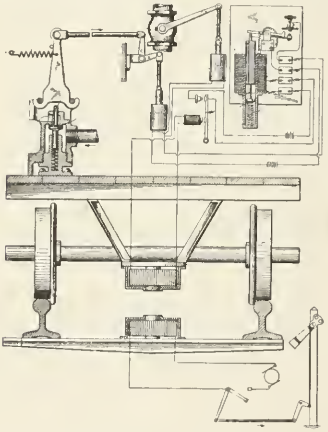
882,691. TORREFYING APPARATUS FOR THE TEXTILE INDUSTRY; Charles F. Kaisser, Lille, France. App. filed Nov. 26, 1906. In an apparatus of the character described, the combination with a body of refractory material having an interior cavity, and a slot in one face, of a heating device arranged within the said cavity.

882,695. SYSTEM FOR AUTOMATICALLY STOPPING CARS OR TRAINS; Edward E. Kleinschmidt, of New York, N. Y. App. filed Feb. 8, 1906. Has an electromagnet placed between the rails in proximity to a signal and a coil supported preferably from the under side of a car so as to be carried in proximity to the track magnet. The track magnet is controlled by a signal mechanism so as to be energized when the signal is at danger.

882,717. COMBINED TROLLEY WHEEL AND SLEET CUTTER; Edmund M. Schollenberger, of Chicago, Ill. App. filed Oct. 30, 1907. A trolley wheel having a cylindrical core and cup-shaped flanges which are hollowed out to fit over the end of the core and be removable therefrom when desired.

882,733. ELECTRIC FURNACE; Edwin Appleby, of Chicago, Ill. App. filed March 26, 1906. The furnace has a removable bottom portion and a pair of carbon-electrodes which can be manipulated to cause an arc within the furnace, by separate depending hand levers.

882,744. SIGNALING DEVICE; Spencer C. Cart, of Spokane, Wash. App. filed April 6, 1907. Details of construction of a signal including an electric bell and an incandescent light which are operated under danger conditions.



882,695.—System for Automatically Stopping Cars or Trains.

882,752. LETTER BOX ALARM AND INDICATOR; Oscar F. Erickson, of Berkeley, and Richard H. Bradshaw, of Oakland, Cal. Circuit-closing device for rural delivery mail boxes, having an electric bell which rings in a predetermined way when mail is deposited in the box.

882,758. FIRE-ALARM SYSTEM; Henry H. Hillier, of Pasadena, Cal. App. filed April 13, 1907. In place of special fire-alarm boxes at points along the street, the patentee makes use of a device used in conjunction with a telephone and which works on messenger-call principle with a specially constructed receiving annunciator.

882,788. ELECTRIC FURNACE; Albert L. Marsh, of Lake Bluff, Ill. App. filed Sept. 19, 1907. A cup-shaped furnace in which the inner lining of the furnace is made in separate rings or sections through which the current flows from top to bottom and which have sufficient resistance longitudinally to become highly heated.

882,803. INSULATOR; Leonard W. Storror, of San Francisco, Cal. App. filed Jan. 2, 1906. Two-part insulator having a zigzag, annular space between the separate portions through which leakage currents are obliged to pass.

882,833. TROLLEY HARP; Frank M. Mudler, of Pittsburg, Pa. App. filed Dec. 5, 1907. The trolley wheel is journaled on a fixed axle which has a transverse duct leading from an oil supply well in the trolley harp.

882,848. SNAP SWITCH; Wm. M. Scott and James H. Wyatt, of Philadelphia, Pa. App. filed Sept. 10, 1907. Two-button snap switch having a number of sheet metal parts which are organized to give a spring-impelled movement to the switch element.

882,872. SYSTEM OF ELECTRICAL DISTRIBUTION; R. N. Chamberlain, Depew, N. Y. App. filed Jan. 17, 1906. System of distribution making use of a storage battery with a booster normally in series therewith, the two being connected in parallel with the main generating apparatus of the system or of a substation.

882,892. ELECTRICAL PROTECTIVE APPARATUS; J. A. Kenny, Chicago, Ill. App. filed Jan. 7, 1904. A double-throw knifeblade switch making use of fuse wires embodied in knifeblade switch elements. Has spaced carbon clocks of special construction to serve as a lightning arrester.

882,958. PROCESS FOR MANUFACTURING NITRIC ACID BY MEANS OF SUPERHEATING, ETC.; H. Pauling, Brandau, Austria-Hungary. App. filed Aug. 12, 1902. Consists in heating a gas mixture containing nitrogen and oxygen to the oxidation-point of nitrogen, cooling said mixture and storing the heat, and transferring the stored heat to a fresh mixture. Makes use of an electric furnace.

882,966. TROLLEY; H. C. Reynolds. Portersville, Cal. App. filed Aug. 24, 1907. The trolley harp is pivoted to the trolley pole so as to swing into an inclined or horizontal position in passing curves and overhead switches.

882,979. STRAIN INSULATOR; W. C. Terry, Boston, Mass. App. filed Feb. 14, 1907. A bar of insulating material, preferably wood, has metallic heads at each end with special clamping devices which engage and bind a bight in the wire.

882,990. RESISTANCE UNIT; L. E. Parringer, Schenectady, N. Y. App. filed Sept. 30, 1907. A resistance unit or member particularly for lightning arresters and comprising alundum, graphite and fire clay.

883,003. AUDIPHONE; O. J. Davy, Washington, D. C. App. filed May 3, 1907. An audiphone comprising a flat yoke, discus pieces secured directly to the ends of said yoke, funnel-shaped ear pieces having their larger ends closed by said discus pieces, a diaphragm in each ear piece, and means for electrically vibrating said diaphragm.

883,007. ALTERNATING CURRENT REGULATOR; A. R. Everest, Rugby, England. App. filed July 13, 1906. Constant current transformer having a secondary winding which is delicately balanced to be movable through a considerable vertical range of movement. Has a specially formed core designed to diminish the changing leakage ratios.

883,008. THERMOSTAT; C. J. Fox, London, Eng. App. filed Jan. 28, 1907. Thermostat element consists of a sheet metal strip which sags downward to establish an alarm circuit in case a predetermined temperature is exceeded.

883,013. VIBRATOR; A. G. Gray, St. John, New Brunswick, Can. App. filed Sept. 4, 1907. A medical vibrator having a longitudinal body member with a bell magnet device at one end.

883,026. SIGNALING ON RAILWAYS; C. M. Jacobs et al., Reading, Eng. App. filed Aug. 9, 1907. Makes use of inclined cam shoes along the track which move circuit closing levers to establish alarm circuits in the locomotive cab under certain conditions.

883,029. ENGINE STOP; V. J. King, Lorain, Ohio. App. filed May 3, 1907. The throttle wheel has a weight impelled drum which can be tripped to revolve and close the throttle by an electromagnet.

883,030. VAPOR ELECTRIC APPARATUS; O. O. Kruh, Schenectady, N. Y. App. filed Sept. 15, 1905. Renewed Jan. 31, 1908. A vapor electric apparatus comprising an exhausted envelop having a plurality of anodes and a cathode, and a tubular member confining the discharge from the cathode.

883,036. APPARATUS FOR PRODUCING A GASEOUS MIXTURE HAVING DISINFECTING AND EXTINGUISHING PROPERTIES; Rene Marot, Paris, France. App. filed July 7, 1904. Has a reservoir adapted to contain liquid sulfur dioxid. Makes use of a fan motor for impelling an air current through the apparatus whereby certain disinfecting gases are produced.

883,043. DYNAMO-ELECTRIC MACHINE; John P. Nikonow, Pittsburg, Pa. App. filed April 13, 1907. A dynamo electric machine comprising a plurality of poles each formed of a series of cores constituting parts of distinct magnetic circuits, the cores being arranged to cause the magnetic circuits to flow from the far side of one pole to the adjacent side of the next pole.

883,059. ELECTRICALLY OPERATED SWITCH; H. F. Starrett, Milwaukee, Wis. App. filed Feb. 7, 1902. Switch in which the movable element is adapted to be controlled by a solenoid. Includes copper brushes and carbon contacts which make the final break.

883,062. STRAIN RELIEVING ATTACHMENT FOR TELEGRAPH KEYS; W. H. Teachworth, Waxahachie, Texas. App. filed June 1, 1906. An attachment for telegraph keys comprising a vibratory arm, a releasing member therefor, a contact adapted to be engaged by said arm, a shiftable key member, and an adjustable connection between the key member and said releasing member for operating the latter when the key member is shifted.

883,078. CONTROLLER FOR ELECTRIC MOTORS; T. E. Barnum, Milwaukee, Wis. App. filed March 2, 1904. Renewed Feb. 21, 1906 A controller for electric motors whereby the direction in which the motor is run may be controlled and the motor automatically stopped a predetermined number of times throughout its range of operation.

883,088. TELEPHONE INSTRUMENT; Clifford E. Cole, Birmingham, Ala. App. filed Jan. 10, 1906. A telephone receiver having a slide acting as a valve to cut off the sound.

883,093. DIVIDED-CENTRAL TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed June 15, 1903. Details of cord and exchange signal circuits.

883,110. ELECTRIC FURNACE; H. L. Hartenstein, Constantine, Mich. App. filed Nov. 30, 1906. An electric furnace having a metallic frame from which there projects downwardly a pair of convergent electrodes which may be made to dip into a cup-shaped crucible which is rolled beneath said frame.

883,114. VAPOR ELECTRIC APPARATUS; O. O. Kruh, Schenectady, N. Y. App. filed Oct. 18, 1905. The combination of a receptacle or container, electrodes therein, and shields therefor arranged one inside of the other.

883,139. CYCLIC PROCESS OF RECOVERING METALLIC TIN; Franz von Kugelgen et al., Holcombs Rock, Va. App. filed June 10, 1907. The cyclic process of receovering metallic tin from tin-bearing materials, which consists in treating a charge of the material with an anhydrous selective solvent of tin and producing a tin compound, decomposing said compound into metallic tin and an acid radical, and employing said acid radical to treat another charge of material.

883,140. PROCESS OF ELECTROLYZING AQUEOUS SOLUTIONS OF STANNIC CHLORID, Franz von Kugelgen et al., Holcombs Rock, Va. App. filed June 10, 1907. The process of electrolyzing aqueous solutions of stannic chlorid, which consists in conducting the electrolysis in a diaphragm cell and combining the stannic hydrozid and hydrochloric acid present in the anolyte and catholyte, respectively.

883,141. PROCESS OF ELECTROLYZING AQUEOUS STANNIC CHLORID SOLUTIONS; Franz von Kugelgen et al., Holcombs Rock, Va. App. filed June 10, 1907. Relates to modifications of the above.

12,765. Reissue. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. Reissue of 721,774. Cluster lamp socket making use of a sheet metal frame with a transversely extending insulating diaphragm which supports the center contacts and the threaded shells of the lamps.

12,766. Reissue. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. Reissue of 721,777. Relates to modifications of the above.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, APRIL 11, 1908. No. 15.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office....................................590 Old Colony Building
Cleveland Office....................................1015 Schofield Building
Philadelphia Office..........................Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico..........................per year, $3.00
Dominion of Canada..4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 16,000 copies are printed.*

NEW YORK, SATURDAY, APRIL 11, 1908.

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Electrical Exports.

The export trade of the country has expanded recently at a very high rate, the increase being such that it could hardly be maintained. But the electrical exports have not quite held up to the level of last year, owing to the sharp falling off in instruments and apparatus. The total of electrical machinery and instruments for the eight months including February is $10,946,814, while the corresponding period of 1906-7 gave $11,169,989, a falling off of $223,175. This is not a material amount and might well be explained by the drop in copper, but as an actual fact, the loss occurs not in heavy machinery, but in the minor apparatus where copper does not cut much figure. The export of electrical machinery for the month rose handsomely from $561,672 to $844,047, but the export of apparatus fell from $579,855 to $479,779. An investigation of the figures shows that in apparatus the demand from the United Kingdom fell off from $1,237,363 for the eight months to $467,830, a sharp shrinkage of over $750,000. This is in accord with the general dulness of electrical conditions in England and far more than accounts for the net decline noted above. We are glad to believe that a revival of electrical industry is expected in England, which electrically is not much better developed than Portugal or Peru, and where an enormous market exists in every branch of industry if the data of Germany and the United States are any criterion of public consumption of electrical goods and energy.

The Relation Between Iron and Copper in Transformers.

The alternating-current transformer is the simplest type of induction coil to understand and to design. This is perhaps equivalent to saying that no type of induction coil has been studied so thoroughly as the alternating-current transformer, and certainly no type has been constructed in such large numbers. When we attempt to understand the operation of spark coils or of high-frequency induction-coils, we meet with difficulties and uncertainties at every turn; but we have comparatively little difficulty in predetermining the behavior, efficiency and expense of any ordinary form of transformer, when the quality of the materials used in its construction is duly known or specified. In particular, if the geometrical type of transformer be decided upon, such as a core-transformer or a shell transformer of a certain ratio between length, breadth and thickness, the comparative performances of such transformers in different sizes can be predetermined with considerable precision. Of course, there will always be disturbing factors, due to unexpected practical causes, such as obtrude themselves inevitably into all shop practice, and which rudely upset, at times, the most beautifully constructed array of curves, figures and estimates.

A graphical synopsis of costs of material in constructing a particular type of transformer is given at page 768 this week in an article by Mr. M. Kawara. The transformer is of the rectangular frame core type and the cross-section of the core is presumably square. Five sizes of transformer are analyzed; namely, 2, 4, 8, 16 and 32 kilowatts. In each of these cases the mass of iron per kilowatt, or, to a modified scale, the total mass of iron used, is plotted as abscissa and the corresponding mass of copper and other properties of the apparatus are plotted as ordinates. A transformer bears a close analogy to the ordinary direct-current motor in this respect: that, although there is no definite quantity of iron, number of turns, or frequency of magnetic flux reversal through the turns, that must be used, yet the product of the flux, armature wires and revolutions per second in the motor, or of flux, primary turns and cycles per second in the transformer, are rigidly determined by the e.m.f. on the mains. Consequently, in either case, with a fixed motor-speed, or transformer frequency of alternation if we increase the iron we decrease the copper, and *vice versa*.

The curves of Mr. Kawara indicate that there is a rapid deduction in the weight of copper for a given size of transformer as the iron is increased. This, of course, would be expected according to the above reasoning. They also show that the total cost of iron laminations and copper taken together is nearly constant through a considerable range in the weight of iron as selected. We may increase the iron 50 per cent and not change the total cost of iron and copper more than, say, 6 per cent in some of the cases presented. There will be a certain relation of iron to copper for minimum cost, and also another relation for maximum efficiency, but the relative uniformity of both cost and efficiency is remarkable if it is correct in practice. The curves also show that at the prices of iron and copper assigned in the article, the relative proportion of iron in any of these sizes of transformer for minimum cost is distinctly greater than it would be if efficiency only were considered. This is a conclusion that reason marks as fair on the face of the proposition. Since iron is about four times cheaper than copper per pound, if we assume that a certain proportion exists for the highest efficiency at rated load, it must be cheaper to change the ratio in favor of more iron up to a certain point.

Complex Quantities in Alternating Currents.

At the Chicago meeting of the American Physical Society last December, a paper was presented, by Dr. George W. Patterson, which clears up a difficulty that has long been outstanding in the use of vector diagrams representing alternating currents. If we represent a simple alternating e.m.f. and the current it sends through a simple inductive circuit on one and the same vector diagram, we first draw a straight line of such length as shall indicate the magnitude of the e.m.f to a selected scale of volts, and then we draw another straight line from the same origin to represent the current strength to another convenient scale of amperes. The angle between these two lines is made equal to the difference in phase, or the lag of the current behind the impressed e.m.f. If the case presented were that of a direct-current circuit, the angle of lag would vanish, the two lines would coincide in direction, and the power in watts expended by the e.m.f. upon the current would be the product of the lengths of the two lines. As soon as we revert to alternating current conditions, and restore the phase angle, the power in watts ceases to be the simple product of the two vector lengths and has to be multiplied by the cosine of the phase angle. That is to say, the introduction of the phase angle changes the power from a simple numerical product to a particular type of vector product without any apparent corresponding change in the formula from which power is determined. The vector diagram corresponds then to the rules of the direct-current circuit in all respects except as to power in watts.

The paper shows that the difficulty arises from the fact that in the vector diagram we are actually concerned with the projection of the rotating vector on a certain plane, and not with the vector itself, which maintains constant length. If we take a pair of oppositely rotating half-vectors, instead of a single full vector rotating in one direction, the resultant of the pair is always equal to the actual sinusoidal quantity under consideration. On this principle, the vector diagram of a simple inductive circuit would be a pair of complementary half-vectors rotating in opposite directions to represent the impressed voltage, and a similar pair to represent the current, the positively rotating couple having the phase difference between them measured counterclockwise and the negatively rotating pair having the phase difference measured counterclockwise. The ordinary formula of product for voltage and current in this system then includes the cosine of the phase angle and also gives the double frequency circulating power. The proposed system thus avoids the difficulty inherent in single vectors, but unfortunately it greatly complicates the vector diagram by duplicating all the lines. An additional merit of the new diagram is, however, that since it employs both positively and negatively rotating vectors, it would remove the opposition now existing between different alternating-current text-books in this particular.

Physical Theory of the Power-Factor Meter and of the Synchronoscope.

In dealing with alternating-current apparatus, it is well to employ all kinds of mental guides and working theories in order to apprehend as clearly as possible the behavior and relations of the parts. A purely mathematical theory may satisfy the mind in regard to precision and to rigidity, but may be very defective in regard to concreteness. On the other hand, a purely mechanical analogue may be all that is desired in simplicity, and yet leave an aching void of doubt as to its applicability. A physical theory, again, may satisfy the mind to a considerable degree in several of these directions. In the final analysis we are not entitled to lay the flattering unction of completely satisfactory comprehension to our souls until we can explain the facts from all points of view—electrically, mechanically, analytically, synthetically and by various analogies. Alternating-current phenomena are intricate at their easiest, and we cannot have too many methods of coming into mental contact with them, whether our purpose be to utilize them industrially or to understand their applications.

Mr. A. R. Dennington's article, on page 771 of this number, deals with a physical explanation of the behavior of the power-factor meter on central-station switchboards, and also of the synchronoscope. The article uses a vector method of developing a resultant magnetic field at successive sixths of an alternation. With reference to the power-factor meter, the description given is clear insofar as the three-phase system is balanced. The line of reasoning might advantageously be extended to show what effect an unbalancing of the system, in voltages, or in currents, or in both, would exert upon the power-factor indications of the instrument. The general theory of action in a balanced system is readily explained, however, without the use of any vector diagrams along the lines of the description in the text. It is known that if we have two indicating wattmeters in a balanced three-phase system, the readings of the two instruments will differ more and more as the power-factor varies from unity or 100 per cent. If we consider the two readings as equal at unity power-factor, we could readily place the two moving coils on a common axis and produce equal and opposite deflecting forces or zero resultant deflection. We might then suppress one voltage coil if we allowed the corresponding current coil to act on the other voltage coil after being given a displacement of 120 deg. We should then arrive substantially at the usual power-factor meter construction.

With reference to the synchronoscope, the article clearly reveals the resultant torque on the rotor during one half cycle by the method of resultant vectors. It also shows how to take into account, by that method, distortions in the wave forms of e.m.f. in either alternator. The usual physical explanation of the instrument's behavior lacks this extensiveness, but is readily grasped. We may consider the single-phase magnetic flux generated by the field coils as developing two simple opposite rotating magnetic fields in the stator poles, of the busbar frequency. The split-phase arrangement of armature circuits produces a single rotating magnetic field in the core of the rotor, of the frequency of the incoming machine. If these two frequencies be identical there will be no rotation of the rotor, the rotating polar line of which will be in synchronism with the corresponding rotating element of polar line in the stator. If there be a difference between these two frequencies, there will be a differential mechanical rotation of the rotor of such magnitude as will maintain the magnetic synchronism. The article provides not only one particular physical method of apprehending the behavior of the instruments discussed, but it also gives unusually simple diagrams of the electrical connections of these instruments. This is a great aid to any description or tentative theory.

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Gasolene-Electric Railroading.

The recent run of a gasolene-electric car over the Pennsylvania Railroad from Jersey City to Philadelphia is evidence enough that the application of such cars to special railway service must be taken somewhat seriously. The combination motive power is no new thing—it has been several times exploited, but in its earliest incarnations it was intended to be used in street railroading proper, to which it proved itself to be little adapted. There was little to be gained by such use and the cost, weight and complication of the equipment was very much against it. To-day there is a call for a peculiar kind of railway service to which the gas-electric car seems at least not ill-adapted—to wit, in frequent service over long branches or what one might perhaps call light interurban service where the distances are fairly long and there is no likelihood of dense traffic. In such cases the fixed charges against an electrical generating plant and distributing system are very severe, since the load factor is unavoidably bad and the distances are relatively considerable. On the other hand, one must admit that gasolene is intrinsically a costly fuel and that the combination of dynamo and motor is not a very efficient transmission gear albeit it is wonderfully flexible. Its good points are unfortunately most conspicuous in classes of service other than the one here considered. It is, of course, true that by this device the size of engine is minimized by the ability to run it at uniform high speed, yet in long and fast runs this gain is available by other methods.

On the Union Pacific capital work has been done by regular gasolene engines driving the car exactly as they would drive an automobile. In such case there is some loss of efficiency in starting and acceleration, while the full speed part of the run is under very excellent conditions for high economy. With the gasolene-electric car there must be some sacrifice of full output efficiency, and whether this sacrifice pays is a somewhat difficult question. As between such cars and a straight electric system, the economic situation turns on traffic density. In the rough, one may say that the losses in the distributing system will offset those due to the gasolene-electric driving gear, leaving the gasolene engine equipment set over against the generating units in the power station. In pure thermodynamic efficiency the gasolene engine probably has somewhat the advantage, but loses tremendously in fixed and maintenance charges when aggregate outputs are considered. At some undetermined point of traffic density the cost by the two methods will be equal; above this point ordinary electric traction will have the advantage, and below it the gasolene electric car takes its turn along with straight gasolene equipment. From an operative standpoint there is little doubt that either system can make good, and experience is as yet too meager to allow of passing judgment between them. An instructive side line is the possible recrudescence of the steam dummy in somewhat glorified form with the general equipment of a high-grade steam automobile on the body of a high-speed interurban car. Here again there would be loss of thermodynamic efficiency offset in whole or in part by great facility in speed control.

The interesting feature of the situation is the rise of active competitors against the regular electric service that has been so potent a factor in suburban and interurban traffic. The ordinary methods of steam railroading have proved incapable of holding their own with electric traction in many cases of keen competition, but the railroad motor-car puts a new phase of the matter in evidence. In some respects the straight gasolene car seems, as in the case of the ordinary automobile, the simplest and most desirable thing; yet in ordinary automobile service the gasolene electric plan has given a good account of itself, and steamers are well known to be at present reliable and powerful, being especially excellent in the matter of reserve power. It would indeed be a strange turn of the wheel if electric traction on the longer lines should find itself hard pushed by the automobile railway car. But the distribution difficulty is so serious on long lines with light traffic that such a revolution might easily occur were it not for the introduction of high-voltage distribution and single phase traction motors. With these resources at command, electric railroading will be exceedingly difficult to displace from its position of supremacy. A 10,000-volt trolley system, worked from a power plant operated by modern steam units or by producer gas, can give a hard rub to anything that rolls on wheels when it comes to considering economy. An interesting consideration on the other side of the situation is the possible evolution of the gas turbine, which seems to be one of the things to be reckoned with in the near future. Altogether, the traction situation is one that, like many another, is getting somewhat unsettled and is likely to become more so. The beginning of the century has assuredly shaken things up and one hardly knows in what direction to look for the next surprise.

More Indictments in Tungsten Lamp Patent Case.

As the result of further investigation a Grand Jury of the District of Columbia, on April 6, returned additional indictments against Ned W. Barton, former assistant examiner in the Patent Office; Henry Everding, patent attorney of Philadelphia, and John A. Heany, of York, Pa. The indictments charge conspiracy, forgery and destruction of public records in order to obtain for Heany patents to which he had no right or claim in connection with tungsten filaments for incandescent lamps. It is charged that Barton, an employee of the Patent Office, appropriated ideas of other inventors and placed them to the credit of Heany, so that as completed his patents represent composites mainly of ideas of others.

Consolidated Gas Co. Decree Affirmed.

The final decree in the case of the Consolidated Gas Company against the City and State of New York to test the validity of the 80-cent gas law, was affirmed last Saturday by Judge Hough in the United States Circuit Court. Accompanying the affirmation is an order enjoining Attorney General Jackson and District Attorney Jerome from suing for the penalty or forfeiture described in Chapter 125 of the laws of 1906, or in any way enforcing that Act or the order of the late Gas and Electricity Commission.

As will be recalled, following the passage of the 80-cent gas bill by the Legislature, the gas company entered suit on the grounds that the 80-cent rate was confiscatory, and on rulings, which allowed the company to enter certain items as capital on which dividends were entitled to be earned, the gas company won the suit. Assistant Corporation Counsel Burr, who, with Alton B. Parker, represents the city in the case, said, "The gas case will now go directly to the United States Supreme Court on the question by Judge Parker as to whether or not a public-service corporation may capitalize a franchise. which concededly represents no investment, for the purpose of earning a return on such capitalization."

Telephone Jurisdiction Bill Reported.

The New York Assembly Committee on Electricity, Gas and Water Supply has reported favorably on Assemblyman Wainwright's bill extending the jurisdiction of the New York Public Service Commissions to telephone and telegraph companies. The commissions are more restricted than in dealing with railroads and lighting companies. It is stated that the bill was divided into two parts, one of which covers the telegraph and telephone matter, and that, owing to opposition which has arisen, this section of the bill will be defeated. In this event Governor Hughes will, it is thought, probably call an extra session of the Assembly to deal with the subject. It is stated the Public Service Commission does not really desire this legislation which the Governor advocates, and is not prepared to deal with it. Governor Hughes, however, is known to be ready for it.

Canadian Niagara Power.

The commissioners of Victoria Park, on the Canadian side at Niagara, have gone on record as favoring the cancellation of power franchises that have not as yet been developed. This position is taken in the annual report just submitted to the Ontario Legislature, in which the commissioners say: "Impressed with the vital importance of the subject, the commissioners would again draw attention to the charters which have been granted by the Parliament of Canada to several corporations to generate power at various points in the Niagara district, but which charters have not, up to the present time, been proceeded with. Without question the works already constructed by the three companies operating on the Canadian side are of sufficient capacity to supply the demand for electricity for lighting and power purposes for Canadian users for a great many years to come. As the undeveloped charters are all without limitation as to the volume of power which may be developed and without restrictions as to the quantity of water which may be taken for such developments, it is essential to the safeguarding of the Falls that immediate steps should be taken to cancel them or to place a limit on their operation, so that the menace they now present to the preservation of the Falls as a great natural wonder may be removed. In this connection the commissioners would strongly recommend that the government of the province of Ontario, being chiefly interested, should be officially represented at any international conference that may be held having in view the uses of the waters of Niagara for commercial purposes or for the limitations of such uses in furtherance of the preservation of the Falls."

In the report of the commissioners for 1906, reference was made to the system of measurement that should be adopted for ascertaining the sums which become payable by the power companies as rental for all power generated and sold or disposed of in excess of the amounts for which a fixed sum is to be paid by each company, and in the report for 1907, just submitted, the commissioners again take up this subject. They state that acting under the advice of their solicitor, and with the approval of the government, the commissioners have rendered accounts to the Canadian Niagara Power Company and the Electrical Development Company for all excess power generated above 10,000 horse-power upon the "increasing rental" peak power system, as defined by Dr. Galbraith, whereas the companies claim under their agreements payment should be made only upon the average daily load, or what may be called the "fluctuating rental, average power" system. Payment on this basis for excess rentals has been tendered by one of the companies. This company is the Canadian Niagara Power Company, which has paid over $16,655.75 in this manner, the payment not to affect the status of the case pending settlement.

International Congress on Safety to Life and Labor.

The Eighth International Congress on Safety to Life and Labor will be held this year in Rome from Oct. 12 to 16. This season has been selected on account of the vacations at the universities and parliament so that the great leaders may be free to attend. This congress meets triennially, and is always characterized by the high character and influence of the governmental officials, statesmen, social economists, publicists and men of affairs, who bring to the deliberations an experience of things done. The minister of agriculture, industry and commerce has accepted the presidency of the congress. Among the topics to be discussed are workmen's insurance, the organization of a school of social medicine, insurance of women, prevention of accidents, labor inspection. One very important report will be made by the commission appointed at the Vienna Congress for the standardization among the nations of the world of the statistics of accidents to labor.

A prominent member of the Italian committee is Commissioner V. Mogaldi, who is arranging for a brilliant series of educational visits at the close of the congress in Central and Southern Italy. The social by-products of this congress are most valuable in making the personal acquaintance of the men who are shaping some of the world's forward movements along the lines of social insurance.

Membership in the congress is $2, which entitles each subscriber to the volumes of published proceedings, which constitute a most valuable series of reports by experts. Subscriptions may be sent to Dr. W. H. Tolman, 231 West Thirty-ninth Street, New York, by whom they will be acknowledged and forwarded to Rome, as it is desirable to have a large representation of influential Americans.

Schoolhouse Lighting Rates in Question in Boston.

Notice has been served on the Edison Electric Illuminating Company by the Boston School committee that it will pay no more for schoolhouse lighting service than it has been paying for four years past. A few days ago the company transmitted a new schedule of rates for the lighting of public buildings of the city of Boston, and under this schedule the school committee's rates were advanced about 6 per cent. Chairman Storrow stated that when the school department lighting bills are received on May 1, if the rate is increased over the former figure, the auditor will deduct 6 per cent of the amount charged before authorizing payment. He said the committee was determined not to pay more for electricity, and he thought that the company would not take the responsibility of cutting off current from the schoolhouses.

In reply to the position of the committee, the Edison Company has sent a letter to Chairman Storrow, signed by R. S. Hale, general agent. The letter contends that the company desires and intends to charge everyone in its territory the same rates under the same circumstances, and to yield to the suggestion of the school committee would be to give discriminatory instead of uniform rates to the company's customers in the same class or classes, and expose the company to the just criticism of those who insist upon the treatment of all alike. The letter states that the company itself suggested the cancellation of the existing contract, the result of which is to decrease its income by $1,000 a month, although in the case of the school department its payments would be slightly more.

New York City Rates for Light and Power.

At hearings held last week before Commissioner Maltbie, of the New York City Public Service Commission, representatives of the various New York City electric companies presented schedules of the rates charged by them. Mr. Arthur Williams, of the New York Edison Company, handed in 43 forms of contracts used by his company. Of these 25 were made prior to the enactment of the present law fixing the price per current at 10 cents per kw-hour; the cost of current, which depended upon the average use of installation, was a trifle less than 10 cents per kw-hour, but the company did not wish to raise the service to old customers. There were two contracts under which the service was rendered on a flat monthly rate, and one special tunnel contract in which the cost of service is based on the amount of work done by the contractor; this latter was an experimental contract and after its expiration in a few months will not be renewed. Among the old contracts, one combines the service of two separate buildings based on the old rate of 20 cents per kw-hour, and two combines the service of two separate power installations at a basic rate of 13 cents per kw-hour. With the exception of one contract of the 43 and 6 sign contracts, all of the 43 may be set aside on 30 days' notice by either party. Mr. Williams said that no one was supplied with current without a contract except in the case of use of prepayment meters. Under one form of contract known as "class wholesale A," the customer shall consume not less than 2,000 kw-hours monthly, with an average daily use of two hours during the 10 months of the year. Installations are made free if the mains of the company pass within 100 ft. of the customer's property. There is no free service, not even to officers of the company.

Mr. John W. Lieb said that the company supplied the very best lamps made, which were tested by a special testing organization. Lamps are supplied free, except tantalum lamps, which are furnished at a charge of the difference of cost between the tantalum and carbon-filament lamp—about 35 cents. The company, he said, was considering a policy whereby the new tungsten tamp can be made available to the consumer. In the Bronx, where alternating service is given, the Nernst lamp is furnished on a free renewal basis. Mr. Frank W. Smith, of the United Electric Company, said that there are 83 customers on the books of that company who furnished their own lamps, receiving 10 per cent deduction from their bills; the company, however, had ceased making such contracts, as it has been found that certain customers were getting lamps from other consumers who got them from the company for nothing. The United Company has installed 150 prepayment meters. Mr. W. W. Freeman, of the Brooklyn Edison Company, said that the forms of contract used by that organization might be classified as retail, wholesale and power contracts. It is the purpose of the company to simplify and limit the classifications where terms of contracts do not intervene. In certain cases the Brooklyn Company has advanced sums of money to prospective customers, who wish to replace steam power by electricity, the customers returning the sums thus advanced in monthly payments. Mr. J. T. Cowling said that the Westchester Company had but two forms of contracts, for lighting and power. Mr. Henry E. McGowan, of the Flatbush Gas Company, stated that a guarantee of $1.20 a month, minimum charge, is strictly enforced, and there is no power contract paying less than $2 a month, minimum. Current is usually cut off in six weeks if a bill remains unpaid. Nernst and Gem lamps are supplied on the basis of free renewals and tungsten lamps at $1.50 net There is no charge for meters or for overhead service connection, but where lines are run in the property of a consumer the charge is 15 cents a foot. Mr. McGowan said that his company had never refused to make connections no matter how far the customer's property was from the company's line. The city is charged $97.50 for each arc lamp for street lighting, of which there are 810. Incandescent lights for public service are supplied at 10 cents per kw hour and there is a 12-cent rate per power, with a sliding scale of discounts. Mr. E. H. Rosenquest, of the Bronx Gas & Electric Company, stated that 93 consumers paid 12 cents per kw-hour and 107 10 cents per kw-hour, while the 12 power users average 7 cents per kw hour. Public buildings are supplied at the rate of 10 cents per kw-hour, with a charge for city arc lamps of $107.50 per year. Mr. John T. Cowling, of the Westchester Light Company, thought it a good policy to have contracts with customers in order to meet the case of those who, after the company may have spent a considerable sum for the installation, would only take current for a short time. Mr. C G. M. Thomas, of the New York & Queens County Company, said that his company at first began to make a service charge last November to consumers who were situated more than 150 ft. from the company's mains, but this charge was refunded in monthly amounts equal to one-half the sum billed for current, and credit given for other connections made to the same line. City arc lamps are supplied at $90 a year, and public buildings lighted at 10 cents per kw-hour. Mr. Carleton Macy, of the Queens Borough Company, said that as his company had many summer customers, a deposit is required of consumers of about $10. No charge is made for installation where the property is not more than 125 ft. away from the lines. Mr. James F Phillips, of the Richmond Light & Railway Company, said that his company does not require a deposit where a man owns his home; otherwise the deposit varies from $25 to $30, on which no interest is paid. A bid for public lighting filed recently specified arc lamps at $100 per year and incandescent lamps at $25 per year, with 10 cents per kw-hour for light and 5 cents per hp-hour for power.

New York Central Overhead High Tension System.

Commissioner Eustis, of the New York City Public Service Commission, continued last week the hearings in the matter of overhead tension wires installed by the New York Central & Hudson River R. R. Mr. William P. Burr, assistant corporation counsel, said that the contention of the city is that even if the company does all in its power to render the overhead system as safe as possible, the only safe method of high tension transmission is by conduit. Prof. George F. Sever, consulting engineer of the city, supported the contention of the corporation counsel that the system should be a conduit one. Counsel A. S. Lyman, of the New York Central, maintained that the present distributing system was, as an overhead system, the safest possible that could be installed. Mr. C. S. LaCombe, engineer of the water supply department, gave testimony to show that an overhead high-tension system is more unsafe than an underground transmission system; he frankly agreed that the present New York Central overhead system is the best of its kind in operation anywhere, but contended that it did not meet the fullest requirements of safety, and that a railroad which operates as many trains as the New York Central should have a conduit system for its wires. Mr. George W. Kitteridge, chief engineer of the New York Central, testified that there was no danger of a derailed train colliding with the latticed poles supporting the high-tension wires, as these are 14 ft. away from the nearest of the four tracks. Mr. George Gibbs dwelt on the simplicity of construction of the high-tension overhead transmission system and was of the unqualified opinion that the present system of the New York Central is entirely safe and has the additional advantage of being more accessible and cheaper than the conduit system. The latter, he said, was always subject to danger from electrolysis and clogging by mud and water. Mr. E. B. Katte, chief engineer of the New York Central, said that the former New York Central Electric Commission had studied both systems carefully and decided in favor of the overhead system. He re-enforced his conclusion that the overhead system is entirely safe by describing a recent occurrence in which a Western Union telegraph pole fell over the high-tension wires without causing any disturbance whatever. He stated that the reason why underground construction is now used in some places, is because the right of way was restricted below the Harlem River and in the Harlem depression, and that poles could not be erected in these places.

Long Acre Light & Power Company.

Adjourned hearings were held last week on the matter of the application of the Long Acre Light & Power Company to issue bonds. Considerable of the testimony related to the operation of the American Electric Illuminating Company in 1889 and 1890, this matter having a bearing on the validity of the Long Acre franchise. Mr. Walter H. Knight gave testimony as to the present distributing system of the Long Acre Company, which was shown to be very small in extent.

Mr. Andrew W. McLimont, counsel for the commission, testified that he had examined the Long Acre power plant and considered the inventory of the property given at the previous hearing, valuing the plant at $16,000, to be a fair appraisal. Mr. Arthur G. Pierce, auditor of the Long Acre Company, submitted a balance sheet dated March 1, 1908, as follows:

ASSETS.	
Treasury bonds	$500,000.00
Franchise, good will and contracts	550,000.00
Second Avenue plant	16,000.00
Cash on hand	18,010.21
Profit and loss	59,315.59
LIABILITIES.	
Capital stock	$50,000.00
Mortgage bonds, 4 per cent	1,000,000.00
Bills payable	75,150.80
Accounts payable	18,175.00

Outside of bond issues and franchise, the company has assets amounting to $34,010.24. The liabilities, exclusive of stock, are $93,325.80. Mr. Henry W. King testified that he had presented an offer from Mr. John C. Sheehan on behalf of the holders of the franchise of the American Electric Illuminating Company, to sell the franchise to the Long Acre Company for $500,000 out of the million-dollar issue of 4 per cent 50-year gold bonds and $50,000 in stock of the Long Acre Company. This proposal was made at a meeting of the board of directors of the Long Acre Company on March 22, 1906. The proposal was accepted by the Long Acre Company, and about February, 1907, $500,000 of bonds were authenticated and delivered. Ad interim receipts had been issued for the bonds and delivered to Mr. John C. Sheehan, and the bonds were delivered in February, 1907, to holders of the ad interim receipts; that is to say, to Mr. Sheehan and Messrs. Dittenhoefer, Gerber & James. Mr. King did not know who were the real parties represented by the latter, and could not say who held the bonds at present. Mr. King said that notwithstanding that the franchise had been given by the city for nothing, and that during its career it had been at one time sold for $100, he believed it was worth more than the $550,000 paid for it. The $10,000,000 worth of stock which the company is asking permission to issue will be non-voting stock, and the present holders of the $50,000 capital stock or to whomever they may transfer their holdings will control the company, no matter what the capitalization might be at a future time.

Mr. Walter H. Knight said that one of the reasons why the Long Acre Company should be allowed to build a large plant was that the company would be able to furnish better lamps than those in use at present. He said that the Long Acre Company had a contract with the owner of a new, patented, non-filament, partial vacuum lamp, which has an almost unlimited life and a demonstrated efficiency of twice that of the tungsten lamp, or ½-watt per heffner candle-power, and added that its introduction would practically abolish gas lighting. It was not decided as to whether this lamp would be supplied free to consumers, Mr. Knight being opposed to free lamp renewals, as he thought that there should be some tax on the consumer to prevent indiscriminate waste. The commissioner pointed out that there was nothing in the Long Acre franchise to prevent that company from selling current at 10 cents per kw-hour, and if the consumer had to pay for the lamps it would cost him more than the present system. Mr. Knight thought that the more economically a lamp was made the more widely it would be used, and the better the load that would come on the station. He said that it was the company's purpose to have an 8-cent per kw-hour rate without free renewals, which is approximately one cent less than the Edison current rate. He added that with the new lamp, the 1-cent estimate for lamp renewals was too much allowance and that the current would cost a consumer of the Long Acre Company, counting lamp expenses, less than 9 cents per kw-hour. He said that the Long Acre Company did not hold patent or exclusive right for purchasing this new lamp and that it was quite possible that the lamp company might supply others, but he thought this might be prevented in the same way that the Long Acre Company was prevented from purchasing apparatus from the General Electric Company. He said he applied to the General Electric Company for Curtis turbines and his application had been refused by the salesman of that company, although he had both written and telephoned. The new lamp mentioned would cost, he said, about $1 and would be 50 candle-power, burning ½ watt per hour. It will last indefinitely 5, 10 or 15 years and will not blacken or deteriorate. He said the company had planned to have a maximum rate of 8 cents per kw-hour down to a minimum of 3 cents for wholesale users and such users as did not have the maximum load co-incident with the peak load. Questioned about the construction plans of the Long Acre Company, he said it was intended to build a station of 25,000 kilowatts, which would be extended from time to time until its capacity reached 75,000 kilowatts, that being the minimum capacity necessary to handle the business on Manhattan Island. He said that the needs of the city will ultimately require current to the amount of 500,000 horse-power, but that in five years the Long Acre Company would not expect to build a plant of more than 75,000 kilowatt capacity.

In ten or fifteen years, under competitive conditions, he was of the opinion that the use of electricity in New York would be quadrupled. It would take 18 months to complete a 25,000-kw plant, and he thought that the company could easily have current engaged amounting to the capacity of each section at the time each section was completed.

Pittsfield Meeting of the American Institute of Electrical Engineers.

On March 27 the Pittsfield section of the A. I. E. E. held its first annual banquet, of which 109 members of the local section were present. Mr. Joseph Insull presided, and Mr. Ralph W. Pope was the principal speaker of the evening. Mr. Pope responded in his usual happy manner, mingling laughable stories and anecdotes with his reminiscences of the growth of the Institute and his connection with the work. Mr. Pope began his electrical career in Berkshire County and was quite at home in a Pittsfield audience.

Mr. C. C. Chesney told of pioneer local developments in alternating-current generators and transformer design dating back to 1883, one of the generators of that period having been in regular service ever since. Mr. W. S. Moody spoke of the electrical engineer as a business man and told several stories illustrating his point that the successful engineer of the day is generally a shrewd man in business matters. Mr. W. S. Andrews, of Schenectady, described some of his varied experiences with Edison at Menlo Park in the early days of electric lighting. His witty remarks elicited much laughter and applause.

Mr. H. W. Tobey made a few interesting remarks urging the local members to join the national body and to take active part in the meetings. In addition to the speeches entertainment was furnished by Mr. A. V. Thompson, of Schenectady, and Mr. Boland, of Pittsfield, who gave several songs and responded willingly to vigorous encores.

Development of the Northern California Power Company.

The Northern California Power Company, operating in Shasta County and vicinity, in the northern part of California, may be taken as a thoroughly representative hydro-electric power transmission company. It has modern water-power plants on tributaries of the Sacramento River and has been gradually expanding as the conditions warranted. That the company's system is managed efficiently and economically is shown by the annual report submitted to the stockholders by President H. H. Noble at the annual meeting held in San Francisco March 16. The report is as follows: "Although the past year of our company has not been as prosperous as gave promise at the beginning of the year, yet considering the financial conditions of the country we can congratulate ourselves on the very substantial gain of $82,231.90 in our gross earnings over the previous year. Had not the price of copper dropped to the very low price that it did, we would have earned at least $50,000 additional. When copper declined from 25½ cents to 11½ cents per pound, the Mountain Copper Company and Great Western Company were compelled to shut down their smelters; the Mammoth and Bully Hill Companies ceased pushing their construction work as formerly, and the Balakalala shut down after spending over $700,000 on its smelter and being within 60 days of completion.

"The company has installed in this smelter 1585 horse-power in motors, and at its mine 225 horse-power. The Trinity Copper Company also has 350 horse-power in motors installed that will be in use when the Balakalala smelter is completed. In this connection, I have just learned that the company has been financed and that work will be resumed at once. In order to take care of this increased load, we have run a second transmission line from Keswick to Kennet through Coram, about 14 miles in length, and have erected and equipped a large substation at Coram for the Balakalala smelter; also a substation at the Balakalala mine sufficiently large to take care of the Trinity Copper Company. We have extended our lines to the Sugar Loaf group for the Stauffer Chemical Company, also to Quartz Hill, and a short line to the Milton mine. Owing to the growth of our gas business in Redding we were compelled to build a new gas holder and extend mains at a cost of $11,671.31.

"At Heroult-on-the-Pitt we have put up a substation, where I expect more power will be sold than on all the rest of our system. This is due to the fact that the process of smelting iron ore by electricty has proven a commercial success, and a plant will be installed by the Noble Electric Steel Company just as fast as we can guarantee them power, and only limited in size by the amount of power we can furnish them. The electric pumping plant installed by the Central Irrigation & Canal Company was in operation throughout the summer of last year and proved an unqualified success. The Bully Hill Company will start its new smelter some time before the close of the present month.

"Of the 20 cities and towns that we furnish with light and power, all have shown a material increase, and the number of small pumping plants that have been installed is very gratifying, especially in view of the fact that we have been working on these lines for so many years. At the present time we have many applications that we cannot fill, owing to the long distance which it would be necessary to run our lines. In behalf of our Battle Creek Power Company we have purchased the Hazen property of 2360 acres, together with water rights on South Battle Creek, which will enable us to develop 5000 horse-power at a very low cost; also the Willows Water & Light Company, which will add very materially to our income. We have installed a complete new water system for the city of Redding which is not equalled by any of its size in the state, consisting of a substation with 450 kilowatts in transformers, a pump house equipped with two 150-hp motors direct connected to two centrifugal pumps capable of pumping 3500 gal. per minute to the reservoir.

"We have disbursed $40,000 in dividends during the past year and reinvested $95,478.82 of our net earnings in land water rights and extensions.

"Some 10 months ago we had arranged to sell $500,000 of our Battle Creek bonds. On the strength of this sale we commenced active construction of the Horseshoe Bend plant of 12,500-hp capacity, made contracts for machinery and had a large force of men at work on the dam, when the financial troubles of the country came on and the party to whom we had arranged to sell the bonds was unable to take them. We were compelled, however, to continue with our work for a number of months in order to save that which had already been done. As a result the indebtedness of the company was increased to an undesirable total, and in November of last year your directors were, reluctantly, compelled to suspend the payment of monthly dividends.

"However, the Mammoth Copper Mining Company has at last started its converters, and we can now calculate on an increase of at least $4,000 per month in its power bill. This and the blowing-in of the Bully Hill smelter will bring our net income for the coming month above $20,000. We also have a good prospect of selling our Battle Creek bonds, and this will put us in a very strong financial position and enable us to pay the accumulated dividends." Earning statements for the year ended Feb. 29, 1908:

Gross earnings	$207,061.[illegible]
Operating expenses and fixed charges	[illegible].00
Total	$ 3[illegible]91
Profit on repair work and sales of material	[illegible]
Net earnings for 12 months	$ 35[illegible].82
Dividends paid, eight of $5,000 each	4[illegible]
Surplus for 12 months	$95,478.82
Surplus March 1, 1907	107,830.46
Surplus March 1, 1908, reinvested in land, water rights and extensions	$203,3[illegible]

The following board of directors was re-elected at the annual meeting: H. H. Noble, Edward Coleman, J. Henry Meyer, C. R. Downes and A. S. Carman. After the shareholders' meeting the board organized, re-electing H. H. Noble, president; J. Henry Coleman, vice-president; the Bank of California, treasurer; Edward Whaley, secretary; E. V. D. Johnson, manager, and W. H. Pearce, assistant secretary

Technical School for Halifax, N. S.

A new technical college will begin work in Halifax, N. S., in the fall of 1908. It will be located on Spring Garden Street, adjacent to the Court House, on a site which is not only large enough for future expansion, but which is one of the best for the purpose in the city. Mr. F. H. Sexton, a graduate of the Massachusetts Institute of Technology, class of 1901, will head the new institution.

The main building, containing the lecture rooms, laboratories, etc., is to cost $100,000. Plans have already been made and bids received from the contractors. The engineering laboratories are to be housed in buildings of the factory type. The new college will offer training of a college grade in electrical, civil, mining and mechanical engineering. It is intended to supplant the junior and senior years of the scientific schools now connected with the colleges of Nova Scotia, and in addition, the new college will undertake such research work as will assist manufacturers and industrial concerns in solving some of the problems, which will thus improve the efficiency of their operation. By this arrangement with the regular colleges, no duplication of educational facilities will take place. No one college has previously had sufficient financial support behind its engineering department to enable it to carry through successfully such a plan as the new college anticipates.

The chemical, electrical measurement, mechanical, geological and research laboratories will all be placed in the main building, as well as the lecture and recitation rooms. The mining laboratory will be equipped with special apparatus for coal washing and coking, and other machinery illustrating the theory and practice of ventilation. The tuition will be nominal.

CURRENT NEWS AND NOTES.

A. I. E. E.—The April meeting of the American Institute of Electrical Engineers will be held on Friday, April 10. Mr Henry Floy wil present a paper entitled "The Engineer's Activity in Public Affairs—Public Utility Commissions and Franchise Valuation."

ELECTRIC LIGHTS IN THE WINTER PALACE AT PEKING.—The Winter Palace of the Chinese Emperor at Peking will shortly be brilliantly lighted throughout by electricity. For some time a number of the rooms have been lighted by electricity, but an order has recently been given for electric fittings for a complete installation.

ELECTRIC LIGHT MERGER AT DAVENPORT, IOWA.—The People's Light Company, of Davenport, Iowa, has purchased the assets of the Independent Light & Power Company, which had in course of construction a competing system. The latter company had secured a franchise about a year ago to build and operate gas and electric plants, and had expended about $250,000 in power plant and conduit construction.

SERVICE CASH DEPOSITS.—The Ohio House of Representatives has passed the Foster bill, providing that no person, firm or corporation furnishing water, gas or electricity shall require customers who are freeholders or who can furnish security to make a cash deposit. Those who are unable to furnish security may be made to furnish a cash deposit not exceeding their average monthly bills plus 30 per cent, and on which the company shall pay 4 per cent interest.

BRITISH WIRELESS STATIONS.—The British Admiralty has now 11 wireless stations on the British coast and 3 more will be installed during the present year. Together with war signal stations there are now 167 stations in the United Kingdom from which communications can be made to and received from war vessels. A station is now being installed at the Admiralty building in Whitehall, London, for the purpose of keeping the naval authorities in touch with naval ports and the home fleet.

SEVEN RIDES FOR A QUARTER.—It is reported that an agreement has been reached by Mayor Johnson, of Cleveland, Ohio, and the traction interests of that place, whereby, instead of three-cent fares as demanded by the former, tickets will be sold seven for 25 cents, with universal transfers. According to the terms of the agreement, the existing three-cent fare line will be merged with the other Cleveland lines under a holding company, which will all be run as a single system.

CHICAGO ELECTRIC CLUB SMOKER.—The recently-formed Chicago Electric Club had a smoker and entertainment at the Grand Pacific Hotel the evening of April 3. Mr. Perry N. Boole acted as toastmaster during the speaking which occupied the first helf-hour. Mr. William S. Taussig was master of ceremonies during the vaudeville entertainment part of the program. The latter brought out considerable talent from among the club members. This club now has a membership in the neighborhood of 250. It is a noonday lunch club meeting every Wednesday at 12:30 for lunch at the Grand Pacific Hotel.

GRAND RAPIDS ELECTRICAL SHOW.—The Grand Rapids Electrical Show Association has been formed at Grand Rapids, Mich., to conduct an electrical exposition May 11 to 16. Mr. W. J. Fenton is secretary of the association and in charge of the preparations. The exhibit will be held in the Waters Building, where 15,000 sq. ft. of space are available for show purposes. This will be allotted in booths of 100, 200, 300 and 400 sq. ft. or more. Twenty concerns have already signified their intention of exhibiting. The Grand Rapids-Muskegon Power Company will occupy 1000 sq. ft. of space. Plans for the arrangement of the exposition hall have been prepared by a local firm of architects to assure uniformity in the assemblage of the exhibits and harmony in the decorations. Grand Rapids is the electric city of Michigan, being the headquarters of the Grand Rapids-Muskegon Power Company, the largest electric company in the State.

MUNICIPAL PLANT DEFICIT AT PINE RIDGE, N. J—A report has been filed with the Supreme Court of New Jersey, by Commissioner Demarest, appointed to inquire into the affairs of the Borough of Pine Ridge, in Bergen County, New Jersey. The report is practically a discussion of the municipal lighting plant. The accounts of the borough are described as being in a wretched confusion, but certain main facts emerge. The voters authorized an issue of $15,000 to cover the whole cost, but there have been two such issues bringing in $30,351. On the other hand the total outlay and obligation is now $54,547, leaving a deficit of $24,195. The commissioner reports that the second bond sale was in a manner contrary to law, that several illegal loans were made and one or more illegal certificates of indebtedness issued to the contractors, with whom there was subsequent litigation resulting in a liability of $6,000 for a judgment against the borough.

SCENIC NIAGARA.—Results of the study made by the Niagara Scenic Commission, appointed by Secretary Taft, are now beginning to present themselves at Niagara Falls, as the work of restoring that section of the débris slope of the gorge between the upper steel arch bridge and the power plants of the Niagara Falls Hydraulic Power & Manufacturing Company to its primeval state has begun. A force of men has been set to work below the high bank turning over the soil of the slope preparatory to the planting of trees, shrubs and vines and it is stated that from 40,000 to 80,000 plants or trees will be set out to assist in the work of restoration. The strip of bank under treatment is in full view of all visitors to Niagara as they cross the upper bridge or ride on the steamer *Maid of the Mist*, as well as of those who pass along the Canadian side of the river in the enjoyment of the belt line. The section is below the manufacturing plants on the lands of the Niagara Falls Hydraulic Power & Manufacturing Company, where the trees and shrub growth had all practically been destroyed.

PARIS-LONDON TELEPHONE RATES.—Proposals are now being considered by the British and French authorities for reducing the Paris-London telephone rate from 8 shillings, or 10 francs per conversation of 3 minutes, to 4 shillings or 5 francs for the same service.

RONTGEN-RAY MARTYR.—Dr. Hall-Edwards, who has lost his left hand and will lose the fingers of his right hand from injuries received while experimenting with Rontgen rays, has been granted a civil list pension of £120 and has received a purse of £800 raised by subscription.

NEW JERSEY PUBLIC UTILITIES BILL.—The New Jersey Senate has passed the Robbins Public Utilities bill by a vote of 17 to 3. The Robbins bill does not give to the proposed commission power to fix rates and in other respects is much less drastic than the measure which was recently passed by the House.

MR. CARNEGIE'S GIFTS.—According to a list published in the New York *Tribune* of April 4 the grand total of Mr. Carnegie's gifts to date is $150,000,000. The largest of these is for libraries in the United States, the total being $30,000,000. The donations thus far to the Carnegie Institute of Pittsburg foot up to $16,000,000; another item is $2,000,000 for the "Polytechnic School" in Pittsburg.

N. E. L. A. GAS ENGINEERS.—The Committee on Gas Engines of the National Electric Light Association, consisting of Mr. W. C. Eglin, of Philadelphia, chairman; Messrs. J. B Klumpp, I. E. Moultrop and C. H. Williams, are making a tour of the country inspecting gas engine and gas producer manufacturing plants and the principal operating installations of this class of machinery. They will go as far west as Madison, Wis., and the trip will last about 10 days.

OHIO ELECTRIC LIGHT CONVENTION.—The Ohio Electric Light Association will hold its fourteenth annual convention at Hotel Victory, Put-in-Bay Island, Tuesday, Wednesday and Thursday, Aug. 25, 26 and 27. This is the place at which the great majority of this association's conventions have been held. The Hotel Victory, which is now under new management, has fixed rates for those attending this convention not to exceed $3 per day, with 50 cents additional for bath. No charge will be made the associate members for exhibitors' space. Mr. D. L. Gaskill, Greenville, Ohio, is secretary.

MERIDIAN TIME BY WIRELESS.—In a communication presented last week to the French Academy of Science by M. Bouquet de la Grye, it was proposed to establish on the Eiffel Tower a wireless telegraph station for the purpose of communicating Greenwich or Paris time to every ship in the world equipped with wireless apparatus. By pre arranged signal either noon or midnight would be indicated and ships would thus be able to regulate their chronometers. The proposal has already been accepted by the French government, and experiments will first be undertaken in communicating with French ships in the Atlantic and the Mediterranean. It is proposed to send the hour of midnight according to Paris time, this being preferable to noon owing to less liability to local disturbance.

ENGINEERING EDUCATION.—In a letter to London *Engineering*, a writer who signs himself *B. Sc.*, suggests the following reforms in the engineering courses of British colleges: 1. More freedom in the choice of lecture courses, etc. making it optional for students to take the higher pure theory courses in physics and mathematics, giving average students—i. e., students of average abilities—a better chance, and the opportunity to devote more of their time to engineering subjects. 2. Fewer examinations; examiners to be practical men themselves; less dependence on mere examination results, and more on practical work, such as drawing and laboratory work 3. Lecturers in science subjects to be more in touch with engineering work, particularly in mathematics, generally so poorly taught to engineers, and when well taught of the wrong kind 4. Workshops not so elaborate, and but little time spent therein for reasons given earlier. 5. Shorter courses with shorter vacations (where the "sandwich" system is not adopted); no engineering degree course to be longer than three years. 6. Closer co-operation between works and colleges, practical men and professors, and so on. In conclusion he says that a system of training necessitating the spending at college of three and even four years, and then three years more spent in the shops seems to be open to severe criticism, especially when the student meanwhile does not earn even so much as to keep himself The "sandwich" system of alternating college and shops seems in every way an excellent one, and he cannot understand how it is that it has not been universally adopted.

HEAT OF CATHODE RAYS.—In a paper presented before the Royal Society, Hon. Charles A. Parsons described some experiments on the conversion of diamond into coke in high vacuum by cathode rays. Alternating current of 85 cycles was passed through the primary of a Rhumkorff coil, giving a secondary voltage that could be varied from 5000 to 12,000 volts. Two diamonds, each about 0.2 in. in diameter, were experimented with. The first was entirely converted into coke without difficulty, while in the case of the second the process was stopped when most of it had been so converted, the residue being black throughout its mass. As the proper degree of vacuum in the tube was reached by working the mercury pumps, and as the volts were raised, the diamond in each case became red, and then intensely white hot, till, with about 8000 volts and 44 milliamperes (352 watts) passing through the tube, the diamond began to throw off small sparks. On the volts being increased to 9600, and the current rising to 45.5 milliamperes (436 watts), the sparks thrown off became more numerous and the diamond commenced to become black. Finally, with 11,200 volts and 48 milliamperes (537 watts), a rapid disintegration of the diamond took place, with considerable increase in volume, the residue having much the appearance and consistency of coke. The temperature of the diamond, as given by a Fery optical pyrometer during disintegration, was 1890 deg. C.

COST OF GENERATING ELECTRICITY.—According to our London contemporary, *Electrical Times*, the disputed question as to the "actual cost" of generating electrical energy has recently been adjudicated in England, in a case originating in Bulawago, Africa. The disputants were the municipality of that far-off place and the water works company. The latter provided street lighting under contract at a rate payable quarterly which was to yield them "10 per cent over the actual cost of generating the light"; and the two parties came to blows over the expression "actual cost." They fought one another in the Rhodesian courts, they appealed and cross-appealed at Cape Town, and finding their litigious thirst still unslaked they decided to wind up regardless of expense at the bar of the House of Lords. The Judicial Committee of the Privy Council has laid it down that "actual cost" included not only the generally accepted charges, but also depreciation and insurance. "The effect of including a sum for depreciation in the quarterly accounts would simply be to distribute the actual cost of the plant over the whole period during which it would, in the ordinary course, be of any service in the generation of electricity and light." Our contemporary adds that "there is hope for the litigants yet. The House of Lords has merely affirmed a principle; as to its application to the particular plant in question there is ample scope for further hostilities. And if that fails, they can come to the House of Lords again a few years hence to settle whether antiquation is included in depreciation, and if not where the line is to be drawn."

ILLUMINATING ENGINEERING SOCIETY.—The April meeting of the New York section of the Illuminating Engineering Society will be held on the evening of Thursday, April 9, in the Engineering Societies Building. Dr. Clayton H. Sharp will deliver an illustrated address on the new types of electrical lamps.

HIGH-VOLTAGE INSULATORS.—Mr. Walter T. Goddard read a paper on "High-Voltage Insulator Manufacture" before the Toronto branch of the Canadian Society of Civil Engineers on March 26. He stated that the best insulator construction involved the use of porcelain manufactured of a mixture of ground flint and feldspar, raised to a vitrifying temperature.

FOX RIVER ASSOCIATION.—The Fox River Street Railway and Lighting Association has been organized in Appleton, Wis., N. C. Draper, of Fond du Lac, being elected president. Every electrical concern between Fond du Lac and Green Bay was represented. Another meeting will be called in the near future, at which time other officers will be elected. The object of the association is to discuss matters of mutual interest and make uniform changes in schedules.

CORRECTION.—In the review of a book entitled "Introduction to the Study of Electrical Engineering," which appeared on page 731 of our issue for April 4, a typographical error caused the author's name to appear as H. H. Morris instead of H. H. Norris. As is well known, the book was prepared by Professor Norris for the special needs of students of mechanical and electrical engineering, at Cornell University, and was intended to afford a general perspective, the details being treated subsequently.

PETITION TO HAVE CABLE CODE RETAINED.—Secretary Straus, of the Department of Commerce and Labor, has received a petition signed by merchants and bankers of New York, asking that a government delegate be sent to the next International Telegraph Conference, which will be held at Lisbon on May 4, who shall be instructed to oppose a proposed return to the rule limiting cable code words to bona fide words taken from seven European languages. The present system, adopted at the last conference in London in 1903, permits the use of any code words, provided they are composed of pronounceable syllables.

ANOTHER ELECTRIC GUN.—According to a dispatch from London, Col. F. W. Maude, in the April *Contemporary Review*, describes a gun which "can impart by the application of electricity an initial velocity of 30,000 ft. per second to projectiles of all sizes, and which can be practically handled under war conditions" on ships or on land. Col. Maude states that with this gun shells could be fired from London into Paris or vice versa. A Scotchman named W. S. Simpson is stated to be the inventor of the gun, which discharges without smoke, flash or recoil. Whether a projectile at the velocity given would not be heated by air friction to the point of melting is not stated.

RADIUM AND THE WORLD'S AGE.—In a lecture before the Royal Institution, London, Mr. R. T. Strutt pointed out the possibility of fixing the age of the earth by means of the radioactive properties of radium and helium. Accepting the hypothesis that helium is constantly produced at a definite speed from radium, Mr. Strutt proposed a quantitative estimation of the radium and the helium present in various minerals, as a means of determining their relative ages. Proceeding on similar lines, when once the rate at which radium is transformed should have been estimated, a simple operation in arithmetic would solve the problem of the age of the earth. "I have," said Mr. Strutt, "been able to find that the age of flints present in chalk is only one-thirtieth of the age of the mineral that is being mined in Cornwall. It is to be hoped that in this way it will be possible to form an exact estimate of the date on which man first appeared upon the earth."

WOOD PRESERVATION.—Much study is being devoted by the United States Forest Service to the preservation of wooden poles, ties, etc., by creosote oil and to determining what the composition of the oil should be to give the best results in preserving timber, under different conditions, and how the most desirable creosotes may be obtained. The reports of these studies, together with detailed description of the more economical processes of applying the preservatives to wood, have been worked into circulars which the government has placed at the disposal of all users of timber, and which will be furnished to all who make the request of the Forester, at Washington.

NEW ONTARIO POWER PLANT.—In the Ontario Legislature a bill has been introduced to provide for the development of water power at Dog Lake. The measure provides for the construction by the Hydro-Electric Commission of a dam or dams in Dog Lake or the Kaministiquia River for the purpose of storing or controlling the flow of water. It empowers the commission to develop electrical energy, and it may sell or lease such water power to such persons, firms or corporations as the government may see fit. The cost of the work is not to be over $20,000, and it is to be paid out of the consolidated revenue fund of Ontario. It is understood that the bill is introduced in connection with Port Arthur's power scheme.

MUNICIPAL OWNERSHIP IN WINNIPEG.—Advices from Winnipeg, Manitoba, are to the effect that the city of Winnipeg on March 30 concluded arrangements for the purchase of the entire holdings of the Winnipeg Electric Company, estimated to be worth about $15,000,000. The determination of the company to sell its property, it is stated, was hastened by arrangements now being made by the city for the construction of a municipal power plant at Lacdubonnet at a cost of $3,500,000 to enter into competition with the company, which now has a monopoly in the city for supplying electricity. The street-railway system also passes over to the city, which already owns the waterworks, stone quarries and asphalt plant. The provincial government owns the telephone system.

ST. LAWRENCE RIVER CANAL.—In an address recently delivered at the Clarkson School of Technology, Mr. Cecil B. Smith, formerly assistant professor of civil engineering at McGill University, spoke of the possibility of a dam across the St. Lawrence River at Long Sault, near Massena, New York. At present there are plans involving the development of something like 700,000 horse-power in this vicinity. Mr. Smith said that although he would hesitate to say that a dam would ever be built across the St. Lawrence River, should an international conference give permission, thereby making it necessary for all the lake shipping to go through canals, it would result in one of the greatest hydro-electric developments in the world, as great, in fact, as at Niagara Falls, since the amount of water to be taken for power purposes there has been limited.

EXHIBIT OF SAFETY DEVICES.—An exhibition will be made, beginning April 13, at the Museum of Safety Devices 239 West Thirty-ninth Street, New York, of a number of interesting appliances and inventions for the protection of life and limb. Among the exhibitors are the Union Switch & Signal Company, Carnegie Steel Company, Westinghouse Air Brake Company, Travelers' Insurance Company, Yale & Towne and the municipal authorities of the city. No charge is made for space, and the exhibition is open freely to the public. Three solid-gold medals will be awarded for the best devices in transportation and mining and for the best safety device for motor boats and motor vehicles. The chairman of the committee of direction is Mr. Charles Kirchhoff, and of the exhibits committee Prof. F. R. Hutton. It is proposed to hold a series of conferences during the continuance of the exhibition.

Generating and Distributing System of the Portland (Ore.) Railway, Light & Power Company.—I.

The properties of the Portland Railway, Light & Power Company comprise three separate and distinct systems, as will be noted by reference to the accompanying map. These are called the Vancouver System, the Upper Willamette Valley System, connecting Salem with several small towns in that vicinity, and the Lower Willamette Valley System, including Portland, Ore. Although these three systems are separate at the present time, it is proposed in the very near future to build a line south from Oregon City to Salem, and also from Portland north to Vancouver, thus interconnecting the three systems.

The Vancouver System consists merely of a steam generating station of 820-kw capacity, which supplies the town of Vancouver with electricity. The current is two-phase at a frequency of 60 cycles and with a potential of 2300 volts.

The Upper Willamette Valley System derives its energy principally from the Lower Willamette Valley or Portland System, being connected with Station B, Oregon City, by means of a 30,000-volt, 33-cycle, three-phase transmission line, which also supplies the substations of the Oregon Electric Railway Company, located along this line. A steam relay station is located at Salem, and a water-power plant at Silverton is operated during seasons of the year when water is plentiful. The bulk of the energy generated is utilized in the city of Salem. The potential is stepped up to 20,000 volts for connecting Salem and Silverton, and for distribution to neighboring towns as far south as Woodburn.

The Lower Willamette Valley System includes two water-power generating stations, a steam generating station and nine substations. Five of the substations are utilized solely for supplying direct current at a potential of 600 volts to the railway system, and are distributed along the interurban railway lines of the company. In addition to the above, there is a small substation located at "The Oaks," which is a summer resort owned and operated by the company, and this station is used solely for supplying electricity for lighting the grounds and buildings of this park. There is also a small substation at Estacada for furnishing electrical energy to that town. The generating station B at Oregon City serves as a substation for feeding that city with 60-cycle, three-phase current at a potential of 2300 volts, a motor-generator set serving for this purpose.

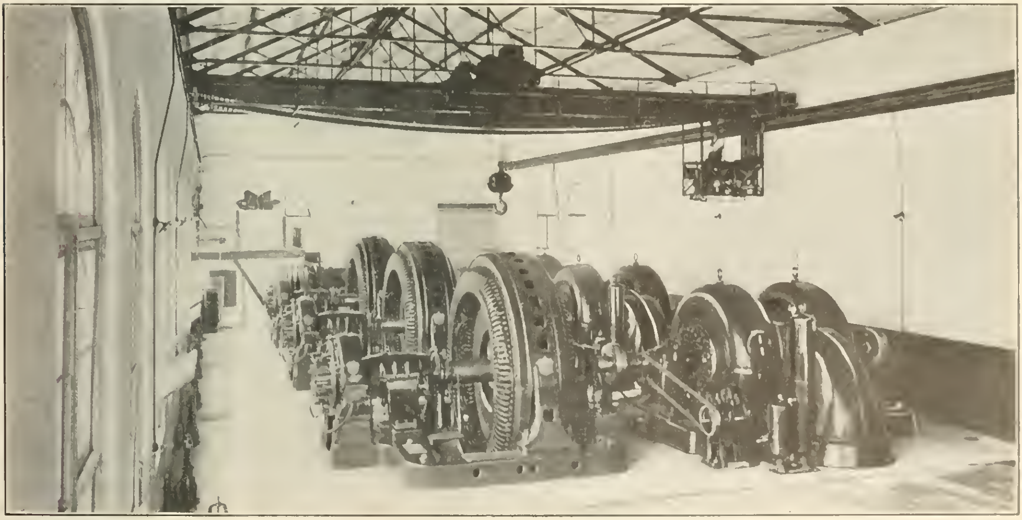


FIG. 1.—INTERIOR VIEW OF STATION G, CAZADERO, ORE.

The two main substations of the company are "a," located on the west side, and "d," on the east side of the Willamette River. These substations are centers of distribution for supplying electrical energy for lamps and motors to the city of Portland and for the operation of the street railway system.

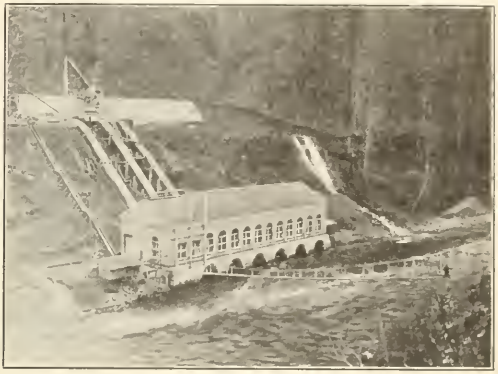


FIG. 2.—EXTERIOR VIEW OF CAZADERO POWER PLANT.

A substation, "c," in St. Johns, a suburb of Portland, about five miles to the north, is equipped for supplying direct current at 600 volts to the interurban road in that locality, and for furnishing electrical energy to St. Johns, and to the number of large mills and factories in that vicinity.

HIGH-TENSION FEEDERS.

The high-tension feeders from generating stations to substations and interconnecting substations all carry 10,000-volt, 33-cycle current, with one exception. The Cazadero station (G) generates electricity at 10,000 volts, 33 cycles, and the potential is stepped up to 33,000 volts and transmitted directly to substation "d" in Portland, a distance of about 31 miles.

Duplicate lines connect these two stations, no taps being taken off of either line between the two points. The lines are constructed for almost the entire distance along the railway right of way of the company, one on either side. At substation "d" the potential is stepped down to 10,000 volts and feeds into the buses directly in multiple with the 33-cycle, 10,000 volt current from Station B at Oregon City and Station E in Portland.

Station B at Oregon City generates electricity at 10,000 volts, 33 cycles, and the energy is transmitted at this voltage by duplicate lines along the west bank of the river to substation "a" in Portland, and also by a single line following the east bank of the river to substation "d" in East Portland. Similarly, substation "a" receives energy from Station E in North Portland by means of duplicate 10,000-volt, 33-cycle tie lines, and the two main substations, "a" and "d," on opposite sides of the Willamette River are also connected by duplicate 10,000-volt tie lines.

The several substations on the east side of the river are tied together with a 10,000-volt, 33-cycle line from St. Johns to Cazadero. This tie line is looped into each station in such a way that energy may be derived from two directions, thus allowing of the cutting out of any section at any time, as may be necessary for repairs or construction work.

Lighting and power feeders are all operated in multiple, and the entire system is tied together by means of the duplicate lines acting as a reservoir, receiving and distributing energy and also making it possible to shut down any station or line.

DISTRIBUTING SYSTEM.

Electricity is distributed throughout the city of Portland and suburbs at a potential of 2400 volts and at a frequency of 60 cycles, derived at substations "a" and "d" by means of motor-generator sets.

The city is divided into districts, with a separate feeder to selected centers of distribution in each district. The voltage is stepped down to 240 for a three-wire system, by means of transformers distributed throughout the district, and the secondary system as far as practicable is tied together.

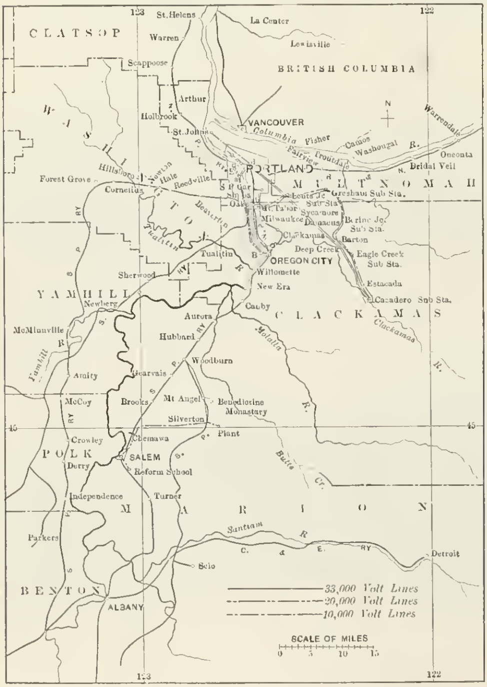


FIG. 3.—MAP OF TRANSMISSION SYSTEM.

For feeding motors a third wire parallels the several 2300-volt primary feeders, where required, from which a 220-volt, three-phase current is derived. This third leg is used in connection with the feeders to the outlying districts only, and the ratings of motors allowed on these feeders are limited, in order that the regulation may not be noticeably affected. For supplying energy to the business and manufacturing sections of the city special 2300-volt, three-phase feeders are run, which are used solely for feeding motors with energy.

A 10,000-volt, 33-cycle feeder extends from substation "d" along the water front, for supplying electricity to some large mills and factories in that locality. The business section of the city is supplied from a 600-volt, direct-current feeder for the operation of elevators and special apparatus. Substations "a" and "d" also supply 600-volt direct current for the operation of the network of street railway lines in the city.

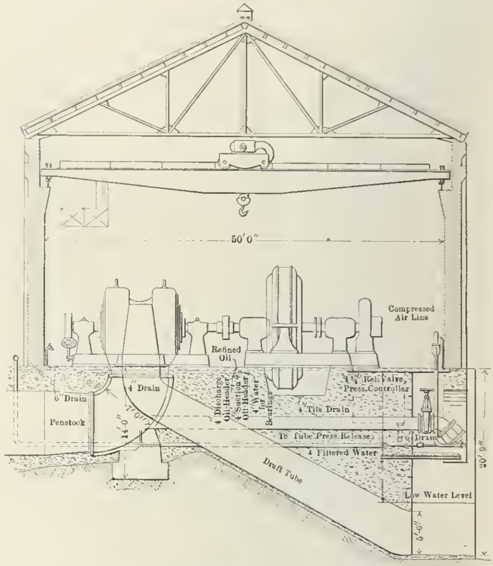


FIG. 4.—CROSS-SECTION VIEW OF POWER HOUSE.

The streets throughout the system are lighted by means of G. E. magnetite arc lamps, of which about 1500 are in use. These lamps are supplied with energy from 75-light mercury arc rectifier sets, and constant-current transformers, which are operated directly from the 10,000-volt, 33-cycle, three-phase generating system.

STATION G.

The hydro-electric plant at Cazadero, Ore., is the latest addition made to the system of generating stations operated by the Portland Railway, Light & Power Company. This station was placed in operation on Feb. 26, 1907, and is an interesting example of modern hydraulic and electric construction. Water diverted from the Clackamas River by means of a dam is conveyed through a flume and ditch to a reservoir, whence, at a distance of 1.7 miles from the point of diversion, it enters the penstocks, and after passing through the turbines returns again to the river channel.

The dam as originally designed consisted of a wedge-shaped structure built of rough logs about 2 ft. in diameter, laid crosswise and lengthwise in such a way as to form vertical pockets from 10 to 20 ft. square. These pockets were filled with broken rock and clay. A cover was built upon the log crib work. This at the edge, which points up-stream, consists of logs extending to the bottom of the stream in an inclined position, but over the greater part of the dam is made a double layer of heavy planking.

To prevent a washing-out of the stream bed, five rows of steel-capped piles were driven across the stream along the upper edge of the transverse logs of the dam and into the bedrock, while on both sides a heavy log bulkhead, also rock filled, was built on top of the wedge dam at the down-stream end to confine the flood waters to the center or spillway.

The dam proper is 176 ft. wide and 230 ft. long at the base, while the length over all is 400 ft. The water spillway between the bulkheads is 153 ft. wide and 51 ft. high above low water.

The bulkheads confining the water to the spillway are 60 ft. long by 43 ft. wide, and 57 ft. long by 35 ft. wide, respectively. The concrete bulkhead containing the gates adjoins the west timber bulkhead and rests on bedrock. It is built like a box without a lid, with two rows of gates, one row on the up-stream side and one row on the down-stream side. The up-stream gate openings are, with one exception, 8 ft. wide and 16 ft. high, the exception being 10 ft. wide. Two of the down-stream gate openings are 8 ft. wide and 16 ft. high, one is 7 ft. wide and one 9 ft. wide, the height being the same as the others.

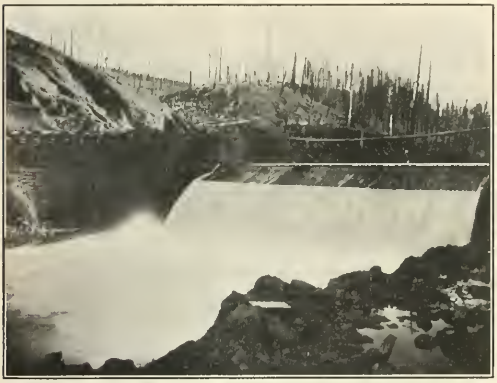


FIG. 5.—SPILLWAY AT DAM, STATION G, CAZADERO.

During the construction it was decided further to strengthen the dam by means of a rock-filled crib work of rough-sawed timbers, so placed as to act as a wedge against the east end of the dam. The length of the main body of this crib work is 120 ft. and the bottom width 40 ft. It rests on bedrock, to which it is securely anchored, and has a height of 65 ft. Thousands of yards of rock were used to fill the cribs in this dam, and many more thousands of yards of selected clay were scraped from the hillsides and used in the backfill to cement the dam and prevent a cutting-out around the ends, while hundreds of cords of brush cut from the surrounding hills were sunk by means of sacked rock ballast into interstices by a simple clay puddle.

As it stands to-day the dam is practically without leaks. The gates already mentioned are provided with hoisting gear, to be operated either by power or by hand, and when wide open admit of the passage of much more water than can be used by the power plant. This large gate area provides a means of reducing the height of the water above the dam when extreme freshets might threaten to overflow the bulkheads; excess water being wasted over both of two additional spillways, one located in the flume, into which the gates discharge the water, and the other at the lower end of the reservoir.

The flume is built upon crushed rock foundations, the bents or supports are spaced 6 ft. apart and are made up of two 6 in. x 12 in. sills (resting on 6 in. x 8 in. x 3 ft. sub sills), to each end of which is secured and bolted a post 8 in. x 18 in. and 18 ft. high. These posts are 25 ft. 10 in. apart and are held in place at their upper ends by means of an iron rod, ¾ in. steel upset to ⅞ in. at the ends, and a timber cap 6 in. x 8 in. in dimension.

The bottom of the flume consists of a double layer of boards, the lower being 3 in. thick, the upper layer 2 in., laid so as to break joints and seams, and the sides are made so as to vary in thickness from 5 in. at the bottom to 2 in. at the top. This flume follows the contour of the hillside along the river for a distance of 2622 ft., where it empties into a ditch through a concrete outlet, so designed as to prevent eddies and consequent cutting of the banks. The bottom width of this ditch is 35 ft,. its depth 22 ft., with a slope on the embankment of one in one. The total length of the ditch is 2898 ft. to its outlet into the lake.

At a distance of about one half the length of the ditch from the flume outlet there is a stretch of flume 360 ft. long, with concrete inlet and outlet, also built with the idea of eliminating eddies.

This piece of flume is of the same cross-section as that already described and was built to carry the water across the dangerously narrow strip at the bend of the river. In excavating across this strip it was found necessary to remove a very large part of the hillside. The material excavated was very conveniently used in the reservoir embankment.

The reservoir, from which the water is taken dirctly to the water wheels and which is supplied at its upper end from the ditch, covers an area of 50 acres when filled to an average depth of 20 ft. When filled to this level the lake would supply power sufficient to run the wheels at their rated output for about six hours after the gates at the dam had been closed.

At the lower end of the lake, or reservoir, and at a distance of 1 7/10 miles from the dam, is located another set of gates. These gates are known as forebay gates, and are set into a massive steel concrete wall built on the top edge of the river bluff, and including all of the essential features of a dam, namely, a waste way for lowering or drawing off the water for purposes of repair, a spillway for taking care of flood waters and gates for the control of the water into the supply pipes.

The spillways as here constructed are provided with sectional gates, so that it is possible to keep the lake level at whatever height is desired. This reinforced concrete wall, 8 ft. thick at top and 20 ft. thick at bottom, rests upon a foundation 47 ft wide, built upon sandstone bedrock. A core-wall of reinforced concrete, 4 ft. at the bottom and 2 ft. thick at top, with 6-in. offsets or steps at points in its height, extends from the main dam or wall for 40 ft. into the earth embankment of the lake.

FIG. 6.—CLACKMAS RIVER ABOVE DAM

A water "cut-off" or pilaster has been built about mid-length of this core-wall, and a selected clay has been carefully packed against a heavy wing wall, extending into the lake a distance of 79 ft. from the main wall and making an angle of about 47 deg with the core-wall. The distance from the top of the main wall to the foundation is 33 ft., and the length of the main wall is 290 ft. At one extremity it joins the lake embankment, while at the other it enters the hillside rock.

The foundation upon which the main wall rests extends upstream 27 ft. beyond the gates, which slide vertically against the up-stream face of the wall. These gates were arranged to be operated either by hand or by power, and when operated by power can be controlled from the power house. Provision has been made for the operation of five units of wheels and generators. At present, however, but three units are in use, the two remaining gate openings having been closed.

To prevent drift and other foreign matter getting into the wheels, iron racks have been placed in front of the gates, which are 9 ft. in diameter. The penstock openings through the bulkhead are 8 ft. in diameter, the inlet ends being enlarged to a diameter of 9 ft. The penstocks rest upon a concrete web and cross-wall arrangement and are inclined at an angle of about 45 deg. along the hillside. One of these penstocks is provided for each gate, and at its lower end connects directly with a pair of water-wheels located in the power house.

These wheels, each pair of which will develop under a total head of 125 ft. 5,000 horse-power, will, as they are now installed, have a head of 138 ft. at low water with lake full, or a 13-ft. greater head than they were designed for.

As the water comes down through the penstocks from the forebay gates it divides on each pair of wheels, half acting in one direction along the shaft against one wheel, the other acting in an exactly opposite direction along the shaft and against the other wheel; yet, through the influence of the directing curves of the small gates, controlled by the governor, the entire body of water tends to rotate the shaft in one direction.

Besides having a governor, each wheel is provided with two relief valves to prevent damage through "water hammer." These valves are arranged to discharge into the tail race. The wheels and generators are set on a massive concrete foundation, and there is very little vibration when they are all running at full speed.

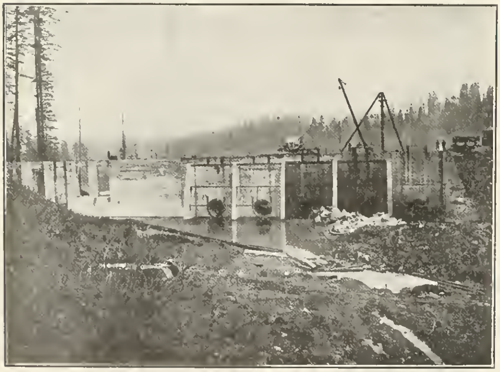


FIG. 7.—INSIDE OF RESERVOIR BEFORE BEING FLOODED.

The power house is a well-lighted, thoroughly-ventilated building, 180 ft. long and 54 ft. wide. Along the north side of the building there are 13 arched windows 8 ft. x 14 ft.; two such windows and a door, 12 ft. x 14 ft., on the west side, which, together with the windows on the east and south sides, admit an abundant amount of light and air. Clusters of incandescent lamps have been placed between the windows at a height of 12 ft., and others under them are 6 ft. above the floor.

A 20-ton electric traveling crane, which can be run the full length of the building, facilitates any repair work that might be necessary, and the railway spur terminates inside the power house, so that any loading or unloading of heavy machinery can be done by means of this crane.

Each of the water-wheel sets consists of one pair of 42-in. horizontal Victor turbines of the Francis type. They were manufactured by the Platt Iron Works, of Dayton, Ohio. A friction brake is provided on the end of the water-wheel shaft, of sufficient capacity to stop the wheels when gates are closed. Each unit is provided with a Lombard type N governor.

The generators were manufactured by the Allis-Chalmers Company. They are of the 11,000-volt, 33-cycle, revolving-field type and are rated at 2500 kilowatts each. A 75-kw exciter is mounted on the extended shaft of each generator. The guaranteed regulation is 8 per cent from no load to full load, with 100 per cent power factor. Each generator is capable of standing a momentary overload of 100 per cent without injury. The electricity is conveyed from the generator to the motor-operated oil switches by means of three-phase, 15,000-volt cables.

A reinforced-concrete structure, consisting of a core-wall flanked by wings and surmounted by a gallery, upon which are located switch cells and a concrete bus bar compartment, contains the high-tension equipment. On the main floor and immediately in front of this gallery is located the switchboard. The latter is composed of Monson slate panels, there being a panel for each generator and a panel for each exciter, also a line totaling panel and a panel for the station circuits.

The remote-control operating switches for the oil switches are located on this switchboard, as are also the time-limit relays for operating the trips. A basement underneath the switchboard provides ample room for the location of the field rheostat for the generator. This basement is provided with a ventilating shaft reaching to the top of the building. Curve-drawing-indicating wattmeters are used in connection with each generator.

On leaving the power house the energy passes directly over the Clackamas River to a transformer station located on the opposite bluff. This building consists of a series of cells for the accommodation of nine 850-kw, water-cooled, 11,000-33,000 volt transformers, manufactured by the Stanley Electric Company, and a switch room, in which are located the outgoing line switches. These switches are of the Stanley, 60,000-volt, three-pole, single-throw type, and are solenoid operated, the control switches being located on the main switchboard in the power house on the opposite side of the river.

The transformers are guaranteed to operate at 57,000 volts, Y-connected, with grounded center, though at the present time the transmission voltage is 33,000. The design of the building is such as to provide ample space between all wires, and each wire is separated from its neighbor by a concrete barrier. Special attention has been given to the water-cooling equipment, an alarm being provided which will warn the attendant in the station across the river in the event of any interruption to the water supply. Multiplex lightning arresters of the General Electric make are installed in the transformer station. A gallery for the convenient operation of the disconnecting switches is also provided. The Cazadero plant was designed by Mr George I. Brown, at that time chief engineer of the Oregon Water Power & Railway Company. The uncompleted plant was taken over by the Portland Railway, Light & Power Company in May, 1906. Mr. Brown is now vice-president and general manager of the Jersey Central Traction Company, of Keyport, N. J. He is associated with Mr. J. H. Morris, the Philadelphia banker, whose firm financed the Cazadero project.

British National Physical Laboratory.

The committee which was appointed to investigate the grievance against the British National Physical Laboratory has made its report. An account of the report is given in London *Electrical Engineering* for March 5. The grievance was essentially based on the complaint that the laboratory undertakes commercial work outside of its proper domain. The committee recommends that the ordinary testing of materials to ascertain if they fulfill the requirements of contracts should, with certain exceptions, not be undertaken by the laboratory, and should be left to private practitioners. On the other hand, the rule as to compulsory publication of the results is to be relaxed. An interesting point brought out in the evidence relates to a request by Sir Joseph Swan, that could not be granted, that the laboratory should undertake for him certain investigations with regard to the properties of certain refractory metals and metalloids, the results of which, Glazebrook said, might have had a great influence on the metallic-filament lamp industry in England.

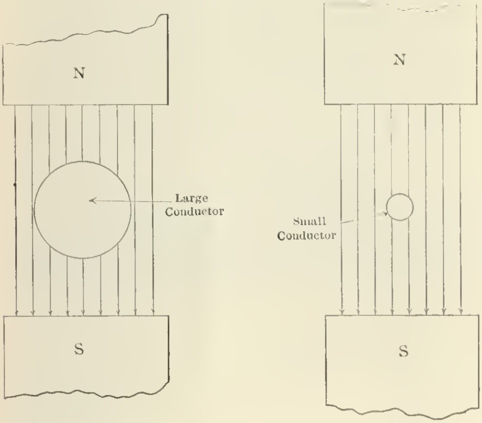
Electromagnetic Force.

By A. S. McAllister.

In connection with the article by Mr. Carl Hering in the issue of the Electrical World for March 14, calling attention to the misconception which may result from the usual statement of the so-called "law of electromagnetic induction," it may be well to point out the discrepancy between certain well-known facts related to electromagnetic force and the usual explanation thereof as found in the modern treatises on electro-physics.

Experiments have proved conclusively that when a straight conductor conveying a certain current is situated at right angles to, and within, a magnetic field of certain density, which would be uniform if the current were not present, the conductor experiences a force, at right angles to both the field and the conductor, equal numerically to the product of the flux density, the length of the conductor and the strength of the current, all values being expressed in proper units. In explanation of this fact it is usually stated that the flux which surrounds the conductor locally causes an increase of the flux lines on one side of the conductor, and a decrease on the other side, and the attempt of the flux of the main field to prevent the distortion produces a tension in the lines which acts as a mechanical thrust against the conductor. If such an explanation were correct, the mechanical thrust would vary with the distortion of the main field, that is, with the number of lines surrounding the conductor locally.

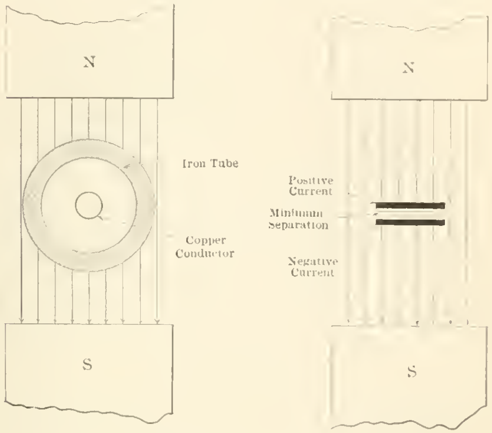
In order to investigate in the simplest possible manner the actual conditions that have bearing on the accuracy of the above explanation, assume in Fig. 1 a conductor conveying unit current at right angles to, and within, a field having a normal flux density of unit value, the force will evidently have unit value per unit length, as repeatedly verified experimentally. For purpose of comparison with Fig. 1, the conductor in Fig. 2 conveys unit current at right angles to, and within, a field of unit flux density, and the force again has unit value per unit length, although in the latter illustration the conductor is of much smaller diameter than that in the former, so that the local flux surrounding (and within) the conductor of Fig. 2 is much greater than is true in Fig. 1. That the local flux is larger with the smaller conductor is shown conclusively by the well-known fact that the reactance of a transmission circuit is greater the smaller the conductor.



Figs. 1 and 2.—Large and Small Conductors in Magnetic Fields that are Normally Uniform.

Consider now the conditions illustrated in Fig. 3, where a conductor carrying current of unit value in a field of unit density is placed within an iron tube; the force has unit value per unit length, although the local flux is considerably greater than in Fig. 2, and correspondingly greater than in Fig. 1. If one recalls the excessive reactance of an alternating-current conductor when placed in an iron pipe (the return conductor being external to the pipe), he will not question the statement that the local flux is increased by the presence of the iron tube.

Referring to Fig. 4, assume two thin flat conductors carrying equal currents in opposite directions to be placed parallel to each other and insulated by the minimum possible separation of the best possible insulating material. When the current in each conductor has unit value, and the flux density of the field is unity, then the force experienced by each conductor has unit value, although there is no measurable local distorting flux. That the distorting flux is eliminated and the force is not affected thereby is proved beyond any doubt whatever by the operation of compensated-series motors, and of generators provided with Ryan balancing windings. It cannot be argued that the force exerted by each conductor is merely that existing between two parallel conductors conveying currents in opposite directions, because in the first place the actual force depends upon, and varies directly with, the main field flux, and in the second place it is exerted at right angles to the small force between the two conductors.



Figs. 3 and 4.—Conditions for Producing Maximum and Minimum Local Flux.

It is improper to state that the force upon a conductor is expressible as a certain value per unit area according to the densities of the local flux and of the normally uniform field, because if such a relation were true the force on a conductor would be doubled when placed in proximity to a similar conductor carrying an equal current in the same direction.

The above examples, illustrating relations the knowledge of which is universal, are sufficient to prove that, contrary to the statements made directly by many writers and implied in every known treatise on electro-physics, electromagnetic force is *not* a function of the flux surrounding (or within) a conductor locally; it is related, however, to that which *tends* to produce local flux. The force depends upon the local flux, but the actual numerical value of the force cannot be expressed solely in terms of this flux; account must be taken of the mechanical arrangement of the conductor and its surroundings, and the fact that the force is not exerted on the current, but on the material, cannot be ignored. It is noteworthy also that the force exerted on each element of a conductor in a normally uniform magnetic field depends solely upon the current carried by that element and it is not affected by the flux which may surround that element by reason of its proximity to current in other elements.

The above outline does not show, and is not intended to show, that the expression for electromagnetic force, $f = Hli$, is incorrect; it points out merely that the usual explanation for the relations indicated by this expression is misleading.

The Relation Between Iron and Copper in Transformers.

By M. Kawara.

The design of transformers is greatly facilitated by the use of the accompanying curves. The curves from I to VI, inclusive, have for data the amount of necessary copper per kilowatt, the price of copper, of core lamination, the total price of copper and iron, the full-load efficiency and the lamination iron per kilowatt. How these curves were derived will be explained later.

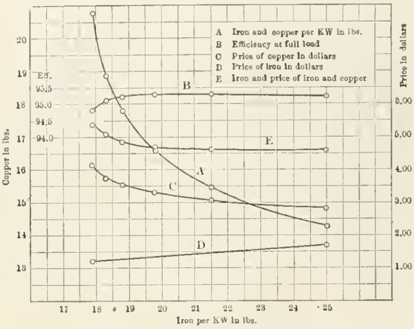


FIG. 1.—CAPACITY 2 KILOWATTS.

The copper-iron curves are very nearly hyperbolic. As *b* (Fig. 7) is increased, the length of the core also increases, and consequently the core loss becomes larger, but, at the same time, the mean length of the windings decreases, and hence the copper loss also decreases. These facts are clearly brought out. It is to be noted that the point of the highest efficiency falls very near to the point of the lowest cost of material. This is a very fortunate coincidence for the manufacturers and users of transformers. However, the writer found that in small transformers the point of the lowest cost is far from the desirable dimensions. For instance, in 2-kw transformers, *b* is about eight times *a* at that point under the assumed conditions. The highest efficiency point comes a little nearer to the practical dimensions, as *b* is four times that of *a* at that point. In larger ones, both the lowest cost point and highest efficiency point lie inside of the practical dimensions, and the points come nearer together as capacity goes up. Of course, the lowest cost point shifts as the relative prices of copper and iron change. Hence the cost curves must be revised from time to time.

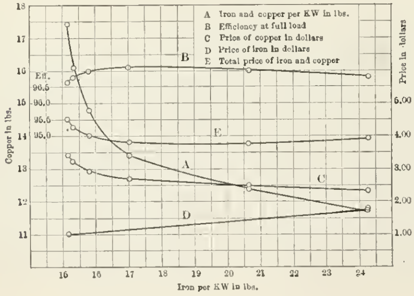


FIG. 2.—CAPACITY 4 KILOWATTS.

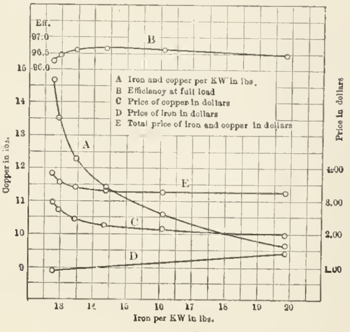


FIG. 3.—CAPACITY 8 KILOWATTS.

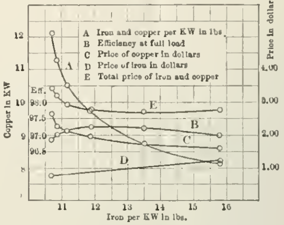


FIG. 4.—CAPACITY 15 KILOWATTS.

The curves of Fig. 7 were drawn from the six preceding ones. The meanings of the curves are clear without any explanation.

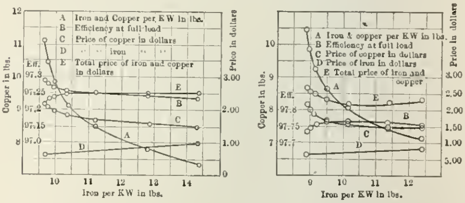


FIG. 5.—CAPACITY 24 KILOWATTS. FIG. 6.—CAPACITY 32 KILOWATTS.

The assumptions made in calculating the curves of Figs. 1 to 6 are as follows:

$$\text{Total number of flux } N = \sqrt{\frac{80 \times KW \times (10)''}{4.44 \times 60}}$$

Number of cycles per sec	60
Flux density in core	50,000
Current density in windings	1500 circ. mils per ampere
Copper space ÷ winding space	= 0.40
Copper loss per lb. of iron	1.00 watt
Core loss per lb. of iron	1.00 watt
Primary voltage	2200
Mean length per turn	$4 \times \left(c + \frac{a}{2}\right)$
Insulation between laminations	10 per cent
Secondary voltage	220

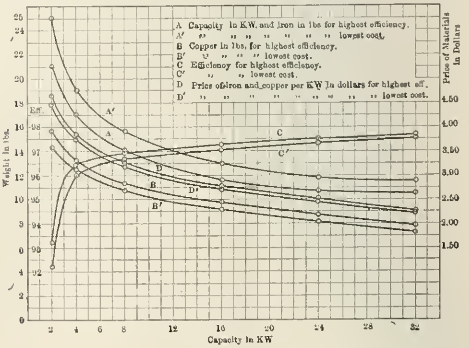


FIG. 7.—COMPARISON OF CURVES.

Where *a* and *c* have the meanings as indicated in Fig. 8: Primary voltage, 2200; secondary voltage, 220.

Further, the core type of transformer with square core was assumed (Fig. 8). The shape of the winding space ($a \times b$)

was varied from that of square to narrow rectangle, keeping the product $a \times b$ constant. In calculating the full-load efficiency, the copper and core losses only were taken into consideration. The price of laminations was taken at 7 cents per pound, and that of copper at 20 cents. Therefore, smaller machines are shown in a more favorable light than in actual cases.

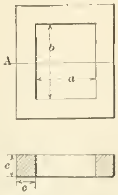


FIG. 8.—TYPE OF TRANSFORMER.

Standardizing Laboratory of the Georgia Railway Electric Company.

By E. P. Peck.

A LABORATORY fitted up for central-station work is in many particulars very different from a general laboratory. It should be adapted to make any measurements called for in any part of the system, and should be able to make them to a satisfactory degree of accuracy. In some cases approximate results are all that are required. In other cases the highest possible accuracy is necessary. In any case, the results must be obtained without unnecessary delay.

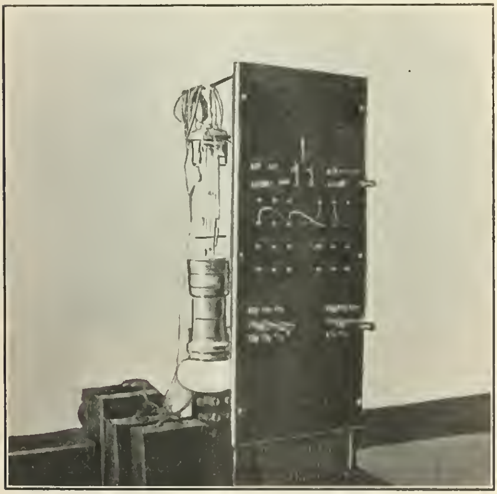


FIG. 1.—MAIN SWITCHBOARD.

The problem in equipping such a laboratory is to get such an arrangement that approximate results may be obtained quickly, but highly accurate results must be obtainable on occasions. All tests which are frequently repeated must be so arranged for that they may be made without time lost in making connections. The arrangements should be as flexible as possible also, for many tests of an unusual nature must be made, as the laboratory is the final court of appeals in any disputed case. It is here that the apparatus may be tried out and its limitations determined.

The limit of accuracy in the work is generally about 0.1 per cent, though 0.02 per cent may be obtained on some work. By approximate results the writer means results within 5 per cent. For example, comparisons between the standard apparatus in the laboratory are made to 0.02 per cent to 0.05 per cent; tests of standard indicating and recording meters are made to 0.1 per cent to 0.2 per cent; tests of station indicating meters are made to 1 per cent to 2 per cent; measurements of magnet coils may not be made within 5 per cent. In constructing the laboratory described, the above needs were kept constantly in mind, and about 18 months' work has shown that the requirements are filled satisfactorily.

The standardizing laboratory of the Georgia Railway & Electric Company is considered a branch of the testing department, and part of the work consists in maintaining the indicating and recording meters in the stations. There are a large number of meters for direct current and for 25-cycle and 60-cycle alternating current, which range in size from low-capacity portable testing instruments to meters for measuring the total output of the stations. The portable meters are used by the testing department, meter department and repair shop for all testing. The meter department handles all of the meters on customers' premises. As standards they have both indicating and recording meters for direct and 60-cycle alternating currents. The repair shop repairs and adjusts arc lamps, tests and repairs transformers used on the distributing circuits, and maintains the station electrical machinery and companies motors. The testing department makes miscellaneous tests on every part of the system and equipment, and acceptance tests on all new station machinery.

The standardizing laboratory was laid out for the purpose of keeping all testing instruments in the best possible condition for accurate work, and by means of these portable instruments, keeping the station meters within close limits. The laboratory proper consists of one room 14 ft. x 27 ft. There is also a work-shop 14 ft. x 21 ft. In the work-shop all of the repair work and coil winding are done. This room contains a work-bench fitted with a vise, coil winder and electric soldering iron. Two circuits are wired to this bench so that rough testing may be done here. The main switchboard for both rooms is in the same room. This switchboard is supplied with direct current from the station storage battery at 115-230 volts, three-wire; 60-cycle, alternating-current, 110-220 volts, three-wire; and 220 volts three-phase; 25-cycle, alternating-current, single-phase and three-phase. By means of the switches and the cord connections on this board, any of these circuits may be connected to any bench in either the shop or laboratory.

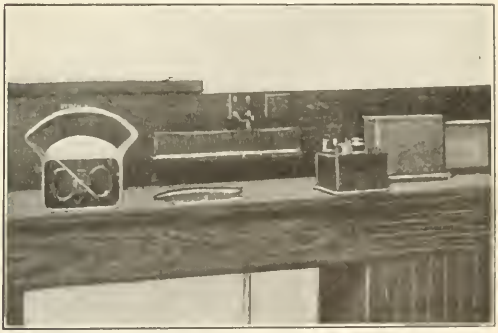


FIG. 2.—VOLTMETER BENCH.

On bench No. 1, in the laboratory (Fig. 2), is a five-point switch and slide resistance. This apparatus may be connected to any of the voltages coming into the laboratory, and by its means voltage variations from a fraction of a volt to 230 volts can be obtained. The switch gives the large changes, and the slide wire the fine graduations. In the same figure is shown a precision wattmeter and resistance, and a station voltmeter in for repairs.

All direct-current instruments are checked against a potentiometer with its accompanying standard resistances. The instrument with its galvanometer and standard cell is shown in Fig. 3. The volt-box used for voltage measurements over 1.5 volts is shown just to the left of the potentiometer. A portable Wheatstone bridge is also shown. For current measurements, a potentiometer is used with a Standard resistance, of which there are three—0.1 ohm, .01 ohm and .001 ohm. With these, currents from 0.5 ampere to 500 amperes may be measured very exactly. These instruments were sent to the Electrical Testing Laboratories for verification before being accepted.

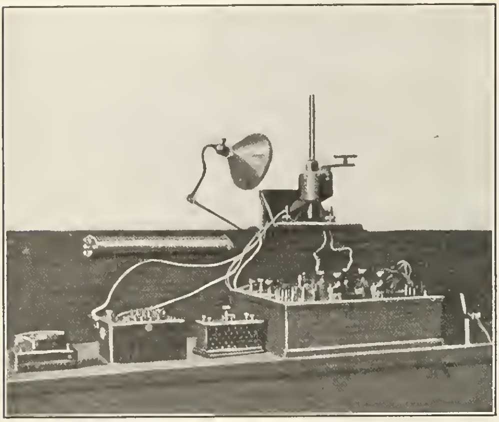


FIG. 3.—POTENTIOMETER.

The precision wattmeter is used for all checks on wattmeters both alternating and direct current. This instrument has coils for 5, 20 and 100 amperes, and may be used on voltages from 15 to 600 volts. While this is an excellent instrument and has always given satisfactory results, it is checked against the potentiometer before any very important work is done with it. This is done so that there may be no question as to the accuracy of the results.

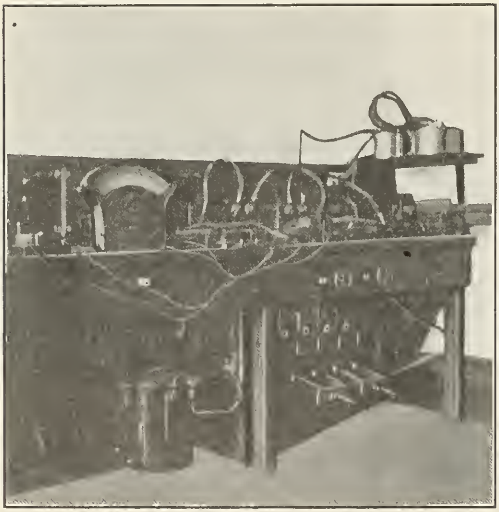


FIG. 4.—HEAVY CURRENT BENCH STAND.

As many of the meters brought in are for heavy currents, one bench is arranged specially for this work. For direct-current work there are six cells of storage battery from which 1000 amperes may be taken for a short time. This battery is arranged with a heavy multi-point switch so that any number of cells, from 1 to 6, may be used. The large switch shown under the bench at the extreme right, Fig. 4, is connected to the battery.

For heavy alternating-current work, the transformer shown at the left of the same figure is used. This transformer may be connected to 25 or 60-cycle circuits, and furnishes current up to 600 amperes. It is connected to the switch just to the left of the direct-current switch for the storage battery. A heavy busbar is run above the bench at the back, and is arranged so that instruments may be connected in series with the source of current. This busbar is connected to the switches under the bench, and is in series with the current-regulating devices. The two handles shown projecting from the front of the bench are on carbon rheostats. These rheostats may be connected in series or parallel by the double-throw switch shown, and with two similar rheostats on the bench are used to take care of currents up to 200 amperes. When greater currents than this are necessary, a strap is clamped on a set of iron strips connected in parallel with the carbon rheostats. By varying the length of the strips, rough current variations are obtained, and the carbon rheostats give the fine graduations. On this bench, meters from 5 amperes to 1000 amperes direct current and 5 amperes to 500 amperes alternating current have been checked. On any meter the current is easily adjusted to any required value.

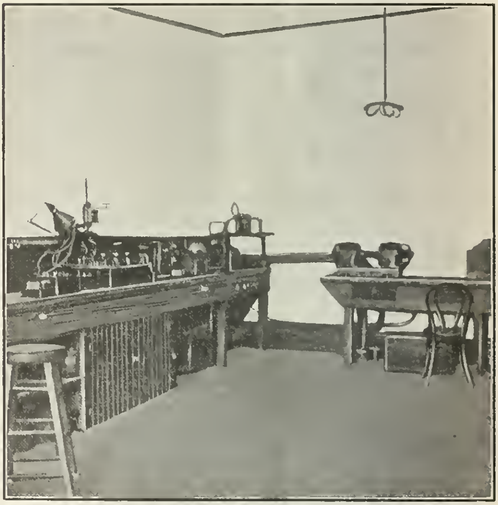


FIG. 5.—POTENTIOMETER AND STANDARD RESISTANCES, AND MOTOR GENERATOR.

In order to keep down the effect of stray magnetic fields, all of the apparatus for heavy currents is arranged in one corner of the laboratory, and indicating meters are kept as far as possible from the current-carrying leads. When making checks, heating errors are constantly watched for, and, if apparent, their magnitude is determined. In many cases considerable time must be given the apparatus to cool between readings. Fig. 4 shows a large station ammeter and shunt connected in circuit ready for checking against the standard ammeter.

A motor-generator set, shown at the end of the room, Fig. 5, furnishes means for obtaining very steady current for checking direct-current voltmeters. The motor of this set, which is of ½ horse-power, is run from the same storage battery which supplies the current for ammeter checks. The motor is wound for 10 volts, and will run at greatly reduced speed on four volts; consequently, by changing the number of cells connected to the motor, four different speeds may be obtained. The generator is wound to give 600 volts maximum. The field current for the generator is supplied from the battery which drives the motor. A slide resistance, shown to the left of the potentiometer at the back of the bench in Fig. 3, is in series with the generator field. By means of this resistance and changes in speed, the voltage of the generator may be changed by almost imperceptible steps from 20 volts to 600 volts. Two sets of binding posts are connected to the generator, one set for the potentiometer or standard meter, and the other set for the meter on test. If the brushes and commutators are kept in good shape, the results obtained by this arrangement are all that could be wished for on the class of work for which the set is used.

A 10,000-volt testing transformer is used for making tests on insulation cloths, tapes, etc. One very simple but useful piece of apparatus is a leveling board. This board was necessary because the testing benches, which were very carefully leveled when made, have warped slightly, and it is essential that many meters be level when in use. This board is made with a horizontal surface for portable meters, and a vertical surface carefully made to be perpendicular to the base, each surface being about 16 in. square. When the base is made level by means of its leveling screws, the back is vertical, and any meter properly placed on the base or back piece is leveled ready for testing. The board is made portable, for it is often handy to be able to move a meter around when working on it.

For testing alternating-current meters in their place on the switchboard, a small transformer has been constructed with a low-voltage secondary. This is arranged on a base with two small carbon rheostats and a plug switch. The dimensions are 10 in. x 10 in. x 4½ in. for the whole device, and it weighs 11 lb. The transformer has a ratio of about 100:7, and may be used on either 110 or 220 volts, 25- or 60-cycle. With 110 volts primary it gives about eight volts on the secondary. This device is made for five amperes, secondary, and has ample capacity for six single-phase meters, if the connecting wires are made reasonably short. As practically all of the station meters are used with current transformers and wound for five amperes, secondary, the little testing transformer is the only loading device needed in alternating-current ammeter and wattmeter work. Of course, when the transformer is used on wattmeters, the effective power-factor of the wattmeter circuit is not unity, and varies with each adjustment of the secondary circuit; this arrangement is thus not used for exact work in the laboratory. It has been found, however, that the station wattmeters, both indicating and recording, when calibrated by this method will check on a non-inductive load, such as lamps. If anything, the lower power-factor is an advantage in station work, for the power-factor on a commercial load is never unity.

For tests on meters with current transformers connected, and for measuring the output of generators on acceptance tests, a portable polyphase meter is used with current transformers. For exact results, the meter reading is corrected from a curve obtained by checking against the precision wattmeter in the laboratory. The meter, with its transformers, gives results within 1 per cent if used above one-third of the scale reading, and for ordinary work no correction is applied.

A record is kept of every meter worked on. This record shows the size, kind and style of meter, the circuit used on, and the work done on the meter. If a meter cannot be made correct throughout its whole scale, a correction curve is supplied, and a copy of the curve is kept with the other data of the meter. This record is very useful, for the whole history, with all previous checks and repairs, is always at hand.

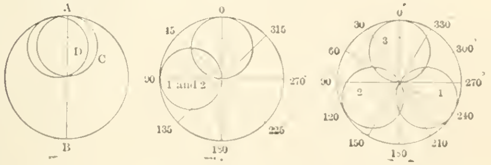
In the year 1907, out of 371 indicating meters rebuilt, repaired or calibrated, only 1.3 per cent had to be sent to the factory for repairs. When it is remembered that a very long time is required for a meter to return from the factory, generally more than a month, it may be seen that the laboratory is a great convenience, for ordinarily a meter is not in the laboratory over two days, and in case of slight repairs, only a few hours.

Physical Theory of Power Factor Meter and Synchroscope.

By A. R. Dennington.

The following treatment of the action of the power factor meter, or phase-angle meter, and the synchroscope is an analysis of the field relations which produce the deflections of the pointers, considered from the standpoint of directional tendencies.

In order to aid in analyzing the relations of currents and fields at different parts of a cycle, the diagrams shown below may be used. In Fig. 1 consider the diameter *A B* to rotate about the center of the large circle; the portion included by the small circle will represent in magnitude the time-value of the current or e.m.f. which is being considered. The positive values may be considered to be those cut from the radius bearing the arrow head, while the negative values may be taken as those cut from the opposite radius. If both current and e.m.f. are being considered it is only necessary to draw another small circle *D*, having an angular space displacement from *C* equal to the time angle of lag or lead. In case the current lags in time behind the e.m.f. the circle *D* or current circle will be placed to the left of the e.m.f. circle *C*, and if the current leads *D* will be at the right of *C*, considering a counter clockwise direction of rotation. Fig. 2 shows the arrangement for a two-phase system, and Fig. 3 the arrangement for three-phase circuits.



FIGS. 1, 2 AND 3.—TIME-VALUE RELATIONS IN ONE, TWO AND THREE PHASE CIRCUITS.

With these circular diagrams we shall trace the action of a power factor meter through one-half cycle.

THE POWER FACTOR METER.

The principle on which a power factor meter operates is essentially the same as that of a wattmeter. Consider the action of two wattmeters having their series coils in two different lines and their shunt coils connected between these lines and the third wire in a three-phase system; the true power is given by the sum of the readings. If the load is balanced and the power factor unity, the readings of the two meters will be equal. Instead of having two shunt coils in the two instruments, the two series coils may be arranged to act on a single shunt coil, and the same angular space relation will be maintained by placing the current in the second series coil at an angle of 120 time degrees with the first. The method of obtaining the electrical angular relations mentioned is illustrated graphically in Fig. 4. The relations of current and e.m.f. in a three-phase circuit are indicated by the full lines. If connections to the coil which

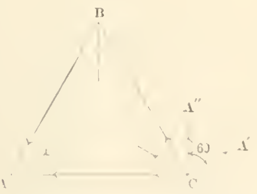


FIG. 4.—RELATION OF MAGNETIC FIELDS.

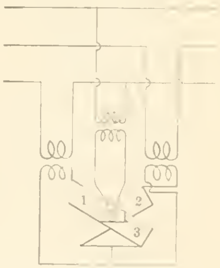
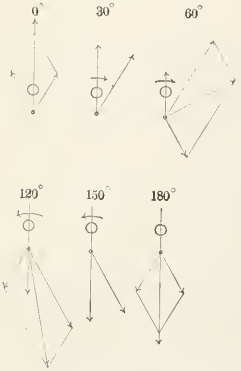


FIG. 5.—CONNECTIONS FOR THREE-PHASE POWER FACTOR METER.

carries current A be reversed and the coil be mechanically placed so as to act on shunt coil BC, the time phase relations indicated by CA' would be produced. If, instead of the reversal of current, which is equivalent to the reversal of the coil, the coil is made to have an angular displacement of 120 space degrees; with the coil-carrying current C it will have a time-phase relation with respect to pressure coil BC, as indicated by CA''. The coil-carrying current C and that carrying current A will then have equal and opposite effects on the pressure coil, which will have no tendency to move as long as the time-phase relations remain unchanged and the currents are equal.



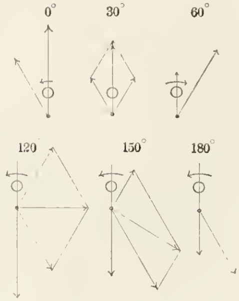
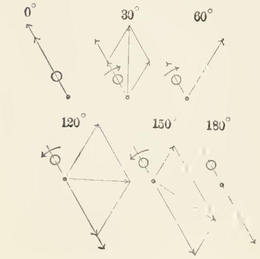


FIG. 6.—ROTATIONAL TENDENCIES AT UNITY POWER FACTOR. FIG. 7.—ROTATIONAL TENDENCIES, 30 DEG. LAG.

With the arrangement and connections of the coils, shown in Fig. 5, the forces acting on the movable element at each angle of 30 time degrees throughout one-half cycle are given in Fig. 6 for unity power factor. When the current in movable coil 3 has its maximum value the currents in coils 1 and 2 are equal and opposite, so that the resultant field will coincide with that of 3, as indicated by the diagram marked 0°. When the cycle has advanced 30 time-degrees the relations of the fields will be as shown. There is a tendency for the movable coil to be rotated in a clockwise direction, as indicated by the arrow. At 60 time-degrees there is a greater tendency for rotation, but from this point on the tendency will decrease until at 90 time-degrees it is zero. There is then a rotational tendency in the opposite direction, which continues with varying intensity, as illustrated, until at 180 time-degrees the torque is again zero. The same action will be carried on throughout the other half-cycle, with the result that the movable coil will remain stationary.



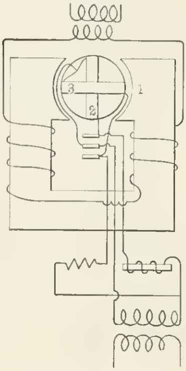
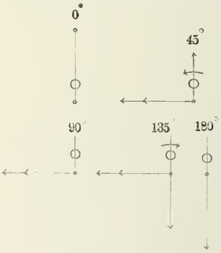


FIG. 8.—ROTATIONAL TENDENCIES, 30 DEG. LAG. MOVABLE COIL 30 DEG. FROM INITIAL POSITION. FIG. 9.—CONNECTIONS FOR SYNCHROSCOPE.

Fig. 7 shows the rotational tendencies when the current lags 30 time-degrees behind the e.m.f. The movable coil is assumed in the same position as in Fig. 6. An inspection of the figures shows that there is an unbalanced tendency for the coil to rotate in a counter clockwise direction. If the coil is assumed to move to a position 30 space-degrees from its original position the turning will be as represented in Fig. 8, which shows that there would be no further rotation.

Thus far the effect of distortion of the current and e.m.f. waves has not been considered. An examination of Fig. 3 will show that, if the e.m.f. and current waves have their maximum values at the same instant, there can be no deflection of the pointer, because the same relative conditions exist at all parts of the cycle as existed with a sine wave. However, if the e.m.f. and current waves are dissimilar the pointer tends to take up a space position indicating the time angle between the maximum values of the curves, unless one of the curves has two maximum values symmetrically located with respect to the maximum of the other. With e.m.f. and current curves, as shown in Fig. 11, the pointer would indicate a space angle somewhat less than the actual time-phase angle between the maximum e.m.f. and current ordinates. The actual power delivered under the conditions assumed will also be somewhat less than would be indicated by the product of the effective values of current and e.m.f. The sum of the products of the instantaneous values of current and pressure is greatest when the small ordinates of pressure are multiplied by the small ordinates of current, and the maximum values of current and pressure are also multiplied together. The tendency of the instrument will then be to indicate an angle, the cosine of which will represent closely the correction factor necessary to take account of the wave distortion.



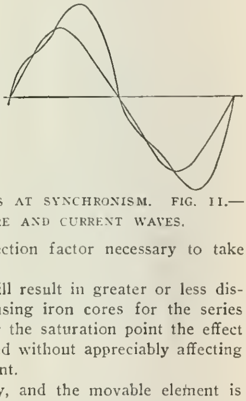


FIG. 10.—ROTATIONAL TENDENCIES AT SYNCHRONISM. FIG. 11.—UNSYMMETRICAL PRESSURE AND CURRENT WAVES.

Unbalancing of the system will result in greater or less discrepancy in the reading. By using iron cores for the series coils and magnetizing them near the saturation point the effect of unbalancing may be decreased without appreciably affecting the sensitiveness of the instrument.

If all the coils are stationary, and the movable element is made up of an iron vane, it is evident that the vane will tend to take up a position depending on the resultant of the three fields. If the field shifts symmetrically back and forth, as indicated in Fig. 6, the pointer will remain in a vertical position. If the field does not shift symmetrically the pointer will move until the vane reaches a position giving no further torque. In Fig. 7 the ultimate position of the vane would be at an angle less than 30 space-degrees, because of the effect of the field set up by the shunt coil. If this field is made weak, in comparison to the others, the deflection may be increased to more nearly the correct value, but there must always be sufficient magnetizing force in the pressure coil to prevent rotation.

THE SYNCHROSCOPE.

In the synchroscope a rotating field is obtained by the relations of two fields of varying frequency. When the frequency becomes the same the rotational force is no longer present and the pointer becomes stationary.

Fig. 9 shows the essential elements of this instrument. The main fields are excited from the busbars through a shunt transformer, and the two coils on the movable element are excited from the incoming machine. In order to get a phase difference as nearly as possible equal to 90 time-degrees a reactance is connected in series, with one coil and resistance in series with the other. At synchronism the field set up by coil 2 coincides with the main field. The rotational tendencies under these conditions are shown for a half-cycle in Fig. 10.

At the position marked 0° the currents in coils 1 and 2 have zero values, so that there is no tendency for the pointer to move. At 45 time-degrees there is a tendency for counter-clockwise rotation, but at 90 time-degrees this has dropped to zero; at 135 time-degrees the torque is in a reverse direction, while at 180 time-degrees it has again dropped to zero. The net turning moment for each half-cycle is zero, so the pointer will remain stationary in a vertical position, being kept in this position by the action of the directional field 2.

If the frequency of the incoming machine is higher than that of the busbars, the field set up by the movable coil is successively in advance of the positions shown in Fig. 10 and the result is a rotational tendency in a clockwise direction. If the incoming machine has a lower frequency than that of the busbars the rotation will be in the opposite direction, because the resultant field of the movable coils will be successively behind the positions shown in Fig. 10.

New Telephone Patents.

MULTIPLE SWITCHBOARD CIRCUIT.

Common battery switchboard circuits are usually so designed that multiple strand connecting cords and multiple part plugs are required. In some instances a single strand serves all talking purposes, but one or more strands in such cases have been necessary in addition for signaling purposes. E. J. Burke, of Brooklyn, N. Y., has now obtained a patent for a system using a cord with but a single strand. This strand carries talking current only. The calling line lamp serves in the dual capacity of calling and supervisory lamp. When serving the former purpose, it is energized by an intermittent current giving a flashing. For disconnection it responds to a steady flow of current. A single key-board lamp gives supervision over the called line.

TELEPHONE DICTATING SYSTEM.

There have been several recent patents pertaining to telephone dictating systems. With these it is proposed to accomplish dictation to any one of a group of stenographers without the necessity of their leaving their places. J. W. Kelly, Jr., of Camden, N. J., has recently obtained a patent for such a system, embodying in addition the means of intercommunication between the various dictating stations.

MAGNETO GENERATOR.

Harry Tideman, of Menominee, Mich., has invented a combination hand generator for producing current for a great variety of possible demands. Through a cleverly constructed commutator device coupled with collector rings, there may be obtained alternating current, direct current, either positive or negative impulses with the generator short circuited during the inactive period, or impulses with the generator circuit open during this period.

PARTY-LINE SWITCH.

There have been brought out heretofore several different systems of party-line working upon the group plan. A number of stations are given individual lines to a convenient common point from which a trunk line extends to the exchange. A switch located at this common point controls the connection of the various branches to the trunk.

Mr. E. W. Smith, of New York City, has patented a switch for such a system when the branch lines do not exceed four. Each branch is led through an electromagnet of the switch. These various magnets are spaced about the switch arm, and this arm is permitted motion toward any one of them. When the receiver at any branch is lifted, the magnet corresponding is energized and the switch arm is deflected and opens the circuits of all other branches.

C. W. Underwood has obtained a patent for an improvement on repeaters. He uses the usual telephone microphone principle, but finds that if he supports his moving system upon steel wires given considerable longitudinal stress, the instrument is increased in sensitiveness. The supporting wires cross the line of motion of the armature at right angles, and they are made taut with straining screws. It is probable that such an arrangement brings the natural periodicity of the moving system up near that of the voice currents.

PROTECTOR AND SWITCH.

Mr. A. N. Wright, of Jackson Center, Ohio, has invented a telephone protector of the plug switch type, with an open space cut-out feature. The base plate carries bars with plug switch sockets to cut the station out of circuit. Between the bars a ground strip is run so as to afford a sparking path to ground. The switch is merely a variation in detail of the old protector common on telephone boxes a few years ago.

NEW RECEIVER.

The earliest telephones employed a non-magnetic diaphragm driven by an armature attached to it. However, such instruments have been little known since the introduction of the magnetic diaphragm which combines armature and diaphragm in one. Recently, however, H. G. Pope, of New York City, has invented a receiver with the armature and diaphragm separated. Fig. 1 shows a part section of such an instrument. The coil is enclosed in a magnetic shell and thus both pole and core are presented to the armature. A rod passing through a hole in the core drives the diaphragm.

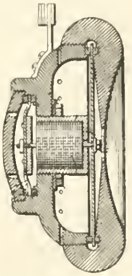


FIG. 1.—POPE RECEIVER.

SWITCHBOARD CIRCUIT.

In Fig. 2 is shown a switchboard circuit system for common-battery working, patented by W. A. Fricke, of Chicago, and assigned by him to the Monarch Telephone Manufacturing Company. It will be noted that during conversation all current for the subscriber's line passes successively through the line relay, supervisory relay and cut-off relay in series. When the circuit is opened at the hook switch, all become de-energized, but the cut-off relay becomes immediately re-energized from the supervisory lamp circuit.

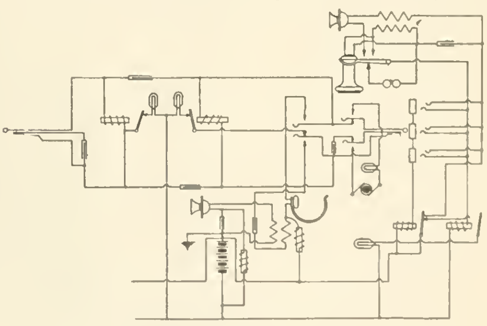


FIG. 2.—FRICKE SWITCHBOARD CIRCUIT.

LETTERS TO THE EDITORS.

Directive System of Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—I have read with much interest the article by Messrs. E. Bellini and A. Tosi, in your issue of Dec. 21, 1907, on "A Directive System of Wireless Telegraphy," and also the editorial commenting thereon. It would, however, have been well if the values of the intensity in the diagrams of Figs. 9 and 10 were given in microamperes, since the results would then be comparative with the investigations of others. Referring to the editorial in your issue Oct. 26 on "Received Energy in Wireless Telegraphy" it is very desirable to make measurements of received current as far from the transmitter as possible. With my barretter, which was described in your issue dated June 30, 1906, it is possible to measure microamperes with the aid of pointer galvanometers, and over a distance of more than 100 kilometers. I believe Messrs. E. Bellini and A. Tosi have made measurements in this instance also, and it would be very interesting to learn the results they obtained.

BUDAPEST, HUNGARY. BÉLA GÁTI.

Does the Inventor Get a Square Deal at the Hands of the United States Government?

To the Editors of Electrical World:

SIRS:—The interesting article by Mr. H. Ward Leonard on this subject in your issue of March 14 is convincing because Mr. Leonard states facts and speaks from experience.

The question is a difficult one to answer. If we look over the technical literature of the past 30 years or more, we find repeated complaints by inventors regarding the defective patent laws and insufficient protection, yet the same conditions prevail to-day. What is the cause of this state of affairs? Is it the fault of the government or of the inventor? What are the methods used by the inventor to obtain the desired legislation? Has he done anything himself to remedy this trouble further than writing articles in technical journals?

Perhaps we may be able to learn a lesson by investigating the methods used by others who have succeeded in righting wrongs. In Colonial times the complaints of the colonists made at the British Court availed them nothing. It was necessary that they realized the importance of their own ego. This accomplished, they joined hands in the common cause and created a government "of the people," "for the people," "by the people." When capital became oppressive, labor, after long suffering, became conscious of its own importance. It organized, caused the making of more equitable laws and influenced public sentiment in its favor. How about the inventor? Has he realized his ego? It is a fact that as a rule he is absorbed in invention and neglects the most important duty—self-protection. He hopes for large returns from his labors and his inventions, but experience shows that others reap this harvest.

Mr. Leonard speaks of the Constitution and points out defective conditions in our social fabric. This Constitution was written by the representatives of the people for the people. Does this not mean that the government cannot take cognizance of individual cases, but will take care of the "people's" case?

We notice that improvements in patent laws have been introduced in the House of Congress by the American Bar Association, whose members count, no doubt, into the thousands. They are endeavoring, *from their viewpoint*, to make improvements and will doubtless be successful, because they form a "self" exerting body. The inventor's activity has consisted in sporadically making an outcry of injustice done him. Does anyone know how many inventors there are in the United States? Are they counted by the hundreds or thousands? How can the government know from these individual utterances whether or not they actually represent the thought and suffering of a large class of its citizens? When the anthracite coal strike came before the people and the government no one was in doubt as to the approximate number of souls involved in the struggle. It was evidently a people's cause and the government took it promptly in hand.

Have the inventors of the United States ever got out of their lethargy? Not yet. It would be to their advantage if they did. If they would unite in a national society for their mutual protection and betterment, they would be surprised to see how quickly adequate laws suited to their needs would be enacted.

Let us look for a moment at the commercial side of this question. Under the present laws an inventor of Edison's capacity loses during his lifetime a million dollars, at least. Other inventors of smaller capacity, but just as meritorious in their way, have lost from $50,000 to $250,000. The majority of inventors get initiated into commercial life by losses varying from $500 to $20,000. In this latter category belong also authors and composers. The latter sees his works used by the automatic musical instrument makers without recognition or compensation. However, they have an organization with headquarters in Pittsburg, and their grievance will doubtless be speedily adjusted.

The manufacturer, especially the electrical manufacturer, carries on his books a special fund of from $3,000 to $15,000 to cover legal attacks upon his firm, which he knows may come even though he does not deserve them. The policy of some large corporations is to "manufacture" patents for the purpose of crushing or discouraging small producers, by suing under the apparent right of such patent that had no justification for existence in the first place. Should the court comprehend the technical truth involved (which sometimes, but rarely, happens) after a litigation extending over a number of years, the legal expenses imposed on the small manufacturer are not compensated, but remain his loss.

Under such conditions would not the individual inventor fare a great deal better by joining in a common cause, even if the necessary expenses might involve a yearly fee of from $5 to $10, or even more? What can not an organized band of intelligent men accomplish? Look at the example of the 300 Spartans at Thermopylæ—at the signers of the Declaration of Independence! In each case but a handful of men. The inventor, instead of exerting himself, hopes for a *deus ex machina* to perform a miracle for his special benefit. To succeed, it becomes necessary to show our government that the inventors are a large body of men in sympathy with this movement. Better patent laws and business methods on a higher moral plane may be the result of the united efforts of an organization of American inventors.

ST. LOUIS, MO. LUDWIG GUTMANN.

To the Editors of Electrical World:

SIRS:—I read with great pleasure the article by Mr. H. Ward Leonard, in your issue of March 14 entitled, "Does the Inventor Get a Square Deal at the Hands of the United States Government?" and believe that hosts of inventors will agree with the author's ideas. I wish, however, to call attention to some other points relating to the same subject on which Mr. Leonard does not touch.

United States letters patent do not show whether the patentee or assignee has any real right to manufacture the article patented. While the features of the invention, which are covered more or less broadly by the claims, are protected, as a rule there are many details, and even parts of the invention, which are not claimed. It is very important to know the status of these as they may seriously interfere with other patents. Usually, however, it is impossible to learn this from the patent specification, or even after examining all of the correspondence of the patent attorney with the Patent Office. There may be considerable controversy over particular claims; sometimes the examiners yield, and sometimes the inventor has to cancel or modify some claims, with the result that he is wholly uncertain whether he can manufacture the thing or not, even if he obtains finally a patent with a couple dozens of claims. In European countries a patent covers the whole scope of the invention as it is set forth in drawings and specifications, and gives unquestionable rights to make the whole device or apparatus, although usually one claim is considered sufficient for the patent. If, however, the invention interferes in its main part with some other invention, but has nevertheless some patentable features, then there is issued a subordinate patent which cannot be worked independently.

There appears to be some misunderstanding as to the relative value of claims. An inventor may get very broad claims and then find that other inventors have been granted patents on similar inventions, but with limited claims, although involving the same principle. On the other hand, an inventor may be allowed claims so broad as to cover more than he actually invented. There is also danger in laying too much stress in the value of wording of claims, as pointed out by Mr. H. Ward Leonard. Simple and apparently unimportant words may sometimes invalidate the value of a patent.

I fully agree with Mr. Leonard that the present patent system, while originally intended to benefit the inventor, now works in the interest of the manufacturer for the following reasons: First, because it is easy to contain a patent claiming unimportant changes and details; second, because the interference proceedings are unjustly troublesome and expensive. Owing to the present patent situation manufacturers can safely disregard the rights of inventors, boldly using their inventions, and obtain patents for unessential modifications.

Evansville, Ind. J. Nikonow.

Why Wooden Poles Break Above Ground.

To the Editors of Electrical World:

Sirs:—Following the lines of Mr. C. B. Smith's article on the above subject in your issue of Feb. 29, 1908, if certain assumptions are made, the selection of a pole for a given load (horizontal and concentrated at the end) depends only on the diameter at the top, and is independent of the height. These assumptions are as follows:

A uniform taper for all poles, determined by the growth of the tree itself, and taken as 1/90 in. on a diameter per inch of height. A maximum compressive stress in the outer fiber of 900 lb. per square inch, which is about one-sixth of the ultimate for chestnut or cedar, the compressive strength of wood being less than its tensile.

Using Mr. Smith's notation, the equation

$$f = \frac{F}{.0982} \frac{x}{(d + tx)^3} \tag{1}$$

has a maximum value of

$$f^1 = \frac{1.51\,F}{td^2} \tag{2}$$

when

$$x = \frac{d}{2t} \tag{3}$$

Substituting in (2) $f^1 = 900$, $t = 1/90$ and solving for d there results

$$d = .388\sqrt{F} \tag{4}$$

and in (3) $t = 1/90$ there results

$$x = 45d \tag{5}$$

Thus from (4) a pole for a load of 425 lb. should be 8 in. across the top; and from (5) the danger section or the place where it would fail is 30 ft. from the top, if this were at or above ground, and at the ground if below it.

It is interesting to consider the stresses graphically. In Fig. 1 B is the contour of this pole drawn to unequal horizontal and vertical scales, and curve f_b the unit fiber stress at points along the pole. Its equation is

$$f = \frac{4320x}{\left(8 + \frac{x}{90}\right)^3}$$

having a maximum of 900 lb. at $x = 360$ in. $= 30$ ft. Contour A is that for the ideal pole; and f_a the corresponding curve of fiber stress, which is uniform and equal to 900 lb. Contour A is obtained from Mr. Smith's equation

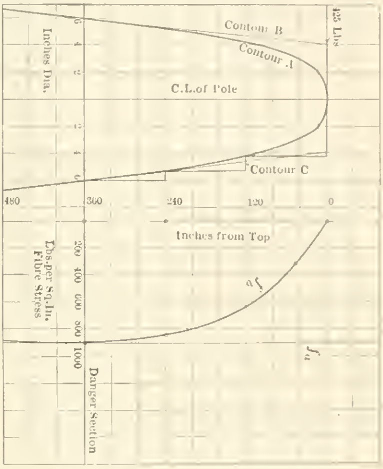
$$Fx = .0982 d_x^3 f$$

by substituting $f = 900$, $F = 425$ and solving for x

$$x = .208 d_x^3$$

It is a cubic parabola lying wholly within B and tangent to it at the danger section. This section is located at a distance from the top $x = \frac{d}{2t}$ or at a distance as determined by the taper such that the diameter at this section is 3/2 that at the top.

All the material between contours B and A is wasted, and contributes nothing to the strength of the pole. From this it is evident that a sectional cylindrical pole will contain the least material if its contour approximates that of A by steps, as for contour C.



CONTOURS AND STRESSES IN POLE.

Some of the above statements are also given by Mr. W. T. Ryan in the issue referred to.

Philadelphia, Pa Carl P. Nachod.

Synchronous Generators in Switzerland.

To the Editors of Electrical World:

Sirs:—In connection with Mr. W. L. Walker's interesting paper presented at the meeting of the A. I. E. E., held on Feb. 14, I wish to call the attention of your readers to the electrical plants of the Rheintalische Binnenkanal, in Switzerland, which are, so far as I know, the only ones of some importance utilizing synchronous generators in Europe. In your Digest of Dec. 7, 1907, a mention of these plants occurs.

There are three central stations separated by a distance of about three miles and operating in parallel. Two of them are equipped each with two three-phase induction generators and the third one with three synchronous generators which produce a current of 10,000 volts and 50 cycles. The total turbine power available is 1750 horse-power (7 × 250 horse-power). Only the three turbines driving the synchronous generators have regulators in service. It should be noted that the distributing system does not supply energy to synchronous motors and has a power factor of only 0.8.

The plants have been in regular service more than two years, and operate in a very satisfactory manner. The simplicity with which these machines can be thrown in parallel is especially appreciated. All of the practical special measures, made in this case with respect to parallel operation, current distribution, etc., are in conformity with the theoretical provisions. The Maschinenfabrik Oerlikon designed and installed all the electrical part of the above stations and is at present equipping two more plants with synchronous generators.

Zurich, Switzerland. M. Yazidjian.

Looping vs. Cutting Theories of Electromagnetic Induction.

To the Editors of Electrical World:

Sirs:—I have read with the greatest interest Mr. Carl Hering's very valuable article on the "Loop vs. the Cutting Lines of Force Laws" in your issue of March 14. I concur very heartily in the opinion which he appears to hold, that the cutting conception is more fundamental than the linking one.

The very ingenious experiment, illustrated by the figure on page 559, does not, however, it seems to me, necessarily furnish an instance of the breaking down of the loop law. In that experiment it is *assumed* that the circuit through the massive conductor *C* follows the straight line joining the contacts *B B*. A very critical reader might ask for a statement of grounds justifying that assumption. Presumably the circuit is to be taken as the path followed by the current; if a current flows in the massive conductor between *B B* it spreads out, flowing in a set of stream lines (or, more correctly, stream tubes) between the contacts *B B*. As long as the conductor is at rest, the straight line joining *B B* is the central one of such stream lines, and as such may presumably be taken as representing the part of the circuit within the conductor. But just as soon as the conductor *C* begins to move, the stream lines will be deflected outward (or inward), since the self-induction of the circuit makes the current tend to continue in the same path, *relatively to the material of the conductor.* During motion, therefore, it would seem that the straight line joining *B B* could no longer be taken as the path of the circuit, and the result is that the magnetic flux linked with the circuit does in fact increase (or decrease) when the conductor moves, and does not, as appears at first, remain constant.

University of State of Florida. J. R. Benton.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Train-Lighting Dynamo.—S. Iglesis.—An illustrated description of a dynamo of Iglesis and Regner giving constant current at variable speed. It is specially adapted for lighting trains and automobiles. It has only two brushes and is said to be of very robust construction. The special feature is the use of a movable primary frame which "balances the electromagnetic reactions." The primary frame is mounted in two bearings and has a particularly unsymmetrical form. The brushes are fixed. When the dynamo is running and generates current the frame is moved by electromagnetic reaction so as to assume in space successive positions according to the speed in such a way that "the couple corresponding to the electromagnetic reactions balances the couple due to gravity."—*La Lumière Elec.*, Feb. 29.

Commutation.—R. Goldschmidt.—A reply to the recent letter of Menges concerning the question why the covering of open slots with thin iron pieces does not affect the commutation. Menges thinks the reason is that the ordinary theory of commutation is wrong. Goldschmidt, on the other hand, thinks the reason is that the iron becomes highly saturated provided it is thin enough. The fact is that if the iron is too thick it is harmful.—Lond. *Elec.*, March 6. Menges in his reply maintains his original position.—Lond. *Elec.*, March 13.

Commutation.—A. Press.—A note with reference to Goldschmidt's method of covering open slots with thin pieces of iron. The writer has made some experiments with copper strips placed over open slots to improve the commutation. He makes some further suggestions on Goldschmidt's method.—*Elek. Zeit.*, March 5.

Brush Gear for Turbo-Generators.—An illustrated description of a pneumatic brush gear used by a British company for direct-current turbo-generators. It admits of the use of a smooth cylindrical commutator and the use of carbon brushes. —Lond. *Elec.*, March 6.

Lamps and Lighting.

Free Lamp Renewal.—H. N. Muller.—A discussion of "poor light" complaints from the standpoint of the central-station manager. Such complaints are generally due to four causes. First, to an exaggerated idea of the proper illuminating value of the units used by the customer; second, to an unfavorable location of lamps, fixtures and surroundings; third, to low voltage; and fourth, to old and inefficient lamps. The last cause is at the bottom of most complaints, and the company with which the author is connected found that the free installation and renewal of the lamps was an effective remedy which justified the great outlay. The system used by the company is based on the following principle: Assuming a 50-watt 16-cp lamp to have a useful life of 600 hours, one 16-cp or two 8-cp lamps would be issued for every 30 kw-hours billed. This would make it optional with the customer as to which lamps to renew. Another plan, followed by lighting companies in other parts of the country, is to provide each customer with a certain percentage of his installation in spare lamps, thus enabling him to replace any burned-out or unsatisfactory lamps, the old lamps in turn being placed in a box and called for at regular periods by the company's representatives. The methods used by his company are described. The principal difficulties met with were due to the great variety of receptacles used and to the different voltages in use and it was found necessary to standardize the receptacles and to standardize the voltage. The author remarks finally that an entirely new situation has been presented by the advent of the high-efficiency metallic-filament lamps and that it is very questionable whether electric-lighting companies will be able to afford free renewals of lamps which will cost 100 per cent more for the same candle-power with one-third the energy consumption and consequently one-third the revenue.—*Elec. Jour.*, March.

Enclosed Flame Arc Lamp.—With respect to the Jandus regenerative enclosed flame arc lamp recently described in the Digest, a British patent of Jones is interesting since it gives the composition of the paste inserted in the grooves of the positive electrode. It is a mixture of two parts of calcium fluoride (which alone would give the arc a whitish-yellow color) and two parts of calcium tungstate (which alone would give the arc a purple-white color). One part of sodium tungstate or potassium sulphate is added to steady the arc. The mixture is formed into a paste with a suitable binder, such as dextrine solution, and laid in the grooves of the positive carbon. The resultant light from the arc is of a brilliant yellow color, and the color and brilliancy are maintained, although the arc is enclosed.—Lond. *Elec. Eng'ing,* March 5.

Tantalum Lamps for Alternating Current.—A note states that tantalum lamps, specially made for alternating-current circuits, are now available in England. All the lamps from 50 to 75 volts, which range in sizes from 12 to 32 candle-power, are available for alternating currents, as are also the 100 to 130-volt, 25-cp lamps and the 32- and 50-cp lamps for 100 to 160 volts. The 16-cp lamp for from 100 to 120 volts of the same specific consumption, namely, 1.7 watts per British candle-power, is recommended only for direct current, but a 16-cp lamp for slightly higher consumption (2.2 watts per candle-power) is available for alternating current at these voltages.

Another size which is at present available only for direct current is that for 25 candle-power at from 140 to 160 volts. Better results are, as a rule, obtained on 50-cycle circuits than on those of higher frequency.—Lond. *Elec. Eng'ing,* March 5.

Double-Metal Filament Lamps.—A note on a recent British patent of Siemens & Halske Company. A tantalum filament is drawn through a solution of plastic mass consisting of a chemical compound of another difficultly fusible metal; for instance, tungsten. The coating thus obtained is reduced in an atmosphere of hydrogen by passing the coated filament through a tube, which is heated by an electric current, and through which hydrogen is passing. The coating is thus reduced to a metallic skin and the final filament combines to a certain degree the favorable properties of both metals.—Lond. *Elec. Eng'ing,* March 5.

Power.

Flame-Proof Motor for Mines.—One of the difficulties in using electric motors in mines is due to the danger of explosion from electric sparks if the mine happens to become "fiery." The employment of "gas-tight" motors has not proven satisfactory. The Felten & Guilleaume-Lahmeyer Company has developed a half-enclosed machine which is protected on the principle of the Davy safety lamp. The design permits the motor to be ventilated, and fans are attached to the shaft to supplement the natural ventilation. Any explosion inside the gas is prevented from passing outward by means of screens. Various constructions were tried, but the "laminiform" protector has proved the most satisfactory. It consists of a number of hollow circular or rectangular metal sheets built up one above the other with narrow air spaces between them. The sheets should be of brass or other non-rusting metal.—Lond. *Elec.,* March 13.

Centrifugal Pumps.—A. Bazillac.—An article on high-tension centrifugal pumps. The author considers Rateau to be the originator of the present system. Some results obtained in practice are given.—*La Lumière Elec.,* Feb. 22.

Suction Gas Plant.—An account of a recent test of a small 15-hp suction gas-producer plant under ordinary working conditions. The results, which are given in a table, are quite satisfactory.—*Eng'ing Record,* March 28.

Traction.

Controller for Single-Phase Railways.—C. Kraemer.—An illustrated article on two systems of control developed by the Felten & Guilleaume-Lahmeyer Company for single-phase railways. In the first system the mechanism is actuated by compressed air, in the second it is purely electromagnetic.—*Elek. Zeit.,* March 5.

London Subway.—An illustrated article on the progress which has been made with the extension to the Kingsway tramway subway which is soon to be opened. Most of the new subway is double-track tunnel, but a short length is composed of separate tubes for each track. A simpler form of conduit construction is used than in the case of the London County Council surface lines.—Lond. *Elec. Eng'ing,* March 5.

Corrugation of Rails.—A. Manaut.—A résumé of former investigations on this subject with critical remarks.—*La Lumière Elec.,* Feb. 22, March 14.

Installations, Systems and Appliances.

German Central-Station Statistics.—The thirteenth edition of the annual statistical tables of German central stations generating electrical energy for light and power purposes and using public streets. Private plants are considered in these statistics only when they supply energy for public lighting in the same town or to towns in the neighborhood. The tables cover more than 75 full pages, besides a summary, and give statistical figures up to April 1, 1907. All stations in the same town which belong to one company are counted as one plant. During the years 1906 and 1907 a tendency has been manifest to unite several plants in one district into a single plant. It seems that at present there are about 1700 central stations in Germany, although the statistical data in the tables refer to only 1530 stations. The largest plant is that of the Berlin electricity works, comprising several stations, with an aggregate rating of 138,700 kilowatts and, if the Rummelsburg plant is counted in, 150,700 kilowatts. The different electrical systems in use are given in the following table:

	Number of plants.	Rating in kilowatts of— Machines.	Storage batteries.	Total.
Direct-current	1,217	178,169	64,853	243,022
Single-phase and two-phase	41	26,201	115	26,316
Three-phase	129	151,123	1,536	152,659
Single-phase and three-phase	2	975	14	989
Direct-current and single-phase or two-phase	*19	13,828	2,838	16,666
Direct-current and three-phase	116	334,492	58,146	392,638
Direct-current, single-phase and three-phase	*2	25,963	588	26,551
Unknown	2	....	....	....
Total	1,530	730,751	128,090	858,841

Each of the groups marked with an asterisk (*) contains a plant with monocyclic generators. The storage batteries in the alternating-current works are used for excitation or station lighting. The following table shows the kind of prime movers used in the different plants:

	Number of plants.	Kilowatts of machines.
Steam	669	544,581
Water power	161	16,352
Gas or other internal combustion engines	210	25,079
Steam and water power	288	116,088
Steam and gas	53	15,952
Water and gas	86	6,681
Steam, water and gas	27	5,263
Gas and wind	1	10
Electric energy bought in bulk	32	745
Unknown	3	.
Total	1,530	730,751

The above figure for the rating of the machines (transformers or converters) in the works buying electric energy in bulk is too low, since the rating for most of these works is unknown. Concerning the size of the different works the following table gives information:

634 plants have a rating between 0 and 100 kilowatts
625 plants have a rating between 101 and 500 kilowatts
105 plants have a rating between 501 and 1,000 kilowatts
60 plants have a rating between 1,001 and 2,000 kilowatts
37 plants have a rating between 2,001 and 5,000 kilowatts
16 plants have a rating between 5,001 and 10,000 kilowatts
12 plants have a rating above 10,000.
41 unknown.

Total..1,530.

Of all the 1530 plants 1025 are owned either by the State or by municipalities, 501 are owned by private persons or corporations, 4 unknown. The total connections to all plants are as follows:

	Number.	Horse-power.	Kilowatts.
Incandescent lamps, each of 50 watts	[illegible]	......	[illegible]
Arc lamps, each 10 amp or [illegible] watts	[illegible]	....	[illegible]
Electric motors		[illegible]	[illegible]
Total			[illegible]
Total connections, lamps			[illegible]
Total connections, motors			[illegible]
Total			[illegible]

The greatest number of plants opened in any one year was 144 in 1900, while 98 were opened in 1901, 107 in 1902, 122 in 1903, 117 in 1904, 123 in 1905, 117 in 1906 and 28 during the first three months of 1907.—*Elek. Zeit.,* March 12.

Current Rushes at Switching.—J. S. Peck.—When transformers are connected to a circuit, there are at times very heavy rushes of current which are sufficient to open circuit-breakers, although the circuit-breakers may be set for a current much in excess of the full load value. As long as transformers were made solely for high-frequency circuits, rushes of current at switching were practically unknown, and did not become noticeable until lower frequencies, that is, from 25 to 33, came into general use. This was due to the fact that on high-frequency circuits, transformers were seldom worked at inductions higher than 6000 c.g.s. lines per sq. cm, while on 25 cycles inductions of twice this value were adopted. The author shows with the aid of diagrams that when a transformer is connected suddenly to a single-phase line, the maximum flux value obtainable is somewhat less than double the normal, unless there is some residual magnetism, in which event it may be greater or less than twice the normal, also that this maximum is obtained only when the switch is closed at the zero point of the voltage wave. The maximum current which will flow will depend on the permeability of the iron at the high induction and on the ohmic resistance of the windings. With three-phase transformers the same phenomena occur, one phase reaching a higher induction than either of the others. Improvements in methods of ventilation and the introduction of alloyed steel with its low losses make it possible to work now at much higher induction than was thought possible a few years ago, and as permeabilities have not been increased materially, it appears that modern apparatus is more subject to rushes of current at switching than is that of older design. There has been little or no trouble traceable to this current rush at the time of switching, and it has been mainly objectionable on account of the occasional opening of a circuit-breaker. There are, however, two sources of danger: first, to the system, and, second, to the apparatus. The danger to the system is that the heavy current rush may set up surges which produce high voltages on certain parts of the system. On some systems there is also likely to be a sudden drop in voltage at the time of switching, which may give an objectionable wink in the light. The principal danger to the apparatus is that the coils may be distorted or given severe shocks, which often repeated may do serious damage.—*Elec. Jour.*, March.

Emergency Transformer Connection.—M. C. Godbe.—At a mine where some 4000 kilowatts in transformers, designed for 88,000 volts primary and 460 volts secondary, and 3000 horse-power in motors, were being installed, it became necessary to furnish temporary service to some 2300-volt and 460-volt three-phase motors from a 4000-volt, four-wire, three-phase line. It was very important that power be furnished to these motors before the substation and permanent service were complete. Three 250-kw, 2,300 to 460-volt transformers, which were to be used to step up from the switchboard e.m.f. of 460 volts to 2300 volts for some motors operating a mile from the substation, were available and these were temporarily connected, as shown in Fig. 1, to the 4000-volt line from which it was permitted to take a maximum of 300 kilowatts. The primaries of transformers *A* and *B* were connected to the neutral and lines 1 and 2. The secondaries of these transformers were connected in "V" for 460 volts by reversing the secondary of one transformer. For the 2300-volt service three phase power was obtained by connecting the neutral and line 3 for one phase. The low-tension side of transformer *B* was used to excite *C*, the primary of which was connected as shown to give the proper three-phase relation with the phase from neutral to 3. Satisfactory service was furnished in this manner and no trouble was experienced. The e.m.fs. on the 2300-volt motors were not perfectly balanced at full-load, but were not enough out of balance to give the slightest trouble.—*Elec. Jour.*, March.

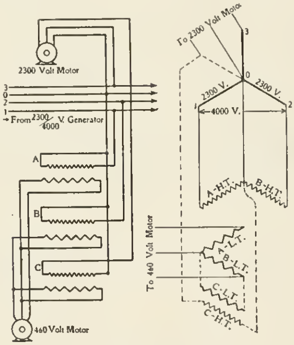


FIG. 1.—DIAGRAM OF CIRCUITS.

Protective Relays.—M. C. Rypinski.—A continuation of his illustrated serial or protective relays, dealing with single-phase and polyphase systems and describing instruments for instantaneous action and for definite time-element action.—*Elec. Jour.*, March.

Carbon-Break Circuit Breakers.—F. W. Harris.—An article giving details of construction of carbon-break circuit breakers, especially concerning the carbons, the carbon arm, nuts and terminals, coils and calibrations, bases and barriers, handles and cross bars.—*Elec. Jour.*, March.

Regulations.—A long and detailed account of the inquiry which is now being held in London before James Swinburne into the objections raised to last year's draft of the Home Office Regulations on the use of electricity.—Lond. *Elec. Eng'ing*, March 5 and 12.

Wires, Wiring and Conduits.

Fuses.—A. Schwartz and W. H. N. James.—The first part of an illustrated paper in which the author discusses at great length the different points which must be considered in choosing the metal for a fuse. Pure metals, such as copper, are preferable to alloys on account of constancy of composition. The melting point of the metal used determines the fire risk, the method of connecting the fuse to the fuse contacts, and the character of the jacket material for enclosing fuses. On low-voltage circuits the resistance of the fuse forms a considerable portion of the total resistance of the circuit and therefore plays a not inconsiderable part in limiting the current rush on short circuit. Some metals are non-oxidizable, while on others a skin or sheath of oxide is formed, which is fluid at the temperature of the fuses of the metal. Both these kinds of metals may be considered in the same class and copper and silver belong to this class. With other oxidizable metals, such as aluminum, zinc, cadmium and tin (especially in the case of small round wires), the oxide sheath may be sufficiently strong to hold all the molten metal until vaporization occurs. Another class is that of oxidizable metals for enclosed fuses in which the oxide sheath is capable of combining with the filling and forming a sheath or tube. This class includes enclosed fuses with silicious fillings capable of combining with the oxide sheath and of forming a containing tube around the arc. The mass of the metal required for a fuse has an effect on the fire risk, the time element and in enclosed fuses on the diameter of the jacket employed. The authors then discuss at length the arcing properties of a fuse. They have studied them in three ways. First, by photographing the fuse itself where blowing; second, by observing the minimum length of break at which on short circuit the character and duration of the arc is such that little or no damage is done to the terminals; thirdly, by oscillograms of the current rush and inductive pressure-rise on short-circuiting the fuse. In considering the "no-arc" length for enclosed fuses, the following properties of the filling have to be taken into account: In general, silicious fillings favor the formation of tubes, whereas cretaceous or chalky fillings do not. Thus experiments show that Calais sand and pumice form tubes, coarse emery, fine emery and crushed limestone give a slight formation, and Trent sand and chalk do not form tubes. The specific heat and thermal conductivity of the filling influence the results only indirectly, in that they affect the normal fusing current of the fuse. The size of the particles of the filling has an effect on the duration of the arc. The more finely the material of the filling is divided the more quickly is the arc extinguished, and consequently the pressure rise on an inductive circuit would be high. This result was obtained from a large number of oscillograms with various powders, both coarse and fine. The fine powders seem to be more effective in repressing the arc than the coarse ones, owing to their interstices being smaller and less air being included. It was found that with fine powders the minimum no-arc length was shorter for both tight and loose packing than with coarse powders. This points to the presence of air spaces in the filling as having an adverse influence on the minimum no-arc length, since the tightness of the packing has little influence in reducing the air spaces with coarse powders. Moisture in the filling may not very seriously affect the action of the fuses as far as the separation of the arc is concerned, but its presence in enclosed fuses is not desirable since it leads to corrosion and electrolytic troubles, particularly if a contact difference of potential exists between the wire or lug connecting it to the fuse contacts. A special form of enclosed fuse is described in which a special liquid enclosed in a small glass tube is disseminated throughout the filling when the fuse is subjected to a short circuit; the object is to break the arc very quickly, due probably to its being cooled by the evaporation of water. When the fuse blows with a moderate overflow the glass tube is not broken and the filling remains dry.—Lond. *Elec.*, March 6.

Interior Wiring.—A note on a new system of interior wiring in which protected insulated wires are used. The two insulated wires are surrounded by a rigid tube of copper, brass or iron, which fits tightly around the pair. This covering may be a seamless tube, in which case the material can be procured in lengths not greater than 22 ft. If the covering is rolled and folded, however, it can be obtained in lengths of 325 ft. if necessary. These tubes are very small in diameter, and as the metal covering is only 0.3 mm thick, they are easily handled and bent to the required shape. Special clamp joints and other fittings are provided, and it is practically impossible for moisture to get to the insulation. The tubes can be laid on the surface or in the plaster.—Lond. *Elec. Eng'ing*, March 5.

Insulators.—An illustrated description of an English pottery making a specialty of insulators for electrical purposes, and of the different steps in their manufacture.—Lond. *Elec. Rev.*, March 6.

Insulators.—G. Aufossi.—On a 25,000-volt transmission line, running along the sea coast near Genoa, dust deposits formed on the inner surface of the insulators so that it became necessary to introduce a new design of insulator.—*La Lumière Elec.*, Feb. 29.

Electrophysics and Magnetism.

Electric Discharges Through Gases.—J. J. Thomson.—An account of the first of a series of Royal Institution lectures. A charged body supported on an insulator loses its charge gradually. This is due partly to leakage along the insulator, but there is also a loss through the air. A review is given of various experimental researches on the discharge of a charged body into air. If air is a conductor of electricity, though a very poor one, the question arises, how can the earth keep its negative charge? The author thinks that the rain is concerned in this problem, falling rain being negatively charged. Another thesis suggests a continuous stream of negatively-charged particles coming from outside, from the sun.—Lond. *Elec.*, March 13; a longer abstract in Lond. *Eng'ing*, March 13.

Analogy Between Hydrodynamics and Electromagnetism.—A. P. Wills.—A theoretical paper suggesting a variation of the Bjerknes analogy between hydrodynamic and electric or magnetic fields. Velocity in hydrodynamics corresponds to field intensity in electromagnetism, specific momentum corresponds to flux, and density to inductivity. The hydrodynamic system of the analogy consists of a "fundamental fluid" of infinite extent within which there are certain fixed regions called "fluid bodies." The "fundamental fluid" may be consistently assigned properties which are analogous to those of the free ether, while the "fluid bodies" may be consistently assigned properties which are analogous to those of the stationary electric or the stationary magnetic field.—*Phys. Rev.*, March.

Electrochemistry and Batteries.

Induction Furnace.—V. Engelhardt.—An illustrated translation in abstract of his recent German paper on the electric induction furnace and its use in the iron and steel industry.—*Electrochem. and Met. Ind.*, April.

Diaphragms.—J. R. Crocker.—An illustrated article on the construction of diaphragms for electrolytic cells.—*Electrochem. and Met. Ind.*, April.

Indigo.—Chaumat.—A paper on the electrolytic reduction of indigo.—*Bull. Soc. Int. des Elec.*, January.

Units, Measurements and Instruments.

Capacity of Cables.—F. J. O. Howe.—The first part of an article on commercial capacity tests of cables. The usual method is to charge or discharge, firstly, the cable, and secondly, a standard condenser through a galvanometer, the capacity of the cable being directly deduced from the two galvanometer "throws" obtained and the value of the standard condenser. This galvanometer "throw" obtained in charging a cable is really composed of two parts, one due to the passage of the quantity of electricity required to charge the cable, the other part due to the leakage of electricity through the cable dielectric, which requires the continual passage of a certain quantity of electricity through the galvanometer in order to keep the charge up to the full potential. The correctness of the results obtained by the charge method, therefore, depends upon the relative value of the charging and leakage currents. It is found by experience that the charge method gives results of sufficient commercial exactness in the case of rubber, gutta percha and jute cables, but for paper cable the results obtained can be four or five times as high as the true capacity of the cable measured. This error in the case of paper-insulated cable does not suggest any difference between paper and, say, rubber as a dielectric, but is due simply to the fact that in the case of paper-insulated cable the leakage current can have such a value compared with the charging current as to make the results obtained by the charge method of no practical value whatever. The error becomes the greater the higher the voltage of a paper cable. In the case of a high-tension paper cable the capacity diminishes with increasing paper thickness, but the insulation resistance keeps constant or even diminishes, on account of the alteration of the impregnating compound which becomes necessary with increasing paper thickness. In order to render the cable flexible without splitting the paper insulation, the percentage of resin used with resin or castor oil must be decreased with increase in paper thickness so that the impregnation becomes softer and more oily. An account of comparative tests is given in which a high-tension paper cable was first tested by the usual charge method at 100 volts and then tested by the charging current method at 30,000 volts. In the latter case a 40-000 volt transformer was used connected to a generator giving an e.m.f. wave closely approximating to a sine; one terminal of the transformer was connected through a hot-wire ammeter to one core of the cable, while the other two cores and the lead sheath were earthed, as was also the other terminal of the transformer. The capacity could then be quite accurately found from the current in the hot wire ammeter and the voltage applied. In this case the usual charge method with 100 volts gave results more than 200 per cent too high. When testing capacity by the discharge method, six tests on the same cable may give six different results, according to the time of charging, and therefore due to the amount of polarization set up in the dielectric. Some manufacturers have concluded that the increase of capacity obtained by increasing the time of charging shows that the cable requires some appreciable time to charge it, and they have therefore adopted a standard time for charging of from 10 to 30 seconds, but the present author emphasizes that this adoption insures the introduction of the greatest possible error in the results obtained. The charging-current method with a high voltage is reliable and quick, but is dangerous to the workman and requires large running machinery. The author has therefore worked out another method which is practicable for commercial purposes and which is essentially based on the method of De Sauty, the principle being indicated in the left hand diagram of Fig. 2. When balance is obtained in the bridge using alternating current, the ratio of the impedance of a to that of b equals the ratio of the impedance of c to that of d. If a and b are pure resistances and c and d are pure capacities, then the ratio of capacity c to d equals the ratio of resistance b to a. For the first trials a meter bridge and small induction coil were used, a sensitive telephone serving as the current detector. The apparatus was that used for rough self-induction tests, a standard condenser, however, replacing the variometer, as shown in the right-hand diagram. No silence was obtained in the telephone, but a minimum, extending, however, over some distance. The meter bridge was next replaced by a high-resistance box of the plug pattern, one coil of which served as one ratio arm, the remaining coils forming the other. The range of the minimum sound was thereby reduced, but the capacity values obtained were still too low. The induction coil was next replaced by a three-phase high-frequency machine having three-speed gears of 500, 800 and 2000 revolutions per minute, giving frequencies of 125, 200 and 500 periods per second. This arrangement gave results much more clearly defined as to the minimum sound in the telephone. However, the results obtained were still lower than the true capacities, especially in the case of the test of three cores against the lead, which, by the way, was characteristic throughout all the tests taken by the telephone method. This, therefore, suggests that the lowness of the results obtained was due to the difference of insulation resistance between the cable and the condenser. In order to increase the sharpness of the tone in the telephone the wave of the high-frequency e.m.f. was made a sine wave by means of resonance, the connections being shown in Fig. 3. By this arrangement it was possible to balance the resistance ratio very quickly and with precision. The results obtained, however, were still from 2 to 5 per cent lower than those obtained by the charging-current method. The paper is to be concluded.—Lond. *Elec.*, March 20.

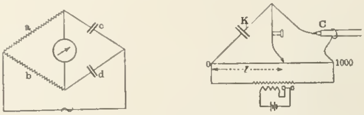


FIG. 2.—MEASURING CAPACITY OF CABLES.

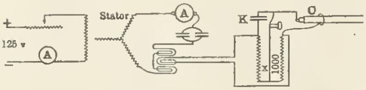


FIG. 3.—MEASURING CAPACITY OF CABLES.

Resistance Comparator.—W. C. Fisher.—The conclusion of his illustrated article. He first discusses the three possible chief errors of his instrument which are caused by ohmic difference per unit length, by the position of the sliders on the slide wire, and by the difference in the ohmic value in the slide wire as a whole and that of the remainder of the measuring circuit. Concerning the comparison of resistances bearing any ratio to each other, he remarks that if the resistances be in the ratio of, say, 10 to 1, the higher value may be shunted by a relatively high resistance, and the potential of a one-tenth of that be compared with the lower value, so bringing the balancing points close to each other, instead of one being a tenth that of the other. Further, if this high-resistance shunt be suitably divided and adjusted, it is possible to bring both readings at the same identical balancing point on the instrument, in which case the exact shunt ratio gives the absolute difference that exists between the two resistances. Whether a correction is necessary for the shunting effect is governed by the relative ohmic value of shunt and resistance, but in any case it is, of course, absolutely necessary that the shunt ratio be accurate, or its errors definitely known, so that corrections may be applied. Galvanometers useful for such measurements are those of D'Arsonval or Broca. The latter may be made of increased sensitiveness. Further, the D'Arsonval instrument, with any given suspension and coil, has a fixed degree of damping, period and sensitiveness, while in the case of the Broca all three can be varied over very wide limits. The author then describes his design of standard resistance and finally recommends what he calls the "ribbon-plotting" method of recording results. Instead of collecting the results of resistance measurements in the form of figures in a book he recommends to plot them diagrammatically on curve sheets, the ordinates representing parts in ten thousands or percentages of the whole resistance.—Lond. *Elec.*, March 13.

High-Frequency Spark Gap.—J. Koehler.—A description of a spark gap which, as shown in Fig. 4, consists of two small spheres *c d* about 2 cm in diameter each, connected to the high-tension supply (influence machine or induction coil) *J*, and two larger spheres, *a b* (about 5 cm in diameter), between which the high-frequency discharge is obtained at *z*. Two small hydrogen flames, about 5.7 mm high, out of the glass nozzles, *h i*, are placed in the auxiliary gaps, *x y*. The hot gases of the flames act as conductors for the current, and no sparks pass at *x* and *y*. A high-frequency spark, however, is found to pass at *z*, when the influence machine is at work. If the machine is rotated slowly the sparks are intermittent, but if the speed is raised sufficiently, a bright line of light results at *z*, and coherer and other experiments show that this is composed of high-frequency oscillations.—Lond. *Elec. Engineer*, March 6.

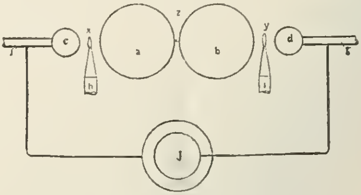


FIG. 4.—HIGH-FREQUENCY SPARK GAP.

Meter.—An official communication from the Reichsanstalt by which ampere-hour meters with periodic damping for direct-current two-wire systems, made by a German company, are admitted for calibration. The principle of the instrument is described and illustrated. An armature with three coils is connected in parallel with a constant resistance inserted in the consumer's line. This armature rotates in the field of a permanent magnet. The energy is consumed by eddy currents in an aluminum disk.—*Elek. Zeit.*, March 5.

International Bureau.—C. E. Guillaume.—A paper on the organization and the work of the International Bureau of Weights and Measures.—*Bull. Soc. Int. des Elec.*, January.

Telegraphy, Telephony and Signals.

Radio-Goniometer.—E. Bellini and A. Tosi.—An illustrated description of an instrument devised by them for use in directive wireless telegraphy. The receiving instrument consists essentially of two primary coils, vertical to each other and wound on a secondary cylinder. The theory, which is somewhat complicated, is given with the aid of diagrams. A similar arrangement is used for sending as for receiving. With the receiving instrument the operation involves two steps; first, to tune the apparatus to the wave length received; and second, to set the apparatus in the direction of the unknown transmitting station. It is claimed that when receiving signals the bearings of the sending station can be determined within one degree. By taking bearings of two known stations a ship at sea can ascertain its position with considerable accuracy. The transmitting instrument is based on the same principle.—Lond. *Elec. Eng'ing*, March 5.

Wireless Telegraphy and Telephony.—A. Campos.—The author thinks that the arc method of producing undamped oscillations for wireless telegraphy and telephony is only a transitory arrangement destined to be shortly replaced by more perfect methods. He considers the possibility of obtaining a mechanically-driven generator which will produce undamped oscillations and replace the one or other similar arrangement in the Duddell circuit. Series or shunt dynamos might be used and on account of the limited power usually required dynamos without iron will probably be sufficient and should correspond even better to the most favorable conditions. —Lond. *Elec.*, March 6.

Miscellaneous.

"America Revisited."—W. H. Preece.—A lecture before the (Brit.) Inst. Elec. Eng., giving an account of his visit to this country last year and his impressions as to the developments which have taken place since his previous visits in construc-

tional work generally and especially in telegraphy and telephony, electric lighting and railway electrification. The "message load factor" in telegraphy is much better in the United States than in England where there is a peak of telegrams in the morning and another and smaller one in the afternoon. The author speaks favorably of the Barclay method of using typewriting machines at both the sending and receiving ends of a telegraph line. Concerning the Rowland system he says that he was not so much impressed with this system as with the Barclay. "It is more complicated and dearer to work. It is a mistake to imagine that speed of working is a great desideratum in telegraphy." In referring to the revision and increase of telegraph rates in this country he asks "What would they say in England if the postoffice ventured to raise the rates?" With respect to telephony he refers to the much more extended use of telephones in this country than abroad. There are used per 100 population at New York 8.12 telephones, at Chicago 7.44 and Philadelphia 7.41 against 4.43 in Berlin, 2.34 in Paris, 1.98 in London and 1.64 in Vienna. As to the switchboards he remarks that the predominant feature remains the multiple board. In New York Mr. Carty has introduced what he calls a "partial multiple board," and in London Sir John Gavey introduced a similar board. He does not believe in automatic switchboards except for small private branch or local exchanges. "They are really more costly to work than manual boards, for they want so much highly paid technical attention. They are certainly less reliable." He expresses his admiration of Gahill's telharmonium, but says, "that notwithstanding the wonderful effect, he is not impressed with the commercial value of this music, and it does not seem to be making progress." In giving a review of progress in electric lighting he says that "the Curtis turbo alternator is in great fashion in America, principally because it is American, and being vertical it occupied smaller space than the Parsons. The American is very patriotic. He often employs inferior processes simply because they are American." He speaks very well of the Electrical Testing Laboratory in New York and says that the lamp tests made there have improved the quality of incandescent lamps manufactured in the United States. "They are very much superior to those manufactured in England." He then gives a review of electric traction in New York City. Concerning wireless telegraphy he suggests that "considerable trouble arises from the use of the American Morse alphabet. The adoption of the European code would be a wise movement."—Lond. *Elec.*, March 20.

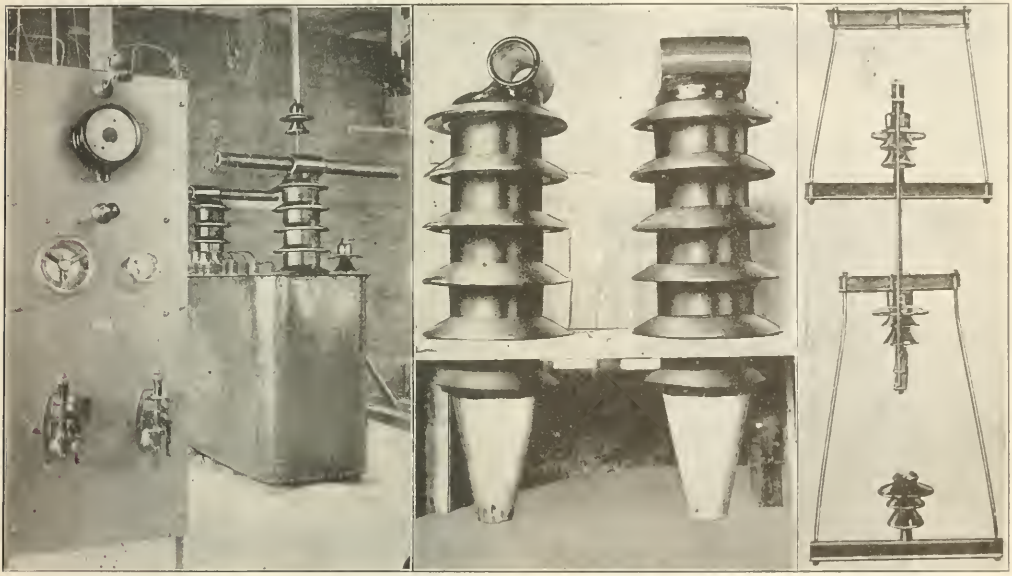
Poincare.—A note on Henri Poincaré as successor of Sully-Prudhomme in the French Academy.—*La Lumière Elec.*, March 7.

Insulators for High-Voltage Lines.

By F. M. Locke.

The frame-type insulator shown in Fig. 1 has been designed for lines of 150,000 volts. It will stand a spray test of 280,000 volts, thus giving a large factor of safety. It will carry a mechanical load of 20,000 lb., and can be constructed to carry as much more as desired by increasing the eye-beams and side rods and the bearing surface of the porcelain; the frames are interlocked like a chain and the line cannot come down. All the porcelain parts are under compression and are designed to have a surface large enough to carry the required mechanical load with a large factor of safety. Under an electrical test this insulator does not show the usual static stresses, and is extremely quiet up to the point of arcing, which takes place between the frames. An arc from lightning would take place between the frames and thus not injure the insulator. These insulators are furnished in any size for line voltages from 70,000 volts up to 300,000, with a factor of safety of two under a spray test, and for any mechanical load desired. It will be observed that this is the only insulator giving unlimited test voltage, unlimited mechanical strength and an unlimited factor of safety on all points. It is designed for the hanging type, but can be supported at either end; it can be used horizontally or perpendicularly. It is manufactured exclusively by the Lima Insulator Company, Lima, N. Y.

Fig. 2 illustrates a 450,000-volt, 150-kw transformer used to test the above-described insulator; this is installed at the Lima Insulator Company's plant and was made by the Central Laboratory Supply Company, Lafayette, Ind. Fig. 3 shows porcelain bushings manufactured by the Lima Insulator Company for the Locke 450,000-volt, 150-kw transformer, and is insulating successfully the lead wires. These bushings are oil-filled and the holes through the top caps are to support the choke coils at each terminal. They weigh about 200 lb. each.



FIGS. 1, 2 AND 3.—INSULATORS FOR HIGH-VOLTAGE LINES.

New Cooper Hewitt Mercury Lamp.

By F. H. von Keller.

One of the problems that requires the serious attention of the engineer in connection with the mercury vapor lamp is in starting it. In the so-called "tilting-lamp," a conducting connection is temporarily formed between the electrodes by tilting the tube in such a way that the mercury is caused to flow along its entire length and form an uninterrupted bridge between electrodes. When the stream breaks, the lamp lights. The tube is then allowed to drop back into its original position by gravity.

This operation of tilting the tube is usually performed by hand, but may be performed by means of an electromagnet, which renders the lamp automatic. This method is, for mechanical reasons, usually confined to tubes not exceeding 21 in. in length. This lamp is known as the "automatic tilting lamp."

In some cases it is important that the lamps be automatic; for instance, in installations where the lamps are suspended at considerable height, or where for other reasons it is impracticable to have the operator tilt each lamp. Therefore the type of lamp shown in Fig. 1 has been developed. Here the tube, which is 50 in. long, is entirely stationary and subjected to no motion to effect starting. The initial discharge of current is brought about by applying a relatively high potential across the tube terminals, thus breaking down the starting reluctance and sending current at the supply voltage through the tube. The high potential is created by interrupting the current through an inductance coil in series with the lamp, by means of a quick-break mercury-switch—the so-called "shifter." This is connected in series with a starting resistance across the tube terminals (see Fig. 2). The lamp is switched into circuit through the inductance coil, the shifter, the starting resistance and the series resistance. The inductance coil actuates an armature which thereupon causes the shifter to break connection and open the starting circuit. The inductance is thereby caused to create a high potential across the tube terminals sufficient to break down the starting reluctance of the tube.

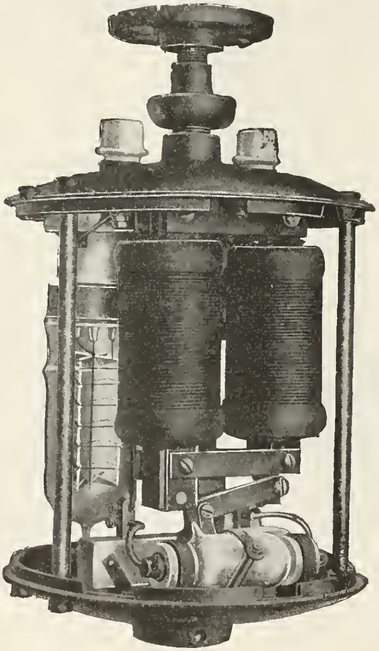


FIG. 1.—ARRANGEMENT OF PARTS.

Fig. 1 shows the arrangement of parts. The shifter, in the foreground at the bottom, consists of a small glass bulb about 2 in. long, provided with a V-shaped indentation forming a partial partition and serving to separate the mercury with two puddles forming the electrodes. To each one of these puddles leads a small platinum wire making connections with suitable terminals. The bulb is exhausted to a high degree of vacuum. When the circuit is closed the shifter is in such a position that the mercury forms a bridge connecting the two leading-in wires together. The shifter is thereupon turned upon its longitudinal axis by the action of the armature, and the partition divides the mass of mercury into two separate puddles, thus breaking the electrical connection. When the mercury bridge is thus severed, the shifter operates for a moment as a small mercury vapor lamp started on the tilting lamp principle. However, the amount of current flowing in the shifter is limited by the starting resistance to about one ampere and the shifter therefore continues to light only for a fraction of a second and is then extinguished. At this instance the initial reluctance of the shifter re-establishes itself, and the current is thereby interrupted so suddenly that a high potential rise results.

The starting reluctance of the tube is chiefly due to an inherent characteristic of the negative mercury electrode. Not only does this reluctance assert itself when the lamp is being started, but it also tends to re-establish itself at intervals in the lighted lamp, thereby tending to extinguish it. The frequency with which this will occur increases with decreasing current. The inductance in series with the lamp tube reacts upon these impulses of the negative electrode with a high voltage kick which keeps the lamp lighted continuously at its current consumption of 3.5 amperes. This same inductance, however, maintains the current flow in the shifter for a fraction of a second, the current in this case being only one ampere.

When the shifter current is interrupted, there takes place a shifting of the current from the shifter to the tube, i. e., the tube starts. Hence the name "shifter." To accomplish this shifting it is, of course, necessary that at the instant of current interruption the (re-established) initial reluctance of the shifter should exceed that of the lamp tube. For otherwise the induced voltage-kick if sufficiently high would restart the shifter and not the tube. The fact that the tube does start shows that the initial reluctance of the shifter with a separation of electrodes of ¼ in. exceeds that of the tube with a separation of electrodes 50 in., and this strikingly demonstrates that the vapor separating the two electrodes is not the main seat of this reluctance. This distinct quantitative difference between the re-established reluctance of the shifter and initial reluctance of the tube is brought about by an ingenious device applied to the tube which reduces the initial reluctance of the latter to a large extent and thus makes the starting possible. This device is called the starting band.

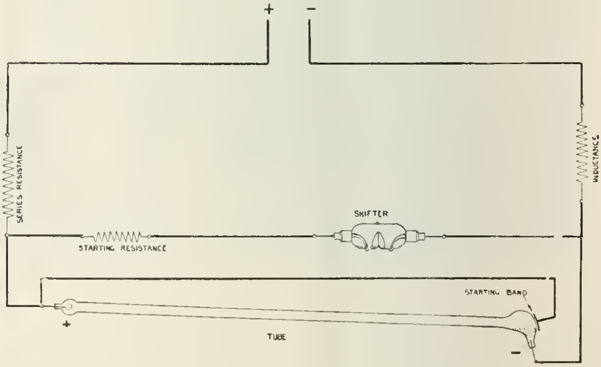


FIG. 2.—DIAGRAM OF AUTOMATIC LAMP CONNECTIONS.

The starting band is a metallic coating painted upon the outside of the condensing chamber at the negative electrode of the lamp, and extending above and below the mercury edge formed inside of the chamber. It is connected to the positive terminal of the tube (see Fig. 2) in such a way that it experiences the full rise of potential against the negative electrode during the starting operation. The starting-band thus forms one side of a condenser, the other side of which is furnished by the mercury electrode, the glass serving as dielectric. When the high voltage kick takes place, minute sparks may be observed jumping from the mercury surface to the glass inside the bulb. As though these sparks had punctured a highly resisting film upon the mercury surface, the main current now issues from one or several of these punctures. This result is of a similar nature as that produced by the contact (tilting) method; the production of conducting vapor and thereby a considerable reduction of the negative electrode starting reluctance.

The successful application of this method is an advance in the art of mercury vapor lighting, for while the automatic lighting of mercury vapor lamps may be brought about by other means, this is the only method by which the tube as a whole as well as every part of it remains perfectly stationary during the lighting process. The tube itself, naturally the most fragile part of the complete lamp, is thereby submitted to the least possible strain during the starting operation resulting in decreased breakages. Moreover, the tube remains comparatively simple in construction, is easily handled and readily shipped.

A lamp employing the above method is shown in Fig. 3. The tube is of the familiar form of Cooper Hewitt mercury-vapor lamp, provided with the customary condensing chamber at one end and an iron positive electrode at the other end. All the auxiliary apparatus is contained in a compact round housing, from which the tube holder is suspended.

The lamp yields approximately 800 candle-power with a current consumption of 3.5 amperes at 110 volts. Thus a specific consumption of approximately 0.5 watt per candle is obtained. The light emitted is highly diffused on account of the great length of tube, while the light source itself is made least offensive by a relatively low intrinsic brilliancy.

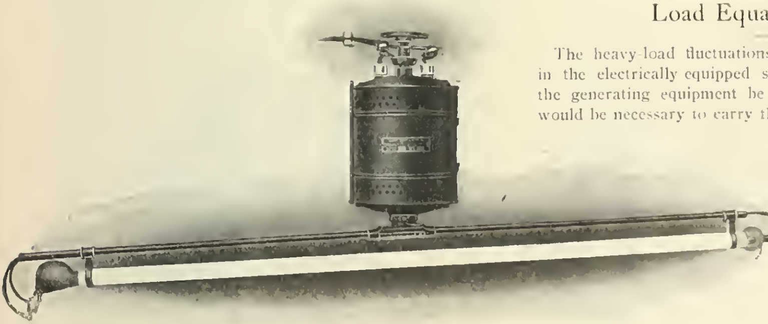
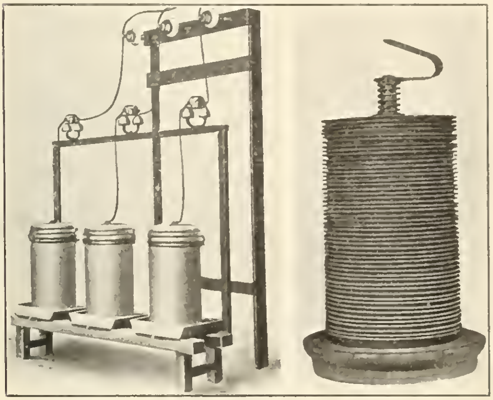


FIG. 3.—AUTOMATIC LAMP COMPLETE

Electrolytic Lightning Arresters.

As the result of experiments covering a number of years, the Westinghouse Electric & Manufacturing Company has developed the electrolytic lightning arrester shown in the accompanying illustrations. It consists of a number of aluminum plates pressed into tray form so that when set one within the other, separated by small insulating washers, they may be built into a column capable of withstanding high voltages and still retain the safety-valve characteristics of a single plate. These columns are made in two sizes, one for voltages between 4000 and 7500, the other for voltages between 7500 and 15,000. The columns are enclosed in substantial stoneware jars. The jars may be mounted one upon the other to form arresters for any desired voltage. A gap on the line side of the electrolytic elements, which will withstand the normal voltage of the system, breaks down with over-voltage and permits the surge to discharge through the electrolytic units.

The electrolyte is dissolved in pure water and poured into the top of the arrester unit. It thus fills the first tray and runs over into the second and so on through the column, the surplus escaping through a hole in the bottom of the containing jar through the next jar, if there be more than one, to the pan at the bottom. The electrolyte fills only the trays and not the jar, so there is no opportunity for the current to pass except from tray to tray. Each unit when placed in the pan or on another unit automatically makes contact.



ELECTROLYTIC LIGHTNING ARRESTER.

The electrolytic solution causes a very thin film to form on the aluminum plates. This film has an apparent resistance of very high value when moderate voltages are impressed upon it, but when the voltage reaches a certain value, it breaks down in myriads of minute punctures, making almost a short circuit. As soon, however, as the voltage is reduced again, the punctures seal up at once and the original high resistance reasserts itself. These arresters are arranged for installation either indoors or out, as suits the convenience of the user.

Load Equalizing System.

The heavy-load fluctuations occasioned by the rolling mills in the electrically equipped steel plant necessitate either that the generating equipment be of a much larger capacity than would be necessary to carry the average load of the plant or that special apparatus be provided to care for these sudden load variations. The first condition is evidently undesirable, as it not only puts heavy strains upon the generating equipment, but also necessitates that it be worked at lower efficiency than if it were run at a steady load at the normal rating of the machines.

It is, therefore, particularly interesting to note how this undesirable condition has been eliminated in some of the larger plants, and consequently a brief description of the equipment that has recently been installed in the plant of the Edgar Thompson Works, of the Carnegie Steel Company, merits special mention. The chief cause of the load fluctuations in this plant is the operation of two 750-hp. 250-volt motors on one of the rolling mills. The current taken by these motors often varies from 0 to 15,000 amperes within a period of a few minutes. To prevent this from causing heavy load variations on the generating equipment, a storage battery, consisting of 125 elements, type R-85 "Chloride Accumulator," manufactured by the Electric Storage Battery Company, of Philadelphia, together with switchboard and two regulating boosters, one of which is a spare unit, has been installed. The battery has a capacity of 10,000 amperes in regulating the ordinary load fluctuations, and can be discharged at a rate of 15,000 amperes in time of emergency, having a greater current output than any other individual battery installation in the world.

The booster sets, which were manufactured by the Western Electric Company, have several special features of interest. Each set consists of a motor direct-connected to a duplex generator. The generator is designed to carry a maximum load of 900 kilowatts or 15,000 amperes at 60 volts, and will carry any current up to 15,000 amperes at any voltage from 0 to 60 without sparking. The maximum output of the motor is, therefore, approximately 1300 horse-power, having an input of approximately 4500 amperes at 250 volts. This load is carried by the motor without any sign of sparking or heating.

The frames of both motor and generator are horizontally divided, and the main poles are laminated. The auxiliary pole windings consist of copper bars, bent on edge and held in place by substantial bolted-on lugs. The copper bars are spaced by means of wooden blocks, so that a very free circulation of air is obtained around them, resulting in cool operation of the field winding. The armature is provided with a commutator at each end. The rocking rings, supporting the brush-holder arms, are held by means of arms extending out from the frame. The box type of brush-holder is used on both motor and generator. Each armature is mounted on its own shaft, and the two shafts are connected by a solid flanged coupling. Each set has three bearings of a size amply large to insure cool running. The sub-base, which is of the box type, is grouted in on the concrete foundations.

Each booster is mounted over a pit and all connections between collector rings and auxiliary pole windings and the lines are made under the set in the pit, so that the two sets present an unusually neat appearance. Exciting current is provided for the generator by means of two motor-driven exciter sets, each of which has sufficient capacity to take care of both booster sets when operating in parallel.

As previously mentioned, the generators have laminated poles, and are also provided with large clearances between the pole faces and armature in order to insure that they will respond quickly to sudden demands for heavy currents, this being one of the principal features upon which the successful operation of the battery, with widely and quickly varying loads, depends.

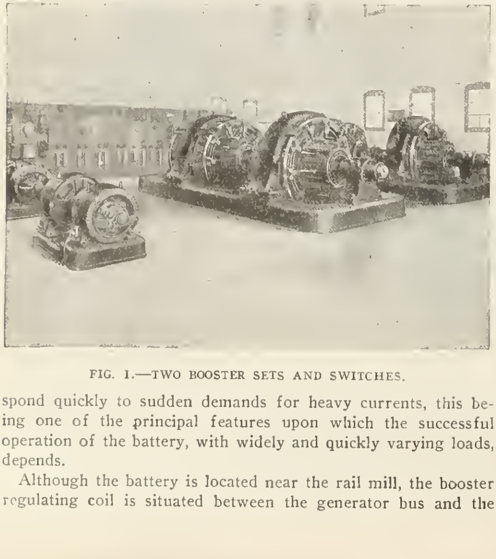


FIG. 1.—TWO BOOSTER SETS AND SWITCHES.

Although the battery is located near the rail mill, the booster regulating coil is situated between the generator bus and the feeder panels, so that the smaller fluctuations of load, due to cranes, skip hoists, etc., are also handled by the battery, giving a practically constant load on the generating equipment at all times.

That this equipment has greatly improved the service in this plant is shown by the fact that since it has been installed it has been found possible to cut off a 1000-kw generator from the system, which means that the plant is often operated with less than half the generating equipment that was found necessary before the battery and booster sets were installed.

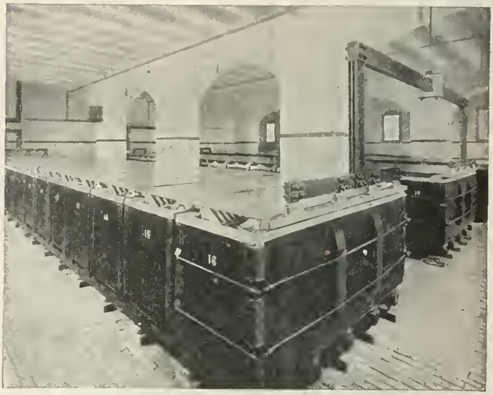
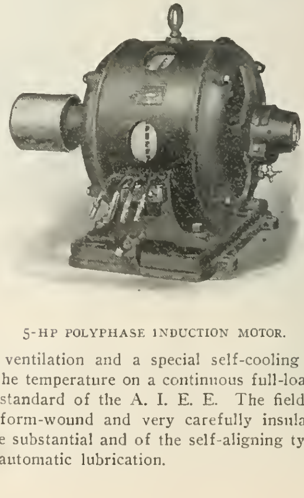


FIG. 2.—PART OF THE BATTERY EQUIPMENT.

Polyphase Induction Motors.

The accompanying engraving illustrates the general appearance of a 5-hp, three-phase, 60-cycle induction motor of the squirrel-cage type, manufactured by the Ideal Electric & Manufacturing Company, of Mansfield, Ohio, which embodies the latest features of the best European design. Two types are manufactured in any voltage frequency or speed, the squirrel-cage type being ordinarily used where constant speed only is desired, and the form-wound or slip-ring type where variable speed or very low starting current is the consideration. A special form of starter has been designed for use with the motors, which is giving great satisfaction. These motors are adapted for wall and ceiling suspension, as well as direct-connection of machine-tools and elevators. Owing to their peculiar method of ventilation and a special self-cooling arrangement the rise in the temperature on a continuous full-load run is well within the standard of the A. I. E. E. The field coils of the stator are form-wound and very carefully insulated, and the bearings are substantial and of the self-aligning type, with provision for automatic lubrication.



5-HP POLYPHASE INDUCTION MOTOR.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports from the various sections of the country show a dulness in almost all lines of trade, a seeming reaction from a period of too rapid recovery. The jobbing trade was quiet and the retail trade, during the last week, has not held up to the point expected. The ranks of the unemployed have been swelled by 250,000 miners in the bituminous coal fields from Pittsburg west to Iowa. It is reported that the operators insist on a changed basis of cost of production, in view of the depression which has prevailed in the coal trade for a long time. The decrease in the number of idle cars, while extremely slow, is encouraging, there being a decrease of 5 per cent from two weeks ago and a decrease of 13 per cent from the high point of empty cars reached in February. Crop reports are irregular, owing to the cold wave which followed the warm spell. It is conceded that the state of the iron and steel trade is not so brisk as it was a month ago. Heavy steel rails are in light demand and structural material has but a small market. Collections still continue backward, and although money is easy, the borrowing demand is slight, owing to lack of new enterprises and new business. The success of railroad managers in reducing railroad operating expenses in proportion to reduced earnings is an element in the business situation that makes for optimism, and the monthly showings from now on should appear much better. Business failures for the week ended April 2, according to *Bradstreet's*, were 247, against 286 of the previous week, 137 in the corresponding week of 1907, 151 in 1906, 170 in 1905 and 201 in 1904. The relaxation felt during the week in general trade was reflected in electrical fields. The Western Electric Company for the first quarter of 1908 reports goods billed equal to about one-half the amount for the corresponding period of a year ago. The Westinghouse Electric Company during the last few days has received orders for 100 locomotives to be shipped to various parts of this country and Mexico. A representative of that company, who has recently returned from a Western trip, says that "business in the West and Southwest shows some improvement. Consumers of electrical equipment show a greater willingness to buy. They are all talking crops out there and the indications point to a good harvest." An Eastern representative of the General Electric Company reports trade in a fair condition in Massachusetts and vicinity. "There are indications of improvement," he says, "both in inquiries, orders and in the general tone of the business community. People are less timid and do not clutch their money with such a rigid clasp as formerly. The recovery in electrical lines is slow in New England, but it should be remembered that that section was perhaps as little affected by the panic as any part of the country, and consequently has less distance to go in getting back to normal conditions again."

THE COPPER MARKET.—Almost daily reductions marked the copper market during the last week, but the decline was checked somewhat on Monday, when prices became a little firmer. Domestic consumers are quite willing, if the market starts on a too rapid upward turn, to withdraw and let the market settle back again, as happened on the last upward movement. Increasing business has not forced them into the market, and they can obtain enough of the metal for their immediate needs at bottom prices. March sales, though in many cases grossly exaggerated, were undoubtedly better than at any time since the recession late in the summer of 1907. A leading copper producer estimates that about 35,000,000 pounds of copper were sold to domestic consumers during the last month, and there seems little likelihood of lower figures for April. Inquiries among the larger electric interests show that, as in past months, no more copper is being bought than required for immediate needs. Copper exports for March were 21,620 tons, a falling off from February of 3020 tons, from January of 11,324 tons, and from December of 15,414 tons. The average price received from copper exported during February, according to the Department of Labor and Commerce, was 13.4 cents, comparing with 13.5 cents in January, and 23.6 cents in February, 1907. The total exports from the first of this month were 3920 tons. It is expected that April will show a decrease from March in the metal exported, as the foreign demand by consumers is light, and the foreign dealers are well stocked with copper at the present time. Monday's prices on the Metal Exchange were as follows:

Lake	12⅞ @ 13⅛
Electrolytic	12¾ @ 13
Castings	12½ @ 12¾

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	59	5	0	59	2	6
Standard copper, futures	59	15	0	59	12	6
Market	Firm.			Easy.		
Sales of spot						100 tons
Sales of futures						500 tons

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	6
London, best selected	67	10	0	61	0	0

Reports from Butte state that all the properties of the Amalgamated Company, with the exception of the Parrott and the Neversweat mines, are in full operation, some of them at normal capacity. The March output of the Butte mines was 18,127,250 lbs. of copper from 584,750 tons of ore.

CONSOLIDATION OF BRISTOL COMPANIES.—The Bristol Company, of Waterbury, Conn., has come under the control of Prof. William H. Bristol, whose inventions this company has been manufacturing since it was first organized in 1889. Prof. Bristol assumed active charge of the management of the business on Friday, March 27, and now owns the majority interest. The business which has been carried on under the personal name of Wm. H. Bristol at New York will hereafter be combined with The Bristol Company. The Bristol Company was organized in 1889 under the name of Bristol's Manufacturing Company to manufacture Bristol's pressure gages and Bristol's steel belt lacing, for which Wm. H. Bristol had taken out patents. To these were added many other inventions from time to time, and in 1894 the business was incorporated under the name of The Bristol Company. Two years ago Wm. H. Bristol withdrew from the presidency of the company, and since that time has developed new inventions, including an electric pyrometer and patented smoked-chart recorders. Another instrument which will be soon put on the market is a long-distance electric thermometer, designed especially for indicating and recording refrigeration, atmospheric and drying temperatures. The new lines of Wm. H. Bristol instruments supplement those of The Bristol Company, supplying a variety for applications for which the old instruments could not be recommended. For example, the standard Bristol's recording thermometers cannot be successfully used for temperatures above 600 deg. F., while the Wm. H. Bristol pyrometers are being applied to great advantage for the higher ranges of temperature, especially for ranges from 600 deg. to 2600 deg. F. The new lines of Wm. H. Bristol pyrometers are fitted with special movements made by the Weston Electrical Instrument Company, and are designed for extremely accurate measurements.

CURTIS TURBINE BUSINESS.—A recent statement of the General Electric Company shows that total orders for Curtis turbines to Dec. 31, 1907, covered 1096 machines for 549 plants and aggregating a capacity of 1,075,605 kw. Of the 549 machines, 261 were for lighting and traction plants and the remainder—288—for industrial plants and miscellaneous. The average capacity of all machines was 980 kw: the average for electrical generating plants was 3778 kw, and for all other plants, 305 kw. During the year ending Feb. 1, 1908, orders were received for 286,320 kw, or more than 25 per cent of total sales since the Curtis turbine was placed on the market.

ELECTRIC OPPORTUNITIES IN SPAIN.—A British Consul, writing from Spain, states that there are good opportunities in that country for electrical undertakings. Nearly all of the Spanish towns of any size have a fair service of public and private lighting, but there is still opportunity for much improvement and further development.

ELECTRIC TURRET-TURNING GEAR.—The contract for the electric turret-turning gear of the U. S. S. *Delaware*, now under construction at Newport News, has been awarded to the Cutler-Hammer Manufacturing Company of Milwaukee. This company designed and built the electric turret-turning gear installed in the port after turret of the *Indiana*, the crew of which holds the world's record for marksmanship—10 shots in two and a half minutes, all hits.

MARCH MOTOR BUSINESS DOUBLED.—Mr. O. F. Conklin, chief engineer of the Robbins & Myers Company, in speaking of business conditions, said that at the Springfield, O., factory no men had been laid off, no hours reduced, no wages cut and furthermore that they have practically no stock on hand, being well sold up. The New York office, of which Mr. C. W. Kragh is manager, had during March of 1908 more than doubled the sales of March last year.

Financial Intelligence.

THE WEEK IN WALL STREET.—The uncertainty displayed by the market during the week seems to indicate that the high level for prices has been reached, for the present, at least, and reflects the aspect of the commercial world, where it is becoming evident that the prosperous times, while certain to return eventually, are not coming back with any marked rush. While the market showed no distinct weakness, yet its fluctuations indicated that there was considerable profit-taking going on which developed more or less heaviness in standard stocks, such as the steel stocks and copper shares. The reduction from 6 to 5 per cent of the dividend on the common shares of Atchison also had a depressing effect upon the market, and the methods of marketing Yukon gold were a reflection on men whose reputation has been above reproach in financial circles. The difficulties of the Erie Railroad was the chief theme of Wall Street, and the trouble which that railroad had in completing plans for meeting its obligations, undoubtedly was largely responsible for the unsettled condition of the market. Positive developments during the week were the Supreme Court's decisions in railroad rate cases, President Roosevelt's conservative message, and the anti-trust laws amendments. Rates on day-to-day loans on the Stock Exchange dropped to 1 per cent during the week, the lowest figure reached since Sept. 23, indicating the accumulation of money and the reluctance of bankers to let go of funds for anything other than temporary loans. The general dulness which characterized the week continued on Monday, and trading fell off to midsummer levels. Closing prices were as follows:

NEW YORK.

	Mar. 31.	Apr. 6.	Shares sold.		Mar. 31.	Apr. 6.	Shares sold.
All-Ch.	7¾	7⅜*	1,110	Int.-Met., com..	7½	7⅞	1,000
All-Ch. pfd.....	18½*	17½*	300	Int.-Met., pfd..	20	18½*	1,400
Amal. Cop.....	60½	58¾	209,495	Mackay Cos....	57*	57*	100
Am. D. T......	39*	39*	———	Mackay Cos. pfd.	62½	65	516
Am. Loc.......	45	43¾	14,475	Met. St. Ry....	17*	17*	———
Am. Loc. pfd...	93¼	91¼	1,200	N.Y. & N.J. Tel.	102	100*	25
Am. Tel & C'bl.	50*	50*	———	Steel, com.....	34	33⅛	358,100
Am. T. & T....	108½*	108½*	———	Steel, pfd......	98½	97⅜	23,028
B. R. T........	46	45⅛	34,500	W. U. T.......	53	51	2,900
Gen. Elec......	126	125*	1,100	West'h, com....	51¾	55	8,700
Hud. R. Tel....	—	—	———	West'h, pfd....	80	60*	300

BOSTON.

	Mar. 31.	Apr. 6.	Shares sold.		Mar. 31.	Apr. 6.	Shares sold.
Am. Tel. & Tel.	109	109½	———	Mass. E. R. pfd.	47	—	———
Comb'lnd Tel...	105½	—	———	Mex. Tel. pfd..	5¾	—	———
Edison El. Ill..	204	—	———	New Eng. Tel'p.	109½	108	———
Gen. Elec......	126¼	126½	———	W'st Tel. & Tel.	7	6½	———
Mass. Elec. Ry.	10	10½	———	W. T. & T. pfd.	62½	62½	———

PHILADELPHIA.

	Mar. 31.	Apr. 6.	Shares sold.		Mar. 31.	Apr. 6.	Shares sold.
Am. Rys.......	42¾	42¾	———	Phila. Elec.....	7¾	7¾	———
Elec. Co. of Am.	9	9⅛	———	Phila. R. T.....	17½	17	———
Elec. Stor. B'ty.	28	29	———	Phila. Traction.	86	—	———
E. S. B'ty pfd..	—	—	———				

CHICAGO.

	Mar. 31.	Apr. 6.	Shares sold.		Mar. 31.	Apr. 6.	Shares sold.
Chicago City Ry.	149	155	———	Met. Elec. Com.	16	17	———
Com. Edison ...	92	92	———	National Carbon.	59	57	———
Chicago Subw'y.	18½	18½	———	Nat. Carbon pfd.	107	107	———
Chicago Tel Co.	116¾	115¾	———				

*Last price quoted.

Shares sold are for week March 30-April 4.

MECHANIC'S LIEN ON WHITNEY COMPANY.—The affairs of the Whitney Company, the $10,000,000 corporation organized to develop water powers on the Yadkin River in North Carolina, and which went into a receiver's hands in February, took a sudden and surprising turn last week when a mechanic's lien on the company was filed by the T. A. Gillespie Co., and a judgment in the sum of $730,000 was asked. Through the receiver, John S. Henderson, the Whitney Co. had alleged that the contracting firm of Gillespie & Company had made overcharges, failed to take advantage of discounts and to do other things agreed upon in the contract, and was indebted to the company to the extent of $975,000.20. The Gillespie Company denies any violation of contract or any indebtedness and sets up a counter claim of $730,000. The Gillespie Company denies that the amount to be received by it in compensation under the contract was limited to 20 per cent of a maximum cost of $1,550,000 for the whole work to be done, but alleges that the contract provides that "if the cost of the work should be increased by changes or additions, the specified maximum sum on which the contractor is entitled to receive 20 per cent shall be increased to the extent of such increase in cost." It denies the allegations that it falsely and fraudulently represented to the Whitney Company that the work was done in the best manner and at the lowest cost, and further answered that all bills rendered by it to the Whitney Company were correct and that the work was properly performed under the contract and at the lowest price. It answers that the whole amount of $2,906,625.52 paid by the Whitney Company to the Gillespie Company was paid in accordance with the approval of the Whitney Company's engineer, being due to the Gillespie Company up to February 1, 1908, together with $14,588.59. The total claim for $730,000 includes damages of $30,000 incurred by the fact that since February 14 the Gillespie Company's plant and machinery have been idle and it claims that it is entitled to $20,000, which it will cost to remove its plant and machinery to the Whitney Company's railroad station. By the adjournment last Saturday of the meeting of the bondholders of the Whitney Company, action on the reorganization plan formulated by Brown & Co. was indefinitely postponed. The plan drafted by A. O. Brown & Co., which controls about 50 per cent of the company's stock, involves the formation of a new corporation, which is to issue $5,000,000 of 5 per cent, first-mortgage, 20-year construction bonds; $5,000,000 of 7 per cent non-cumulative preferred stock, and $5,000,000 of common stock. The plan provides that the present holders of the company's bonds surrender them at 50 per cent of par for income bonds. The company is now in the hands of a receiver, and it is estimated that $2,200,000 will be required to enlarge the old plant, and about $600,000 to complete the new plant.

NEW READJUSTMENT PLAN FOR WESTINGHOUSE ELECTRIC COMPANY.—In a circular to the creditors of the Westinghouse Electric & Manufacturing Company, the Merchandise Creditors' Committee propose a plan of readjustment of the company's debt, terminating the receivership and providing for all cash requirements for a period of five years without placing a mortgage on the property, as proposed under the Mortgage Bond Plan, announced on Jan. 20 by the Reorganization Committee, of which James N. Jarvie is chairman. The new plan provides that instead of making a new issue of first mortgage bonds, the company shall continue its existing funded debt, and shall issue assenting stock at par in full settlement of the claims of the merchandise creditors, and of such other creditors as may take stock, provision for the remainder of the bank debt to be made by the issue of 5 per cent convertible bonds of the existing authorized issue and unsecured notes. Under this plan the stockholders of the company are to subscribe at par for $6,000,000 of assenting stock for additional working capital. Among the arguments presented in favor of the plan are that it prevents a mortgage bond issue, prevents an unduly large issue of bonds of any kind, increases the working capital; the capital required cannot be raised easily under the Mortgage Bond Plan; reduces the fixed charges, and thereby makes it more desirable for the stockholders to supply the $6,000,000 required of them.

RECEIVERS FOR UNION RAILWAY COMPANY.—A receiver for the Union Railway Company, of the Bronx, has been appointed by Judge Lacombe in the United States Circuit Court, in an action brought by the Lorain Steel Company, to recover the sum of $23,323 for material used and labor performed. Frederick W. Whitridge was appointed receiver, the secretary of the Union Railway Company joining in the petition. Mr. Whitridge is also the receiver for the Third Avenue Railroad.

CANADIAN WESTINGHOUSE COMPANY.—The fourth annual report of the Canadian Westinghouse Company for the year ending Dec. 31, 1907, makes an excellent showing, with a net profit of $427,053.25 from the company's operations during the last fiscal year, an increase of 23 per cent over the previous year. The surplus on Dec. 31, 1907, after payment of a dividend of 6 per cent on the capital stock, and the addition of $100,000 to the reserve heretofore created for depreciation of property and plant, was $391,284.55. During the year additional capital stock to the amount of $884,600 was subscribed to by the stockholders at par, to provide additional working capital made necessary by the growth of business of the company. The additions to the property and plant during the year amounted to $265,360, including heavy machinery, tools and equipment for the electrical department, ordered in 1906-7, and the enlargement and reconstruction of the plant of the Air Brake Department. The report says that orders for new apparatus showed a satisfactory increase up to Sept. 30, 1907. The general commercial and financial depression existing throughout the Dominion during the last quarter of 1907, in common with a similar depression in the United States and other countries, resulted in a sharp curtailment of orders, although shipments on previous orders were continued with only slight reductions. The total value of orders for the year accordingly shows a decrease of 14 per cent, while the number of sales increased 25 per cent, indicating that individual orders while greater in number were, on an average, smaller in amount than during the previous year. Unfilled orders on hand Dec. 31, 1907, aggregated $1,136,000.00. The output of the air brake department showed an increase of 35 per cent over the previous year. At the annual meeting in Hamilton, Ont., held March 31, the following directors were elected: George Westinghouse, President; H. H. Westinghouse and L. A. Osborne, vice-presidents; Paul J. Myler, vice-president and general manager, and John H. Kerr, secretary. Other directors chosen were Thomas Ahearn, W. Y. Soper, J. M. Gibson, Charles F. Sise, George C. Smith and Charles A. Terry.

WESTINGHOUSE COMPANIES.—In connection with the reorganization plan of the Westinghouse Electric & Manufacturing Company, it is announced that more than one-half of the securities have already been deposited. It is said that a new plan, which will be in the nature of amendments to the present plan of reorganization, will be submitted to the creditors of the company. The committee for the readjustment of debt, of which James N. Jarvie is chairman, has given notice that a majority of the convertible bonds, of three year, 6 per cent collateral notes and of bills payable and a large amount of the debenture certificates and accounts payable having been deposited under the plan of readjustment of Jan. 20, the time for the deposit of obligations and claims has been extended to May 15. On April 3 an order was made by Judge James S. Young, in Pittsburg, by which 300 creditors of the Nernst Lamp Company will be paid in full at once. Their claims amount to about $16,000, most of them being for small amounts. The Veta Colorado Mining & Smelting Company has awarded a contract to the Westinghouse Electric & Manufacturing Company for three 500-hp generators and other equipment for its plant near Parral, Mex. These are additions to the equipment installed last year. The machinery is to operate mines and smelters and an electric railway connecting them.

RECEIVERS FOR WESTINGHOUSE MACHINE COMPANY DISCHARGED.—Judge James Young, in the United States Circuit Court for the Western District of Pennsylvania, on March 31, granted the petition of the Westinghouse Machine Company for the discharge of the receivers. The Westinghouse Machine Company went into the control of the courts Oct. 23 last along with several other companies belonging to the Westinghouse interests. As far as the machine company was concerned, the move occasioned considerable surprise because it was known that this company had always done a large and profitable business. However, it was explained that the abnormal conditions existing at the time made this procedure a matter of necessity. During the tenure of the receivership the operations of the company have proceeded unimpaired and the works have continued in profitable operation. The Westinghouse Machine Company is the second of the Westinghouse companies restored to the stockholders, the Westinghouse Lamp Company having had its receivers discharged on March 1. There now remains principally the Westinghouse Electric & Manufacturing Company to have its affairs rehabilitated, and from recent reports the plan of reorganization is making encouraging progress toward an early termination of its receivership.

WESTERN ELECTRIC'S FIRST QUARTER.—Sales for the first three months of 1908 by the Western Electric Company are reported to be about 50 per cent of sales made for the similar period last year, but according to developments in the last few weeks, the percentage will not run so low for the next quarter, as inquiries and prospective orders have increased considerably of late. The Western Electric Company, at the close of its fiscal year, which ended Nov. 30, 1907, had a floating debt in bills and accounts payable of $11,449,000, a reduction from the high point of the year of more than $12,000,000. Continuing its policy of reduction, the company, since the first of the year, had effected, up to March 1, a further reduction in floating obligations of $2,500,000, with a loss in cash of but $650,000. This rapid reduction will, without doubt, make it unnecessary for the company to issue the $15,000,000 of bonds authorized some time ago.

NEW HEAD FOR WESTINGHOUSE MACHINE COMPANY.—Mr. William H. Donner has been elected vice-president of the Westinghouse Machine Company, and will have direct responsible charge of all the activities of that concern. His salary will be $50,000 per year. Mr. Donner was one of the receivers as well as one of the large creditors of the company. For many years he has been a large factor in the Western Pennsylvania industrial field, where he revolutionized the tin plate industry. He founded the thriving mill towns of Monessen and Donora, and when he formed the Union Steel Company he was backed by Henry C. Frick to the extent of $20,000,000. This property he later turned over to the steel combination at a personal profit, it is reported, of $2,500,000.

DIVIDENDS.—The directors of the Columbus Railway & Light Company have declared a dividend of ½ of 1 per cent on the common stock, payable April 15. The Edison Electric Company, of Boston, has declared the regular quarterly dividend of 2½ per cent, payable May 1. Directors of the Nebraska Telephone Company have declared the regular quarterly dividend of $1.50 per share, payable April 10. The directors of the Milwaukee Electric Railway & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock and 1½ per cent on the common stock, payable April 30. The regular quarterly dividend of 1½ per cent, payable May 15, has been declared by the directors of the New England Telephone & Telegraph Company.

HUDSON RIVER WATER POWER COMPANY BONDS.—The Public Service Commission of the Second District has reserved decision on the application of the Hudson River Water Power Company to issue $62,000 bonds. The company proposes to purchase the Hudson River Electric Power Company, a transmission line from Ballston Springs to Elplaus, Schenectady County, with $51,000 of these bonds. The commission directed that a petition be filed by the applicant company for the right to acquire a portion of the Hudson River Electric Power Company, and that a petition be filed by the Hudson River Electric Power Company to acquire certain bonds of the Water Power Company in the same transaction.

CANADIAN BELL COMPANY SELLS LINES.—Dispatches from Canada state that arrangements have been completed by the Bell Telephone Company, of Canada, for the sale to the province of Alberta of all the Bell Company's lines in that province. The purchase price is given as $675,000. Later dispatches state that C. F. Sise, president of the Bell Company, of Canada, denies that the company has sold its plant and rights to the government of Alberta

BELL TELEPHONE COMPANY OF MISSOURI.—The report of the Bell Telephone Company of Missouri, for the year ending Dec. 31, 1907, gives gross earnings of $1,937,482 and expenses of $1,392,501; the net earnings for dividends were $544,981. On Dec. 31 the company had a total of 45,279 stations and had expended for maintenance during the year $465,476.

NATIONAL GAS, ELECTRIC LIGHT & POWER COMPANY.—The report of the National Gas, Electric Light & Power Company for the first two months of 1908, shows gross earnings of $146,307 as against $130,772 for the same period last year. The net profits of the company for the two months showed an increase of $5,054

AMERICAN MACHINERY IN GERMAN ELECTRICAL WORKS.—Captain Godfrey L. Carden, who is now in Europe as a special agent for the Department of Commerce and Labor to examine into the use there of American machinery, has reported as follows concerning the German electrical works:

ELECTRICAL WORKS.—AMERICAN TOOLS IN USE—A GOOD OUTLOOK FOR THE INDUSTRY.

Prominent among the great electrical plants of the German Empire are the Siemens & Halske and Siemens-Schuckert Werke. I visited the Wernerwerke shops of this firm at Nonnendamm, where 6000 employees are on the rolls. The electrical business in Germany appears to be good. At Wernerwerk there is at least one year's work in sight, and for the last two years its shops have been working on night and day shifts. Four weeks ago overtime was cut out, but it is understood that night work will shortly be resumed in at least two departments. The standard of work turned out at the Siemens & Halske and Siemens-Schuckert Werke is very high. This work calls not only for expert workmen, but where machine tools are used the tools must be of the very best. In the machine-tool branch of the works only American and German tools are observed, and in no case did I see any English or French tools. The American tools installed are, it is thought, fully comprised in the following list:

Brown & Sharpe, Providence, R. I.; Warner & Swasey, and Cleveland Automatic Machine Company, Cleveland, Ohio; Cincinnati Milling Machine Tool Company, and the Cincinnati Machine Tool Company, Cincinnati, Ohio; Landis Machine Tool Company, Waynesboro, Pa.; Becker & Brainard, Hyde Park, Mass.; Garvin Machine Tool Company, New York City; Dwight Slate Machine Company, and the Hartford Automatic Screw Company, Hartford, Conn.; Pearson Machine Tool Company, Chicago, Ill.; Niles Tool Company, Hamilton, Ohio, and Sloan & Chase, Newark, N. J.

In the tool-hardening department the only ovens found installed were those of the American Gas Furnace Company, of Elizabeth, N. J. The opinion is held here that these furnaces are superior to any now made in Germany. The German tools installed at a plant such as Wernerwerke may be fairly taken to represent those tools which, in their respective types, are in active competition with the leading American machines. The German tools in use were, for the most part, millers, drill presses, lathes, gear cutters and threading machines. There were also quite a number of presses in service. Among the German firms represented, the following makes were observed: Malik & Walkow, Beling & Lübke, and Ludwig Loewe, Berlin; Schubert & Salzer, Chemnitz; E. Kirkneis, Aue in Sachs (Saxony), and Kirchner, Leipzig.

THE PRODUCTION OF MILLING MACHINES.

Noteworthy in this last list are the milling machines of the Wanderer Fahrrad Werke of Chemnitz, and the opinion has been expressed by German experts that the products of this firm are pressing the best American millers very closely. The millers of the Chemnitz establishment undoubtedly have merit, and certainly possess much form. It would not be too much to say that these Saxony tools represent in a very high degree the best that is being turned out by German tool manufacturers. The Wanderer Fahrrad Werke has adopted the plan of specializing and is confining itself to turning out only millers. From the best information that can be obtained the Chemnitz firm is selling its tools much cheaper than American manufacturers demand for the same type of machine; in fact, the figures first quoted are so considerably less as to make it advisable for American manufacturers of milling machines to watch this German development closely. The competition is already keen enough to warrant the prediction that there will be good milling machines on the market for some time to come.

The writer has seen few manufacturing plants, either in Europe or in America, which can excel in design and in attention to sanitation these great new works of Siemens & Halske and Siemens-Schuckert. There is not a dark room anywhere in the entire establishment where men and women have to work. There is good light and plenty of it. The air is pure and the whole atmosphere of the place is healthy, morally and physically. Like many other German firms, Siemens & Halske and Siemens-Schuckert have given the closest attention to the welfare of their workmen. The German law requires that certain essentials in the way of insurance and pensioning be complied with, but the firm has gone further than this, and has made it worth while for a man to remain in its employ. It is true that the firm has had its own troubles in the handling of workmen, but these troubles are happily of the past. I found at Wernerwerke that it is the practice to feed the employees during the noon hour. There are different eating rooms for different classes of employees, and good meals are supplied at from 15 to 35 pfennigs (100 pfennigs = 1 mark = $0.238). It is not to be assumed that this cost covers the expense, but it insures keeping the employees together, and obviates some of the hardships which would ensue naturally in the case of a plant located at a considerable distance from the workmen's homes.

THE LAW CARES FOR WORKMEN.

The German law requires that all machine tools for cutting, stamping, and pressing purposes be protected by screens. We are accustomed in America, in many instances, to see a cutting machine which is operated by the foot. When working rapidly accidents occur. This is practically impossible with the German machine. Not only is the cutter screened to the very limit of practicability, but in order to insure that the workman's hands are off of the plate, two levers must be pulled. This means that both the right hand and the left hand must be on the levers, and away from the plate. It means a little slower operation, a little more cost in production, and a fractional shade lower per cent in shop efficiency, but it means safety for the workman, and a better protection of life.

The wages are increasing right along, I am told, in shop work in eastern Prussia. In the Berlin territory a good man at a machine tool considers that he has a right to be dissatisfied if he does not earn 85 pfennigs per hour. Some of the shops are working their men nine hours per day, while others are on an eight and one-half-hour basis. The prediction is made that the wages will increase still more, and in view of the fact that living has immensely increased of late in Germany there is good reason to expect an increase in cost of labor.

MARINE GAS ENGINE.—A GAS PRODUCER FOR SMALL CRAFT—THE CAPTAINE SYSTEM.

Emil Captaine, who died recently, was regarded as one of the foremost engineers in Germany in the development of a "gas producer" for ship use. Messrs. Thorneycroft some time ago secured the English rights for his design, and at this time Messrs. Beardmore of Scotland have completed an engine of the marine type of between 500 and 600-hp, and have another engine under construction of larger power. I understand this latter engine will approximate 2000-hp, but on this point cannot speak advisedly. Messrs. Beardmore inform me that they are at present experimenting with the completed engine, but find that there are many points requiring careful consideration before they can declare themselves ready to put their work in the market, points that have more to do with producers than engines. It should not be long, however, before the Beardmore experiences are available, when some interesting data may be expected. The Captaine system is already in service to a considerable extent in Europe, and where employed the suction gas plant is utilized. This service, it must be understood, is with small craft.

In the suction gas-system the gas instead of being generated by the combustion of fuel by air and steam being forced through it under pressure, is generated by the air being drawn through the producer, the whole of the apparatus working somewhat below atmospheric pressure. The advantage claimed for this system is that neither the steam boiler working under pressure nor a gas container for holding the gas is required; and the further very important advantage for marine work is that there is no danger from leakage of gas from the producer. If leakage takes place it is from the atmosphere into the producer itself.

Already the designers are encountering obstacles in the utilization of the gas producer for marine purposes owing to inability to use bituminous coal. It is conceded that it is too difficult to make a satisfactory small plant work with bituminous coal. It is claimed, however, that for larger powers and for vessels that have to take up fuel at different ports, the producer must be capable of dealing with coal other than anthracite, which may be of a tarry or caking character. Engineers who are well informed on this subject declare that the gas engine will yet be doing service aboard ship. There is a variance of opinion as to the practicability of the gas engine in powers above 1000-hp, and there are good German engineers who assert that the gas producer for marine purposes must be a pressure gas producer and not one of the suction system.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

ATMORE, ALA.—The Town Council has granted W. S. Brantley a 10-year franchise to construct and operate a telephone system in Atmore.

RUSSELLVILLE, ALA.—At an election to be held April 20 the citizens will vote on the proposition to issue $24,000 in bonds for the construction of an electric light plant and water works system.

COTTON PLANT, ARK.—Bids will be received until April 23 by J. M. Philpott, city clerk, for the construction of a power house, a 30,000-gal. steel tank and tower, and for furnishing an 85-hp gas engine, a 300-gal. triplex pump and a 45-kw direct-connected generator and switchboard. W. G. Kirchoffer, of Madison, is engineer.

RISON, ARK.—It is reported that the United States Government will build a telephone line from Mena to Waldron.

TEXARKANA, ARK.—The capital stock of the Texarkana Gas & Electric Company has been increased from $100,000 to $200,000.

YELLVILLE, ARK.—The property of the G. A. Ward Telephone Company, which was sold at auction on March 21, was purchased by Scott Tegarden for $800.

ALAMEDA, CAL.—The Electric Light Commissioners are planning to erect a new building for the municipal electric light plant at a cost of $50,000.

BERKELEY, CAL.—Samuel L. Napthaly, manager of the City Electric Company, of San Francisco, is said to be planning for his company the erection of an electric lighting and power plant in Berkeley. This company is interested in the electric railway line which is to be built from Berkeley over the tunnel road into Contra Costa County, tapping Walnut Creek, Lafayette and those towns along the proposed course. The right of way has been secured by the company and preliminary surveys have already been made. Mr. Napthaly states that the actual work of building the railway will soon begin.

LOS ANGELES, CAL.—A franchise has been awarded to the Los Angeles Railway Company for the South Park Avenue line from Thirtieth Street to Slauson Avenue, for which the company paid $500.

LOS ANGELES, CAL.—The permanent organization of the Los Angeles-San Francisco Short Line Electric Railroad Company has been completed and plans for the construction of the new road have been decided upon. The route has been changed to take in Bakersfield. The company is capitalizd at $2,000,000 and the officers are: Capt. John Cross, president and general manager; Walter F. Haas, vice-president; Charles S. Burnell, secretary, and Charles Weir, treasurer.

OXNARD, CAL.—Thomas Blackburn has applied for a street railway franchise on A Street in this city. The company proposes to establish a passenger service between this city and Hueneme Harbor and Ormond Beach.

SAN FRANCISCO, CAL.—Plans are being made for the extension of the San Francisco, Oakland & San José Railway Company.

WILLOWS, CAL.—Work has been commenced by the Glenn County Telephone Company on the telephone line from Orland to East Park Reservoir (part of the Stony Creek project), near Stonyford. The line is to be used by the Government officials while work is in progress on the large dams to be built in that locality. It is stated that the Government will have full control of this line for at least two years, after which time the Glenn County Telephone Company will take possession.

BRIDGEPORT, CONN.—It is said that the New York, New Haven & Hartford Railroad Company will award contracts during the spring or early summer for the construction of a large power plant on the Housatonic River in Milford. The new plant will be similar to the one located at Cos Cob and will furnish electricity for operating the electric trains between this city and New York. It is proposed to erect the third power house in or north of New Haven.

EAST NORWALK, CONN.—The citizens of this village have voted to establish a municipal electric lighting system, and will erect a pole line for the distribution of electricity. The East Norwalk Fire District Committee has been authorized to make a contract with the city of South Norwalk to furnish electricity for the lamps and to erect the distributing system, at a cost not exceeding $7,000.

NEW BRITAIN, CONN.—The city has awarded the contract for lighting the streets of the city for a term of three years to the Connecticut Company. Under the terms of the contract the company is to furnish not less than 182 incandescent lamps in addition to the 109 of the existing series, of 25 cp. each, at the rate of $20 per lamp per year. These lamps are to replace the Welsbach lamps now in use.

NORWICH, CONN.—The Uncas Power Company has awarded the contract for the construction of a dam and power plant on the Shetucket River, in the town of Scotland, to Tucker & Vinton, New York, N. Y. The dam will be 225 ft. long. The equipment of the power house will include three sets of duplex water turbines having a rating of 2500 horsepower. The plant is expected to be ready for operation by next fall. The transmission line between this city and Scotland has been completed.

WASHINGTON, D. C.—Bids will be received until April 15 for furnishing electrical supplies, etc., to the Smithsonian Institution, United States National Museum, International Exchanges, Bureau of American Ethnology, National Zoological Park, and Astrophysical Observatory, during the fiscal year ending June 30, 1909. Blank forms with specifications for proposals and further information will be furnished on application at the office of the secretary. Charles D. Walcott is secretary.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until April 15 for furnishing electrical supplies, etc., for the fiscal year beginning July 1, 1908, and ending June 30, 1909. Blank forms of proposal and specifications can be obtained at the office of the property clerk, District Columbia, District Building, Washington, D. C.

BARNESVILLE, GA.—The citizens have voted to issue $9,000 in bonds, the proceeds to be used to enlarge and improve the electric light plant and water works system and to improve the Gordon Institute.

BOISE, IDAHO.—The Gooding-Milner Electric Railway Company has awarded the contract for the construction of its railway from Gooding to Milner to Grant & Son, of Faribault, Minn.

CHICAGO, ILL.—The Chicago City Railway Company is planning to build 60 miles of new track during the coming year, for which arrangements for materials have practically been made.

CHICAGO, ILL.—Sealed proposals will be received by the Sanitary District of Chicago until April 29 as follows: Division A—steel poles and cross arms. Division B—weatherproof insulated copper wire. Division C—insulators. Plans, specifications and form of contract can be obtained at the office of the electrical engineer of the Sanitary District, American Trust Building, Chicago, Ill. Robert R. McCormick is president Board of Trustees.

GRIDLEY, ILL.—D. A. Steiner, of Bern, Kan., is seeking a franchise to install and operate an electric light plant in Gridley.

HAMBURG, ILL.—Fred Hamlin, of Pittsfield, is reported interested in a proposed electric light plant at Michael to furnish electricity for lamps in the towns of Hamburg, Kampsville and Hardin.

MIDDLETOWN, ILL.—The village has granted W. M. Goggin a ten-year franchise to construct and operate a lighting, heat and power plant and water works system.

MILLSTADT, ILL.—The West Side Telephone Company has filed a notice with the Secretary of State of an increase in capital stock from $2,700 to $4,500.

ORION, ILL.—The municipal electric light plant was nearly destroyed by fire recently, causing a loss of about $8,000. At present the streets of the village are in darkness. Plans are being considered to extend a transmission line from Alpha to Orion, as the Alpha company is ready to furnish the service.

HARTFORD, IND.—The Hartford City Lighting Company is contemplating some improvements and changes to its plant, but as yet nothing definite has yet been decided.

INDIANAPOLIS, IND.—The Consolidated Telephone Company, the Farmers' Co-operative Telephone Company and the Bell Telephone Company, of Hendricks County, have been merged, the Consolidated company taking over the property and holdings of the other two companies. The consolidated plants includes 2000 telephones and the exchanges in Danville, Brownsburg, Plainfield, Pittsboro and North Salem as well as the farmers' lines. The lines will be all brought into one system.

INDIANAPOLIS, IND.—The State Board of Agriculture has abandoned the idea of erecting an electric plant on the State Fair Grounds and has contracted with the People's Heat & Light Company to wire the buildings and extend its wires to the fair grounds for $6,500. The company will furnish electricity for lamps during the fair and other entertainments in the pavilion at five cents per kw-hour.

INDIANAPOLIS, IND.—Owing to the threat of the Board of Public Works to put in a system of gas lighting to replace the electric lamps now in use in the city market and Tomlinson Hall the Merchants' Heat & Light Company proposes to install a new system of electric lighting in the city market. The company's proposition is to replace incandescent electric lamps in the market with new tungsten filament lamps.

LEBANON, IND.—A company is being organized to build and install a central hot water heating and lighting plant in this city. Philip Adler, A. H. Felker and R. D. Tollotson are among the promoters of the enterprise.

LIBERTY, IND.—The corporation of Liberty is contemplating changing the street lighting system from gas to electricity and would like to communicate with firms and parties installing electric light plants. G. E. Stevenson is chairman of light committee.

MT. VERNON, IND.—The City Council has awarded the contract for lighting the streets of the city for ten years, beginning July 1, 1909, to the Mt. Vernon Electric Light & Power Company.

NEW CASTLE, IND.—The Light, Heat & Power Company, of this city, has voluntarily reduced its rates 25 per cent besides allowing a cash discount. The action was taken in order to induce the more universal use of electricity, the company's new big plant being capable of supplying a much larger demand.

POSEYVILLE, IND.—The Town Council has granted a 25-year franchise to Frank Seib and associates to build and install an electric light plant in this place.

WASHINGTON, IND.—The stockholders of the Washington Light & Water Company have ratified the act of the directors in employing S. I. Woodward, of Shelbyville, Ill., to take charge of the electric light plant and supervise the work of improvement about to be made.

DAVENPORT, IA.—The People's Light Company and the Independent Light & Power Company, of Davenport, will be consolidated. In consideration of the transfer the stockholders of the Independent company have agreed to take the value in stock of the People's Light Company. It is said that the Independent company has expended $250,000 for the power plant and conduit work, and existing contracts are said to approximate $100,000. J. G. White & Co., of New York, N. Y., are operating managers of the People's Light Company.

HARTLEY, IA.—The citizens have voted to issue $12,000 in bonds, the proceeds of which to be used for the construction of an electric light plant. F. R. Lock is mayor.

FRANKFORT, KAN.—The question of installing an electric light plant is under consideration.

OSKALOOSA, KAN.—The Oskaloosa Electric Light Company will commence May 1 to furnish a day service for lamps and motors. C. M. Buck is manager.

PADUCAH, KY.—The Royal Investment Company, of Minneapolis, Minn., has closed a deal with the Kentucky & Ohio River Interurban River Railway Company, of this city, for the construction of an electric railway connecting Cairo and Paducah, 50 miles in length; also for the purchase of $1,000,000 of first mortgage bonds.

CROWLEY, LA.—The Board of Directors of the Odd Fellows' Home is contemplating extensive improvements to the Odd Fellows' Home consisting of the installation of a lighting and water works system. A committee consisting of C. W. Ward, of Alexandria; John T. Nixon, of Crowley, and Mrs. J. H. Huston, of Lake Charles, has been appointed to ascertain the cost of work.

RUSTON, LA.—The citizens have voted to issue $50,000 in bonds for making improvements and extensions to the light and water plant.

AUBURN, ME.—The Lewiston & Auburn Electric Light Company has petitioned the City Council for permission to erect its pole line within the city to connect the Deer Rips power station with the one at Littlefields.

BIDDEFORD, MAINE.—The Maine Railroad Commissioners have issued a decree renewing the charter of the Biddeford Pool Electric Railway for a term of three years. Among the directors are: Charles M. Moses, of Saco; Charles B. Harmon and Charles E. Atwood, of Biddeford.

FAIRFIELD, MAINE.—The stockholders of the Caratunk Power Company have voted to change the name of the company to the Franklin Power Company, and to increase the capital stock of the corporation to $100,000.

ANNAPOLIS, MD.—A bill has been introduced in the State Legislature to incorporate the Rural Electric Railway & Power Company. The company is capitalized at $500,000 and proposes to build an electric railway from Lauraville to the Falls Road and from Baltimore to Sparrows Point. The incorporators are: Hugh T. Gallaher, Walter A. Gedhart, W. T. Dietrick, Harry C. Hess, Robert W. Mobray and Jacob S. Parr.

BALTIMORE, MD.—The State Legislature has refused to grant a charter to the Baltimore Light, Heat & Power Company. It is said that the company will seek incorporation in some other state. H. B. Fentress is interested in the enterprise.

ADAMS, MASS.—The Selectmen are contemplating installing an electric light plant at the town farm. It is said that there is sufficient water power to operate the plant.

BOSTON, MASS.—The managers of the Farm and Trades School, on Thompson Island, in Boston Harbor, are endeavoring to raise $10,000 to meet half of the cost of a new power house and for neded improvements to the present buildings. If the managers raise this amount a friend of the school has agreed to give $10,000 to the fund.

BOSTON, MASS.—The city has cancelled the old contract made with the Edison Electric Illuminating Company for lighting the municipal buildings and has accepted the regular schedule, which will save the city approximately $1,000 per month.

HOLYOKE, MASS.—The contract for the construction of the addition to the electric light station has been awarded to Casper Range for $41,000. Contracts for the machinery have already been awarded. W. H. Snow is manager of the municipal lighting department.

ORANGE, MASS.—It is reported that the Rodney Hunt Machine Company will receive bids at once for the construction of a concrete dam at the Partridgeville mill, recently purchased by the company. The dam when completed will furnish power to operate the electric plant of the company, which will furnish electricity for lamps and motors for the manufacturing plant of the company and also for other manufacturing plants.

DETROIT, MICH.—Estimates to the amount of $377,796 for the public lighting commission have been approved by the City Council, of which $106,000 was allowed for improvements to the plant; $61,335 for constructing conduits for fire, police and public lighting wires in certain sections of the city.

KALAMAZOO, MICH.—Part of the dam of the Commonwealth Power Company on the Kalamazoo River was washed away March 27.

STARVILLE, MICH.—A company has been organized in this place to construct and operate an independent telephone line. The officers are: Charles Basney, president; M. Gibbons, vice-president; E. B. Hill, treasurer.

SOUTH ST. PAUL, MINN.—Plans are being considered by the St. Paul Union Stock Yards Company for the purchase of a 50-kw direct-connected unit; a 60-kw belted unit, switchboards, motors, feeders, centrifugal pumping plant, etc. Edward P. Burch, of Minneapolis, is consulting engineer.

CROOKSTON, MINN.—A rural telephone line is being built by the farmers of Nesbit, Fanny, Lowell and Fisher. The line will be 40 miles in length, extending from the Minnesota State experiment farm into the northeast. The line will be built and operated in demonstration work by the students of the Minnesota farm.

CANTON, MISS.—The Municipal Electric Light and Water Works Commissioners have awarded a contract to the Westinghouse Electric & Manufacturing Company for a 75-arc lamp series alternating-current street lighting system. The commissioners contemplate changing the system from 1100 volts, 133 cycles to 2300 volts, 60 cycles, in June or July, and will then probably purchase two alternators having a rating of 180 and 120 kilowatts, respectively, and also a Corliss engine to drive the smaller generator. John T. Sharp is superintendent.

LOUISIANA, MO.—We are informed that work on the proposed electric railway between Louisiana and Bowling Green will probably begin this summer. The road will be built by the Louisiana Light, Power & Traction Company and will be 11 miles in length. The power station will be located at Louisiana and the overhead trolley system will be used. The company is capitalized at $200,000, and the officers are: D. Turnbolt, president and general manager; F. E. Murray, secretary, both of Louisiana.

MEXICO, MO.—The Mexico, Santa Fé & Perry Traction Company has filed a mortgage for $850,000 to secure an issue of bonds, the proceeds of which to be used for the construction of the road.

ST. CHARLES, MO.—The St. Charles Electric Light & Power Company has submitted a proposition to the City Council for the city to take over the plant, payments to be made in yearly installments. The company has made several efforts to obtain an extension of its franchise, which has about six years to run, but has failed.

HARLOWTON, MONT.—Plans are being considered by the Harlowton Electric Light & Water Company for the installation of an electric light plant.

RED LODGE, MONT. The Northwest Improvement Company is planning to resume work on the construction of an electric power plant on the west side to furnish electrical energy for the mines.

ORD, NEB.—The plant and holdings of the Ord Electric Light & Power Company have been purchased by M. Mickelson, of St. Paul, Neb. The new owner took possession of the plant April 1.

WAHOO, NEB.—The citizens have voted to issue $65,000 in bonds for the construction of an electric light plant and water works system.

PATERSON, N. J.—Plans are being considered by Charles Curie, owner of the Colt Building, for the installation of a private electric lighting plant for the purpose of furnishing electricity for the Colt Building, and also for buildings in the block bounded by Market, Colt, Ellison and Church Streets.

BERGEN, N. Y.—The Village Board has discontinued operating the electric light plant and the streets of the village are in darkness. The building, boilers and engine are owned by B. R. Baninger, of Rochester, and the dynamos and outside equipment belong to the estate of B. L. Lewellyn. The board has been operating the plant since Nov. 16, 1907. No arrangements have yet been made for restoring the service. The village has been lighted by electricity since 1901.

BUFFALO, N. Y.—The Buffalo & Lake Erie Traction Company has filed a notice with the Secretary of State at Harrisburg, Pa., of increase of indebtedness from $4,755,000 to $5,005,000 for the purpose of making an extension of five miles in Mill Creek Township, Pa.

GENEVA, N. Y.—Plans are being considered by the Geneva-Seneca Electric Company for the construction of an entire new power plant. F. L. Dame, of New York City, is consulting engineer.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent school buildings, until April 15, for installing electric equipment in new Public School No. 17, Forty-seventh and Forty-eighth Streets, Borough of Manhattan.

NEW YORK, N. Y.—Contracts have been awarded by C. B. J. Snyder superintendent school buildings, to T. Frederick Jackson, 592 Columbus Avenue, New York City, for installing electric equipment as follows: Public School No. 153, Borough of Brooklyn, for $8,344; Public School No. 90, Borough of Queens, for $9,951.

ROCHESTER, N. Y.—Surveys are being made for the Rochester, Syracuse & Eastern Railroad between Syracuse and Lyons. The power house at Savannah is completed.

ROCHESTER, N. Y.—The Rochester-Corning-Elmira Traction Company has been authorized by the Public Service Commission to issue capital stock to the amount of $3,880,000, making a total of $5,000,000, and bonds to the amount of $4,210,000, and the execution and delivery of a mortgage upon all its property, franchises, etc., to the amount of $6,000,000 to secure payment of said bonds. The company applied for permission to issue a first mortgage for $8,000,000 and $8,000,000 in bonds under the mortgage. The total capitalization now allowed is $9,210,000, instead of $12,000,000, as applied for. The proceeds of stocks and bonds to be used for acquisition of property, etc., in construction of the proposed road and for construction of the road and necessary power plant, machinery and rolling stock, etc. The company proposes to build a double-track railway from Rochester to Elmira, a distance of 120 miles.

UTICA, N. Y.—The Central New York Telephone & Telegraph Company has completed arrangements for taking over the business of the Oneida County Rural Telephone, of Holland Patent, and the Camden Home Telephone Company, of Camden.

SALISBURY, N. C.—The Salisbury-Spencer Railway Company contemplates securing electrical energy for operating its street railway system from the Southern Power Company, of Charlotte. H. W. Frund is manager of the street railway company.

EDGELEY, N. D.—The Village Board is considering the question of establishing an electric lighting system.

CLEVELAND, OHIO.—Plans have been completed by George S. Rider, consulting engineer, for an addition to the power plant of the Cleveland Worsted Mills Company, including the construction of a boiler house, coal bunkers, a 225-ft. brick chimney, mechanical stokers and water-tube boilers of 2500 horse-power.

DAYTON, OHIO.—Plans are being made by the Dayton Street Railway Company to begin the laying of its tracks at an early date. About 14 miles will be laid.

FREMONT, OHIO.—It is reported that the Lake Shore Electric Railway Company contemplates extending its branch line from Gibsonburg to Helena.

NEW PHILADELPHIA, OHIO.—The People's Telephone Company has filed amendments to its charter increasing its capital stock from $5,000 to $15,000.

TONTOGANY, OHIO.—The Mutual Telephone Company is making extensive improvements to its system here, and is substituting the present wires with cables in the south part of the town.

WEST MILTON, OHIO.—Plans are being considered by L. A. Pearson for the construction of a hydro-electric plant at a cost of about $10,000. It is proposed to install an electric lighting system, including 25 arc lamps of 2000 cp and 1000 incandescent lamps. As yet no engineer has been employed.

OKLAHOMA, OKLA.—Plans are being contemplated by the Oklahoma Gas & Electric Company for extending its electric light system.

EUGENE, ORE.—The Pacific States Telephone & Telegraph Company is planning to make extensive improvements to its local system, including the placing of its wires under ground, enlarging the central office and switchboard, the cost of which is estimated at $20,000.

PORTLAND, ORE.—A deed has been filed in the office of the Multnomah county clerk making a formal transfer of the properties of the old Portland General Electric Company to the Portland Railway, Light & Power Company. The holdings of the company included all the appliances, plants and franchises for distribution of electricity in Portland, and several Willamette Valley cities, including the Cazadero power plant, the Salem electric light plant and street railway, the Union electric light and power plant of Marion County, Portland Hydraulic Elevator Company, Willamette Falls Company, the Vancouver Electric Light & Power Company, the Union Power Company and the Willamette Transportation & Locks Company. The Portland Railway, Light & Power Company owns all but a few shares of stock in each company.

WESTON, ORE.—Plans are being made for an Independent telephone system to connect Weston with Bingham Springs, on the Umatilla River, and the permanent camp of the Government Forest Rangers. The system will require 20 miles of wire.

GERMANIA, PA.—A number of farmers of Germania, Yocum Hill, have decided to construct a telephone line from Yocum Hill to Galeton by the way of Germania, and also propose to build several branches throughout that section of the country. John Handwerk, William Thomke, John Schaar and William Heinrich are interested in the project.

HARRISBURG, PA.—The City Council has passed an ordinance granting the Central Pennsylvania Traction Company permission to make certain extensions in East and West Harrisburg.

IRWIN, PA.—A company has been formed to construct a street car line from Manor to Claridge, and surveys are now being made of the proposed route. The officers of the company are: H. A. Lauffer, president; William J. Kemerer, vice-president; John Naley, secretary, and F. R. Rankin, treasurer.

SHAMOKIN, PA.—The Shamokin & Coal Township Light & Power Company has filed amendments to its charter increasing its capital stock from $191,000 to $600,000.

TUNKHANNOCK, PA.—The capital stock of the Tunkhannock Electric Company has been increased from $15,000 to $35,000.

WEST CHESTER, PA.—The West Chester and Wilmington Electric Railway companies, one of which had been chartered in Pennsylvania and the other in Delaware, have been consolidated under the name of the West Chester Electric Railway Company. The new company has a capital stock of $254,000. The road will be continued to Brandywine Summit later. Thomas E. O'Connell is president.

MANILA, P. I.—The contract for furnishing and installing electrically driven pumps and motors for the new sewer system for the city of Manila has been awarded to Frank L. Strong, of this city. The contract calls for Worthington pumps and General Electric motors. John M. Luther is secretary of the Municipal Board.

WESTERLY, R. I.—The Westerly Light & Power Company contemplates extending its transmission lines to Ashaway and Pleasant Valley and also reducing the price of electricity to consumers on a sliding scale from 15 to 60 per cent. The new rates will go into effect if a ten-year contract for lighting the town is given company. The company will continue to furnish electrical energy for operating the Pawcatuck Valley Street Railway Company, which was recently sold by the company to the Norwich & Westerly Railway Company. The purchasing company intends to reconstruct the Watch Hill railway and run through cars from Norwich.

ETOWAH, TENN.—Plans for the construction of an electric light plant are being considered by the Etowah Electric Light & Power Company.

MEMPHIS, TENN.—The South Memphis Traction & Electric Company, it is said, will be organized at an early date for the purpose of constructing an electric railway to South Memphis.

BRENHAM, TEX.—Arrangements are being made to build a new telephone line from Brenham to Longpoint and from there to Guy Hill and to Burton.

LYNDONVILLE, VT.—Plans are being considered to increase the output of the municipal electric light plant, which will include the installation of another dynamo and heavier wire.

ELKTON, VA.—The Elkton Milling Company is considering the question of installing an electric light plant to be operated by water power.

STAUNTON, VA.—John M. Spotts has purchased the entire capital stock of the Blue Ridge Light & Power Company, which operates the street railway system and electric light plant in Staunton. Mr. Spotts has been president of the company for the past three years. The new management proposes to make extensive improvements to the street car system.

CHENEY, WASH.—The Hayes-Stroup Telephone Company has completed arrangements for the construction of a telephone line from Cheney to Tyler, a distance of eight miles. H. F. Adams, of Cheney, will have charge of the work.

SPOKANE, WASH.—We are informed that the Okanogan Electric Railway Company has practically completed all its surveys, and expects to commence work on the construction of the road not later than June [illegible]. The railway will be 60 miles in length. The power station will be located near Cuess, on Sinlahekin Creek. A. M. Dewey is president and general manager.

SPOKANE, WASH.—Official announcement has been made that the Washington Water Power Company will expend $1,000,000 for extending its transmission line in the Big Bend County. It is also announced that the output of the steam relay station at Ross Park, Spokane, will be increased from 4000 to 16,000 horse-power, and that of the hydro-electric plant at Post Falls, Idaho, from 12,000 to 15,000 horse-power, which will give the company an output of 44,000 horse-power by next August.

SPOKANE, WASH.—It is stated that the Power Development Company, a subsidiary company of the Spokane & Inland Electric Railway Company, will have a surplus of from 10,000 to 15,000 horse-power from the power station at Nine Mile Bridge, as soon as the plant is completed, after supplying electrical energy for operating the railway lines of the system. The company proposes to utilize this surplus by supplying electricity in Spokane for lamps and motors under the franchise purchased by Jay P. Graves, president of the system, and associates from Frank P. Hogar.

CHARLESTON, W. VA.—The contract for rewiring the entire state capitol has been awarded to the Sackett Mine Supply Company, of Columbus, Ohio. L. A. Sackett is president of the company.

JUNEAU, WIS.—Bids will be received until April 18 by F. [illegible] O'Neill, city clerk, for the construction of a brick power house, and for furnishing a 300-gal. deep well triplex pump and a 25 hp gasoline engine. W. G. Kirchoffer, of Madison, is engineer.

STURGEON BAY, WIS.—James J. Johnson, superintendent of the municipal electric light plant, has presented a proposition to the City Council, which involves the moving of the electric light plant from its present site to the Market Square on Court Street.

CALGARY, ALBA., CAN.—The City Council will receive proposals for the construction, equipment and operation of a street railway in the city of Alberta under a limited franchise. For particulars apply to H. [illegible] Gillis, City Clerk.

HOSMER, B. C., CAN.—The Cranbrook Light, Power & Telephone Company, Cranbrook, B. C., announces that it will build a long distance line from here to Fernie, which will be in operation by the middle of May.

VIRDEN, MAN., CAN.—Sealed tenders will be received by James F. C. Menlove, secretary and treasurer, until May 10, for the construction of a rural telephone system in the municipality of Wallace. Plans and specifications may be seen at the municipal offices, Virden, and also at the department of telephones, Winnipeg, Man.

GODERICH, ONT., CAN.—Plans for the route of the proposed electric railway to Kincardine have been completed by the Ontario West Shore

Electric Railway, and contracts for the construction of the road will soon be awarded. H. J. McEwan, of Goderich, is secretary.

OTTAWA, ONT., CAN.—The company which proposes to construct an electric belt railway from this city running through Carlton, Russell, Dundas, Brockville and Prescott, making a complete belt line of about 200 miles, will make an application for a charter. Mayor Cossitt, of Brockville, is said to be interested in the enterprise.

MONTREAL, QUE., CAN.—Arrangements have been completed by W. H. Cushing, Minister of Public Works for the Province of Alberta, with the Bell Telephone Company, of Canada, for the purchase of its lines in the province for $675,000.

MILESTONE, SASK., CAN.—Application is being made to the local Legislature for permission to change the name of the Farmers' Mutual Telephone Company No. 1 to the Milestone Farmers' Mutual Telephone Company and for permission to increase the capital stock to $10,000 in order to take over the proposed lines around this town under one system.

REGINA, SASK., CAN.—Hon. Walter Scott, Premier of Saskatchewan, is negotiating with the Bell Telephone Company for the purchase of its system in this province.

PARRAL, MEX.—The Veta Colorado Mining & Smelting Company has awarded a contract to the Westinghouse Electric & Manufacturing Company for three 375-kw generators and other equipment for its plant near Parral, Mex. This is in addition to the equipment installed last year, and will generate electricity to operate the mines and smelters and an electric railway connecting the mines and smelters.

New Industrial Companies.

THE ELECTRIC MACHINE & EQUIPMENT COMPANY, of Stockton, Cal., has been incorporated with a capital stock of $25,000 by M. McKay, R. F. Urquhart and L. F. Youdall.

THE SOUTHERN ILLUMINATING COMPANY, of Birmingham, Ala., has been incorporated, with a capital stock of $15,000. The company proposes to act as Southern agent for the tungsten lamp and other electrical goods.

THE JOSEPH REID GAS ENGINE COMPANY has been incorporated, with a capital stock of $100,000, by J. H. Russell, of Robinson, Ill., for the purpose of selling gas engines. The company is a Pennsylvania corporation.

THE LENHER ENGINEERING COMPANY, of Elizabeth, N. J., has been incorporated with a capital stock of $100,000 by Stonewall J. Lenher, Charles N. Walsh and George H. Stevens. The company proposes to manufacture electrical engines.

THE NEW JERSEY METER COMPANY, of Rutherford, N. J., has filed articles of incorporation with a capital stock of $10,000. The incorporators are H. W. Kuhl, W. E. Walter and J. P. Walter. The company is to manufacture meters, etc.

THE INDEPENDENT TELEPHONE CONSTRUCTION COMPANY, of California, Pa., has been chartered, with a capital stock of $5,000, by Allen J. White, Walter J. Weaver, H. L. Lamb, of California, and Homer Wheelock, of Townville, Pa.

THE P. H. DOYER & COMPANY, of Portland, Ore., has been organized, with a capital stock of $50,000, for the purpose of carrying on a contracting and lighting business. E. P. Doyer is president, and P. H. Doyer, treasurer, both of Portland, Me.

THE AMERICAN FLAMING ARC LAMP COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $150,000. The officers are: Charles H. Sprague, president; Joshua D. Robinson, treasurer, and Dana P. Bartlett, secretary, all of Boston, Mass.

THE HAVERSTICK & COMPANY, of Rochester, N. Y., has been incorporated by Frantz Haverstick, Harvey Cory and Henry D. Shedd, of Rochester. The company proposes to manufacture steam, water, gas, electrical and mill supplies and specialties. The company is capitalized at $50,000.

BATCHELLER, CLARK & BATCHELLER, of New York, N. Y., has been incorporated, with a capital stock of $20,000, by Clement Batcheller and Hillard G. Batcheller and Horace D. Byrnes, all of New York, N. Y. The company proposes to manufacture machinery, engines, boilers, etc.

THE VACUUM IMPREGNATING MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $50,000 to manufacture electrical apparatus. The incorporators are Raymond W. Marshall, Adolph Schneider, of Brooklyn, and Cassius C. Perrin, of New York.

THE RILEY ELECTRICAL COMPANY, of Holland, N. Y., has been incorporated, with a capital stock of $20,000, for the purpose of manufacturing electrical supplies and appliances. The incorporators are: Philip M. Riley, Dennis A. Whitney, of Holland, and Albert H. Shoff, of Buffalo, N. Y.

THE CAROLINA ELECTRIC COMPANY, of Raleigh, N. C., has been chartered, with a capital stock of $15,000, by N. L. Walker, J. R. Young, T. B. Crowder, C. R. Durfy and D. J. Thompson. The company proposes to do a general contracting business and install electric light and power plants, etc.

THE HAMILTON-HUFFMAN CONSTRUCTION COMPANY, of Fairmont, W. Va., has been incorporated, with a capital stock of $25,000 by A. A. Hamilton, D. S. Huffman, J. R. Pinn, James Bambridge and A. S. Fleming. The company proposes to build electric and steam railroads, bridges and other construction work.

THE FT. WAYNE ENGINEERING & MANUFACTURING COMPANY, of Ft. Wayne, Ind., has filed articles of incorporation with the Secretary of State with a capital of $200,000. The company proposes to manufacture engines, boilers, electric supplies, etc. Henry C. Paul, F. S. Hunting and John Asbom are the directors.

THE GENERAL LIGHT COMPANY, of Camden, N. J., has filed articles of incorporation, with a capital stock of $100,000, for the purpose of manufacturing machinery, engines, etc., for producing light. The incorporators are: J. L. Sweigard, of Philadelphia, Pa.; E. P. Gerber, of Reading, Pa.; S. Foredberger, of Philadelphia, Pa., and C. S. King, of Camden.

New Incorporations.

SAN BERNARDINO, CAL.—The Standard Gas & Electric Company has been incorporated here with a capital stock of $50,000.

STOCKTON, CAL.—Articles of incorporation have been filed for the South San Joaquin Improvement Company with a capital stock of $100,000. The company will engage in a general development business and promote the construction of an interurban railway between Manteca and Stockton. Among the directors are: D. O. Castle, J. A. MacAfee, E. J. Baker, of French Camp; E. Powers and J. D. Maxey, of Manteca; B. A. Goodwin and C. B. Matthews, of Ripon.

HARTLEY, DEL.—The People's Telephone Company, of Delaware, has been chartered, with a capital stock of $90,000. The directors are: David Rothenburg, David Rodemay and Joseph M. Hazel, of Hartley.

MACON, GA.—The Flint River Power Company has been incorporated by W. J. Massee, John T. Moore and Walter T. Johnson.

WEST PALM BEACH, FLA.—Articles of incorporation have been filed for the Ariston Ice & Electric Company, with a capital stock of $40,000. The officers are: Edward G. Black, president; John E. Brady, secretary, and Alfred W. Varian, treasurer.

ELBERTON, GA.—Plans are being made to organize the Broad River Power Company to construct a hydro-electric plant on the Broad River to furnish electricity for lamps and motors. A. S. J. Stovall, A. S. Oliver, E. B. Tate, I. G. Swift and others, of Elberton, are interested in the project. The Solomon-Norcross Company, of Atlanta, Ga., is making surveys for the proposed plant and will have charge of the work.

CHENOA, ILL.—The Chenoa Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are: John F. Johnson, Frank Watson, A. M. Blake, and others.

CHICAGO, ILL.—The Interlake Railroad Company has been chartered with a nominal capital stock of $5,000 to construct an electric railway from Lake Michigan to Fox Lake, in Lake County. The incorporators are: Otto Hopper, S. N. Conway, Martin D. Smith, A. F. Struckman and S. S. Welcher.

LITTLETON, ILL.—The Littleton & Brooklyn Telephone Company has been organized with a capital stock of $2,000, and is planning to commence active operations in the near future. The officers of the company are: John L. Day, president; H. D. Sellers, secretary, and E. B. Dixson, treasurer.

KOKOMO, IND.—The Darrough-Chapel Rural Telephone Company has been incorporated. The directors are: Richard S. Reed, B. L. O. Tate and E. M. Tate.

MASON CITY, IA.—The Lake Shore Telephone Company has filed articles of incorporation, with a capital stock of $4,500, for the purpose of constructing and operating telephone lines in this county.

RHODES, IA.—Articles of incorporation have been filed for the Rhodes Telephone Company, with a capital stock of $5,000. The officers of the company are George W. Marsh, president; A. C. Meyers, vice-president; Melvin F. Baker, secretary, and O. Luttikin, treasurer.

DEMOCRAT, KY.—The Upper Rockhouse & Beaver Telephone Company has been formed with a capital stock of $1,200 by T. A. Cook, Ewins Cook, C. C. Martin and others. The company proposes to construct a telephone line from Republican to Democrat, 20 miles in length, with numerous small branch lines.

FRANKFORT, KY.—Articles of incorporation have been filed with the Secretary of State for the Ballard County Independent Telephone Company, with a capital stock of $1,800.

GRAYSON, KY.—The Grayson County Telephone Company has been organized by Richmond Day, Isaac Miles and William Wellston. The company is capitalized at $2,500 and proposes to construct and operate an independent line from Grayson via Kelley's and from Siding to Stanton, a distance of about 35 miles.

LINCOLN, KY.—The Kentucky Farmers' Telephone Company has been incorporated, with a capital stock of $1,000.

RUSSELL, KY.—The Jamestown & Wilson Telephone Company has been incorporated, with a capital of $350.

STANFORD, KY.—The Kentucky Farmers' Telephone Company has been organized, with a capital stock of $2,000, to construct and operate a telephone line from Stanford to Mt. Vernon. Jesse Overby, of Stanford; Danver Prater, of Hustonville, and William Smith, of Jesse, are interested in the enterprise.

OXFORD, ME.—The Oxford & Otisfield Telegraph & Telephone Company has filed a certificate of incorporation, with a capital stock of $5,000. The incorporators are H. M. Stone, James G. Howe, E. R. Stone, of East Otisfield; George B. Turner, William Faunce, L. H. Dunn, Orrin Stevens and others, of Oxford.

CLARISSA, MINN.—The Clarissa Rural Telephone Company has been organized for the purpose of operating a telephone system. Work has commenced on the installation of a local exchange.

LEAF RIVER, MINN.—Articles of incorporation have been filed for the Clover Hill Rural Telephone Company, with a capital stock of $1,200, by G. W. Alberts, J. B. Wallace and A. J. Broadfoot.

MOORHEAD, MINN.—The Buffalo River Telephone Company has been organized, with a capital stock of $40,000. The officers are: Jorgen Jensen, president; G. O. Lee, vice-president, and C. Grover, treasurer.

PINE ISLAND, MINN.—The farmers of Pine City and vicinity have organized a telephone company to construct a line from Pine Island to Bowerville, and throughout the surrounding country. The officers of the company are C. A. Anderson, president: John H. Bogert, vice-president; E. E. Johnson, secretary, and John Rapp, treasurer.

TECUMSEH, NEB.—The business men and farmers of Cook and vicinity have organized a new telephone company and will install a metallic system. The following officers have been elected: J. E. Proffitt, president; George F. Dorsch, secretary, and S. B. Wilson, treasurer.

CHATEAUGAY, N. Y.—The Farmers' Rural Telephone Company has been organized to build a telephone line from Chateaugay to Frontier, by the way of Earlville.

NEW YORK, N. Y.—The Orange & Cronomer Lakes Power Company has been incorporated, with a capital stock of $100,000, by Arthur H. Ferber, Emily S. Henning and M. C. King, all of New York.

NEW YORK, N. Y.—The Hudson & Long Island Traction Company has filed articles of incorporation with a capital stock of $50,000 to construct and operate an electric railway from Twelfth Avenue and West Forty-second Street, New York, to the plaza of the Blackwell's Island Bridge in Long Island City, four and one-half miles in length. The directors are: Frederick K. Morris, Anthony Stumpf, Arthur C. Hume, Harold B. Weaver, Cassius M. Wicker, Henry A. Belden, William V. Lomax and John J. Clancy, of New York, and William B. Spencer, of Montclair, N. J.

OXBOW, N. Y.—The Oxbow Telephone Company has been incorporated, with a capital stock of $550, to build a telephone line from Oxbow to Antwerp and to Rossie. The directors are Elmer Storie, William Laucto, W. C. Baldwin, William Hutton, A. B. Jelark and others.

WATERTOWN, N. Y.—Plans have been perfected for the construction of a new telephone system, which will be known as the Jefferson County Telephone Company. C. H. Poole and S. H. Ferris, of Utica, are interested in the enterprise.

LEAKSVILLE, N. C.—A charter has been granted to the Leaksville Light, Power & Milling Company to operate a lighting plant, flouring and grist mills, etc. The company is capitalized at $125,000, and the incorporators are: E. B. and J. B. King and others.

FESSENDEN, N. D.—The German Oshkash Telephone Company has been chartered by Andrew Dietz, Carl Ebbert and Charles A. Krueger, all of Fessenden.

LEEDS, N. D.—The Springfield Telephone Company has been incorporated by John F. Fosen, A. Strasbe, F. D. Anderson and others.

WILLISTON, N. D.—The Muddy Valley Telephone Company has been incorporated, with a capital stock of $9,000, by John A. Wageman, Marchall H. Jeffery and Fred Cutter, of Williston.

WILLIAMSBURG, OHIO.—The Williamsburg Home Telephone Company has been chartered, with a capital stock of $10,000, by J. O. Fuhr, W. T. Elrod, J. H. Weaver, J. P. Allen and C. C. Patten.

FT. GIBSON, OKLA.—The Grand River Light & Power Company has filed articles of incorporation, with a capital stock of $15,000. The incorporators are: T. J. Bardmont, M. C. Meigs and others.

GUTHRIE, OKLA.—The Glose Heat & Power Company, of Chicago, Ill., and Guthrie, Okla., has been incorporated, with a capital stock of $10,000, by J. J. Butler, G. A. Mason, of Chicago, Ill.; G. V. Pattison and H. W. Pentecost, of Guthrie.

GUTHRIE, OKLA.—A charter has been granted to the Cherokee Belt & Interurban Railway Company to build an electric railway from a point on the Midland Valley Railroad to the Missouri, Kansas & Texas Railway. The capital stock of the company is placed at $500,000 and the incorporators are: F. E. Montel, of Kansas City; C. W. Butterworth, of Tulsa; J. R. Caudley, E. Pease and A. E. Leahe, of Collinsville.

HUNTER, OKLA.—Articles of incorporation have been filed for the Hunter Telephone Company, with a capital stock of $5,000. The directors are E. P. Thomas and P. Cochran, of Hunter.

LEBANON, OKLA.—The Lebanon Telephone Company has filed articles of incorporation. The capital stock is placed at $10,000, and the directors are G. M. D. Halford, J. M. Whitsel, S. M. Keisie, H. Moss and H. F. Keller, of Lebanon.

HARBOUR CREEK, PA.—The South Harbour Creek Telephone Company has been incorporated, with a capital stock of $6,000, by Clayton A. Bell, Homer O. Walker, Alfred E. Wood and others, of Harbour Creek.

PHILADELPHIA, PA.—The Philadelphia Terminal Transfer Company has been chartered, with a capital stock of $150,000, by E. B. Colket, president; M. B. Colket, George W. Freed, Jr., Fleming Parke, of Philadelphia; Clarence L. Potts, of West Chester; C. S. Ardmore; Franklin McCall, of Haverford, and Herbert K. Adams, of Eddington.

FOMBELL, PA.—The Fombell Telephone Company has been granted a charter to construct a telephone line from Ogel to Oak Grove Church. The company is capitalized at $5,000. J. F. Schramm, of Fombell, is treasurer.

TOWER CITY, PA.—The Sterling City Light, Heat & Power Company has been chartered, with a capital stock of $22,000, by John T. Pfeiffer, of Tower City, treasurer; Harper T. Bressler, B. W. Fees, Pierce Maher, Robert Sterling and others, all of Tower City.

NASHVILLE, TENN.—The McKenzie Home Telephone Company, of Carroll County, has filed articles of incorporation with the Secretary of State. The capital stock is placed at $1,500, and the incorporators are R. J. Parnell, J. C. Blackburn, H. E. Sexton and others.

SALINA, UTAH.—Articles of incorporation have been filed with the Secretary of State for the Salina Telephone Company. The company is capitalized at $10,000, and the officers are: A. J. Lewis, president; E. M. Peyton, vice-president, and H. F. Jorgensen, secretary.

POUND, VA.—The Indian Creek & Pound Telephone Company has been organized, with a capital stock of $2,000, by Y. Hughes, Jr., of Almira; R. D. Hughes, of Potters Creek, Ky., and Miller Smith, of Pound.

BAD AX, WIS.—The Bad Ax Telephone Company, of Vernon County, has been incorporated, with a capital stock of $7,000, by S. Anderson and others.

RHINELANDER, WIS.—Articles of incorporation have been filed for the Rhinelander Lighting Company, with a capital stock of $100,000, by John Lind, C. F. Dixon and others.

BRIGHTON, N. B., CAN.—The Farmers' Telephone Company, Ltd., has been incorporated, with a capital stock of $5,000, by Henry A. Smith and others.

ALAMEDA, SASK., CAN.—With a capital of $15,000 the Alameda Rural Telephone Company is being organized to build a long distance line between here and Arcola, touching Douglaston, Dalseboro and Curt Hills.

Legal.

ELECTRIC WIRES IN A BUILDING ARE FIXTURES AND SUBJECT TO A MECHANIC'S LIEN.—The statutes of the state of Oregon provide that every person performing labor upon or furnishing material of any kind to be used in the alteration or repair of a building shall have a lien upon the building for the work done or the material furnished. It was held that under this provision a person doing repair work on the electric wiring in a building was entitled to a lien. It was argued by defendant's counsel that the lien undertaken to be imposed on the property for material furnished and labor performed was not for the alteration or repair of a building, but of electric wiring and fixing, and also in making connections in and about the building; that it is possible for electric wires to be run into a building and connections made without such wires being attached in any manner to the structure; and that the statute does not give a lien for the alteration or repair of electric wires. The contention, however, was not acceded to by the court, which held that the wires employed to distribute electricity to one or more rooms in a building, if attached in such manner as to indicate an intention to make them fixtures, become a part of the structure and are as necessary as conduits for gas or water. "These connecting and distributing wires, when made fixtures, become the property of the owner of the building in which they are placed, and the value of the material furnished and of the labor employed in making the improvements are burdens which, under a statute like ours, may be imposed on the land for the construction, alteration, or repair of any buliding." Rowen v. Alladio, Supreme Court of Oregon, [illegible]3 Pac. Rep. 929.

DUTY TO INVESTIGATE WHEN WIRES ARE REPORTED TO BE DOWN AND TO SEE THAT CURRENT IS TURNED OFF TILL REPAIRS ARE MADE.—The plaintiff, a minor, brought an action, through his next friend, against the city of Madison, Ga., to recover damages for personal injuries. A glass insulating cuff, on a cross-arm of a pole to which a wire was attached, was merely set on loosely, so that it was easily jarred from the peg. The cross-arm was slanting, so that less force was required to jerk the cuff to which the wire was attached from the peg than if the arm had been horizontal. On the day the plaintiff was injured a scantling toppled over to the street and struck the wire, causing it to fall from the pole to the street, with the cuff still attached to it. The wire fell into the street about a quarter to 4 o'clock in the afternoon, and a little before dark a workman was sent to telephone to the electric light plant that the wire was down. Between sundown and dark the plaintiff, then about [illegible]½ years of age, while walking along the street, came to the fallen wire, which was then about two feet from the ground. The plaintiff caught the wire with his hands to raise it so as to pass under it and was severely shocked and burned. Where plaintiff grasped the wire with one of his hands the insulating covering was off for an inch or more, and the appearance indicated that it had been off for a considerable time. It was held that the defendant had been negligent and was liable in damages. "If the superintendent of the electric plant received notice that the wire was down, and the electric current was then on, he should have instantly turned the current off and kept it off, until, after due investigation, the report was found to be untrue, or, if found to be true until proper precautions were taken to prevent danger to persons or property from the fallen wire. If at the time of receiving such report the current was not on, then he should have seen that it was not turned on until he had ascertained that the wire was not down, or, if down, the danger from its having been down in the street had been obviated." Mayor of City of Madison v. Thomas, Supreme Court of Georgia, 60 S. E. Rep. 461.

ELECTRIC COMPANY NOT LIABLE FOR INJURIES RESULTING FROM THIRD PARTIES TAMPERING WITH ITS WIRES.—In a recent decision an electric light company has been held free from legal liability for an injury occurring under rather unusual circumstances. One of its wires, running over a shed, through some unknown cause, became uninsulated at a point near the shed. On the day of the accident two boys were seen playing on top of the shed with a baled hay wire, the end of which was bent and thrown over the electric wire. The boys managed to push the hay wire along until it rested on the spot where the insulation was worn off of the electric light wire. At this juncture the end of the hay wire hung down in a pool of water which had formed in the alley over which the electric wire was strung, and the hay wire began to sputter and emit sparks, whereupon the boys ran away. Shortly afterward the plaintiff drove a milk wagon into the alley to make a delivery of milk. He did not observe the down wire, and the horse stepped into the pool and was immediately electrocuted. When the horse fell the plaintiff leaned over the side of his wagon to see what caused him to fall and was thrown from the wagon, by the force of an electric shock, to the ground, where he received several additional shocks by coming in contact with the horse's feet as he kicked in his death struggles. It was held that notice of the dangerous condition of the light wire would be imputed to the defendant company and that the company was negligent in failing to restore the insulation. The court held that it was essential to the plaintiff's cause of action to show that the defendant's failure to insulate was the proximate cause of the injury. And it was held that the failure to insulate was not the proximate cause and that the defendant company could therefore not be held responsible in damages. Quoting from the opinion: "To hold the defendant liable, we must hold that it was responsible for the acts of trespassing boys. To do this would practically make the defendant an insurer of the lives and limbs of every person against loss or injury caused by the wrongful and unlawful tampering with its wires by any and all persons whomsoever." Sutherman vs. Laclede Gaslight Company, St. Louis Court of Appeals, Missouri, 104 S. W. Rep., 1128.

Personal.

R. LEO VON DER NAITTEN, of Santa Rosa, Cal., has been appointed the local manager of the Oroville Water, Light & Power Company, of Oroville, Cal.

MR. E. P. WETMORE, general manager of the Augusta-Aiken Railway & Electric Company, Augusta, Ga., has resigned his position to take effect this month.

PRESIDENT DUDLEY FARRAND, of the National Electric Light Association, has gone to Chicago to complete the final arrangements for the convention to be held there in May.

MR. L. EARL RIGHTMYER, of the construction department of the General Electric Company, Schenectady, is at Porto Rico inspecting work on water power plant being erected there for J. G. White Company.

MR. C. WELLINGTON KOINER has resigned the position of general superintendent and engineer of the Los Angeles Gas & Electric Company, Los Angeles, Cal., to become general manager and engineer of the municipal lighting plant at Pasadena, Cal.

MR. WILLIAM LEDERER, formerly of the Commonwealth Edison Company, Chicago, is now connected with Stephen T. Williams & Staff, factory engineers, as engineer in the Chicago office, First National Bank Building, Chicago.

MR. E. A. STEVENSON, of the cable electrical staff of the Telegraph Construction & Maintenance Company of England, has recently retired on pension after long and faithful service. He is well known in this country, and is the father of Mr. E. W. Stevenson, the electrical expert of the Hazard Manufacturing Company, of Wilkes-Barre, Pa.

MR. EDWARD Y. PORTER, who for the past ten years has been superintendent of the Moore Electrical Company, of Newark, N. J., has opened an office at 702 S. Spring Street, Los Angeles, Cal., as an electrical and illuminating engineer. He will give his attention to the design of all kinds of lighting systems and is equipped for making illumination and photometric tests.

MR. B. E. SUNNY has been elected vice-president of the American Telephone & Telegraph Company. Mr. Sunny was connected with the Chicago Telephone Company some 18 or 20 years ago, since which time he has been in charge of the Western office of the General Electric Company, of which company he is a vice-president. He will make his headquarters in Chicago and have charge of the Western interests of the Bell company.

FORD, BACON & DAVIS, of New York City, have been appointed consulting engineers to the receivers of the New York City Railway Company with regard to certain important improvements now being made on the property. The representative of the firm, acting in the capacity of chief engineer, will have his office at the company headquarters. The firm has done a large amount of electric railway engineering and construction throughout the United States.

MR. H. F. GRANT, for many years manager of the Seattle Electric Company, of Seattle, Wash., and district manager for Stone & Webster interests in the Pacific Northwest, has resigned, and Mr. E. E. Potter appointed as acting manager. Mr. Grant will devote his time to Stone & Webster interests in the Northwest as district manager. Former General Superintendent J. B. Lukes becomes superintendent of power of the Stone & Webster companies in the Pacific Northwest. Mr. Z. A. Hammond resigns as claim agent.

Trade Publications.

MECHANICS' TOOLS of all kinds are listed and briefly described in a neatly illustrated catalogue recently issued by the Cincinnati Tool Company, Cincinnati, Ohio.

TIME SWITCHES for electric circuits are described in an illustrated folder, designated as Bulletin No. 28, recently issued by the Campbell Electric Company, Lynn, Mass.

DIRECT-CURRENT MOTORS rated at .33 hp and .50 hp are described in detail in bulletin No. 3213 of the Emerson Electric Manufacturing Company, St. Louis, Mo.

DIRECT-CURRENT FANS.—Bulletin No. 21, of the Diehl Manufacturing Company, Elizabethport, N. J., is devoted to direct-current bracket, desk, oscillator and telephone-booth fans.

ELECTRIC SIGNS.—The 1908 catalogue of the Haller Sign Works, 319 South Clinton Street, Chicago, Ill., illustrates and describes a complete line of artistic electric signs for all purposes.

FANS.—The Baltimore Electric Supply Company, of 215 North Calvert Street, Baltimore, Md., has issued a folder illustrating and describing a large number of electric fans which it keeps in stock.

POTHEADS.—The G. & W. Electric Specialty Company, 128 West Jackson Boulevard, Chicago, has a new set of bulletins showing a complete line of potheads and cable terminal belts for use in stations.

DIRECT-CURRENT GENERATORS AND MOTORS of the belted type for outputs of from .5-hp to 85-kw are briefly described and illustrated in Bulletin No. 1057, of the Allis-Chalmers Company, Milwaukee, Wis.

HIGH-FREQUENCY APPARATUS.—The Fred'k Pearce Company, 18 Rose Street, New York, is devoted to Willyoung X-ray and high-frequency apparatus, accessories and supplies and induction coils for colleges and schools.

COUCH BRACKETS.—The Federal Electric Company, Chicago, describes in Bulletin No. 8 its ornamental couch bracket, which has attracted so much attention, as "five lamps in one" being adapted to so many different purposes.

ELECTRO-THERAPEUTIC APPARATUS.—A folder of the Campbell Electric Company, Lynn, Mass., deals with various types of high-frequency devices for physicians' use in electro-therapeutical treatment and cautery operations.

ELECTRICAL SUPPLIES.—The F. Bissell Company, 226 Huron Street, Toledo, Ohio, is issuing a series of calendar cards which are distributed each month to those interested in electrical supplies and machinery.

DIRECT-CONNECTED GENERATORS of the direct-current type are fully described in a neatly illustrated bulletin, designed as No. 107, recently issued by the Sprague Electric Company, 527 West Thirty-fourth Street, New York.

FOUR-STROKE CYCLE GAS ENGINES, governed on the hit-and-miss principle, are described in Bulletin F, of the Jacobson Machine Manufacturing Company, Warren, Pa. These machines range in rating from 3 hp to 35 hp.

Unclassified Items.

MR. EDWARD TERRY, a well known hydraulic and mechanical engineer and inventor died April 7 at his home in Hartford, Conn., after a week's illness from pneumonia. Mr. Terry was born in Terryville, Conn., in 1850, and was a graduate from Yale Scientific School in 1871. He was secretary of the Farmington Power Company, president of the Terry Steam Turbine Company and a member of the American Society of Civil Engineers. He is survived by a widow and one son.

KEYPORT, N. J.—The Jersey Central Traction Company contemplates building about four miles of new track.

VINCENNES, IND.—The Vincennes, West Baden & Louisville Railway Company is planning to begin work on the construction of its road in June or July. The road will be about 42½ miles in length. The company is capitalized at $1,500,000, and the officers are: Thomas H. Adams, of Vincennes, president; Anthony M. Yelton, of Vincennes, secretary; John O. Davis, of Petersburg, treasurer.

COLUMBUS, OHIO.—We are informed that the Findlay-Marion Railway & Light Company is planning to commence construction work on its road about May 1. The electric railway will connect Findlay and Marion, a distance of 46 miles. The overhead trolley system will be used. G. W. Meeker is secretary and the Riggs & Sherman Engineering Company, electrical engineers.

MURPHYSBORO, ILL.—The Murphysboro Railway, Light, Heat & Power Company contemplates extending its street railway system for a distance of about two miles, and purchasing electrical equipment for a small power station and also a number of cars. John G. Hardy is secretary.

SOUTH BEND, IND.—Arrangements are being made by the Kalamazoo, Elkhart & South Bend Traction Company to commence work on the construction of its road next month. The road will be 72 miles in length. A. D. Harris is president.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago Inland Traction Company to build an electric railway from Crete to Kankakee, a distance of 32 miles. The incorporators are: Edward Doepp, of Blue Island; C. W. Rhodes, Elmer Schlesinger, E. D. Lawler, of Chicago, and H. C. Bangs, of Glencoe.

EUNICE, LA.—The City Council is considering a proposition to construct a municipal electric light plant.

WILKES-BARRE, PA.—The County Commissioners are considering the question of installing an electric light plant in the new court house. It is estimated that energy for lighting, elevators and fans for the court house will cost from $10,000 to $12,000 per year if furnished by a private corporation. It has been proposed to install an electric plant at the county jail, at a cost of about $30,000.

NEW YORK, N. Y.—The contract for installing electric equipment in addition to and alterations in School No. 16, Borough of Bronx, has been awarded by C. B. J. Snyder, superintendent school buildings, to the A. Feldman Construction Company for $7,250.

CHICAGO, ILL.—Bids will be received until April 15 by the clerk of the Sanitary District of Chicago, American Trust Building, Chicago, Ill., as follows: Division A—15,000 ft. of four-duct sectional conduit. Division B—50 manholes, collars and covers. All of the above mentioned material must be delivered within 21 days after the award of the contracts. All proposals must be made upon blanks furnished by the Sanitary District and in accordance with plans and specifications on file in the office of the electrical engineer, room 1500, American Trust Building, Chicago, Ill., which can be obtained upon application therefor. Robert R. McCormick is president of the Board of Trustees, and I. J. Bryan clerk,

HOT SPRINGS, ARK.—Articles of incorporation have been filed for the Essex Valley Land Company by J. A. Riggs and W. S. Kirkham, of Hot Springs. The company has been organized for the purpose of doing a general real estate business and proposes to build an interurban electric railway from Hot Springs to Essex Park and Potash Sulphur.

DEFIANCE, OHIO.—Plans are being made by the Ohio Electric Railway Company to equip the Columbus & Lake Michigan Railroad to be operated by electricity during the coming summer. At present the road is operated as a steam road. It is stated that contracts have been awarded for equipping ten miles of the Lima-Bellefontaine extension.

Business Notes.

THE GIBSON MANUFACTURING COMPANY, of Danbury, Conn., recently incorporated, is equipping a plant for the manufacture of glass telephone instruments, including glass receivers and mouthpieces for transmitters, etc.

VENTRES & JONES, of Lenox, Mass., have purchased the business of the Lee Wiring Company and will have its headquarters at the store of the Lee Hardware Company. The business will be operated separately from the Lenox business, and the name of the Lee Wiring Company will be retained.

COLUMBIA LAMPS FOR SINGER BUILDING.—The new Singer Building, New York, will require about 25,000 lamps to fill the sockets, and the first shipment of 10,000 lamps has been made; 230-volt Columbia lamps will be used, the contract having been secured by the Central Electric Company, of Chicago, general Western sales agents for the Okonite Company.

MR. F. R. CHINNOCK will sever his connection with the B. F. Sturtevant Company, of Readville, Mass., on May 1. Mr. Chinnock has had charge of the electrical department of this company through its New York office. It is Mr. Chinnock's intention to enter the field of construction work, with offices in the Taylor Building, 39 Cortlandt Street, New York City.

THE MASSACHUSETTS ELECTRIC EQUIPMENT COMPANY, recently organized, has decided to locate in New Bedford, Mass., and is negotiating for the Parker garage. The company will manufacture electrical equipment, including wireless apparatus, and will also continue to maintain the garage. The officers are: Rufus B. Delano, president; Walter M. Thomas, treasurer, and Charles E. Alden, chief scientist.

O. E. CHANEY & COMPANY, telephone brokers, Metropolitan Building, Minneapolis, Minn., report that they have had a franchise pass the first reading of the City Council, in the City of Anoka, Minn., for an independent telephone exchange. The same firm has consummated the sale of the Frasee Telephone Exchange, of Frasee, Minn., to Mr. Justus Anderson, of Kennedy, Minn. Mr. Anderson bought the exchange of Mr. C. O. Wheeler, of Tower City, N. D. The consideration of the sale was $8,000.

DOSSERT & COMPANY, 242 West Forty-first Street, New York, have received an order from L. K. Comstock & Company for solderless connectors and terminals for use in the Silversmiths Building on Maiden Lane, New York. The same company has also ordered a large number of lugs of 1,500,000 circ. mil. size for the generators and generator panels in the City Investing Building. Among other recent orders received are third-rail clamp connectors for 1,000,000 circ. mil cable from the New York Central & Hudson River Railroad Company, cable taps, 400,000 circ. mil. main to No. 0000 bleeder, from the Chicago City Railway Company, and cable taps for 1,000,000 circ. mil. cable from the Syracuse & South Bay Electric Railway Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 31, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

883,170. ELECTRODE FOR THE RECOVERY OF METALS FROM SOLUTIONS BY ELECTROLYSIS; Samuel B. Christy, Berkeley, Cal. App. filed March 10, 1906. Compound pervious electrodes containing on the anode side some suitable pervious electro-conducting material insoluble in the electrolyte, and on the cathode side some suitable pervious electro-conducting substance in electric contact with the anode side.

883,181. ELECTRIC STREET RAILWAY SWITCH; John P. Dowd and Thomas P. Dowd, of Cedar Rapids, Iowa. App. filed Sept. 30, 1907. Means for operating a track switch, including a pair of electromagnets depending from a frame on a car and which are selectively energized to directly attract the switch point.

883,195.—SYSTEM OF DISTRIBUTION; David Hall, of Norwood, Ohio. App. filed Feb. 7, 1906. Multiple voltage system of distribution particularly for three-wire system, in which the voltages are either unequal or equal between the two sides of the system. Provides a balancer comprising a pair of compound wound dynamo-electric machines, and means controlling their field windings.

883,200. CONTROLLER FOR ELECTRIC MOTOR; Henry D. James, of Pittsburg, Pa. App. filed May 16, 1906. A controller including a field rheostat and an armature-reversing face plate member. Has a rheostat arm rigidly connected with the operating handle and a contact arm for the face plate member, having a lost motion connection with said handle.

883,201. TERMINAL CONNECTOR; Harry T. Johnson, of New York, N. Y.; App. filed March 22, 1906. Comprises a sheet metal disk having radially extending curved ears which are adapted to be engaged around a conductor by a clamping nut.

883,217. AUTOMATICALLY TRIPPING TROLLEY POLE MECHANISM; Thomas H. Mars, of Chicago, Ill.; App. filed April 5, 1906. An automatic tripping trolley pole having a system of links and a latch so arranged that the pole is tripped in case of too great an upward movement.

883,225. COUPLING APPARATUS FOR ELECTRIC CIRCUITS; Nicholas F. Niederlander, of St. Louis, Mo.; App. filed Sept. 2, 1902. A coupler for electric trains analogous in construction to the ordinary air-brake couplers and including engaging sleeves with central spring-pressed plungers.

883,226. FIRE-ALARM AND SIGNALING SYSTEM; John D. Nole[illegible], of Toledo, Ohio. App. filed Sept. 15, 1905. Fire-alarm and watchman's signaling system, including a normally wound box so constructed as to be available at all times for use in sending in a fire alarm, and adapted to be manipulated by a watchman in reporting his rounds without sending in a fire alarm.

883,227. INSULATOR; Edward F. Padden, of Chicago, Ill. App. filed Sept. 23, 1907. Has a cylindrical block exteriorly threaded and longitudinally grooved on one side to receive a conductor. Has a set screw projecting into said groove to hold the conductor in place.

883,241. WIRELESS RECEIVING INSTRUMENT; Frederick G. Sargent, of Westford, Mass. App. filed May 22, 1907. A detector for wireless currents of the coherer type. Has a steel electrode, a carbon electrode, and a loose dry mixture of zinc filings and carbon between said electrodes.

883,242. ATTACHMENT FOR TROLLEY HARPS; William F. Savage, of Columbus, Ohio. App. filed May 3, 1907. The patentee provides a pair of laterally projecting curved horns on either side of the trolley wheel, which have conical, spirally grooved rollers at their bases to direct the wire upon the wheel.

883,246. DYNAMO ELECTRIC MACHINE; Robert Siegfried, of Pittsburg, Pa. App. filed March 3, 1906. A means for supporting electric motors in concentric relation to the driving wheels of an electric locomotive so as to permit a certain yielding movement. The motor armature is on the usual sleeve, having [illegible] connection with the drivers through specially constructed spiral springs.

883,247. SUPPORTING STRUCTURE FOR DYNAMO ELECTRIC MACHINES; Robert Siegfried, of Pittsburg, Pa. App. filed March 3, 1906. Relates to modifications of the above.

883,248. SUPPORTING STRUCTURE FOR DYNAMO ELECTRIC MACHINES; Robert Siegfried, of Pittsburg, Pa. App. filed March 3, 1906. Covers additional modifications.

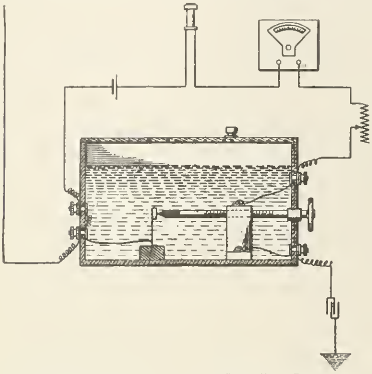
883,272. COMBINED FUSED CONNECTOR AND LIGHTNING ARRESTER FOR ELECTRIC WIRES; Frederick C. Woods, of Galesburg, Ill. App. filed Feb. [illegible], 19[illegible]. Makes use of a cylindrical insulating casing in which are imbedded a plurality of metal [illegible] and coiled means exterior of the casing for connecting said members whereby electric current may flow therebetween.

883,276. ELECTROMAGNETIC MOTOR; Arthur Hopkins Beard, of Memphis, Tenn. App. filed Jan. 31, [illegible]. An electric motor having an oscillating arm with a pair of electromagnets which are alternately attracted and repelled from a pair of stationary magnets.

883,280. LIGHTNING ARRESTER; Millard Berry, of Fayetteville, Ark. App. filed Oct. 18, 1906 Details of construction of a lightning arrester making use of an insulating block having certain sheet metal parts constituting the current-carrying members. The device is adapted to be used on an ordinary distributing board.

883,303. SECURITY LIGHTNING ARRESTER; William E. Drake, of Grand Island, Neb. App. filed Feb. 21, 1907. Provides a form of lightning rod which has a specially formed ground plate or terminal adapted to anchor the building in place against damage by heavy winds, in addition to its lightning-protecting function.

883,310. TROLLEY HARP; Edward J. Harrison, of South Bend, Ind. App. filed June 10, 1907. The trolley harp carries a fixed axle and a pair of U-shaped spring blades which bear against the trolley wheel to establish good electrical connection therewith.



883,437.—Receiver for Space Signaling Systems.

883,311. ELECTRICAL SMELTING FURNACE; A. F. Hiorth, Christiania, Norway. App. filed Nov. 20, 1906. The combination with a plurality of furnaces, a magnetic circuit common to all of them and a single magnetized coil for said circuit.

883,335. ELECTRIC THEFT ALARM SYSTEM; John J. O'Connor, of St. Paul, Minn. App. filed Sept. 26, 1907. The patentee provides a plurality of circuit wires which are looped through the articles to be protected so as to establish continuous alarm circuits which are necessarily disturbed or broken when the goods are removed.

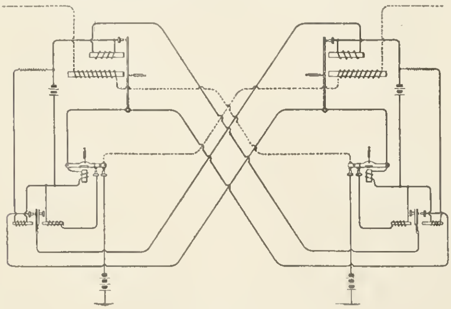
883,366. ELECTRIC SWITCH; Arthur L. White, of Cresco, Iowa. App. filed Nov. 21, 1907. An electric switch for use in motor starters. Is designed to provide an arrangement of insulators which, while simple and easily installed, are intended to effectually prevent arcing and burning out.

883,346. INDUCTOR ELECTRIC GENERATOR; Parnell Rabbidge, of Neutral Bay, near Sydney, New South Wales, Australia. App. filed Oct. 31, 1906. An induction generator making use of one stationary coil and having another coil wound around the first coil so as to act as a primary to inductively connect the other in circuit with it.

883,389. SWITCH CLIP; J. Clay, New York, N. Y. App. filed Aug. 20, 1907. An attachment for the blade or arm of an electric switch and adapted to engage the jaws of the switch clip and pinch them more tightly upon the switch blade.

883,397. INSULATOR; W. T. Goddard et al., Victor, N. Y. App. filed July 29, 1907. A suspension system particularly for high potential trolley conductors making use of a tubular body of porcelain with metallic caps at each end to constitute fastening devices.

883,409. SECTIONAL OUTLET CONDUIT; J. L. Kruger, New York, N. Y. App. filed March 27, 1906. Has a tubular sleeve with a laterally projecting lamp receptacle and adapted to be telescoped over a pair of abutting ends of the conduit pipe.



883,530.—Telegraph Repeater.

883,416. ELECTRIC ALARM FOR LOCKS; F. M. Merrill, Los Angeles, Cal. App. filed June 11, 1907. A burglar alarm circuit-closing device directly incorporated in the latch of a door and designed to produce an alarm signal whenever the lock is tampered with.

883,437. RECEIVER FOR SPACE SIGNALING SYSTEMS; L. D. Wildman, San Francisco, Cal. App. filed July 24, 1906. Has a pair of relatively movable contacting surfaces normally in imperfect electrical contact and submerged in a bath of oil under pressure.

883,447. CALL BOX; H. S. Bullock, Jr., New York, N. Y. App. filed Dec. 15, 1906. A signal transmitter of the fire alarm or messenger call type, making use of an intermittently toothed wheel which is displaced by clockwork mechanism, and engages a contact member analogous to the contacts of a telephone jack in construction.

883,490. WATER HEATER; A. W. Schramm, Riverton, N. J. App. filed Nov. 14, 1907. A cup formed with an outer and an interior shell between which is a resistance coil. The base of the cup includes a form of rheostat for cutting out sections of the coil to vary its heating value.

883,530. TELEGRAPH REPEATER; S. D. Field, Stockbridge, Mass. App. filed June 20, 1907. A telegraph repeater designed to overcome a characteristic defect of repeaters now in use, namely, the clipping or mutilation of the signals due to the sluggishness of the repeater receiving sounders. Provides a system by which the repeating sounders are caused to be no more strongly energized by telegraph signal dashes than by the dots, so that the armature moves off of the contact with equal promptness in any case. Provides a number of other features, among them a magnetic shunt which exerts "a kick back," so that a very slight retractile spring is sufficient. Also has a self-regulating maintaining shunt around the local contacts of the line relay which insures only a very light holding force of the relay on its armature.

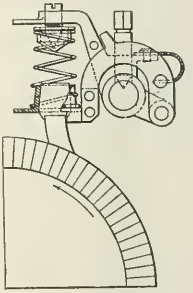
883,539. ANNUNCIATOR; S. J. Heinrich, Bellevue, Pa. App. filed March 14, 1906. Renewed Feb. 15, 1908. Provides an annunciator mechanism disposed within and enclosed by a casing of cylindrical outline and having a dial like a clock or a steam gage.

883,549. FITTING FOR ELECTRIC CONDUITS; A. R. Lakin, New York, N. Y. App. filed June 29, 1907. An outlet box for conduits of generally T-shape and having a removable cornerpiece with openings for a plurality of conductors, and which exposes the entire interior of the box.

883,550. BRUSH AND BRUSHHOLDER FOR DYNAMO-ELECTRIC MACHINES; Frederick H. Loring, London, England. App. filed Nov. 4, 1907. A current collecting brush comprising a taper head of circular cross section shaped to fit a correspondingly tapered socket, and a contact portion of substantially rectangular cross section attached to said head.

883,589. ELECTROLYTIC PRODUCTION OF PURE TIN; A. J. M. Thirot, Bourges, France. App. filed March 22, 1907. A method for obtaining tin from its compounds which consists in treating the compounds with caustic soda, purifying the solution and subjecting the solution to electrolysis.

883,594. PROCESS OF OBTAINING METALS AND ALLOYS BY REDUCTION; Emilien Viel, Rennes, France. App. filed Oct. 31, 1906. The process of reducing refractory metallic compounds consisting in subjecting a mixture of said compounds and a reducing agent in a continuous stream to the heat of an electric arc directed thereon with a furnace chamber to effect reduction of the compound to the metallic state, and then passing the metal so reduced immediately into a cooling zone before it leaves the furnace.



883,550.—Brush and Brushholder for Dynamo-Electric Machines.

883,595. APPARATUS FOR OBTAINING METALS AND ALLOYS; Emilien Viel, Rennes, France. App. filed Oct. 31, 1906. Divided and this application filed Oct. 29, 1907. Apparatus for carrying out the above process.

883,613. LIGHTNING ARRESTER; H. V. Bastin, Lancaster, Ky. App. filed Oct. 12, 1907. Makes use of a coil forming part of a circuit and surrounded by a line cylinder and ground cylinder, the ground cylinder being located between the coil and the line cylinder, and each comprising a large number of points for the lightning discharge.

883,625. CABLE TERMINAL; Frank B. Cook, Chicago, Ill. App. filed July 12, 1907. Details of construction of outlet or enlargement box for telephone cable.

883,626. ELECTRICAL LINE PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed Sept. 26, 1907. A protector device comprising a fuse adapted to be suspended from a line wire, an annular metallic casing inclosing the lower end of the fuse, a lightning arrester comprising annular electrodes inserted within the said casing around the fuse, an annular drip carried by the fuse above the annular metallic casing, and means for connecting the fuse and lightning arrester as protectors for the circuit.

883,646. SAFETY DEVICE FOR ELECTRIC POINT SHIFTING, SIGNALING, LOCKING AND SWITCHING APPARATUS; Lorenz Kottmair et al., Munich, Germany. App. filed June 9, 1904. A safety device for electric shifting or adjusting apparatus, such as switch point-shifting, signal-shifting and other locking and switching apparatus.

883,651. ELECTROLYTIC PRODUCTION OF CHROMIC ACID; Max Le Blanc, Karlsruhe, Germany. App. filed Jan. 31, 1906. The process of making chromic acid continuously by electrolytically oxidizing a chromium compound of a lower degree of oxidation by treating an acid solution of the said chromium compound with an electric current while continuously passing the said solution into an electric cell in such strength and quantity that the liquid treated at the cathode remains acid, all substantially as described.

883,653. APPARATUS FOR EXHIBITING THE FLUORESCENCE OF FLUORESCENT SUBSTANCES; W. G. Levison, New York, N. Y. App. filed Nov. 29, 1905. Fluoroscope making use of a plurality of certain specified minerals to obtain fluorescence of different colors.

883,665. COMBINED POLICE CALL, FIRE-ALARM AND WATCHMAN'S BOX; J. G. Nolen, Chicago, Ill. App. filed March 3, 1904. A manually operated signal transmitting box, capable of use as a police call box, as a fire-alarm box, and also as a watchman's box.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, APRIL 18, 1908. No. 16.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE..............................1015 Schofield Building
PHILADELPHIA OFFICE........................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.........................per year, $3.00
Dominion of Canada..4.50
Other Foreign Countries within the Postal Union...................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, APRIL 18, 1908.

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ELECTRIC LIGHTING EXPANSION.

There seems to be a general impression that the activity in electric lighting development was not maintained during the past year, or at least had fallen off in the past six months. We have therefore taken the trouble to make a careful analysis of the situation from the statistics available with the object of ascertaining the facts as fully as possible. This, of course, is difficult owing to the magnitude of the industry, now comprising between five and six thousand companies, and for the reason that in few States are the figures required officially; while mere incorporation is not sufficient evidence of actual work or intention to build. The returns compiled for the McGraw Electrical Directory are therefore the best first-hand data obtainable, and it is these we have taken as a basis of examination. The result is extremely gratifying and encouraging as to the growth of the industry and the vigor with which it is being pushed all over the country.

The Directory, as our readers know, issues twice a year from this office, and comprises all the private companies and municipal plants in the United States, Mexico and Canada. Two issues will therefore roughly furnish the data of one year. We are just going to press with the March number, which being a little overdue will possibly include, with the issue of last September, figures for about 13 months, as some of the reports included are very recent. It appears that the number of new companies or plants included in the September issue were 220, while the number which will be brought to account for the first time in the April issue is no less than 265. This makes a gain of 485 for the year, and 5498 for the total number at the present time. It will thus be seen that the gain during the past six months of financial and industrial depression was better than in the preceding period of strenuous prosperity.

The gain is also pronounced when the capitalization is considered. Of these 485 plants, 256 have reported their capitalization, or, if municipal, their cost or the amount of bonds issued for them. In the second six months, when 150 thus reported, the amount was $30,161,565. In the first six months, when 96 gave this item, the amount was $32,458,100, showing a marked gain even in the amount since October last with its blight on development in general. It is usually the small plants that do not report cost or capitalization, but it would not be unfair on such a showing to assume that the 229 systems not reporting would bring the $62,619,565 for the year as reported by the other 256, up to at least $75,000,000. Hence, putting aside altogether the immense amount of money spent on renewals and extensions by old systems, it is certainly a most hopeful sign of good times to see at least $75,000,000 of new capital in a bad year pledged to the expansion of the electric light and power industry. All the indications point to an increase in this rate of growth, which is distributed throughout the continent. It may be added that of the 485 new plants reporting, 441 are in the United States. We think our electrical manufacturing friends can afford to "brace up and get busy," and that operating companies will be glad to welcome so large an accession to their ranks.

Recent Magnetic Observations and Deductions.

The Department of Terrestrial Magnetism of the Carnegie Institution of Washington has recently collected and published a table of the mean values of magnetic elements for the early years of the twentieth century, at 61 magnetic observatories. These observatories range in latitude from Pawlowsk nearly 60 deg. north, to Christchurch 43½ deg. south, and in longitude from Christchurch 172½ deg. east to Hawaii 158 deg. west. The horizontal magnetic density is recorded as a maximum at 0.387 gauss in Taungoo, British Burmah. Apparently this is the only claim of that locality to distinction; i. e., the compass needle aligns itself there more forcibly than anywhere else. The recorded minimum is 0.155 gauss at Sitka. The secular movement of the earth's magnetic poles continues to puzzle magneticians and to baffle explanation. The late Lord Kelvin used to dilate upon the wonder of this remarkable migration. We are informed by astronomers that the earth's terrestrial poles wander more or less, so that a stake driven into the ground to mark the position of the true terrestrial pole on a certain date, would soon become excentric. But the wandering of the earth's terrestrial pole is a small matter—so small that it has only been detected in recent times—and the stake would not usually roam outside of a one-acre lot, if the lot could be laid off on the surface of the ground. Moreover, the south pole is subjected to corresponding symmetrical meandering, the polar axis always being taken as a straight line connecting the poles through the earth's center.

In contradistinction to the behavior of the magnetic poles, the geographic poles are models of stability. It is hard even to define what shall constitute the earth's magnetic poles. If, in accordance with custom, we take the localities where the dipping needle stands vertical, their positions will be definite but dissymmetrical on the globe. If we take the point where the earth's magnetic axis intersects the surface, we may obtain diametrically opposite points; but we find them distinctly displaced from those indicated by the preceding definition. Even the magnetic axis is hard to define. But whatever definition we select, the earth's magnetic poles wander from decade to decade at a speed of something over a mile a year. According to the deductions of one well-known magnetician, based only on observations of declination extending over three centuries, the north magnetic pole has worked its way southward from latitude 82 deg. north to 69 deg. north about the year 1800, in longitude roughly 90 deg. west, or in the vicinity of the Gulf of Bothnia. Having thus nearly worked its passage to the edge of the Arctic circle, it changed its direction rather suddenly and is now retreating northward again not far from its line of previous advance.

It is now believed that the earth's magnetism is divisible into three parts; first and greatest a part due to internal actions, or conditions beneath the earth's crust; second, a part due to external actions, or such as might exist in and above the atmosphere; and third, a portion attributable to electric currents upward and downward in the atmosphere such as might be due to movements of air carrying electric charges. It is pointed out by Dr. Bauer that no analysis of the secular movement of the earth's magnetic poles can be reasonably complete without differentiating the movements of these components. In regard to the mean diurnal swing of the declination at different points of the earth's surface, a curious fact has been substantiated recently in accordance with what is known as Bauer's law; namely, that the range increases with the magnetic latitude, being inversely proportional to the plane area enclosed by the latitude circle. Stations like Grinnell Island, at a high magnetic latitude, show a mean daily range of declination of about 1½ deg., so that the compass needle will daily swing through this angle on the average; while stations like St. Helena, at a low magnetic latitude, show a mean daily range of only about 1/30 of 1 deg. in declination. Observations made at Teplitz Bay on the far northwestern coast of Greenland, during a certain magnetic storm of October, 1903, showed that the declination varied over 17 deg. in about 100 minutes. This large and rapid variation, if it occurred in lower latitudes, would be likely to frighten a navigating officer on board ship into mental aberration. Fortunately, few ships navigate within the Arctic circle, and violent magnetic storms are rare.

The Design of Electromagnetic Brakes.

The electromagnet is now a well-known substitute for the arm of an attendant in a machine so situated that an attendant cannot conveniently be set over it. The attendant is situated instead at some remote point, and closes a circuit through the plunger electromagnet on the machine. The plunger immediately proceeds to exert a pull of from 1 lb. to, perhaps, 100 lb. weight, over a distance of from ¼ in. to, say, 6 in., according to the size and design of the electromagnet. In particular, the electromagnet has come into extensive use in connection with electric hoists, cranes and elevators, either for operating distant switches or for applying electromagnetic pulls to brakes, or for both these purposes. In every such electromagnetic mechanism, the underlying law of force is capable of very simple expression. Each square inch of opposed polar surface exerts a magnetic pull, perpendicular to its face, directly proportional to the square of the flux density. In simple forms of electromagnets, it may be easy to compute the flux-density and also the total surface area and total resultant pull. In many practical instances, however, complex shape of the parts, and the varying degree of saturation of the magnet, make the computation hopeless from an engineering standpoint, and it becomes necessary to resort to rough approximations and empirical methods

Mr. J. Nikonow's article this week, on page 811, discusses the design of electromagnetic brakes with reference to particular well-known types that have come into practical use. In hoisting mechanism it is often preferable to make the electromagnet remove the brake when excited, and set the brake when unexcited, for the reason that if any electrical accident should occur, the brakes will set automatically and prevent the possibility of damage by failure to brake. Such an electromagnet must, however, be kept excited all the time the machine is running, and this is a disadvantage that may turn the scale in favor of the opposite mode of operation. The efficiency of any such reciprocating electromagnetic mechanism must always be very small. In no case does it seem possible to secure an efficiency exceeding 50 per cent, whereas 2 or 3 per cent is a more common ratio of the useful mechanical work done to the electrical energy received. Consequently, an electric motor substituted for a reciprocating electromagnet could always be made more efficient. But, as pointed out in the article, the amount of work to be done by such an electromagnet is usually very small, so that the efficiency is of very little consequence; while the relative simplicity and directness of an electromagnet far outweigh the energy saving of an electric motor for ordinary brake-setting operations.

It is pointed out that an alternating-current electromagnet has the interesting and often useful property of developing a much larger reactance at the end of its stroke than at the beginning. This means that after the magnet has done its work and pulled up its plunger, the alternating-current strength which it receives is greatly reduced automatically. In the case reported near the end of the article, the current strength at the end of the stroke was 14 times less, and the copper heating, therefore, 200 times less, than at the beginning of the stroke. This means that such magnets do not require the injection of resistance into their circuits in the same manner that direct-current electromagnets so frequently require it. Moreover, for the same reason, the pull of an alternating-current electromagnet with plane poles may be nearly uniform throughout its stroke, whereas the pull of the same type of electromagnet operated by direct current is very much weaker at the beginning than at the end of the stroke.

The Growth of a Transmission Network.

The transmission system around Portland, Ore., is an excellent example of the upbuilding of a power transmission plant in response to the needs of a growing city. It is in fact one of those cases in which growth is bound to continue, since Portland seems certain to occupy a position of ever-increasing importance on the Pacific Coast. The Falls of the Willamette, at Oregon City, till recently the chief source of electric power for Portland, were early developed. The situation was such that a fair supply of power could be obtained by a dam that was scarcely more than a low crest wall at the head of the fall. A small lighting plant was established here rather early in the days of alternating current working—the predecessor in business of Station B. Plans for this station were made in 1893 and it was, when completed a couple of years later, not only one of the very early three-phase transmission plants, but, if we remember correctly, the first American station to use high-voltage generators. Up to that time the practical limit of generator voltage here was about 3000 volts and no large machines had been worked even at that modest figure. In the original equipment of what is now Station B the machines were wound for the then extreme and precarious figure of 6000 volts, with revolving armatures at that, the revolving-field machine being still in American practice looked upon as a questionable innovation.

The frequency of 33 cycles used in this station is also of significance as a bit of ancient history. The plant was laid out in the helpless infancy of the rotary converter. Everybody revolted at designing a rotary for 50 cycles or 60 cycles on account of difficulties of commutation, and it was well known that incandescent lighting at 25 cycles, a frequency commonly used for rotaries, was bad if not quite intolerable. The frequency of 33 cycles was therefore a compromise between the requirements for synchronous converters and those for incandescent lighting. It proved a satisfactory figure and still persists, almost the only one of its kind, just as the early Redlands plant in southern California has impressed its frequency of 50 cycles upon the whole huge network there—all of which goes to show that frequency within moderate limits is really a matter of small moment. To this initial hydraulic plant at Oregon City has recently been added the five stations at Cazadero on the Clachamas River. This is a typical modern hydraulic plant with three 2500-kw three-phase generators directly coupled to horizontal turbines working under a head of 138 ft. The generators are for 33 cycles, like those in the original plant at Oregon City, and give directly 10,000 volts, stepped up to 33,000 for the 31-mile transmission into Portland. The B station on its part not only feeds Portland, but extends its lines up the Willamette Valley at 30,000 volts, reinforced by a steam station and a small hydraulic plant. Substations here and there feed the whole valley and the electric roads of the neighborhood. A third section of the same great distributing plant occupies Vancouver just across the Columbia River. This is operated by a steam plant at 60 cycles.

The inconvenience of a low-frequency supply for lighting purposes is evidenced by the fact that the lighting over the territory covered is almost entirely at 60 cycles, obtained by motor generators from the original 33 cycles. Fortunately the railway is so considerable that the loss from this transformation is in part offset by the greater convenience of the low-frequency rotaries. In the long run it appeared that while incandescent lighting at 33 cycles was perfectly good, it entailed so heavy a cost of special transformers that frequency-changing was the best way out of the scrape. Just at present the upper Willamette Valley, the lower Willamette Valley (including Portland) and the Vancouver systems are physically separate, but the final step of building interconnecting lines is soon to be taken and thenceforward a great network will be built up to do for western Oregon what the two immense plants to the southward have done for California. There is no field of endeavor in which great combinations do work of more general and conclusive value than in electrical generation and transmission. This does not mean merely the construction by a powerful company or the biggest known station yet built, but the coherent union of the natural resources of a great territory to be used for its good. An interconnected network of electrical generating plants, whether steam or electric, can do in efficiency and reliability what no one plant can reasonably hope to accomplish. It can supply its territory with less loss and more cheaply; it can take advantage of the locations where cheap fuel or water power is most available, and it may even gain the combined storage capacity and security of two watersheds. The big Oregon system we are here considering is only one of a group of great enterprises that have made the Pacific Coast notable and have taught the world a lesson in engineering that will not soon be forgotten.

Power Plants Affected by Government Regulation.

Mr. William G. Kerckhoff, of Los Angeles, general manager of the Pacific Light & Power Company, of Los Angeles, and prominently connected with H. E. Huntington in his power interests at Fresno and other southern California cities, recently gave an address before the Chamber of Commerce, at Fresno, in which he said that the attitude of the national administration on the power question would have the effect of preventing further development. "As things now stand we will simply conserve such power plants as we have, but will not undertake any large new developments. We object to regulation only when regulation makes it impossible for us to obtain capital for development. If capital will look favorably upon it, the question is simple enough. Electrical development has attracted capital as a profitable kind of investment and money was flowing regularly into these big enterprises. Suddenly the government steps in and imposes certain restrictions, such as a 40-year lease, and hedges the privilege about with other charges that cannot be definitely determined in advance, and capital has halted. This is exactly the fix in which we now find ourselves.

"Of course, whatever additional expense there is in the generation of electricity, whether government charges or what, must ultimately be borne by the consumers. That is, up to the point of competition with electricity generated by coal, oil or other fuel. As soon as electricity can be manufactured cheaper than it can be made available by long-distance transmission, we will have to shut up shop and go out of business. That is a simple business fact. Even now in our contracts for electric power for pumping and other purposes at $40 and $50 a hp-year we have protected ourselves with a clause imposing the government charge upon the consumer." Mr. Kerckhoff stated he believed that in time the government authorities would look at the matter of power charges in a light that would again appeal to capital.

Mr. Frank H. Short, attorney for the power company, who made two trips to Washington in the interest of the power companies on the water charge issue, stated that some weeks ago all hope of getting a bill through Congress satisfactory to the power interests had been given up, on account of President Roosevelt's outspoken opposition to all such measures.

New York Central Overhead High-Tension System.

Mr. E. B. Katte, electrical engineer of the New York Central Railroad, at an adjourned hearing on Thursday, April 9, before the New York City Public Service Commission, continued his testimony on the subject of the overhead high-tension system of the New York Central. He stated that the cost of putting underground duct lines for the system from Putnam Crossings to Kingsbridge substation, and from Kingsbridge substation to a point 350 ft. west of Broadway, a distance of about 3.4 miles, would be $608,000, including the cost of taking down present lines. His second estimate for putting the system in tile ducts from the substation at Kingsbridge to a point 350 ft. west of Broadway, gave a cost of $120,000, the distance being about three-tenths of a mile. Mr. Katte testified that there were 513 miles of aerial pole lines in Greater New York, carrying voltages from 1000 to 3000 and 47 miles with voltages from 6000 to 11,000. Of the 513 miles there is but one mile in Manhattan, 130 in Brooklyn, 80 in the Bronx, 132 in Queens, and 150 in Richmond. None of the 47 miles of high-voltage lines is in Manhattan, 15 miles are in Brooklyn, 12 in the Bronx, 20 in Queens and none in Richmond. After giving in detail the cost of the subway construction in the places mentioned, Mr. Katte said that to his knowledge there have been only two fatalities from the present overhead system, namely, those of two boys who had climbed the poles and were killed.

Mr. Katte said that praotically no trouble had been experienced with the overhead lines, but that there had been several short-circuits on the 11,000-volt underground cables. The question of the proper limits of a voltage test on a cable was discussed at some length, and the matter of proper insulation of cables was also taken up. Mr. Katte said that there had been no difficulties experienced in the last two summers from lightning. The circuit-breakers are set to open instantly on a short-circuit of 800 amperes and at about three seconds on short-circuits of 500 to 600 amperes. He said that the first consideration that led the Electrical Commission to adopt the overhead system was reliability of service rather than economy.

The commission, attorneys and expert witnesses inspected the system on Saturday, and another hearing has been fixed for April 16.

Educational Courses for Central-Station Employees.

On Friday evening, April 3, the Brooklyn Edison Company completed its second year of educational work under the direction of Prof. Sydney Whitmore Ashe. The topic of the last lecture was alternating current measurements. The course this year was similar to that of last year, consisting of experimental lectures, except that the number of lectures was increased from 12 to 20. The course was this year given under the direction of the Edison Club. The interest last year was so great that 120 of the club members came together and pledged $3 each as a contribution toward the expenses of this year's course, the balance of the expense being made up by the Edison Company. The attendance was then limited to those who were interested enough to contribute to the work, the result being an average attendance which was not so great as last year, but the attention was more earnest. In giving the lectures, an attempt was made to show the direct application of the experiments to the company's methods. This scheme proved very successful and in carrying on the work another year this method will be followed to a still greater extent, the entire lecture course to be devoted to the company's apparatus and methods.

It is realized that in giving experimental lectures on the Edison Company's apparatus, it would be well in the last 15 minutes of each lecture to have a department head conclude the lecture, bringing out such operating features as had not been dwelt upon by the professor in charge. In this manner both the theoretical and practical side of the subject would be touched upon. There are quite a number of employees of the Edison Company who have attended all the lectures given by Professor Ashe at the Edison Club during both seasons.

The course of experimental lectures on electrical engineering, given during the past winter by Professor Ashe before the employees of the New York Edison Company, was completed on March 25. This course, one of the most extensive of its kind ever undertaken, registered a total attendance of 5956 men. The course consisted of 20 original lectures, five of which were repeated, making in all 25 lectures. The lectures were given weekly, each lecture being delivered at 1:30 p. m. and 8 p. m. on the same day, so as to afford all employees an equal opportunity to attend. The principal feature of the lectures was the experimental demonstrations which developed each step in a practical way as the course progressed. This maintained the interest of the men to a marked degree. As an example, several standard books on electrical engineering having been selected by Prof. Ashe and referred to from time to time during the lecture course, about 130 of these books were purchased by the men for home study. Several sets of these books were purchased by the management of the Edison Company and placed in the library for reference, where they were in frequent use. The course as a whole has done much to stimulate the enthusiasm of the men, to create in them an interest toward self-development, and to instill many of the operating features and fundamental principles of the company's apparatus.

Public Utility Commissions.

At the meeting of the American Institute of Electrical Engineers held on April 10, Mr. Henry Floy presented a paper entitled "The Engineer's Activity in Public Affairs—Public Utility Commissions and Franchise Valuations." Mr. Floy commented upon the comparatively unimportant public part taken by the engineer and the lack of public recognition of his work. The engineer's inconspicuousness was attributed to his keen interest in the purely scientific aspect of the enterprises with which he is connected, his natural hesitancy in pressing his own claims to recognition, his lack, in the past, of a broad general education and his too frequent inability to speak fluently in public.

By reason of the work and position of the engineer in the business and technical world, it is reasonable to expect that at least one-half of the membership of the public utility commissions, being named from time to time throughout the country, should be composed of experienced broad-gage engineers. The commercial importance of the engineer is steadily growing, and he should recognize the claims upon him to take part in public affairs and assume the responsibility more and more laid upon him of leadership. His increasingly closer business relations with public matters and his reputation for integrity give his opinion and influence steadily greater weight in large affairs, which he should appreciate, accept and respond to.

With regard to operation, public utility commissions should restrict their action to general principles; they should not interfere with details, otherwise they will remove the present responsibilities from the shoulders of the directors to their own shoulders, restrict and hamper the efficacy of the organizations, still the incentive to work and destroy the reasons for promotion of the employees—all of which will result in depreciating the service rendered the public and the financial standing of the corporations themselves.

In referring to franchise valuation, Mr. Floy suggested that a franchise can in most cases be valued at one-third of the actual replacement cost of the corporation's assets. For example, if the legal rate of interest is 6 per cent and the investor is unwilling to accept less than 8 per cent, a franchise valuation of one-third of the investment allows him simultaneously to receive 8 per cent on his outlay and accept 6 per cent on the total capitalization.

Mr. George S. Coleman, counsel of the Public Utilities Commission of the First District of the State of New York, said that a public service commission should be made up of men who are intelligent, open-minded, have had some experience in affairs, are patient, are thorough, industrious and who, above all, have good judgment. Such men may or may not be engineers, and it is certainly not essential for them to be engineers. Mr. Coleman expressed the opinion that the time has come when bodies of engineers should give the benefit of their concerted thought and action to any public question on which they are especially well informed. Engineers, as a class, have, in the past, been too modest.

Mr. Charles F. Lacombe, chief engineer of the Light and Power Department of New York City, stated that there should be some engineering representation on the Public Utility Commissions. A commission dealing largely with engineering subjects, made with a proper representation of lawyers, engineers and business men, would be of more value than one in which either element was left out.

Mr. H. M. Brinkerhoff, consulting engineer, remarked that public utility boards and railroad commissions should have upon them some experienced men who cannot be fooled and who will not ask the impossible. If matters be discussed in a fair, candid manner better results will be obtained than by the formal legal methods now pursued.

In a written communication, Mr. L. A. Ferguson expressed the opinion that public service corporations would be satisfied with a lower rate of interest upon their investments where their rates and other business dealings with the community are controlled by a commission composed of trained engineers than they would deem satisfactory if their rates and other business dealings were controlled, as they are now, by State Legislature or Boards of Aldermen.

Mr. H. L. Doherty, in a written communication, stated that a commission cannot do either intelligent or effective work without engineering advice or assistance, and in selecting proper commissioners the engineering fraternity should not be overlooked as a very likely source of the best available timber.

Mr. W. W. Freeman said that he would regret exceedingly to have it appear that the American Institute of Electrical Engineers advocates any plan that involves a limitation of the gross income of the company to its expenses, plus the amount which would be required as the minimum reasonable distribution to its stockholders.

In closing the discussion Mr. Floy said that a commission should protect the interests of the corporation as well as of the public, and if investors are assured of protection they can be interested in a 6 per cent return, although in the past corporations have not been able to obtain money on that basis.

Natural Illumination.

Mr. J. J. Sorber read a paper before the Chicago section of the Illuminating Engineering Society, April 9, on "The Relation of Direction of Light to Human Construction." He argued that there was some relation between the fact that man walks upright and the fact that his activity is greatest when the sun is high in the heavens. From this he drew the conclusion that artificial illuminants should be in large units and placed high rather than in the shape of "small suns" hung low at numerous places around a room. He also suggested that in selecting colors for walls of rooms it would be well to remember that outdoors nature usually provides landscapes of restful colors, such as green, grays and browns and blue sky.

Mr. George C. Keech, in the discussion, said that one of the practical advantages which, in his observation, had been obtained by the use of large units placed high in accordance with Mr. Sorber's suggestions is the avoidance of great contrasts in the illumination at various parts of a room or object. For example, a desk may be very brightly illuminated at one point with much less illumination at another. Sudden and frequent changes from highly illuminated to less illuminated surfaces are detrimental to the eye, according to the testimony of oculists at the February meeting.

New York City "Break-Down Service."

As a result of the investigation conducted by Commissioner Milo R. Maltbie, of the New York City Public Service Commission, and according to the recommendations made by him in a preliminary report to the Public Service Commission, the New York Edison Company has modified its rates for "break-down service" so that the charge shall be based upon the maximum demand of the consumer and not upon the full capacity of his installation. This agreement is to last for one year, during which time it is also agreed the company will place recording devices upon every break-down connection and take the records of the current furnished under the supervision of the commission for determining a fair service charge.

Commissioner Maltbie finds that a satisfactory decision of the rate question cannot be made until such records are taken and he recommends that the work be carried out and that the electrical engineer of the commission be instructed to supervise it. The fact that no such records have been taken in the past makes it impossible to arrive at a just and adequate charge for this kind of service.

The report points out that "break down service" includes three kinds of service:

1. The service supplied by the company to a private consumer having his own plant when that plant breaks down and is unable to produce the current required by the consumer.

2. Auxiliary service supplied to private consumers using current at nights, on Sundays and holidays, and during periods when a small amount of current is used as compared with the total installations.

3. Peak load service—additional current furnished to private consumers at that hour of the day when the peak load or the maximum demand from all consumers occurs.

As to the first class of break-down service, the report says it is probable, in view of the comparative infrequency of complete disability, that the actual demands made upon the supply company would be very few and would not involve great expense, either in the way of fixed charges upon the duplicate plant kept ready for use, or in the way of operating charges for units revolving slowly.

In order to furnish such a service the supply company must provide merely the distribution system and the service connections for the maximum load to be demanded at any one time, and such apparatus in the generating and substations as would be equivalent to the private plants disabled at any one time. It is not necessary to duplicate the total installations of the private plants, but merely such a portion as would be at any one time out of use.

To supply the second class of consumers, says the report, the supply company would need to provide the necessary service connections and distribution lines for each user, but as current would be demanded when the stations of the company would otherwise not be operated, at their maximum capacity, it would not be necessary to provide station equipment specifically for this service; it might be necessary to keep certain units revolving slowly, but in this respect the service would not differ from the ordinary service, where there must be constant readiness to serve in excess of the demand at that moment.

The third kind of service, the report continues, is the most expensive of all, for if any restriction were placed on the amount of current consumed or the time of its use, breakdown consumers could easily so plan their equipment that they would have sufficient capacity to supply all the current required, except during the peak hours of the day. When the peak load began to come on, the breakdown user could take sufficient current from the supply company to handle this peak, breaking the connection when the peak hour passed and the consumption again became normal.

Inasmuch as the peak period for the breakdown consumer is apt to be the peak period for the supply company, this would mean that the company would be called upon for a considerable amount of current during the short period when the demands of the ordinary consumers are at their height. Thus the supply company would be obliged to maintain a considerable plant during the whole day, in order to supply the breakdown consumer during one or two hours and to carry the surface plant throughout the year, in order to handle the winter maximum due to the short period of daylight and cloudy weather.

Commissioner Maltbie concludes that a charge based upon installation and not upon the maximum demand would be generally unjust. After several conferences the representatives of the Edison Company agreed to change this charge so as to base it on the maximum demand, instead of on the total installation of private consumers. The breakdown rate as now agreed to, therefore, will be a service charge of $30, including the supply of electric light at the best rate of the class for each kilowatt of maximum demand for which the consumer may make written request to the company, and which maximum demand is to be the basis of a year's contract. The company puts this rate into effect for one year, with the privilege of withdrawing it at the end of that time if it is found to be unsatisfactory.

Eastern Association of Physics Teachers.

A largely attended meeting of the Eastern Association of Physics Teachers was held at the Worcester Polytechnic Institute on March 28. The morning session was first addressed by Dr. Charles P. Steinmetz, professor of electrical engineering, Union College, Schenectady, N. Y., and consulting engineer of the General Electric Company. His subject was "The Teaching of Science." Dr. Steinmetz emphasized the fact that engineering is applied physics, and devoted most of his attention to the defects in the present methods of teaching as evidenced by the work of young engineers that has come under his observation. Only a relatively small part of the knowledge at present taught can be retained by a man, and so the tendency is to remember disconnected individual experiences and isolated facts, more in the nature of recipes. Thus, a man will recall the equation of a falling body, while he forgets the underlying general law, being unable to apply this general law to a problem in connection with the issuing of a steam jet from a turbine nozzle. The theory of periodic vibrations is similarly not connected with light and sound in studying hydraulic problems.

Dr. Steinmetz pointed out that different forms of the same law are not recognized, and that men find cases in practice outside the region of their school work difficult to handle. Great difficulty in observing is another trouble that needs remedying. Many young graduates of the present-day training have never, for instance, counted the frequency of the waves on the ocean or lake under different conditions. One of the first duties of the observer of periodic motion is to count this frequency. At the time when considerable trouble was being experienced by the manufacturers of synchronous motors from surging or hunting, over and over again it happened that men sent out from the factory to study the matter failed to count these surges in a given time. The trouble is that we try to teach too much, and it cannot all be digested. We try to teach the student everything that he may possibly meet in practice and this cannot be done, even approximately.

There is not time enough to teach the fundamental laws and their relations. Few threads tie together the different bodies of knowledge, and these are soon broken, with the result that more or less of the knowledge passes into oblivion. We must have plenty of references and cross-references in order to use any file of knowledge. The great underlying laws of the conservation of energy, gravitation and central motion should be taught thoroughly first, rather than special applications. The main problem in engineering is to find ways of calculation and methods of doing things, applying general laws to individual phenomena.

The object to be sought in teaching is to get the maximum efficiency out of the student. The best progress of the able student should not, as is too often the case under American conditions, be sacrificed to the attempt to force along the man without aptitude for engineering. It is better for him and for the world at large that he should drop out and go into something for which he has a natural bent. In this country the born engineer does not get as much out of his college course as he ought, because of the attention paid to inferior men. The teaching force is overloaded in trying to push along the student not fitted to take up engineering.

Dr. A. W. Duff, professor of physics at the Institute, then showed the convention Braun's apparatus for illustrating the resonance of electric waves, the Glimmer oscillograph for showing the wave forms in the secondary of an induction coil, Boy's gravitation balance for finding the mean density of the earth and constant of gravitation, and the molybdenite block method of rectifying a telephonic circuit.

In the afternoon the meeting was addressed by Prof. Harold B. Smith, of the department of electrical engineering at Worcester, the subject being high-voltage power transmission. The lecture was illustrated by lantern slides and experiments involving the use of potentials between 200,000 and 250,000 volts. This was thought to be the first time that such high potentials have been used in a lecture room. The high-voltage service was supplied from a large transformer located in the basement of the high-potential laboratory, the fine wires of the transformer secondary being led to the lecture room through Locke multiple vitrified clay bushings.

After Prof. Smith's lecture the association was shown the car-testing equipment of the general electrical laboratory in service. This consists of a complete double-truck four-motor interurban car mounted on wheels carried by axles which transmit the power to special electric absorption dynamos.

Work of the Public Service Commission.

An examination of the work of the Public Service Commission of the First District of New York (New York City), at the end of the first nine months of the commission's existence, shows that in the departments of gas, electric light and power there has been much activity. Formerly gas and electric meters had been tested in a slipshod way, and to correct this the commission organized a staff of inspectors provided with proper seals, and the work of inspection was laid out systematically. During the first six months, from July 15 to Dec. 27, 1907, the commission tested in all 127,846 meters, of which 44,227 were new meters, 82,057 repaired and removed meters, and 1562 tested on complaints of consumers. Of the 1562 tested on complaint, 203, or 13 per cent, were found to be correct; 211, or 13½ per cent, were less than 2 per cent fast (the limit allowed by law); 598, or more than 38.3 per cent, were 2 per cent or more fast, and 550, or 35.2 per cent, were slow. The average of the fast meters was 3.43 per cent fast and the average of the slow meters was 2.89 per cent slow. For the three months ended March 31 last the commission tested 81,681 meters, which added to the total for the preceding six months gives a grand total of 209,527 during the first nine months of the commission's life. Of 2805 meters tested on complaint since Jan. 1, 324 were correct, 1820 were fast and 661 were slow. The average per cent of the fast meters was 3.4 per cent fast and that of the slow meters 2.3 per cent slow for the three months.

The commission is conducting an investigation of the contracts made and service given by electric light and power companies and has taken up the matter of a uniform system of accounting for the light and power companies. As a result of the investigation of "breakdown" service the New York Edison Company has made pronounced concessions and accorded rates much more satisfactory to consumers than the former rates. The New York Central Railroad has been called upon by the commission to justify the installation of the overhead high-tension system of wires which are used in the operation of its electric system.

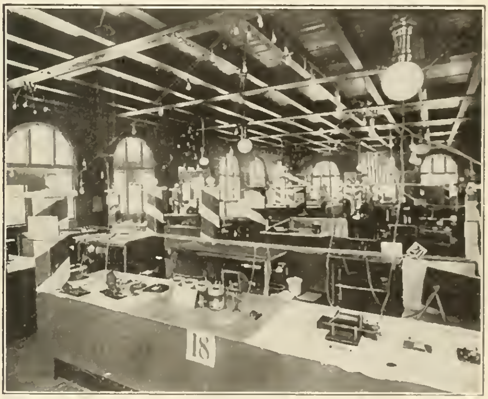
Electrical Show at the University of Illinois.

For a second time the electrical and railway students of the University of Illinois have carried out a most successful show on March 26, 27 and 28. The university community had its curiosity aroused for some days in advance by the flashings of a searchlight from the tower of University Hall, by the interior illumination of the handsome library tower and an arrangement of apparently revolving lamps on the military flagstaff, visible for miles around. These signs, together with other more usual advertising methods, served to bring crowds to the Electrical Laboratory on the three evenings which taxed the capacity of the building. The record shows 1925 paid admissions. The three floors of the laboratory were given over to the students' exhibits. In the basement was a complete lighting plant of one arc and several incandescent lamps run by a small dynamo driven by a gasoline engine, to illustrate the ease with which a country house may now be equipped with electricity. Other electrical house features, such as all varieties of cooking and heating apparatus, were well shown on the second floor by young ladies, who served electric candies. The welding of iron, and the vagaries of high-frequency current, especially in the production of vacuum-tube lighting, were not only shown, but carefully explained.

The main laboratory floor was flooded with incandescent lamps hung in long festoons, dispensing with the usual arc lighting of this space. This special lighting gave a very attractive effect, modeled somewhat after the lighting scheme used in the Electrical Show in Chicago last January. Exhibits here included complete wireless stations, where messages were actually sent as presented by visitors, the received copy delivered from the receiving station serving as a souvenir of the occasion. Two electric incubators in operation were arranged to show that alternating current may be expected to produce speckled chickens and direct current only a black variety. The drilling of a ½-in. iron plate by means of the electric arc was one of the exhibits that attracted great attention. A house receiving dangerous strokes of static electricity was shown to be fully protected by a lightning rod that could be slipped into position. A cleverly concealed electric motor within a pulley of unsuspicious appearance running under a sign, "Perpetual motion at last. No stock for sale," created much interest and favorable comment.

An electrical blue-printing establishment and a photograph gallery were in constant operation. One of the attractive exhibits was a handsome equitorially mounted telescope where the "moon" was made visible. A miniature electric railway was shown in operation, and the stimulation of plant growth by electricity, though exaggerated to an extent amounting to a burlesque, maintained crowds in constant attendance. A newly installed substation consisting of a motor-generator set for the production of either direct or alternating currents for laboratory use was made a feature. This set was actually supplying the energy needed for the various exhibits.

A fine display of tungsten, as compared with other lighting by arc and incandescent lamps, occupied the Illumination Room up-stairs. There was also shown a motor in rapid rotation by "static electricity." A good exhibit of X-rays and a demonstration of cutting lines of force were included in the display of the Department of Physics. A carefully arranged telephone room showed very clearly the difference between manual operation of the usual switchboard and automatic operation.



GENERAL VIEW OF MAIN FLOOR EXHIBIT.

The electric and dynamometer test cars of the railway department were open for inspection, and the electric car was arranged so that any one could "make the wheels go round" by handling the controller. Too great acceleration was prevented by the use of an e.m.f. of only 110 volts for this occasion. The car was jacked up so as to allow the wheels to revolve.

The show was a revelation to visitors as to the executive ability that may be found in apparently inexperienced students when they are allowed full sway. The admission charge was for the purpose of establishing a loan fund for electrical students, and a good start was made in this direction. Experience gained by the student managers of the show and by all connected with it will doubtless be of direct benefit to them in the way of self-confidence when they are called upon later to take charge of business enterprises. That it was carried out with entire success and the absence of any unfavorable criticism speaks well for the boys. Everything was in readiness on the opening night, which is more than can be said of some exhibition enterprises. The appointment of sufficient "conductors" to guide visitors desiring their services was again a feature of the show, making it easy for all visitors to quickly find any desired feature that had been announced.

N. E. L. A. Convention.

An efficient system of registration of visitors to the coming Chicago N. E. L. A. convention has been organized. Cards are being sent to members, to be filled in for return by mail or presentation at Chicago. The system is similar to that which last year gave excellent results.

Mr. H. J. Gille, of the Minneapolis General Electric Company, will have charge of the presentation on "Commercial Day" of the topic, "Preparation of a Campaign," and Mr. L. A. Ferguson will similarly take care of the topic, "Relation Between the Engineering and Commercial Departments." The first-mentioned paper will have five sub-titles, as follows: (a) Field Work and Other Essentials; (b) Analysis of Customers' Accounts; (c) Proportion of Lamp Equivalent Lost to Lamps Connected—Showing Percentage in Cities of Varied Population; (d) Policy of Handling Complaints; (e) Policy of Handling Collections. Contributions to the development of the topics will be obtained from a number of experts selected from communities where conditions are widely varying.

President Roosevelt on Water Powers.

In a special message to Congress, on April 13, President Roosevelt pointed out that there are bills pending which propose to give away without price rights to streams equal to developing 1,300,000 horse-power. The President made the deduction that this practically meant the free gift of 25,000,000 tons of coal a year, and he followed this with the comment: "This natural wealth is the heritage of the people. I see no reason for giving it away."

The President sent the message in vetoing a bill extending by three years the time given to the Rainy River Improvement Company to build a dam in the Rainy River. He held that these stream privileges should be leased. He expressed the belief that natural resources should not be granted and held in an undevoloped condition either for speculative or other reasons. He said that the provision for a charge is of vital importance, that the income from charges would "materially aid in the complete improvement of our navigable waters for which there is now such crying need." He said that there is every reason for not imposing conditions so burdensome as to prevent the utilization of the power, but that "we are now at the beginning of a great development of water power, and that already the experience of the past shows the necessity of caution in making unrestricted grants of this great power." It also was said by Mr. Roosevelt that "already the evils of monopoly are becoming manifest."

The President laid down a policy in five clauses. The first for a limited grant, the second for power to annul the grant if plans are not carried out as provided in contract with the government. The third clause was for an officer to see that navigation and power are developed to the maximum. The fourth provides for a license fee or charge, and the fifth terminates the grant at a definite time.

Electric Service and the Fire at Chelsea.

Early in the progress of the fire which on April 12 destroyed over $6,000,000 in property at Chelsea, Mass., and several lives, the local street railway service of the Boston Elevated Railway Company and the Boston & Northern Street Railway Company through Chelsea was suspended. The Boston Elevated car house, at Broadway and Gerrish Avenue, was destroyed at an estimated loss of $50,000, and the Bellingham car station of the Boston & Northern Road was burned, at a loss of about $10,000. The Boston Elevated Company was able to save the cars in the city of Chelsea, by active work in the face of the fire's advance. The loss to the Boston & Northern is estimated at about $26,000, a large part of which is represented by overhead feeders and pole line fixtures. The tracks were also considerably damaged. In some places the heat of the fire was so intense that 9-in. girder rails were warped out of their foundations and broken.

Up to Monday noon the Boston Elevated Railway Company had not been able definitely to determine its losses on wires, poles and tracks. Seven snow ploughs were burned in the fire. The Boston & Northern lost but one car, it is believed. Soon after the fire got under way the Chelsea exchange of the New England Telephone & Telegraph Company was burned at a loss estimated at $20,000, and a little later the electric light and power service of the Chelsea Gas Light Company was cut off in order to prevent danger from live wires. The loss to this company is largely a loss in earnings in the burned district, for most of the electricity sold in Chelsea is supplied by the Edison Electric Illuminating Company of Boston, distributed locally by the Chelsea organization.

The wire service in Chelsea was a complete wreck, but while the ruins were still smouldering, linemen were set at work by the telegraph and telephone companies in an effort to re-establish communication. The New England Telephone & Telegraph Company had a load of lumber on hand at the site of its burned building on Fourth Street on Monday morning, and a temporary shelter was planned to be erected by night for that service.

Largest Single Telephone Installation in the World.

With a capacity of 3000 pairs the telephone installation in the new Terminal Buildings, Cortlandt and Fulton Streets, at the Manhattan end of the tunnels of the Hudson Companies, is the largest of its kind ever put into any office building in the world, exceeding by nearly 200 per cent the next largest office installation, that in the Broad Exchange Building, New York, which has 800 direct lines, and by 100 per cent that of the Waldorf-Astoria, which has a private branch exchange operating 1500 extension stations. The first section of this huge installation, consisting of 3000 lines within the building and 1200 lines to the central office, has been completed and will be ready for use when the tenants move into the building on May 1.

From the main exchange of the New York Telephone Company, at 15 Dey Street, the cables run into a vault in Cortlandt Street, and thence through a subway into a terminal room situated at the southeast corner of the concourse floor in the building. In the terminal room is the central frame, the center of the whole system and where the 3000 pairs of conductors in the house cables converge. The two buildings are 22 stories high and together have floor space of about 1,000,000 square feet. In the Fulton Building the arrangement allows one pair of conductors for every 310 square feet and one pair of conductors for every 300 square feet in the Cortlandt Street Building.

A certain number of the circuits, about 1200 in all, will go directly to various offices from the central office of the telephone company. There are three main cables in the Cortlandt Street building with 600 pairs of conductors each and two in the Fulton Street building with 600 pairs of conductors each. A tenant who occupies more than one floor, as in the case of the American Bridge Company, will have a special private line cable from their switchboard direct to the floors which they occupy. The main cable from the central office to the floors is continuous and has no wires exposed. All wires, in fact, are concealed in shafts, conduits and in moldings from the point where they enter the building to each instrument. In the installation about 5,000,000 ft. of No. 22 wire is used which, if connected in one line, would reach from New York to St. Louis, about 1000 miles.

About 10,000 lb. of copper is required for the wiring, not including the bridle wiring from the terminus to each instrument; the entire weight of the wire used, including the coverings, is estimated at 100,000 lb. When the entire system is completed it will be possible for every one of the 3000 instruments to be used at the same time. On the first section of

1200 it is fair to estimate about 10,000 outside calls a day. Tenants moving from other places of business into the Terminal Buildings require that the changes in their telephone connections shall be made without interruption of business, and 60 men working day and night are at work making the changes. The number of lines in the building is about one-third of the average number of lines ever put into one exchange district in New York City, 10,000 lines being the maximum.

Extensions to New York Public Service Commissioners' Powers.

A bill now before the New York State Legislature makes a number of important amendments to the former act creating the Public Service Commission for the regulation of electric and gas corporations. A clause extending the powers of the commission over telephone and telegraph companies has been removed from the present bill and will form a separate measure.

The bill gives to the commission additional power of supervision over all property owned, leased, operated or controlled by any such gas corporation or electric corporation, and delegates power to order improvements in the maintenance and operation of works, wires, poles, lines, conduits, ducts and other devices, apparatus and property of gas corporations and electrical corporations; to prescribe methods of regulation of the electric supply system, (a) as to voltage regulation of all constant-potential systems, (b) as to current regulation of all constant-current systems, and (c) as to initial efficiency of all carbon filament incandescent lamps, when furnished and renewed free and supplied for use on constant-potential systems, the service for which is charged by meter. It may also, in its discretion, prescribe, by order, the form of accounts, records and memoranda to be kept by such persons, corporations or municipalities. Notice of alterations by the commission in the required method or form of keeping such accounts shall be given at least six months before the same shall take effect. Where the commission has prescribed the form of accounts required and memoranda to be kept, it shall be unlawful to keep any other accounts, records or memoranda than those so prescribed relating to said business. Whenever the commission shall be of opinion after a hearing had upon its own motion or complaint that rates are unjustly discriminatory or unduly preferential or that the regulations, practices or methods are improper, unjust, unreasonable, unjustly discriminatory or unduly preferential or in anywise in violation of any provision of law, the commission shall fix by order the proper, just and reasonable maximum rates and charges and shall determine by order the proper, just and reasonable regulations and practices and methods; and whenever the commission shall be of opinion that the plant, system, equipment, devices or appliances are unsuitable, improper, inefficient or inadequate, the commission shall determine by order the suitable plant system, etc.

The commission is given power to compel the production of any accounts, books, etc., and to require the filing with it all schedule of rates and charges, copies of all forms of contracts and agreements relating to such charges. Prices fixed by the commission shall be the maximum price to be charged by such person or corporation for gas and electricity for a period to be fixed by the commission, not exceeding three years, and thereafter until the commission shall, upon its own motion or upon complaint of any corporation or person interested, fix a higher or lower maximum price of electricity to be thereafter charged.

Exhibit of Safety Devices.

The yearly exhibit of the Museum of Safety Devices, McGraw Building, New York City, was opened on April 11, and will be in full running order by the end of this week. It contains a number of new and interesting appliances, as well as large, typical exhibits by the Pennsylvania Railroad, Carnegie Steel Company and Travelers' Insurance Company. There are several exhibits of an electrical character, and the whole is well worthy of visit and study. The public is invited, and there is no charge for admission. Dr. W. H. Tolman, the director, is in charge. Prof. F. R. Hutton is the chairman of the exhibit committee and Mr. Charles Kirchhoff is chairman of the committee of directors.

CURRENT NEWS AND NOTES.

NEW JERSEY PUBLIC SERVICE COMMISSION.—The New Jersey State Legislature adjourned without passing a public utilities bill, which measure had the support of Governor Fort.

THREATENED TELEGRAPHERS' STRIKE.—The Commercial Telegraphers' Union will, it is reported, order a strike against the Western Union Company unless that company restores wages by June 1. It is said that the Postal Telegraph Company will not be affected, as it did not pursue the course of the Western Union in reducing wages after the strike of last year.

THE ELECTRICAL TRADES SOCIETY, of New York, is making a vigorous effort to extend its membership. The corresponding Chicago society is in the lead with respect to membership, the claim being made that it exceeds in membership the combined lists of the affiliated societies in Boston, New York, Philadelphia, San Francisco and Montreal. Mr. Franz Neilson, 80 Wall Street, is secretary of the New York Society.

MEETING OF PITTSFIELD A. I. E. E. BRANCH.—The tenth meeting of the Pittsfield section for the present season was held April 10, at Hotel Wendell, and about 70 members were present to listen to a paper presented by Mr. W. S. Moody, chief engineer of the Transformer Department of the General Electric Company, entitled "Feeder Regulators." Previous to the meeting the usual dinner was held for the speaker and the members. The section will hold one more meeting this season, the latter part of April.

PITTSBURG A. I. E. E. BRANCH.—At the April meeting of the Pittsburg A. I. E. E. Branch, several papers were read, as follows: Mr. James Farrington, electrical superintendent of the La Belle Iron Works, on the relative advantages of various methods of operating reversing mill tables; Mr. W. A. Dick, on the application of motors to rolling-mill work, and Mr. B. Wiley, on the same subject. The papers of the evening were discussed by Messrs. W. Edgar Reed, C. T. Henderson, Friedlander and James.

AMERICAN VS. ENGLISH BOYS.—Sir William H. Preece, in a paper before the Society of Arts, of London, on "Technical Education in America" said that it is difficult, if not impossible, to make comparison of the methods of technical education in England and America, conditions being totally different. The American boy, he said, possesses the energy and smartness of a new race, the European boy being mentally two years behind him. This, he said, would account for the difference observed in curricula and in papers set for examinations. Canon Jephson, who was, with Sir William, a member of the Mosely Commission which several years ago visited this country to study our educational methods, takes exception to this comparison. The Canon says that owing to the American system of co-education and the preponderance of women teachers, the American boy is retarded in many ways where the English boy is pushed ahead. The English lad, particularly the Londoner, has, he believes, far more shrewdness and common sense than the American boy.

ILLUMINATING ENGINEERING SOCIETY.—Dr. Clayton H. Sharp, past-president of the society, delivered an illustrated lecture on "New Types of Lamps" before the New York Section on April 9. The subject was discussed by Messrs. Doane, Hammer, Williams, Jones, Elliott, and by Dr. Hyde and Dr. Sharp.

NEW ENGLAND SECTION OF I. E. S.—For the meeting this week of the New England Section of the Illuminating Engineering Society, an admirable means to bring out a discussion of value has been adopted. In advance of the meeting a blue print was sent out giving the plan to scale of a shoe store and solutions asked for the problem presented in securing the most effective illumination for the specific case.

THE KELVIN.—At a technical conference of the faculty and student officers of United States Army Signal School, at Fort Leavenworth, Kan., held March 25, a resolution was adopted in the name of the school favoring the adoption of the word *Kelvin* to designate the commercial unit of electrical energy at present known as the *kilowatt-hour*, as a recognition of the services of the late Lord Kelvin in the advancement of electrical science.

DELAWARE RIVER WATER POWER.—At a meeting in New York City last week of representatives of the states of Pennsylvania, New York and New Jersey, the matter of the control of the waters of the Delaware River was discussed, mainly to avoid flood damages. A plan was stated to be under consideration so to control its waters as to utilize them for power purposes and joint action for this purpose by Pennsylvania, New Jersey and New York was discussed.

TORPEDO WIRELESS CONTROL.—A London dispatch announces still another in addition to the many systems which have been proposed for the wireless control for torpedoes. In this case the inventor is Grendell Matthews, who says that by his system a torpedo can be controlled absolutely up to a distance of 7¼ miles, and can be exploded either by concussion or by means of wireless. The same inventor asserts that he has discovered "An electrical wave which cannot be interfered with."

ELECTRIC SHOW STOCKHOLDERS' MEETING.—The stockholders of the Electrical Show, Incorporated, held a meeting on March 6. The old board of directors were re-elected and are as follows: Messrs. Dudley Farrand, Arthur Williams, George F. Parker, Walter Neumuller, W. W. Freeman, James R. Strong and James C. Young. Mr. George F. Parker was reelected vice-president of the company. The management reports that contracts for space have been received in such numbers as to guarantee the success of the show and warrants the assertion that the exhibition will be the largest and most truly representative of any ever held in New York.

HIGH-TENSION LINES IN NEW YORK STATE.—A bill has been introduced in the New York State Legislature which calls for the installation of a properly grounded "catch-net" under every line of 20,000 volts or over, crossing public streets, highways, railway tracks, canals or which passes over other aerial wires. It is specified that the net should be at least 8 ft. below the high-tension circuit, shall not be less than 20 ft. wide nor less than 22 ft. from the ground, nor less than 4 ft. from any other wire. Furthermore, it shall be supported by poles, towers or other structures erected outside of the limits of the public street, highway, etc., for the full width of the crossing and at least 6 ft. beyond on each side, and of sufficient width and so constructed as to assure the retention of any transmission lines that may fall upon it.

RUMFORD MEDAL AWARDED TO DR. ACHESON.—Dr. Edward G. Acheson, of Niagara Falls, was the guest of the American Academy of Arts and Sciences at the Algonquin Club, Boston, on April 8, the occasion being the award to him of the Rumford Medal. The address of introduction was given by Prof. Charles R. Cross, chairman of the Rumford committee. He spoke of the twin trusts reposed by Count Rumford in the Royal Society and the American Academy, whereby awards are given for important discoveries in light or heat. He noted that the present award was one distinctly in the line of the useful arts, and stated that "interesting as was the work of Moissan in the fabrication of artificial diamonds the work of Acheson far transcends it, for it is a contribution to the direct progress of man." The medals were presented by Prof. John Trowbridge, vice-president. In reply Dr. Acheson referred to his youthful desire to receive one of the medals and gave an account of his researches with the electric furnace. The meeting was arranged at the Algonquin Club through the courtesy of Prof. Elihu Thomson.

STORAGE BATTERY ELECTROLYTE IN COURT.—A somewhat spectacular demonstration was made during trial in New York City of a damage suit brought against the New York Transportation Company by a boy whose lawyer claimed had been knocked down and had rolled in the puddle of electrolyte fluid which had formed after the breaking of the batteries of an electric cab in a collision. He claimed, further, that the electrolyte had burned the boy so severely on the head and face that the burns had not healed for six months. As soon as this allegation was made, both Mr. Wing, counsel for the company, and Mr. William H. Palmer, jumped to their feet and volunteered to wash their hands in the same kind of acid which the plaintiff's lawyer claimed had burned the boy. The boy's lawyer dared them to carry out the proposed demonstration, and they accepted his challenge. With the consent of the judge, a battery of the same type used on the electric vehicle which had been in the collision was then brought in the courtroom, and the acid emptied from it into a basin. Mr. Wing and Mr. Palmer then washed their hands in the electrolyte fluid and rubbed a generous quantity of it on their faces. Mr. Wing, to prove further the harmlessness of the fluid, actually swallowed some of it. The jury was apparently so well satisfied with this demonstration of the inability of electrolyte to inflict the injuries which the plaintiff's lawyer claimed that it brought in a verdict for the company after being out only 15 minutes.

ELECTRIC TRAINS ON THE NEW HAVEN RAILROAD.—The New York, New Haven & Hartford Railroad announces that at present there are 83 trains operated by electricity on week days between New York and Stamford, and 33 on Sundays. By July 1 additional electric locomotives will be in commission and then all trains between the two points will be run by electricity. The power house at Coscob is now working to its full contract capacity, but a fourth unit is to be added to furnish power in case of emergency in the operation of the service. All the repeated and complicated difficulties encountered in installing the electric service, the company says, have been overcome. Electrically-operated trains have been running on the New York Central lines since last July and are considered successful from the operating, engineering and financial standpoints. With the electric system it is possible to use the "air-rights" of the corporation; that is, to build office buildings over the terminal yards. The New York Central property at the Grand Central terminus is worth $50,000,000 more now that the road is to be operated throughout by electricity, taking into account this possibility of erecting revenue-producing buildings on it. Money is also saved in the lighting of yards and terminals, since with the present facilities it is easy to provide current for other purposes, and in this way the road will save $200,000 a year. The power house is designed to take care of peak loads, and electric power will be used in the operation of bridges, unloading machinery, etc. Switching will be done largely by electricity and by the use of electrical automatic stops, the presence of more than one man at the front of the train is unnecessary.

Generating and Distributing System of the Portland (Ore.) Railway, Light & Power Company.—II.

Station B.

THIS generating station, located at the falls of the Willamette River opposite Oregon City and distant approximately 13 miles from Portland, is the second water-power plant of the Portland Railway, Light & Power Company as regards size.

The power station is of concrete construction and consists of a series of pier walls, vertical and horizontal arches, connected and reinforced by the use of iron rods built in the concrete, arranged to form separate chambers or independent sections, below the generator room floor for the draft tubes, flume and water wheel rooms. The flume or wheel rooms are connected by arched openings through the dividing pier walls. The first set of arches above the foundations forms the floors for flume and wheel rooms and the second set of like arches forms the roof over the flume and wheel rooms and the floor of the generator room. The generator room is 246 ft. long; for 206 ft. the room is 38 ft. wide and for the remaining 40 ft. the room is 64 ft. wide; the walls are 17 in. thick, of concrete, and 20 ft. high from floor to roof truss plate and are strengthened with pilasters every 16 ft. The room is well lighted and ventilated by 26 windows.

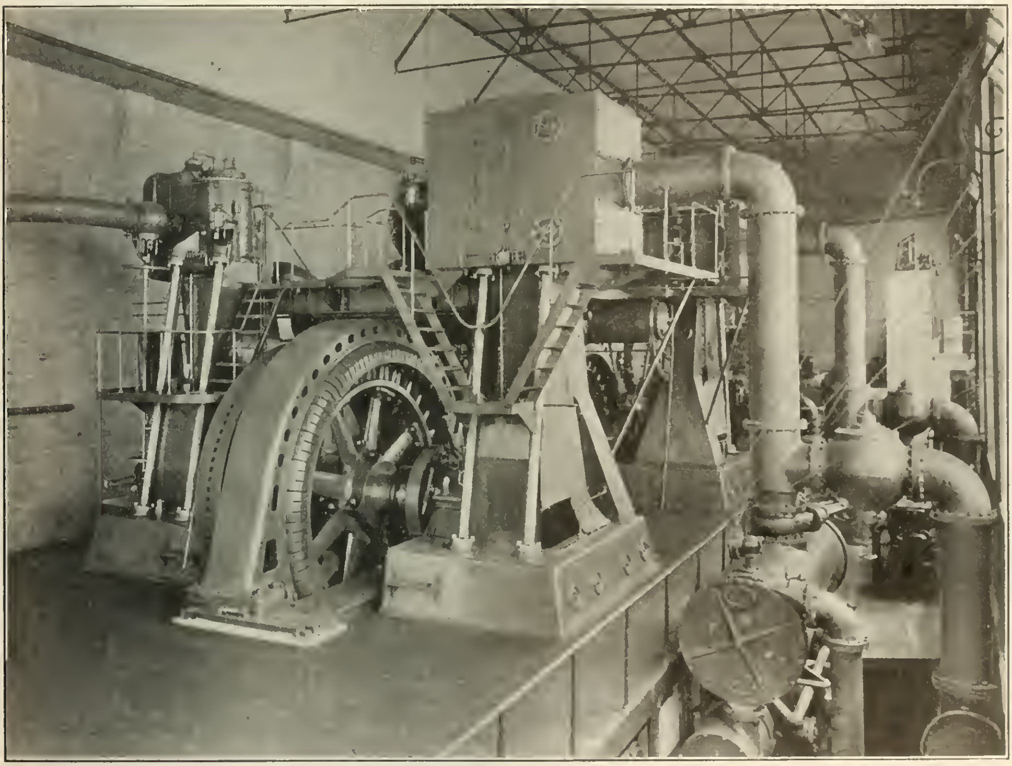


FIG. 1.—PARTIAL INTERIOR VIEW OF STATION E AT PORTLAND, ORE.

The elevation of the flume or wheel floor is 21 ft. above the low-water surface of the tail race and 57 ft. above the lowest part of the foundation. The generator room floor is 56 ft. above the low-water surface in tail race and 6½ ft. above the highest known water level in the river below the falls. The roof is of timber-truss, plank-sheathed construction, covered with composition-felt and gravel roofing.

The station is equipped with a 12-ton electric traveling crane and two 12-ton manually-operated traveling cranes. The electric crane can be used throughout the entire length of the building except in the end offsets which are served by the manually-operated cranes. The switchboards and electric controlling apparatus are located in the central portion of the building. The racks to prevent débris getting to the wheels are set at an inclination of 1½ in. per foot to facilitate cleaning, and are supported by a steel frame of I-beams and channel-beams, securely tied together and built into the concrete walls of the station. The forebay is open and extends in front of and up to the concrete wall of the station.

The tail race is a natural arm of the river into the edge of which the station has been built. The penstocks are of wrought steel having cast-iron heads and covers, and are connected to the open forebay by short, steel, cylindrical feed pipes extending through the concrete wall of the power station; each unit being independent and equipped with a supply gate operated by hand power through gearing. The supply gate is provided with large balanced iron wickets, so that it may be closed and the water shut off from the penstock without difficulty even though the wheel gates could not be closed nor the wheels shut down through accident to their gate gearing or from other cause.

The original overflow dam was a timber crib, plank deck, rock filled structure, fitted and secured to bed rock with iron anchor bolts and had an upstream slope of 2 horizontal to 1 vertical and downstream slope of 1 horizontal to 1 vertical, the slopes converging to an apex formed of heavy timber, rounded off. The height of dam varied from 3 to 20 ft. and the base was 30 ft. at the widest part.

This original dam structure on the west side of the river and extending to the center of the falls, was replaced in 1904 by a solid concrete dam, made necessary by new works constructed at the falls, and it is proposed to replace the balance of the timber crib dam with a tight concrete dam, thereby shutting off all leakage and waste of water during the low-water period. The present length of the overflow dam is 2460 ft.

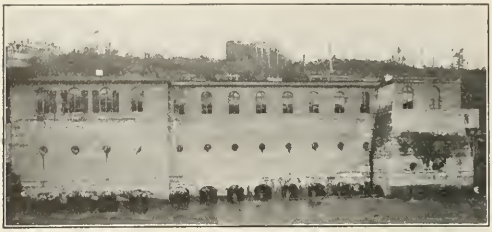


FIG. 2.—REAR OF STATION B, OREGON CITY, ORE.

The storage area directly above and in front of the wheels, considering the open forebay only, is 27,500 sq. ft., and it has a depth of 20 ft. at low water. The water supply of the Willamette River above the falls is furnished and maintained by the watershed immediately tributary to it and numerous streams the most important of which are the McKenzie, Calapooia, Santiam, Pudding, Molalla, Long Tom, Mary's, Luckiamute, La Creole, Yamhill and Tualatin Rivers, with their numerous forks and smaller branches, having their sources in the Calapooia Mountains at the extreme headwaters of the Willamette itself and in the Cascade and Coast Range Mountains respectively; the whole system draining an area estimated at, approximately, 10,000 square miles.

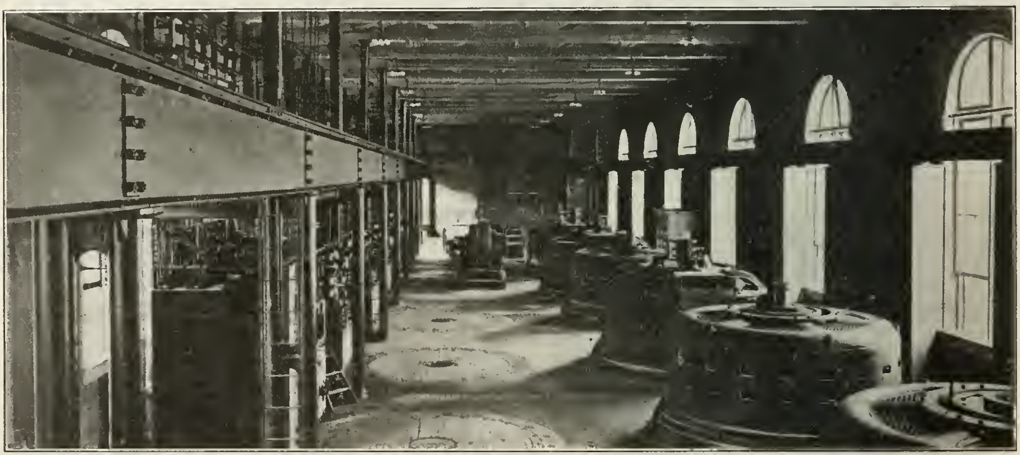


FIG. 3.—VIEW OF INTERIOR OF STATION B AT OREGON CITY, ORE.

The maximum flow of the river occurs during the wet season from December to March inclusive, and approximates an average of 350,000 cu. ft. per second. The average flow for a number of years past has approximated 66,500 cu. ft. per second and the minimum flow of the river is about 7000 cu. ft. per second.

The physical conditions are very exacting, as the hydraulic installation has to work under a maximum head of 40 to 42 ft. and a minimum head of only 20 ft. There are ten 42-in. Victor, vertical-shaft turbines, each direct-connected to a generator on the wheel shaft in the room above; and ten 60-in. vertical-shaft turbines. One of each of these sizes of turbine is placed in the same section or compartment as the 42-in. wheels. The smaller wheel is so placed as to utilize the higher head during the low-water stage, and the large wheel is placed back of the other one, it being designed for use during high water or low head. Its power is transmitted to the shaft of the smaller one by belting; there being a 46-in. double-leather belt whose tension is regulated by a belt-tightener. Both turbines have draft tubes, and it is customary to run both at ordinary stages of the river. During times of high water in the lower river when the head obtainable does not exceed about 30 ft., only the 60-in. wheel is operated. During the lowest stages when the supply is insufficient, only the 42-in. wheel is used, as it is more efficient.

The wheels have a vertical height of 21 ft. above the surface of the tailrace during low water. Both the wheels are arranged so as to drive the generator at the fixed speed of 200 r.p.m. at all heads from 20 to 40 ft. There are also two separate 48-in. Victor turbines each of which is fitted with a direct-current generator, used as exciters, and two pairs of 51-in. McCormick horizontal-shaft turbines, each driving a three-phase generator at a speed of 143 r.p.m. All the turbines have cylinder gates, and all of the vertical wheels except the 60-in. turbines are provided with ring and oil-pressure piston thrust bearings. The 60-in. wheels have only ring thrust bearings. The piston bearings are placed in cases supported on cast-iron columns and they are arranged to carry the weight of the revolving part of the generator and of the pulleys and shafts. No part of these weights comes on the water-wheel steps, as each shaft is in two parts connected just above the wheel by a pin drive or a jaw coupling.

FIG. 4.—VIEW OF WILLAMETTE FALLS.

The following generators extend in a row down the room at this station:

Seven 450-kw three-phase 10,000 volt revolving-armature, 33-cycle vertical generators; three 500-kw, three-phase 10,000-volt revolving-field, 33-cycle, vertical generators; two 540-kw, three-phase, 10,000-volt revolving-field, 33-cycle, horizontal alternating-current generators; two 200-kw, vertical, 125-volt direct-connected generators, used as exciters and operated by the two 48-in. wheels set in vertical shafts, in one section. All generators were supplied by the General Electric Company.

The switchboard is made up of marble slabs, one for each of the generators and exciters. Energy is transmitted by means of cambric-insulated cables to hand-operated oil switches, located at the rear of the generator panels in concrete compartments; the operating handle for each switch being located on its respective panel. After leaving this switch the electricity passes through disconnecting switches directly to the 10,000-volt busses. These busses are located above and at the rear of the switchboard panels on a gallery provided for the purpose. The generator field rheostats are also located on this gallery.

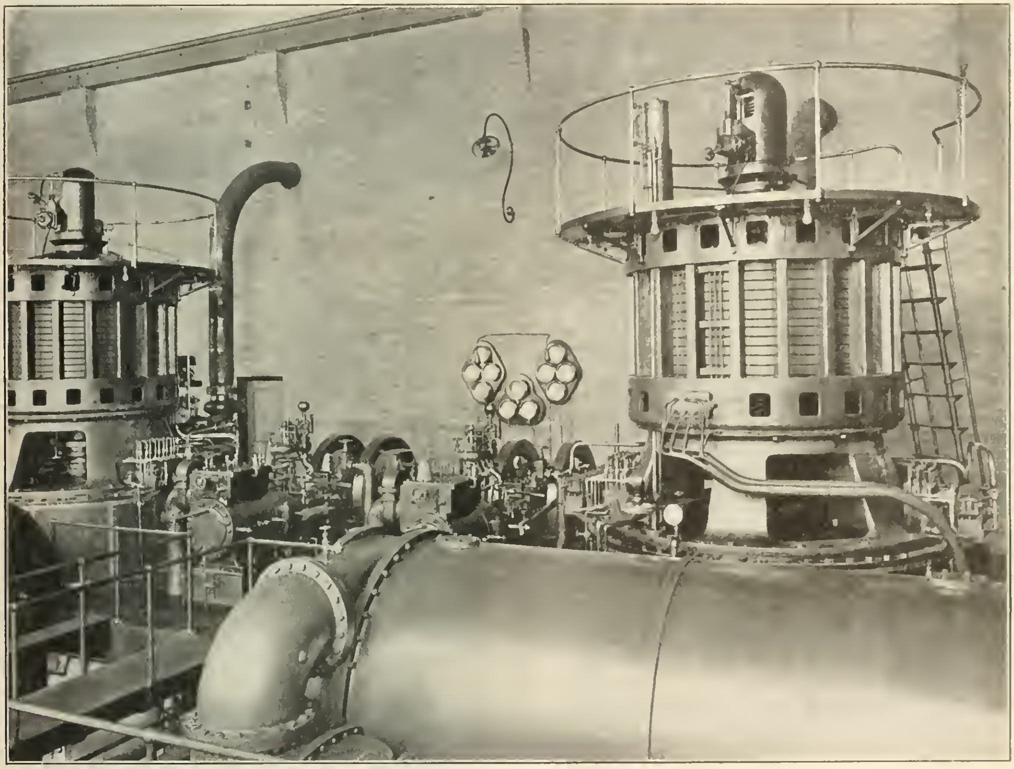


FIG. 5.—INTERIOR VIEW OF STATION E, PORTLAND, ORE., SHOWING TURBO-GENERATORS

In addition to the usual instruments, each generator panel is provided with a governor control switch, and bus sectionalizing switches are provided for separating the bus into two sections for convenience of operation. All the 10,000-volt generators are connected in parallel on the busses. A system of signals used by the attendant on the generator floor enables him to keep in touch with the water-wheel tender on the floor below. Leading from the busses are three 10,000-volt, three-phase feeder lines running to Portland; two on a pole line down the west side of the river and one on a pole line down the east side of the river. In addition to these feeders, a 10,000-volt feeder crosses the canal to the transformer substation located on the bluff overlooking the river, where by means of seven 750 kw oil, water-cooled transformers, manufactured by the General Electric Company, the voltage is stepped up to 33,000 and the electrical energy sent to Salem, a distance of about 40 miles, feeding the substations of the Oregon Electric Railway Company on the way.

In addition to the above there are located in this station a 500-kw frequency-changer set, two 400-kw rotary converters, six single-phase, 150-kw, air blast transformers, suitable alternating and direct current operating panels, and one blower set for supplying air to the transformers.

Oregon City is supplied with 60-cycle alternating current for lamps and motors. A Tirrill regulator is used to maintain a constant voltage on the generator. A 50-light mercury arc rectifier-set is provided for feeding the arc lamps in Oregon City and surrounding territory.

STEAM GENERATING PLANTS.

There are three steam generating stations operated in the city of Portland in connection with the Lower Willamette Valley System of the Portland Railway Light & Power Company: stations C and E, located in the northern part of the city near two large saw mills, and station F, located at the Inman-Poulsen Lumber Company's plant in East Portland.

Stations C and E are adjacent to each other on a piece of property situated at the intersection of Nicolai and Front Streets, with a detached strip 40 ft. wide extending out to the harbor line of the Willamette River.

Station C is made up of a boiler room 100 x 40 ft. and an engine room 100 x 120 ft., all being included in a frame structure covered with galvanized iron siding with wooden truss roof and tar and gravel covering. The engine room and boiler room are separated from one another by a 12-in. curtain wall of brick.

The fuel used in this station is sawdust and cut fuel, the latter being the product obtained by passing refuse at the mill through a "hog" which chops it up into a fine condition so that it can be handled by means of a conveyor. This fuel is brought from the mills by means of an industrial railway, which the company has constructed, and deposited in the top of a stock house; the railroad running up to this on an incline and the cars dumped directly into the stock bins. A system of conveyors which consists of hard wood floats fastened to a log chain and all driven over suitable sprockets by means of a small steam engine or electric motor, conveys this material from the stock house into the boiler room and thence into an opening in the top of the extended portion of the boiler furnace known as a Dutch oven. The boiler room equipment of this station comprises fourteen 100-hp. horizontal tubular boilers, and four 125-hp. horizontal tubular boilers. These operate at 100 lb. pressure.

The engine and generating equipment of this station is as follows: one 1600-hp double Wheelock non-condensing engine connected by means of rope drive to an 800-kw railway generator; one 1000-hp Allis cross-compound condensing engine connected by rope drive to a 750-kw, 10,000-volt, 33-cycle alternator; and one Fulton compound, marine-type engine direct-connected to a 200-kw railway generator. The 750-kw alternator delivers electrical energy to the operating busses located in station E and also to the 10,000-volt feeder system connected in parallel with the alternators in station E.

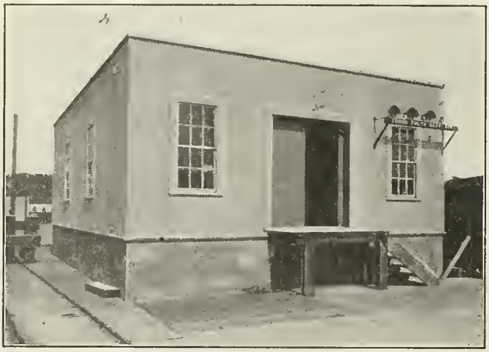


FIG. 6.—EXTERIOR OF PUMP HOUSE OF STATION E.

Station E is a handsome, one-story, brick structure surmounted by a flat steel-truss roof with steel purlins. The roof sheathing is made up of matched boards and covered with a tar and gravel roofing. The boilers are located in a very commodious boiler room provided with concrete floor and surmounted by a large ventilator. The feed-water pipe is located in suitable pits in the floor, these pits being covered with cast-iron plates. A reinforced-concrete stack 230 ft. high and 12 ft. in diameter stands immediately outside the boiler room and provides ample draft for the five batteries of Cahall water-tube boilers which form the boiler-room equipment.

These boilers are rated at 520 horse-power each with two to a battery, and are operated at 175 lb. pressure. Three of the batteries are equipped with Foster superheaters built to superheat the steam to 175 deg. Fahr. One end of the boiler room has been reserved for a commodious pump pit in which are installed Blake outside-packed, plunger feed-pumps; the suction of these pumps can be taken either from the discharge of the circulating water as it comes from the condenser or directly from the river. Arrangements are also so provided in case either of these two sources of supply fail, that water can be forced into the boilers from the city mains.

The Goubert feed-water heaters are provided for heating the water previous to its introduction into the boilers. The high-pressure steam piping, which was furnished by the M. W. Kellogg Company, is made extra heavy of lap-welded, mild, open-hearth steel with Vanstone joints. All the low-pressure piping, except the free-exhaust from the feed-water heaters, is of standard-weight, wrought-iron pipe, the free exhausts above mentioned being spiral-riveted, sheet-iron pipe.

The boilers in station C, like those in station E, are provided with Dutch ovens for burning sawdust and cut fuel. There are two of these ovens for each boiler or four for a battery. The ovens are also equipped for oil burning, two Morrissey oil burners being used in connection with each oven. The steam and oil piping is so arranged that by means of unions the burners can be quickly and easily disconnected when it is desired to change from one fuel to the other. Underground storage tanks of sufficient capacity to hold eight car loads of oil are located on the company's property just outside the station. A duplicate oil pump system has been installed.

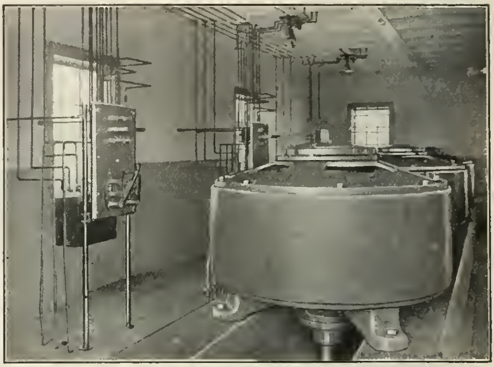


FIG. 7.—INTERIOR OF PUMP HOUSE, STATION E.

The generating equipment of station E consists of two 1400-hp marine-type, vertical compound engines built by the Willamette Iron & Steel Works of Portland, connected to two 1000-kw, 33-cycle, three-phase, General Electric alternators; one Ideal engine exciter set of 85-kw capacity; one motor-generator exciter of 60-kw capacity; and two Curtis steam turbines rated at 1500 kilowatts, but good for 2000 kilowatts continuously. The condensing system of station E consists of two Worthington surface condensers each having 2300 sq. ft. of cooling surface, and two Worthington surface

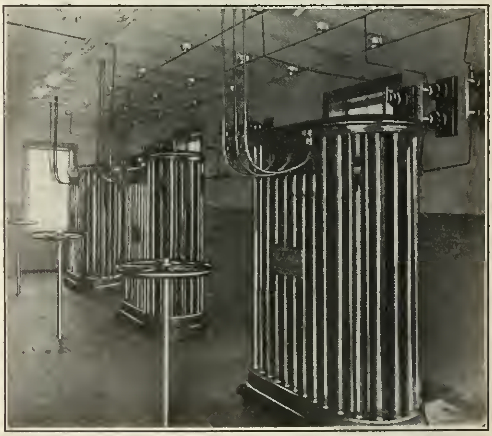


FIG. 8.—TRANSFORMERS IN PUMP HOUSE, STATION E.

condensers each having 7800 sq. ft. of cooling surface, the latter being used with the Curtis turbines. These condensers are provided with air coolers and hot wells and with the necessary dry-vacuum and hot-well pumps. The turbines are also provided with two outside-packed, plunger pumps for forcing the water into the step bearings at a pressure of 450 lb. per square inch. An accumulator is used in connection with these pumps.

A gravity oil system is used in connection with the engine and turbines; small pumps located in the condenser pits force the oil to tanks near the roof. The White Star oil filters are used in connection with this system.

The switchboard in station E is composed of General Electric apparatus; busbars, oil-switch mechanism, lightning arresters, potential transformers, etc., all being placed in concrete compartments and controlled by panels placed at a suitable distance in front of these compartments. Remote control is used for all high-tension switches. The lightning arresters, field rheostats, potential transformers and watt-hour meters are located in a basement, the panels being on the main operating floor. Two tiers of oil switches are used, the one being on the operating floor and the other located in a gallery immediately above. The generators are connected to the switchboards by means of cambric-insulated, three-phase cables drawn into ducts under the floor.

For supplying water to the circulating system a pump house has recently been installed at the harbor line at the end of the 40-ft. strip owned by the company. In this pump house are located three 16-in. vertical, centrifugal pumps manufactured by the Platt Iron Works, and direct-connected to three General Electric, 200-hp induction motors. The water thus obtained is discharged into a 33-in. sheet-steel riveted pipe which conveys the water a distance of approximately 1000 ft. directly into the condenser pit in station E. After passing through the condenser the return water leaves by means of another 33-in. main and discharges again into the Willamette River at a distance of about 600 ft. from the point of intake.

FIG. 9.—DUTCH OVENS, STATION E.

The motors driving these pumps are supplied with energy from the busses on the station E switchboard at 10,000 volts, the potential being stepped down at the pump house by means of three-phase oil-cooled transformers.

Station F, which is located at the Inman-Poulsen Lumber Company's plant at East Portland, is a one-story brick structure divided into two portions by a heavy brick curtain wall. The boiler room is provided with 13 return-tubular boilers having an aggregate horse-power of 2060. The station equipment consists of one 625-kw engine-driven railway generator and two 325-kw railway generators with suitable switchboard panels to control the same.

A 1000-kw, six-phase, 600-volt direct-current rotary converter, with the necessary transformers, blowers, switches, etc., has recently been installed at this substation and the steam apparatus shut down, but arranged to be held as a relay in case of need.

Sawdust and cut fuel are used at this plant, a stock house being provided as at stations C and E. The nearby mill furnishes this fuel. In the event of a lack of sawdust and cut fuel, provision is made so that slabs of wood may be burned in the Dutch ovens.

THE UPPER WILLAMETTE VALLEY SYSTEM.

The steam plant at Salem is the main generating station of the Upper Willamette Valley system. This plant generates 60-cycle current at 2300 volts and direct current at 550 volts. The generating equipment of this station is as follows: one 250-kw, 2300-volt, 60-cycle Westinghouse generator; one motor-generator set consisting of a 400-kw, 60-cycle, 2300-volt General Electric alternator direct-connected to a 600-volt direct-current generator, and one motor-generator set consisting of a 200-kw, 2300-volt, 60-cycle motor, direct-connected to a 150-kw, 600-volt generator. These sets are used as double-current generators. In addition there are one 400-kw vertical engine set for 500-volt railway service, and two constant-current arc transformers, suitable panels, instruments, etc., for controlling this apparatus.

A 1000-kw, six-phase, 600-volt, direct-current rotary-converter, together with the necessary transformers, blowers and switchboards, etc., has recently been installed in the substation building adjacent to the steam-power house where the energy transmitted from Station B, Oregon City, is transformed and used for the local street-railway system and through motor generators sets for lighting purposes. The steam plant has been shut down and is now used for relay purposes only.

VANCOUVER SYSTEM.

The Vancouver system is provided with one generating station situated in the city of Vancouver. The generating system is two-phase, 2300-volt, 60-cycle, and the equipment consists of one 330-kw inductor-type alternator; one 75-kw inductor-type alternator, and one 400-kw, General Electric alternator A constant-current transformer is provided for supplying the city arc lighting system.

The boiler equipment is made up of six water-tube boilers. In this plant, as in the plants in Portland, cut wood and sawdust is the main fuel used. When there is not sufficient supply of this on hand either slab or cord wood is fired into the boilers.

The station at Vancouver is a frame structure covered with a composite roofing. The company contemplates erecting a substation at this point in the near future at which time the generating plant will be shut down and held in reserve.

Design of Electromagnetic Brakes.

By J. Nikonow.

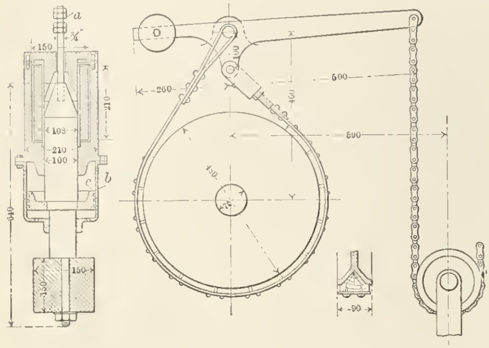
WHETHER a given design of an electromagnet is actually the best for a certain application is a matter of some difficulty to determine owing to the absence of standards of comparison such as exist for other classes of electrical machinery. The criterion of efficiency is usually inapplicable to magnets, owing to many other considerations rendering efficiency of minor importance. Electromagnets, designed to operate brakes, are in the nature of small auxiliary apparatus, consuming a relatively trifling amount of energy, but involving several special points of prime importance which must be considered in connection with the design of the brake itself. Among these points are the following:

1. Will the magnet do the work required under the worst operating conditions? 2. How quick and reliable will be its action? 3. Size and weight. 4. Cheapness in construction. 5. Adaptability to the machine of which it forms part (crane, hoist, etc.).

It must be borne in mind that each of these magnets must allow a definite travel for its plunger, and the designer's task is to make this travel as short as possible in order to decrease the m. m. f. of the magnet coil and, therefore, its size and cost.

Sometimes a little change in the design of the magnet or the brake may lead to quite an appreciable improvement in these respects, as will be shown later.

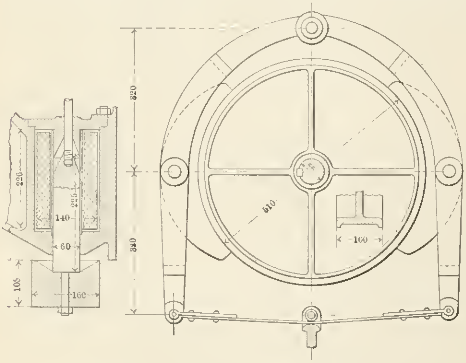
Fig. 1 represents a very common type of plunger magnet. It is designed to operate two powerful brakes of a 30-ton hoist, built by the Allgemeine Electricitaets Gesellschaft in Berlin. The plunger carries on the top of the rod *a* a wheel 8 in. in diameter, with a chain connected to the arms of the two brakes, as may be seen in Fig. 2. The weight of the plunger tightens the brakes until released by the current in the coil. Because of the considerable weight of the plunger, an air chamber *b* is added with a piston *c*, which acts to dampen the movements of the plunger. Two side brackets (not shown) are used to attach the magnet to the frame of the hoist. The wooden shoes fitting the channel in the brake wheel proved to be an excellent braking device. Two brakes were used in this case, as the hoist had four motors with series-parallel control, in order to give three efficient speeds for the rope, namely, 10, 20 and 40 ft. per minute.



FIGS. 1 AND 2.—COMMON TYPE OF PLUNGER MAGNET.

Such a magnet operates at about 6500 ampere-turns and requires 10 amperes on a 110-volt line. It is connected in series with a non-inductive resistor to decrease its time-constant and in multiple with another resistor which takes the inductive discharge when the circuit of the coil is opened quickly. Two inches of travel is sufficient to release the brakes completely.

This type may be called an automatic brake with negative action, the braking being produced by the weight of the plunger, so that the hoist can work only when current exists in the magnet coil and the plunger is raised. This arrangement insures automatic braking of the hoist when power is off or when the electric circuit is defective. It has, however, the disadvantage that the total pull must be exerted when the plunger is in its lowest position and, therefore, when the air-gap is longest and the magnetic flux is at a minimum. Such a magnet should be designed to have the full working flux coincident with the longest air-gap. In certain cases it is possible, however, to use electromagnets with positive action, and therefore non-automatic, the weight of the plunger releasing the brake and the magnetic pull tightening it. In that case the necessary pull is produced at the end of the travel when the air-gap is the smallest, so that the magnet will have comparatively small dimensions for the work required.



FIGS. 3 AND 4.—COMMON TYPE OF PLUNGER MAGNET.

An electromagnet will develop the same pull no matter how many turns of wire are put on its coil, provided the number of ampere-turns is constant. It appears, therefore, that in every case it is advisable to have as many turns as possible and to use the smallest possible current. In practice, however, following this rule leads to some difficulties, as may be illustrated by a practical example.

A positive brake was built in connection with a 150-hp motor. The magnet had the same dimensions as that of Fig. 1, but the coil contained 7020 turns of No. 16 wire, having about 165 ohms of resistance; thus about .65 ampere existed in the coil when subjected to 110 volts.

The magnet proved to be strong enough to operate the brake, but it worked extremely slowly owing to its high inductance, an interval of several seconds occurring after closing the circuit before the plunger began to move. As this was not satisfactory the coil was rewound for about 6 amperes with some external non-inductive resistance; the brake then worked properly and did not require any dash pot to dampen its movements. Of course, in the second case, the efficiency of the magnet was only about one-tenth of what it was before, since it required 10 times as much power to operate.

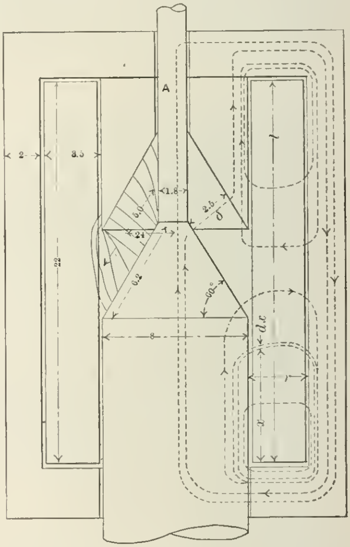


FIG. 5.—LEAKAGE PATHS AROUND A CONICAL PLUNGER.

To make the matter of efficiency clear, consider the condition of a magnet from the moment when the circuit is closed. It is necessary to expend some energy to overcome the inductance and to bring the magnetization of the system to its final condition. This energy is stored in the form of a potential energy and while the magnet remains in circuit it possesses this amount of stored energy independent of how many watts in the coil are being converted completely into heat. If the circuit is opened this stored energy is released in the form of kinetic energy, in the mechanical movement of the plunger, or in heating the coil. The presence of the moving plunger changes the form of the kinetic energy, because it changes the condition of the inductance of the magnet.

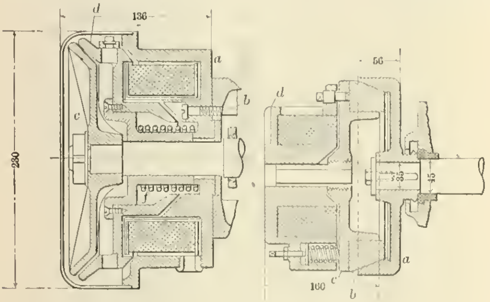
A mathematical analysis will show that by decreasing the current the inductance is increased, and that by decreasing the inductance the current is increased for the same work. Unfortunately, use cannot be made of a simple formula for the determination of the inductance of ordinary magnets containing iron, because the magnetic permeability is constantly changing with the change of current.

Fig. 3 shows a similar magnet, built in the foot of the motor bracket of a 10-ton hoist. Here the plunger is hung by means of a rod on a steel strap connecting two cast-iron brake shoes surrounding the brake wheel, as is shown in Fig. 4. When the coil is energized, the plunger releases the brake shoes. (In Figs. 3 and 4, and also in Figs. 1 and 2, the dimensions indicated are in millimeters.)

All these magnets have a conically divergent air-gap with sides inclined at 60 deg. to the axis of the plunger. Theoretically, in such a case the total pull is four times as strong as for the same travel with a flat air-gap. Practically this is true when the air-gap is comparatively short.

That the pull will be four times as strong will be appreciated when it is remembered that the pull varies directly with the product of the square of the magnetic density and the area of the plunger. When the angle is 60 deg. the area is increased by 100 per cent and the effective air-gap is decreased by 50 per cent so that the magnetic density is doubled. Thus the pull perpendicular to the air-gap is increased to eight times its former value, and that component in line with the travel is changed to four times its former value.

For a very large air-gap conditions are somewhat different. Fig. 5 shows diagrammatically the air-gap of a magnet having a plunger 80 mm in diameter and a coil 35 mm thick (with the insulation) and 220 mm long, surrounded with a yoke 20 mm thick. The total weight of the plunger is 9.828 kg, and it is raised 50 mm when the coil has a m.m.f. of 5460 ampere-turns. The rod in the middle is probably saturated magnetically, and the direction of the magnetic lines may be represented as shown on the left side of Fig. 5. These lines are considerably elongated on the outside and inside extremities of the gap, so that in these places the magnetic density is reduced. The decrease in density may be taken into account by assuming a smaller cross-section for the gap. The reduced width of the gap, as shown on the drawing, is 5 cm. Therefore the area is 75.4 cm and the magnetic density as computed for the weight of plunger and area of gap is 2560, which requires a m. m. f. of 5120 ampere-turns. This value of m. m. f. must be increased, as the iron of the magnet has some reluctance and requires also a certain number of ampere turns. The total flux in the gap is 193,000 lines, and the density in the yoke is therefore 1810 lines per square centimeter.



FIGS. 6 AND 7.—BRAKE MAGNETS.

Leakage, however large it may be, does not change directly the condition of the useful flux, but it increases the density in the yoke, and also the inductance by increasing the total amount of flux in the magnet. By increasing the yoke density, the total reluctance is somewhat increased, so that the leakage affects the useful flux indirectly. This influence, however, may be very different, depending upon the saturation of this yoke, so that in one case the leakage may be 100 per cent, and in another 25 per cent, and yet in the latter case a larger value of m. m. f. may be required.

To find the magnetic induction in the yoke it is necessary to find the leakage flux. One part of this may easily be found, namely, the flux in the rod *A*. This rod is of soft steel and is magnetized up to saturation, having a density probably of about 18,000 lines per sq. cm. Multiplying by the area, 5.65 sq. cm. the total flux in the rod is 102,000 lines. This flux must be added to the useful flux to obtain the actual density in the yoke. Apparently it is advisable to make it smaller by decreasing the diameter of the rod, for instance, or by using a rod of hard steel.

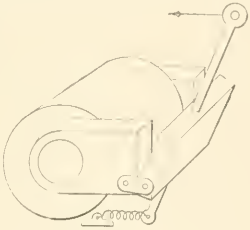


FIG. 8. ARRANGEMENT OF SMALL MAGNET.

As the coil is very closely surrounded by iron, the leakage flux must be very large. At the ends of the coil magnetic lines encircle a smaller number of ampere-turns, but at the middle of the coil the number of the ampere-turns is increased, and therefore the flux is also increased. With a uniform thickness of coil the flux will increase in direct proportion with the distance *x*. The smallest induction will be obtained with the location of the air-gap right in the middle of the coil, as represented in Fig. 5. In that case the total leakage flux is divided into two equal halves. A mathematical calculation shows that the leakage flux in air is 130,000 lines. Hence the total flux produced by the magnetizing coil must be $193{,}000 + 102{,}000 + 130{,}000 = 425{,}000$ lines. The magnetic density being 3960 lines per square centimeter, the required m.m.f. is 196 ampere-turns for the cast-iron yoke. The plunger, which is made of wrought-iron, requires about 30 ampere-turns. The top part of the frame, which is made of cast-iron, requires 180 ampere-turns. Hence the total m. m. f. required is $5120 + 196 + 30 + 180 = 5526$ ampere-turns. Experimentally it was found necessary to use 5460 ampere-turns, so that the above calculations give a value very closely approaching the experimental result.

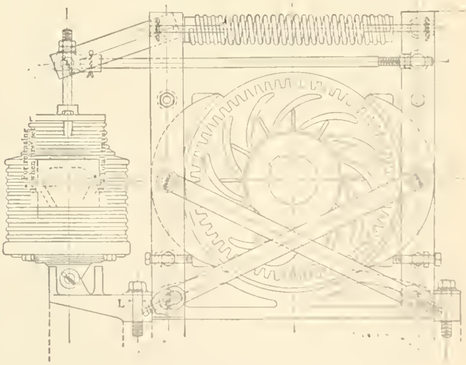


FIG. 9.—BRAKE MAGNET FOR MILL MOTOR

The problem may arise as to how to estimate the mean length of the working air-gap. With a short air-gap the full length may be taken, but when the air-gap is comparatively long it is better to take a length shorter by from 10 to 20 per cent. The best way, of course, will be to divide the air-gap into different parts, according to the possible directions of the lines of force, and determine the magnetic density and the length of the lines for each particular section, and then take their sum. With the direction of the lines as shown in Fig. 5, the result will be almost the same as with the mean length of the gap section assumed above. The air-gap between the plunger and the magnet is very small and it can be neglected in comparison with the working air-gap.

It is interesting to calculate the performance of the same magnet built with a flat air-gap. The leakage flux will be the same as before, so that working (calculated) number of ampere-turns will be again 5120. The useful magnetic density will be 1365 lines per square centimeter. The area of the gap being 44.35 sq. cm, the tractive force will be 3.35 kg. This value is only one-third of what it was before.

Suppose the magnet shown in Fig. 5 has a travel of only 2 cm and is subjected to a m. m. f. of 5950 ampere-turns, what will be its performance?

It is impossible to solve such a problem exactly, but after two or three approximations it is found that the magnetic density in the gap will be about 4370, which gives the total useful flux of 417,000 lines. The air-gap is comparatively short now, so that its full area of 95.5 sq. cm may be taken. Leakage flux in the rod, which will be almost unchanged, may be taken as 102,000 lines, and the coil leakage will be increased in proportion with the increase of the ampere-turns, to 142,000 lines. This leakage will actually increase more than in proportion to the increase in m.m.f. on account of the somewhat increased leakage area, but the error of assuming exact proportionality is comparatively small.

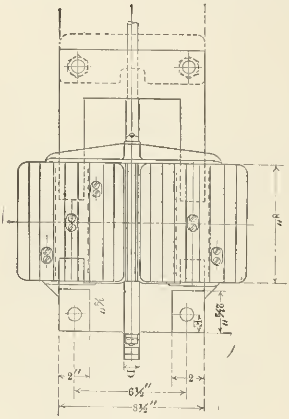


FIG. 10.—SMALL PLUNGER MAGNET.

The total flux in the yoke will be 661,000 lines, and the magnetic density 6180 lines per square centimeter, requiring a m.m.f. of 730 ampere-turns for the yoke. The magnetic density in the core being 12,600, the m.m.f. will be 1590 ampere-turns. The plunger being subjected to a magnetic density of 13,200, the m.m.f. must be 105 ampere-turns. The useful m.m.f. will be $5950 - (730 + 1590 + 105) = 3535$, or approximately 3500 ampere-turns, which gives the useful magnetic density of 4370, and a tractive force of 36.3 kg. By test the tractive force was found to be 37.2 kg.

Fig. 6 is a magnet with a brake built in connection with a Siemens-Schuckert hoist (½ ton, 60 ft. per minute speed of the rope). Magnet frame *a* with the coil is attached to the end of the bearing by means of the screws *b*. Dish-like bronze friction plate *c* is firmly attached to the end of the motor shaft. The plunger *d* is made from soft steel and is always pressed against the bronze plate by action of the spring *f*. After the coil is energized, it pulls back the plunger *d* against the spring and releases the motor shaft. A cover renders the equipment dustproof.

The great advantage of this construction is that the travel is very small (from 1/16 to 1/8 in.) so that the magnet is very small in size for the work required; it is rapid in action and is perfectly reliable.

A similar construction is shown in Fig. 7. This is a brake for a high-speed ½-ton hoist built by the Actiengesellschaft Volta. Here a steel friction plate *a* rubs against the fiber ring *b*, attached to the plunger *c*. Three springs hold the plunger against the plate *a*. The magnet *d* is screwed to the frame by means of two side brackets (not shown).

Fig. 8 represents a very good arrangement for a small magnet. Experience shows that with such an arrangement for the same length of travel, the magnet develops considerably larger pull than with the ordinary parallel motion of the armature.

Fig. 9 represents a Westinghouse electromagnetic brake for mill motors. Here the braking is produced by the spring, and the magnet releases it. The pulling force is considerably less than the tension of the spring, due to a very ingenious arrangement of the levers.

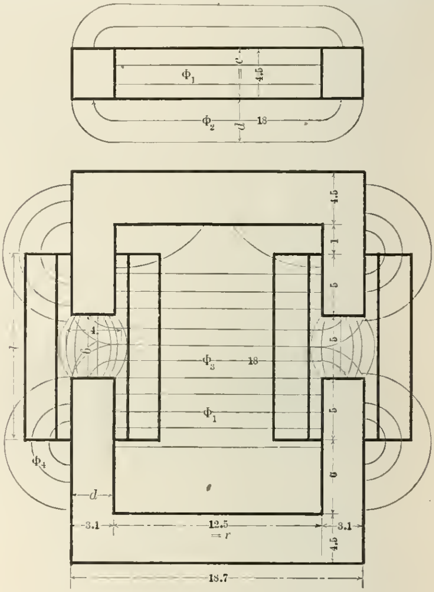


FIG. 11.—MAGNET WITH FLAT SURFACES.

ALTERNATING-CURRENT MAGNETS.

With alternating current it is necessary to use a laminated core, so that all such magnets have a very simple form, such as shown in Fig. 10, which represents a Westinghouse magnet for a 3-in. travel for lifting 150 lb. The design of such magnets is somewhat more complicated than is the case with direct-current apparatus. For example, suppose that it is desired to design a magnet for a 5-cm (or about 2-in.) travel and a lifting force of 18 kg to operate on a 440-volt, 25-cycle line. After some trials the reactive electromotive force is found to be 410 volts. Moreover, by trials it is found that a convenient number of turns for two coils would be 2350. From transformer relations it is found that at a frequency of 25 cycles a coil of 2350 turns at 410 volts would require 156,500 lines. Assuming a maximum density in the iron of 12,000 lines per sq. cm and noting that 8 per cent of the section of the core is occupied by the insulation between laminations, the cross-section is found to be 14 sq. cm.

Fig. 11 represents such a magnet with a cross-section of the iron of $3.1 \times 4.5 = 14$ sq. cm. Due to a very long air-gap and considerable density in the iron, lines of force spread out in the gap, as shown, so that the mean area of the gap must be taken as about 22.9 sq. cm. It would be a serious mistake to assume the area of the gap equal to that of the iron. The flux in the gap is considerably less than in the iron, due to a very large magnetic leakage with magnets of such a form. We have now all data necessary to calculate the useful flux in the gap. The magnetic density will be:

$$B = \sqrt{\frac{P \times 8\pi\, 981000}{A \times 2}}$$

Where P is the pull in kg $A =$ area of the gap. Substituting numerical values,

$$B = \sqrt{\frac{18 \times 8\pi\, 981000}{22.9 \times 2}} = 3120$$

And the total flux is

$$\phi = 3120 \times 22.9 = 71{,}500 \text{ lines.}$$

The required number of ampere turns is

$$IN = \frac{2B\delta}{.4\pi\sqrt{2}}$$

Where δ is the length of the gap. In that case the gap is twice as long as the travel, an extremely unfavorable condition as compared with direct-current magnets, where it is possible to make the gap shorter than the travel.

Substituting numerical values,

$$IN = \frac{3120 \times 2 \times 5}{.4\pi\sqrt{2}} = 17600$$

Adding about 300 ampere-turns for iron, the total amount of m. m. f. is 17,900 ampere-turns.

By actual test it was found that the magnet took 7.65 amperes, or 18,000 ampere-turns, and the magnetic density was 3180, and the total useful flux 72,900 lines.

The difference between the total and the useful fluxes represents the leakage flux of $156{,}500 - 72{,}900 = 83{,}600$ lines. Hence the leakage flux amounts to about 115 per cent of the useful flux.

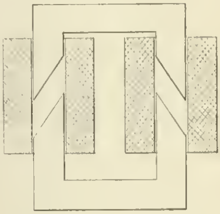


FIG. 12.—MAGNET WITH INCLINED SURFACES.

In order to make the leakage as small as possible the following methods may be employed:

1. The air-gap must be somewhere inside of the coil, preferably in the middle.
2. The coils must be as far as possible apart.
3. Dimension d must be longer than c.
4. Dimension l, Fig. 10, must be as short as possible.
5. The form in Fig. 10 possesses larger leakage than that in Fig. 5. It has also another disadvantage in that the air-gap is twice as long as the travel. It might be helped, however, to some extent, by using the form shown in Fig. 12, which undoubtedly will give better results than that in Fig. 9.

The power factor of an alternating-current magnet is always very low, even with the longest travel. On account of its reactance it should not be connected in series with the motors, as it is very often done with direct-current magnets for series-wound motors.

Another interesting feature of an alternating-current magnet is that the flux and pull remain almost unchanged with all positions of the plunger from the beginning to the end of the travel, because the flux depends only upon the voltage, number of turns and cycles (frequency); the length of the gap affects only the current, which decreases in proportion with the decrease of the gap, until a large degree of saturation in the core is reached. The magnet described above draws only about .55 ampere at the end of the travel, or about one-fourteenth of the value at the beginning.

For operation at 220 volts the coils of the magnet must be connected in parallel, and then it would develop the same flux and pull, taking about 16.3 amperes. For 110 volts it is necessary to use four coils in parallel, the current then being 32.6 amperes.

When the same magnet is used at 60 cycles, instead of 25 cycles, it will operate with about the same current as before, provided the e. m. f. is increased to 2.4 times its former value.

College Training of Electrical Engineers.

By Prof. Arthur C. Scott.

Lord Kelvin said that the first object of an education is "to enable a man to live," and the second, "to assist other men to live." The truthfulness of this statement is nowhere more apparent than when considered with respect to the engineer of the present time; to him is due, more than to any other, the great improvements in communication, transportation, illumination and sanitation, which so manifestly assist other men to live. Moreover, it must be admitted that the phenomenal advance made in electrical engineering within the past few years has brought comforts and luxuries to the public at large never before considered possible.

It has been well said that "the recent rapid development of the electrical industry owes its vitality to the engineering school. Its graduates have done the designing, constructing, operating and directing which have made possible the rapid progress and wise extension in the use of electricity."

Granting that this is true, the questions of vital interest and importance at present are:

Does the average university or college technical school properly prepare its students for their life work as engineers?

Does the sequence of courses taught, and do the methods of teaching afford the maximum opportunity for the student, when viewed from a common meeting point of the psychological and pedagogical standards within the college, and the practical or operating standards outside it?

Such questions as these, or something akin to them, have of late been the source of voluminous, and no doubt profitable discussion, although a digest of papers recently published in the American Institute transactions, the Electrical World, and the proceedings of the Society for Promotion of Engineering Education, appears to show that no common ground of agreement has yet been reached.

A few years ago the manufacturers and heads of corporations gave the college graduate but little encouragement because they did not appreciate the value of concentrated theory; the probable reason why to-day they are saying, "Give us technically educated men," and are filling vacancies in their factories and systems with college men, is on the one hand that the college is constantly endeavoring to improve methods of instruction, including such practical testing and laboratory work as will be more in line with their requirements, and on the other, the manufacturer or corporation manager is becoming educated to recognize the importance of sound theoretical training.

The most potent criticism by large manufacturers and property managers of their college graduate employees, at the present time, appears to be that they lack a certain kind of human common sense, and that they do not know how to adapt themselves to new conditions, or to adjust their personalities to the wishes of their superiors; that they lack most decidedly the ability to direct men and are loath to assume responsibility which requires originality or initiative on their part.

To meet such deficiencies several of the large concerns have established special apprenticeship courses, and it has recently been shown that with one large company, of those who finished the apprenticeship course, 50 per cent are now with the company, and the others are with operating or electrical supply companies, or acting as consulting engineers or instructors.

The apprenticeship course attests the validity of the criticism, but there are grades of adverse criticism, and it appears that the sort presented is the best, for the following reason: A student passes from three or four years of cramming, memorizing effort in the high school to the college. During the first two years of his college course he is likely to go on memorizing as in the high school, and does not really learn how to study or concentrate his mind on the work before him until some time during the junior year, or possibly the senior year. As a matter of fact, it appears that there is not sufficient time for him to obtain a knowledge of the fundamental principles underlying a broad education in engineering, and at the same time carry on work involving much originality, or the direction of men. Therefore, the criticism of the manufacturers in general of college graduates is what one familiar with professional college work might expect. There appears to be no doubt, however, in the minds of all that fundamental principles of mathematics, mechanics, physics, chemistry, English, foreign languages and political science are a necessary part of the engineering graduate's proper training, as well as the more specialized subjects of engineering.

One writer representing a large manufacturing company says: "Engineering students usually hate rhetoricals and language courses. They should remember that engineers are sometimes called upon to fill positions which are worth more than $75 per month, and that in such positions they will need to know how to speak and write the English language."

In attempting then to answer the question as to whether the average university or college technical school properly prepares its students for their life work as engineers, a noteworthy distinction should be made between the technical courses of the colleges and the technical courses of the trades schools. While the latter may take the student as far in the strictly technical subjects of engineering as do the college courses, these schools do not assume to spend any time upon the so-called culture studies that are required in college courses in engineering. If the culture studies were removed from the college courses, there would be more time available for the student to develop originality in his work and possibly to obtain some instruction concerning the direction of men, and commercial accounting.

Under these conditions, however, he is likely to become narrow-minded concerning his work; he gains nothing socially which a knowledge of the culture studies may accord him; he is limited to a direct line of work because he has insufficient training to give him the confidence in himself to start in any other. His earning capacity "in the long run" is decreased proportionally, as has been well shown by statistics collected some time ago by James M. Dodge.

It appears that it is unwise for the university technical school to attempt to go much farther toward the manufacturers in attempting to turn out students who shall just suit them at the start. In the first place it is impossible to graduate men who would suit the requirements of all the manufacturers or employers. Methods are different in different places, and require time and attention spent on them by anyone, whether student or not, before he is in a position to show much originality or power of direction.

It stands to reason that the *general aim* of the courses of the average technical college at the present time is commendable; namely, the thorough training of the student in all subjects fundamental to engineering, with the introduction of such culture subjects as will serve to place the student on an even footing, intellectually and socially, with men in other professions, and in so far as this result is accomplished the college directs its student in the proper way. In other words, the graduates have the rudiments of their profession, and the essentials of cultured citizens; personal characteristics, environment and time are depended upon for final results.

The time is at hand, however, when the engineer should be so educated as to appreciate the artistic possibilities in his product, and to exhibit esthetic sense in design. When the great engineering feats of to-day become the ordinary products of to-morrow, the public will demand beauty of design, as well as rigidity and utility of construction and installation. And when the demand is made the men who have finished an A. B. course in the university, followed by a full engineering course, will occupy first positions because of the important cultural training which they possess.

I am thoroughly of the opinion, therefore, that the average technical college does not *properly* prepare students for their future work as electrical engineers. The chief reason is that an attempt is made to complete subjects in a four-year course, which, if properly taught, would require fully six years. It is no wonder the student does not develop the spirit of original research—he has no time to do anything but attend lectures in the morning and laboratory practice in the afternoon for six days per week, and even at that pace does not properly cover the ground. The electrical engineer must be more of an all-round engineer than any other; he must not only have the fundamental knowledge of theoretical and applied electricity, but in addition must be reasonably familiar with much of civil, steam, hydraulic and gas engineering.

Moreover, he should have some general instruction concerning the public service corporation methods of the division of labor, accounting and general policy toward the public; on the law of contract; and on the interpretation of specifications and plans concerning both buildings and equipment.

Many of the universities are recognizing the fact that the engineers are doing from one-third to one-half more work during the four years taken to graduate than are the academic students. This, of course, is largely due to the relatively great number of hours spent in the laboratory, and commendable changes are already being made in several technical colleges, substituting a five or six year course for the four-year course heretofore required.

With the ever-increasing additions to the present great store of technical knowledge, I have no hesitancy in expressing my belief that the institutions that are in the lead with a five or six year technical course will readily find better positions for their graduates than will the others. It certainly appears reasonable that in an institution having well-equipped laboratories and a corps of competent instructors, it is possible for the student during the one or two extra years to do much more for himself than would be possible in the same time after leaving at the end of a four-year course with what amounts to a too hastily swallowed dose of everything taken; this is evidenced not infrequently by cases of acute mental indigestion and, as complained of by the manufacturers, an utter lack of originality, judgment, or logic in meeting shop requirements.

The longer course gives the student time for some attention to athletics, social functions, perusal of current engineering literature, a better training in culture subjects and a much more thorough training in theoretical and applied engineering, than a four-year course. My view of the situation, considering the best interests of the students, is that any college offering technical courses leading to an electrical engineering degree, should require the equivalent of a five-year course to obtain the B.Sc. degree in electrical engineering, with the further provision that the E.E. degree be allowed for an additional year of study involving a thesis covering original research work; maintaining the standard entrance requirements as at present and the same for all students.

I venture to presume that the two additional years thus covered by the student in the university would be of more benefit to him eventually than the first five years following the completion of a four-year course if spent elsewhere.

The answer to the first question involves to some extent the answer to the second. It is evident, if the presumption be granted that four years is too short a time for the college man to complete an electrical engineering course, that the methods of teaching might be improved. It does not necessarily follow, however, that an increase of time required would involve a change in sequence of subjects.

Professor Karapetoff in his paper on "The Concentric Method of Teaching Electrical Engineering" outlines a four-year college course which in some respects quite reverses the customary sequence of subjects as taught in college technical schools.

The advantages claimed for the arrangement are:

1. The student selects his profession after having had an outline course in it, in parallel with a few other allied specialties.

2. The method of beginning with the practical side, in other words, with the ultimate results, is more psychological than beginning with abstract auxiliary sciences.

3. The interest and the professional feelings in the student are early aroused.

4. He can spend his vacations more profitably, having had engineering courses from the start; he can also be interested in technical literature and societies earlier than is possible with the present method.

5. A possibility is created for producing "learned artisans" who have taken one or two of the early years, and may then be useful in practice as assistants, or can do independent work in newly opened parts of the country, etc.

6. The theory, being built on the known facts of experience, will be less abstract, and more in unity with the requirements of practice.

It will be seen from the discussions of his paper that there is a great difference of opinion as to the value of Karapetoff's method, with adverse criticism in general preponderating.

As to the first advantage claimed for the arrangement, I thoroughly agree that the first and possibly the second years should be identical for all engineering students, so that the student may wisely select what he wants after having moved in the university atmosphere long enough to clarify some of his nebulous notions. But it appears that to carry out Karapetoff's plan would necessitate an outline course in several engineering subjects from the practical or manipulative side. If this were given, it appears that the first year would be largely given up to playtime exercises, which would not benefit the student materially because it would tend to weaken his ambition by a complete reversal of the order of advancement in his former secondary school training. It would probably mean that nearly the same per cent of students would fail as with the present plan, with the added expense and inconvenience to the colleges that would result when such failures come in junior and senior years instead of in the freshman year.

Moreover, a large freshman class would necessitate a relatively large amount of apparatus to inspect and manipulate; an increased number of instructors; and above all, a necessary increase of time to do such work in addition to the requirements of the already established four-year course. I do not see how Professor Karapetoff would be able to find the time in a four-year course for this arrangement and maintain even the present adversely criticised standard of completed courses for the engineering degree.

Referring to the second point, it appears decidedly more psychological and pedagogical to begin with the finished product, and reason toward the underlying sciences and general theory, than to consider the subjects in the reverse order. But in attempting to do so in the case of engineering work great care would be necessary to prevent the student from obtaining a distorted idea of the importance of the finished product. Finished products change from year to year as a result of the more accurate application of theory in manufacturing. Beginning with the practical side of a college course in engineering will no doubt tend to stimulate the interest of the student, but what appears to me to be of equal or greater importance, is that he comes in contact with members of the strictly electrical engineering faculty much earlier in his course than would otherwise be the case. Both of these points are worthy of careful consideration, and in order to cover them and also arouse the professional feelings of the student as early as possible, a course in what might be called Electrical Engineering Physics, would serve the purpose. This course should be given during the freshman year by the head of the school or an associate professor, and should not presume to duplicate the subject of general physics, except in so far as electricity is concerned. As a part of the course the use of vectors, the algebra of complex quantities, practical lessons in curve plotting, and practice in interpreting machine drawings might very profitably be taught. The course would involve the study of various machines, controlling devices, lamps and illumination, from the physics standpoint largely, but including such illustrations with the laboratory equipment as would readily give the student an idea of commercial apparatus.

This course should in no way substitute for or interfere with the regular required course in physics, and should not require the duplication of physics apparatus to any considerable extent, because the course should be so given as to make it possible to use such apparatus as should be on hand for electrical engineering course demonstrations in general. As a matter of fact, the pure physics demonstration work should be left entirely with the school of physics, except in so far as engineering apparatus is concerned.

I believe that such a course taught by a professional engineer would give the student a perspective that would serve to hold his interest, and tend thereby to improve his work all along the course. The professor, moreover, would become acquainted with the students early in their course, which is likely to be of mutual benefit.

Aside from this somewhat radical departure from historical methods of teaching electrical engineering, there are two other changes that, to my mind, ought to be made in some of the existing methods of teaching this subject.

The first concerns itself with lectures, recitations, quizzes and examinations; the second with the plan of conducting laboratory work.

Concerning the first, I believe that the student is handicapped when a text book alone is used. No text book on electrical engineering to-day is up to date in all particulars, hence notes should be furnished, or a text book supplemented by notes used. This is, however, of less importance than the method pursued with respect to recitations. I believe that for every two or three hours of lectures to juniors and seniors there should be a conference hour wherein the points of importance concerned with any of the previous lectures may be discussed with a perfect freedom between the members of a class, or of sections of a class, and the instructor. Occasionally the conference hour should be used as a quiz period without previous announcement to the class. This keeps the students alert and up with the subject at all times, and is but a mild prelude to what they will encounter later on as engineers. When the layman wants information from an engineer, he is seldom so thoughtful as to give the engineer a week's notice before asking his question. The engineer must train himself to think quickly, and logically, and independently of any text book.

Problems should be given in abundance to oblige the student to make rigid application of theoretical principles; conferences and quizzes serve to keep him up to date in his work; and final examinations necessitate the correlation of the various parts of the subject covered.

So far as laboratory courses are concerned, I believe it to be possible to meet the criticisms of employers of students to some extent. In some of the engineering laboratories the students have nearly all connections made for them and their chief duty one and all in a test is to read instruments and record their readings. I think that is the limit of poor laboratory instruction. The student regards it as a special dispensation at the time, but if he is required to direct a shop test later on, he will no doubt act as though devoid of "human common sense." He does not know what do do, much less how to direct others. The laboratory course that will most nearly meet the adverse criticism of employers to-day is the one wherein the students are required to make all machine and instrument connections, and also that requires some one of the members of a section to act as director of the test at every period, and be responsible to a reasonable extent for the use of machines and instruments. This arrangement is not intended to relieve the instructor from his duties in the least; on the contrary, it may add something to them, for the student whose turn it may be to direct the test should confer with him beforehand in order to be sure that he understands the test completely, and also to learn what instruments are available for the test.

It is only by actually directing men that one learns how to do it, and if the students gain some practice in this way in the laboratory, they may be less criticised after entering practical work.

Much has been said and written advocating the teaching of mathematics, physics, chemistry and other fundamental sciences of engineering in college or university technical schools by engineers. With this idea I cannot agree.

I have personally had the opportunity of teaching students physics from the preparatory school on through the completion of their college course in electrical engineering, and while the results were at the time eminently satisfactory to me, I believe that I may have unconsciously emphasized the engineering side too much.

The university graduate is presumed to be broadly educated, and he can only be so in fact by studying under specialists in the respective subjects required in the curriculum. When the graduate enters into practice, and throughout the years of his life, he will find it necessary to adapt himself to the ever-changing conditions; every problem in engineering of any magnitude will present features differing in one respect or another from any that have preceded it, and the solution is accomplished by ability to select the right fact or principle out of the mental storehouse, and apply it with good judgment and perseverance. Why, then, should it be considered necessary to have mathematics, for example, taught in the university by an engineer? The common reply is: "Because an engineer will give the student practical engineering illustrations and engineering problems that the pure mathematician cannot or will not." The answer may be true, but does not the danger lie in the possibility of his giving about all of his illustrations and problems an engineering significance? From the mathematics standpoint the student's mind is narrowed toward engineering. He is presumed to be studying *mathematics, not engineering,* and should be taught *mathematics.* It is *his* business to make the application of mathematics to his engineering work whenever he needs this handy tool for a purpose. I believe the subject, when taught by a man who is first of all a *true professional mathematician,* will serve its purpose in *educating the student in the subject,* regardless of what he intends to be, and regardless of whether the professional mathematician be also an engineer, a linguist, or a college president. The same may be said of physics, chemistry, English, and all other subjects entering into the courses required of students who graduate from the standard college or university.

Each required subject, if taught by a specialist in that subject, should have enough interesting features in the teaching to hold the attention of a student possessing a scientific or engineering mind; if it does not, he is in the wrong line, and the sooner he changes his course the better it will be for him. Physiography, mineralogy, geology and astronomy, while not ordinarily included in the curriculum of the electrical engineering course, are improper subjects and by no means outside the scope or demands made on the electrical engineer's training to-day. A part or all of these subjects might well receive attention in connection with a five or six years' course in electrical engineering to the ultimate profit of the student taking them.

To sum up, then, finally:

(1) The demands of present-day electrical engineering are such as to make the extension of the normal college course of four years to five years highly desirable.

(2) To stimulate the interest of the students in professional engineering early in their college course, and to bring the students into contact with professional electrical engineers, the head of the school or an associate professor should give a course in electrical engineering physics to first-year men.

(3) Conference hours should be held in connection with theoretical work; one conference hour for each two or three hours' lectures to juniors and seniors on engineering subjects.

(4) Laboratory courses in electrical engineering strictly, should require the students to arrange all connections to instruments and machines in the electrical laboratories, or the connecting of all auxiliary apparatus for tests in steam or gas engineering laboratories, together with the direction of the section on each test performed by some one of the section previously designated by the instructor.

Such changes, I believe, would materially assist the engineering students to attain the scholarship rank of students in other university departments and also to more successfully meet the demands of commercial practice.

LETTERS TO THE EDITORS.

Varnished Cloth Insulation.

To the Editors of Electrical World:

Sirs:—I have read with much interest the article on page 379 entitled "Varnished Cloth Insulation" and would like to ask through your columns a few questions of those who so enthusiastically advocate its use.

First: Is the varnish as prepared for use on oiled or varnished cloth a neutral compound?

Second: Under the working conditions of electrical equipment, subjected as it is to various mechanical and chemical changes, do the insulating properties of oiled linen increase or decrease; and if either, why?

Third: Does the fabric in varnished cloth rot or weaken under the working conditions of electrical equipment?

Fourth: Why does one kind of oil or varnish tend to rot the cloth more rapidly than another?

Fifth: Could other than a neutral insulating material be considered permanent, used in the preparation of this cloth?

Boston, Mass. C. B. Tibbetts.

Patents and Inventions.

To the Editors of Electrical World:

Sirs:—Having recently served on the Examining Corps of the United States Patent Office I am much interested in the able articles and strong editorial appearing in your issue of March 14, and criticising this branch of the Interior Department.

If I may be permitted, however, I would like to add a word of discussion in regard to a portion of the editorial. On page 542, near the bottom of the first column, you state that "A patent once granted, it is apt to control the advancement in the art on account of the enormous expense now attendant on patent litigation; and even if litigated, our patent courts, as now constituted, appear to lay inordinate stress on the presumption of invention in cases where others have not previously availed themselves of the idea in suit."

I wonder how many readers know the curious and almost paradoxical condition of affairs that exists in connection with the question of patent litigation? One would naturally suppose that, after the government had made a "grant" to an inventor, and had endowed him with an "exclusive right" by affixing its "great seal" to a solemn instrument, such grant would be respected. One would suppose that an inventor, armed with such a document, would be justified in imagining himself able to hold the field against all comers. One would suppose, *at least,* that there would be a *presumption* in favor of the validity of the patent; that any one denying such validity would be compelled to prove his contention, and that, in the absence of such proof, the patentee could exercise his rights and prevent piratical inroads upon his ideas.

But such is not the case. A patent is absolutely valueless until it has been proven *good* in a court of proper jurisdiction. A manufacturer may infringe with impunity any patent he chooses, and the owner of such patent has no relief and can secure no injunction until the patent has successfully withstood the refining fires of a lawsuit, and all the efforts of its enemies to cast a cloud upon it have proved vain. In other words, the patent is *presumed* to be *bad* until a court of record has decided that it is *good!*

Queer perversion! And, since a clever attorney may cause a suit to drag along for a protracted period, it is evident that a patent may be infringed for *years* in many cases without the owner having any remedy, and frequently the suits may be continued until the owner's resources are quite exhausted and he gives up the fight in disgust.

It appears, therefore, that "the enormous expense" of patent litigation is apt to be felt more heavily by the owner of the patent—by him whom the government has adjudged to be entitled to protection—than by those who are endeavoring to utilize the inventor's ideas. This state of facts tends to lessen very much the possibility of a patent being "apt to control the advancement in the art," and for this reason may be regarded as beneficial, although undoubtedly imposing a heavy burden on the inventors of the country.

As to the courts laying stress on "the presumption of invention," it is doubtful if as many patents are sustained as should be. The records show that, of all patents, small and large, which get into the courts approximately *one-half* are for one reason or another held to be *invalid and void,* or else not infringed. And in this connection it is to be borne in mind that these litigated cases represent the *cream* of the patents—those of real commercial value.

Washington, D. C. J. Hanson Boyden.

[The remarks to which Mr. Boyden refers were intended to apply more particularly, not to patents that involve the exercise of the inventive faculty and are, therefore, apt to be real factors in the advancement of an art, but to the class of patents, now seemingly becoming preponderant, which merely cover the steps of normal engineering evolution and tend, through the control they exercise over an art, to stop its development along the lines of real invention. As to "holding the field," a worthless patent may effectually close the field to all meritorious inventors who cannot command means to establish its invalidity; the fight of the independent inventor is nowadays not to hold a field, but to gain entry to it, or prevent being forced out. The final paragraph of Mr. Boyden's letter seems to have little application to the point to which the detached quotation relates.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Single-Phase Commutator Motors.—M. Osnos.—An article discussing the effect of the short-circuit currents under the brushes of single-phase commutator motors on the phase displacement of the armature current. The short-circuit currents are due to two causes, first, to the rotation of the armature in the field in the commutation zone, and, second, to the transformer effect of the alternating field. The short-circuit currents of the first kind are called dynamic, and those of the second kind are called static. The author shows that the static short-circuit currents always diminish the phase displacement, while the dynamic short-circuit currents produce either a decrease or an increase of the phase displacement according to the phase of the resulting commutation field. An undercompensated commutation field diminishes the phase displacement in the motor, while an overcompensated commutation field increases.—*Elek. u. Masch.* (Vienna), Feb. 23.

Effect of Wave Form on Transformers.—L. T. Robinson and A. Holz.—Any core loss in a transformer should be stated in terms of the loss occurring on a sine wave and any losses determined on other than sine waves should be corrected to that standard. The exciting current is influenced by wave-form variations, and corrections for this should be applied. In the present installment the authors discuss the effect of wave-form variations on hysteresis loss and on eddy-current loss. The paper is to be continued.—*Gen. Elec. Rev.*, April.

Testing Direct-Current Machines.—S. P. Smith.—A communication describing two methods for testing a single direct-current machine, the object being to investigate in a single dynamo the heating and commutation under full-load conditions when only the losses are supplied by the machine.—Lond. *Elec.*, March 20.—Some critical remarks by W. Lulop on these methods in Lond. *Elec.*, March 27.

Lamps and Lighting.

Metallic-Filament Lamps in Overloaded Systems.—O. F. Brastow.—An article discussing the tantalum lamp as the salvation of overloaded systems. The savings due to the introduction of the tantalum lamp are shown for a special case in which 1000 16-cp carbon lamps constituted a heavy and excessively dangerous overload on both the engine and the generator. While each 16-cp carbon lamp consumed 65 watts, the new 20-cp tantalum lamps consumed only 40 watts, so that besides the gain in illumination a gain in output of 25 kilowatts was obtained.—*Gen. Elec. Rev.*, April.

Leading-In or Supporting Wires for Metallic-Filament Lamps.—A note on a recent patent of the British Thomson-Houston Company (General Electric Company of this country). The end of the supporting conducting wire is fused round the filament by means of an electric arc. The fusing is done below the surface of a liquid, such as water, alcohol or benzine, in which inert or reducing elements are liberated by the action of the arc. The liquid cools the globule of metal quickly, and ensures a good contact with the filament.—Lond. *Elec. Eng'ing*, March 5.

Leading-In Wires.—A note on another British patent of the British Thomson-Houston Company for fusing metallic filaments to the leading-in wires. The welding of the wire to the filament is performed by means of an electric arc, in a protecting jet of some reducing gas, such as hydrogen, surrounded by an envelope of an inert gas, such as carbon dioxide. A special nozzle for the gas jet is described.—Lond. *Elec. Eng'ing*, March 12.

Power.

Swiss Energy Transmission.—An illustrated description of the high-tension transmission line and the transformer substations of the Engelberg-Lucerne 25,000-volt transmission system in Switzerland. Along the edge of the Lake of Lucerne the steel lattice poles are supported on brackets extending out from the shore over the surface of the lake, this unusual method of construction having been necessary in order to keep the high-tension wires away from the telegraph and telephone wires previously strung along the edge of the lake. Three substations, for the double purpose of providing a local supply and of dividing up the line into sections, are situated between Obermatt and Lucerne.—Lond. *Elec. Eng'ing,* March 12.

Electric Driving in Silk Industry.—A. Kidd.—Since the conditions in silk mills demand constant speed, the induction motor is the best type of machine to be used. The method of driving a group of machines by one motor is used extensively where the machines are run continuously, such as the preparatory machines in silk mills. The motor should work up to its full rating, in which case the highest operating economy is obtained. The author then discusses the advantages of the individual drive. These are chiefly of increased production, which is "conservatively figured at 5 per cent," and the reduction of the maintenance item to a minimum.—*Gen. Elec. Rev.*, April.

Induction Motor for Driving.—P. Ehrlich.—An analytical investigation of the dynamic phenomena which occur when a machine of periodically varying power (pump, compressor, etc.) is driven by a motor, the power of which depends on the speed (like the three-phase induction motor).—*Elek. u. Masch.*, (Vienna), March 1.

Traction.

Single-Phase Traction.—L. H. Kidder.—An illustrated article on the working of the 6600-volt, single-phase railway between Pittsburg and Butler, which has now been in use for one year. The experiences and conclusions obtained during this period are dealt with, and it is noted that any troubles encountered have been due to defective material and workmanship rather than defective design. The most serious troubles encountered were with the pantographs and the overhead-line construction. —*Elec. Jour.*, March.

Berlin.—An illustrated description of the new substation on the Berlin electric elevated and subway railways. The original power station generates direct current at 780 volts. Further extensions of the line have made the erection of two substations necessary. These converter stations will be supplied with three-phase currents from a new generating station, but for the present one of these substations is fed with three-phase currents from the original direct-current generating station, which for this reason has been equipped with inverted synchronous converters.—Lond. *Elec.*, March 13.

Installations, Systems and Appliances.

Lightning Arresters.—R. P. Jackson.—A continuation of the long illustrated serial on the protection of electric circuits and apparatus from lightning and similar disturbances. The author discusses cable protection, and then treats of the selection of protective apparatus. Since the protection afforded in any case is directly proportional to the difference in resistance to static discharges offered by the lightning arrester from that offered by the apparatus it is intended to shield, preference should be given to devices that have the lowest equivalent spark-gap, which should always be considerably lower than that of the apparatus to be protected. By equivalent spark-gap is meant that definite size of gap which, when placed in multiple with the arrester, just fails to take the discharge. The length of this gap is the measure of the freedom of discharge of an arrester. The most recent designs of lightning arresters possess equivalent gaps about as low as is likely to be obtained by any reliable self-restoring devices. By this is meant devices which do not have to be reset after each discharge. The author then discusses the present practice of lightning arresters for low-tension distribution systems. The multiple-path lightning arrester, which is suitable for either alternating current or direct current for any e.m.f. up to 1000 volts, receives its name from the fact that the static discharge spreads itself over a carborundum block along a number of minute discharge paths. The nominal e.m.f. between the line and the ground is subdivided between so many minute gaps that the e.m.f. across each gap is too small to maintain an arc after a high-voltage discharge has passed. This arrester has a very long life, say, some 2000 discharges. The author then discusses at some length the electrolytic lightning arrester in which aluminium plates in tray form are set one within another (separated by small insulating washers) so as to form a vertical column, which is enclosed in a stoneware jar. Some details of construction are given, but the nature of the electrolyte is not stated. Electrolytic arresters are made for all e.m.fs. from 4000 volts up to almost any practical value. Both the gap and the electrolytic unit may be installed either indoors or out. While the electrolyte will freeze at about 28 deg. Fahr., it is not permanently damaged by freezing, yet when in frozen condition its conductivity is comparatively low, and the protective power of the arrester is correspondingly decreased. Hence, in order to obtain the best results during the periods of low temperature, the electrolyte should not be allowed to freeze. The electrolytic arrester is used in combination with a horn-gap which will withstand the normal voltage of the system, but will break down with overvoltage and permit the surge of discharge through the electrolytic units. By means of the curve shown in Fig. 1 the proper lengths for horn-gap may be determined. Horn-gaps should not be used on e.m.fs. lower than 13,500 volts, since the gap for lower voltages is so small that the arc will not rise properly and break.—*Elec. Jour.*, March.

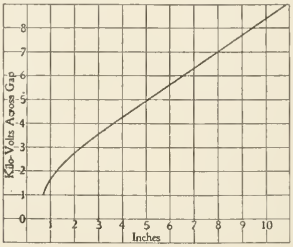


FIG. 1.—VOLTAGE CURVE.

Frequency-Changing and Load-Equalizing Plant.—J. S. Peck —A note on a recent British patent for an arrangement for equalizing the load on alternating-current systems, and for supplying low-speed induction motors with low-frequency currents from high-frequency circuits. "The stator winding of the induction motor of a motor-converter set is connected to the supply mains, the rotor winding being connected across to the suitable points on the armature winding of the direct-current generator. This generator has a shunt-field system of the usual type, and the current generated is supplied to a direct-current motor coupled to a flywheel. The working motor is fed with current taken off by means of slip rings connected to the cross-connections between the two rotors of the motor-converter set. The working motor thus normally receives its current directly from the rotor of the induction motor, and in cases of overload, also from the armature of the direct-current machine, which acts as a rotary-converter, taking in current from the fly-wheel motor, which then acts as a generator and converting it to alternating current for driving the working induction motor. When the induction motor is not working, the converter set supplies energy to the fly-wheel motor, which it accelerates."—Lond. *Elec. Eng'ing*, March 12.

Excessive Rate Indicator.—In cases where electrical energy is paid for by a system according to which a certain rate should not be exceeded, it is necessary to let the consumer know when he exceeds the limit. For this purpose use is made of a rocking arrangement which consists essentially of an electromagnet attracting an armature, fixed to a beam and oscillating about an axis, mounted on a fixed support. This beam carries at one end a point which dips into a mercury cup. The current passes through this cup to the beam and coil, and the attraction of the latter is counteracted by a spring. When, however, the current exceeds a certain predetermined amount, the force of the spring is overcome, the beam is attracted and the circuit broken. The beam then flies back and a succession of "makes and breaks" is thus obtained. The oscillatory effect which makes it impossible for the curernt to be used, continues until the excess-consuming devices are cut off. Regulation can be effected by means of a screw.—Lond. *Elec.*, March 6.

London Central Station.—An account of the annual report of the Charing Cross, West End & City Electricity Supply Company, operating both the West End and the City districts, which are practically two independent systems. The combined total cost of energy generation in the combined systems works out at 3.1 per cent per kw-hour including allowance for depreciation.—Lond. *Elec. Eng'ing*, March 5.

Electrophysics and Magnetism.

Electric Discharges Through Gases.—J. J. Thomson.—An account of his second lecture on this subject. He first recapitulates his views on the importance of the positive and negative particles disseminated through the air for atmospheric electricity. Water is condensed by preference on the negative particles, which rain or hail then carry down to the earth, thus replenishing the negative charge of the earth. If the particles are produced by the radium in the earth imparting radium emanation to the atmosphere, particularly with a low barometer, then radium plays a very important part in atmospheric electricity. He then demonstrates various ways by which air may be rendered conductive, as well as a method by which conducting particles of the air can be filtered off. Various agents are capable of splitting the molecules of a gas up into positive and negative ions (which may not be the electrolytic ions), but due to their mutual attraction there is again a tendency to recombine. If two metallic electrodes in air are connected with a battery, the current will send the ions to the electrodes, and the conductivity will thus decrease. As long as the current is small no loss will be noted with increasing e.m.f. But when the potential is further increased, the current carriers in the gas will finally be removed as fast as generated, and the current increase will stop. The current will first follow Ohm's law and then become constant, independent of the potential difference. If a curve of current and potential difference be drawn, the curve will first be a straight line, then become parallel to the abscissa, giving the ordinate of the constant current, and will finally rise and move rapidly, just before the spark passes. The limiting current value, as well as the generation of ions, now depend upon the quantity of gas between the electrodes. If we start with a small gap and double that gap, we double the current intensity; if the gap be increased to threefold, the current will be three times as strong. That is the characteristic paradox of the discharge through gases, which is often misunderstood. We have, of course, to start with a sufficiently high potential to obtain the constant current.—Lond. *Elec.*, March 20.

Magnetization.—O. W. Richardson.—An article suggesting the possibility of a mechanical effect accompanying magnetization. After some theoretical considerations he proposes an experiment in which a long, thin cylindrical bar of iron is suspended by a fiber passing through its axis so that it is capable of vibrating about a vertical axis. It is suggested that the sudden application of a vertical magnetic field might have the effect of twisting the suspended system as a whole. So far the experimental research has not given definite results.—*Phys. Rev.*, March.

"Magnetic Rays."—A. Righi.—A note on the discovery of a new kind of radiation which he terms "magnetic rays" and which consists of a projection of molecular magnets from the cathode when immersed in a strong magnetic field. The molecular magnets follow the magnetic lines of force and trace them out visibly. That cathode rays are projected along the magnetic lines of force when the field is very strong was proved as long ago as 1858, by Plücker, and Villard studied this phenomenon in detail two years ago. Now a cathode particle or electron, projected along a magnetic line of force, describes a spiral whose generating circle is smaller the stronger the field. The axis of the spiral coincides with the magnetic lines of force, and when the generating circle is very small the path of the cathode particle cannot be distinguished from the line of force. These magnetic rays do not, however, as a rule, convey a charge. The author concludes that they really consist of binary systems, an electron revolving round a positive atom, with the plane of its orbit normal to the direction of propagation. Such a system would constitute a very flexible molecular solenoid and would have considerable stability. A divergent field would produce a retardation of the system and eventually a return to the cathode.—*Rendiconti dei Lincei*, Feb. 2; Lond. *Elec. Eng'ing*, March 12.

Magnetic Properties of Gases.—B. Tänzler.—An account of an experimental investigation. Oxygen is paramagnetic and its volume susceptibility is 0.123 x 10^{-6} per cubic centimeter, and so is air, with a volume susceptibility of 0.0264 x 10^{-6}. Both argon and helium are diamagnetic. Argon has a volume susceptibility of —0.00953 x 10^{-6} and helium —0.00175 x 10^{-6}.—Lond. *Elec.*, March 20.

Units, Measurements and Instruments.

Capacity of Cables.—F. J. O. Howe.—The conclusion of his illustrated article on measurements of the capacity of cables. The methods described in the Digest last week had three disadvantages. First, the use of a telephone; second, the unsuitability of the plug resistance box when using a telephone as detector; and third, the necessity of having a high-frequency machine requiring regulation of excitation and adjustment to the resonance state. The second objection is overcome by using a switch arm resistance—in fact, a Wheatstone bridge—the first and third by using an Ayrton and Perry secohmmeter with an ordinary d'Arsonval galvanometer in the place of the high-frequency machine and telephone. The arrangement is shown in Fig. 2. The secohmmeter is driven by a small motor, the speed of which may be varied between wide limits. By plugging the Wheatstone bridge ratio arms to 1000 ohms and using a 1.0 microfarad condenser the apparatus becomes direct reading up to 9.9999 microfarads. Tests taken by means of the secohmmeter agree extremely well with the capacity calculated from the charging current. The capacity of the cable equals the value of the condenser multiplied by the ratio of the resistance of dials to the resistance of arms. The author then discusses the method to be adopted. It was desired to keep the order of testing the same as that formerly adopted; that is to say, that the capacity and dielectric resistance tests be taken on one and the same test table, and as near as possible in the same time as that required when testing by the old method. The arrangement adopted, as being the most suitable and at the same time requiring the shortest possible time in carrying out a test, is shown diagrammatically in Fig. 3, and its arrangement on the test table in Fig. 4. It consists of a five-dial switch arm resistance-box with a plug and slide-wire lead compensator *b*, forming the variable resistance arm; a 500-ohm resistance box forming the fixed resistance arm. The third arm consists of the standard condenser of 0.5 microfarad or a variometer; the former for capacity tests, the latter for self-induction tests; the fourth arm consists of the cable to be tested. The galvanometer is provided with a universal shunt with a short-circuit plug.

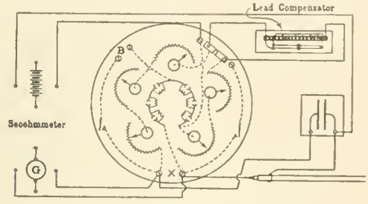


FIG 2.—SWITCH-ARM RESISTOR.

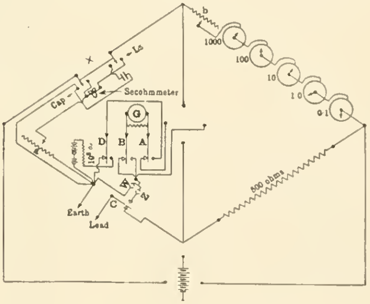


FIG. 3.—CIRCUIT DIAGRAM.

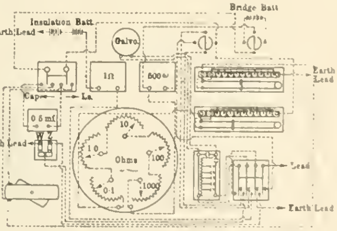


FIG. 4.—TEST-TABLE APPARATUS.

The battery key is quadruple and has two positions. To make capacity or dielectric resistance tests the secohmmeter is set running and remains running throughout the test. First, the constant of the instrument is determined by putting a plug in *W*, depressing the quadruple key and opening the galvanometer circuit with a suitable shunt. This gives the deflection due to the current through 1 megohm. The key is next released and the plug shifted from *W* to *Z*. The double-pole switch *X* has to be in the "condenser" position. The next point is the test on the leads running from the instrument to the cables to be tested. The resistance dials are switched to zero and the galvanometer opened. The lead compensator is then adjusted until balance is obtained in the bridge circuit. When this balance is obtained and the galvanometer re-short-circuited, the quadruple key is depressed, thus switching on the battery and disconnecting the testing lead from the secohmmeter circuit; the test is now made as usual. When the cable is connected on to the leads, the same routine is followed, excepting that the variable resistance *b* remains unaltered, the balance being obtained by adjustment of the dial resistances. The tests can, therefore, be carried out with more simplicity than by the usual method. The chief idea of this arrangement is that when the quadruple key is depressed, the cable is joined up for insulation testing in the ordinary way. When released the cable is joined up to the capacity bridge, and this bridge is manipulated exactly as the Wheatstone bridge, the capacity being read off directly from the dials. Thus, with the above-described apparatus, the capacity of any cable would be $\frac{0.5}{500} \times$ reading of dials; that is, the first dial represents microfarads, the second tenths of microfarads, etc., and could be engraved in microfarads. To make self-induction tests, the double-pole switch, *X*, is switched over on to the variometer, and the resistance-slide *b*, together with the resistance-dials, set to 500 ohms total, thus making the right-hand arms of the bridge equal in value. The secohmmeter is brought to rest, thus obtaining the ordinary Wheatstone bridge connections. The resistance of the variometer forms the third arm of the bridge, and the resistance of the cable together with the variable resistance *a* form the fourth. Balance is obtained by varying the resistance *a*. Next the secohmmeter is set running, and balance is again obtained by turning the variometer, thus measuring the self-induction directly in the ordinary manner.—Lond. *Elec.*, March 27.

Capacity of Condensers.—B. V. Hill.—An abstract of an Amer. Phys. Soc. paper on the variation of apparent capacity of a condenser with the time of discharge and the variation of capacity with frequency in alternating-current measurements. —*Phys. Rev.*, March.

Alternating-Current Instruments with Iron.—W. E. Sumpner and J. W. Record.—A long paper read before the (Brit.) Inst. Elec. Eng. on several new alternating-current instruments in which iron-cored electric magnets are used. The instruments more particularly dealt with are a wattmeter, a magnetostatic voltmeter and phase meters. Attention is first drawn to the difference between a shunt and series electromagnet. With the former the eddy currents caused in small pieces of brass do not affect the magnetism caused by the exciting voltage. In the instruments of the authors a shunt magnet is used so that it is permissible to use brass clamping-pieces in the neighborhood of the moving system. The field is even more reliable than that of a permanent magnet as used in direct-current instruments. The field of the shunt magnet, though caused by the voltage, is not in time phase with it, so that for the wattmeter a special form of current transformer and for the voltmeter an ordinary condenser are needed, and these accessories are called "quadrature transformers," since their function is to produce a moving-coil current which is in time-quadrature with the circuit e.m.f. on current. The readings of the instrument are independent of the frequency. The form of magnet shown in Fig. 5 has been selected so as to reduce the magnetic reluctance of the circuit to a minimum, on account of its easy mechanical construction, and to allow a large angular deflection of the pointer. The block of iron stampings *A* is securely clamped on a brass framework *L*. The cross-section of iron is about 1 sq. in., the flux is approximately 32,000 c.g.s. lines and its density about 5000 c.g.s. at the normal applied voltage on 50-period circuits. As the section of the gap is five or six times that of the iron core, the flux density in it is correspondingly reduced. It is usually about 1000 c.g.s. lines per sq. cm and is comparable with that in the air-gaps of good permanent-magnet instruments. To reduce the copper drop the largest size copper wire that can be wound in the available space used. About 200 ampere-turns are normally needed. The moving coil *B* consists of about 40 turns of fine copper wire former wound, and fixed to an axle fitted with hardened steel pivots. The effect of temperature variations on the copper windings is minimized by the use of about 80 ohms of manganin wire wound non-inductively and joined up in series. This also serves to nullify the slight deflection which would be produced by induction if the terminals of the moving coil were short-circuited. The pointer carries at its end a damping vane so placed that its weight as nearly as possible balances the weight of the moving coil, and all gravity control is eliminated. An air chamber *H* for damping is provided, and the dial forms the top of this dash-pot. *I*, *I* are the exciting coils in shunt across the mains. The torque on the moving-coil system is about 1.2 gram-cm for 90 deg. deflection, which is greater than that usually employed in dynamometer or induction-type instruments. To indicate watts it is necessary to connect the electromagnet across the mains and the moving coil to the secondary of a special series transformer. The secondary current of the latter is 90 deg. out of phase with the primary and therefore in correct phase relation to the magnetic flux in the electromagnet air gap. The core *A* (Fig. 6) consists of two blocks of iron stampings with butt joints at *J*, *J* and an air-gap *G*, about one-tenth of the iron circuit. *P* is the primary winding and *S* the secondary. The latter consists of a few turns of fine wire the ends of which are joined through a high non-inductive resister to the wattmeter moving coil. This long air-gap in the quadrature transformer renders the flux proportional to the primary current and reduces the error due to hysteresis to a negligible quantity. Fig. 7 shows how the instrument should be connected for

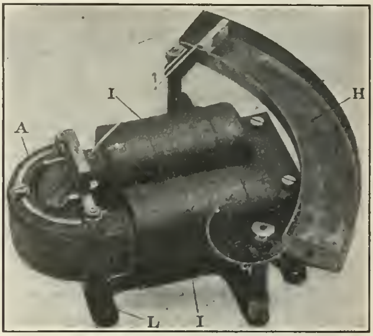
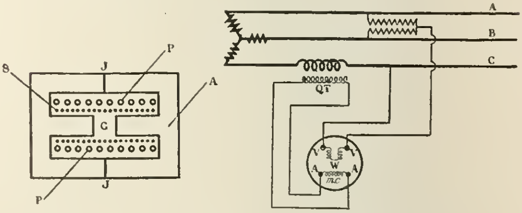
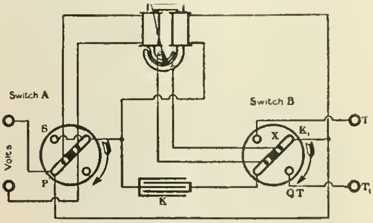


FIG. 5.—ALTERNATING-CURRENT METER.



FIGS. 6 AND 7.—MAGNETIC AND ELECTRIC CIRCUITS OF METER.

measuring the power of a three-phase circuit with balanced load when the neutral point is not available. A specially-designed choking coil is used across two of the mains, the wattmeter itself being joined to the third main and to the junction point of the choking coil. The total power of the circuit is equal to twice the wattmeter reading. The wattmeter may be used to measure volts by changing the connections of the moving coil from the secondary of the quadrature transformer and placing them in series with a condenser of suitable capacity across the mains. The readings will be correct on circuits of any frequency or wave form, provided the ratio of voltage to frequency is not made too great so that the resultant induction density in the iron is made excessive. The instrument may be used as a portable general testing set as indicated in Fig. 8. Switch *A* enables the coils of the electromagnet to be put in parallel or series, thus giving two scales. Switch *B* is for connecting the moving coil either in series with a condenser *K*, across one of the field coils, or directly across terminals *T* and T_1. It will be noticed that the e.m.f. applied to the condenser is the same for the same e.m.f. per turn applied to the field coils, whether these latter are series or parallel-connected. With switch *B* in the position shown, the instrument is a direct-reading voltmeter having two ranges; the readings are quite independent of frequency, wave-form, hysteresis, stray magnetic fields or electrostatic influences. When the switch *B* is turned to join the moving coil across *T* T_1, the instrument can be used for a wattmeter or for a variety of special purposes, one of the most useful being the measurement of capacity of cables and condensers. The condenser fitted in the instrument can also be employed as a standard of capacity, and a special scale can be made for the instrument, so that this is direct reading in microfarads for tests at any fixed voltage. The readings on this capacity scale will be proportional to the readings on the watt scale, and hence proportional to the square of the readings on the volt scale. For constant-voltage circuits the wattmeter can be used to measure wattless volt-amperes. For single-phase circuits all that is necessary is to substitute for the quadrature transformer a non-inductive strip resistor, to which the moving coil is suitably shunted; or, alternately, an ordinary series transformer with a secondary coil of many turns short-circuited by the moving coil. For three-phase circuits it is necessary merely to change the connections of the potential leads. The authors then describe iron-cored phasemeters. The phasemeter is merely an ohmmeter, having, in effect, an alternating magnetic needle, due to the flux caused by an alternating current traversing a moving coil, and having two alternating magnetic fields in fixed directions (but not in the same time phase) due to the cyclic currents through its fixed coils.—Lond. *Elec.*, March 20 and 27.



PORTABLE GENERAL TESTING SET.

Wattmeter for Measuring Phase Difference.—W. Lulofs.—The author first shows that in polyphase circuits it is possible to determine the phase difference in a simply way by means of a wattmeter. He then shows that the wattmeter may also be used for measuring the phase difference in a single-phase circuit if an inductance coil is inserted in the short circuit of the wattmeter.—*Elek. Zeit.*, March 12.

Telegraphy, Telephony and Signals.

Telegraphy.—W. Bubenik.—A mathematical article illustrated by diagrams. Formulas are given for the loss of current due to imperfect insulation of the line against earth. The currents at the transmission end as well as at the receiving end depend on the insulation resistance of the line, as does also the magnetizing force of the telegraph apparatus. With a change of the insulation resistance due to weather or change of distance, etc., the magnetizing current of the instrument changes, and it may become necessary to adjust either the instrument or the voltage at the transmission end. The author prefers the last method, and shows that it is possible to subdivide the source of current so that lines of any installation resistance may be connected to the source.—*Elek. u. Masch.* (Vienna), March 15.

Telephone Exchange.—An illustrated description of the East Ham telephone exchange of the National Telephone Company which was recently opened, and which is a typical small common-battery exchange. A multiple switchboard is employed with a present accommodation for 500 lines, and an ultimate equipment of 800 subscribers' lines. Electromagnetic calling signals are used instead of lamps, and these are restored by gravity when the current is removed from the magnet coil by the insertion of the answering plug. The subscribers' operators' cord circuit is divided by a condenser instead of by a repeating coil, and a 16-cell battery is employed instead of a 11-cell.—Lond. *Elec. Eng'ing*, March 5.

Pupin Telephone Cables.—An illustrated article in which it is pointed out that with the rapid growth of large cities the municipal water pipe and gas pipe systems are growing to such an extent that it has become necessary for the sake of control to lay special telephone cables along the pipes. The cost of laying the cables is low; moreover, cables are greatly preferable to overhead wires. To reduce the cost of the cable itself, it is stated that in various German cities the Pupin system of cables loaded with inductance coils finds increasing application. So far the largest of these systems is that of the city of Schoeneberg with a cable connection between the pumping station and a canalization plant at a distance of 28 km. By using the Pupin system the cost of the cable can be considerably decreased.—*Jour. f. Gasbel.*, March 14.

Portable Telephone.—G. Foerster.—The poles supporting a transmission line are often used for the telephone wires connecting the different substations and power plant. When repairs on the transmission line become necessary it is important to be able to telephone from the place of the repair directly to the next station. A portable telephone apparatus, specially designed for such purpose, is described and illustrated.—*Elek Zeit.*, March 12.

Controlling Apparatus from a Distance by Electric Waves—L. Dubois.—An illustrated description of Branly's "telemechanic" apparatus for controlling electric apparatus at a distance by means of electric waves; for instance, for controlling torpedoes, starting motors, etc. The receiving apparatus consists of a steel shaft which is driven at a regular rate by a small electric motor. On the shaft are mounted a series of contact disks, each of which is designed to control one of the working circuits. Each of the disks carries an enlarged part or sector against which there bears a contact brush. Suppose there are five disks on the shaft, the five sectors are spaced over one-fifth of the circumference and there is only one of them in contact at a time. At the receiving station there is a single coherer and a sensitive Claude relay which works in connection with it, and the relay circuit is closed whenever a spark is sent from the distant operating station. In order to close the circuit at the moment when the brush makes contact with the proper disk, the operator at the sending station must be informed as to when each of the disks is making contact at the brush. Two methods for this purpose are described. However, in this arrangement accidental sparks coming from outside sources might cause trouble. For this reason Branly has modified this apparatus so that the circuit to be actuated is not closed by one or several sparks, but a continuous stream of sparks must be received within the proper operating interval. The various arrangements employed by him are described and illustrated.—Lond. *Elec.*, March 6.

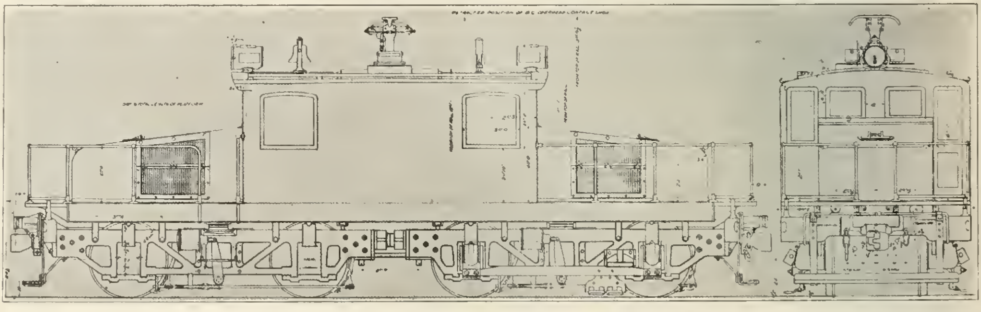
Miscellaneous.

Specialization in Engineering Education.—Dalemont discusses the question whether technical schools should tend toward specialization or only toward education in general principles. He seems to be in favor of a specialized technical education to which complimentary studies should be added.—*L'Eclairage Elec.*, Vol. 53, 1907, p. 230.—Barbezat replies to the former article and compares the educational systems of England, France and Germany. He emphasizes that general education even when carried quite far, and the over-developed study of mathematics, are not superfluous or useless. They are useful and even necessary, but applications in them should be taught not by theorists, but by practical men who can verify the hypotheses on which they are based and interpret results to which they are led.—*La Lumière Elec.*, Jan. 4.—The two papers of Dalemont and Barbezat are translated in abstract in Lond. *Elec.*, March 13.—Blondel discusses the same subject at some length. He distinguishes a preparatory scientific phase, a second period devoted to general technical education and a third period devoted to special technical education. He emphasizes the practical necessity of the co-existance of various technical schools of different types and he shows that it is possible to introduce specialization and explains how far one should go.—*La Lumière Elec.*, Jan. 11, Feb. 15.—H. Bureau discusses the same problem from the standard of the young engineer in *La Lumière Elec.*, Feb. 29.

Electric Locomotives for the Detroit River Tunnel.

The accompanying illustrations show one of the six electric locomotives now being built for the Detroit River Tunnel Company by the General Electric Company and the American Locomotive Company. These locomotives will be used to haul both passenger and freight trains through the tunnel now being constructed under the Detroit River from Detroit, Mich., to Windsor, Ont.

They are moderately slow-speed machines and weigh 100 tons on the drivers. The frame is of the articulated type, and can best be described as consisting of two four-wheel trucks hinged together. The trucks are of a very solid construction with cast-steel side frames of truss pattern carried on semi-elliptical journal box springs. The diameter of the driving wheels is 48 in. The draft rigging is carried directly on the outer end frames of each truck, the two trucks being hinged together by substantial hinges and pins. By adopting this method of construction, the draft of the locomotive is carried directly through the truck frames and the center pins are relieved of all hauling strains.



FIGS. 1 AND 2.—SIDE AND END ELEVATIONS OF DETROIT LOCOMOTIVE.

The superstructure consists of a main operating cab and two auxiliary end cabs. The main cab is 15 ft. 6 in. in length and contains the engineer's operating mechanism and valves, while the contactors, rheostats and air reservoir are contained in the auxiliary cabs. The height of the end cabs is such as to permit the engineer to obtain a good view of the tracks. Easy access to the couplers is provided by a narrow platform running from the main cab to the ends of the locomotives.

The electrical equipment of each locomotive consists of four 300-hp motors and the Sprague-General Electric multiple-unit train control. Each motor will at its hour-rating develop a tractive effort of 9000 lb. at a speed of 12 miles per hour, while a complete locomotive is capable of hauling a 900-ton train up a 2 per cent grade at the required schedule speed. The motors are of the commutating-pole type, and are among the largest units of this type yet constructed for railway work. The current will be supplied to the motors from an inverted third-rail at a potential of 600 volts. On account of the heavy torque developed, which amounts to 4050 lb. at a 1-ft. radius, a pinion is mounted on each end of the motor shaft.

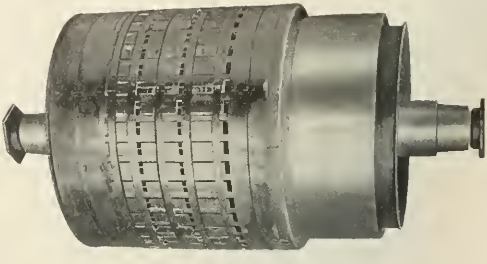


FIG. 3.—VIEW OF ARMATURE.

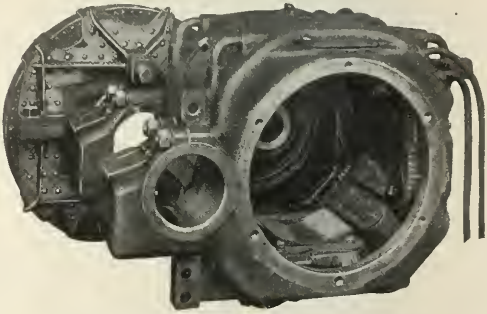
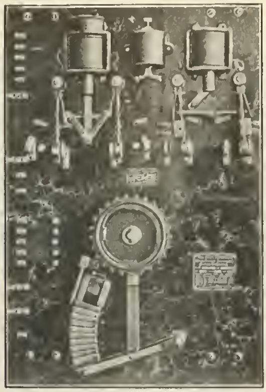


FIG. 4.—SIDE VIEW OF MOTOR FIELD STRUCTURE.

The motors will be cooled by forced ventilation, a blower having a capacity of 2000 cu. ft. per minute being installed in the main cab for this purpose. A separate compressor with a capacity of 100 cu. ft. per minute piston-displacement provides air for operating the air-brakes.

Motor Controller for Elevator Service.

The accompanying illustration shows a 10-hp, 500-volt, single-speed type of elevator controller which embodies several new features in its construction. The controlling devices are mounted on a panel 30 in. wide by 42 in. high, attached to a channel-iron frame which supports sand-packed, tubular resistors. The front may be swung away from the frame by taking out two bolts, and as the wiring connections are arranged vertically along one side of the panel, it is not necessary to disturb these wires in swinging out the front so as to enable the wireman to trace out the circuits in case of trouble.



AUTOMATIC CONTROLLER FOR ELEVATOR SERVICE.

The double-pole, main-line switch at the upper left-hand corner is shown closed on the generative or dynamic brake contacts. When the magnet circuit of this switch is energized from the car switch, the core is pulled up, and by a toggle motion produces through a spring connection a strong pressure of the carbon buttons in the switch arms against the copper contacts located at their extremities. This coil carries considerably more current than it would stand continuously during the throw of the switches; but a resistor is inserted in series with the coil at the extreme upper limit of its throw by a switch arm, not clearly shown, but directly back of the link connecting the core with the toggle, and its resistance is such as to reduce sufficiently the current through the magnet circuit. The closing of the main-line magnet switch not only connects the motor through its resistance with the line, but simultaneously causes the magnet brake to be energized as well as the magnet of the starter clutch on separate contacts. To energize the main magnet switch, current must flow through the small contacts on the reverse switch in the right direction to feed this from the opposite sides of the line according to the position of the car switch, thus insuring the setting of the reverse switch in its proper position before the main-line switch can be closed.

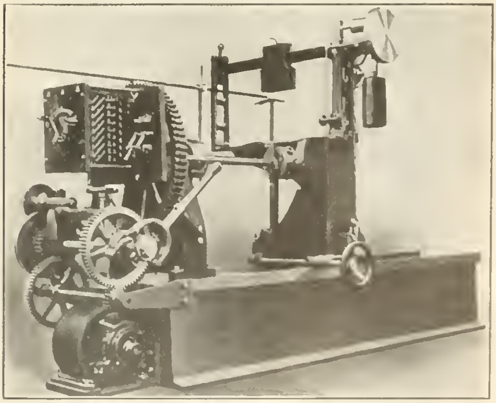
The reverse switch is shown at the upper right-hand corner of the panel. The switch has two similar arms spring-pressed to contacts, the magnet winding of which is energized only during the actual throw of the switch, current being supplied to the magnet through small contacts engaging the weight shown below the core. This weight when once set in motion by the pull of the core breaks the energized circuit and through its momentum assumes the opposite position, thus, through a crank connection, shifting the reverse switch arms. Current to energize this magnet is supplied through contacts bridged by a small solenoid in the center. This solenoid is wound in series with the shunt field coils of the motor, and as long as the shunt field coils are energized the bridge is open, thus making it impossible to produce a reverse movement on the reversing switch until the field is dead. When the main-line switch opens, the contacts close on generative brake resistance in series with a magnet winding placed above the main coil and so arranged as to pull down on the core as long as the motor continues to act as a generator, thus insuring a firm contact and preventing the reopening of this circuit instantly, which would produce arcing.

The starter is of Whittingham motor-driven type, driven either by a sprocket from an extension of the drum shaft or through worm gear by a small belt from the armature of the motor. The operation of this starter prevents an excessive rush of current and provides a time element in cutting out the resistance directly proportional to the load on the motor; as the cutting out of the resistance follows the acceleration of the armature no injurious sparking can occur on the contacts. These contacts are small flat strips of copper on which the carbon brush slides easily to the upper position. As soon as the arm is carried to the upper position by revolution of the starter clutch magnet, the small retaining magnet acts to hold the arm in that position and de-energizes the clutching magnet, at the same time the resistance arm comes in contact with the copper laminated brush, thus effectually short circuiting the carbon and producing a metallic short circuit through the starter. The starting resistance is of the Whittingham sand-packed tubular type, in which the resistance coil is supported in a glass tube bedded in sand, with copper fireproof insulated conductors leading out through porcelain bushings. This makes an almost indestructible resistance unit which meets the requirements of the Underwriters. In the larger sizes the main and reversing switch contacts are made self-aligning with spring supports so as to adjust themselves accurately to the surface of the contact arm, and in all ratings above 100 amperes, the resistance is placed below the line of the slate so as to leave the back connections entirely exposed.

The controllers are built by the Automatic Switch Company of New York City and slightly modified forms are made for controlling single and polyphase alternating-current motors.

Electric Motors in Laboratory Service.

Electricity supplied to a motor that can be relied upon is the ideal power for driving the apparatus necessary for laboratory testing. The illustration shows a typical application of a Westinghouse direct-current motor to a machine of this description. Space is generally an important consideration in a laboratory, and it will be seen that the motor fits into the machine so as to require no more space than if it were not present. The machine to which this motor is connected is an improved torsion-testing machine for testing 1½-in. round or square specimens of any length up to 5 ft., designed and manufactured by Tinius Olsen & Company, of Philadelphia.



MOTOR-DRIVEN TORSION-TESTING MACHINE.

Motor-Starting Rheostats.

The Ward Leonard Electric Company has developed a line of motor-starting rheostats shown in the accompanying illustrations. Fig. 1 shows a plain no-voltage release motor starter; Fig. 2 shows this same starter equipped with an interlocking automatic overload circuit-breaker, which gives protection against overload and short-circuit, both during the period of starting the motor and at all other times; Fig. 3 shows the resistance portion of these motor starters.

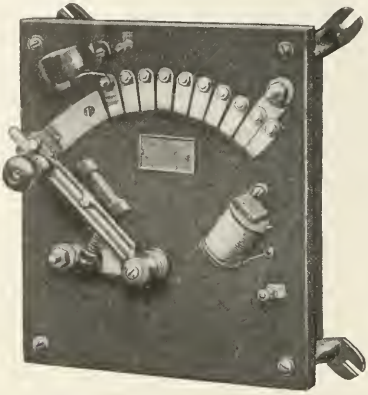


FIG. 1.—MOTOR-STARTER WITH NO-VOLTAGE RELEASE.

The resistance portion consists of a material composed of a special alloy having high resistivity, high fusing point and low-temperature coefficient. The resistance is attached to the back of the plate by means of suitable pins, and between the resistance coils and the slate several layers of sheet asbestos are placed, so that comparatively little heat can be transmitted to the slate. A metal casting, closed on all sides except one corresponding to the slate, is then fastened to the back of the slate, leaving a clear space between the resistance and the casting in every direction. The entire space surrounding the resistance, and the hollow chamber thus formed, is then completely filled with clean sand, poured in through a hole in the casting, which is afterward closed by means of a renewable plug.

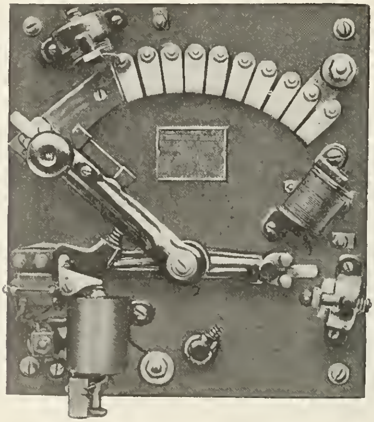


FIG 2.—MOTOR STARTER WITH OVERLOAD CIRCUIT-BREAKER AND NO-VOLTAGE RELEASE.

Pure sand has a great many exceptionally desirable qualities for a motor starter. It has a very high specific capacity for absorbing heat energy, so that a large amount of heat can be developed in it, which will be absorbed without a great increase in its temperature. This heat will be conducted to the iron box and slowly radiated by it at a low surface temperature. It is very highly insulating, and does not absorb moisture. In case the resistance be fused by excessive current, the arc is instantly extinguished, just as in the case of an enclosed fuse. This type of resistance fulfils the latest rules and requirements of the Underwriters' National Electric Association, which states that motor starters must be so constructed that even if the resistance conductor be fused, the arc or any resulting flame or molten droppings shall be confined within the rheostat.

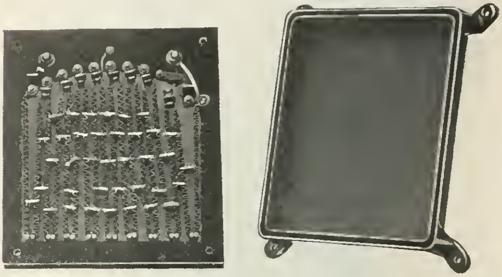
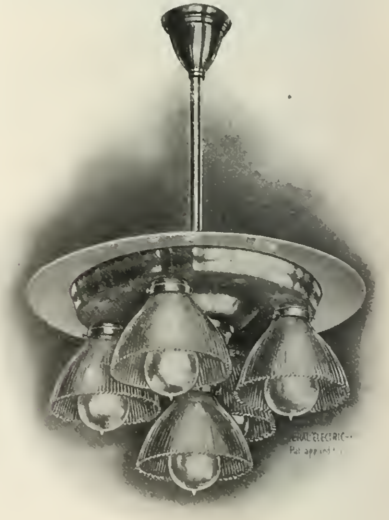


FIG. 3.—RESISTANCE PORTION OF MOTOR STARTER.

Clusters for Tungsten Lamps.

The Federal Electric Company, of Chicago, has met the demand for a low-priced cluster adapted to the efficient use of tungsten lamps by bringing out the cluster shown in the accompanying engraving. This cluster is intended for the cheaper class of work where central stations wish to replace gas arc lamps with tungsten clusters and give maximum illuminating results by using a bowl reflector over each lamp. This cluster can also be made to go directly against the ceiling without the white enameled top. If desired, a drop cord and pendant switch can be substituted for the middle lamp. The company has also recently brought out some one-light ceiling and chain pendant fixtures for large incandescent lamps.

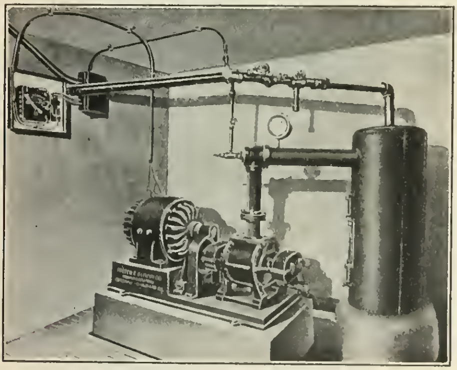


CLUSTERS FOR TUNGSTEN LAMPS.

Keystone Vacuum-Cleaning System.

The Foster & Glidden Company, of Oak Park, Ill., makes vacuum-cleaning outfits operated by electric motors, the distinguishing characteristics of which is that the pump which produces the vacuum is a Root blower operated as a vacuum pump. This company is licensed under the Root blower patents. The Root blower is applicable to use as a vacuum pump in this work by virtue of the fact that the air suction is drawn through water for the purpose of purifying the air, and in this process the air takes up enough moisture to act as a primer for the pump. The result is that a vacuum of 8 in. to 10 in. is maintained by the machine in normal operation. The friction losses of this kind of a pump are stated to be so low as materially to reduce the horse-power and weight of a machine needed to do a given work, as compared with a reciprocating pump. The pump also has the advantage that it is free from the jar and pounding of reciprocating pumps, and that it can pass any solid material drawn in through the suction without damage. The smallest outfit made, which employs a 2-hp motor, is designed to operate one utensil at a time, maintaining an 8-in. vacuum. Machines larger than this, up to 30 horse-power, maintain a 10-in vacuum.

A very interesting application of one of these machines is found in the Vaile Apartments, at Oak Park, Ill., a suburb of Chicago. It is a four-story building with 16 apartments. In the basement is a 7½-hp machine, which is designed to maintain a 10-in. vacuum with four tools in intermittent use. The pipe risers have been so placed that there is a tap in each apartment, to which hose can be attached. When any one of the tenants wants the use of the vacuum-cleaning outfit, the hose and tools are procured from a locked closet, where they are regularly kept. The absence of the hose from this closet indicates that the machine is in use by another tenant. The motor is so wired that it can be started by throwing a switch in the kitchen of any one of the apartments. When such a switch is thrown, the motor operates on current obtained through the meter belonging to the apartment in which the switch is located. Thus, each tenant operates the cleaning machine from current which he purchases. The motor is provided with an automatic-starting rheostat. The owner of the building, because of this vacuum-cleaning service, charges $2.50 per month more rent for each apartment. As there are 16 apartments, this represents an income of $40 per month when all apartments are rented. This should take care of maintenance and depreciation and leave a good profit on the investment, in addition. The cost of piping a building with the necessary risers to give service in each apartment is not great, since but a small amount of pipe is required per floor. The company figures roughly that $12 per floor would cover the cost of materials and labor. The piping should be free from sharp bends where large articles are able to lodge and the construction adopted should be similar to that used in conduit for electric wires.



MOTOR-DRIVEN VACUUM CLEANER.

Porcelain Station Pothead.

The pothead or cable bell mouth illustrated herewith is intended for use in stations around switchboards where lead-covered cables terminate, as a substitute for the usual brass bell potheads. Both the bowl and the cover are porcelain. In the bottom of the bowl is a metal collar which is drilled and tapped to a size to screw upon the lead sheath of the cable. The lid fits into the top of the bowl and is provided with as many holes as there are conductors to be led through it. The advantage of porcelain over metal for the bell is that conductors can be given a greater separation and no particular care need be exercised to keep the conductors away from the sides of the bell, as would be the case if it were metal. Of course, the lid keeps the spacing of the conductors the same at all times, and if sealed, keeps out moisture and gives a finished appearance to the installation. This particular pothead does not have the disconnecting feature which is found in other G. & W. potheads. This pothead is intended simply as a substitute for metal where a permanent joint is made in the cable. It is made by the G. & W. Electric Specialty Company, 128 Jackson Boulevard, Chicago.

PORCELAIN POTHEAD.

Induction Motor Equipment of a Copper Smelter.

It is stated that the electrical equipment of the Great Washoe smelter of the Anaconda Copper Company, at Anaconda, Mont., is unique among all plants of its kind so far built in that it includes four of the largest induction motors installed west of Niagara and was the first smelter in the country to be driven exclusively by electric motors. The concentration building is 600 ft. long. The jigs, tables, etc., are driven from a main line shaft 500 ft. long. Two induction motors are installed in each half of the mill and connected to the main shaft by rope drive and friction clutch pulleys. Each motor has an output of 1200 horse-power, synchronous speed being 360 r.p.m. Connection is made to the main shaft by 18 2-in. ropes.

These motors are notable not only on account of their large rating, but also because of their having squirrel-cage rotors, something unusual in motors of this size. Their guaranteed full-load efficiency is 91 per cent and full-load power factor 92 per cent. Squirrel-cage motors were chosen for this installation because the conditions under which they have to start are favorable and also because of the higher power factor of this kind of motor as compared with the wound rotor type.

The stator punchings of the motor are supported in a substantial yoke to which the housings carrying the bearings are bolted. The stator is wound with copper strip with the slot insulation formed around it under pressure in steam-heated molds. The rotor is mounted on a spider provided with cast steel end rings between which the laminations are held. The rotor slots are of the partially closed type, and the rotor bars are securely held in place by the overhanging tips of the teeth. The bars are bolted at each end to bronze rings, thus making a very strong rotor that can be safely run at high peripheral speed.

In addition to the four large motors there is also provided a 200-hp, variable-speed, 60-cycle, 2080-volt induction motor for operating the pumps in the mill.

This motor is of standard type with wound rotor and collector rings for the insertion of resistance in the secondary. The normal speed is 450 r.p.m. and the speed can be reduced to 225 r.p.m. by means of a grid type resistance furnished with the motor.

The Allis-Chalmers Company, which built the motors, has also furnished for this plant three 300-kw synchronous motor-generator sets and one small induction motor generator set for starting and exciting the synchronous sets. The 300-kw sets are driven by 12-pole, 2080-volt, 60-cycle synchronous motors and run at a speed of 600 r.p.m. The direct-current generators for these sets are compound wound for 550 volts and are easily able to carry 50 per cent overload for two hours without heating more than 55 deg. C. and without sparking. At normal full load the temperature rise does not exceed 35 deg. C. in any part. The sets have three bearings and the stator of the synchronous motor is arranged to slide sideways on the base to give access to the field and armature windings. These units are to operate crane motors throughout the plant and also to furnish power for other purposes.

The fields of the synchronous motors are excited from a 120-volt, 25-kw, direct-current generator driven by an induction motor. The same motor is also coupled to a small 500-volt, direct-current machine. This machine has commutating poles, and a very large current can be taken from it for short intervals without sparking at the commutator or undue heating in any part of the machine.

Formerly all the power required by the Washoe smelter, which has been equipped throughout with electric drive, was obtained from steam engines, and a certain amount of steam power will probably always be used, as some of the steam boilers utilize the heat contained in the waste gases from the furnaces. However, this power, obtained as a by-product, is not nearly sufficient to operate the whole plant, and all additional power is now transmitted 100 miles at 50,000 volts from Canon Ferry on the Missouri River.

Locking Sockets.

While the theft of current from electric-lighting companies by dishonest meter connection, etc., has received considerable attention, but little has been said of another source of trouble of a similar nature, namely, the stealing of incandescent lamps from their sockets. Central stations whose policy it is to make free renewals find that there is a continual demand for new lamps without the exchange of burned-out lamps being offered in return, and factories, hotels and public buildings are often mulcted by their employees and patrons. The majority of the lamps are probably stolen for use by the thieves, but several instances have been uncovered where a regular trade was carried on in such lamps. The advent of high-efficiency filaments, with the greatly increased value of the lamps, has given this traffic much more importance in central-station economics, and the device shown in the accompanying illustration has been perfected to protect the companies from this loss

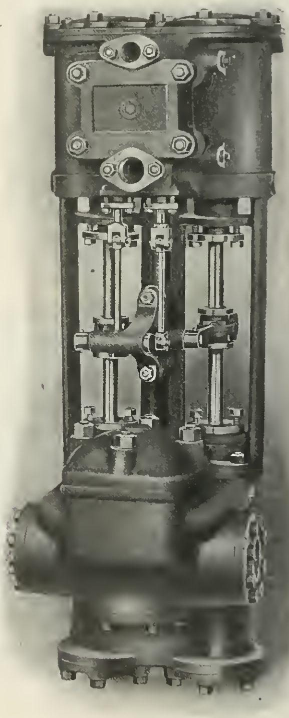
LOCKING SOCKET.

In appearance, the locking socket is similar to the ordinary key or keyless socket, the only difference being a small keyhole. The screw shell in the socket, however, swivels freely until it is locked by a key in the keyhole. To place a lamp in this socket or to remove one from it, it is necessary to lock the interior shell by use of the key before the lamp can be screwed in or out. As the lamp turns freely at all other times, it will not be broken by a person thinking it is merely stuck in the shell and trying to force it out.

The locking mechanism is safe and simple, and with the exception of the locking feature the socket has all of the characteristics of the ordinary socket and can be installed in the same manner, either on bracket, chandelier or as a pendant socket. It differs from other burglar-proof devices by being left unlocked, the key being used only to hold the inside shell rigid while the lamp is being inserted or taken out. The socket is made by the General Electric Company, Schenectady, N. Y.

New Vertical Pump.

For many years there has been a growing demand for an inexpensive vertical steam pump of small and moderate size adaptable to boiler feeding and general service, and where the modern high-working pressure necessitates substantial construction. The Blake & Knowles Steam Pump Works, of New York City, have just perfected a new design for a vertical duplex pump which meets these conditions and which is shown in the accompanying illustration. It is especially adapted for services where compactness and strength are of prime importance as in power houses and establishments where the economy of floor space is an important consideration. The pump cylinders are of the piston pattern and fitted with substantial brass linings. The pump pistons are very deep and packed with fibrous packing suited for hot or cold water. The piston rods are of Tobin bronze and the steam cylinders are of the regular duplex pattern. The cast-iron cradle or center piece which ties the steam and water ends, is extremely rigid, an improvement on the ordinary tie-bar construction, as it prevents any possibility of the cylinders getting out of alignment. The cylinders are fitted with brackets for bolting to a bulkhead or wall, although a special base may be fitted for placing the pump directly on the engine-room floor. The pumps are suited for a working water pressure of 200 lb. per square inch.



VERTICAL STEAM PUMP.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Excellent crop reports and the continuance of favorable weather during the last week, stimulated somewhat both the jobbing and retail trades, but fall trade reports are not any more satisfactory. The gross earnings of the railroads for March show a decrease of 10 per cent from March, 1907. Money continues to accumulate in the banks, and, while easy on call, is high on long-time accommodation, showing that the lesson of the panic has sunk deeply. Building reports from 67 large cities show an increase of 50 per cent over the preceding month, but a decrease of 39 per cent from March, 1907. The iron and steel trades are reported dull. Production in March exceeded the February output by 14 per cent, but stocks are accumulating. Steel rails are dull, but the market for structural material is good. The prices of general commodities show a tendency to recover from the downward trend of the last few months. *Bradstreet's* reports, for the week ending April 9, 258 failures, against 247 for the preceding week, as compared with 194 in the corresponding week in 1907, 161 in 1906, 196 in 1905, and 198 in 1904. In electrical fields and allied lines no unusual activity is reported, with the exception of brass and wire trades, both of which are doing a good business. One of the largest brass manufacturing firms reports an increase of more than 50 per cent over the corresponding week in March. The Western Electric Company reports that the sale of equipments to non-licensee customers for the month of April will far exceed the regular licensee business, thus demonstrating the wisdom of the company's new policy. An officer of the Westinghouse Electric Company says: "Our business is about 35 per cent less than that of a year ago, but it is surprising how well the miscellaneous orders keep up. More motors are being sold than ever before. There was a great deal of trolley work pending in the agricultural sections when the panic occurred, most of which is now held up. States like Iowa, where the agricultural wealth is great, seem to have been the least depressed, but it is there that the most projects in the transportation line have been suspended. Good crops will revive general business, principally because they will stimulate building of lines to further facilitate communication between producing areas and the centers of consumption."

THE COPPER MARKET.—With few buying orders the copper market through the week receded from its firm position and became weak and unsettled. The production for this month will be considerably in excess of the consumption, and the large dealers have been obliged to shade their prices considerably to bring inquiries from consumers. Manufacturers have fairly good orders on hand, but are not inclined to buy for the future. The United Metals Selling Company, during the week, reduced the price of the metal from 13½ to 13 cents, and at the latter price fairly good orders from Europe and from domestic consumers are reported. Apparently the foreign demand for copper at 13 cents or under is insatiable. Prices much lower than those at present are not looked for by copper experts. "I believe the metal will rest between 12½ and 13½ cents," said one of the large buyers, "until there is a decisive turn for the better in conditions." Closing prices at the Metal Exchange on Monday were as follows:

Lake	12¾ @ 12⅞
Electrolytic	12⅝ @ 12¾
Castings	12⅜ @ 12½

The London market was as follows:

	Noon			Close		
	£	s	6	£	s	d
Standard copper, spot	57	15	0	58	0	0
Standard copper, futures	58	5	0	58	10	0
Market	Steady.			Firm.		
Sales of spot				150 tons		
Sales of futures				300 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	61	0	0

STANDARD OIL NOT INTERESTED IN CALIFORNIA LIGHTING COMPANIES.—Unqualified denial was made by the officers of the Standard Oil Company of a story telegraphed from San Francisco throughout the country last week, which asserted that in a transaction involving $45,000,000 the Standard Oil Company had acquired control of the Pacific Gas & Electric Company, parent corporation controlling numerous light and power companies throughout the State. "The Standard Oil Company," said John D. Archbold, "has no interest whatever in the deal named, if such a deal really has taken place, nor has any person connected with the Standard Oil Company." Another officer of the company stated that it was believed that certain of the western power companies were about to float bond issues, and the story had probably been sent out to create a ready market for the issues.

AMERICAN GAS & ELECTRIC COMPANY.—Under the management of the American Gas & Electric Company the old properties of the Electric Company of America are showing a remarkable increase in earnings. In February the gross increased 27 per cent over the February of 1907, and the net increase was practically the same percentage. March earnings when fully compiled will make even a better showing, and it is expected that the increase will be more than 30 per cent for both gross and net. The new bonds are still in the hands of the engravers and will not be ready for delivery before May 1. After that each of the 15,000 bonds must be signed by three persons, so it will be at least the middle of May before they are ready for distribution to stockholders.

WESTINGHOUSE TURBINES.—On Dec. 31, 1907, 433 Westinghouse-Parsons steam turbines, aggregating 487,150-kw capacity, were in operation or in course of erection. At the same time there were orders on hand for 60 turbines aggregating 153,550-kw capacity. The total is thus 493 machines aggregating 640,700 kw. The average of the electric traction turbines (69) is 1975 kw and of central station turbines (73), 1440 kw. No less than 81 turbines were sold to manufacturing plants, mostly of a capacity of about 500 kw, and mining and irrigation work is represented by 19 machines of an average capacity of 686 kw.

ALLIS-CHALMERS' SALE OF MINING EQUIPMENT.—A large contract for mining machinery recently let to the Allis-Chalmers Company by the Yampa Smelting & Refining Company, Bingham, Utah, comprises an equipment for converting copper matte into blister copper, and consists of two electrically-operated converter stands with six converter shells, as well as all accessories, such as copper molds and cars, ladles, tamping machinery, a complete silica crushing plant for converter lining, with electric motors, and a cross-compound blowing engine for furnishing the blast to the converter.

ORDER FOR CABLE DETAILS.—The San Francisco Gas & Electric Company have received a large shipment of solderless cable taps comprising 200 for No. 0000 cable, 100 for No. 0 cable, and 100 for No. 2 cable for the underground department, from Dossert & Company, 242 West Forty first Street, New York. Dossert & Company have also received a large order for solderless connectors and terminals, to be used in the wiring of the magnificent new office building for the Senate in Washington, D. C.

THE GOVERNMENT AND THE ROCKY MOUNTAIN TELEPHONE COMPANY.—A contract has recently been made by the Government with the Rocky Mountain Telephone Company, by which the 1300 miles of Government telephone wire, strung through the Government reserves in the Rocky Mountain region, will be connected with the lines of the telephone company. Settlers along the Government line will be allowed to make connections with the Government wires.

NEW GENERAL ELECTRIC BUILDING.—Work has been recommenced on three new buildings at Schenectady for the General Electric Company, the erection of which was interrupted last fall. One is a brick addition to shop No. 7, and the other two are new buildings, one of which is a five-story concrete structure, costing $60,000.

Financial Intelligence.

THE WEEK IN WALL STREET.—Dominating the entire Wall Street situation last week, the uncertainty of the fate of the Erie Railroad kept the stock market dull and quiet until Wednesday, when it became known that the present crisis in the road's affairs had been tided over, whereupon the market began to show some signs of activity. The market was favorably affected by the government crop report, while such news as the rumored reduction of prices in finished steel products, and an investigation of Wall Street by the Legislature, had little bearish influence. New York tractions showed unexpected activity during the week. On Saturday Third Avenue closed at 36, a gain of 17 points during the week, while Brooklyn Rapid Transit and Inter-Met. stocks also showed substantial gains. Of course, there were various stories afloat to account for the advances in the tractions, but in reality there were no new developments of a character sufficiently favorable to cause any marked increase in the prices of the securities mentioned, and the advance was almost wholly due to manipulation. General Electric was also strong without any tangible reason. Those in close touch with the market characterize the trading as at present as professional, and advise their customers to wait until the market becomes less manipulative and more aggressive, or at least buy only on declines. Money is reported easier in the exchanges throughout the world. The market on Monday was almost entirely professional and stocks were heavy, many of the leading securities showing fractional declines. Closing prices on Monday were as follows:

NEW YORK.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
All-Ch.	7⅜*	7⅝	200	Int.-Met., com..	7⅞	10⅝	20,700
All-Ch. pfd.....	17½*	20¼	1,800	Int.-Met., pfd...	18½*	28⅜	33,150
Amal. Cop.....	58¾	57¼	123,360	Mackay Cos....	57*	59⅞	410
Am. D. T......	39*	39*	—	Mackay Cos. pfd.	65	65*	500
Am. Loc.......	43¾	44¼	6,600	Met. St. Ry....	17*	33	1,650
Am. Loc. pfd...	91¼	91⅜	1,210	N.Y. & N.J. Tel.	100*	100*	—
Am. Tel & C'bl.	50*	50*	—	Steel, com.....	33⅛	33⅝	204,775
Am. T. & T....	108½*	113	210	Steel, pfd......	97⅜	91¼	15,314
B. R. T........	45⅛	46⅞	43,085	W. U. T.......	51	51	400
Gen. Elec......	125*	131	3,800	West'h, com....	55	54¼	10,085
Hud. R. Tel....	—	—	—	West'h, pfd....	60*	60*	—

BOSTON.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
Am. Tel. & Tel.	109½	113¼	—	Mass E. R. pfd.	—	45	—
Comb'lnd Tel..	—	108¾	—	Mex. Tel. pfd..	—	—	—
Edison El. Ill.	—	—	—	New Eng. Tel'p.	108	111¾	—
Gen. Elec.....	126½	133	—	W'st Tel. & Tel.	6½	6	—
Mass. Elec. Ry.	10½	10½	—	W. T. & T. pfd.	62½	66	—

PHILADELPHIA.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
Am. Rys.......	42¾	42½	—	Phila. Elec.....	7¾	8	—
Elec. Co. of Am.	9⅛	9 1/16	—	Phila. R. T.....	17	17⅝	—
Elec. Stor. B'ty.	29	28	—	Phila. Traction.	—	86½	—
E. S. B'ty pfd..	—	—	—				

CHICAGO.

	Apr. 6	Apr. 13	Shares sold.		Apr. 6	Apr. 13	Shares sold.
Chicago City Ry.	155	155	—	Met. Elec. Com	17	16	—
Com. Edison...	93	91¾	—	Met. Elec. pfd.	—	47	—
Chicago Subw'y.	18½	18	—	National Carbon.	57	58	—
Chicago Tel Co.	115¾	119	—	Nat. Carbon pfd.	107	109	—

*Last price quoted.

Shares sold are for week April 5-11.

DIVIDENDS.—Directors of the Binghamton Light, Heat & Power Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 15, and the regular dividend of ¾ of 1 per cent on the common stock, as of the same dates. The regular quarterly dividend of 1½ per cent on the preferred stock and 1½ per cent on the common stock, both payable May 1, have been declared by the directors of the American Light & Traction Company. At the reorganization meeting of the directors, all the old officers of the company were re-elected. The shareholders' of the Rio de Janeiro Tramway, Light & Power Company have ratified an issue of $15,000,000 of preferred stock. It is proposed to dispose of the issue in Paris. At the annual meeting of the directors of the Philadelphia Electric Company the directors and former officers were re-elected. At the annual meeting of the United Railways & Electric Company the directors were re-elected. The directors of the Electric Bond & Share Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. The directors of the United Electric Securities Company have declared a regular semi-annual dividend of $3.50 on the preferred shares, payable May 1, to holders of record April 21. The directors of the New England Telephone & Telegraph Company have declared the regular quarterly dividend of $1.50 a share, payable May 15. The Montreal Street Railway Company has declared the regular quarterly dividend of 2½ per cent, payable May 1. The Oklahoma Gas & Electric Company has declared the regular quarterly dividend of 1¼ per cent on its preferred stock, payable April 15. The Central District & Printing Telegraph Company has declared the regular quarterly dividend of 2 per cent, payable April 30. The San Diego Consolidated Gas & Electric Company has declared the regular quarterly dividend of 1¼ per cent on its preferred stock, payable April 15. The directors of the United States Telephone Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 15. Directors of the East St. Louis & Suburban Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1. The directors of the Lincoln (Neb.) Traction Company have declared the regular semi-annual dividend of 4 per cent on the common stock, payable April 15. The Savannah (Ga.) Electric Company has omitted the usual April semi-annual dividend of 3 per cent on its $1,000,000 preferred stock. The Michigan State Telephone Company has declared the regular quarterly dividend of 1½ per cent on its preferred stock, payable May 1. The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¾ per cent on the common stock, payable May 15. The Grand Rapids Railway Company has declared a dividend of 1¼ per cent on the preferred stock, payable May 1. The Columbus Railway Company has declared the regular quarterly dividend on the preferred stock, of 1¼ per cent, payable May 1.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The response of the creditors and stockholders to the Merchandise Creditors' Committee's plan for the readjustment of the debt of the Westinghouse Electric & Manufacturing Company is said to promise a successful conclusion to the plan. Briefly the plan provides that (a) The holders of the merchandise debt are to take new, fully paid, assenting stock at par, in settlement of their claims. (b) Such of the bank debt as is not converted into "assenting stock" is to be provided for, partly by convertible bonds of the existing authorized issue at par, and partly by 5 per cent notes, running at least five years or an average period at least five years. (c) The existing issues of convertible bonds, debenture certificates and collateral notes are not to be distributed. (d) The stockholders are to subscribe at par for $6,000,000 of the new "assenting stock." The mortgage bond plan apparently did not appeal very strongly to the stockholders, due largely to the fact that it would have resulted in a heavy increase of fixed charges. Under the Merchandise Creditors' plan the fixed charges will be $800,000 less per annum than under the mortgage bond plan, and will assure a more speedy resumption of dividends on the company's stock. A committee of the stockholders of the Westinghouse Electric & Manufacturing Company consisting of Charles Francis Adams, Charles J. Canda, George W. Guthrie, Alvin W. Krech and George T. Oliver have issued a circular requesting the stockholders to co-operate in carrying through the Merchandise Creditors' plan. The holders of preferred and common stock are asked to subscribe for "assenting stock" of the company at par, at the rate of at least one share of new stock for every four shares of existing stock, the subscriptions to be paid for in five installments, the last being on April 1, 1909. The readjustment committee, of which James N. Jarvie is the chairman, in view of the undertaking of the Merchandise Creditors' Committee, has decided to extend the time for depositing obligations and claims until May 15, 1908. The readjustment committee states that a majority of the convertible bonds, of the three-year, 6-per-cent collateral notes and of the bills payable and a large amount of the debenture certificates and accounts payable, have already been deposited. A consolidated statement of the income of the Westinghouse Electric & Manufacturing Company for the seven fiscal years ended March 31, 1907, and for the seven months ended Oct. 31, 1907, shows that shipments billed from 1901 to 1907 increased from $15,908,154 to $33,026,240 and for the seven months ended Oct. 31, 1907, shipments billed were at the rate of more than $38,000,000 a year. The Merchandise Creditors' Committee have until June 1 to carry out their plan.

AMERICAN RAILWAY EARNINGS.—The subsidiary companies of the American Railways Company report gross March earnings of $207,774, a decrease of $19,376 from the same period last year. From July 31, 1907, to March 31, 1908, the gross earnings were $2,181,200, an increase of $59,534 over the same period in the preceding year.

WESTINGHOUSE ELECTRIC'S LIABILITIES REDUCED.—Among the liabilities of the Westinghouse Electric & Manufacturing Company, enumerated in the January report to stockholders, were certain guarantees of bank loans to the British Westinghouse Company, amounting to $621,835, and notes of the British Company discounted with the endorsement of the Westinghouse Electric & Manufacturing Company, amounting to $121,300. The total of these two items, $743,135, has been fully provided for by the British Company by the sale of $1,250,000, out of an issue of $1,500,000 prior lien debentures, which provides for all the debts of the company and leaves a cash surplus for its requirements. This sale also completes the arrangements made with the receivers of the American company, whereby the latter accepts shares of the Traction & Power Securities Company in settlement of notes and open account due the American company, amounting to about $800,000. The Westinghouse Electric Company, Ltd., of London, acting as agent for the American company, had discounted Russian Westinghouse Company bills given to the British Company, prior to the appointment of receivers for the American Company, amounting to $70,000, which have since been paid by the Russian Company. The Russian Company has also paid $95,000 on account of its overdue notes, totaling $500,000, given to and discounted by the American Company, and has agreed with the banks holding these notes to pay the remainder this year. These two payments, totaling $165,000, are in addition to $246,139 payments amounting to $246,139 made by the Russian company to the French company at about the time the receivers were appointed, for the account of the American company, thereby reducing the liability of the latter with respect to the purchase of debentures of the French company to $750,000. The total reduction in the indebtedness of the Westinghouse Electric and Manufacturing Company as of Oct. 23, secured by the payments enumerated, is $1,154,274.

PHILADELPHIA ELECTRIC COMPANY.—The report of the Philadelphia Electric Company, for the year ending Dec. 31, 1907, gives a gross income of $4,984,350, as compared with $4,503,878 for 1906. Expenses, taxes and charges were $4,075,349, equal to 9.09 per cent on the $10,000,000 paid-in capital stock, as compared with a surplus of $820,717 for the previous year. Dividends were declared of $499,035, the same as last year, leaving a surplus of $409,414, as compared with surplus of $320,782 for 1906, and a total surplus for 1907 of $2,141,934 against $1,732,519 for the previous year. President McCall stated that the policy of the company in sharing with the consumers the profits arising out of the economy of unification and increase in the growth of the business, had resulted in common benefit. He emphasized the fact that the gross income for 1907 over 1899 shows an actual increase of 121 per cent, notwithstanding the reductions in price and terms to consumers, and added that if the average price prevailing in 1899 had been maintained in 1897, the gross income would have been approximately $7,500,000, or an increase of 242 per cent, showing, he said, that the consumers of the company have practically shared equally with the company as the business has developed and grown. The report shows an increase in the number of consumers in the period mentioned of 14,828 or 182 per cent, and in connected load of 987,518 16-cp equivalent or 192 per cent. The retiring directors were re-elected. The stockholders present voted in person 15,000 shares, and the largest vote was polled in the history of the company.

RECEIVER FOR UNITED STATES INDEPENDENT TELEPHONE COMPANY.—Vice-Chancellor Howell, sitting in Newark, appointed Frederick T. Johnson, a Newark lawyer, as receiver for the United States Independent Telephone Company, of Rochester, last week. His bond was fixed at $5,000. The telephone company is a $50,000,000 corporation, and was adjudged insolvent last week because of a deficiency judgment of $16,000,000 entered against it recently in the Supreme Court of New York. Pending an appeal from the court's findings, the receivership was stayed on application of counsel for a number of creditors who have gone into a scheme proposed for reorganization. It was contended at previous hearings that M. E. O'Grady, of Rochester, who brought about the insolvency proceedings, had agreed to the proposed reorganization scheme, and that the claim of the intervening creditors had become merged in the deficiency judgment.

MASSACHUSETTS ELECTRIC COMPANY'S EARNINGS.—Gross earnings of the Massachusetts Electric Company for March show a decrease of about 3 per cent, as compared with March, 1907. It is likely that carnings for the three months ended March 31 will slightly exceed the same period of 1907. The ordinary maintenance expenditures charged to operation are but 10 per cent of what they were a year ago This means that the fixed charges for the next year will show practically no increase. The matter of the issuance of $2,000,000 preferred 6 per cent stock of the subsidiary companies is before the Gas & Electric Light Commission for approval.

KANSAS CITY RAILWAY & LIGHT.—A report of the Kansas Railway and Light Company for February and nine months (June 1 to Feb. 29) shows a February gross of $464,118 as compared with $423,509 for February, 1907; expenses of $251,389 against $230,314 for 1907, leaving a February net of $212,729, as compared with $193,195 for February of the previous year. Deducting taxes and interest of $151,050, leaves a February surplus of $61,679 against $46,319 for the previous year. The nine months net was $2,247,542 against $2,148,097, and the nine months' surplus was $868,471 as compared with a surplus of $836,086 for the previous year.

UNITED RAILWAYS OF BALTIMORE.—The United Railways & Electric Company, of Baltimore, for the year ending Dec. 31, 1907, reports a gross income of $7,018,081, as compared with $6,853,102 for 1906; expenses of $3,470,087 as compared with $3,220,942, leaving a net of $3,547,994, against $3,632,160 for 1906. The income for 1907 was $3,554,499, against $3,636,885 for 1906. Deducting charges left a surplus of $1,066,557, as compared with a surplus of $1,271,298 for 1906. All of the directors of the company were re-elected.

UNION ELECTRIC COMPANY BONDS.—The Union Electric Company, of Dubuque, Ia., offers $125,000 first mortgage, 5 per cent gold bonds due May 1, 1924. The company has $727,000 preferred 6 per cent stock and $655,000 common stock. The authorized amount of the first mortgage, 5 per cent bonds is $980,000, of which $650,000 has been issued. For the calendar year of 1907 the gross earnings of the company were $294,922.37; operating expenses, $204,474.09, and net earnings, $90,448.28. Deducting $32,500, the interest on bonds, gave $57,948.28 applicable for dividends.

UNITED RAILWAYS NOTES.—The United Railways Investment Company announces that subscriptions have been received for the entire issue of $3,500,000 6 per cent serial notes of 1908. The note issue was to provide means to enable the investment company to acquire at par $3,500,000 of first preferred 7 per cent stock of the United Railroads of San Francisco, being the remainder of a $5,000,000 issue of that stock, of which $1,500,000 was acquired in 1907 by the United Railways Investment Company.

HAVANA ELECTRIC COMPANY.—The Havana Electric Company's report to the New York Stock Exchange for the year ended Dec. 31, 1907, gives a total income of $924,951. Deducting $13,790 for taxes and rents, $440,036 for interest and $105,050 for sinking fund installments, leaves a net profit for the year of $366,074. Deducting $275,000 as a 5½ per cent dividend on the preferred stock, leaves a surplus for 1907 of $91,074, and a total surplus of $241,795.

CONEY ISLAND ROAD TO ISSUE BONDS.—The Coney Island & Brooklyn Railroad Company last week asked permission of the Public Service Commission to issue bonds to the amount of $468,000, to be secured by the consolidated mortgage of 1904. About $278,000 of the issue, it is planned, will be used in the construction of a railway on Coney Island Avenue, from Prospect Park to Coney Island, and $83,000 of the remainder will be used in reconstructing the company's power plant.

LOS ANGELES EDISON ELECTRIC COMPANY.—For the fiscal year ended Dec. 31, 1907, the Edison Electric Company of Los Angeles, Cal., reports gross earnings of $2,206,381, operating expenses of $868,374, and net earnings of $1,338,006. Deducting fixed charges of $574,517 leaves a surplus of $763,489, as compared with a surplus of $696,724 for 1906.

PORTLAND RAILWAY & LIGHT EARNINGS.—The gross earnings for February of the Portland Railway, Light & Power Company were $332,298, an increase of $62,501, and net earnings were $157,541, an increase of $76,374 over the same period last year.

UNITED RAILWAYS COMPANY, OF ST. LOUIS.—The quarterly report of the United Railways Company, of St. Louis, shows 49,071,395 revenue passengers carried on the street cars in the three months ended March 31. The number of trips was 1,438,848.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

JASPER, ALA.—The Jasper Light & Power Company is considering the question of enlarging its power plant. J. M. Cranford is president.

GRAVETTE, ARK.—The City Council has granted a franchise to the Sulphur Springs Power & Light Company to install a lighting system in this city.

LITTLE ROCK, ARK.—The Little Rock Railway & Electric Company has filed a mortgage executed to the Bank of Commerce and the Trust Company, of Memphis, Tenn., for $5,000,000, of this $2,000,000 is to take up outstanding bonds and the remainder to provide for future developments.

BERKELEY, CAL.—Plans are being considered by the Board of Trustees to establish an electric lighting plant in connection with the incinerating plant, which the city is planning to erect. As a result the trustees are contemplating giving the Berkeley Electric Light Company a contract for electric lighting for one year instead of two years, as customary. The cost of the proposed plant is estimated at $15,000.

BERKELEY, CAL.—The Town Trustees have made a contract for street lighting with the Berkeley Electric Lighting Company. The town accepted the moonlight schedule at a rate of $6 per lamp per month for every month, excepting November, December, January and February, when an all-night schedule at a rate of $7 per month will be maintained. The rate for the electroliers will be $1.75 per month. The difference in the all-night schedule for the four winter months will amount to about $240 per month above the rate paid under the last contract.

GEORGETOWN, CAL.—Norval Douglass has filed notice of appropriation of 5000 in. of water in the Travis Creek below the junction of Bear Creek, the power to be used to generate electricity.

NEVADA CITY, CAL.—The Ethel Mining Company is planning to erect an electric power plant. A. Maltman is superintendent.

SACRAMENTO, CAL.—The Great Western Power Company has made application to the Board of Supervisors for a franchise to construct electrical transmission lines throughout the county, including the river islands. The company proposes to extend its lines to San Francisco. A. M. Seymour is attorney for the company.

SAN FRANCISCO, CAL.—Bids will be received at the office of the constructing quartermaster, Fort Mason, San Francisco, Cal., until May 1, for furnishing electric motor, pumps and pipe lines for the Army General Hospital, Presidio, of San Francisco. Plans and specifications can be seen and necessary information obtained at the above-named office. Major George McK. Williamson is quartermaster, U. S. A.

SANTA CLARA, CAL.—Morrison Brothers have been awarded the contract to construct the new power house for the municipal plant.

SOULSBYVILLE, CAL.—R. A. Nichols, owner of the local electric light plant is considering the question of installing a new dynamo in his plant.

UKIAH, CAL.—The Snow Mountain Water & Power Company's plant on Eel River was put into operation on March 30 and now furnishes electricity for lighting Ukiah. The transmission line will be extended to Santa Rosa in a few months and contracts for the work are already being let.

WALLACE, CAL.—The San Andreas Mining Company is planning to erect a transmission line to transmit electricity from the Emma mine property to the dredger in the river.

DENVER, COLO.—Combined with the construction of a tunnel through the Continental Divide for the Denver, Northwestern & Pacific Railroad, known as the Moffat line, is a project of bringing water through the tunnel to supply the valley below for irrigation and power purposes. The Continental tunnel will be put through at an elevation of 9000 ft., or 3000 ft. lower than the top of the Divide, and it will be 22 ft. high, 19 ft. wide and 6.04 miles in length. The estimated cost is $5,000,000 and the company will be financed by the same interests as the Denver-Steamboat Springs Construction Company, in which D. H. Moffat, D. C. Dodge, Thomas F. Walsh, John F. Campion, L. C. Phipps, H. M. Porter, Charles Boettcher, C. J. Hughes, William Byrd Page and S. M. Perry are the leading promoters. The water supply will be secured from the Snake River and other streams rising in the plateau west of the Continental Divide.

DENVER, COL.—At the annual meeting of the Northern Colorado Power Company, held April 4, a bond issue of $3,000,000 was authorized, the proceeds of which will be used for extending the transmission system of the company. The company has a plant now in operation at Lafayette, and proposes to erect transmission lines to practically every town north of Denver. The following named officers were elected: William J. Baker, president; George C. Smith, of New York, N. Y., vice-president; George Best, secretary, and Thomas Keely, treasurer.

LAS ANIMAS, COL.—Bids will be received until May 16 by R. C. Hollyday, chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., for an electric lighting system at the Navy Hospital, at New Fort Lyon. Plans and specifications can be obtained on application to the bureau or to the medical officer in command, Naval Hospital, Los Animas, Col.

GREENWICH, CONN.—The Connecticut Company is installing additional machinery to its generating plant, and is contemplating enlarging the entire plant in the near future to meet the demands made upon it. On April 1 the company put in force a new schedule of rates for electricity for lamps and motors, which reduced the cost from 30 to 50 per cent.

WILMINGTON, DEL.—Only two bids were received by the directors of the Street & Sewer Department for lighting the streets of the city. One was from the Wilmington City Electric Company for electric lighting and the other from the American Street Lighting Company for gas lighting. Both companies hold contracts for lighting the city, which have been extended until Sept. 30, 1908. Both bids were returned unopened.

WASHINGTON, D. C.—The contract for the electrical fixtures for the new municipal building has been awarded by the Commissioners of District of Columbia to the Enos Company, New York, N. Y., for $6,278.

SARASOTA, FLA.—Is is reported that H. P. Porter, of Tampa, Fla., will install a water and light plant in Sarasota.

CANTON, GA.—An electric light plant, water works and sewerage system will be installed in this city, for which $30,000 in bonds has been voted.

BURLEY, IDAHO.—Plans are being prepared by Messrs. Saunders & Vandenheuvel for the large electrical plant and pumps to be installed at the dam at this place, contracts for which, it is stated, will be let the latter part of this month.

BURLEY, IDAHO.—A. P. Davis, chief engineer of the Reclamation Service, states that the large electric plant to be installed by the government in connection with the Minedoka project will generate 16,000 horsepower, and that the government will supply electricity in Burley for heating, for operation of farm pumps and machinery. The transmission line will be extended to Burley at the close of present year.

HAGERMAN, IDAHO.—Preparations are being made by the Twin Falls Company to begin work on the construction of a large power plant on the Snake River at Lower Salmon Falls. It is expected to have the plant completed by Jan., 1909. The cost is estimated at between $400,000 and $500,000. The plant will furnish electricity for railway purposes.

SPIRIT LAKE, IDAHO.—The Spirit Lake Land Company has been granted a franchise to erect poles and wires for the distribution of electricity for lighting purposes.

BONDVILLE, ILL.—The Bondville Telephone Company is considering the question of extending its telephone lines to Mahomet.

CHADWICK, ILL.—Plans are being considered by the Farmers' Telephone Company for extending its telephone line from Chadwick to Thomson.

ORION, ILL.—H. V. Conover, clerk, writes that plans are being made to rebuild at once the municipal electric light plant which was recently destroyed by fire.

BOONEVILLE, IND.—The Evansville Terminal Railway Company has secured a franchise to cross the county with its proposed line from Evansville to Newburg.

CONNERSVILLE, IND.—Announcement has been made by the officials of the Indianapolis & Cincinnati Traction Company that plans are being made for the construction of an extension to its electric railway to close the gap between this city and Hamilton, work on which will begin in the near future. The cost of the work is estimated at $250,000.

EVANSVILLE, IND.—The Town Board has granted a franchise to the Evansville Terminal Railway Company to operate its railway through the town. The company proposes to construct an electric railway from Evansville to Newburg.

EVANSVILLE, IND.—The Evansville, Suburban & Newburg Railroad Company has applied to the County Commissioners for a new right of way through the county, and to the City Council for a right of way over Lincoln Avenue to enter the city.

LAFAYETTE, IND—A deal has been closed whereby C. L. Souders, of Lafayette, becomes owner of an independent telephone system operating in a number of towns south of Terre Haute, with headquarters in Washington. It is the intention of the new owner to improve and enlarge the system.

MADISON, IND.—It is rumored that A. A. Boyd, R. F. Garrettson, of Michigan City, and William L. Taylor, of Indianapolis, have purchased the plant of the Madison Light & Railway Company. It is understood that the new owners will rebuild and re-equip the plant.

PAOLI, IND.—Plans have been prepared for additions and improvements to the municipal electric light plant, which will include the installation of a new tubular boiler; a 75-kw, 250-volt generator; one 100-hp engine; 5400 ft. 70,000 cm cable; heater, pump and all accessories. The cost of the work is estimated at $6,000. C. D. Stinson, of West Baden, is engineer in charge.

RICHMOND, IND.—Plans for the construction of a conduit system in Main Street by the Central Union Telephone Company have been approved by the Board of Public Works, and work is to begin at once. The plans were held up for some time, with a view of providing a conduit system of sufficient capacity for all the wire companies, in compliance with an ordinance requiring the burying of all wires on Main Street. The Light, Heat & Power Company proposes to construct a pole line in the first alley north of Main Street and thus avoid its share of the cost of a conduit system.

CLINTON, IOWA.—The construction of a new office building in Clinton is contemplated by the Iowa Telephone Company, and also extensive improvements to its system in Muscatine is under consideration.

GREENE, IA.—The mill property and the water rights at this place owned by the Greene Manufacturing Company have been sold to the Greene Electric Light & Power Company for $3,500. The dam, which was recently washed away, will be rebuilt and will furnish power to operate the electric light plant and the flouring mill.

AKRON, KAN.—The Farmers' Telephone Company is contemplating improvements and extensions to its system in this city, including the installation of a new switchboard.

WINFIELD, KAN.—Bids will be received until April 29 by the State Board of Control, Topeka, for a 75-kw direct-current generator and engine for the School of Feeble Minded Youth, Winfield. Also for remodeling the boiler.

WINCHESTER, KY.—Extensive improvements are planned by the Old Kentucky Telephone & Telegraph Company including the installation of a new switchboard, placing its main wires in cables and thoroughly overhauling the entire system.

LECOMPTE, LA.—Bids for the construction of the municipal electric light plant, which were opened April 7, have been rejected and further action on the matter deferred until Feb. 1, 1909.

NEW ROADS, LA.—The Cumberland Telephone Company is contemplating extending its line from Port Allen to New Roads, which will ultimately be extended to Torras, a distance of about 35 miles.

SHREVEPORT, LA.—The Shreveport Telephone Company is preparing to extend its underground and cable systems.

VASSALBORO, MAINE.—Plans are being considered by the Vassalboro Electric Light & Power Company to develop the water power at the outlet of China Lake to generate electricity. The company proposes to develop about 200 horse power and will furnish electricity in the towns of Vassalboro and Winslow for lamps and motors. Edward Chase, of Winslow is interested in the enterprise.

WINSLOW, MAINE.—The dam of the Fort Halifax Power Company is nearly completed and work has commenced on the construction of the power house. The equipment will include eight Hercules water wheels made by the Holyoke Machine Company, of Holyoke, Mass., with an aggregate rating of 2800 horse power; three generators and exciters from Fort Wayne Electric Works. The plant will have an output of 2100 kilowatts. There will be two units, one of which will be a three-phase, 25-cycle, 400-volt, alternating-current, the other a double-current generator furnishing three-phase, 25-cycle, 400-volt current on one side, and at the other 60-cycle, 4100-volt. The transmission line will be 50 miles in length, and will furnish electricity to operate the Lewiston, Augusta & Waterville Street Railway.

HAGERSTOWN, MD.—The municipal electric light plant has made an excellent showing the past year, the receipts showing an increase of $4,516 over last year. A new 500-hp condenser has been ordered, which will cost about $1,500.

BEVERLY, MASS.—The Beverly Gas & Electric Company has announced a reduction of 10 per cent in its price for gas and electricity. Under the new schedule the price of electricity for lamps is 15 cents per kw-hour, with a discount of 20 per cent instead of 10 per cent for all bills paid on or before the 15th of the month. The present price is 13½ cents per kw-hour, with a discount of 10 per cent. The new schedule goes into effect July 1, 1908.

FITCHBURG, MASS.—Arrangements are being made by the Fitchburg Gas & Electric Company to place its wires in underground conduits during the coming summer.

GRAFTON, MASS.—The citizens have voted to authorize the Selectmen to enter into a contract with the Grafton Electric Company for lighting the streets of the village for a term of five years at the rate of $13.50 each per year for 25-cp incandescent lamps. A committee was also appointed to investigate and report on the advisability of installing a municipal electric lighting system and to report Aug. 22.

PEABODY, MASS.—The citizens have voted to appropriate $2,500 to install and maintain an incandescent street lighting system on Lowell Street in West Peabody.

PITTSFIELD, MASS.—The city has renewed the street lighting contract with the Pittsfield Electric Company for another year under the same terms as last year. The company is to furnish 130 arc lamps at $79 each per year and 725 incandescent lamps at $17.25 per lamp per year. All lamps to be operated on an all-night schedule. Under the terms of the contract the company is to substitute tungsten lamps of 32-cp for the 25-cp incandescent lamps now in use. The company also agrees to reconstruct nearly all the arc lamps in use.

SHARON, MASS.—The town of Sharon is considering a proposition of making a contract with the Edison Electric Illuminating Company, of Boston, for a term of 20 years, the company to furnish incandescent lamps for street lighting for $12 per lamp per year, instead of $15 per lamp. Electricity for lighting the town is furnished from the Medfield plant.

WAKEFIELD, MASS.—The managers of the municipal electric light plant are considering plans for installing gas engines and gas producers in the municipal electric plant, and would like to correspond with manufacturers of the same.

WESTFIELD, MASS.—The Bigelow Boiler Company, of New Haven, Conn., has been awarded the contract for installing a 150-hp tubular boiler in the municipal electric light plant. George Pettibone is manager of the plant.

WILMINGTON, MASS.—The citizens have voted against the proposition to light the streets of the town by electricity. It was proposed to make connection with the Reading municipal electric plant, which would have involved an expenditure of $12,000. The cost of maintenance for the first year was estimated at $2,300.

HOUGHTON, MICH.—Plans are being considered by the Michigan Telephone Company for extensive improvements to its local plant.

MARQUETTE, MICH.—The municipal electric light plant has just closed the most successful year of its existence. The receipts for the past 12 months were $55,527; the operating expenses, including depreciation and new construction, $22,580, and the net earnings $32,527. Interest on bonds amounted to $3,239, leaving a net revenue of $29,288. The rates for electricity for lamps for commercial purposes are five cents per kw-hour, and for residences seven cents per kw-hour. The plant is operated by water power.

UNION CITY, MICH.—The city has decided to repair and improve the pole lines of the municipal electric light plant, at a cost of about $2,000. J. G. Wetmore is superintendent.

BELGRADE, MINN.—Plans are being made by T. J. Anderson, of this city, to erect a new telephone line from Belgrade to Eslarm.

BIWABIK, MINN.—Plans are being considered for increasing the boiler equipment of the municipal electric light plant.

DETROIT, MINN.—Plans are being made to construct a rural telephone line from Lake Sally and Lake Melissa districts. The Union Telephone Company will erect a line from Osage to Detroit.

LUVERNE, MINN.—The Council contemplates removing the municipal electric light plant and water works system to another location, and installing new machinery at a cost of $15,000.

ST. CLAIRE, MINN.—The Village Council has granted the St. Claire Telephone Company a franchise to install and operate a telephone system.

SPRING VALLEY, MINN.—The Northwestern Telephone Company has sold its telephone system in this place to the Tri-State People's Telephone Company. The company operates about 150 telephones.

JACKSON, MISS.—J. W. Abernathy is interested in a project to build an interurban railway to connect the towns of Hazlehurst, Brown's Wells, Barlow and Dentville. The road will be about 40 miles in length.

NATCHEZ, MISS.—Plans are being made for laying the submarine cable of the Cumberland Telephone & Telegraph Company to connect Natchez and Vadalia, La., to replace the one lost last year. J. T. Featherston is general superintendent of construction.

FARMINGTON, MO.—Plans are being prepared for a municipal electric light plant, the cost of which is estimated at $25,000. Thomas B. Carter is engineer in charge.

ST. JAMES, MO.—The St. James Ice & Power Company is making preparations to construct an electric light plant and cold storage plant in this city, the cost of which is estimated at about $24,000. The company is now receiving estimates for the equipment of the plant. Louis Decker, of St. Louis, is interested in the project.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company contemplates the construction of an interurban railway to Savannah. The cost of the work is estimated at $300,000. Plans are also being considered by the company to enlarge its power plant at Main and Felix Streets, which will involve an expenditure of about $50,000.

ST. LOUIS, MO.—President O'Reilly of the Board of Public Improvements has asked the City Counselor for an opinion on the legality of the franchise obtained by the Trans-Mississippi Electric Company, in 1897, to string wires and lay conduits for lighting purposes. The company filed an acceptance of the ordinance at the time, but did not file a bond. Recently it applied to the board for permission to establish conduits and erect wires in the districts bounded by Euclid Avenue, Lindell and Forest Park Boulevards and King's Highway.

ST. LOUIS, MO.—L. Frank Ottofy, attorney for Browning, King & Company, states that the company owns a franchise to manufacture and sell electricity for lamps and motors, and that plans are under consideration for the construction of a large plant. The company proposes to operate a general commercial lighting business in competition with the Union Electric Light & Power Company. The company has a perpetual franchise obtained from the city in March, 1884, under the terms of which it is to pay the city 2½ per cent of its annual gross receipts until 1900, and thereafter 5 per cent. The company accepted the ordinance and filed a $20,000 bond, which is still in effect.

TERRY, MONT.—The Terry Telephone Company is in the market for equipment for a telephone system, including switchboard, wire, cable, insulators, instruments, etc.

FREMONT, NEB.—In addition to the extensive improvements and extensions being made by the Fremont Telephone Company to its local system, it is proposed to build a number of new lines.

UPLAND, NEB.—To meet the requirements of its increasing business the Upland Telephone Company has decided to build a new exchange building. The system will be improved and a new switchboard installed.

RENO, NEV.—The Selby Consolidated Mining Company has closed a deal with the Truckee River General Electric Company for the installation of electrical machinery and to furnish electricity for the operation of a 60-ton Kinkead mill to be installed in the new camp in the Jumbo mining district.

SALEM, N. H.—The mill formerly owned by James Dustin, of North Salem, has been purchased by the Salem Light, Heat & Power Company, and will be equipped with modern machinery and used as a power station. The new plant will be operated by water power. E. R. Woodbury is superintendent.

BOUND BROOK, N. J.—Plans are being considered by the Home Telephone Company for improvements to its system in this city, involving an expenditure of about $10,000.

HOBOKEN, N. J.—Plans are being made by the New York & New Jersey Telephone Company to place all its wires underground in this city by Aug. 1. The cost of the work is estimated at nearly $50,000. It is the intention of the city to compel the Public Service Corporation and the Western Union and Postal Telegraph companies to place their wires underground.

PRINCETON, N. J.—Plans have been prepared for the construction of a new power house for the Princeton Theological Seminary. The building will be erected by William T. Matthews at a cost of $13,800. The Richard D. Kimball Company, of Boston, Mass., have charge of the construction of the plant.

SORCORRO, N. M.—Plans are being made to install an electric light and power plant. Dr. E. L. Woods is interested in the enterprise.

BERGEN, N. Y.—The Village Board is negotiating with the Genesee County Electric Light, Power & Gas Cimpany to furnish electricity for lighting the village. The streets have been in darkness for several weeks.

BROOKLYN, N. Y.—The Coney Island & Brooklyn Railroad Company has applied to the Public Service Commission asking for permission to issue bonds to the amount of $462,000, to be secured by a consolidated mortgage of 1904. Of the proceeds $278,000 will be used for the construction of the railway on Coney Island Avenue from Prospect Park to Coney Island, the balance to be used for reconstructing the company's power plant.

CANANDAIGUA, N. Y.—The cars of the Rochester & Eastern Rapid Railway Company are now operated by Niagara power furnished by the Niagara, Lockport & Ontario Power Company. The power house of the railway company will be maintained, and for the present operated part of the time. The power company also furnishes electricity for lighting the streets of the town.

FULTON, N. Y.—In order to hasten the work on the barge canal the contractors are about to build a coffer dam which will shut off the entire water power of the Fulton Light, Heat & Power Company, and throw the company entirely upon its steam reserve plant.

HEMLOCK, N. Y.—The Canadice Telephone Company, recently organized, has completed its telephone line to this place and has established connections with many of the surrounding towns. It is planning other extensions.

INWOOD, N. Y.—A committee has been appointed by the Village Improvement Society to make arrangements to form a lighting district and make provision for lighting the streets of the town.

PATCHOGUE, L. I., N. Y.—The Village Board has rescinded its action of April 6 to enter into a five-year contract with the Patchogue Electric Light Company to furnish 25-cp incandescent street lamps for $18 per lamp per year. The matter was referred to a special committee.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings until April 20, for installing electric equipment in addition to and alterations in Public School No. 3, Borough of Bronx; also in Public School No. 4, Borough of Manhattan.

SPENCERPORT, N. Y.—The Ogden Telephone Company has placed a contract with the Inter-Ocean Telephone Company, of Buffalo, for the construction of a new telephone system for $16,000. The contract calls for 400 telephones and two exchanges, one in this village and the other in Adams Basin. The line is to be completed by July 4, 1908.

UTICA, N. Y.—Clifford Lewis, Jr., of this city, is conducting a survey in Fulton County for the Garoga Valley Electric Light & Power Company, a new company recently organized. The company is capitalized at $1,000,000 and is placing contracts for furnishing electricity in Amsterdam and Schenectady.

SALISBURY, N. C.—Owing to certain restrictions in the franchise granted by the Board of Alderman to the Southern Power Company to erect an electric plant in this city, the company refused to accept the franchise, and it is possible that the franchise may be revoked.

WINSTON-SALEM, N. C.—Preparations are being made by the Southern Bell Telephone to install a new telephone system in this city, including the erection of a new exchange building, the cost of which including the equipment is estimated at $35,000.

MINOT, N. D.—Plans are being considered for organizing an electric light company here. K. C. Sanborn is interested in the project.

COLUMBUS, OHIO.—A bill has been passed by the Senate giving a city or Village Council power to purchase water works and electric light plant, when owned and operated as one property by a private company, provided a majority of the people so decide at a special election for that purpose. The bill was introduced for the relief of the situation that has developed at Warren.

COLUMBUS, OHIO.—Proposals will be received by the Board of Public Service until April 20, for furnishing the following supplies for the municipal electric light plant: 125,000 ft. No. 8 Brown & Sharp gauge, triple braid, weather proof solid copper wire; 125,000 ft. No. 6 Brown & Sharp gauge, triple braid, weather proof solid copper wire; 15,000 ft. No. 8 Brown & Sharp gauge, single braid, rubber covered standard copper wire. All wire to conform to the national electric code rules and requirements. Each bidder must submit samples of the wire bid upon and also state the shortest time of delivery of all or part of wire. For further information address E. W. Hirsch, Secretary Board of Public Service.

DENNISON, OHIO.—The United Electric Company has made extensive additions and improvements to its plant, including the installation of a 200-kw, 2200-volt, 60-cycle, three-phase belted generator and 50 Westinghouse arc lamps, and also expects to install 50 additional arc lamps. The lamps are operated from a mercury arc rectifier. O. B. Welch is manager.

LIMA, OHIO.—W. Kesley Schoepf, president of the Ohio Electric Railway Company, has informed the City Council that his company will furnish street lamps at $70 per lamp per year on the renewal of the contract, which is a reduction of $15 per lamp now being paid on the old contract. The Council has already voted a bond issue for a lighting plant.

LOGAN, OHIO.—Bids will be received by the Village Council until April 28, for lighting the streets, alleys and public places for a period of 10 years; also for a period of three years, from Aug. 1, 1908, with not less than 50 arc lamps of 2000 cp. D. V. Thurness is Mayor.

RAVENNA, OHIO.—The Ravenna Gas & Electric Company has increased its capital stock from $60,000 to $120,000.

KLAMATH FALLS, ORE.—Three large plants are now in course of construction in Klamath County. The largest is the Southern Pacific plant at Spencer Creek, which will take three years to construct. The next in importance is the government plant to be built on Link River, in conjunction with the Keno Canal. It will have an output of 1600 horsepower and will furnish electricity to operate all the pumping stations in the various parts of the Klamath project. The last is the Moore power plant, which is located a short distance down the river from the government site, which will be completed this year, and will furnish electricity for lamps and motors in the towns of Bonanza and Merrill. The transmission lines are nearly completed to both towns.

UNION, ORE.—The City Council has passed an ordinance providing for submitting to the citizens at the June election a proposition to amend the city charter so as to empower the city to incur an additional indebtedness of not to exceed $55,000 for installing an electric light plant and improving the water system. The Mayor and Recorder have been empowered to at once take steps to carry out the orders of the Council.

CORRY, PA.—The plants and holdings of the Corry Electric Light Company have been sold to James E. George, of Cleveland, Ohio. It is understood that the new owner will improve the plant.

CRESSON, PA.—Arrangements are being made by the American Union Telephone Company to install a new exchange in this city and to establish connections with Loretto, Ashville and other surrounding towns.

ELK LICK, PA.—The Pennsylvania & Maryland Street Railway Company has filed a notice with the Secretary of State of an increase of bonded indebtedness from nothing to $1,000,000.

HUNTINGDON, PA.—The Raystown Water Power Company has filed a notice with the Secretary of State of an increase of capital stock from $5,000 to $750,000; also an increase of bonded indebtedness of the same amount was filed. The company is building a large power plant in Huntingdon, and proposes to furnish electricity to the Pennsylvania Railroad Company and towns in this vicinity.

LEWISBURG, PA.—Extensive improvements are contemplated by the Buffalo Valley Telephone Company to meet the requirements of its increasing business.

NEW CUMBERLAND, PA.—The Borough Council of Goldsboro has accepted a plot of ground along the Little Conewago Creek from Clarence Williams, a business man of the town, for a site for a municipal electric light plant. An ordinance was recently passed appropriating $9,000 for the construction of an electric light plant, work on which will commence at once. The street lighting system will consist of 25 arc lamps.

SOUTH CANAAN, PA.—The Southeastern Telephone Company contemplates the construction of new lines to South Canaan and other points.

GREENVILLE, S. C.—Surveys are being made by the Southern Power Company for its transmission lines from Spartansburg to this city. The company will furnish electricity in this city as soon as its lines are completed.

WALLACE, S. D.—The Wallace Farmers' Telephone Company contemplates the installation of a new telephone system and other improvements to its plant.

BROWNSVILLE, TEXAS.—The power house of the Brownsville Light & Power Company was completely destroyed by fire on April 4, and the streets of the town are in darkness. The plant will be rebuilt as soon as possible.

CHILDRESS, TEX.—The Childress Ice & Light Company, recently incorporated, will install an electric light plant and ice factory. P. C. Maricle is manager.

GOLIAD, TEX.—Plans are being considered by the Chilton Electric Light Company to construct an electric light plant, the cost of which is estimated at $2,100. L. W. Chilton is manager.

HEREFORD, TEX.—A franchise has been granted to Messrs. Obethier & Meadows to construct an electric light plant. The equipment will include a 75-kw, 60-cycle generator and a Corliss engine.

JACKSONVILLE, TEX.—The City Council has granted a franchise for the electric interurban railroad, being promoted by H. L. Norton, of Boston, Mass., through the streets of Jacksonville. The railway will connect Jacksonville and Alto and intervening towns.

HOUSTON, TEX.—The Houston Home Telephone Company has purchased a site for its new telephone exchange in this city. The company proposes to install a cable plant.

MEMPHIS, TEXAS.—Plans are being made to enlarge and improve the local telephone system, including the installation of a new switchboard and erecting additional wires and cables. Horace Gooch is owner of the system.

PORT ARTHUR, TEX.—The Port Arthur Water Company contemplates installing an electric power plant to furnish electricity for motors. It is stated that two units of 1500 hp will be installed.

TAYLOR, TEX.—The Citizens' Light & Power Company has taken over the plant and holdings of the Taylor Electric Light Company. The new company will enlarge the power house and install new machinery. The officers of the company are: T. W. Marse, president; E. A. Robertson, vice-president; C. B. Challenner, secretary, and C. H. Booth, treasurer.

WACO, TEX.—The Brazos Valley Telephone Company is planning to rebuild its plant in Waco, and improve its system in Moody.

FOREST DALE, VT.—The Selectmen have entered into a contract with the Neshobe Electric Company, of Brandon, to light the streets of the village. The contract calls for 45 incandescent lamps of 16 candlepower.

ROANOKE, VA.—The Common Council has awarded the contract for lighting the city for a term of five years to the Roanoke Water Power Company. Under the terms of the contract the company is to furnish arc lamps at $49 per lamp per year. The city is now lighted by the Roanoke Railway & Electric Company at $70 per lamp per annum.

ROCKYMOUNT, VA.—The Franklin County Telephone Company is in the market for 600 cross arms and 2000 insulators.

DAYTON, WASH.—Announcement has been made that the Columbia & Walla Walla Traction Company will commence the construction of part of its road this season. The road will be 80 miles in length and will connect Dayton and Wallau and intervening towns. It is stated that the power station will be located on the Tocannon River. M. C. Moore, of Walla Walla, is president, and J. H. Morrow, of Waitsburg, general manager.

OLYMPIA, WASH.—The Pacific Power & Railway Company has notified the State Land Commissioner that it will apply for condemnation and appropriation of the water of the middle fork of the Toutle River, in Cowlitz County. The water is to be used for power purposes.

SEATTLE, WASH.—Contracts will be awarded by the Board of Public Works within the next 30 days for the iron poles and cluster lamp fixtures for First and Second Avenues from Jackson to Cedar Streets. The cost of the work is estimated at more than $60,000.

TACOMA, WASH.—F. G. Simpson, the electrical engineer, appointed by the city to investigate the municipal electric lighting plant and its operation, recommends that a commission of engineers be appointed to make plans for a city lighting plant with an output of not less than 10,000 horse-power.

WENATCHEE, WASH.—A right of way has been secured by the Entiat Power Company for its transmission line from Entiat to Wenatchee, and construction work will begin in June. Electricity will be furnished to ranches on the Columbia and Entiat rivers.

WHITE SALMON, WASH.—The Town Council has granted a franchise to Messrs. Shepler & Rogers to install an electric lighting plant.

BURKHARDT, WIS.—Plans are being prepared by Edward P. Burch, of Minneapolis, Minn., consulting engineer, for remodeling the electric plant and distributing system of the Burkhardt Milling & Electric Power Company.

CHILTON, WIS.—The State Railroad Commission has denied the petition of the city of Chilton for permission to erect a municipal electric light plant to compete with the Wisconsin Electric Service Company. The Council and the company have not been able to agree for some time. The company offered to sell its plant to the city for $20,000, which it claims is $10,000 less than it cost.

LOYAL, WIS.—The Village Board is in the market for direct-current meters to be delivered in small quantities throughout the year. A contract will probably be awarded on April 23.

MANITOWOC, WIS.—The Newton & Osman Telephone Company will construct a telephone line between Newton and Osman, and install a switchboard in each city.

MILWAUKEE, WIS.—The building committee of the Auditorium Board has decided to recommend the adoption of plans for installing a complete plant to furnish heat and power for the building. The cost of the plant is estimated at $10,000.

SPRING BROOK, WIS.—Plans are being made by N. D. Sergeant for the construction of a rural telephone line from this city north into the Gull Lake territory.

CALGARY, ALB., CAN.—The power and light committee is considering the question of installing an additional engine, which will practically double the output of the civic power plant. For further information address Chairman Creaves. At a meeting held recently the committee made arrangements for another reduction in the price of electricity for lamps.

EDMONTON, ALB., CAN.—Griffin & Company, who are now building a packing plant on the outskirts of this city, will install an electrical generating plant to furnish electricity for lamps, heating and motors in their plant.

EDMONTON, ALB., CAN.—Messrs. Cannel & Spencer have been awarded the contract for the construction of the power house to be built in connection with the general hospital for $40,000. R. P. Barnes is the architect.

LETHBRIDGE, ALB., CAN.—The City Council has decided to engage Cecil B. Smith, C. E., of Toronto, to report on the local power proposition.

RED DEER, ALB., CAN.—The Alberta Government will soon construct a rural telephone line between this city, Edwell and Pibe Hills. S. Edward, of Edmonton, Alb., is superintendent of construction.

WINNIPEG, MAN., CAN.—Arrangements are practically complete for the purchase of the street railway system of Winnipeg by the city. The deal involves a cash outlay of more than $13,000,000 and includes all the equipment owned by the Winnipeg Electric Company, consisting of the electric power plant at Lac du Bonnet, street railway system in Winnipeg, gas plant, substation of the Winnipeg, Selkirk & Lake Winnipeg Electric Railroad. It is understood that the city will be required to buy up all the stock of the company at the Toronto quotations.

FORT WILLIAM, ONT., CAN.—The Bell Telephone Company has submitted a proposition to the Town Council to sell its local telephone plant to the town for $6,000.

OTTAWA, ONT., CAN.—The bill to incorporate the Ontario & Michigan Power Company, giving the company power to develop water power on the Pigeon, Sturgeon and Nipigon rivers, and to export power to the United States was defeated in the Senate railway committee.

GOMEZ DEL PALACIO, MEX.—The F. C. Electric de Lerdo Torreon is contemplating building a new power house in Torreon and installing two 400-hp suction gas units. E. P. Stein, of Gomez Palacio, is manager.

New Industrial Companies.

THE TERRY ENGINE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000. The directors are George H. Terry, C. A. L. Brown and Clifford H. Eagle, of New York, N. Y.

THE BESSEMER GAS ENGINE COMPANY, of Robinson, Ill., has been incorporated with a capital stock of $200,000 by H. B. Willower, of Robinson, Ill. The company proposes to deal in engines and machinery.

THE UNITED ENGINEERING & CONTRACT COMPANY, of Dover, N. J., has been incorporated with a capital stock of $250,000 by T. E. Cheyney, G. H. Evans, of Philadelphia, Pa., and R. B. Kenney, of Dover, Del.

THE ELECTRICITY PUBLISHING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000. The incorporators are: E. Leavenworth, John G. Jackson, and Joel B. Liberman, of New York, N. Y.

THE AUTOMATIC CONSTRUCTION COMPANY, of Houston, Tex., has been incorporated, with a capital stock of $35,000, by F. G. Read, S. P. Kelley and J. S. Slusher. The company proposes to construct an automatic telephone system in this city.

THE GILMORE ARC HEADLIGHT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $3,000 by Alfred C. Gilmore, Roscoe L. Wickes and Frederick Arnd. The company proposes to do a general manufacturing business.

THE MOYER ENGINEERING & CONSTRUCTION COMPANY, of Newark, N. J., has been chartered to carry on a contracting and construction business. The incorporators are: John E. Helm, H. Dye, John G. Van Blarcom, all of Newark, N. J.

THE EBERSOLE CONSTRUCTION COMPANY, of Portland, Maine, has been incorporated, with a capital stock of $200,000, for the purpose of constructing telephone and telegraph lines. E. E. Ebersole is president and E. A. Ebersole clerk, both of Portland, Maine.

THE SHEFFIELD ELECTRICAL COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $5,000, to manufacture gas and electric lamps, fixtures, etc. The incorporators are: William A. Paulson, John L. Pohl, Edward S. Smith and others, of Brooklyn, N. Y.

THE SANDO ENGINEERING COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $25,000, for the purpose of carrying on a general engineering business. The officers are: D. A. Decrow, of Buffalo, N. Y., president; W. J. Sands, of Milwaukee, Wis., treasurer.

AXLE CUSHION & MOTOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $250,000, for the purpose of manufacturing motors, engines, machinery, etc. The incorporators are: Joseph B. Roberts, Leon B. Leavitt, Herbert B. Shonk, and others, of New York, N. Y.

THE WITCH MANUFACTURING COMPANY, of Portland Maine, has been organized with a capital stock of $20,000, for the purpose of doing a mechanical and electrical engineering business. The officers are: James E. Manter, president; Clarence E. Eaton, treasurer, both of Portland, Maine.

THE LUTZ-LOCKWOOD MANUFACTURING COMPANY, of Roselle, N. J., has been incorporated with a capital stock of $100,000 by Richard M. Barwise, Whittemore Dodd and Charles W. Low, of Roselle, N. J. The company proposes to manufacture electric batteries, supplies, motors, vehicles, machinery, etc.

THE CAWLEY-BOETTIGER ENGINEERING COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $15,000, to carry on an engineering and construction business. The incorporators are Philip Boettiger, Michael J. Cawley, Franklin C. Haven, of Brooklyn, and Oscar Storck, of the Borough of Bronx.

THE AUTO-SECURITY EQUIPMENT COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $27,000, for the purpose of manufacturing automobiles, motors, electrical devices, etc. The incorporators are Woolsey A. Shepard, William P. Hammond, Augustus S. Houghton, of New York, N. Y.

THE DELANEY-ROBERTS COMPANY, of New York, N. Y., has been chartered for the purpose of carrying on a general engineering and construction business. The capital stock of the company is placed at $5,000 and the incorporators are Harold B. Roberts, of Pelham; Leonard B. Le Vake and John M. Delaney, of New York, N. Y.

THE EMPIRE EQUIPMENT COMPANY, of Schenectady, N. Y., has been incorporated with a capital stock of $50,000 by P. M. Pfell, of Pittsburg, Pa.; J. H. Van Alstine, Arthur C. Mills, of New York; Charles L. Steinrock and H. W. Bachelder, of Schenectady, N. Y. The company proposes to do a general engineering and contracting business.

THE CENTRAL CONSTRUCTION COMPANY, of Omaha, Neb., has filed articles of incorporation, with a capital stock of $200,000. The purpose of the company is to construct long-distance telephone lines in Nebraska. The incorporators are Charles G. Cockerill, Jefferson, Ia.; C. H. Smith, of Sioux City, Ia., and J. E. Baum, of Omaha, Neb.

THE STANDARD AUTOMOBILE COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing compressed air, electricity and carrying on a general mechanical engineering business. The incorporators are R. H. Stamper, D. H. Goff, of Camden, N. J.; J. W. Stamper, of West Philadelphia, Pa., and R. Miller, of Philadelphia, Pa.

Company Elections.

HUMBOLDT, KAN.—At the annual meeting of the Humboldt-Speiser Telephone Company the following named officers were elected: C. Lionberger, president; J. R. Hunzeker, vice-president; R. F. Conrad, secretary and treasurer.

LOUISVILLE, KY.—At the annual meeting of the Louisville Lighting Company the following named officers were elected: F. M. Sackett, president; Harry Bishop, vice-president; T. B. Wilson, secretary and treasurer.

BALTIMORE, MD.—At the annual meeting of the United Railways & Electric Company the retiring board of directors was re-elected.

MERIDIAN, MISS.—At the annual meeting of the Meridian Light & Railway Company the following named officers were elected: A. J. Patterson, president; W. H. Armbrecht, first vice-president; J. A. Gibson, second vice-president; C. S. W. Price, Jr., secretary and treasurer, and A. B. Patterson, general manager.

MEDFORD, N. D.—At the annual meeting of the Medford Mutual Telephone Company the following named officers were elected: Daniel McKeith, president; A. H. Kellogg, vice-president; M. B. Kellogg, secretary, and William Falter, treasurer.

JEFFERSON, CITY, TENN.—The Citizens' Telephone Company, recently organized, has elected the following named officers: J. V. Cline, president and general manager: R. M. Bales, vice-president; G. A. Moody, secretary and treasurer.

CAMERON, WIS.—At the annual meeting of the Farmers' Telephone Company the following named officers were elected: O. L. Olsen, president; S. E. Severson, vice-president; M. A. Worman, secretary, and J. O. Juve, treasurer.

DALLAS, WIS.—At the annual meeting of the Dallas Farmers' Telephone Company the following named officers were elected: John Borgen, president; M. Casper, vice-president; W. Franzen, secretary, and H. Klemmo, treasurer.

New Incorporations.

BAY MINETTE, ALA.—Articles of incorporation have been filed for the City Ice & Light Company with a capital stock of $20,000. E. G. Nelson is president.

PINE BLUFF, ARK.—The Pine Bluff-Little Rock Transit Company has been organized for the purpose of building an electric railway from Pine Bluff to Little Rock. The officers of the company are: W. F. Campbell, president; B. F. Foreman, of Texarkana, vice-president; Mrs. F. A. Gibson, of Redfield, secretary and treasurer.

WINSLOW, ARK.—The Winslow Telephone & Electric Light Company has filed articles of incorporation, with a capital stock of $1,000. The directors are E. E. Miller, J. H. Smith, J. F. Black, G. A. Winn, V. M. Dunlap and others.

GLENDORA, CAL.—The Glendora Light & Power Company has been formed here, with a capital stock of $20,000, by J. A. Jones, president; H. G. Baker, vice-president, and C. S. Whitcomb, secretary and treasurer. The company will install a plant within 60 days.

GONZALES, CAL.—The Gonzales Electric Company has been incorporated, with a capital stock of $75,000, by H. M. Pitman, of Calistoga; M. C. Clark, of Gonzales, and E. Johnson, of Oakland.

LOS ANGELES, CAL.—The Standard Gas & Electric Company has been incorporated, with a capital stock of $50,000. The directors are: W. S. Cramp, Horace Slater and R. J. Dunn, all of Redlands.

MAYBELL, COL.—The Maybell Telephone Company has been incorporated, with a capital stock of $50,000, by W. T. Stillings, T. C. Smith, B. A. Arbogast and others.

DAHLONEGA, GA.—The Mill Creek Water Power & Mining Company has been chartered with a capital stock of $100,000 by H. W. Gilbert and others. The purpose of the company is to develop water power to generate electricity.

AURORA, ILL.—The Elgin, Woodstock & Lake Geneva Railroad Company has been chartered with a capital stock of $25,000 to construct a railway from Elgin to Raymond. The incorporators are: G. W. Youngs, F. R. Spear and G. H. Bryant.

LORAINE, ILL—The Woodville Telephone Company has been incorporated with a capital stock of $900 by E. P. Poling, John Nelson and Nathan Hopson.

SHANNON, ILL.—The Shannon Telephone Company has been incorporated by G. W. Bolinger, Henry Veitmeier and C. I. Byington.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Indianapolis, Cloverdale & Terre Haute Traction Company by E. M. Bowman, H. F. Metze and Denis C. Rutherford. The company proposes to construct and operate street and interurban electric railways in and connecting Indianapolis and Terre Haute and intervening cities, and also to furnish electricity for lamps, heat and motors. The company is capitalized at $10,000.

TONGANOXIE, KAN.—The telephone systems of Tonganoxie, Basheor and Linwood have been consolidated under the name of the Suburban Telephone Company, for which a charter has been secured, and the following directors elected: W. C. Allen, E. H. Cox, A. A. Jones, J. W. Kemler and F. B. MacKinnon. The company contemplates the construction of new lines in the near future.

FRANKFORT, KY.—Articles of incorporation have been filed for the Concord & Pleasant Hill Telephone Company, of Russell County, with a capital stock of $300.

PORTLAND, MAINE.—The Arizona Power Company has been incorporated, with a capital stock of $4,000,000, for the purpose of furnishing electricity and other power. J. E. Mantor is president and I. A. Sutherland treasurer, both of Portland.

PORTLAND, MAINE.—The Santo Domingo Water, Light, Heat & Power Company has filed articles of incorporation with a capital stock of $1,400,000. A. P. Chickering, of North Andover, Mass., is president of the company.

PORTLAND, MAINE.—Articles of incorporation have been filed for the Upper Iowa Light & Power Company with a capital stock of $305,000. The company proposes to operate light and heating plants. J. E. Manter is president, and C. E. Eaton is treasurer, both of Portland.

BEMIDJI, MINN.—The Plantagenet Telephone Company has been organized by A. H. Jester and others, and plans are being made for the construction of a telephone line from Bemidji to Lake Plantagenet.

CARLISLE, MINN.—The Carlisle Telephone Company has been incorporated, with a capital stock of $2,500, by John J. Tomhave, Jacob J. Tomhave, C. R. Wright and Ferdinand Pergande.

LOWRY, MINN.—The Lowry Telephone Company has been chartered, with a capital stock of $16,000. Peter Engebretson is president of the company.

OSTRANDER, MINN.—The Ostrander-Cherry Grove Co-operative Telephone Company has filed articles of incorporation. The following-named officers have been elected: H. E. Olsen, president; Herman Aarness, treasurer.

COLUMBUS, MONT.—Articles of incorporation have been filed for the Columbus Electric Light & Water Company with a capital stock of $20,000 by James Craig and others.

OKLAHOMA CITY, OKLA.—The Oklahoma-Shawnee Interurban Company has been granted a charter by the Secretary of State with a capital stock of $300,000. The incorporators are: H. M. Wyatt, A. M. Spencer, Stephen Brown, Joseph Brown, and J. A. Stephenson, all of Oklahoma City.

GOLDFIELD, NEV.—The Rawhide Water Power & Milling Company has been incorporated here, with a capital stock of $300,000, by W. Stouford, W. B. Kolman and others.

NEWARK, N. J.—The Federal Electric Company has filed articles of incorporation, with a capital stock of $125,000, for the purpose of generating electricity for heating, lamps, motors, etc. The incorporators are C. Weigand, H. Weigand and J. N. Becker, all of Newark.

GAGE, N. Y—Articles of incorporation have been filed for the Benton Telephone Company, with a capital stock of $1,000, by J. K. Turner, W. D. Beattie and Charles Legg, of Gage, N. Y.

PITTSTOWN, N. Y.—Articles of incorporation have been filed for the Pittstown Telephone Company for the purpose of constructing a telephone line from Pittstown to Brunswick and intervening towns. The capital stock of the company is placed at $500 and the directors are: E. E. Rayner, president; S. W. Humphrey, Paul Sherman, E. L. Dutton, W. B. Sherman, of Pittstown; Edward Everett Welling and T. Brownell, of Tomhannock.

SOCORCO, N. M.—Articles of incorporation have been filed for the Socorco Electric Company to construct, acquire and operate electric plants to furnish electricity for lamps and motors. The capital stock is $30,000. Emmett A. Drake, Morris Loewenstein, A. C. Abeytia and J. G. Fitch are the directors.

WEST BERNE, N. Y.—The West Berne Telephone Company has been chartered, with a capital stock of $2,000. The directors are A. J. Haverly, G. D. Shultes, I. B. Schoonmaker, W. H. Williamson and others.

WILLIAMSVILLE, N. Y.—Articles of incorporation have been filed for the Williamsville Electric Light & Power Company, with a capital stock of $35,000, by Oscar A. Simon, of Williamsville; James D. Ferris, Arthur B. Jenkins, Louis E. R. French and Nelson S. Hallett, of Buffalo.

WILSON, N. Y.—Application has been made for the incorporation of the Wilson Telephone Company, which is to connect with the lines of the Home Telephone Company.

FARGO, N. D.—The Oakport & Kragnes Telephone Company has been organized. A. G. Kassenborg is president of the company.

ELYRIA, OHIO.—The Home Telephone Company has been organized. The capital stock of the company is placed at $10,000.

WARREN, OHIO.—The Hydro-Electric Company has been organized here and will be incorporated, with a capital stock of $100,000, by C. M. Wilkins, O. D. Morgan, D. E. Hoover and C. R. Siegfried, of this city, and Henry Herbert, of Newton Falls. The company proposes to develop water power for the purpose of generating electricity for lamps, motors and electric railways.

WILMINGTON, OHIO.—Articles of incorporation have been filed for the Cincinnati, Wilmington & Xenia Traction Company, with a capital stock of $50,000, by K. H. Grantham and others.

CALUMET, OKLA.—Articles of incorporation have been filed for the Mistletoe Telephone Company, with a capital stock of $800, by Eugene Schaeffer, Elmon Denney, W. S. Meyers, S. K. Booth and M. Vandiver.

FLORENCE, OKLA.—The Kent Rural Telephone Company has filed articles of incorporation, with a capital stock of $850. The incorporators are J. King, A. V. Ray and others.

MUTUAL, OKLA.—The Canadian Valley Railway Company has been incorporated, with a capital stock of $2,000,000, to build an electric railway from Mutual to Oklahoma.

STIDHAM, OKLA.—The Oklahoma Telephone Company has been organized, with a capital stock of $1,000, by V. K. Hill, F. L. Smith and others.

STUART, OKLA.—The A. C. McNally & Brothers Telephone Company has been chartered, with a capital stock of $500, and the following directors: A. C. McNally, W. H. McNally and M. F. McNally, all of Stuart.

LEBANON, PA.—The Bunker Hill Electric Light & Power Company has been chartered, with a capital stock of $5,000. The directors are: Daniel Weaver, treasurer; John S. Weaver, A. Gingrich, Monroe Gingrich, all of Lebanon, and Elias B. Gingrich, of Jonestown.

AMBRIDGE, PA.—A charter has been granted by the Secretary of State to the Ambridge Borough Light, Heat & Power Company with a capital stock of $5,000. The incorporators are: C. R. Wilson, treasurer; T. K. Bevington, George N. Martin, all of Pittsburg, Pa.

WARRINGTON, PA.—The Warrington Mutual Telephone Company has been organized to install a telephone system in the town.

ARMOUR, S. D.—The Armour Telephone Company has been incorporated, with a capital stock of $25,000.

BISHOPVILLE, S. C.—The Bishopville Telephone Company has been chartered, with a capital stock of $5,000. The following-named officers have been elected: Thomas G. McLeod, president; Robert Shelor, secretary and treasurer.

FAIRVIEW, S. D.—Articles of incorporation have been filed for the Fairview Center Telephone Company and the following officers elected: E. O. Swenson, president; Stein Larsgaard, vice-president; Carl Ammson, secretary, and Miner Sorum, treasurer.

GORDONSVILLE, TENN.—A local telephone company has been organized to build a telephone line to Hickman, a distance of two and one-half miles, to connect with the exchange at that place. The officers are: W. A. Davis, president; J. D. Rives, secretary, and J. F. Gwaitney, treasurer.

AMARILLO, TEX.—The Glenwood Electric Park Company has been incorporated with a capital stock of $20,000 by H. A. Nobles, J. C. Paul, John G. Hartman and others.

TRENT, WASH.—Articles of incorporation have been filed for the Trent Water Power by J. A. Narup, M. G. Narup and R. J. Benson. The company proposes to furnish water for irrigation purposes and to build power plants. The capital stock of the company is placed at $10,000.

TACOMA, WASH.—The Bremerton-Charleston Light & Fuel Company has been incorporated, with a capital stock of $70,000, by F. C. Brewer and T. L. Stiles.

MYRA, W. VA.—The Lincoln County Telephone Company has been incorporated, with a capital stock of $25,000, by T. B. Snodgrass, W. E. Tabor, W. F. Black, J. E. Morgan, David Miller, of Myra; A. W. Stone and A. F. Kranklin, of Sheridan, and others.

MAY, WIS.—An Independent Telephone Company has been organized in this city. The officers are: Peter Witherby, president, and O. Engberg, treasurer.

PIGEON FALLS, WIS.—The Pigeon Valley Farmers' Telephone Company has been incorporated, with a capital stock of $10,000, by S. D. Simrod, J. J. Staff, A. N. Anderson and others.

RHIENLANDER, WIS.—The Langlade Power Company has been organized by E. A. Forbes, C. A. Wixson and A. W. Shelton, of Rhienlander, and E. T. Sherry, of Milwaukee, for the purpose of developing water power on the Wolf River, 24 miles from Antigo. It is proposed to develop 4000 hp and to build a transmission line to Antigo to supply electricity in that city for motors.

LUTHER, WYO.—Articles of incorporation have been filed for the Pioneer Telephone Company for the purpose of building telephone lines between Hillsdale, Luther, Egbert, Pine Bluffs and Carpenter. The officers of the company are: George N. Brady, president and general manager; M. J. Wragg, vice-president; Henry D. Colburn, secretary, and S. D. Schultz, treasurer.

Legal.

RECEIVER FOR TELEPHONE COMPANY.—Vice-Chancellor Howell, sitting in Newark, N. J., has appointed Frederick T. Johnson, of Newark, receiver for the United States Independent Telephone Company, of Rochester, N. Y., recently declared insolvent.

RECEIVER FOR GAS AND ELECTRIC COMPANY.—F. L. Hay has been appointed receiver for the People's Gas & Electric Company, of Defiance, Ohio. The application for a receiver was made by the Guardian Savings & Trust Company, of Cleveland; the Anderson Coal Company and the Lorain Coal & Dock Company.

RECEIVER FOR CONSUMERS' ELECTRIC COMPANY.—Samuel Insull, president of the Commonwealth Edison Company, of Chicago, Ill., has been appointed receiver of the Consumers' Electric Company, of New Orleans, La., with a capital stock, bonds and other obligations aggregating about $2,500,000. The receivership was asked for by the National Conduit Cable Company, of New York, N. Y., holder of $2,080,000 first mortgage bonds of the company. The petition for the receivership states that the company had defaulted in payment of interest due on bonds.

FEDERAL DISTRICT MAKES INJUNCTION AGAINST DETROIT ORDINANCE PERMANENT.—Judge Swan, of the United States District Court, April 6 made permanent an injunction restraining the city of Detroit from enforcing the Hally ordinance, which would have compelled the United Railway to operate its cars on streets where franchise right have expired under regulations which provide for the sale of five tickets for 15 cents, universal transfers, the payment of taxes on an ad valorem basis and caring for the paving between tracks and the foundations under the rails. The city will appeal.

DUTY OF ELECTRIC LIGHT COMPANY TO PERSON NOT IN ITS EMPLOY.—An electric light company owes a duty to exercise a proper degree of care to prevent a dangerous current from entering a house taking its service and endangering any one who may rightfully be upon the premises; and for an injury received the company is directly responsible, although the owner of the house may also own the wires therein. In a case involving this proposition of law a workman engaged in installing a furnace was killed by contact with the lighting fixtures. It appeared that the transformer used to reduce the current before it entered the building had become out of order, and that although defendant had been notified of the fact some hours before, it had done nothing to remove the danger. The deceased was told by a fellow workman that an employee of the owner had received a shock when turning on a light, that the company had been notified, and had sent an expert who had left some two or three hours before. There was evidence tending to show that deceased attempted to turn on the light in order to see better in finding his tools. It was held that the question of his contributory negligence was properly left to the jury, and that their verdict against the company would not be disturbed, it not appearing but that the workman might well have supposed that the trouble with the lights was trifling, and had been fully remedied by the defendant's expert. Union Light, Heat & Power Co. v. Arnston, United States Circuit court of Appeals, 157 Fed. Rep. 540.

Personal.

MR. GEORGE G. WARD, vice-president of the Commercial Cable Company, is leaving with Mrs. Ward for Lisbon, Portugal, to attend the forthcoming submarine cable conference, which apparently will be held in spite of the recent political troubles there.

MR. JOHN B. OLMSTEAD, of Buffalo, N. Y., has been appointed by Governor Hughes a member of the Public Service Commission in the Second District in place of Mr. Charles H. Keep, who recently resigned to accept the presidency of the Knickerbocker Trust Company, of New York, N. Y.

MR. GEORGE L. COLLINS, formerly general manager of the Consolidated Gas & Electric Company, of Batavia, N. Y., has been appointed manager of the Ontario Light & Traction Company and the Canandaigua Gas Light Company, of Canandaigua, N. Y., and will assume management of the properties May 1.

MR. W. H. HORTON, who recently resigned as superintendent of the Rutland Railway, Light & Power Company, of Rutland, Vt., has accepted a position as assistant superintendent of the Atlantic, Gulf & Pacific Construction Company, of New York, N. Y., which now has charge of construction work on the canal at Whitehall, N. Y.

MR. WILLIAM H. DONNER has been elected vice-president of the Westinghouse Machine Company, of Pittsburg, Pa., which was taken out of the receivers' hands a few days ago. A circular has been issued by President George Westinghouse announcing Mr. Donner's election and stating that the latter will have direct charge of all the company's activities.

MR. VICTOR L. SCOTT, of San Antonio, Tex., who brought out some very effective literature not long ago showing electric light managers how to meet gasoline competition has just recovered from a severe illness due to overwork. He is proposing to seek a change of climate, and will probably engage in some commercial department of the work in the Northwest.

MR. E. B. DOEN, superintendent of the Syracuse Lighting Company, of Syracuse, has resigned his position to go into the electrical contracting business. Mr. Doen has been in the employ of the company for over 21 years. He intends to open a place of business in this city in the near future. Mr. M. G. Kennedy, who was formerly assistant inspector of plants, succeeds Mr. Doen.

MR. E. E. KELLER, for over 20 years connected with the Westinghouse interests and for 14 years vice-president of the Westinghouse Machine Co., having completed his duties as receiver and general manager, severed his connection with the management of that company on the first of this month. Mr. Keller will take a much needed rest and will then devote most of his time to several personal interests.

MR. S. E. WOLFF, vice-president and general manager of the Saginaw Valley Traction Company, which controls all the gas, electric and traction companies of Saginaw and Bay City, Mich., has resigned to accept a more responsible position with Hodenpyl, Walbridge & Company, of New York, N. Y., who own the local corporations. Mr. Wolff will be succeeded by Mr. John F. Collins, at present general superintendent of the Toledo Railway & Light Company, of Toledo, Ohio.

Obituary.

MR. ALBERT K. HISCOCK died at his home in Syracuse, N. Y., April 7. He was 47 years old and was vice-president of the Trust & Deposit Company, of Onondaga, and treasurer of the Auburn & Syracuse; Rochester, Syracuse & Eastern; Syracuse, Lake Shore & Northern, and Syracuse & South Bay railways, and a managing director in the Auburn & Northern Company; Oswego Traction Company; Monroe County Belt Line, and Skaneateles Lake Transportation Company. He was also a director of the construction companies building the electric railway lines.

Trade Publications.

OUTLETS AND BUSHINGS, which correspond to the National Code Standard, are listed in a bulletin of the Steel City Electric Company, Pittsburg, Pa.

TIME RECORDERS.—The Calculagraph Company, 9 Maiden Lane, New York, has issued an interesting article by Mr. R. W. Higgins on cost accounting in factories. This article contains many hints of value to those engaged in estimating cost of labor in factory products.

ELECTRICAL SPECIALTIES are listed, illustrated and briefly described in the latest catalogue of the Tregoning Electric Manufacturing Company, Cleveland, Ohio. The catalogue covers porcelain receptacles, rosettes, attachment plugs and "lobster-claw" battery connections.

LIFTING MAGNETS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued an exceptionally well-illustrated catalogue describing various types of lifting magnets and their uses. The last three pages of the catalogue contain a partial list of users of the magnets.

INCANDESCENT LAMPS.—Publication No. 575, of Veritys, Ltd., Aston, Birmingham, England, is devoted to the "Atonlite" system of illumination. The apparatus consists of a metal trough, with sides containing panels of white opal reflector glass, in front of which is a straight-filament incandescent lamp.

COPPER HISTORY.—The Wire & Telephone Company of America, Rome, N. Y., has recently issued a "Copper History" folder giving the monthly and yearly average selling prices of copper since 1883. A copy will be forwarded to anyone for the asking.

PENNSYLVANIA TUNNELS.—The United Engineering and Contracting Company, 32 East Thirty-third Street, New York, has issued a well prepared illustrated description of the main features of the engineering work of the Manhattan crosstown tunnels of the Pennsylvania Railroad, now under construction.

AMMONIA RECOVERY GAS PLANTS are fully described and attractively illustrated in a bulletin issued by Crossley Bros., Ltd., 10 S. Bride Street, Ludgate Hill, E. C., London, England. It is stated that ammonia recovery apparatus can be used economically with gas plants burning at least 100 tons of coal per week.

WORCESTER POLYTECHNIC INSTITUTE.—The thirty-eighth annual catalogue of the W. P. I. states that the total present student registration is 465; 146 of these students are freshmen. Of the remaining students, 101 are in the electrical engineering department. The total number of students registered to date is 2337, 1195 of whom have graduated.

DIRECT-CURRENT MOTORS rated at from 10-hp to 105-hp of the open type, and from 7.5-hp to 50-hp of the enclosed type, are listed and described in Bulletin No. 224, of the Sprague Electric Company, 527 West Thirty-fourth Street, New York. Bulletin No. 310 deals with motors for operating ventilating fans and blowers.

MOTOR-DRIVEN AIR-PUMPS and various other medical devices are described in a well-illustrated catalogue recently issued by the Globe Manufacturing Company, Battle Creek, Mich. A folder of the same company is devoted to a variable ratio alternating-current transformer for use with electric cautery knives and diagnostic lamps.

CENTRIFUGAL AIR COMPRESSORS rated at from 750 to 10,000 cu. ft. of free air per minute at pressures ranging from .88 to 4.0 lb. per square inch are described in Bulletin No. 4564 of the General Electric Company. Low maintenance and repair, high-efficiency in operation and minimum required floor area are claimed for these compressors.

STANDARD WIRE SYMBOLS.—The Allis-Chalmers Company has prepared, with the permission of the National Electrical Contractors' Association, a reprint of the standard wiring symbols which have been adopted by that association for use in wiring specifications. A copy of this bulletin will be sent to anyone interested, upon receipt of a request.

STEAM GAGES AND VALVES, indicators and kindred appliances for governing, indicating, measuring, recording and controlling steam, water, air, gas, oil or ammonia are thoroughly covered in a handsome 247-page catalogue bound in cloth, recently issued by the American Steam Gauge & Valve Manufacturing Company, 208 Camden Street, Boston, Mass.

Unclassified Items.

QUINCY, MANCHESTER, SARGENT CO., of Plainfield, N. J., will discontinue the manufacture of the line of pneumatic compression riveters it acquired at the time of purchasing the Pedrick & Ayer business, and has disposed of this entire line to the Hanna Engineering Company, of Chicago. This measure was decided upon in order that all effort may be concentrated on the company's lines of metal sawing machines, cranes, hoists and car steps.

THE CROCKER-WHEELER COMPANY, on April 24, will move across the street to new quarters at 32 Cortland Street in the Cortlandt Building, Hudson Terminal. The new location is of special convenience to the Crocker-Wheeler Company, as it brings its New York Office into closer touch than ever with the works and main office at Ampere, N. J.

CHICAGO, ILL.—At the annual meeting of the Chicago & Milwaukee Electric Railway Company the following named officers were elected: A. C. Frost, president; H. C. Osborn, of Toronto, Ont., vice-president; Pierce G. Beach, secretary, and W. O. Kilman, treasurer.

INDIANAPOLIS, IND.—At the annual meeting of the Indianapolis Street Railway Company the following officers were elected: George Brown, president; J. A. Lemcke, first vice-president; James S. Neff, of Philadelphia, Pa., second vice-president; Henry Jameson, secretary and treasurer.

RICHMOND, VA.—Plans are being considered for the construction of an electric railway from Fulton to Warwick Park, located five miles below Richmond. It is reported that the railway will be constructed by the South Richmond Railway Company, which was incorporated in 1902. The cost of the road is estimated at $100,000, work on which will commence as soon as the right of way is secured. Tentative arrangements have been made with the Virginia Passenger & Power Company for electrical energy to operate the road, which will be supplied from the Twelfth Street power house. Col. C. P. E. Burgwyn is engineer of the proposed road.

CALUMET, MICH.—Plans are being considered by the Calumet & Lac la Belle Traction & Power Company to construct an extension of its railway from Calumet across the Centennial Heights to the shore of Lake Superior.

GRAFTON, ILL.—Plans are being prepared for the construction of an electric light plant and water works system, the cost of which is estimated at about $22,000. W. S. Merkel, 1106 Pine Street, St. Louis, Mo., is the engineer.

MARQUETTE, MICH.—It is stated that the Marquette County Gas & Electric Company is planning to extend its electric railway from Negaunee to Marquette, a distance of 12 miles.

CLARKSBURG, W. VA.—Surveys are being made for the extension of the Fairmont & Clarksburg Traction Company's system from Grasselli to Bridgeport.

AMERICUS, GA.—The Americus Railway & Light Company has awarded a contract to Kite & Wilson, of Columbus, for the construction of a power house.

ST. VINCENT, MINN.—It is proposed to erect a farmers' telephone system in this vicinity at a cost of about $10,000. T. M. George is interested in the project.

COLORADO SPRINGS, COL.—Arrangements are being made by the Central Colorado Power Company to resume operations on all outside work at an early date. The company temporarily suspended work last fall, owing to the closing of the Knickerbocker Trust Company, of New York, N. Y.

NEW HAVEN, CONN.—At the annual meeting of the Connecticut Railway & Lighting Company the following named officers were elected: A. M. Young, of Branford, president; R. A. C. Smith, of New York, N. Y., first vice-president; Randal Morgan, of Philadelphia, Pa., second vice-president; W. S. Douthirt, secretary, and Lewis Lillie, of Philadelphia, Pa., treasurer.

FORT GIBSON, OKLA.—The Grand River Light & Power Company, recently incorporated, has placed contracts for the construction of its plant, to cost about $15,000.

TOPEKA, KAN.—The citizens on April 7 voted to issue bonds not to exceed $65,000 for repairing the municipal electric light system.

SPENCER, IND.—Articles of incorporation have been filed for the Spencer Light, Power, Heat & Water Company with a capital of $75,000, by Laurent Lowenberg, of Cincinnati, Ohio; Carl J. Keefer and others.

MOBILE, ALA.—John T. Cochrane, 614 City Bank Building, Mobile, would like to receive prices on dynamos and electrical outfit for plant to furnish electricy for 300, 500 and 750 lamps respectively.

Business Notes.

THE GREGORY ELECTRIC COMPANY, Chicago, reports a marked increase in its business during the last six weeks and that at present its trade is as large as at any time during the boom year of 1907.

MR. HORACE WINTHROP SCANDLIN, formerly assistant advertising manager of the Edison Electric Illuminating Company, of Brooklyn, is with the Siegfried Advertising Agency, of New York City

THE FLEMING-HARRISBURG engines sold by Mr. A. M. Morse, manager of the Chicago office of that concern, will be found operating the electric plants of the Auditorium Hotel and Annex and the Fine Arts Building, where the National Electric Light Convention meets in May. A large number of these engines can be found in isolated plant service elsewhere in Chicago.

FLAMING ARC LAMPS FOR TOWER CLOCKS.—The Excello Arc Lamp Company, 24 East Twenty-first Street, New York, makes a specialty of flaming arc lamps for indoor use. A rather novel application of such lamps is found in the tower of the Lackawanna Terminal at Hoboken, N. J. where two lamps are connected to the alternating-current circuit for illuminating the clock dials at night. One of the chief requirements is reliability of operation with a minimum of attention. To obtain this incandescent lamps were first installed, but owing to the thickness and quality of glass used and the height of the tower the number on the dial could not be seen. Excello flaming arc lamps were then tried with success.

MAC GOVERN, ARCHER & CO. have just made arrangements to move into their new warehouse and shop on Carbon Place, near West Side Avenue, Jersey City. This is a most convenient and high grade constructed factory building with adjoining lots and outbuildings covering approximately two acres of land. The main factory building has an area of 10,000 sq. ft. on one floor, which is of heavy concrete suitable for the storage of heavy machinery. The entire property has a direct siding off the C. R. R .of N. J., which makes it most convenient for the receiving and shipping of heavy apparatus, such as the company handles largely. One of the attractions of the factory is its accessibility, it being within 20 minutes' time from New York City. This company announces that it is about to move into commodious quarters in the Engineering Building, 114 Liberty Street, in the offices formerly occupied by the International Steam Pump Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 7, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

883,756. HEAT RADIATOR FOR HYDROCARBON AND OTHER HEAT MOTORS; Klaus J. Steiner, Pittsburg, Pa. App. filed Dec. 28, 1906. A process of making the radiator of automobiles by electrolytic process, so as to provide a copper lining which resists the solvent effects of the hot water.

883,760. SYSTEM OF DISTRIBUTION; Lewis L. Tatum, Norwood, Ohio. App. filed Feb. 19, 1906. Relates to multiple voltage systems of distribution in which balancers are employed for supplying current to the branches of the system which carry the heaviest currents, to maintain the voltages of the branches at their proper predetermined values.

883,777. CLUSTER LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed April 14, 1904. A cluster socket of the type having a porcelain base from which projects downward a pair of concentric hemispherical cups and which support the threaded shells. The center contacts are supported directly on the base.

883,822. DYNAMO ELECTRIC MACHINERY; Charles Algernon Parsons, Newcastle-upon-Tyne, England. App. filed April 23, 1906. An armature winding having a wrapping of tape containing strips of metal of high thermal-conductivity interposed between the separate conductors of the coils.

883,823. INSULATOR SUPPORT; Charles L. Peirce, Jr., Elkhart, Ind. App. filed Aug. 19, 1907. Makes use of a U-shaped strip having legs or prongs arcuate in transverse section and fitting closely around a central supporting pin.

883,829. AUTOMATIC SIGNALING MECHANISM; Josef Reuter, of Rochester, N. Y. App. April 15, 1907. A signal transmitter having a clock-driven gear train including a plurality of cam cylinders which operate to transmit a particular sequence of signals corresponding, for example, to the box number of a fire alarm.

883,701. SWITCHING DEVICE; James A. Duffy and Oscar Irwin, Pittsburg, Pa. App. filed Jan. 19, 1904. An electrical track switch of the type in which the motorman may cause a selective operation by the action of his controller. Has semaphore signal features to indicate the positions of the switch point.

883,723. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed July 12, 1907. Relates to telegraph and telephone signaling in proximity to a power circuit having inductance effects. Makes use of a special return conductor for the power circuit connected through condensers with the telephone wires so as to neutralize the induction effects therein.

883,724. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed July 18, 1907. Relates to modifications of the above.

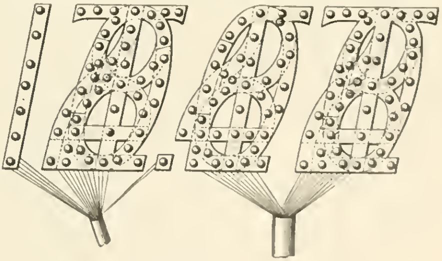
883,725. WORKING OF ELECTRIC VAPOR LAMPS; Richard Küch, Hanau, Germany. App. filed Dec. 7, 1905. The method of working gas or vapor electric lamps having mercury electrodes which consists in applying to said electrodes an electric potential of not less than twenty-five volts per centimeter of the length of column of light.

883,846. ELECTRICAL MULTIPLE INFLUENCE OR CONDENSER MACHINE; Heinrich Wommelsdorf, Charlottenburg, Germany. App. filed Feb. 28, 1905. A Wimshurst static machine in which the plates or segments are imbedded in the insulating disk so as to prevent sparking across. The disks are employed in series and the segments are connected by metallic pins extending throughout the entire series.

883,919. REACTIVE COIL; Charles P. Steinmetz, Schenectady, N. Y. App. filed May 19, 1906. The combination with a vapor electric device, of reactive means connected thereto, and means for retarding the drop of current in said reactive means.

883,924. ARC LAMP ELECTRODE; William S. Weedon, Schenectady, N. Y. App. filed April 21, 1903. An electrode consisting of titanium carbid incased in a copper sheath.

883,943. REVERSE CURRENT CIRCUIT BREAKER; Charles E. Eveleth, Schenectady, N. Y. App. filed May 25, 1904. Relates to circuit breakers, and more particularly to means for automatically opening the breaker when the direction of the current flow through the main circuit is reversed. Provides means operated by the field adjacent to the circuit breaker contact for controlling the action of a tripping mechanism.



883,992—Electric Time-Indicating Device.

883,944. ELECTRIC LIGHTING; Walter C. Fish, Lynn, Mass. App. filed Dec. 8, 1904. A means for supplying the red rays which are desirable in mercury vapor lamp illumination. For this purpose the mercury vapor lamps shine upwardly against an opalescent reflector behind which is provided a bank of incandescent lamps, the rays from the two sources being thereby blended.

883,956. MOTOR STARTER; Albert J. Horton, White Plains, N. Y. App. filed June 13, 1906. Compound motor starter having means whereby it is impossible for the operator to leave the starting lever in an intermediate position and weaken the field circuit with the resistance still included in the armature circuit.

883,961. ELECTROMETALLURGICAL PROCESS FOR EXTRACTING COPPER FROM ITS ORES; Lucien Jumau, Paris, France. App. filed Jan. 19, 1907. The herein-described electrolyptic process for obtaining pure copper from its ores, which consists in lixiviating the ores with an ammoniacal solution, precipitating the copper from said solution in the form of a precipitate containing cuprous sulfite, dissolving said cuprous sulfite in an ammoniacal solution, and in subjecting said last solution to electrolyptic action in the presence of carbonate of ammonia.

883,964. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; Harry N. Latey, New York, N. Y. App. filed Jan. 19, 1904. A signaling system actuated automatically whenever the potential in a section shall have fallen to a predetermined point, thereby warning the operators of trains approaching the section of its condition.

883,992. ELECTRIC TIME-INDICATING DEVICE; William F. Wentz, New York, N. Y. App. filed Dec. 22, 1904. An electric sign and mechanism for operating the same, particularly adapted to display time indications in numerals denominating hours and minutes. The composite figure formation is especially adapted to this particular purpose, consideration being given to the fact that certain figures never occur in in the tens of the minute numerals or in the tens of the hour numerals. The circuit controlling mechanism includes an hour drum and a minute drum having pins which engage spring blades to move them into circuit closing relation.

884,002. CONTROLLER FOR ELECTRIC MOTORS; Thomas E. Barnum and Henry H. Cutler, Milwaukee, Wis. App. filed June 18, 1902. A motor for controlling electric elevators having means to prevent the admission of current to the motor until all of the starting resistance is in circuit, and to prevent operating the motor for any length of time with any of the resistance in the circuit of the motor.

884,007. TRAIN CONTROL FOR ELECTRIC ACCUMULATOR LOCOMOTIVES; Otto Böhm, Berlin, Germany. App. filed Aug. 6, 1907. A control mechanism for accumulator locomotives in which the control of any number of locomotives coupled together can be effected from a single controller. Each car has a motor and a battery, and the controllers of locomotives which have no drivers are all set to full speed.

884,015. ELECTROLYTIC CELL; Albert S. Gray, Chicago, Ill. App. filed March 15, 1906. Electrolytic cell for the treatment of ores, adapted to provide for the rapid escape of gases that would otherwise prevent the proper passage of the current through the cell.

884,018. INCUBATOR ALARM; Fremont R. Harris, Kenmare, N. D. App. filed May 22, 1907. A form of thermostat having a vane poised above the chimney of the lamp and operating to close an alarm circuit when it is no longer held elevated.

884,021. APPARATUS FOR MAKING COPPER; Marcel A. Jullien and Emile L. Dessolle, Levallois-perret, France. App. filed April 4, 1907. An apparatus of the class described comprising, in combination a receptacle for the electrolytic bath, an actuated member on which the metal is deposited, a carriage movable with respect to said member, a polisher pivotally mounted on said carriage and bodily removable abreast of said member, and means mounted on said carriage for imparting movement of the polisher about its pivotal mounting.

884,028. ACCUMULATOR PLATE; Michail Margulis, Odessa, Russia. App. filed June 7, 1907. A form of accumulator plate designed to prevent distortions during charging and discharging. Makes use of a frame with depending corrugated lead strips, which are kept in alignment by transversely extending rods of hard lead.

884,047. AUTOMATIC ALARM SYSTEM; John E. Shepherd, Chicago, Ill. App. filed Jan. 13, 1908. Automatic alarm system adapted to supervise the heat conditions in an area to be protected, and to respond by the initiation of an alarm to sudden rises in temperature.

884,049. PNEUMATIC HOLDER FOR COMMUTATOR BRUSHES; Charles William Speirs, Battersea, London, England. App. filed Feb. 23, 1907. A holder for a commutator brush having a piston in communication with a source of air pressure. The piston has a rubber diaphragm of peculiar construction, to avoid packing rings.

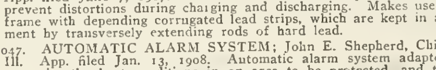
884,066. AUTOMATIC ALTERNATING CURRENT CONTACT APPARATUS; Charles Eugen Lancelot Brown, of Baden, Switzerland. App. filed Nov. 7, 1903. Has an electro-magnet and a non-magnetic rotatable disk from which depend a weighted cord. In case the disk revolves, the cord drops and closes an electric circuit.

884,070. SPACE TELEGRAPHY; Sewall Cabot, Brookline, Mass. App. filed Nov. 13, 1906. In a space telegraph system, a sonorous circuit, a normally closed power circuit, a normally open intermediate circuit connecting said sonorous circuit with said power circuit, and means for controlling said normally open circuit, and means comprising a switch having a plurality of series-contacts.

884,071. SPACE TELEGRAPH; Sewall Cabot, Brookline, Mass. App. filed Dec. 31, 1906. In a system of space telegraphy, an elevated conductor system comprising a laterally extending conducting surface having its inner portion cut away and its perimeter large compared with its distance above the earth.

884,074. ATTACHMENT FOR TROLLEY POLE CLAMPS; Curtis W. Clark and Charles E. Yingling, of Eaton, Ind. App. filed Jan. 13, 1906. Has a pair of clamping plates adapted to surround a trolley pole, and a supplemental plate operatively connected to said clamping plates and provided with means for producing a clamping movement between said two plates.

884,075. ELECTRODEPOSITION OF IRON: Sherard O. Cowper-Coles, London, England. App. filed Sept. 16, 1907. The process of obtaining the electro deposition of iron, which consists in forming an electrolyte from a substance containing iron, and in maintaining the electrolyte charged with iron, substantially as described.



884,007—Train Control.

884,076. SPACE TELEGRAPHY; Ernest R. Cram, Cambridge, Mass. App. filed May 7, 1906. In a space telegraph receiving system, an elevated receiving conductor system; a resonant receiving circuit attuned to the frequency of the waves the energy of which is to be received; and a series of circuits, interposed between said elevated receiving conductor system and said resonant receiving circuit and each having a pronounced natural rate of vibration different from that of said resonant receiving circuit, the first circuit of said series being tightly coupled to said elevated conductor system.

884,102. ELECTRIC LAMP SOCKET; Mortimer Norden, New York, N. Y. App. filed March 4, 1907. An incandescent electric socket for use with electric signs for decorative purposes. Has a porcelain block adapted to be screwed on the rear of a sheet metal plate having a socket portion in alignment with an opening in such plate.

884,106. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed May 7, 1906. Has a plurality of inductively related oscillation circuits in a succession of series between the aerial and the detector.

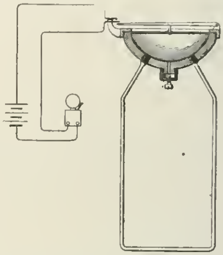
884,107. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed Aug. 3, 1908. In a space telegraphy receiving system, an elevated conductor system comprising a parallel branch circuit including capacity in one branch and inductance in the other branch, an elevated conductor and an earth connector; said elevated conductor and earth connector being connected in parallel with respect to said parallel branch circuit.

884,108. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed Aug. 3, 1906. Relates to modifications of the above.

884,109. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass. App. filed Aug. 3, 1906. Relates to additional modification of the above.

884,110. SPACE TELEGRAPHY; John S. Stone, Cambridge, Mass., and Sewall Cabot, Brookline, Mass. App. filed Jan. 4, 1907. Covers further modification of the above.

884,116. ELECTRIC IGNITION SPARK COIL FOR GAS OR VAPOR ENGINES; E. Q. Williams, Syracuse, N. Y. App. filed Dec. 28, 1904. Relates to several features of induction coils, including a form of vibrator clamping and also certain metallic locking screws by which the electrical connections are made when a coil unit is dropped into and clamped in its receiving box.



884,047—Automatic Alarm System.

884,121. AUTOMATIC ELECTRIC ALARM FOR BEDS TO BE OCCUPIED BY PATIENTS, SUCH AS HOSPITAL BEDS; Frank Apold, of Philadelphia, Pa. App. filed Aug. 4, 1906. Automatic electric alarm for use in hospital beds to indicate movements of the patient which should be called to the attention of the physician.

884,124. PROCESS FOR THE LECTROLYSIS OF FLUID SALTS OR COMPOUNDS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed Jan. 2, 1907. A process for dissociating alkali salts or compounds into their acid and basic constituents by electrolysis.

884,129. ELECTRIC SIGNAL; Arthur J. Cleveland and Frank S. Brown, Minneapolis, Kansas. Makes use of a special trolley conductor adjacent the track rail and which is engaged by a shoe depressible by a lever in the locomotive cab.

884,130. ELECTRIC TIME SWITCH; James Joseph Coachman, London, England. App. filed July 18, 1905. A device whereby an electric contact is made or broken after the lapse of a given time. Makes use of a weighted piston which has its movement impeded by a fluid.

884,142. INSULATOR; Ernest Jay Foreman, Trinidad, Col. App. filed Nov. 2, 1906. A cylindrical porcelain insulator deeply grooved on one side to receive the line conductor, and having additional grooves in which binding wires are received.

884,158. SYSTEM OF AUTOMATIC BLOCK SIGNALING FOR ELECTRIC RAILWAYS; Winthrop K. Howe, Buffalo, N. Y. App. filed Sept. 28, 1906. A signaling system having an alternating current generator and separate means connected therewith to produce a difference of potential across the rails and a continuity current along the rails of a block section.

884,170. THIRL RAIL ELECTRIC RAILWAY SYSTEM; Charles Kozesnik, of ———. App. filed Dec. 17, 1907. A form of third rail for electric systems, having insulated sections, which are energized during the passage of a train by switches which are actuated magnetically.

884,224. RAILWAY SIGNAL; John S. Sims, Longbeach, Cal. App. filed March 22, 1907. Mechanical features of a semaphore signal having an oscillating arm moved through a rack and pinion connection with the armature of an electromagnet. Circuits are shown adapted to illuminate a signal lamp.

884,235. RECEIVER FOR TELEPHONES; Louis Steinberger, New York, N. Y. App. filed Feb. 18, 1907. A form of bi-polar telephone receiver having a cap which automatically locks itself in its tightened relation so that it cannot be unscrewed by unauthorized persons. Has a special form of resonance sound chamber.

884,264. STORAGE BATTERY; Georgie A. Carpenter, New York, N. Y. App. filed April 4, 1907. A form of storage battery plate making use of a lead inclosing box filled with active material. The arrangement is designed to give an equal area in the positive and negative plates.

884,271. ELECTRIC LIGHT SOCKET; Franz Frankofski, North Braddock, Pa. App. filed Sept. 12, 1907. Requires a special incandescent lamp and receiving socket. The parts have co-operating pawls or dogs which secure an interlocking engagement which cannot be released without breaking the bulb.

884,296. ELECTRIC CURLING IRON; Clara A. Richards, Portland, Ore. App. filed Oct. 15, 1907. The bar of the curling iron is made hollow and contains a resistance element adapted to an incandescent lamp circuit. Has a detachable plug connection with lamp circuit.

884,304. FIRE ALARM; Albert S. Trask, Concord, N. H. App. filed May 14, 1907. A thermostat for fire alarm systems including a pair of spring blades which are held apart by a strip of solder which will melt and permit the engagement of the blades in case of fire.

884,312. ELECTRICAL CONNECTOR; James L. Carnall, New York, N. Y. App. filed Dec. 14, 1907. A device for tapping-in an electrical device or instrument; for example, an extra or special key in a telegraph system. Relates to mechanical features of construction.

884,343. ELECTRIC WATER HEATER; Herbert N. Roche, San Francisco, Cal. App. filed March 28, 1907. A cylindrical casing is made part of the water circulatory system and contains an interior cylindrical chamber having resistance coils. The device includes an electric lamp which glows whenever the current is turned on.

884,345. CONTROLLER; Emmett W. Stull, Norwood, Ohio. App. filed Oct. 26, 1907. Has two blow-out magnets, the pole pieces of which form bearings for the controller shaft.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN

VOL. LI. NEW YORK, SATURDAY, APRIL 25, 1908. No. 17.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE..............................1015 Schofield Building
PHILADELPHIA OFFICE.......................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico........................per year, $3.00
Dominion of Canada...4.50
Other Foreign Countries within the Postal Union...................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,500 copies are printed.*

NEW YORK, SATURDAY, APRIL 25, 1908.

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OVERSHOOTING OF TUNGSTEN INCANDESCENT LAMPS.

When we connect a carbon-filament lamp of the ordinary non-graphitic type to constant-potential mains, the initial resistance of the filament is about twice the resistance at the final working temperature, and hence the initial heating power developed in the filament is only about half the final steady heating power. This condition prolongs the interval of temperature elevation in the filament, or the interval between closing the lamp circuit and the attainment of substantially full incandescence. This period is, however, very short under practical conditions, being only a fraction of a second, but it is appreciable to the eye. The eye recognizes that there is a rise in brilliancy, or that the brilliancy is less at first perception than after the first second. In the case of a metallic-filament lamp, and particularly in the case of a tungsten-filament lamp, the initial resistance may be five times less than the resistance at the final working temperature. Consequently, the initial heating power developed in the filament may be about five times the final steady power. On this account the filament comes up to full incandescence in a much shorter period, or much smaller fraction of a second than in the case of the carbon-filament lamp. If we close the circuit of a tantalum, osmium or tungsten lamp, we fail to detect any initial defect in brilliancy. The first effect of which we are aware is full brilliancy.

In an articles on page 859 Mr. John B. Taylor describes the above-mentioned conditions, and goes further. He reports that the first brilliancy detected is actually greater than the final steady brilliancy of the tungsten lamps examined, a phenomenon which he names "overshooting." We have not been able to satisfy ourselves as to the objective existence of this phenomenon in experiments with the unaided eye on such tungstens or tantalum lamps as we have at hand. However, the article describes certain photographic evidence to show that the initial candle-power is greater than the final candle-power, and if such experiments are properly made, they are competent to settle the question of fact. We think, however, that the experiments should be repeated by other observers with success before we are justified in accepting the fact as established, because we all know that sensations received from the retina are not reliable when they are undergoing rapid variation. Assuming the proposition to be established experimentally that there is an initial overshooting of temperature and luminescence in tungsten lamps under certain conditions, the explanation is to be looked for either in the initial electrical actions—that is, in the initial circuit conditions—or in the initial radiation conditions of the filament. Unless the resistivity of the filament has a time lag, a very difficult idea to frame, the rising temperature should automatically cut down the power in the filament, and prevent overshooting. It is conceivable that on an alternating current circuit, such as is described in the article, the presence of inductance in the lamp circuit might tend to check the first inrush of current and also to carry over the current when the resistance increased. Any such inductive effect would probably be limited, however, to a single cycle, or sixtieth part of a second, whereas the report is that the overshooting has a duration of the order of one-tenth of a second. If the effect were due to inductance, it would not be found on direct-current circuits. The explanation suggested in the article is an initial variation in the radiation conditions. This might be determined by experiments in the laboratory before the lamp is sealed off, and while the degree of evacuation is still measurable. At all events, the subject is well worth investigation, even although it does not seem to be of great practical importance.

Concerning Luminous Arcs.

Mr. Dyott's article, printed elsewhere in this issue, and dealing with some of the idiosyncrasies of the magnetic arc, points a somewhat extensive collection of morals. Chief among them stands the necessity of something like a scientific study of luminous arcs, of something going beyond the production of a salable arc, of some manner of general understanding of the principles underlying the performance of such arcs. This is all the more important since it is at the present time entirely clear that the old carbon arc is doomed, and will soon be replaced by some form of arc, perhaps by a form different from any now in commercial use. The fact is that the ordinary carbon arc, so far as light-giving power is concerned, is not an "arc" lamp at all, but an incandescent lamp giving its light in virtue of the enormous temperature of the crater. The arc is merely incidental to the production of this crater and itself is only feebly luminous. The modern arcs of all kinds derive most of their light from the arc itself rendered luminous in and of itself, and receiving comparatively little assistance from whatever crater may exist. It is this radical difference in operation that makes the new arcs of such revolutionary importance. So long as the source of light is a solid incandescent body, so long will the spectrum of that light be continuous with its energy maximum in the non-luminous infra-red and a large part of the visible radiation in slightly luminous red and blue. There hardly seems to be a fighting chance of pushing any incandescent solid to a temperature high enough to push its energy-maximum into the visible spectrum, let alone the advantageous part of it.

The "flame" arcs, on the other hand, give the discontinuous spectra of vapors. In such spectra there is no known relation between the position of the energy-maxima and the temperature. It is quite within the range of possibility to have this maximum in the violet or even the ultra-violet. Hence in a flame arc the energy maximum may, and in some cases does, lie in the part of the spectrum where it will do most good. In choosing a substance, therefore, for loading the electrodes of a flame arc, one must be selected of which the spectrum is very strong within the highly luminous part of the visible spectrum in order to reach high efficiency. To get a good color, however, the electrode-vapor must have a spectrum not mainly confined to the highly luminous yellow and yellow-green, but having a considerable admixture of the weakly luminous red and blue-violet. The highest luminous efficiency is therefore incompatible with a color approximating white and such is found to be the case in practice. The common yellow flame arc of which the electrodes are charged mainly with calcium fluoride, has a spectrum especially intense in the yellow and green and has, therefore, an enormous luminous efficiency, while any admixture that brings the color near to white considerably reduces this efficiency. On the other hand, the titanium flame arc, which gives an admirably white light, has a luminous efficiency not materially higher than can be reached by an open carbon arc pushed to high-current density, although, of course, it is much superior in efficiency to the ordinary enclosed arc. In the new arcs one has, therefore, to face a compromise between efficiency and color-value, a compromise which has not yet been properly adjusted, at least for interior lighting.

Another difficulty is found in the character of the products of combustion. Carbon is one of the few solid elements which oxidizes into a colorless and inoffensive gas. All the materials used in the present flame arcs oxidize into solid particles which, while adding something to the light by their incandescence, produce a smoke which must be disposed of by a draft of some sort lest it render the globe opaque. The more volatile the substance of the electrodes the more débris must be taken care of, and the harder the arc is pushed to win efficiency the worse the problem of disposing of the products of combustion. If the electrodes are charged with a mixture, its several components must be of similar volatility else they will tend to separate and produce such changes in the arc as Mr. Dyott describes in the case of his electrodes. This condition forbids the use of many mixtures which might otherwise be desirable for improvement of the color values. Also, as is suggested by Mr. Dyott's investigations, the electrode substance must be such as will vaporize smoothly and regularly without the formation of any troublesome slag to interfere with the steadiness of the arc. Here also is a condition which may prohibit the employment of substances otherwise desirable. If a flux is to be used to escape the difficulty, it must be one which will not interfere in other ways with the general performance. In spite of all these things the flame arc has made such progress as to put the carbon arc on the road to obsolescence, so that the array of difficulties suggests achievement rather than discouragement. The distribution of light from the flame arcs varies very widely, but is more a matter of design than of electrode material. Any vertical flame arc worked at low current density so that there is no localized region of extreme temperature at the electrodes, gives of necessity a strong lateral distribution, the flame acting as a short vertical luminous pencil. Hard pushed, so that there is enormous activity at the electrode surface, the radiation from that surface increases, giving more light axially.

Another matter not yet satisfactorily settled is the life of the electrodes. In general terms, the more incandescent vapor the greater the light and the shorter the life. The earlier flame arcs of the calcium fluoride type gave conspicuously short life of the electrodes, rather too short for convenience, in fact; requiring electrodes about a foot and a half long for a dozen hours of life. The lamps of the magnetite and the titanium class, on the other hand, have been developed especially for long life, giving a hundred hours or so for one pair of electrodes, but at very modest efficiency compared with the others. Now, as regards trimming, there is a great deal of misapprehension. The actual labor cost of trimming is altogether trivial. In the later days of the old open arc many a company kept its trimming figure down to two cents per trim, and some companies reported less than this, as a glance at old N. E. L. A. discussions will show. Gaining long life at considerable sacrifice of efficiency is justifiable economically only when the cost of the electrodes is a serious matter. It is to be noted that it will be practicable to produce electrodes for flaming arcs which give a better compromise between life and efficiency than those now in use. A thorough search over the list of the chemical elements for improved material ought to be productive here, as it was in the case of incandescent lamps. And given an electrode of suitable life and efficiency, there is still one important qualification to be looked for. Any very efficient arc for maximum usefulness should be available in convenient units. One could, say, double the light from our ordinary arcs to great advantage, but a large further increase for the same energy is less useful than a more modest increase for the same or reduced energy. So far the movement in this direction has been less productive than one could wish, because most of the smaller arcs have been secured at the same voltage as heretofore and great relative reduction of current, so that the distribution problem is not at all simplified. More current, to insure stability and lower voltage at the arc, would give a more valuable combination of qualities.

Decorations in Gas-Lighted Rooms.

In districts where natural gas at from 30 to 50 cents per 1000 cu. ft. is available, the cost of lighting with the use of gas mantle burners is insignificant so far as the simple cost of the gas consumed is concerned. In fact, it can almost be left out of account in figuring the actual total cost of lighting by this method. Even where artificial gas at $1 per 1000 is used, the cost of gas for producing a given number of lumens is very much less than with carbon-filament lamps as commonly used in residences to-day. With the application of good illuminating engineering and lamps of recent high-efficiency types, the practical difference between electricity and artificial gas is reduced almost to zero so far as the light useful to the consumer is concerned. With natural gas it is useless to expect the cost of electricity to approach anywhere near that of gas in the immediate future. Nevertheless, in natural gas districts there is a remarkable indifference among residence owners to the introduction of natural gas lighting in their homes. There must be some good reasons for this and they are easy to find. To begin with, there is the match nuisance to which no one who has ever used electric light wishes to return.

Then there is the cost of mantles and the fact that mantles have a habit of breaking at inconvenient times, and unless used with more care than is ordinarily employed, nowhere near the rated life is obtained from a mantle. These, however, are the lesser of the troubles. The average house owner seldom sits down to figure yearly costs of redecorating over a term of years, and for that reason is more likely to forget the difference between gas and electric light in this respect than is the owner of large apartment and flat buildings who has this matter down to a science. Whether it is the air current created by the heat from the gas burner or whether it is the products of combustion from the gas itself, it is not necessary to inquire. The fact of the matter is that the owner of large flat buildings who has studied the subject knows that cost of papering and calcimining in gas-lighted rooms averages about double that for electrically-lighted rooms. With these practical figures as a starter, it does not take long to arrive at the conclusion that the difference in cost between electric and gas lighting, everything considered, is largely imaginary at the present time, and that the tungsten lamp will definitely swing the balance in favor of electricity.

The Non-Synchronous Generator in Central-Station Work.

The non-synchronous alternating-current generator and the synchronous converter are more closely related than appears at first sight, because the synchronous converter is a particularly appropriate adjunct to the non synchronous generator. The non synchronous generator, as is well known, is merely an induction motor inverted in its functions. If we drive the secondary rotor of an induction motor by an engine, and leave the stator primary disconnected from its mains, we merely revolve a squirrel-cage, low voltage, short-circuited element without other loss than journal friction and windage. If, however, we close the primary windings on the main circuit, the torque produced on the engine will depend upon the conditions in the circuit at that moment. If alternating voltage is being maintained between the mains, there will be a rotating magnetic field set up in the stator, and exciting currents will be drawn from the mains to supply this. If the speed at which the rotor is running happens to be the same as the speed of the rotating magnetic field, then no other effect will be produced, and there will be no torque exerted on the engine. If, however, the speed of the rotor is slightly in excess of the speed of the rotating magnetic field—that is, if there be a small negative slip—then currents will be induced in both rotor and stator. The currents in the stator will have the frequency of alternation existing in the mains, and will be watt currents aiding in carrying the load on those mains. The currents in the rotor will have the slip frequency and will exert a resisting torque on the engine, or absorb power in the dynamo-electric way. At the same time the mains will be called on to supply an increased wattless current to the primary winding.

The advantages of non-synchronous generators in central-station work would lie in simplicity of generator rotor structure, high efficiency, absence of necessity for synchronous connection to mains, reduction in excitation owing to smaller air-gaps, reduction in the magnitude of surges following short-circuits, and absence of distortion in the e.m.f. wave form under load. The principal disadvantage of a non-synchronous generator so far as existing practice has revealed the matter, lies in its inability to carry a lagging current load; or to express the matter in another way, in its inability to furnish a magnetizing current. All it can do is to deliver current substantially in phase with the voltage between mains, provided that the slip is suitably maintained, and that a proportional wattless current is supplied to the primary from the mains in order to satisfy the magnetic leakage in the machine. All magnetizing currents must be supplied from the system, either in the form of condenser charging currents, or in the form of wattless components of current supplied by synchronous machines such as converters.

Long Acre Hearing.

At a continuation of the hearing before Commissioner Maltbie, of the New York City Public Service Commission, on application of the Long Acre Light & Power Company to issue bonds, which was held Tuesday, April 14, Mr. W. H. Knight, chief engineer of the Long Acre Company, handed a number of maps to the commissioner, which showed certain sections of the city and indicated the kind of illumination used in the buildings in the sections shown. The houses and stores which used both gas and electricity, and the buildings which used either form of lighting or none, were indicated. In all, 10 maps were submitted, which embraced tenement sections of New York, and which showed that electric lighting was decidedly in the minority as compared with gas lighting. Almost 100 blocks in all were covered by maps. Mr. Knight said he believed that under competition, electricity would be much more extensively used, as, for instance, in electric heating and electric vehicles, which are largely restricted at present by inadequacy of the present equipment and the present prices. He stated that with the invention and improvements of recent times the cost of light and power had, on the consuming end, i. e., the lamp end, showed a reduction of 200 to 300 per cent, due to increased efficiency of arc and incandescent lamps. He offered in evidence a schedule showing the cost at which light can be produced by the Long Acre Company, and the prices at which the company would furnish light and power to purchasers. The schedule reads as follows:

MOTORS AND STORAGE BATTERIES.

Not exceeding 200 kw-hours per month	8 cents
From 200 to 300 kw-hours per month	7 cents
From 300 to 500 kw-hours per month	6 cents
From 500 to 1000 kw-hours per month	5 cents
From 1000 to 10,000 kw-hours per month	4 cents
Over 10,000 kw-hours per month	3½ cents

ELECTRIC LIGHTING.

Basic rate, per kw-hour	8 cents
Deduction for an average daily use of 4 hours	1 cent
Deduction for an average daily use of 6 hours	2 cents
Deduction for an average daily use of 8 hours	2 cents
Deduction for an average daily use of 10 hours	4 cents

COST OF ELECTRIC POWER IN NEW YORK CITY.

	Per kw-hour.
Power house operation	.6 cent
Cost of power at customer's meter	.8 cent

GENERAL EXPENSES.

	Per kw per year.
Depreciation of power plant, conductors and substations, 3 per cent on $300	$9.00
Rental of ducts	10.00
General expense, legal, insurance, taxes, sales, collections, salaries, administration, etc	18.00
Interest 6 per cent on $300	18.00
Total fixed charges per kw per year	$55.00

FIXED CHARGE PER KW PER YEAR.

Taxes, 1.5 per cent on $300	$4.50
Insurance	.30
Administration and legal expense	6.00
Sales and collections	2.00
Meters, men and inspectors	1.00
Trimmers	.60
Printing, stationery and office expenses	.20
Advertising	.40
Franchise tax	2.00
Rents	.50
Miscellaneous	.50
Total	$18.00

Mr. Knight said that he attributed the large number of houses that have no electrical connections, as shown by the maps, to the indisposition on the part of the present suppliers of electricity to supply electric light when they have a satisfactory customer for gas. He believed that the electric light companies are restrained by the gas companies which own the stock of the electric companies. As shown by the maps, there were blocks and blocks without a single electric light. The Long Acre Company will offer special inducements to bring about the use of electric heaters, charging as for motor work and storage battery work. In answer to a question by Mr. Walker, Mr. Knight summarized the chief factors which are responsible for the inadequacy of the electric light supply in the city to-day. In the first place, he said, electric light is supplied by about one company, under no incentive to competition. Second, that company is interested in electricity's chief rival, gas—a form of illuminant, which while most desirable to the users is, perhaps, more desirable to the suppliers. Third, the growth of the city is so rapid and the growth of the art so rapid that it would be extremely difficult for any one company to properly occupy the field. Fourth, with more energetic canvassing, a more concentrated supply of electric current can be obtained, resulting in greater economy and a corresponding reduction in price, followed by a still greater increase in consumption. With that the Long Acre Company closed its case.

At the previous hearing Mr. Knight created considerable of a sensation by telling of a new lamp which the Long Acre Company will use. This lamp, he said, has twice the efficiency of the tungsten lamp and costs $1. It was not produced at the hearing, but was shown to the Commissioner in private. Information concerning the technical features of the lamp could not be obtained from Mr. Knight other than it was a non-filament lamp considerably larger than the ordinary incandescent lamp, and applicable to low-potential circuits and standard sockets. Mr. Knight intimated that the lamp possesses a therapeutic effect and has an indefinite life.

The only lamp that is at all comparable to the lamp which the Long Acre Company claims to control is the German quartz mercury-vapor lamp described in our issue of October 19, 1907. This lamp has a specific consumption of approximately 0.25 watt per candle and also has a very strong ultra-violet radiation, the effect of which is counteracted by glass screens which absorb this radiation. The quartz lamp, however, has not an indefinite life, nor is it a competitor of the incandescent lamp, it being intended to compete with high-candle-power arc lamps, the mean spherical candle power of two lamps tested being 2680 and 3110 respectively.

Overhead High-Tension System of the New York Central.

At a continuation last Thursday of the hearing on the overhead high-tension system of the New York Central R. R., held before Commissioner Eustis of the New York City Public Service Commission, Mr. E. B. Katte, electrical engineer for the New York Central, went into details as to the causes of death through electrocution on railways where there is possible contact with the third rail or with overhead wires. Other matters discussed were the number of extra ducts built by the New York Central, both for future expenses and for ventilation, the water-proofing of the ducts and the nearness of certain poles to the tracks. In certain instances it was brought out that the poles run so near the tracks that there was clearance room of only 2 ft. between the pole and the side of a passing car. Mr. Charles B. Martin, transmission engineer of the railroad, gave details of the estimate as to the cost of putting underground the present overhead wires and outlined the underground work construction done in Brooklyn by the Brooklyn Heights Railroad Company.

Annual Meeting of American Electrochemical Society.

The annual meeting of the American Electrochemical Society will be held in Albany, N. Y., April 30, May 1 and 2, with headquarters in Hotel Ten Eyck. The sessions of Monday will be held in the hotel, and in the evening the members will attend a lecture by Prof. W. D. Bancroft on "The Electrochemistry of Light," during which the lecturer will present a new electrochemical theory of light. The morning session of Friday will be held in the lecture hall of Union University of Schenectady, and the afternoon of that day will be passed in a visit to the General Electric Works. On Saturday a forenoon session will be held in the lecture room of the Rensselaer Polytechnic Institute at Troy, and the afternoon occupied in visits to industrial plants in Troy and vicinity.

Among the large number of papers on the program are the following having a more or less general electrical interest: Constructive and accurate measurement of resistances of the order of 10,000 megohms, by Mr. H. L. Bronson; nature of the surface film formed on aluminum and magnesium, and the aluminum-magnesium cell, by Messrs. H. T. Barnes and G. W. Shearer; potential of the nickel electrode, by Mr. E. P. Schech; corrosion of iron from the electrochemical standpoint, by Prof. C. F. Burgess; electrochemical corrosion of the Rochester steel conduit, by Mr. Richard H. Gaines; distillation of turpentine by electricity, by Mr. F. T. Snyder; Robert Hare's electric furnace, by Prof. C. A. Doremus; electrical testing of iron during annealing, by Prof. E. E. F. Creighton; passage of direct current through electrolytes without the use of electrodes, by Mr. Carl Hering; electrolytic refining of iron, by Mr. E. F. Kern; problems in the manufacture of dry cells, by Prof. C. F. Burgess.

Meeting of the New York Section of the Illuminating Engineering Society.

The meeting of the New York section of the Illuminating Engineering Society, held on April 9, was devoted to a discussion of the characteristic performance and commercial features of the new types of incandescent lamps, an illustrated lecture being given by Dr. Clayton H. Sharp.

Dr. Sharp outlined the various improvements that have been made in illuminants during the past 10 years, beginning with the work of Welsbach on the incandescent gas mantle. He explained the methods of manufacturing the 3.1-watt carbon lamp, the 2.5-watt graphitized-filament lamp, the 2.0-watt tantalum lamp and the 1.3-watt tungsten lamp. In comparison with the old carbon lamp the new tungsten lamp is not only more efficient, but it is less sensitive to voltage variation on account of its positive resistance-temperature coefficient. Thus for equal fluctuations in brilliancy of the two lamps, the tungsten requires only two-thirds as much copper in the distributing circuits as is necessary with the carbon lamp. Recent improvements in methods of manufacture have largely overcome the objectionable fragility of the tungsten filament.

Mr. S. E. Doane stated that the use of high-efficiency lamps has not tended to reduce the income of electric-lighting companies, because the consumers have preferred to increase the light at the same cost rather than to decrease the cost with the same light. Moreover, the new types of lamps have not caused the sales of the carbon lamp to decrease at least as greatly as in previous years. Although most of the new lamps are made in large candle-power units, progress is being made in smaller units. A 25-watt tantalum lamp will probably be introduced soon, while 20-watt tungsten lamps have been manufactured.

Dr. E. P. Hyde expressed the opinion that the higher luminous efficiency found in the newer types of incandescent lamps is due to selective radiation as well as to the increase in temperature. He stated that a certain lamp of the type shown by Dr. Sharp, with a carbon filament surrounded by mercury vapor, has consumed from eight to nine watts per candle when first connected to the circuit, while the illumination increased within a few minutes to such a value that the specific consumption reduced to from three to four watts per candle, although the actual power consumption was not changed.

Mr. W. J. Hammer called attention to the work done by Mr. John A. Heany, stating that the best tungsten lamps had been produced by this inventor. He attributed the results to purity of the tungsten used and to the high temperature at which the lamps are operated.

Mr. Arthur Williams said that he welcomed the advent of the high-efficiency lamps, because they tend to put electric lighting within the means of the poor man. An increase in lamp efficiency will result in a greater increase in the use of electric lights and lighting companies will be benefited by the improvement.

The chairman, Mr. W. W. Freeman, announced that the lecture by Dr. E. L. Nichols, which had been scheduled for the April meeting, will be delivered before the New York section on May 14. The subject of the lecture will be "Daylight and Artificial Light."

Central Georgia Power Plant.

The plant of the Central Georgia Power Company, to be situated on the Oconee, Ocmulgee and Flint Rivers, which drain the most populous and important industrial sections of Georgia will, when finally completed, cost $15,000,000 and have a capacity of 100,000 to 125,000 horse power, the largest power development in the south, and one of the largest in this country. Of the several power sites to be developed, the one first selected is on the Ocmulgee River, seven miles east of Jackson, the county seat, and midway between Macon, with a population of 56,000, and Atlanta, which is 43 miles distant. The Macon Railway & Light Company, which owns the street and suburban railways of Macon, and furnishes all the electric lighting for Macon and the suburbs, is allied with the Central Georgia Company. In the city of Macon 12 lines of railroads focus, and in neighboring towns the cotton mills operate 227,211 spindles and 4715 looms, while there are many wood-working plants, railway shops, foundries, municipal and private waterworks and numerous other industries which require a large and constantly increasing amount of power. In the past the high price of coal has prohibited the use of electric power except to a limited extent. In a radius of 35 miles of this plant there is a population of 250,000 and a great number of large plantations devoted to cotton and corn, stock farms and extensive orchards. The resources of the Ocmulgee River are sufficient to supply power many times over for the proposed interurban electric railways between Atlanta and Macon, and Macon and Albany.

The proposed power site has a head of 100 ft., a storage basin of more than 3000 acres and natural rock foundations for a dam. At that point the river is 350 ft. wide, flowing through a hilly country with high bluffs on each side. The plan recommended and adopted provides for a concrete and masonry dam at the foot of the shoals, 1425 ft. long on the crest, and giving an effective head of 100 ft., which will back the water 15 miles, creating a storage reservoir area of 5 square miles. The power house of reinforced concrete and masonry will be situated on the western bank of the river, and built against the lower side of the dam and integral with it. The water will descend through large steel feeder pipes to the turbines, and the tailrace will empty directly into the river below the dam. Four turbines, direct-connected to four generators of 10,000-kw total capacity, will utilize the full power of the development and from the transformers and switchboard the 60,000 volt current will be carried by steel-tower transmission lines direct to Macon and the surrounding towns. This plant has a development of 10,293 horse-power under an average 90-ft. head per 18 hours per day in any year, and 12,727 horse-power under 100-ft. head per 24-hour day except during the summer months of an unusually dry season. The rates to be charged for power will be based on rates of the Niagara Falls Power Company, varying according to the average use (30 per cent load factor) from $22 to $33 per horse-power per year. The total cost of the complete development on the Ocmulgee River is estimated at $2,500,000. The estimated gross income is given as $417,000 and the total annual net income $332,000.

The Central Georgia Power Company was organized under the laws of the state of Georgia in March, 1907, under the name of the Ribb Power Company. Its officers are Mr W. Jordan Marsee, president; Mr. John C. Walker, vice-president; Mr. M. F. Hatcher, secretary; Mr. J. T. Moore, treasurer, and Mr. Charles F. Howe, chief engineer. The banking firm of A. B. Leach & Company, New York, is financing the project with a $16,000,000 bond, $20,000,000 stock issue. It has not yet been decided whether the second section to be developed will be situated on the Flint or Oconee, but ultimately there will be power stations on the Ocmulgee River, the Oconee River and Flint River, and the total outlay will be between $15,000,000 and $20,000,000.

Japan's Manufacture and Importation of Electrical Machinery.

By M. Kawara.

The present financial depression, which came so suddenly, seems to have made manufacturers feel more keenly the necessity of extending their export business. It may not be inopportune, therefore, to refer to the situation of the electrical trade in Japan.

The first telegraphic apparatus in Japan was brought from this country by the famous Commodore Perry in his memorable expedition. On seeing its mysterious power of communication, the Japanese thought it was a magic instrument worked by the supernatural power of the "Western Devils," and cast it away. It was in 1868 that the first practical use was made of this apparatus. Since then the telephone, the electric light, the electric railway and the electric motive power have entered into general use one after another as each became adopted in America and Europe.

As the use of electrical machinery increased, enterprising manufacturers began to build simple apparatus, and this industry kept on growing each year, very slowly, however, as compared with other industries. Even as late as in 1904 the total number of private factories engaged in the manufacture of purely electrical machinery was only 26; the power used in these factories, 769 horse-power; and the total number of operatives employed, 756. The national government operates factories which build some electrical apparatus, but their output is no particular factor in the industry in general. The beginning of the real expansion dates from the close of the Russo-Japanese war when the nationalization of all steam railroads was finally decided upon. Then a large portion of the available capital, which had hitherto been invested in steam roads, began to be directed toward the electrical industry, such as hydro-electric power development, electric railways, etc. This brought about a rapid augmentation of electrical manufacturing, and the number and size of factories increased suddenly.

The statistics for the last year are still unavailable, but I learn from an authoritative source that the existing factories are utterly inadequate to meet the demand, which continues to increase at a very rapid rate. As a result, several influential capitalists are contemplating the establishment of large, up-to-date factories. One of these has already been started at Kobé, and another at Nagasaki. Besides these, one of the largest corporations in this country has decided to build one at Kawasaki, midway between Tokio and Yokohama. When all of these factories, including those already in existence, most of which will undoubtedly be enlarged from time to time, are in full blast, the present output will be multiplied many times. Whether this increased production will cut down the imports from foreign countries or not is a question. Now let us turn to a review of the importing trade and see if we cannot answer that question.

Table I.—Importation of Electrical Goods in Yen (Yen Equals 50 Cents in U. S. Money),

Kind of Articles.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Generators and motors	14,000	168,000	91,000	13,000	309,000	389,000	811,000	837,000	1,266,000	2,455,000
Cables, wires, etc.	1,626,000	937,000	594,000	1,011,000	2,349,000	1,483,000	885,000	1,065,000	2,082,000	3,775,000
Elec. cars and carriages	......	......	......	......	......	......	28,000	135,000	906,000	531,000
Total	1,640,000	1,105,000	685,000	1,024,000	2,658,000	1,872,000	1,724,000	2,037,000	3,254,000	6,761,000

The imports of electrical machinery were insignificant up to very recently, being confined principally to telegraphic apparatus. The importations went up suddenly at the close of the Japanese-Chinese war, and for the first time a separate heading for electric dynamos and motors appeared in the custom house returns for 1896. Table I shows the amount of imported electrical goods from 1896 to 1905; 1896 and 1897 were the years in which an abnormal expansion of all industries took place, but a financial depression followed, as some financiers had predicted. In 1900, business returned to normal conditions. From this time on the increase of imports has been steady. The tables of imports for the years 1906 and 1907 at hand do not contain a separate entry for electrical goods, this item being included under the heads of machines, and bars, rods, wires, etc. Since the total amount of machinery imported in 1906 and 1907 was 90 per cent and 187 per cent of that of 1905, the amount of electrical goods would have been 6,080,000 and 12,600,000 yen in the corresponding year if the same ratio of the latter to the aggregate amounts held. It is certain that the ratio was more largely in favor of electrical goods owing to the fact that the nationalization of all steam railroads was approved by the Parliament in 1906, the effect of which has been briefly stated in this article.

Now let us see to what extent American manufacturers benefited from this situation. Table II shows the motors and generators imported from various countries. As will be seen, the Americans supplied the largest portion. Next comes Great Britain, closely followed by Germany. Germany is at the head in the importation of telegraphic wires and apparatus, Great Britain in submarine and underground cables, and the United States in electric cars and carriages. The figures for 1906 and 1907 are not yet at hand, but the general indications are that this country is far ahead of others in importations. It is to be noted in this connection that very recently several German firms have been vigorously pushing their way and it is not unlikely that Great Britain may fall behind Germany. The American manufacturers, too, may lose some of their customers unless they guard their interests with great care.

Table II.—Importation of Generators and Motors in Yen (Yen Equals 50 Cents in U. S. Money).

Countries	1900.	1901.	1902.	1903.	1904.	1905.
United States	195,000	231,000	682,000	524,000	872,000	1,860,000
Great Britain	97,000	58,000	61,000	185,000	228,000	423,000
Germany	15,000	58,000	65,000	119,000	222,000	168,000
Other countries	2,000	42,000	3,000	9,000	3,000	5,000
Total	309,000	389,000	811,000	837,000	1,265,000	2,456,000

Thus far the history of the importation of electrical goods has been one of rapid expansion. Will this continue even if home manufacturing develops as it has been doing? No doubt there will be sharp competition in certain lines of goods, but it does not seem probable that the imports will be materially affected. On the contrary, present indications point toward rapid increase, at least for a good while to come. Small machines can be built in Japan at a cost which compares favorably with imported apparatus. However, large units cannot be produced even at a much higher cost than foreign machines. Again, the experience of engineers in the past has been that they could not rely on the home-made machines as well as on imported ones. This remark is applicable to all machines. Complaints have been received time and again from the users of Japanese-made engines, lathes, etc., as to their poor performance and unusually frequent need of repairing. Another factor adverse to home manufacturers is the scarcity of capital. As a rule, factories in Japan are not as well equipped as in America and Europe. This is one of the reasons why, in spite of the fact that labor is much cheaper, the Japanese cannot produce very large machines or very good machines at a reasonable cost.

There is thus a good opportunity for American manufacturers to increase their business in a market which promises to become of more importance each year. How to accomplish the extension of this business is a matter of personal opinion and judgment. The erection of factories in Japan by Americans, as is being done by one of the companies, seems to be a very wise measure. The advantages resulting from this plan are many, such as nearness to the market, utilization of cheaper labor, exemption from the tariff duty, etc. (The Japanese tariff duty on finished machines is 25 per cent ad valorem.) At any rate, the matter of the Eastern market is worth serious consideration, because success in Japan practically means success in other Oriental countries as well.

United States Patent Court of Appeals.

The Committee on Patents of the House of Representatives, Washington, has reported favorably a bill to establish a single court of final appeal in patent cases, which court would have cognizance of cases now coming before the various United States Circuit Courts of Appeals, nine in number. The bill will be considered by the Judiciary Committee before final report to the House.

Of the five members of the court, only the presiding justice would be permanently attached thereto. The other members would be assigned for fixed periods and selected from the bench of United States Circuit or District Court judges, the choice being thus among about 100 judges in this service.

At the hearings in favor of the bill, Mr. F. P. Fish strongly favored the measure reported. Mr. T. J. Johnston favored a permanent court and argued against the provision whereby four of the five judges would be detailed from other United States Courts, which he held to be unconstitutional. Chairman Currier, in sustaining the provision requiring four of the judges to be detailed by the Chief Justice of the Supreme Court from other United States Courts, referred to the struggle that would ensue for the appointment of members of a permanent court, and the difficulty the President would meet with in making the selections.

Final Arrangements for the N. E. L. A. Exhibition.

On April 16 the Exhibition Committee of the National Electric Light Association, consisting of Mr. W. W. Freeman, Mr. Frank H. Gale, Mr. Walter Neumuller, Mr. Rodman Gilder, Mr. Benjamin Wall and Mr. C. P. Frey held a final meeting to arrange the last details for the exhibition at Chicago. The final assignments of space to exhibitors was decided upon. There are only four sections as yet untaken, and there are 22 applications from prospective exhibitors on file. It is planned to open the exhibition on Monday evening, May 18, at 8 o'clock. Invitations will be sent to Class A and B (company and professional) members for a private view between 8 and 9 o'clock. The general reception of the convention will take place at 9 o'clock in the Gold Room of the Annex. Contracts have been closed for the construction of the booths and wiring. The next meeting of the committee will be held in Chicago. Following is a list of exhibitors:

Pittsburg Transformer Company, Pittsburg, Pa.; Electric Service Supplies Company, Chicago, Ill.; Dossert & Company, 242 West Forty-first Street, New York, N. Y.; The Duncan Electric Manufacturing Company, Lafayette, Ind.; The Triumph Electric Company, Cincinnati, Ohio; G. M. Gest, 277 Broadway, New York, N. Y.; Philadelphia Electric Manufacturing Company, 1228 North Thirty-first Street, Philadelphia, Pa.; Fort Wayne Electric Works, Fort Wayne, Ind.; H. W. Johns-Manville Company, 100 William Street, New York, N. Y.; Wm. D. McJunkin Advertising Agency, 167 Dearborn Street, Chicago, Ill.; Sangamo Electric Company, Springfield, Ill.; Electric Appliance Company, Chicago, Ill.; Minerallac Company, 839 Monadnock Block, Chicago, Ill.; ELECTRICAL WORLD, 239 West Thirty-ninth Street, New York, N. Y.; Wagner Electric Manufacturing Company, 6400 Plymouth Avenue, St. Louis, Mo.; Pettingell-Andrews Company, Boston, Mass.; *Electrical Review*, 13-21 Park Row, New York, N. Y.; National Electric Lamp Association, 4411 Hough Avenue, N. E., Cleveland, Ohio; Crocker-Wheeler Company, Ampere, N. J.; General Electric Company, Schenectady, N. Y.; Westinghouse Electric & Manufacturing Company; *The Illuminating Engineer*, 12 West Fortieth Street, New York, N. Y.; *Western Electrician*, 507 Marquette Building, Chicago, Ill.; *Electrical Record*, 123 Liberty Street, New York, N. Y.; C. W. Lee Company, West Street Building, New York, N. Y.; Allis-Chalmers Company, Milwaukee, Wis.; Simplex Electric Heating Company, Cambridge, Mass.; Western Electric Company, Hawthorne, Ill.

Thursday, May 21, will be Commencement Day at the National Electric Light Association's Convention in Chicago, next month.

Mr. Geo. W. Williams and Mr. Frank B. Rae are joint editors of what will be an interesting feature of that particular part of the convention, namely, an illustrated talk on the methods of creating demand for electricity. This will include stereopticon views showing in detail the progress of the outline and sign lighting in large and small cities.

Mr. Percy Ingalls, who has been engaged in the publicity and public policy work of the Public Service Corporation of New Jersey for a number of years, has been secured as editor of the paper on "Publicity" for the Commercial Day program. This subject is divided in two parts: (a) Methods to create public sentiment. (b) Dormant publicity opportunities of lighting companies. Several assistant editors, all in close touch with this particular work, have been appointed to assist Mr. Ingalls in gathering data on this subject.

Changes in Engineering Curricula of Columbia University.

In 1907 Columbia University revised the entrance examination requirements for its Schools of Mines, Engineering and Chemistry by simplifying them and co-ordinating them with the programs of the best secondary schools. By the adoption at the same time of a uniform program of studies for the first year in all courses, students were no longer compelled to make up their minds at the outset as to the particular course they desired to take, and it became much easier for college graduates to enter the schools with adequate credit for advanced standing. Following these steps have come the co-ordination and revision of the three subsequent years of each of the courses. This revision, which has been the subject of consideration by the committee on program of studies and by the officers of instruction concerned, has just been formally adopted by the faculty at its March meeting and will go into effect on July 1, 1908, and it is believed that the result will be to strengthen very considerably the work of the schools.

In the first place, the programs have been thoroughly coordinated by cutting out such duplication of instruction as has grown up in the development of the several departments, and courses whose value has been lessened by changes in actual professional methods have been replaced by subjects of greater value to the professional students of to-day. Throughout, the inter-relations of lecture and recitation work with practical work in the laboratory have been carefully considered.

Secondly, the work in many subjects has been made more intensive, and as a result it has been possible to reduce the total number of attendance hours in such courses. For example, calculus is to receive five hours weekly during the first half-year instead of three hours during the year, and the same change is to be made in the important courses of analytical mechanics and resistance of materials. These three fundamental courses must be taken by all professional students. A somewhat similar change has been made in the geological and mineralogical courses, which form an important part of the work in mining engineering and in other courses.

Thirdly, the free time created by this work of excision and condensation will make possible the introduction of important new material. For example, new courses in gas-power and steam-power machinery, and in alternating-current laboratory practice have been introduced in the third-year course in mining engineering. This work has also been introduced into the course in metallurgy, and, in addition, work in mining law and in hydraulics.

Courses in excavation and tunneling, in dynamo and motor practice, and in electrical distribution are added to the course in civil engineering, and the theoretical work in geodesy is moved from the fourth to the third year.

The program in electrical engineering will contain courses on steam turbines and machine design in the fourth year, and a new three-hour course in economics in the third year. The course in mechanical engineering will have additional work in machine design, in the design of manufacturing plants, in metallurgy, in shop organization and works management, and the courses will be further broadened by instruction in industrial law and economics. In the fourth year of the course in chemical engineering provision is made for additional work in electrical and mechanical engineering by the transfer of certain courses previously offered in that year to the second and third years.

The results of the change in entrance requirements and the uniform first year have been most satisfactory to the schools, the total of new students in 1907-08 being 239, as against 162 in 1906-07, a gain of 47½ per cent, and the number of entrance conditions carried by students being reduced 62 per cent, and the number of term conditions 43 per cent. It is expected that the new programs in the professional courses, together with the close personal contact which is now being maintained by the dean and the professors with all the students in the schools, will still further enhance the reputation of the historic "Columbia School of Mines."

CURRENT NEWS AND NOTES.

BREAKAGE OF TUNGSTEN LAMPS.—One of the objections urged against the tungsten lamp is the breakage to which it is subject in shipment. The General Electric Company reports, however, that it has shipped over 75,000 tungsten lamps to all parts of the country and that the breakage in shipment has been below 1½ per cent.

NEW YORK HOME SHOW.—Electrical exhibits will comprise one of the features of the Home Show which is to be held at the Grand Central Palace from May 2 to May 9 (inclusive). A large part of the floor space at the Palace will be given over to the exploitation of electrical necessities and conveniences for all parts of the house.

ALASKA CABLE.—Considerable trouble is being caused to the Alaska telegraph cable by earthquakes and volcanic disturbances. The cable steamer *Burnside* has recently discovered two breaks north of Sitka, within a few miles of each other. The damage to the cable between Valdez and Sitka is greater than was at first supposed. A new and active volcano is reported in the vicinity of Valdez. In repairing some of the breaks near Valdez the ends of the cable were found to be buried deep in the volcanic overflow.

SCENIC NIAGARA.—The Niagara Scenic Commission has reported to the Secretary of War that the Niagara, Lockport & Ontario Power Company should be made to restore the beauty of the river bank at the point where its transmission cables cross the Niagara gorge. The point is about four miles from the falls, and the trees and shrubs were cut, broken and injured by the work necessary in the erection of the towers and lines. The scar left on the face of the cliff is not so bad on the New York as on the Canadian side, where the scenic commission has no authority, but the commissioners of Victoria Park may cause the restoration of the bank on that side.

TROUBLE IN BROOKLYN POLYTECHNIC.—A meeting of alumni of the Brooklyn Polytechnic was held last week to protest against what has been charged as mismanagement of the institute. Since 1899, when Henry Sanger Snow, the missing ex-treasurer of the New York & New Jersey Telephone Company, became president and radical changes were introduced, some alumni say that the school has run up a deficit of $268,989, while before it had been self-sustaining. The borrowing capacity of the institution has now been reached, as its indebtedness is $400,000. Abandonment of the arts course, first suggested by Snow, is particularly opposed by the alumni.

DISCOVERY OF HIGH-FREQUENCY CURRENTS.—In publishing in the *Archives d'Electricite Medicale* a French translation of an article on "The Wave Current and High-Frequency Currents," by Dr. William J. Morton, Dr. H. Bordier, editor of the *Archives*, says in a footnote: "This interesting memoir proves clearly the priority of the work and publications of Dr. W. J. Morton relating to currents of high frequency; it is certain that with his arrangement of 1881 he produced high-frequency currents, employing a static machine in place of the induction coil, as was later employed by E. Thomson, Tesla and D'Arsonval."

NEW ELECTRICAL JOURNALS.—Two new monthly electrical journals, both bearing the name *Popular Electricity*, have appeared, the first number of each being dated May. One of the journals is issued from Chicago, and the other from New York. The Chicago journal announces that its mission is to present the wonders of electricity in plain English, and its New York competitor states that the almost infinite variety of wonders which electricity has wrought will in its columns be explained in attractive, comprehensible terms, yet without sacrificing scientific truth and accuracy. Announcement is also made of the early publication of a third popular electrical monthly, to be called *Electro-technics*.

ENGINEERS AND THE PUBLIC.—In an address before a meeting held April 14 under the auspices of the American Society of Mechanical Engineers to discuss the subject of "Conservation of Our Natural Resources," Mr. John W. Lieb called attention to the fact that the first President of the United States was an engineer who was interested in the development of waterways. The concluding address, by Dr. Henry S. Pritchett, president of the Carnegie Foundation, treated of the attitude of the engineer toward the public. Engineering, he said, has grown into a profession that must consider public interests. The practical demonstration of professional ideals lies in the use of fair judgment, a sound sense of justice and quick appreciation of the larger public causes. The engineer not only plans but carries out great enterprises. If he be a true member of his profession, he will, while serving loyally his employer, keep in mind the honor of his profession, the debt he owes to it and the service to the larger interests of humanity.

NEBRASKA ELECTRICAL ASSOCIATION.—At the annual meeting, to be held May 6 and 7, at Omaha, of the Nebraska Electrical Association, the following papers will be presented: "Duties of the Electrical Inspector," by Mr. Waldemar Nichaelsen, city electrician, of Omaha; "Electric Law," by Hon. W. R. Patrick, state senator from Douglas County; "Electric Rates," by Mr. Homer Honeywell, Lincoln Gas & Electric Light Company, which will be discussed by Mr. I. B. Zimman, of the Omaha Electric Light & Power Company; "The Motor Problem from the Standpoint of Small Central Stations," by Mr. V. W. Bergenthal, Wagner Electric Company; "How to Meet Gas and Gasoline Competition in Stores," by Mr. J. R. Cravath, of Chicago. One of the features of the convention will be the Question Box. A large number of questions submitted for discussion have been distributed among the membership and it is expected that this plan will result in much better contributions on the various subjects than is usually the case. Mr. L. E. Watson, of Beatrice, Neb., is chairman of the program committee.

ELECTRIC SIGNALS FOR STEAM LOCOMOTIVE CABS.—The North-Eastern Railroad of England has equipped its express locomotives and about 14 miles of its main line with electrical apparatus for conveying track signals to the cabs of the engines. In the cab is a dial showing a small semaphore arm by which the conditions of line signals are given. Two pointers indicate the route. A bell in the cab directs the attention of the engineer to the indications when made, so that the system is both visual and audible. Connection is made with metallic bars fitted between and parallel with the rails by a metallic brush carried on the engine. The bars are insulated by ordinary telegraph insulators of porcelain. The first bar with which the brushes come in contact causes the bell to ring in the cab. A hundred yards further on a second bar is encountered which sets the semaphore. This signal may be reversed when the engine passes over similar bars farther down the track, should this be necessary. The signals received are duplicates of the signals in the signalman's tower and are not intended to displace the semaphores now in use, but to supplement them, especially during foggy and stormy weather.

CANADIAN WIRELESS STATIONS.—According to a report issued by the Canadian government, the Dominion owns 13 Marconi stations on the Gulf and on the Atlantic seaboard. Three of these are what are known as "low-power" stations and cost $5,000 each; the others are known as "high-power" stations and cost $10,000 each. The Marconi Company receives $2,500 and $3,500 per annum, respectively, for operating them, retaining all of the tolls.

BUFFALO SIGN ORDINANCE.—The Board of Aldermen of Buffalo, N. Y., have passed an ordinance providing that no electric signs shall be hung in the city without a permit from the Common Council, and that a property owner using an electric sign shall put up a bond of $2,500 to the city. Each electrical lighting company putting up signs must file a blanket bond of $25,000 with the city to protect the city against loss and suit and as a guarantee against damage that may be inflicted to property or persons by an electric sign.

ELECTRICAL IMPROVEMENTS IN GERMANY.—The city of Frankfort, Germany, according to the report of Consul General Richard Guenther, will spend $12,400,000 in various improvements, a large number of which are electrical. The municipal executive board has presented a plan which includes the enlargement of the city's electric plant, the building of additional tramway lines and an electric testing station. The city of Wiesbaden has received permission to issue a loan of $5,500,000 to be expended in part in the construction of electric tramway lines and the extension of the municipal gas, water and electric works.

SIR THOMAS LIPTON AND ELECTRIC LIGHTING.—Sir Thomas Lipton is the latest addition to the 70,000 customers of the New York Edison Company. His several New York offices, which handle his tea business in America, will be gathered under one roof in a seven-story building at the corner of Hudson and Franklin Streets, which, after May 1, will be the central American office of the Lipton Tea Company. The electrical installation, including lighting, will have a rating of from 80 to 100 kilowatts. A large roof sign will be erected, and other spaces suitable for the erection of electric signs in the vicinity of New York City are being considered, including a sign in the harbor, if the authorities will permit it.

TENTATIVE ACCOUNTING SYSTEM.—A circular of 158 pages, embodying a tentative system of accounts for electrical and gas corporations, has been issued by the Public Service Commission of the Second District, the author being Mr. W. J. Myers, statistician of that body. The statisticians of the First and Second Districts have under consideration two tentative systems preparatory to submitting to their respective commissions a system of accounts for adoption. The circular is issued with the request that the gas and electric corporations within the jurisdiction of the commission express their opinions as to the adequacy and appropriateness of the scheme of accounts proposed, and that criticisms and suggestions be made in writing to the commission before April 25.

INDUSTRIAL EDUCATION.—The National Society for the Promotion of Industrial Education has decided to organize State associations. At the meeting of the Board of Managers, recently held in New York City, plans were perfected for establishing these branch societies in 38 States. This testifies to the rapid growth of the society, which held its first annual meeting in January of this year at Chicago. The society has established permanent headquarters at 546 Fifth Avenue, New York City. The society will be represented at the International Congress on Art Education, which is to meet in London next August, by its secretary, Dr. James P. Haney. A committee, of which Dr. Henry S. Pritchett is chairman, will, after a thorough study of the subject, recommend to a municipality a model type of trade school of a kind that will be equal to the industry which the particular city desires to promote.

LIFE OF TANTALUM LAMPS.—Bulletin No. 19, of the University of Illinois, is devoted to an account of comparative tests by Mr. T. H. Amrine, of carbon, graphitized carbon and tantalum filament lamps. The lamps were tested under both favorable and unfavorable conditions, in the first case being connected to a storage battery circuit, and in the second case supplied from a badly fluctuating alternating current. On the basis of an average life to 80 per cent of the original candle-power, the life in hours under the favorable conditions was 400 hours for the carbon filament, 780 hours for the graphitized carbon filament, and 820 hours for the tantalum filament; with the alternating current, the figures became 225, 350 and 350 respectively. With the widely fluctuating alternating current, the tantalum lamps thus made a better showing than the carbon filament lamp.

GAS AND ELECTRIC COMPANIES CONFER WITH PUBLIC SERVICE COMMISSIONER.—The hearing in the matter of the investigation now being held by the Public Service Commission of certain gas and electric companies in New York, scheduled for April 15, took the form of an informal conference between Commissioner Maltbie and the representatives of the various electric and gas companies. The specific subject discussed was that of contracts. At the close of the meeting the Commissioner asked the representatives present to confer among themselves at some future time and endeavor to decide upon some simplified form of contract blank which might be used by all the lighting companies, or else to settle upon a common form of application blank in place of contract blanks. Pending the report to the Commissioner of the various companies no further hearings will be held.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its annual meeting in Detroit, Mich., June 23-26. Among the papers to be presented at this session are: "A Method of Cleaning Gas Conduits," by W. D. Mount; "A Method of Checking Conical Pistons for Stress," by Prof. George H. Shepard; "Clutches, with Special Reference to Automobile Clutches," by H. Souther; "Horse-Power, Friction Losses, and Efficiencies of Gas and Oil Engines," by Prof. L. S. Marks; "Some Pitot Tube Studies," by Prof. W. D. Gregory; "The Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck; "A Journal Friction Measuring Mechine," by Henry Hess; "A By-Product Coke Oven," by W. H. Blauvelt; "Tests of Some High-Speed Steam Engines," by F. W. Dean. There will be a symposium upon machinery for conveying materials, with papers by several authorities. The Society for the Promotion of Engineering Education, and the Society of Automobile Engineers will also hold their annual meeting in Detroit at this time, which will enable members of each society to participate in the sessions of the other.

MUNICIPAL OWNERSHIP IN NEW YORK CITY—Comptroller Metz, of New York City, has refused to sanction a plan for isolated electric-lighting plans for the new buildings of the New York Public Library and Bellevue Hospital. He showed that the cost of furnishing lighting by the isolated plant in the American Museum of Natural History was 16 cents per kw-hour; the plant was abandoned and the New York Edison Company is furnishing current at 3½ cents per kw-hour Commenting on municipal ownership, he said that a private company can get better results than can be obtained from a municipal plant. "It is not bound down by any such restrictions as the eight-hour law; the officials of the company see to it that there is no waste or loafing; because it is a commercial project there is more efficiency and as a result any of the lighting companies of this city can sell us light cheaper than we can make it. There is proof in my own office here that it costs the city more to do its business than if it were a private concern. If the finance department was a commercial house, as it really ought to be, and was under the system which prevails in large financial houses, the department would cost the city just about half of what it costs now."

LORD RAYLEIGH has been elected chancellor of the University of Cambridge, succeeding the late Duke of Devonshire.

MICHIGAN ELECTRIC ASSOCIATION CONVENTION.—The convention of the Michigan Electric Association is to be held at Grand Rapids Aug. 18, 19, 20 and 21. Mr. A. C. Marshall, of Port Huron, is secretary.

CARBON-FILAMENT LAMP EFFICIENCY.—In a report on the municipal lighting plant of Tacoma, made by Mr. F. G. Simpson, it is stated that of 363 carbon-incandescent lamps tested, all but eight showed a consumption which varied from 4.8 to 5.5 watts per rated candle-power, and in some instances the consumption approached 15 watts per actual candle-power.

INTERBOROUGH RAILWAY COMPANY CAN SELL POWER.—By a decision of the upper branch of the New York State Supreme Court, the Interborough Rapid Transit Company, of New York City, has a right to sell its surplus power, even though conveyed through ducts owned by the city. This decision overrules that of a lower court against the railway.

JAPANESE POWER PLANT.—Mr. James D. Schuyler, hydraulic engineer, of Los Angeles, Cal., has been appointed member of a board of engineers to investigate and report on a power plant in Japan for an English syndicate to operate the street railways in Tokio and Yokohama, and to furnish current for lighting and power of those cities. The first installation will cost about $5,000,000.

THE TELEPHONE IN SWITZERLAND.—In Switzerland the telephone service is operated by the government, the total length of lines being 10,548 miles. The annual rental charges for offices, business houses and residences is $12.45 per year, with an additional charge of 1 cent for each local connection. For interurban or long-distance calls the additional rate is 2 to 14 cents for three minutes, the latter figure being the maximum rate for any distance in the country. The revenue last year was $668,702 for rentals and $829,732 for calls. The total number of subscribers was 53,711.

TOLEDO A. I. E. E. BRANCH.—At the April meeting of the Toledo branch of the American Institute of Electrical Engineers Mr. T. R. Fishback, of the Electric Controller & Supply Company, of Cleveland, read a paper on lifting magnets and their application. He explained the development of the plate-lifting magnet as well as the more recent application of the scrap-lifting or concave-bottom magnet. A number of views were shown of the actual operation of magnets in lifting heavy plates or large billets of metal. The paper elicited quite a discussion on the part of the members of the local organization.

REJUVENATED SONS OF JOVE.—In the Buffalo *Commercial* of Tuesday, April 7, a full page is occupied by an account of the Rejuvenated Sons of Jove, the object of the organization and the result of some of its work. The national body is divided into districts, of which the western New York district, comprising all the territory west of Rochester, is one, under the jurisdiction of Mr. James B. Eaton, of the Rochester Railway & Light Company as Jovian Statesman, and Mr. Wm. E. Robertson, of Buffalo, as Jupiter. There are about 80 members of the order in Buffalo, including manufacturers and jobbers of electrical apparatus, electrical contractors and engineers in large industries using electrical power.

NIAGARA POWER IN ONTARIO.—In a recent debate before the Ontario Legislature the government made official announcement of the fact that the Hydro-Electric Power Commission would be able to secure electrical energy from Niagara Falls at a figure as low as $9 per hp-year instead of $10 as was provided under the original contract with the Ontario Power Company. By the terms of the contract, the government can satisfy demands for any quantity from 8000 to 100,000 horsepower at rates ranging from $9 to $9.40 per hp-year, according to the quantity taken. It appears, however, that the municipalities purchasing power must pay in addition interest on the cost of the transmission line, cost of its maintenance, repair, etc., and must pay 75 per cent of the power contracted for, and also on the basis of monthly bills fixed by the greatest quantity of energy taken for any 20 minutes thereof.

A SAFE ROENTGEN-RAY TUBE.—Prof. Albert C. Geyser, of Cornell University, announces that he has perfected a Roentgen-ray tube in the use of which there is no danger of serious X-ray burns. In the experiments which resulted in the tube, Dr. Geyser is stated to have experienced some painful burns which have disfigured his hands, the injuries almost necessitating amputation. The tube is made of a heavy lead glass so that no rays are emitted, except through a flint glass window, which corresponds in size to the lesion to be treated. The connecting wires are encased in glass insulators to prevent sparking on any part of the patient while under treatment. The flint glass window is situated at the end of a projection and must be in direct contact with the lesion, thus furnishing a ground and doing away with the air space which, it is stated, "would otherwise be a dielectric between the tube and the patient. When a tube is brought into direct contact with the patient only the ionizing effect of the X-ray is exerted on the tissues, and this effect is all that is needed to furnish the most brilliant therapeutic results."

LOW-VOLTAGE TUNGSTEN LAMPS.—In referring to some tests made by it on small candle-power, low-voltage tungsten lamps, our London contemporary, *Electricity*, points out their suitability to storage-battery installations on account of the comparatively little change in the light as the battery nears its discharge point. In the experiments made, the candle-power was maintained up to the last half-hour of battery discharge. Another point noted in connection with the miniature low-voltage lamps tested was the rapid blackening of the globes which occurs just before rupture of the filament. "This appears to be the definite signal of approaching dissolution, and takes place very rapidly until, when the lamp's useful life comes to an end, the globe is very badly 'smoked.' I have a 4-cp Osram bulb on my desk which presents the appearance of having been held over a smoky flame. It would be interesting to learn the explanation of this rapid blackening of the globe; presumably the filament gradually disintegrates, until, toward the last, a species of subdued combustion goes on, followed by deposition of the oxidized products upon the interior surface of the globe."

POWER DEVELOPMENT IN KLAMATH COUNTY, CALIFORNIA.—Three hydro-electric power plants are now in course of construction in Klamath County, California. The largest is what is known as the Southern Pacific plant at Spencer Creek, which is said to be the largest ever contemplated by that company, and which will take three years to construct. The next in importance is the government plant to be built on Link River, in conjunction with the Keno Canal. It will have a capacity of 1600 horse-power, and will furnish power for all the pumping stations in various parts of the Klamath project. These pumping stations will provide irrigation for the higher lands above the present system of laterals. The cut-off from the Keno Canal is now being made to prevent breaking-in on the completed canal later. The plant will not be pushed this year, as the power will not be needed until more work is done on the project. Moore's power plant is a short distance down the river from the government site, and will be completed this year, and will furnish light and power to the two valley towns of Bonanza and Merrill. Pole lines are nearly constructed to both points. These three plants are stated to represent the utilization of a very small amount of power lying dormant in Klamath County.

Generating and Distributing System of the Portland (Ore.) Railway, Light & Power Company.—III.

SUBSTATION "A."

THIS substation is located in the heart of the business district of Portland, at the corner of Seventh and Alder Streets. The building is a one-story brick structure with basement, occupying a plot 100 x 100 ft., which is divided into two portions, the main station room being 60 x 100 ft. and the high-tension compartments and arc room occupying the remaining 40 x 100 ft. The main operating room is provided with a 20-ton, hand-operated traveling crane. High-tension current at 10,000 volts is transmitted to this substation and here transformed to meet the needs of the lighting and railway systems.

In this substation are installed three 1000-kw rotary-converters, each provided with three, 367-kw air-cooled transformers. The rotaries are located on a substantial concrete foundation extending the full length of the building, and are started on the alternating side, 1/3 and 2/3 taps on the transformers being used for this purpose. A 10,000-volt, three-pole, oil switch with trip is placed between the 10,000-volt busses and the transformers. The direct-current sides of the rotaries are all connected in parallel on one railway bus and suitable feeder panels are located on the operating floor to control the various railway circuits.

A blower system consisting of a 100 and a 90-in. motor-driven blower is located in the basement of the building, the air being conducted to the transformers by suitable galvanized-iron tubes. This blower system takes fresh air from a shaft in the rear of the station, which leads to the roof of the building, thereby insuring clean, fresh air for the transformers.

Inasmuch as the frequency of the high-tension system is 33 1/3 cycles it is necessary to use frequency-changers in order to secure 60-cycle current for lighting and motor service about the city. The equipment at this substation for making this necessary transformation consists of five 1000-kw frequency-changer sets; one 500-kw frequency-changer set, and one 80-kw starting motor generating set.

The larger frequency changer sets are made up of one 1040-kw, 33-cycle, three-phase, 10,000-volt synchronous motor, direct connected to a 1000-kw, 60-cycle, three-phase, 2300-volt, alternating-current generator. On a shaft extension of this machine is located a 60-kw, 120-volt, direct-current combined starter and exciter. The smaller sets are made up of one 500-kw, 33-cycle, three-phase, 10,000-volt synchronous motor, direct connected to a 520-kw, 60-cycle, three phase, 2300 volt, alternating current generator. On a shaft extension is a 50-kw, 120-volt, direct-current combined starter and exciter. These machines take energy from the 10,000-volt bus through three-pole automatic, hand-operated, oil switches. The 80-kw starting set consists of an induction-motor, direct connected to a 120-volt generator. A 100-kw. oil-cooled transformer is used in connection with this set, stepping down the potential from 10,000 to 240 volts. The combined starters and exciters used on these sets are compound wound.

These sets change the frequency from 33 cycles to 60 cycles, the motor being a 10 pole machine while the generator is provided with 18 poles. Two Lincoln synchronizers, one for the generator and the other for the motor, are placed on the

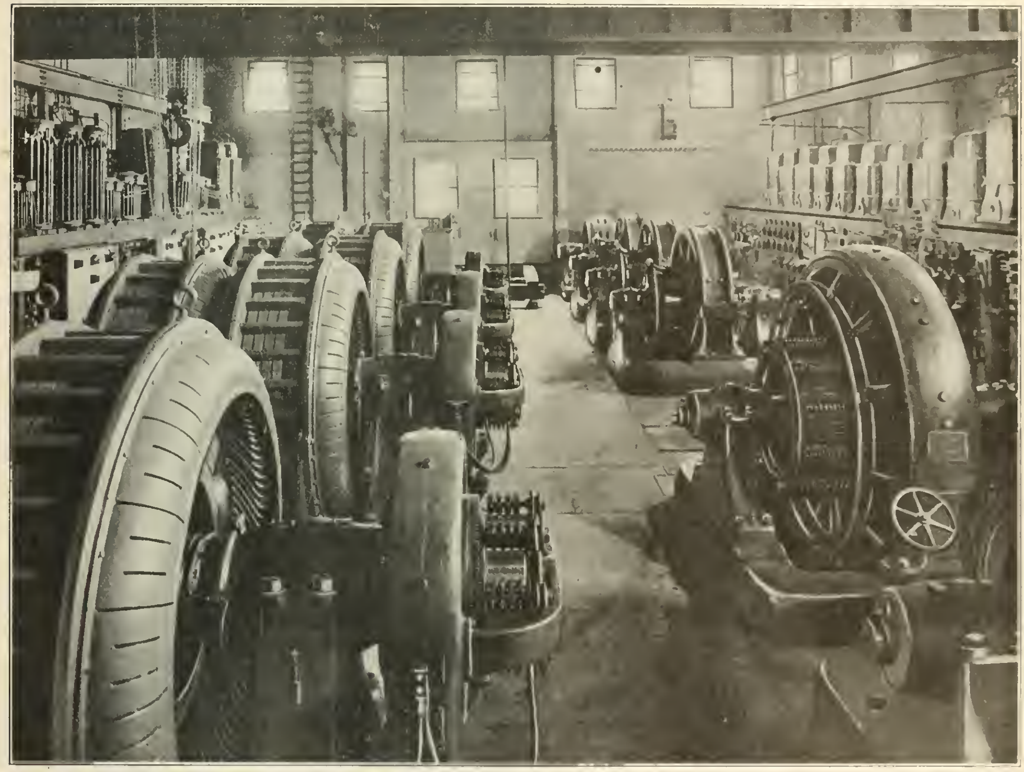


FIG. 1.—INTERIOR VIEW OF SUBSTATION "A," PORTLAND RAILWAY, LIGHT & POWER COMPANY

switchboard. In order to facilitate the synchronizing of the two machines, double-pole, double-throw, field switches have recently been placed on the panels.

All of the lighting panels feeding from the 2300-volt busses are three-phase, the lighting load being fed from one phase, and the third wire is installed whenever necessary to install small motors. A three-phase motor panel is used to feed all of the heavier motors. Tirrill regulators are used in connection with these sets.

The high-tension switch room is located in the rear of the 40-ft. portion of the building. At this point there are six 10,000-volt General Electric motor-operated, oil switches. These switches control the incoming 10,000-volt feeders from the generating station and tie feeders running to other substations. The remote-control switchboard panels for these switches are located on the main station operating floor.

The arc-lighting system in use at this substation is made up of 10 series mercury-arc rectifiers. Each equipment consists of a 44-kw, constant-current, oil-cooled transformer. These transformers are connected to the 10,000-volt, 33-cycle busses and are equally divided on the three-phases. The control panels are each provided with an operating handle for a triple-pole oil switch. On the panels are also situated the ammeter and necessary plugs for making transfer connections. Each panel is further provided with a starting switch and at the top and slightly in the rear is a small panel upon which are mounted the two mercury-vapor arc rectifier tubes. Auxiliary apparatus consisting of exciting transformer, air ducts for leading air to cool the rectifier tubes, reactances, etc., also form part of the equipment. Two direct-connected blowers supply the proper amount of air for the tubes. Each rectifier set is capable of operating 75 magnetite arc lamps. At the present time there are about 700 such lamps operating from this substation.

SUBSTATION "D" AT ALBINA.

This recently completed substation is in a handsome fireproof, brick building of imposing design; the building has a frontage of 141 ft., a depth of 46 ft., in its main portion, with a wing on one end 62 ft. deep. The height over all is 44 ft., the substation room proper being 34 ft. high and the lower floor 10 ft. high.

The operating room is provided with an abundance of light by means of seven large windows. The lower floor is on the level with the street. Heavy machinery is brought into the building through a large door on this lower floor and can be picked up from the transfer trucks by means of a 20-ton traveling crane.

On the lower floor of the station proper are located all of the 10,000 volt busbar compartments, 10,000-volt lightning arresters, disconnecting switches, potential and series transformers, and the accompanying wiring. In the basement is a brick air-tight vault and two 60-cycle, alternating-current blowers are provided for supplying air to this high-pressure chamber over which are located the transformers for the rotary converters. This floor also contains the motor-driven pumps for circulating the cooling water used in connection with the high-tension transformers. A small storage battery for operating the 10,000-volt, motor-operated, oil switches is also on this floor.

The floor of the operating room is of reinforced-concrete construction formed of 18-inch I-beams spaced at suitable distances to accommodate the machinery. Expanded metal and iron bars form the reinforcement. The roof is made up of heavy steel trusses surmounted by 2-in. tongue and grooved seasoned fir plank toenailed firmly to nailing strips which are fastened to the steel purlins by means of through bolts. A tar and gravel covering forms the finished roof. On the roof of the building is located cooling apparatus for the circulating water.

The electrical equipment comprises two six-phase, General Electric, 1000-kw rotary converters together with step-down transformers, operating panels and oil switches. These machines are started in a similar manner to those in substation "a" described before. There are in addition, one 1000-kw frequency changer, together with its panels; one 85-kw induction motor starting set together with its panels; one battery-charging, motor-generating set together with panel; eight General Electric motor-operated oil switches; and 11 mercury arc rectifier panels together with the usual constant-current transformer equipment.

The wing on the east end of the building exceeds the height of the main station by 6 ft. and in this wing are the 33,000-volt lightning arresters and oil switches, disconnecting switches, barriers, etc., which go to make up the high-tension equipment of the station.

On the lower floor of this wing, each in its separate brick fire-proof compartment, are located the nine 33,000/11,000-volt high-tension transformers. These transformers are rated at 850 kw each. Means are provided for observing the flow of the cooling water through the transformers without entering the vaults. All of the high-tension busbar compartments and wings are built up of reinforced concrete, expanded metal being the reinforcement employed. The 30,000-volt lightning arresters are situated between wings on the walls of the high-tension compartment. The 10,000-volt lightning arrester equipment is also mounted between wings, thereby isolating the wires of each phase.

RAILWAY SUBSTATIONS.

Among the minor substations of the Portland Railway Light & Power Company are those which are used entirely for supplying 600-volt, direct-current to the street railway systems. There are five of these stations, equipped as follows:

The Sellwood substation equipment comprises two 400-kw rotary converters, together with direct-current and alternating-current operating panels, feeder panels, etc.; four triple-pole, single-throw, oil switches for subdividing the high-tension feeders which enter and leave this substation: and six oil-insulated, water-cooled transformers, each rated at 150 kilowatts.

The Lents Junction substation equipment consists of two 400-kw rotary converters; six single-phase, 150-kw air-blast transformers, suitable alternating and direct current operating panels, together with triple-pole oil switches; and one blower set for supplying air to transformers.

The Boring substation contains two motor-generator sets consisting of 600-kw synchronous motors, direct connected to a 400-kw Bullock generator, together with suitable switches and panels for operating the same.

The equipment of the Gresham and Eagle Creek substations consists of one 400-kw rotary converter: three single-phase, 150-kw water-cooled transformers, together with proper panels, switches, etc., for operating same.

The St. Johns substation equipment comprises one 400-kw rotary converter; three 150-kw air-blast transformers for the rotary; three 375-kw air-blast transformers for supplying 33-cycle alternating current to several large motors in St. Johns, and one blower equipment for cooling transformers and rotaries.

In addition to the above there are two lighting substations. "The Oaks" substation equipment consists of two 10,000/220-volt, single-phase transformers, one rated at 200-kw and the other rated at 100 kilowatts, which supply enegry at 33 cycles for lighting "The Oaks," which is a large, outdoor amusement park operated by the Portland Railway, Light & Power Company. The Estacada substation contains two 30-kw, air-cooled, 33-cycle transformers. These transformers are used to supply energy for lamps to the town of Estacada. Panels, switches, etc., for controlling the circuits complete the equipment.

It has been the practice of the Portland Railway, Light & Power Company to build substations which are tasteful in design and surrounded by neat appearing grounds. In several cases small homes have been built for the attendants, and at one or two points especially much taste has been displayed in the artistic arrangement of flowers, gardens, shrubbery, etc.

The most important of the above mentioned substations is that at Sellwood. This is a stone building two stories in height, the upper story containing the oil switches which form the connecting link between the several high-tension lines coming in and going out of the substation. A house for the attendants is located at the rear of the station. The rotaries are on the main floor, as are also the operating panels.

At the rear of the station, and located each in its own fireproof compartment, are six oil-insulated, water-cooled, 150 kw transformers. The water-cooling system for these transformers is so arranged that the attendant on the main operating floor can observe the flow of the water supplied to the transformers. He also has at his disposal valves with which he can regulate the flow. A pump, supply tank, and cooling tank are provided in a separate building at the rear of the station. Water is pumped from a well into the tank and after passing through the transformers is cooled off and used over and over again, the waste being supplied from the well. Connection is also made with the city water system, which is thereby available in the case of accident.

Another typical type of substation is that at Lents Junction. This substation is a brick structure one story in height. A home for the attendants is situated in the same lot in the rear of the substation. The high-tension line from which this substation and several others on the Cazadero interurban line are operated is looped into and out of each of the substations, thus enabling the operator to subdivide the line in the event of trouble at any one point on it. This at times is found to be very convenient, as it allows of the operation of all but possibly one of the substations at such times as there is trouble.

OPERATING FEATURES OF THE SYSTEM.

As previously noted, the high-tension system of the Portland Railway, Light & Power Company is composed of three distinct sections: The Lower Willamette Valley System, the Upper Willamette Valley System, and the Vancouver System.

The feeders in the Lower Willamette Valley carry electricity at potentials of 10,000 and 33,000 volts and at a frequency of 33 cycles. The Cazadero station (G), located 30.6 miles from substation "d" in Portland, generates electricity at 10,000 volts, 33 cycles. The potential is then stepped up to 33,000 volts and transmitted directly to substation "d," no taps being taken off either of the duplicate high-tension lines between these two points. At substation "d" the potential is again stepped down to 10,000 volts and fed to the buses which are in multiple with the 10,000 volt, 33-cycle system of Portland.

Station B, at Oregon City, generates electricity at a potential of 10,000 volts and the energy is transmitted at this voltage from that point by duplicate lines directly to substation "a," Portland, and to substation "b" on the east side of the river, proceeding directly from substation "b" to substation "d," and also running out to the Cazadero line of the Oregon Water Power & Railway Company. Station B also furnishes electrical energy for transmission to Salem, a distance of approximately 40 miles, and to the substations of the Oregon Electric Railway Company along the line, the transmission tension being 30,000 volts. Station E likewise generates 33-cycle current at 10,000 volts and transmits energy directly to substation "a."

It will be noticed that the system of feeders forms a sort of reservoir of energy into which the various generating stations pump and from which the several substations are supplied. Lighting and power feeders are all operated in multiple and the system is tied in completely from station E on the north to station B and the Cazadero station on the south.

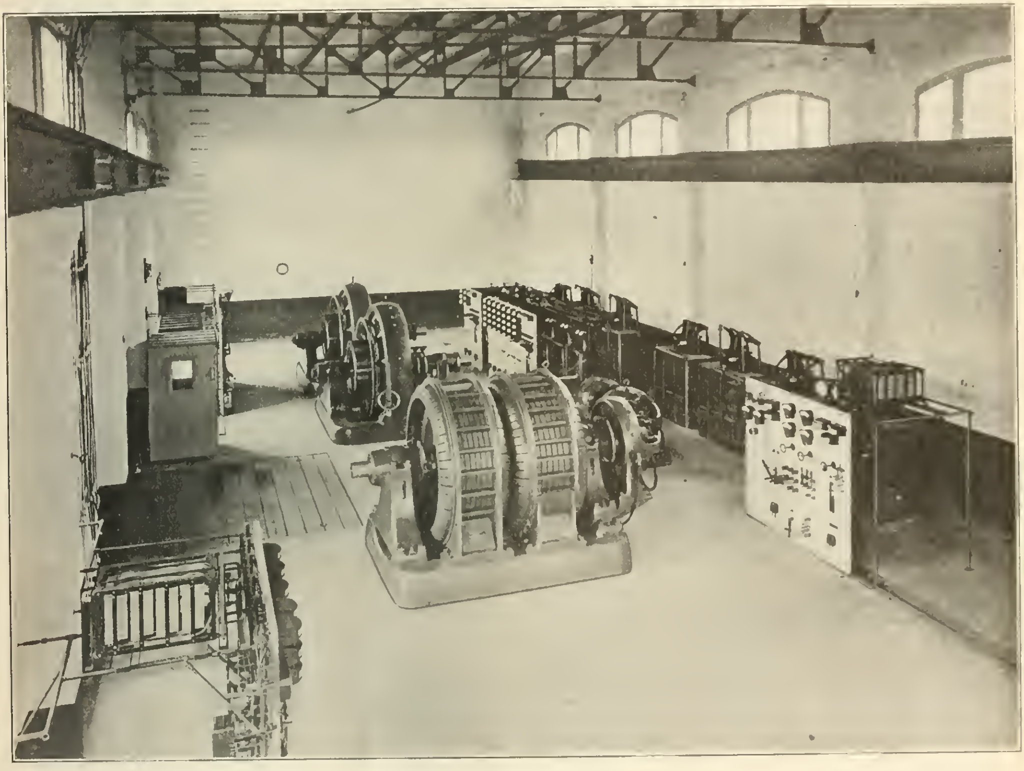


FIG. 2.—INTERIOR VIEW OF SUBSTATION "D," PORTLAND RAILWAY, LIGHT & POWER COMPANY.

By means of numerous tie lines and interconnections of the 10,000-volt system, operating conditions are such as to allow the shutting down of sections of the 10,000-volt feeders at such times as is necessary on account of construction or other work. It is proposed in the near future to run a feeder from substation "c" across the Columbia River to Vancouver, Washington, installing at that point a substation.

The Upper Willamette Valley system derives energy mainly from Station B, Oregon City, although the water-power plant at Silverton is operated during periods when the water is plentiful. A 20,000-volt transmission line, which is over 18 miles long, connects Silverton and Salem, and this line branches off to Woodburn and intervening towns.

The generating station for the Vancouver system is located in the town of Vancouver. The equipment consists of 2300 volts, 60-cycle, two-phase generators, and the system is soon to be tied in with the Portland system.

Mr. F. G. Sykes is the general manager of the light and power department of the Portland Railway, Light & Power Company and to him we are indebted for many courtesies extended in the preparation of these articles. The hydraulic engineer for the company is Mr. T. W. Sullivan. The mechanical and electrical installation is looked after by Mr. O. B. Coldwell and the transmission lines by Mr. H. S. Sladen. These three men comprise the engineering staff of Mr. Sykes' office. W. S. Barstow & Company, of New York, had much to do with the design of all the stations. The officers of the company are as follows: President, Mr. B. S. Josselyn; vice-presidents, Mr. F. I. Fuller and Mr. H. L. Clark; assistant secretary and treasurer, Mr. C. N. Huggins; secretary and assistant treasurer, Mr. G. L. Estabrook. The directors are Messrs. B. S. Josselyn, F. I. Fuller, H. L. Clark, C. N. Huggins, A. C. Bedford, Frederick Strauss, Ogden Mills, Frederick V. Holman, C. M. Clark, F. G. Sykes and Samuel G. Reed.

The Magnetite Arc.

By G. M. Dyott.

In the issue for Dec. 7, 1907, a description was given of the magnetite arc burning under ideal conditions. Such a state of affairs, however, rarely exists in practice, so that care must be exercised in preparing electrodes for commercial purposes, in order that the performance of the lamp may be satisfactory throughout the life of the electrodes.

The development of flame arc carbons has required years of careful investigation to bring them even to their present state of perfection, so that it is only reasonable to expect great improvements in the manufacture of magnetite electrodes also, which, on account of their high efficiency and other excellent qualities, open up great commercial possibilities for the magnetite arc lamp.

The magnetite or luminous arc is more stable on relatively large currents, but for a given arc length and composition of electrode there is a certain current value which it is not advisable to extend. A number of tests were made to ascertain the current most suitable to use with various arc lengths, and to this end a ⅝-in. electrode was prepared, consisting of 60 per cent of Fe_3O_4 (magnetite iron ore), 27 per cent TiO_2 (titanium oxide) and 13 per cent of $FeCr_2O_4$ (chrome iron ore). A large number of readings were taken of the voltage, current and arc length and these were plotted in the form of curves, which are shown in Fig. 1. These curves only apply to an electrode of the composition noted above, used in conjunction with a copper positive electrode, and burning with the negative electrode in the lower holder of the lamp.

In these curves the first point of interest to note is that a drop of approximately 7 volts occurs between the electrodes when they are in actual contact, and that on separating them 1-10 of an inch the potential rises sharply to approximately 35 volts. On further separating the electrodes the voltage rises fairly uniform until a point on the curve is reached, where the voltage once more abruptly rises. This point, which is marked with a cross on each curve, is analogous to the hissing point of the carbon arc and determines the maximum length of flame which it is practicable to use with that particular current. Experience, however, has shown that for commercial work the arc length should, at least, be from 25 to 30 per cent shorter than that indicated by this point.

In order to determine the relations existing between arc length, wattage, etc., another series of curves was plotted, as shown in Fig. 2, giving the power taken by the arc at various currents and arc lengths. From these curves it is evident that if a ¾-in. arc is desired a current of not less than 4 amperes should be used, and preferably 5 or even 6 amperes. When considering these curves it must not be forgotten that the arc is more luminous at the negative end, and the higher the current used the farther away from the negative electrode does this luminous portion extend. In a 6-10-in. arc, for instance, using a current of 3½ amperes, the power consumed is approximately 390 watts, and if 6 amperes were used practically the same power would be required. In the first case it will be noticed that, since this part of the curve lies above the hissing point, the arc would be very unstable. With 6 amperes the arc would not only be very steady, but the total flux of light emitted by it would be almost doubled, due to the extension of the luminous zone over the entire vapor bridge. Fig. 3, which represents a ⅝-in. arc burning with a current of 6 amperes, illustrates this point very clearly, especially when comparison is made with Fig. 4, a photo of the same arc taking only 4 amperes.

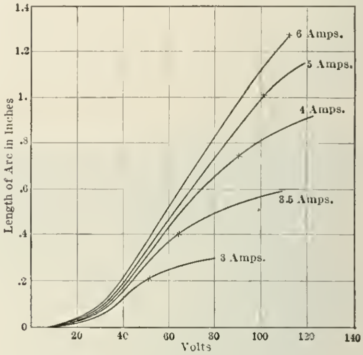


FIG. 1.—RELATIONS OF VOLTAGE, CURRENT AND ARC LENGTH.

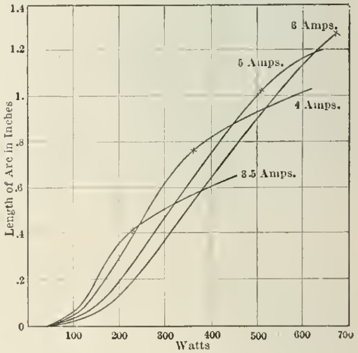


FIG. 2.—RELATIONS BETWEEN ARC LENGTH AND WATTAGE.

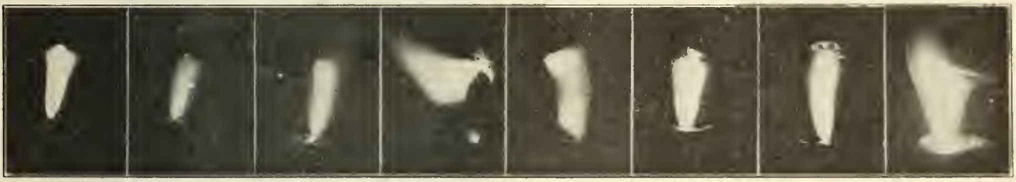
Since on low currents this highly luminous area is confined to the lower extremity of the arc and is in close proximity to the pool of the molten slag, from which it issues and which acts as a reflector (see Fig. 5), it has been claimed that more economical results could be obtained by burning the arc upside down. There is no doubt but what such an arrangement gives an entirely different light distribution curve, in which the maximum intensity of illumination is approximately 80 deg. below the horizontal, but it is questionable whether the total flux of light for the same current and arc length in each case is not considerably less with the inverted arc.

A comparison should be made between Fig. 3 and Fig. 6, showing the two types of arcs, each consuming the same current. The extent of the luminous zone in either case is apparent.

The particular field of illumination for which the magnetite arc is most adapted is series street lighting, and, since for such work the maximum intensity of illumination should be between 25 deg. and the horizontal, and not directly below the lamp, it is doubtful whether the small saving in power consumption of the inverted arc overbalances the better distribution of light obtained by using the negative in the lower holder of the lamp. If the only features of consideration were those involving the mechanical design of the lamp the inverted type would probably show up to better advantage.

Any one who has had experience with the magnetite arc has noticed that at certain periods the arc loses all of its peculiar brilliancy, turning a sickly yellow color. These occurrences last from a few seconds up to several minutes and seriously detract from the striking quality of the light. It has been observed that these yellow streaks occur more frequently toward the latter end of the life of an electrode, and, it was therefore supposed that poor mixing of the ingredients was the cause, but repeated experiments along these lines showed that, while the effect was appreciable, yet it was not entirely responsible for the phenomenon.

It was then supposed that the copper positive electrode might in some way be responsible for it, and a number of tests were therefore made, using positive electrodes of the same dimensions, but made out of different materials, one of iron, one of brass and one of copper. The lower electrode was not changed.



FIGS. 3 TO 10.—PHOTOGRAPHIC VIEWS OF THE MAGNETITE ARC

For a period of 100 hours these arcs were burned alongside one another, and the peculiarities of each carefully noted. At the end of this time the following facts were observed: (a) That the arc used with the iron upper electrode gave the most yellow streaks, and that used with the brass electrode gave the least yellow streaks; (b) that the consumption of the iron electrode was ¾ in. per 100 hours, that of the copper 1-16 in. per 100 hours and that of the brass practically nothing; (c) that the iron positive electrode continually took up globules of molten matter from the negative electrode, that the copper positive electrode did so also to a certain extent, but that the brass electrode remained fairly clean.

From these observations the following deductions might be drawn:

1. That the composition of the upper electrode is not directly responsible for the yellow streaks, otherwise the iron upper electrode would not have given so many, for the oxide of that metal tends to give a bluish-white color to flame; 2. Since the fault is not in the composition of the upper electrode, it must be due to the lower electrode and must be caused by some material in that electrode; 3. It cannot be Fe_3O_4 (magnetite iron ore), for that gives a bluish-white flame; 4. It cannot be TiO_2 (titanium oxide), for that gives a pure white flame; 5. The fault must, therefore, be in the $FeCr_2O_4$ (chrome iron ore). It cannot be entirely due to impurities, for all carbons were the same in each lamp; therefore, it must be due to the material itself.

The solution presumably is as follows: The upper electrode has a globule of molten matter adhering to it. The extreme heat volatilizes the magnetite iron ore readily; the titanium oxide is the next to volatilize and chromium remains behind; hence, the reason why the iron electrode gave the most streaks, more globules adhered to it, and therefore chromium appeared in excess.

It was also found that after a globule had been deposited on the upper electrode and the arc was allowed to play on it for a short time, and then transferred to the lower electrode, a very brilliant and fierce arc ensued, showing an excess of titanium oxide; but if another globule was allowed to stick to the upper electrode for a considerable length of time, and then transferred to the lower electrode a yellow arc was the result, showing that magnetite iron ore and titanium oxide had been consumed, leaving chromium behind.

Spectrum analysis also showed chromium to be present, giving the three characteristic lines in the green. These were predominant during the yellow streaks. This then accounts for the yellow streaks being prevalent after the electrode has burned some time; the chromium is not consumed at the same rate as the other materials and, hence, collects in excess. To avoid these disagreeable yellow streaks it is advisable to use as small an amount of chromium as possible, or, better still, to incorporate certain salts in the electrode, which will act as a flux, preventing the local accumulation of any one ingredient.

In the foregoing tests it appears that a brass positive electrode keeps considerably cleaner than does a copper electrode, and the writer, therefore, advocates the use of certain grades of this material, since the condition of the upper electrode has some bearing on the behavior of the arc. It is, of course, known that on reversing the direction of the current through the lamp the arc undergoes a remarkable change, clearly shown in Fig. 7 Not only does the flame lose in brilliancy, but that part of it adjacent to the anode gives practically no light at all. This being the case, if under ordinary conditions a globule of slag adheres to the positive electrode, and the arc plays upon it, the luminosity of the upper part of the flame diminishes in intensity. This condition is shown in Fig. 8, a photograph which was taken several minutes after the arc had started. Fig. 9 shows the same arc taken at the instant of throwing it on the circuit and when the anode was quite cold. This seems to indicate that the temperature of the positive is responsible for the phenomena, and emphasizes the importance of preserving as clean a surface as possible on the anode. It might be well to add that when the photograph shown in Fig. 7 was taken there were traces of titanium oxide on the copper electrode, hence the reason for the luminous area at the upper end of the flame.

In conclusion it might be well to state that when preparing electrodes the various materials should be in as finely a divided state as possible. Should the ingredients occur in concentrated masses throughout the electrode the arc will not burn with a uniform color. For instance, if the arc issues from a point where magnetite only is present the flame turns blue and presents a very smoky appearance, as shown in Fig. 10. While such refinements may appear trifling, they have considerable bearing on the commercial success of the lamp and should by no means be overlooked

Electric Furnaces for the Iron and Brass Foundry.

By John B. C. Kershaw.

Electricity is undoubtedly an expensive heating agent, and, at first sight, proposals to employ it for producing molten metal for casting may appear to be not worth the consideration of practical men.

The equation for the heat equivalent of the output from an engine when converted into heat, by causing the electric current produced by it to pass through a resistance, is the following:

$$H = .393\,\eta\,P$$

in which H represents the heat produced per second in pound-centigrade units, P represents the indicated horse-power of the engine, and η represents the combined efficiency of the engine and the dynamo.

In a generating plant of the most modern type with a combined efficiency of engines and dynamos of 85 per cent, and using 3.5 lb. of coal per kw-hour generated (equivalent to 2.6 lb. per electrical hp-hour) the following comparison may be made: Heat produced by burning 2.6 lb. of coal, testing 7900 centigrade units per lb. = 20,540 units.

Heat produced by one hp-hour after conversion into electric energy, and use of this energy to produce heat:

$$.393 \times 1 \times .85 \times 3600 = 1201 \text{ lb.—centigrade units.}$$

The ratio between the heat available in the coal burned and that produced by electric energy is thus $\frac{20,540}{1201}$, or $\frac{17}{1}$, and as already stated, when studied in this manner, the proposal to employ electric methods of heating in the iron and brass foundry seems to offer no practical advantage. Even should the electric energy be generated by means of waterfalls, the economic advantage would seem to be on the side of the use of coke for heating purposes, unless the energy could be sold to the consumer at a very low rate, about one-half the lowest rate yet quoted for electric energy, even in Norway and Switzerland. Unless, therefore, some very important and valuable advantages result from the use of electricity as a heating agent, its application in the iron and brass foundry is an innovation which must be long postponed. It is the purpose of the writer in this article to point out what these advantages are and to describe some of the forms of furnace which might be employed for this special purpose.

ADVANTAGES OFFERED BY ELECTRIC METHODS OF HEATING.

The first and most important of the advantages is that the heat can be generated where it is required; that is, within the mass of metal to be melted, and that the efficiency of the resistance type of furnace may by careful work be raised to over 75 per cent. The losses from radiation and conduction are, in fact, greatly reduced as compared with the usual methods of work. How large the heat losses are in metallurgical operations, as ordinarily carried on, can be gaged from the following tabular statement prepared by Prof. Burgess, of the University of Wisconsin:

Product.	Type of furnace.	Per cent thermal efficiency.
Cast iron	Blast	52.6
Steel	Acid process	11.9
Steel	Basic process	10.0
Pig iron	Reverberatory	8.5
Wrought iron	Reverberatory	5.0
Steel	Siemens crucible	4.0
Steel	Greenwood crucible	2.0

The blast furnace stands in a category by itself, and it will be many years before it is displaced. The values for the efficiency of the furnaces used for producing steel and wrought iron were calculated by comparing the heat theoretically required to raise the metal to the molten state with that present in the fuel actually required to produce the effect in practice.

If these efficiencies be accepted as correct, the superior economy of direct heating by fuel largely disappears, for when from nine-tenths to nineteen-twentieths of the heat value of the fuel is lost, and only from one-tenth to one-twentieth is successfully utilized, the two methods of heating are practically on a level.

A second advantage offered by electric heating is that the furnaces and crucibles would have longer life than by the usual methods of work, since they would not be exposed to any external heating, and the highest temperature would be attained within the mass of metal they contained rather than at the exterior of the furnace or crucible walls. Another advantage no less important is that the metal during the melting operation need not be exposed to the air or to the products of combustion of the fuel used, and that, therefore, some of the losses due to the formation of oxides and dross would be avoided. In the melting of the finer kinds of steel, the possibility of conducting the melting operation under the surface of a protective flux or in an inert atmosphere is of considerable value. The final advantage which will be named here is the cleanliness with which the melting of the metal could be carried on. When coal or coke is employed for heating furnaces or crucibles, a certain amount of the ash of the fuel, which is always present as dust in the atmosphere of the building, must get into the molten metal, and the silica, which is the main constituent of this ash, may have prejudicial effect upon the physical properties of the finished metal. With the better forms of electric heating the contamination of the product is impossible, and the chemical constitution of the finished metal can, therefore, be more accurately gaged and controlled.

ELECTRIC FURNACES SUITABLE FOR MELTING IRON AND BRASS.

Electric furnaces are of either the arc or the resistor type. In this article only furnaces of the latter class will be described, since arc furnaces are not suited for the work required.

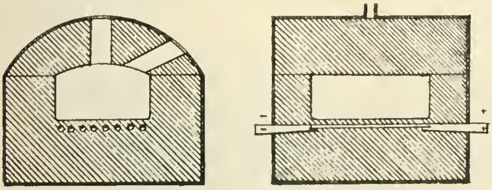
Electricity can be employed for resistor heating in several ways. In furnaces of the first type the crucible is embedded in infusible resistor material, such as granulated carbon, carborundum or "kryptol," and the heat effect is produced by heat transmission through the furnace walls. This type of furnace sacrifices some of the high efficiency expected with the adoption of electric heating, since the heating is external and the losses from radiation may be fairly high. In furnaces of the second type the metal to be melted is used as the resistor; that is, the heat is generated internally and the full advantage of electric heating is obtained. The electricity in this type of furnace is either passed directly through the metal by aid of a suitable conducting medium, or the heat effect is produced by induced currents, using the metal to be melted as the secondary circuit of a furnace erected on the transformer plan. In all cases alternating current is used, since this is more easily controlled than direct current, and the dangers of electrolytic action are obviated.

The temperatures required will range from 900 deg. C., equivalent to 1652 deg. Fahr., for melting brass, up to 1375 deg. C., equivalent to 2507 deg. Fahr., the temperature at which steel melts. The actual current strength required with the particular furnace employed can be ascertained only by actual experiment. The e.m.f., of course, varies with the thickness of the resistor between the two current terminals and it will generally be found best to work with a current supplied at low e.m.f., say, from 50 to 100 volts. The following figures from an article by Vogel upon electric resistor furnaces using solid carbon electrodes as the resistor material will serve as a rough guide to the current strength demanded:

Temperature.	Amperes per sq. mm of cross-section of carbon resistor.
590° C.	.25
710° C.	.33
990° C. brass melted	.45
1,110° C.	.54
1,210° C. cast iron melted	.66
1,600° C.	1.20
1,850° C.	1.60
2,300° C.	2.00

The limits of temperature between which the furnaces for brass and steel melting would operate are, therefore, represented by current densities of from .45 to 1.20 amperes per square mm of cross-section of the resistor material, when this in solid carbon. With the other materials—granulated carbon, graphite and carborundum—the current densities will be somewhat lower, since their electrical conductivity in the granulated state will be less than that of solid carbon electrodes.

One of the earliest electric resistor furnaces designed was patented by Faure in 1883. Figs. 1 and 2 show the construction of this furnace, which was built of firebrick on the usual lines of a reverberatory furnace, but in the bed eight channels were filled with resistor material. These resistors were connected, as shown in Fig. 2, to the current mains supplying electric energy at low potential, but large amperage. The heat produced in the bed of the furnace was thus communicated to the charge lying above it, and by varying the current intensity different temperatures could be attained. Although this furnace has not to the writer's knowledge been employed in electrometallurgy, its simplicity and adaptability to many purposes are points in its favor. Good heat insulation of the bed would be necessary, however, to prevent large losses by radiation.



FIGS. 1 AND 2.—FAURE'S RESISTOR FURNACE.

A crucible form of furnace, heated by an external resistance in which the crucible is embedded, is shown in sectional elevation in Fig. 3. This form of crucible furnace is the invention of Girod, and it is in use for the production of ferro-alloys not requiring a temperature above 1500 deg. C. at three works owned by the Société Anonyme Electro-metallurgique Procèdes Paul Girod.

Graphite, silicon and carborundum are employed as resistor materials with the Girod crucible furnaces. Furnaces of this type, each using 200 horse-power and producing from 1000 to 2000 kgs of ferro-alloys per day, have been successfully operated since 1903 in the three works at Ugine, Courtpin and Montbovon, and there is no doubt that these furnaces could be employed with success for melting steel or brass.

A detailed description of the erection of a small laboratory crucible furnace of the same type, using granular graphitized coke as resistance material, is given by Fitzgerald in the *Electrochemical and Metallurgical Industry*, February, 1905. Readers anxious to experiment with electric heating in the foundry are advised to consult this article, since details are given in it which cannot be reproduced here on account of the limits of available space.

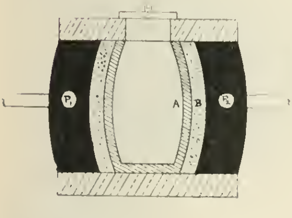
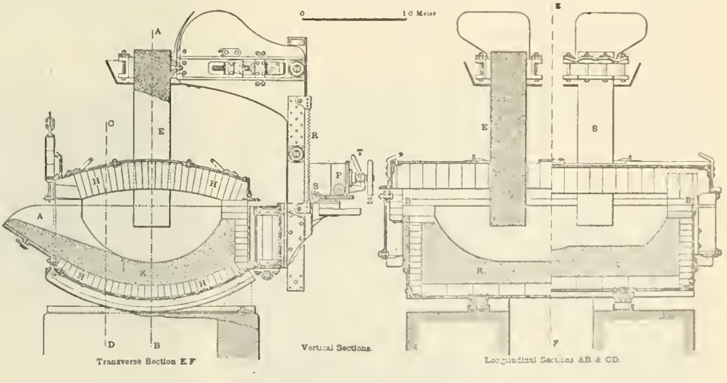


FIG. 3.—GIROD'S CRUCIBLE FURNACE.



FIGS. 4 AND 5.—HÉRAULT'S ARC AND RESISTOR FURNACE.

The crucible form of furnace heated by an external resistor can be adapted for either tapping or pouring the molten metal and can, therefore, be modified to suit foundry requirements.

Turning now to electrical resistor furnaces of the second and more economical type, in which the heat is generated internally by the resistance of the metal itself, four furnaces demand notice, namely those of Héroult, Keller, Kjellin and Colby.

In the Héroult furnace, shown in sectional elevation in Figs. 4 and 5, two massive carbon electrodes are employed to conduct the electricity into and away from the charge of molten metal contained within the furnace. These electrodes just touch the surface of the flux covering the metal, and the heat effect is produced by the resistance of the flux and metal lying between them. In order to adapt this furnace for melting operations and temperatures below 1500 deg. C. it is necessary to exclude the preliminary arc heating. This is effected by always leaving a third or more of the molten contents in the furnace after pouring. The carbon electrodes can then be kept in contact with the flux lying above this residual metal, and the resistor heating can be continued while fresh raw materials are charged. The possibility of increasing the carbon contents of the finished metal is always present with the Héroult furnace when used in this way, and, therefore, it is not adapted for melting the finer varieties of iron and steel. The choice of a suitable protective flux, which shall act as a heating medium, and yet be without action on the constituents of the molten metal, is also another difficulty connected with the operation of the Héroult furnace for foundry purposes.

The Keller resistor furnace is shown in sectional elevation in Fig. 6. In principle it is the same as the Héroult furnace, but the constructional details differ. The massive carbon electrodes are separated, and each is enclosed in a vertical shaft, these shafts being connected below by a lateral canal. The electricity passes from one electrode to the other, by the materials present in these two shafts and in the lateral canal.

The modifications required to adapt it for foundry work are those already named in discussing the Héroult furnace, namely, the prevention of arc-heating by only partial discharge of its contents and the provision of a suitable flux or slag, to protect the molten metal from contact with the electrode carbons or with the atmosphere. This furnace is designed for discharge by tapping.

The last types of resistor furnace which will be referred to in this article are the induction furnaces of Kjellin and Colby. Figs. 7 and 8 show views of the Kjellin furnace. It is in effect a large transformer, in which an alternating current of low amperage, but high voltage in the primary coil *A*, is transformed into a current of large amperage, but low voltage in the secondary coil of the apparatus, which in this case is the molten metal and flux contained in the annular ring *B B*. The Colby furnace is similar in design, the chief difference being that the primary coil is made of copper tube, and is kept cool by water flowing through it during the operation of the furnace. Fig. 9 is a photograph of a small 15-kw experimental Kjellin furnace built at Messrs. Vicars' Steel Works, in Sheffield, England, while Fig. 10 is a photograph of a 300-kw furnace in operation at the Gysinge Works, in Sweden.

It will be observed that both these furnaces are mounted on trunnions so that they can be tilted for discharge. The smaller furnace will melt 30 lb. of metal in from 20 to 30 minutes, and it operates at a power factor of from 57 per cent to 60 per cent. The larger furnace produces 4100 kg (9000 lb.) of steel ingots per 24-hour day in fine castings, 800 to 1000 kg of metal being poured at each stoppage. The energy consumption is 866 kw-hours per ton of 2000 lb. The corresponding values for the 40-kw Colby furnace erected at the Tacony Works of Messrs. H. Disston & Sons, near Philadelphia, are from 550 to 750 kw-hours per ton of 2000 lb., 90-lb. ingots being poured off hourly, and 100 lb. of molten metal being left in the furnace as basis of the next charge.

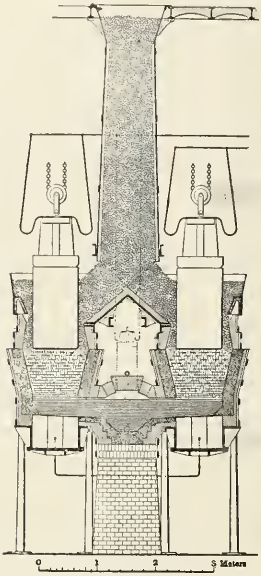


FIG. 6.—KELLER'S RESISTOR FURNACE.

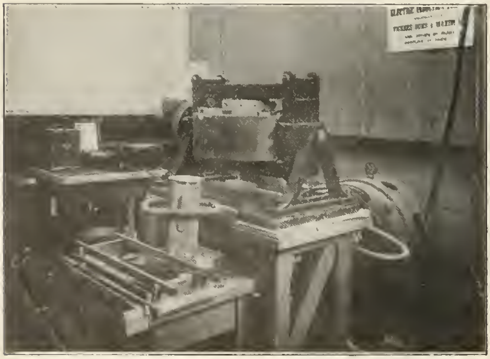
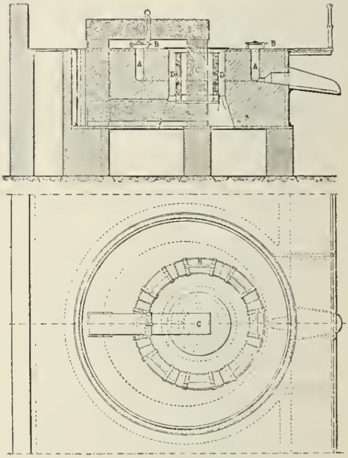


FIG. 9.—KJELLIN FURNACE AT SHEFFIELD.

In this furnace the fusion of the metal was effected in 30 minutes, and a further 30 minutes heating was required to complete the refining process.

CONCLUSIONS.

The above figures give some indication of the energy that would be required in the practical operation of these furnaces for melting steel or brass, since about one-half the electric energy is employed to effect the refining process. As a general rule, one may estimate that from 400 to 500 kw-hours would be sufficient to melt one ton of metal in these resistor furnaces with internal heating, and that with cheap electric energy (say, $10 per hp-year) the cost would not exceed 75 cents per ton. The writer does not suggest, however, that a large furnace for electric heating of the metal required daily in any brass or iron foundry should be erected without preliminary trials in the laboratory or upon a small industrial scale. Each case will demand special consideration by an expert electrometallurgist with no private axe to grind, and it is quite certain that there will be many cases in which no change can be recommended, as there would be nothing gained by substitution of electric for the ordinary methods of heating.



FIGS. 7 AND 8.—KJELLIN'S INDUCTION FURNACE.

In particular cases and industries, however, especially those relating to the production of fine castings in iron, steel or brass, electrothermal methods have much in their favor, while the facts and values given in this article prove that the electric method of working may compare favorably as regards cost with the older process.

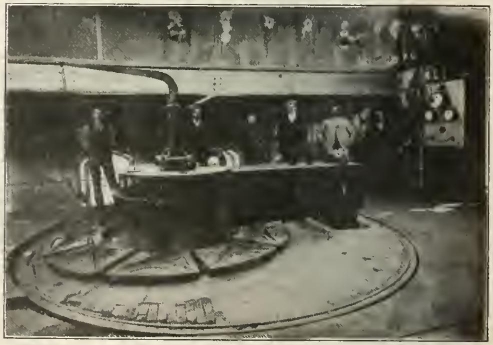


FIG. 10.—KJELLIN FURNACE AT GYSINGE.

cal energy will be $f \triangle s$. The electromotive force will be $Hl \frac{\Delta s}{\Delta t}$, the electrical power will be $H l \frac{\Delta s}{\Delta t} i$ and the electrical energy $H \ l \ \triangle \ s \ i$. This energy must equal the mechanical energy; hence $H l i = f$. The above equations are absolutely general, and they apply under every conceivable condition.

As a result of the relations shown by the above expression for electromagnetic force, each element of a conductor carrying a current in a magnetic field experiences a force which varies directly with the product of the current and the "main field"; the main field being considered as that flux which would cause an e.m.f. to be generated in the conductor if it moved under the action of the force. The value of this force is altered only when changes are made in either the current in the conductor or in the main field. Contrary to the interpretations which one is compelled to give to the usual explanations of electromagnetic force, the force does not bear any simple quantitative relation to the flux which surrounds a conductor locally, although qualitatively the conception of the distorting influence of the local flux upon the main field flux is of help in assigning direction (not value) to the force.

In this connection it should be noted that the direction of the force is not *always* from the position where the flux is densest to the place where the lines are more widely scattered, the usual explanation to the contrary notwithstanding. In a main field that is normally not uniform the force may tend to move the conductor toward the denser field.

New York, N. Y. A. S. McAllister.

Cutting vs. Looping Lines of Force.

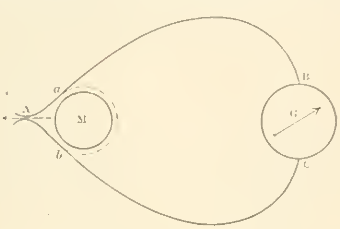
To the Editors of Electrical World:

Sirs:—I have read with much interest Mr. Hering's article in your issue of March 14, on "A New Factor in Induction; the 'Loop' vs. the 'Cutting Lines of Force' Laws," and also a similar article by the same author in the *Proceedings* of the American Institute of Electrical Engineers for March. While agreeing with Mr. Hering that, in many cases, Faraday's statement of the fundamental law of electromagnetic induction may be "simpler," "safer," "more direct" and "much easier for students to learn and comprehend" than Maxwell's, I cannot see that Maxwell's statement of it is "imperfect and that it requires to be modified in order to become universal."

If I may be permitted, I should like to offer through your columns an explanation of Mr. Hering's experiments which does not make them conflict with Maxwell's statement of the fundamental law of electromagnetic induction, and which does not seem to the writer to add any "conditions," "restrictions" or "complicated interpretations" to Maxwell's law as it is *ordinarily* understood.

In discussing in your journal one of Faraday's own experiments, Mr. Hering added a dotted line to Faraday's original figure "to indicate the center line of the path of the current or the completion of the electric circuit." It seems to the writer that the entire copper strip must be considered part of the galvanometer circuit according to Maxwell's use of this word, and that there are no lines of magnetic induction linking this circuit. Inside the copper strip itself there is an infinite number of electric circuits. When these circuits are moved across the magnetic field, an electromotive force is produced in these circuits and eddy currents are caused in the copper strip (unless the field is uniform over the entire strip). The current through the galvanometer is due to the fact that it is shunted across some of these circuits. When the magnet and copper plate are moved together, there is no change in the flux enclosed by *any* circuit and therefore no electromotive force or current produced.

The experiment described in the *Proceedings* of the American Institute of Electrical Engineers is capable of a similar explanation. The accompanying illustration shows very simply Mr. Hering's experiment. *M* is the section of a magnet perpendicular to the plane of the circuit *A B C*, which is in series with the galvanometer *G*. If *M* is suddenly removed from the circuit in the direction shown by the arrow, the original circuit opens at *A*, but the galvanometer circuit is never broken, because it is completed through the magnet. In this case Mr. Hering found that there was no current induced in the galvanometer circuit, and concludes that "it is possible to link and unlink a flux with a closed electric circuit without any induction." The writer cannot see that Maxwell's law would lead us to expect any current in this case, for it does not seem that there has been any true unlinking of magnetic lines from the *galvanometer* circuit. In order to explain what apparently takes place, suppose that, before the magnet is moved, the galvanometer is shunted by the wire *a b*. Now, if the circuit *A a b* is opened at A, the magnet can be removed in any way desired without producing an electromotive force in the galvanometer circuit and yet the galvanometer circuit has not been broken. The above seems a fair analogy of what happens in Mr. Hering's experiment. As soon as the magnet comes in contact with the wires *A B* and *A C*, the entire magnet becomes a part of the galvanometer circuit and there are no longer any lines of magnetic induction linking this circuit. Mr. Hering states that the flux was unlinked without opening the circuit. This is true, if he refers to the galvanometer circuit, but not if he refers to the circuit which originally contained the flux.



GALVANOMETER CIRCUIT.

If the above analogy is true, then it is not established that "it is possible to link and unlink a flux with a closed electric circuit without any induction."

McGill University. Howard L. Bronson.

To the Editors of Electrical World:

Sirs:—The experiment of Faraday, as discussed by Mr. Carl Hering in your issue for March 14, it seems to me, can be explained on the basis of Maxwell's statement of the "law of electromagnetic induction." Referring to Fig. 1, reproduced from Mr. Hering's article, as the strip *C* is moved in the direction of the arrow the flux enclosed by the galvanometer circuit is increased provided all of the strip *C* is included in the circuit (as it properly should be), due to the increasing area enclosed by the electric circuit. If, however, the strip *C* and magnet *N* are simultaneously moved in the direction of the arrow the area enclosed by the electric circuit is increased and the flux per unit of area is decreased and there will be no appreciable resulting e.m.f. generated in the electric circuit.

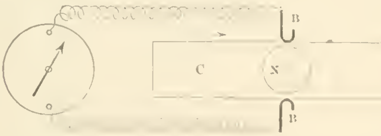
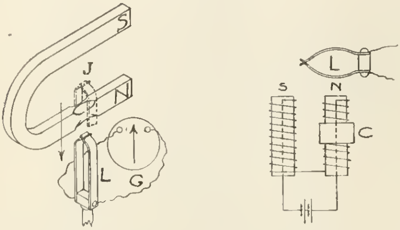


FIG. 1.—FARADAY'S EXPERIMENT

In his recent paper on "Electromagnetic Induction," published in the *Proceedings* of the American Institute of Electrical Engineers, Mr. Hering claims to obtain unlinking of the electric and magnetic circuits when the spring-jawed strip of Fig. 2 is drawn over the horseshoe magnetic. I consider, however, that he has merely separated the electric circuit into two circuits, one of which is the spring-jawed loop and the other is the material of the magnet over which the loop has been drawn. The spring loop still encloses the leakage flux that it also enclosed when surrounding the bar of the magnet, and the material of the magnet encloses the flux through the bar of the magnet. Since the galvanometer is attached to that portion of the circuit which encloses the leakage flux only, and this has not appreciably changed, there will be no deflection. It is as though that portion of the electric circuit enclosing the main flux had been short circuited and then cut off from the loop.

This view of the experiment seems still further confirmed by an examination of Fig. 3, in which there are two loops surrounding the electro magnet, one being the copper ring and the other the spring-jawed loop *L*. When the spring loop is drawn over the ring what really takes place is as follows: The moment the springs touch the ring the electric circuit becomes short circuited and the flux through the solenoid is no longer enclosed by that portion attached to the galvanometer, hence the withdrawal of the spring loop does not affect the galvanometer because the only flux actually enclosed is the leakage flux outside of the solenoid and this does not appreciably change.



FIGS. 2 AND 3.—HERING'S EXPERIMENTS.

ELECTRA, CAL. J. P. JOLLYMAN.

Distortion in Telephonic Transmission.

To the Editors of Electrical World:

SIRS:—Mr. Louis Cohen states in his article on "Distortion in Telephonic Transmission" in your issue of Sept. 21, 1907, page 564, that "one vital point in connection with this subject was entirely overlooked by the preceding investigators," referring to an increase of resistance, which is, according to his calculations, about 7 per cent.

Mr. Cohen neglects totally the value of *K*, or coefficient of leakage, which is assumed in his calculations to be zero. *K* can never be zero; the energy represented by E^2K is many times—1000 to 10,000 times—greater than that customarily calculated from the formula I^2R. I have measured by my barretter method the value of *K*, and have never found it 10^{-6} mho, but always greater. The increase of *K* with frequency is very rapid. Taking the values of *K* in the following correct formula of β we have the following results:

$\omega^2 =$	K =	$\beta =$	$\frac{\omega}{2\pi} =$ c a.
4×10^7	10^{-6}	18.4×10^{-4}	1000
4×10^8	5×10^{-6}	31.6×10^{-4}	3000
1.4×10^{-9}	10^{-5}	47.4×10^{-4}	6000
3×10^6	5×10^{-5}	$173. \times 10^{-4}$	9000
6×10^9	10^{-4}	$330. \times 10^{-4}$	12,000

where the values of *L, R, C* are the same as those given by Mr. Cohen, but with a value of *K* which varied with the frequency between 10^{-6} and 10^{-4} mhos per mile. It will be seen that the difference between this calculation and that of Mr. Cohen is very great. I find that European telephone receivers do not respond to frequencies higher than 8000, and thus the distortion caused by an aerial line is not so serious.

A distortionless circuit of 6000 frequency, β, would correspond to $\sqrt{10^{-5}} \times 2 = 44.7 \times 10^{-4}$; that is, very near to the (calculated) 47.4×10^{-4}. $\frac{R}{L}$ would be $\frac{2}{4 \times 10^{-3}} = 0.5 \times 10^{-3}$, or about the same, while $\frac{K}{C}$ varies as 10^2, 5×10^2, 10^3, 5×10^3, 10^4.

The main variation is caused by *K;* this is the vital point which I had pointed out in the *Electrician,* 1906, Nov., p. 81, and I should be glad to have that investigation known to American telephone engineers.

BUDAPEST, HUNGARY. BÉLA GÀTI.

Patent Abuses.

To the Editors of Electrical World:

SIRS:—The writer finds it impossible to withstand the temptation to add his mite to the interesting United States patent discussion in your valuable paper by Mr. H. Ward Leonard, Mr. Ludwig Gutmann and Mr. J. Nikonow.

I have had considerable experience in the matter of patent litigation and United States patents in general, and I most heartily agree with the gentlemen above-mentioned that something radical needs to be done, and done quickly. The company with which I am connected has suffered acutely during the past four or five years as the victim of trumped-up patent litigation and no remodeling of the United States patent laws will be adequate or just which does not take into consideration this very important detail.

We have had the experience of having two electrical manufacturing corporations join together, employ a large firm of patent attorneys and begin wholesale patent litigation, without even writing a letter of protest or suggesting to us in any way, shape or form that they considered their patents infringed upon. Long-drawn-out and exceedingly expensive litigation has been the result. The culmination in part of the cases has been that the patents have been declared invalid by the courts. In the majority of the remaining cases the complainants, after hearing our testimony, have come into court and asked for a dismissal of the cases at their expense, without a hearing by the judge. Some of the cases still remain and are to be classed with those already disposed of.

The firm to which I have referred has employed some of the best legal talent in the country and conferred with a large number of electrical manufacturing companies before deciding to stand suit on these cases. The unanimous judgment of those consulted has been that the litigation has no foundation in justice and was apparently brought simply for the purpose of driving smaller electrical manufacturing companies out of competition with larger concerns.

I took the matter up with the Department of Justice at Washington, D. C., and after laying before the department the facts in the case I concluded my letter with this sentence: "Now, to put the matter briefly, can you do anything for us?" I shortly received a long communication in reply and quote the letter in part, as follows: "You state that these companies are harassing you by the institution of trumped-up patent litigation. You will, of course, readily appreciate that the government is powerless to prevent the bringing of suits by corporations or individuals who believe that they have a cause of action against another corporation or individual."

This statement of the facts shows the need of new legislation. It seems to the writer that a patent law should be passed which would make it obligatory on the part of the government to investigate such conditions, and where any corporation or individual is found guilty of being engaged in malicious prosecution of its competitors by trumped-up patent litigation, that the government should forthwith declare invalid every patent owned, controlled or assigned to such corporation, and should in the future deny every privilege of the United States Department of Patents to such corporations or individuals.

Another feature of patent abuse, under present conditions, is that the large corporations seem to obtain a class of patents that individuals and small concerns cannot get. The concern to which I refer has applied for United States patents on details which it seems to the writer were exceedingly meritorious and belong to a class upon which the large electrical manufacturing companies obtain patents right along, and yet our applications have been returned with such a string of citations as to immediately kill every hope of ever securing anything like a reasonable consideration of the application.

It has long been considered by the thoughtful owners of small and medium-size manufacturing establishments that a policy of secrecy concerning important improvements in details is often a much better course to follow than to give away the details of the improvement to the Patent Office and have it gobbled by unscrupulous and monopolistic manufacturing interests; and it is the writer's opinion that under present conditions a large class of inventions are better protected by a policy of secrecy than by United States patents. This is particularly true of processes of manufacture and of details of machines not usually subject to being dissected by the owner or by large competing concerns. There is a huge amount of arrogance and overbearance of disposition which characterizes some very large electrical manufacturing concerns, and a smaller concern may have a very superior article and do a nice business for a long time before the former find it out. This period of time may not be 17 years, but when the disadvantages of the patent situation are considered, a policy of secrecy may be quite as productive in the way of dollars and cents.

Under present conditions, letters patent are mostly licenses to begin law suits, and if the Electrical World can, through its valuable columns, be the means of helping to rectify United States patent abuse, it will have rendered a service of which it may well be proud.

Minneapolis, Minn. C. H. Chalmers

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

High-Speed Dynamos.—G. Stoney and A. H. Law.—A paper read before the (Brit.) Inst. Elec. Eng. indicating the chief features of the modern types of turbo-generators. The authors first discuss direct-current generators and deal with the effect of the compensating winding used by Parsons & Company. The advantages of a compensating winding are not only fixed brushes and better commutation, but the number of segments for any certain voltage may be reduced and the ampere-turns on a given diameter of armature may be increased. The change enables a larger output to be obtained for a certain speed or a higher speed to be used for a given output. Before compensating was adopted, 500 kilowatts at 1800 r.p.m. was the extreme limit of size for that speed, and the machine would not carry more than 10 per cent overload. At present, there is a 500-kw machine running at 3000 r.p.m. and a 750-kw machine running at 1800 r.p.m. carrying 30 per cent overload without sparking, and 50 per cent for a short time without injurious sparking. This improvement has enabled not only the cost of the turbine to be largely reduced, but also the steam consumption to be lowered by some 10 per cent. There is no difficulty in running such compensated dynamos in parallel with one another or with other types, although in all cases they are self-exciting. Brass-wire brushes running on a grooved commutator give the best results. The author deals with the design of high-speed alternators and discusses the question of ventilation. In selecting material for high-speed work, it is most desirable not to obtain high tensile strength at the expense of the ductility of the material. Reference is finally made to Parsons and Law's method of compounding alternators which avoids the difficulties where compounding is obtained by commutating the alternating current, by saturation or by altering the effective resistance of the magnet winding. The exciter is provided with an alternative path for the magnetism in parallel with the armature, which is called a "leakage path." This "leakage path" is provided with a winding, which is in series with the stator winding, and as the alternating current in this rises it chokes back the magnetism, or, in other words, increases the magnetic reluctance of the leakage path. Thus more flux goes through the armature, and, therefore, the voltage of the exciter rises and compensates for the tendency of the main voltage to drop. In a three-phase alternator there is generally one leakage path in each phase, and, if the primary current is at high voltage, a series transformer is generally used. These leakage paths are easily adjusted for any desired amount of compounding, or for any power factor. Fig. 1 gives the comparative regulation on varying load with and without the leakage path in action.—Lond. *Elec.*, April 3.

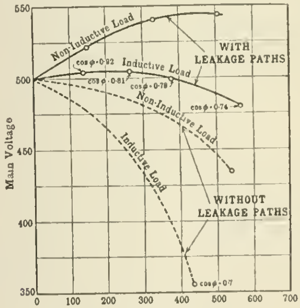


FIG. 1.—VOLTAGE REGULATION.

Rotary Converter.—E. J. Berg.—A continuation of his long mathematical serial in which he discusses the heating of rotary converters when supplying unbalanced load in a three-wire system, the neutral being derived from the transformers.—*Gen. Elec. Rev.*, April.

Three-Phase Motors.—W. Oelschlaeger.—A translation in abstract of his recent German paper on a method of calculating the short-circuit current in three-phase motors.—Lond. *Elec.*, March 13.

Lamps and Lighting.

Tungsten Lamp.—A. Lottermoser.—An article on Kuzel's method of making metallic filaments for incandescent lamps by the colloidal method of Kuzel. The author emphasizes that his notes are based not alone on Kuzel's patents, but on repeated visits to the factory of Julius Pintsch, who manufactures the Kuzel tungsten lamp. The tungsten is first comminuted to as fine a powder as possible by mechanical means. It is then subjected alternately to treatment with an acid and with an alkaline solution and washing with intermittent treatment with water. The tungsten (and many other metals, like molybdenum, titanium, silicon, thorium, etc.) thereby passes into the water as colloid and, therefore, becomes a "hydrosole." The colloid is then precipitated as a paste from the water by means of a suitable electrolyte. According to the author the nature and concentration of the electrolyte is very important, but he does not say what is used in practice. If the colloidal paste contains oxide (never more than 1.5 per cent oxygen) it can be easily reduced by heating in a reducing atmosphere of hydrogen. The further treatment of the filaments is the same as used in other processes. The filaments when pressed and dried are almost non-conductors of electricity. When heated in vacuo or in an inert atmosphere, the conductivity increases. The filaments contract when more strongly heated, and at white heat they become good conductors. They are then cut into the length required for filaments and are connected to the leading-in wires by means of the same paste which serves for the manufacture of the filaments. This paste is treated by heating in the same way as the filament itself. Finally the globe is evacuated or filled with an inert atmosphere. The filaments produced in this way are claimed to be absolutely free from carbon and of absolutely uniform thickness all along their length. Under normal conditions they consume one watt per hefner candle, but if they are overloaded, for instance, so as to consume 0.31 watt per hefner candle, and if they are then brought back to normal condition, they are stated to behave just as if they had not been overloaded. The life is said to be 1000 hours. The preparatory mechanical comminution of the tungsten seems to be of great importance and the grinding machinery used on a large scale is far more effective than the equipment available in laboratories.—*Chemiker. Zeit.*, March 25.

Power.

Austrian Hydroelectric Plants.—An illustrated description of the Kindberg station which supplies several towns in the neighborhood. The power house contains two 150-hp turbines coupled to 3100-volt, three-phase alternators. The voltage of the secondary distribution network is partly 110 and partly 220. —*Elek. u. Masch.* (Vienna), March 1.—The Feistritz works contain two turbines driving two 324-kvolt ampere 10,200-volt, three-phase alternators. The transmission lines have a total length of 13 miles. The secondary e.m.f. for energy distribution in the different towns is 155 volts.—*Elek. u. Masch.* (Vienna), March 8.

Turbine Regulators.—R. Löwy.—An illustrated discussion of the process of regulation with modern indirectly-acting hydraulic turbine regulators.—*Elek. und Masch.* (Vienna), March 8 and 15.

Traction.

System of Electric Traction.—A note on a system of electric traction, due to Colonna, which is now being used on the Vesuvius Railway. The trains usually consist of two motor-cars, each carrying two 75-hp motors, which are electrically connected together in the following way: The main cable from the trolleys on each car is continued on to each of the platforms, where it ends in a socket. In the cable from the main conductor to the motor is placed a shunt whose ends are connected to two sockets fixed on the platform of each car. Two other conductors run the whole length of each car and are connected to the ammeter leads on the other car. The ammeters used are aperiodic and are worked by only a fraction of the total current. As they are not required to give accurate readings, but only indications, the length of the connecting leads is immaterial. Connection between the two cars is made by means of a five-core cable. The two trolleys are in parallel, but the regulating magnets and brake equipment are quite separate on each car. Each motorman watches the readings of the ammeter connected in the circuit of the other car and these readings ensure simultaneous operation. The motorman on the leading car is in command and all his movements are followed by the man on the second car. It is claimed that this system works quite well as, and is much cheaper than, the more general multiple-unit system.—Lond. *Elec.*, April 3.

Petrol-Electric Omnibus.—P. T. Smith and W. A. Stevens. —A paper read before the Society of Road Construction Engineers in London. The authors refer to the "appalling" financial losses of certain of the London motor-omnibus undertakings using the gear-driven petrol omnibus. The object of the paper is to show by diagrams and figures the saving in expense which may be obtained if the adoption of a "petrol-electric" vehicle were adopted in which an internal-combustion motor, direct-coupled to an electric generator, supplies electrical energy to electric motors, directly or indirectly connected to the road wheels, by which means the clutch, gear-box and differential gear are dispensed with.—Lond. *Elec. Eng'ing*, March 26.

Installations, Systems and Appliances.

Installation Rules.—W. P. Steinthal.—A comparison between the installation rules of the German Association of Elec. Eng. and those of the British Inst. of Elec. Eng. While the institution rules "are intended neither to take the place of a detailed specification nor to instruct untrained persons," the author thinks that if an installation is erected according to the regulations of the German association, no further specification could in any circumstances be required. Although the general tendencies of the two sets are similar, there are notable differences. From nine amperes to 20 amperes the current density in conductors permissible in Germany is three times or more, from 20 amperes to 200 amperes twice or more, from 200 amperes to 240 amperes 1½ times or more, and for 500 amperes 1.3 times that of the Brit. I. E. E. rules. There are also differences in thickness of insulation specified for different sizes of wire in England and Germany, and also with respect to insulation resistance. The cross-section of conductors employed for making earth-connections must be proportioned with due regard to the strength of the possible earth current. The smallest cross-section in electric-generating stations is to be 0.248 sq. in. (16 sq. mm), and 0.0062 sq. in. (4 sq. mm) elsewhere; generally for copper conductors 0.00155 sq. in. (1 sq mm) for every 10 amperes may be reckoned. Cells in battery rooms must be so arranged that the attendant cannot simultaneously touch two points between which the difference of potential exceeds 250 volts. The nominal working current and pressure should be marked on switches. The author expresses strong approval of this rule, and also of the following: Plugs for the connection of movable conductors must be so constructed that they do not fit sockets made for a higher current. The normal rated current and pressure should be marked on the socket and on the plug. In the discussion which followed it was pointed out that with metallic-filament lamps the voltage variation possible is greater than with carbon lamps; the permissible drop of pressure should also, therefore, be greater. The German rules are in force in practice, but it is not so with the English Institution rules. It was greatly deplored that there should be so many sets of rules in England and it was thought that only one set should be recognized. If possible, international sets should be adopted.—Lond. *Elec. Eng'ing*, March 26.

Switchboard.—The first part of an illustrated detailed description of the 3200-volt switchboard at Hull. The present plant of approximately 6000 kilowatts is being extended with additional plant to an aggregate rating of 7000 kilowatts. A Ferranti cellular switchboard is used.—Lond. *Elec.*, April 3.

Wires, Wiring and Conduits.

Cell Switches.—F. Steindl.—An illustrated article giving wiring calculations for cell switches.—*Elek. u. Masch.* (Vienna), Feb. 16.

Overhead Construction.—Illustrations showing details of the construction of the 11,000-volt overhead line used by the Clyde Valley Electric Power Company.—Lond. *Elec. Eng'ing*, March 12.

Electrophysics and Magnetism.

Law of Electromagnetic Induction.—A long editorial with reference to C. Hering's recent paper. It is pointed out that in certain cases the idea of variation of flux is not applicable. For example, in the well-known case where a bar electromagnet forms part of the circuit, and a conductor, capable of rotation about the axis of the magnet, makes contact at one extremity with the pole and at the other end with the center of the magnet by means of mercury cups; a rotation of the conductor round the magnet gives rise to an e.m.f. Students often find a difficulty in understanding such a case because there is no change in the flux; there is, however, a continuous cutting of lines. With reference to the crucial experiment described in Hering's paper it is pointed out that variation of the current path in the iron will not cause an e.m.f., otherwise in the case of a conductor rotating round the pole of a magnet, referred to above, there would be no resultant e.m.f. in the circuit at all. The flux in the magnet may be regarded as practically linked in a circuit of its own, and the conditions would be the same if actually a brass band were put round the leg of the magnet over which the loop would be drawn in snapping it off. In following out this process it is at once seen that lines of force do not cut any part of the circuit, and the current need not traverse the iron. It is thought that the rule of the cutting of lines is the fundamental statement of the law of induction.—Lond. *Elec.*, April 3.

Electric Discharges Through Gases.—J. J. Thomson.—An account of his third Royal Institution lecture on this subject. The author demonstrated the difference between the electrical conductivities of metals which obey Ohm's law and of gases where this law holds only for small values of the potential difference. In discussing the nature of the charged particles in gases he showed that it is possible to estimate their size from the speed with which they move through the gas. P. Phillips has found the following velocities in centimeters per second at a pressure of one atmosphere for the two ions under a force of one volt per cm: Hydrogen + 67, — 7.95 cm; helium + 5, — 6.3; oxygen + 1.36, — 1.8; CO_2 + 0.76, — 0.81; acetone + 0.37, — 0.34; aldehyde + 0.30, — 0.28, etc. In light gases the positive ions travel more slowly, while in the complex molecules (acetone, etc.) the two ions have practically the same mobility, or the positive are rather faster. The kinetic theory of gases enables one to calculate from these velocities that these particles consist of aggregates of more than one molecule, but not, as a rule, of more than three or four molecules, and we can imagine that those molecules are condensed about the charged particles, of which there will hardly be more than one in a million molecules. As the negative particles travel faster than the positive ones in *H, O, N,* etc., we should be able to charge a metallic tube electrically simply by sucking air through it, as the negative particles first reach the wall. This was shown with a brass tube, about 1 cm in diameter, nearly 1 m in length, with the aid of a Wilson electroscope, which was connected to the outside of the tube; the effect was very slight. The difference in the mobilities of the particles of opposite signs is very much greater at higher temperatures and at reduced pressure.—Lond. *Elec.*, March 27.

Lines of Force.—F. Sanford.—An article discussing the physical meaning of Faraday's lines of force in electrical theories. The author thinks that as long as electrical phenomena are explained by attractions between positive and negative charges, either the notion of action at a distance must be revived or some kind of a physical line of force must be assumed as attached at its ends to these charges and by its contraction pulling them together. If, on the other hand, electric phenomena may be explained by repulsions due to a pressure exerted by the electrons upon the surrounding ether, no physical lines of force are necessary, and no properties but those required by the elastic solid theory of light need be attributed to the ether.—*Phys. Rev.*, April.

Representation of Alternating-Current Phenomena.—D. W. Rennie.—After a note on the difficulty of graphical representation of alternating-current phenomena in the case of non-sinusoidal wave forms, two analytical methods are discussed, one of Perry and the other Steinmetz's symbolic method, which latter is said to be both convenient and flexible.—Lond. *Elec.*, April 3.

Electrochemistry and Batteries.

E.M.F. of Concentration Cells.—H. S. Carhart.—A mathematical paper giving a comparison of the formulas of Helmholtz and Nernst for the e.m.f. of concentration cells. The author maintains that Nernst's formula is exact only if the heat of dilution is zero, and in this case it is simply a conclusion from the second term of Helmholz's equation.—*Phys. Rev.*, March.

Electric Sterilization of Water.—An illustrated description of a commercial apparatus in which a brush discharge is produced between plates of glass covered with tinfoil by means of a small transformer. Air is drawn through between the plates and then thoroughly mixed with water. The apparatus is intended for house use for sterilizing drinking water.—Lond. *Elec. Eng'ing*, March 12.

Atmospheric Nitrogen.—Blondin.—A review of the work which has been done on the industrial fixation of atmospheric nitrogen.—*Bull. Soc. Int. des Elec.*, January.

Units, Measurements and Instruments.

Artificial Load for Testing.—R. K. Morcom and D. K. Morris.—An illustrated paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. The authors first give details of construction of water resistors. For inductive loads they recommend choking coils without air-gaps, the iron being worked at a flux density so high that the magnetizing current is correspondingly large. This construction has the advantage that the flux density can be increased four-fold, the leaking is very small, and the coil is exceedingly compact for a given load. On account of the high flux density it is important to use the thinnest laminations and to reduce hysteresis by employing the best iron. Artificial cooling is essential. The whole coil and winding may be immersed in water kept in circulation and slowly flowing to waste, or the limbs of the iron core may be surrounded by coils of flat copper tube, in which water is continually flowing. Where the voltage permits it, there is great advantage in the first method, which allows of the use of very high flux densities in the winding. Copper for the windings may even be dispensed with altogether, and the coil wound with iron strip worked at current densities which would be high even for copper if not specially cooled. Such coils are in the highest degree economical to construct and prove perfectly satisfactory if the e.m.f. of the generator to be tested does not exceed 2000 volts. While the coils work well over a wide range of current, their range of voltage is small. To provide a means of regulating the voltage they should be used in connection with a water resistor. The water resistor is arranged in such a manner that the inductive-coil current is shunted by an in-phase component of current in a water load, while, at the same time, resistance may be put in series with the choking coil. The arrangement is indicated in Fig. 2. In the vector diagram *A B* represents the total voltage to neutral; *A C* the voltage across the choking coil; *B C* the voltage across the series resistance; *A d* the current in the choking coil and series resistance; *d e* the current in the shunt resistance, and *A e* the total current. By shifting the plate *B* toward *A* or *C*, the double adjustment may be conveniently effected at one time. Adjustment is also obtained by raising or lowering one or more of the plates. The inductive coil either may be immersed in the tank or may be in a separate place according to the method used. Further variations of voltage and current may be obtained by the well-known methods of paralleling the coils, or changing from star to mesh connection, or both, used always in conjunction with the above combination of water-loads.—Lond. *Elec. Rev.*, March 13.

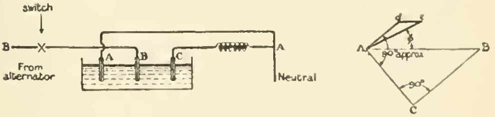


FIG. 2.—CIRCUIT AND VECTOR DIAGRAMS.

British National Physical Laboratory.—An account of the work done in 1907 and of the work proposed for 1908. A large plant for life tests of lamps will be installed. The new laboratory for metallurgical chemistry and the new buildings for the engineering and meteorological departments have been completed. As to the work proposed in the physical department it is intended to obtain to a high order of accuracy the units of current and resistance in absolute measure, while experiments will also be made on such secondary standards as mercury tubes, standard cells and the silver voltameter. In lamp testing the question of color differences will be investigated. The progress of the research on the Violle standard recommended by the International Photometric Commission at Zurich will depend chiefly on the success of Harker's experiments on large refractory furnaces. Work in the thermometry division will include a comparison of thermocouples and the equipment of a new laboratory for high-temperature work. During 1907 a very complete comparison of the mercury, platinum-silver and manganine resistors has been made. The results show that with one exception the relative resistances of the mercury tubes have kept wonderfully constant. Some of the older platinum-silver standards showed considerable changes, while manganin coils have generally remained more constant. In the photometrical section every effort has been made to reproduce the value of the pentane standard in electrical sub-standards which have been set up for reference; this is done by means of 10 large-bulb Fleming-Ediswan laboratory standards. In the electrotechnical division considerable experience has been gained in the use of the quadrant electrometer for absolute measurement of electric power, while tests were also made to discover whether the readings of a 600-ampere Kelvin balance were independent of frequency changes. It was found that the readings of the balance exactly agreed with the calculated values, showing its independence in this respect.—Lond. *Elec.*, March 27.

Standards.—R. T. Glazebrook.—The first of two lectures on standardization in various aspects. In the present lecture the mechanical side of the subject was discussed. The author dealt with the standards of length and weight, and described methods most in use for comparing the length of a certain bar with that of the standard. He also referred to the work of the Engineering Standards Committee on limit gages and on some work done at the National Physical Laboratory.—Lond. *Elec.*, March 27.

Induction Between Parallel Wires.—E. Orlich.—The author gives the mathematical definition of what he calls the "mean geometrical distance" and shows how to apply this conception to the calculation of the self-inductance of long, straight wires. He then deals with the self-inductance of loops and describes an arrangement of measurements which enables one to find the inductance of a single conductor according to its mathematical definition.—*Elek. Zeit.*, March 19.

Barretter.—K. E. F. Schmidt.—A note on some experiments made with a barretter. The barretter studied was of the original thermal type in which an extremely fine wire has its temperature and, therefore, its resistance, altered by the passage of the current from the aerial. The behavior of barretters having wires with diameters from 0.02 mm to 0.01 mm at different temperatures and carrying different currents was studied, and curves were obtained showing their properties. With barretters standardized in this manner measurements were made which proved that an atmosphere of hydrogen greatly increases the constancy of the oscillations produced by a spark. It was shown that the sensibility of the barretter increases with its resistance, and that the finest possible wires should, therefore, be used. The total resistance of the Wheatstone bridge should be as low as possible. The sensibility does not change appreciably with variations of the external temperature within ordinary limits.—Lond. *Elec.*, March 27.

Thermoelectric Couple.—Pecheux.—An account of experiments with a platinum platinum-iridium couple for high temperature measurements. The results of experiments are given which show that with a commercial pyrometer of this type one may measure temperatures up to 600 deg. C. with an exactness of 3 deg. and in the interval from 600 to 1400 deg. with an exactness of 6 deg.—*La Lumière Elec.*, March 7.

Telegraphy, Telephony and Signals.

Transatlantic Wireless Telegraphy.—Marconi.—A Royal Institution lecture on the history of over-sea wireless telegraphy, beginning with the attempts in 1899 to establish communication between England and France, and leading up to the experiments made in 1907 between Clifden and Glace Bay. Two chief features of the latter were the employment of the directional aerial (using the horizontal antenna disposed in a particular manner) and the employment of air condensers to reduce the losses due to dielectric hysteresis and breakages in the dielectric. The wave length used during these tests was 12,000 ft., the capacity 1.6 microfarads and the potential to which the condenser was charged 80,000 volts. Long-distance wireless stations are now being erected in various parts of the world, the most powerful being that at Coltano, owned by the Italian government. Marconi is of the opinion that "telegraphy through space will soon be in a position to afford communication at a cheaper rate than is possible with cables."—Lond. *Elec.*, March 20.

Wireless Telegraphy.—A note on the Poulsen wireless telegraphy station situated at Lyngby, near Copenhagen, which was enlarged last summer, the height of the aerial being increased. This station is in communication with Newcastle, Berlin and St. Petersburg. The generating plant consists of a gasoline engine coupled to a 10-kw dynamo, which supplies energy to a single arc-gap. To supply the inert gas, with which the arc is surrounded, a few drops of alcohol are introduced into the arc-chamber every second. This renders the use of a complicated hydrogen generator unnecessary.—Lond. *Elec. Eng'ing,* March 26.

Wireless Telegraphy.—R. Rüdenburg.—An account of a laboratory investigation into the conditions under which electric waves used in wireless telegraphy are absorbed. His results emphasize the hopelessness of transmitting energy by wireless means in a quantitative manner. The dissipation is enormous even in the best systems. The amount of energy absorbed from a given wave is proportional to the square of its wave length, so that there is a rapid increase of efficiency on lengthening the waves. On the other hand, the somewhat surprising conclusion is arrived at that the effective length of the antenna is without any influence upon the proportion of energy absorbed. This, however, appears not to apply rigidly to a single vertical antenna. It does apply to the "umbrella" form of receiving antenna, whose effective length is about half the height, since downward currents along the ribs reduce the radiation from the vertical wire. The author gives some diagrams illustrating the distortion of the wave-train by a receiving antenna. This distortion extends over about 24 wave-lengths. The area from which energy is absorbed has a radius equal to about one-fifth of the wave-length.—*Annalen d. Phys.*, No. 3; abstracted in Lond. *Elec. Eng'ing,* March 26.

Electrolytic Detector.—H. Abraham.—A note on an experimental investigation of the influence of temperature on the constants of an electrolytic detector. The operation of an electrolytic detector appears to depend on two quantities: (1) Its capacity for polarization in the immediate neighborhood of the standard polarization under which it is used, and (2) its internal ohmic resistance in series with the polarization capacity. These quantities have been measured by means of an alternating-current galvanometer for frequencies of 500, and with which the amplitude and phase of the current can easily be determined. The capacity is of the order of hundredths of a microfarad, and the internal resistance is several thousand ohms for sensitive detectors, such as are used in wireless telegraphy. Detectors with larger wire, which are less sensitive, have a higher capacity and a lower resistance; the variation of these quantities is less rapid than the variation of free surface of electrode. When the detectors are heated to 120 deg., their resistance is reduced to some hundreds of ohms, and their capacity rises to about half a microfarad. This increase does not, however, have any harmful effect on the sensibility. Their low internal resistance allows for the same sensitiveness, better tuning and a more perfect syntony with the vibratory circuit and the exciting waves.—From *Bull. Soc. Franc. de Phys.;* abstracted in Lond. *Elec.*, March 20.

Magnetic Detector.—A. G. Rossi.—A description of an instrument based upon Sella's "magneto-elastic principle." It consists of an iron or nickel wire in a magnetic field traversed by an alternating current and subjected to simultaneous tension and magnetic torsion. Incident wave-trains reduce the amplitude of the torsion and shorten the track of the spot of light cast by a smaller mirror attached to the wire. This circumstance paves the way for direct photographic registration. The wire has a diameter of 0.1 mm and a length of 20 cm. Two bar-magnets, each 10 cm long, are mounted parallel to the wire, near its ends. The magnets are weak, and the alternating current very feeble. The torsional vibrations of the wire are tuned to the incident wave frequency. The wire from the antenna is brought to the center of the stretched wire without touching it, and winds round it in two opposite coils. The main advantage of the new detector lies in the small mass—about 15 milligrams—which prevents any transformation of the energy into undesirable forms, such as takes place in Marconi's magnetic detector.—*Nuovo Cimento,* January; abstracted in Lond. *Elec. Eng'ing,* March 26.

Wireless Photography.—A note on experiments made by J. Rieder with apparatus by which wireless photography is said to be obtained. A glass plate was spread with shellac solution and sprinkled with aluminum powder. This, before it was dry, was brought into contact with a highly sensitive photographic plate which was protected from light waves. When this system was exposed to electric waves a distinct representation was observed on the plate after development. It has further been found that the metal powder at the places of strongest exposure showed the smallest density of aggregation, in opposition to what might have been expected. It was not found necessary to de-cohere by shocks before submitting the apparatus to a new experiment. Researches show that specially prepared plates of this description were sensitive to electric waves at distances of about 250 yards. Rieder is at present conducting further experiments in this direction.—Lond. *Elec.,* March 27.

Loaded Telephone Cable.—A brief note on an attempt made by W. C. Jaetmann to increase the self-induction of telephone cables by using an "electrolytic" sheath of iron over the copper wire. This method intends to increase the self-induction of the cable uniformly all along its length and, therefore, differs from the method of Pupin, who loads the cable with inductance coils at certain intervals.—Lond. *Elec.,* March 27.

Vienna.—The first part of a long illustrated article on the new imperial telegraph station in Vienna.—*Elek. u. Masch.* (Vienna), March 22.

Miscellaneous.

Effect of Electricity on Plants.—J. H. Priestley.—A paper read before the Naturalists' Society, giving a long account of the several attempts which have been made in various localities to apply electricity as a stimulus to plant growth. The author deals especially with the successful experiments made on a large scale by J. E. Newman, who used two different systems, one being an overhead discharge system, wires being spanned over the area to be treated and charged by means of an influence machine; the second system using plates of different metals sunk in the ground and connected by a wire.—Lond. *Elec. Eng'ing,* March 26.

BOOK REVIEWS.

Eliktrische Centralen. By K. Wilkens. Leipzig: S. Herzel. 350 pages; 158 illustrations; 16 plates. Price, 28 marks.

Central-station equipments from the prime-movers to the network of conductors are fully described in the present volume. There are seven chapters, the first of which is devoted to historical matter. The second chapter deals with the distributing circuits. In the third chapter, the economical features of the whole system are treated. The characteristics of the various prime-movers are compared in Chapter 4; this chapter also contains discussions of direct-current and alternating-current generators and substation apparatus. The remaining three chapters are devoted to the general operating features of central stations. The treatment is characterized by thoroughness, the discussion of testing apparatus and methods being particularly good.

Transformatoren und Asynchronmotoren. By W. Winkelmann. Hannover: Max Jaenecke. 136 pages, 79 illustrations. Price, 4.2 marks.

Since the author combines in one volume the treatments of the stationary transformer and the induction motor, it is natural that he should select a method of presenting the features of the transformer which can also be used with induction motors and should consider the induction motor largely from the standpoint of its resemblance to the stationary transformer. He has resorted to the graphical method of representing the phenomena of these devices and has succeeded in producing a book that possesses the element of simplicity to a marked degree. Information is given concerning the operating characteristics and design features of single-phase transformers and auto-transformers, and the combined core and shell type three-phase transformer. The treatment of the performance of induction motors is somewhat too brief to be satisfactory, but the elements of design of this machine are fully covered. The author closes with a short discussion of the use of induction motors as generators, and the excitation and compounding of these machines. The book is well suited to the needs of the designer of the electric and magnetic circuits of transformers and induction motors; mechanical details and insulation data are almost ignored.

Vorlesungen uber die Vektorenrechnung. By E. Jahnke. Leipzig: B. G. Teubner. 235 pages; 32 illustrations. Price, 5.6 marks.

Although this book deals almost exclusively with mathematics and just enough with physics to show that the mathematics is capable of practical application, yet it is not wholly without interest for electrical engineers. Probably no branch of mathematics is used more frequently by electrical engineers than that involving the vector representation of alternating quantities. It is this branch that the present volume covers. However, the treatment employed by the author is one that will appeal more strongly to the mathematical physicist than to the engineer. The first six chapters are devoted to vectors in a single plane, and the last twelve treat of vectors in space; the former are directly applicable to the ordinary single-frequency quantities, while the latter must be used when quantities of several frequencies are to be dealt with. It is customary either to neglect the vector-displacing effect of higher harmonics in alternating-current problems or to calculate the real effect without assigning a position in space to each vector, but for absolute accuracy certain of the vectors should be represented in the third dimension, certain in the fourth, etc. To those who wish to reach this higher degree of accuracy, the book will prove instructive and valuable.

Physikalische Grundlagen der Gleich- und Wechselstromtechnik. By A. Koenigswerther. Hannover: Max Jaenecke. 119 pages; 74 illustrations. Price, 2.6 marks.

In the present volume the electrophysics of direct and alternating current is treated from the standpoint of an electrical engineer rather than of a physicist. The subjects dealt with are those usually treated in purely physical text-books, but special emphasis is laid on the relations that are applied in engineering practice. Moreover, alternating-current phenomena are discussed at some length. The book is intended as an introduction to the study of direct current- and alternating-current machinery and it is well arranged for this purpose.

Synchronmaschinen für Weckselstrom und Dreistrom. By W. Winkelmann. Hannover: Max Jaenecke. 148 pages. 79 illustrations. Price, 3.4 marks.

The design, construction and operation of single-phase and polyphase synchronous generators, motors and converters are treated in this little volume, but the major portion of the book is devoted to the calculation of the magnetic and electric circuits of these machines. Some little use has been made of graphical diagrams, and a few equations are employed, but it can almost be said that the mathematical part of the work has been reduced to arithmetic by the use of machine constants for the symbols in the algebraic expressions. In some instances calculus is employed; but the treatment is not based on a mathematical foundation. Although many hints are given as to design features, these hints are largely incidental and are merely one of the elements in the author's method of presenting the theory by applying it to actual machines. The book can be read with profit by both the electrical engineering student and the designer of synchronous machines.

The Universal Electrical Directory for 1908. London: H. Alabaster, Gatehouse & Company. 1500 pages.

This year's Universal Electrical Directory contains more information and data than ever. A new feature of value is that of giving details as to nature of current, voltage, etc., of the electricity plants enumerated in Great Britain and in the Colonies, etc. The preface speaks hopefully of the general situation in England after a rather prolonged period of depression.

The Insulation of Electric Machines. By Turner & Hobart. New York: The Macmillan Company. 297 pages, 145 illustrations. Price, $4.50.

This work presents a comprehensive study of the applications of insulating materials in the construction of heavy electrical apparatus, and as the pioneer in this field it will be welcomed by those who appreciate the need and the lack of complete and reliable information on the subject. That the field is by no means completely covered is clearly realized by the authors, who state in the preface (and it cannot be too much emphasized) that: "Probably no other properties of any materials employed by engineers are so indefinite as these, and it is essential for anyone, on taking up the subject, to disabuse his mind of the idea that a high degree of accuracy is at the present time attainable."

The book consists mainly of a compilation of the most important papers on the subject that have appeared in recent years in the publications of the electrical societies and in the technical press, both here and abroad, supplemented by copious extracts from trade circulars and by the results of the authors' personal investigations and large practical experience. It is to be regretted that the data from the authors' own work is not more extensive, as it forms one of the most valuable portions of the book—limited as it is.

The opening chapters state the requirements to be fulfilled by insulating materials, describe several forms of high-voltage testing sets used in investigations of dielectric strength, and give typical results of tests, with theoretical explanations of some of the phenomena observed. These chapters, as well as many others, are marred by long extracts from trade publications. Later chapters cover "Some Properties of Insulating Materials," being mostly results of investigations by Steinmetz, Holitscher, Walter, Baur, and others, which have been published elsewhere; also the "Insulation of Magnet Wires," with many good tables, and "Mica and Mica Compounds." The various styles of molded composition are next taken up, the greater part of the data furnished being supplied by the makers, while a chapter on varnishes, oils and impregnated cloths and fibers contains much information of a practical nature. Special chapters are devoted to commutator and field-coil insulation. A good deal of attention is given to the grouping of armature conductors in the slots, and to the "space-factor" or ratio of the copper to the total cross-section, but the actual data on these subjects is disappointing. Transformer insulation is very inadequately treated in 10 pages, devoted largely to oil, practically nothing being given on high-voltage designs. In fact the book scarcely treats at all of high-voltage work, being devoted mainly to low-voltage direct-current apparatus. The remaining chapters are descriptive of factory processes for the manufacture and application of insulating materials, with a final chapter on specifications for insulation. There is added a very complete index and bibliography.

The make-up of the book is poor. In particular, the illustrations are neither well selected nor executed, being crude wood-cuts or half-tones. Many curve sheets are given which appear to be reproductions of hand-lettered sheets and present a most untidy appearance. The metric system is used, but sometimes in combination with pence and pounds—a weird mixture of units. Much attention is given to methods of testing for dielectric strength, particularly to Dr. Walter's so-called "Picein-drop" method, a highly specialized but not very practical scheme, using an induction coil discharge and tending to show a puncture voltage proportional to thickness. Many tables and curves are given representing the dielectric strength of a great variety of materials, prepared and tested in various ways. The work gives results from many investigators using different methods, and there is little attempt at standardization of system; nevertheless it is of value for its suggestiveness, and as giving an introduction to the subject, a first approximation to the magnitudes involved and a general idea of the materials and methods employed for machine insulation

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Inductionsmotors für Einphasen-Wechselstrom. By R. von Koch. Berlin: Julius Springer. 102 pages; 49 illustrations. Price, 2.6 marks.

The title might lead one to believe that this book is devoted exclusively to the machine known in this country as the single-phase induction motor. The author, however, has included the so-called "repulsion" motors and the combined repulsion and induction motors, probably because he considers all of these machines to be induction motors. The treatment is confined largely to a discussion of the performance characteristics of the various machines, and a comparison of the different types. In an appendix the design features of a certain 3-hp, 50-cycle, single-phase induction motor are analyzed. For this purpose use is made of the simple circular current locus, after the value for the magnetizing current has been calculated and the leakage coefficient has been assumed. The book furnishes a fair outline of the several motors, but the treatment is too brief to give depth to the extensive ground which the author attempts to cover.

Wechselstromkurves. By Dr. Ernst Orlich. Braunschweig: Freidrich Vieweg & Son. 117 pages, 71 illustrations. Price, 3.5 marks.

The whole of this little volume is devoted to explaining the devices that are in use for observing the e.m.f. and current curves in alternating systems and the various methods that have been proposed for analyzing the curves into their several components. The devices described include those of Joubert, Franke, Hospitalier, Rosa and Callendar, Goldschmidt and Ryan, Braun, Gehrcke, Blondel, Abraham, Kaufmann, Townsend, and Kühns, in addition to electrochemical and optical apparatus. Among the methods for analyzing the curves are mentioned those of Des Condres, Langsdorf, Clifford, Houston and Kennelly, and Fischer-Hinnen. Descriptions are included of the mechanical analyzing devices of Kelvin, Henrici and Coradi, Sharp, Yule and Le Conte, Wiechert and Sommerfeld, Michelson and Stratton, and of Terada. Each of the above devices and methods is fully explained.

Das Problem der Schwingungserzeugung. By Dr. H. Barkhausen. Liepsig: S. Hirzel. 112 pages, 47 illustrations. Price, 4 marks.

The general subject of the production of oscillations is considered in this little treatise, from the standpoints both of mechanics and of electromagnetics. The parallelism of the phenomena under the two sets of conditions is clearly brought out in such a manner as to enable the student to grasp each the more firmly by the analogy presented in the other. The treatment is mathematical and technical, from the point of view of a technologist rather than from that of a physicist. The volume is well adapted for use as a text-book in connection with applied mechanics on the one hand, or applied physics in electrical engineering. It is of lesser interest to the practising electrical engineer.

Les Découvertes Modernes en Physique. By O. Manville. Paris: A. Hermann. 182 pages; 32 illustrations. Price, 5 francs.

In the space of 180 octavo pages the author gives a clear exposition of the leading facts and the current theories of the "new" physics, i. e., the physics of the ion, the electron and the emanations. It is written for the qualified student who has prepared himself by a suitable equipment of the calculus and the mechanics of energy. It makes no pretence to originality of treatment or of thought, being in the main a résumé of the standard works recently written on the subject. Nor is there any insistence on the theories advanced and defended by English and German physicists. The writer's aim is mainly to familiarize his countrymen with the phenomena of radioactivity and then to leave it to their individual judgment whether or not to accept the revolutionary hypothesis put forward abroad for their explanation.

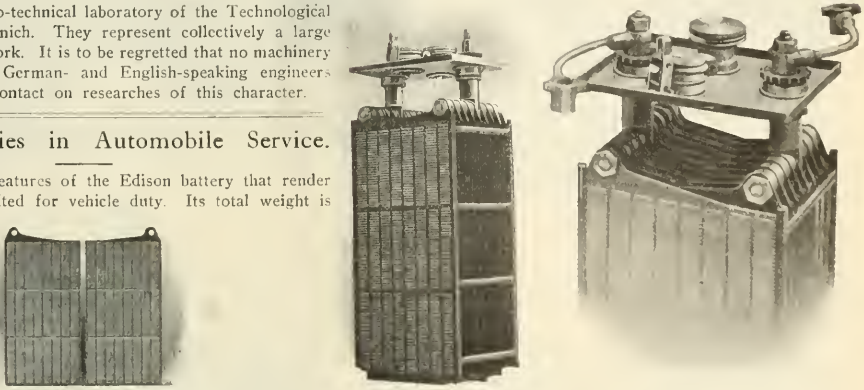
We note that he writes *catode* and its derivatives where other French authors conforming to the Greek write *cathode* or *kathode*. The following are instances of careless writing: MarcClelland, p. 55, for McClelland; Towsend, p. 85, for Townsend; Ruterford, p. 136, for Rutherford; æther et matter, p. 116.

Mitteilungen über Forschungsarbeiten. Berlin: Julius Springer. 152 pages; illustrated.

This number of the well-known German technical series contains important descriptions of three very interesting researches, namely, on the efflux of hot water, on the heating of electrical machines, and on the relation of the specific heat of steam to pressure and temperature. All of these researches were conducted in the physico-technical laboratory of the Technological High School of Munich. They represent collectively a large amount of careful work. It is to be regretted that no machinery exists for bringing German- and English-speaking engineers into closer mutual contact on researches of this character.

Edison Batteries in Automobile Service.

There are many features of the Edison battery that render it especially well suited for vehicle duty. Its total weight is only about .09 lb. per watt-hour or its output is 11 watt-hours per lb. It is mechanically so strong that its life is not decreased by the rough usage to which automobile work subjects it. A life of two years is now assured in average vehicle duty. Moreover, the electrolyte, consisting of a potash solution, is entirely without odor and does not develop objectionable vapors during the charging or discharging period.



FIGS. 1, 2 AND 3.—EDISON STORAGE BATTERY.

For use with automobiles the cells are arranged in sets of 7 or 8 in wooden trays. A tray with 8 cells weighs only 160 lb., so that it can easily be carried by two persons, and hence the battery can be removed readily. The cells correspond almost entirely in their mechanical design and as regards the active electro-chemical material with those exhibited at St. Louis at the World's Fair. The appearance of the plates and of the plate body held together by means of pole bolts and edge frame, the external form of the cells and of the pole terminals, the filling, opening and safety valves are clearly shown in Figs. 1, 2 and 3. An apparatus has been designed for re-filling the cells with distilled water, the bell of which rings as soon as the cells have been sufficiently filled.

The above described batteries are built by the Deutsche Edison Akkumulatoren Company, Berlin, Germany, and are used in the automobiles of the Bergmann Electrical Works, of Berlin. A view of a bare chassis, showing the way in which the battery has been fitted under the front and rear seats of a pleasure automobile without taking up an excessive amount of room, is given in Fig. 4, while Fig. 5 shows the complete vehicle arranged as a Victoria. For an automobile of this type capable of taking four persons inside and two on the box, the battery consists of 64 cells having a rating of 14 kw-hours and weighing 1270 lb. Such a vehicle can run 56 miles on one charge on level roads at a speed of 16 miles per hour. A single 5-hp geared motor acts on the rear wheels through

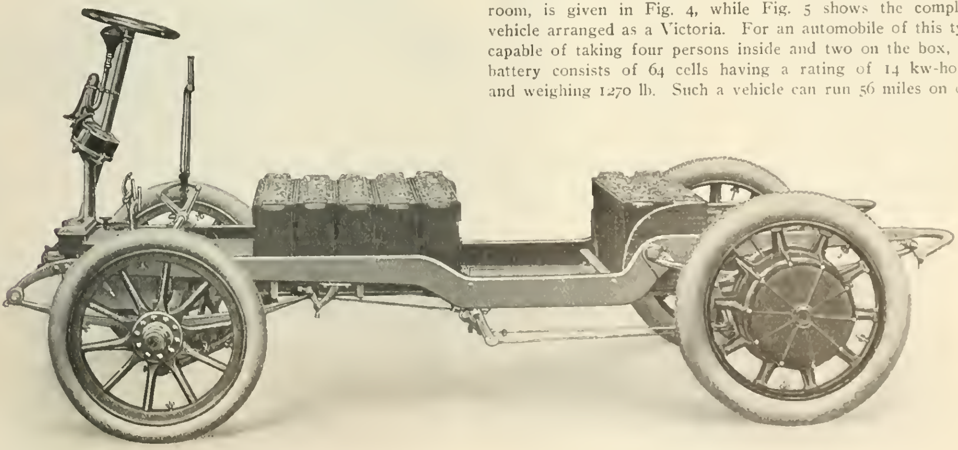


FIG. 4.—BARE CHASSIS WITH BATTERIES IN PLACE

differential mechanism. Noiseless running is obtained by the use of spur gearing provided with angular teeth.

The Bergmann Electrical Works use the Edison battery also in delivery trucks. A 2-ton truck equipped with a 64-cell battery having a rating of 14 kw-hours can be run fully loaded at a speed of about 7.5 miles per hour. On one charge this car can cover a distance of about 37 miles, which suffices in the majority of cases.

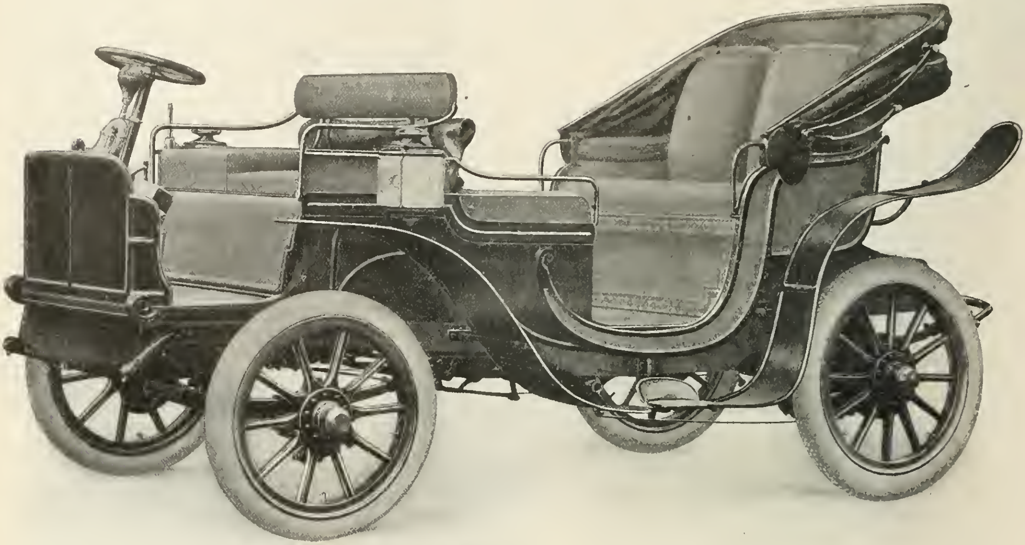


FIG. 5.—COMPLETE ELECTRIC VICTORIA.

New Asbestos Insulating Material.

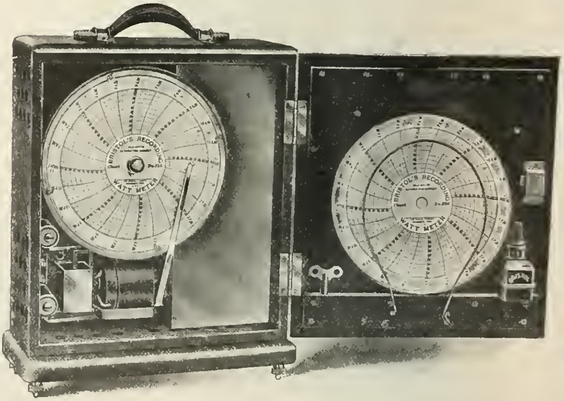
Asbestos wood, the invention of Prof. C. L. Norton, and marketed by the H. W. Johns-Manville Co., is being introduced as an electrical and fireproof insulating material. Many advantages are claimed for it over marble, slate, fibre and wood, for switchboards, switch bases, insulating pieces, etc., as well as for general fireproof construction. It is easily worked with wood-working tools and can be sawed, nailed or screwed the same as hard wood lumber. It is absolutely fireproof, making it especially desirable for all construction where there is danger of short circuits.

One of the many applications of asbestos wood is in the construction of doors in front of high-voltage stations, where an absolutely fire-proof and insulating material is essential. The insulation resistance is extremely high, being almost equal to that of sheet mica, which is the best insulating material known. Asbestos wood has a smooth surface and will take any kind of finish that may be desired. For electrical purposes it is regularly furnished in ebony finish.

Portable Recording Wattmeter.

The recording wattmeter shown herewith has recently been brought out by the Bristol Company. It will be observed that the electrical elements consist of a narrow coil (to the left), which is wound with fine wire and mounted on vertical spring supports so as to be capable of motion toward the wide stationary coil (to the right), which carries the total current to be measured. The pressure coil is wired in series with an auxiliary resistance mounted behind aluminum partitions, shown to the right behind the dial. When this coil is connected across the line, the magnetic effect is proportional to the voltage, while the magnetic effect of the low-resistance current coil will depend upon the current. The mutual attraction of the coils will then be the product of these magnetic forces, and the resulting motion of the pressure coil toward the stationary one is, therefore, proportional to the watts. Since the pen arm is attached to the right-hand support of the moving coil, it multiplies the motion and a record is made on a uniformly revolving chart. The design is such as to eliminate permanent magnets, jewel bearings, shunts, relays or other complexities.

The case is made of wood, conveniently provided with a leather handle and lifting screws. Provision is made to carry charts, ink and the clock key, as shown, so that the operator can feel sure that he has the complete outfit ready for work all contained in one light package. To render the wattmeter "dead beat," even on extremely fluctuating loads, it is equipped with a damping device, consisting of a light vane, which is attached to the moving element and works in a special deep vessel of heavy oil, as shown to the left of the coils. The connections are made to binding posts inside the case to the left, so that they cannot be tampered with when the door is locked.



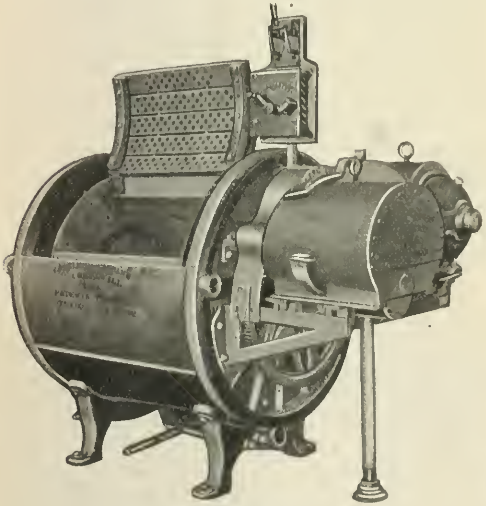
PORTABLE RECORDING WATTMETER.

The meter is made in all capacities for direct current to 200 amperes and 650 volts. For single-phase alternating current it is operated without transformers for light currents at low voltage; but any current and voltage can be recorded by simply operating the wattmeters from small transformers of the proper ratios. For three-phase alternating currents the current coil is operated in series with one phase, or from the secondary of a current transformer, while the voltage coil is wired in star through two resistances.

The wattmeter charts are of the round form, being evenly divided for alternating current, and almost uniformly divided for direct current. This form of chart is easy to handle, inspect and file, and will bear the complete record for any unit of time selected. A strong clock movement drives the chart, giving a speed of one revolution in five minutes for special motor testing work, through all rates of speed to one revolution in seven days, as employed, for example, on lamp tests. The moving coil is held by a simple locking device during transit, so that there is no danger of derangement during the movement from one place to another.

Motor-Driven Washing Machine.

The attitude which is being assumed by leading manufacturers of machinery of various types in regard to electric motor drive, shows that this form of drive is rapidly gaining ground and that the standard machine of the near future will be a unit including the motor. The case of the Conkling laundry washer, shown in the accompanying illustration, may be taken as an example. The principal feature of this machine is the automatic reversing mechanism, so arranged that the inside cylinder makes equal revolutions each way. This mechanism did away with the double-belt arrangement otherwise required for reversing, and required but one belt from the shafting. When it came to attaching an electric motor, the original arrangement consisted of a frame extending across the top of the machine. The motor was secured to the middle of this frame and provided with a long shaft, driving a pulley in line with the pulley on the reversing mechanism and connected by a belt. As the demand for motor-driven machines increased, a more compact and satisfactory arrangement was sought. The result of the efforts of the Conkling Company's engineers is shown in Fig. 1, where the motor rests in a position directly behind the reversing mechanism and is geared directly to it. Westinghouse motors were selected for both methods.



MOTOR-DRIVEN WASHING-MACHINE.

The improved arrangement has many advantages over the old, and makes the unit one of the most satisfactory machines in the equipment of the modern laundry. By doing away with the belts, and gearing the motor directly to the reversing mechanism, a more compact and substantial outfit is provided. The use of belts about laundries is always attendant with more or less dirt and oil, which compels some rewashing. By using gears which are entirely enclosed, there is no possibility of the clothes becoming soiled from the machine.

New Maximum Watt Indicator.

In many cases it is necessary to know the actual maximum watt consumption on alternating-current circuits, especially in motor installations. To meet the demand for this type of instrument the General Electric Company has just placed on the market an indicator designed to operate correctly within commercial limits on two- or three-phase circuits, with balanced or unbalanced, inductive or non-inductive loads. By proper connections it may also be used on single-phase circuits.

This device is a modification of one of the forms of polyphase wattmeters made by the same company, with both electrical elements acting on the top disk and a strong damping system acting upon the lower disk to provide the necessary time lag. In place of the usual register there is provided a single graduated dial and two pointers. One of these is driven by the moving element through a train of gears and indicates at any instant the power passing through the device. The other pointer is driven by the first and remains at the maximum position reached by it, being held in this position by a ratchet. The final position reached by this second pointer indicates the maximum power taken from the circuit. A thumb-nut is used to set the maximum-demand pointer back to zero, and may be sealed to prevent tampering by unauthorized persons.

The length of time required for the pointer to reach its maximum position or the "time lag" will depend on the torque of the motor elements and the strength of the damping magnets and may be varied from one minute to 30 minutes. The indicator is rated by defining the time lag at 90 per cent of full scale, since between 90 and 100 per cent the movement is very slow compared with the speed from zero to 90 per cent. The indicators are made self contained in ratings from 25 to 150 amperes, 220 to 650 volts. Above these capacities current and potential transformers must be used.

FIGS. 1 AND 2.—INTERNAL AND EXTERNAL VIEWS OF INDICATOR.

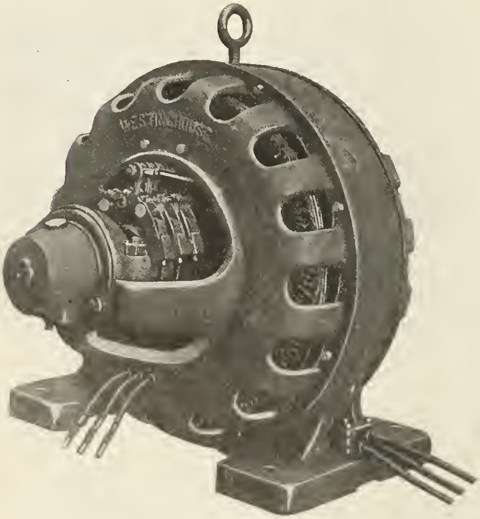
Fixture for Tungsten Lamps.

The Benjamin Electric Manufacturing Company, of Chicago, Ill., has brought out a fixture especially suited for tungsten lamps. The fixture measures 25 in. over all and consists of a stem of 3/8-in. pipe and 3/4-in. casing, crowfoot, wires, deep canopy, cluster body and 18-in. opal reflector. The brass base is provided with a conical-shaped, frosted-aluminum reflector which materially increases the reflecting surface of the device. The fixture is made for four, five or six lamps, with or without a center lamp opening, and with or without a pendant switch. It is symmetrical in outline, pleasing in appearance and offers an effective, convenient and economical fixture for public lighting purposes.

TUNGSTEN LAMP FIXTURE.

New Type of Induction Motor.

To meet the varying conditions imposed by high starting torque with low initial starting current, a modified form of motor has been produced by the Westinghouse Electric & Manufacturing Company, the general appearance of which is shown in the illustration. The frame of the motor is amply ventilated, but so constructed as to protect the laminations from injury. Throughout the motor has been designed for hard service. The insulation on the coils has been very thoroughly made so as to stand much greater stresses than it receives in normal service. It is, furthermore, so built that vibration and consequent wear of the insulation is prevented. A feature of the motor are the brushes by means of which connection is made to an external resistance. These bear on continuous rings of metal so that there is no occasion whatever for sparking. The brushes are liberally proportioned, that they may have long life and require a minimum of attention. The rotor is unlike the usual short-circuited type of armature on induction motors, and has a regular winding in which the resistance is inserted while starting, and thus the starting current is limited. Approximately full-load current is required to produce full-load starting torque. Special covers are provided for enclosing the brushes where this may be desired.

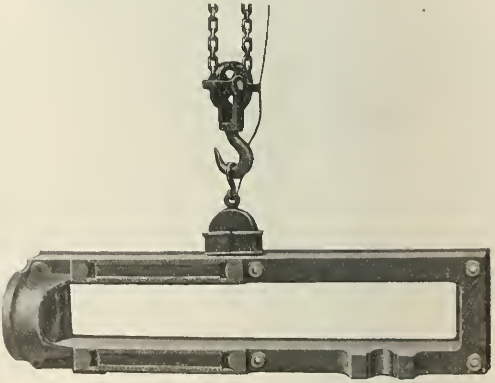


50-HP ALTERNATING-CURRENT MOTOR.

The motors are built in the usual sizes from five to 500 horsepower, and the standard frequencies are 25, 40 and 60 cycles In connection with these motors, special starting devices are supplied by which the current at starting is varied by hand In operation these starters cut resistance out of the circuit of the rotating armature until the handle reaches the full-on position, when the resistance is all short-circuited and the motor runs with practically the constant-speed characteristics of the squirrel-cage armatures. A special short-circuiting switch is provided on motors of 100 horse-power or larger, if desired. This relieves the brushes and the leads and contacts on the starter, as the windings are short-circuited inside the motor.

Electromagnets for Lifting Purposes.

Although electromagnets have been used for some time for lifting purposes, their possibilities are not always fully appreciated. The Sandycroft Foundry Company, of Chester, England, has made a special line of electromagnets for this work and many of them have found extensive use. The saving of time they effect is obvious, especially where a number of rough, heavy pieces of iron or castings require handling. The magnets are also useful in handling packed goods. Ordinarily when packing turned shafts for shipment the cases have to be made somewhat larger than necessary to allow of the slings being drawn, and in the case of heavy shafts and large slings this allowance would be considerable, all of which, with the packing pieces afterward required for steadying the shafts, is dead waste of material, and can be saved by the use of electromagnets. The illustration herewith shows a magnet weighing 84 lb. lifting a casting weighing 2000 lb., the current required being 1½ amperes at 110 volts. The pole faces can be modified to suit special requirements and different sections. The correct proportioning of the magnet has considerable influence on its lifting power, particularly when sections, such as channels, have to be handled.



LIFTING MAGNET.

Electricity in the Meat-Packing Industry.

Two of the many advantages of the electric motor over the steam engine in industrial establishments are economy and cleanliness. These two features have caused the former machine to replace the latter in many establishments where all other advantages were considered of secondary importance. An illustration of an industry in which the use of electric motors has been dictated so strongly by the demands for absolute cleanliness that all other features would have been ignored in order to obtain the desired results, is found in the meat-packing business. In place of the old system of shafting, belting, pulleys and gears innumerable, which formerly stretched in a network across each room, gathering dirt and waste on every exposed surface, there is now used the electric drive with clear headroom, free floor space, excellent light, ventilation and operating conditions. In addition to meeting the prime requirement for cleanliness, the electric equipment has proved more economical than the former equipment, and the output has been increased.

The extent to which motors are now utilized in the meat-curing industry, and their widely diversified application, are illustrated by the electric installations in the various Chicago plants of Swift & Company and Libbey, MacNeil & Libbey, where machines having a total rating of about 9000 horse-power, in units of from one horse-power up, are in daily operation.

Strange and queerly named apparatus, which the average man never heard of and probably would not understand, such as rockers, plotters, candles, crimpers, crutches, neutralizers, etc., are driven by motors on the same current as that supplied to others turning, shaking or agitating the mixtures in machines of homely but perfectly intelligible names, to wit: brainers, splitters, cleavers, skinners, strippers, carcass-conveyors, meat-hoists, metal sharpeners, rip-saws, horn saws, throw outs, etc., in the butcher-shop; rippers, cleaners, stuffers, roller-benches, washers, salters, brine-cooler pumps, fan-blowers, spice mills and mixers, sewing machines, etc., in the sausage plant; oil pumps, mixers, renovators, box churns, suet choppers, salt mills, butter-workers, etc., in the butterine factory; kettle-stirrers, cutters, hashers, presses, mills, oil circulators, molding machines, box mailers, etc., in the soap factory; bone saws, pulverizers, block presses, dryers, washers, compressers, guano crushers, screens, etc., in the fertilizer works; dryers, grinders, reels, etc., in the glue establishment; barrel-headers, hoopers, borers, washers, scourers, etc., in the cooperage plant; paddles, stirrers, etc., in the skin-curing house; cutters, shears, crimpers, etc., in the tin shop; suet-choppers, fat cutters and wringers, stearine presses, lard cylinders, screws, agitators, ice crushers, etc., in the lard and stearine factory; wool-breakers, dryers, dusters, combers, etc., in the wool rooms; pickers, seed-grinders, oil presses, tank agitators, oil pumps, etc., in the cottonseed oil department; and feather fans, hair dryers, etc., in the plants where these products are prepared for market; while hydraulic presses, small pumps of every conceivable description, fans, blowers, elevators, conveyors, separators, hoists and machinery of general utility are electrically operated in all departments and throughout the yards. Then there are the numerous motor-driven tools in the boiler shops, where tanks are made for plants and cars, the woodworking and carpentry shops, machine and general repair shops, and apparatus installed in the coal sheds, power-houses, refrigerating plants, ice houses, ware houses, office buildings, laundries, restaurants and elsewhere—all run by electrical power.

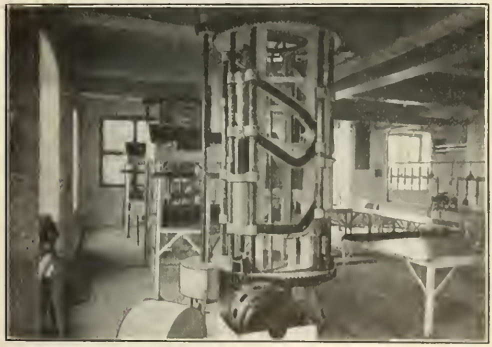


FIG. 1.—MOTOR-DRIVEN STUFFING MACHINE.

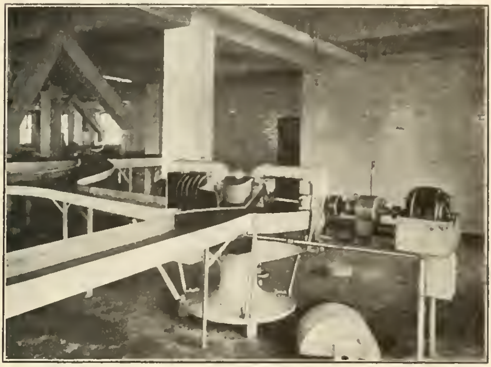


FIG. 2.—MOTOR-DRIVEN MEAT CHOPPER.

Illustrations of some of this apparatus, showing the induction motors for operating them, may be seen in the accompanying illustrations.

As typical of the best modern practice, both mechanically and from a sanitary standpoint, may be mentioned the nine-story "kitchen" of Libbey, MacNeil & Libbey. Meat from an adjoining slaughter house, after being cut into suitable lengths and thoroughly cleansed, is brought to this building by a motor-driven elevator (or, if corned beef, lifted from the pickle-curing cellar) and transferred in buckets on trolleys to the cooking room which occupies the ninth floor. Here may be seen at a glance the feature which is characteristic of this plant, namely, absolute cleanliness. The walls are faced with pure white enameled brick, the ceilings and floors are of concrete, the window sashes shine with polished metal and there is not a piece of wood either in this or the other rooms to be described.

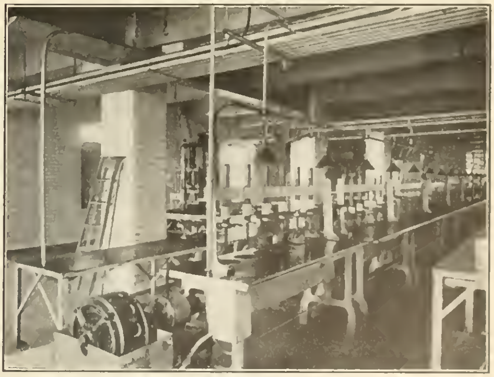


FIG. 3.—MOTOR-DRIVEN CAPPING MACHINE.

From the cooking room, meat is sent on enameled motor-driven conveyors to large white tables in the trimming room on the eighth floor, where it is put in shape for the tins.

Flesh representing over 250 cattle can be trimmed here in an hour, with the aid of five meat choppers, each direct-connected to a 2-hp motor (Fig. 2), and three capping benches, each taking its power from a 2-hp motor (Fig. 3), constitute the principal apparatus used. On the sixth floor is the round-canning room, filled with stuffing machines and capping-benches driven in the same manner as those above described. Both floors are equipped with vacuum pans, enabling the cans to be sealed in vacuum. The six American air compressor pumps installed for this service in an adjoining room are driven by belting from one 40-hp motor.

Each of the various conveyors used in these rooms is indirectly driven by a ½-hp motor.

All of the motors use alternating current and are of the so-called "squirrel-cage" induction type built by Allis-Chalmers Company, Milwaukee, Wis. These offer special advantages for the service, being very simple in construction and easy to keep clean. The arrangement of each with respect to the machines is plainly shown by the photographs reproduced in this article.

The fourth and fifth floors are devoted to storage rooms, in which may be found the cans, bottles, jars, glasses, etc., in which the products of the plant are put up.

From the third floor the shipping is done. On the first and second floors are the offices, electric generating plant and refrigerating machines. Here the walls and ceilings are covered with white enamel. With the absence of overhead gear of any kind, good light and ventilation are secured, making the entire plant with apparatus such as that above described, a veritable triumph of sanitation. What part the use of motors plays in this, the reader will readily understand. All tables, trucks, instruments, etc., are in keeping with the rest of the establishment, there being nothing that will absorb moisture, and every fixed piece stands on legs high above the floor, enabling the latter to be thoroughly flushed at the close of each day.

A total reaching many hundreds of millions of dollars is realized each year from the sale of packing-house products, including fresh beef, mutton, pork and veal, corned beef, tongue, ox-tails, hams, bacon, lard, poultry, eggs, butter, butteries, soaps, tallow, glues, oils, bones, fertilizers, pelts, hides, casings, wool, hair, feathers and various other by-products derived from cattle, sheep, hogs and poultry.

The industry is operated on a very narrow margin and, as there are no secret or complicated processes not open to all, packers such as Swift & Company, Armour & Company and Nelson Morris Company must depend for their very existence, as large corporate concerns, upon such advantages as location at the chief live stock centers, manufacturing in large quantities at the minimum of expense, good refrigeration, utilization of all "waste" material, and highly efficient business management, including the use of the very best mechanical methods and appliances. It is here that motor-drive has been taken up with such notable results, particularly in the conversion of "waste" into dollars; for, were it not for the so-called "by-products," there would be, under present conditions of trade, not only scant profit but an actual loss in the handling of meats from live animals.

In each process through which any part of the animal passes, until its last vestige has disappeared in the fertilizer house or glue factory, a great deal of mechanism is used, and most of this is capable of being electrically operated. A mere perusal of the long list of motor-driven machines mentioned in the first part of this article will show even a casual reader what the change from mechanical power transmission to motor-drive means.

So far as economy is concerned, there can be no question but that an enormous saving has been effected; and what is true of one great industry may be applied with equal force to others, similarly situated, which have not yet taken full advantage of their opportunities in this respect.

Electric Furnace for High Temperatures.

The accompanying illustrations show a new electric furnace for the production of carbon-free alloys, the development of a new furnace well suited to this class of work and general high-temperature work, made by the Hoskins Company, of Chicago, Ill.

The new furnace is a modification of the resistance type. A number of carbon or graphite plates are placed face to face along two sides of the furnace between end plates of graphite and with these end plates form the walls of the furnace chamber. Graphite rods contacting with the end plates serve both to connect the resistor into circuit and to communicate pressure to the resistor plates, applied by means of a screw. The resistor and end pieces are surrounded by a refractory material, such as magnesia, and contained in an iron casing. The current is carried to the furnace by heavy copper conductors clamped on the graphite rods.

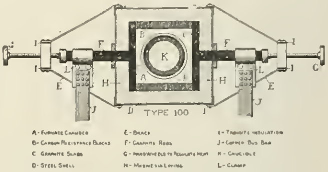


FIG. 1.—DETAILS OF FURNACE.

The furnace operates best at from 10 to 50 volts, depending on the size. Where alternating current is available a special transformer is used to reduce the line voltage to that required by the furnace. An ammeter is connected in the primary circuit as a guide to the control of the furnace. Where alternating current is not available, a rotary converter, a 10-volt plating dynamo or a storage battery may be used.

The furnace is started with little or no pressure on the resistor plates. By increasing the pressure (by simply turning the hand-wheel of one of the screws) the current is brought up to the proper value and is indicated by the ammeter. The heat is developed principally at the points of contact of the resistor plates on account of the high resistance at these points.

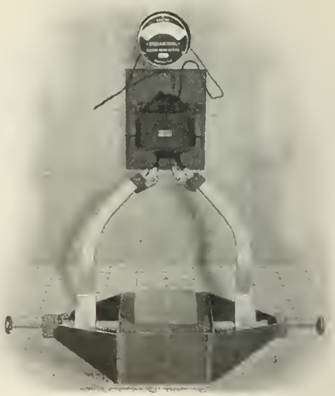


FIG. 2.—FURNACE IN USE.

The resistivity being high compared with that of solid carbon, the cross-section of the resistor can be made large and, therefore, strong and durable. The furnace can be operated efficiently until the resistor is practically all consumed. The renewals are made by inserting the proper number of plates between the graphite end plates, it being the work of a moment.

The furnace as usually constructed will stand temperatures up to 1800 deg. C., but can be made for a temperature of 2000 deg. C. or above. It is suitable for crucible melting of platinum, gold, silver, nickel, cobalt, copper, iron, chromium, steel, etc.; for heating the barium chloride used in hardening steel; for determining the melting points of fireclay and similar materials, and for general experimental work with refractory materials.

The muffle furnace will not reach the highest temperatures, being limited by the ability of the muffle to stand the heat, but is applicable to the treatment of special steels, for assaying and other work requiring a temperature beyond the safe range of wire-wound furnaces. The tube furnace is applicable to a variety of experimental work requiring a uniform and high temperature under perfect control.

Liquid Starting Rheostat.

The Woolliscroft liquid starting rheostat, made by the Sandycroft Foundry Company, of Chester, England, and shown herewith, differs from other liquid starting rheostats in being totally enclosed, the advantage of which is obvious. It consists essentially of a metal drum, Fig. 1, mounted on two centers about which it can freely revolve. In the lower part of the drum is a solution of caustic soda, which remains stationary; the drum moving about it in the operation of starting and stopping the motor. In the upper portion of the drum and attached to, but insulated from it, are blades which dip into or leave the solution according to the direction in which the drum is being revolved. The blades are short-circuited when they are fully immersed, thus cutting out the resistance. The appliance in various forms is suitable for the operation of either starting and controlling, with or without overload and no voltage releases, reverse controlling for cranes, elevators, hoists, etc., or for automatically starting up machinery that may require working intermittently or on a time limit. In the case of a motor-driven pump, for instance, the starting and stopping are automatically effected at the lowest and highest water levels in a tank or well. The continual presence of an attendant at the pump is, therefore, unnecessary.

Maintaining a constant air pressure in the receiver of an electrically-driven air compressor is by no means as simple as it might on the face of it appear to be. The modification shown in Fig. 2 is designed to do this work automatically, the controller being actuated, within certain predetermined limits, by the air pressure, over which it maintains control. The time taken in cutting out resistance can be varied by means of an oil cataract from two or three seconds to as many minutes. The apparatus is suitable for direct- or alternating-current circuits. The salient features of the controller are: Freedom from sparking; practically no evaporation or creeping of the liquid, and it cannot be burnt out. It can be adapted to any voltage up to 500 by simply altering the density of the solution, and it has frequently and successfully been substituted for metallic starters which have given trouble.

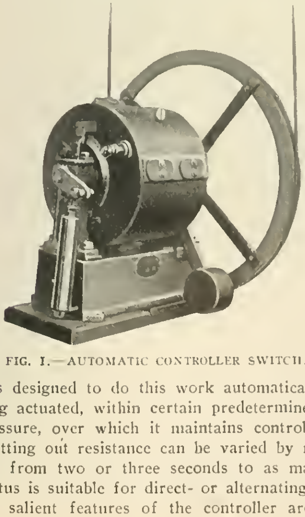


FIG. 1.—AUTOMATIC CONTROLLER SWITCH.

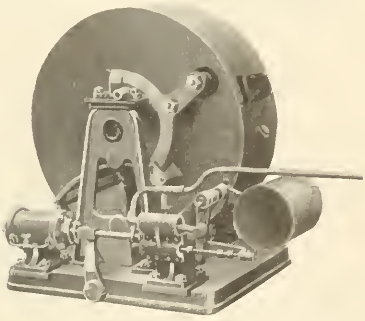


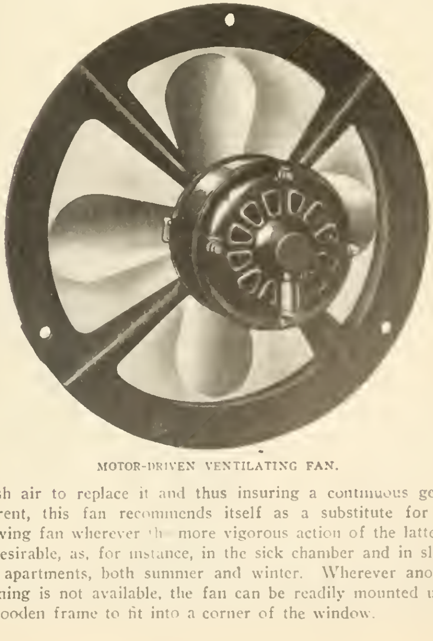
FIG. 2.—LIQUID STARTING RHEOSTAT.

The Electric Ventilating Fan.

The ventilating fan shown in the accompanying illustration is an addition to the line of Westinghouse fans offered for 1908. As will be seen, it consists of a propeller fan carried on the motor shaft and secured within a circular supporting frame for mounting in any convenient opening. It is designed to act as an exhaust fan for the ventilation of rooms and for drawing off the odors and fumes incident to cooking and similar operations. It exhausts the vitiated air, which is replaced by pure outside air in a natural way without creating any noticeable drafts, and thus affords an effectual and satisfactory method of ventilation.

This fan is made for both alternating and direct-current circuits, and with 12-in. and 16-in. blades. The current consumption is practically the same as that of the Westinghouse desk and bracket fans of the same dimensions.

By exhausting the dead air and drawing in a supply of fresh air to replace it and thus insuring a continuous gentle current, this fan recommends itself as a substitute for the blowing fan wherever the more vigorous action of the latter is undesirable, as, for instance, in the sick chamber and in sleeping apartments, both summer and winter. Wherever another opening is not available, the fan can be readily mounted upon a wooden frame to fit into a corner of the window.



MOTOR-DRIVEN VENTILATING FAN.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade reports for the week were, on the whole, rather fair. Easier conditions prevail in the iron and steel markets. Collections remain about the same, money is easier on call and time, and security prices are maintained at the highest level reached on the present spring movement. Railway gross earnings for March show the largest decrease yet reported, and the dulness in building lines affects all lines of materials. Crop reports continue excellent, but with certain sections of the country in need of rain. The combination of circumstances which brought about the immense export movement of last fall and winter seems to have lost its efficacy, and export trade continues to decline, March exports being 15 per cent less than February's exports and 12½ per cent less than those of March a year ago. *Bradstreet's* reports 261 business failures for the week ending April 16, against 258 for the preceding week and 167 for the corresponding week in 1907. Among the large electric companies the export departments continue to show the most activity, but other branches during the last week showed a slight improvement. In New York City and elsewhere last week was "moving week," which for a time always renders affairs more or less chaotic. The improvement during a few weeks in March in the rate at which new business was booked by the General Electric Company, due to three or four large orders, has not been maintained. The General Electric Company, like the Steel Corporation, will, it is stated, make no change of prices in its schedules. Smaller dealers in electrical supplies and contractors report a slight improvement in conditions over the preceding week.

THE COPPER MARKET.—During the week the copper market remained dull but comparatively firm, with prices for electrolytic around 12¾ and 12⅞ cents. The increase in March business proved only temporary, and none of the large electric companies are placing orders of any importance for future delivery. The brass companies, which are doing a good business, are steady buyers, but the speculative element is conspicuous by its absence. Discounting the element of speculation, as matters stand at present there seems to be no reason for a prediction of any considerable change in either direction of the copper market. The shipments of the metal from Atlantic ports since the first of the month aggregate 17,033 tons, and it is interesting to note that, from present indications, by the end of this month the exports will have been about 47,000 tons greater and the imports about 11,000 tons smaller than during the corresponding first four months of last year. The prices for copper at the Metal Exchange on Monday were unchanged and were as follows:

Lake	12¾ @ 12⅞c.
Electrolytic	12⅝ @ 12¾c.
Castings	12⅜ @ 12½c.

The London market was closed on Monday, and Thursday's prices are reprinted, as follows:

	£	s	d	£	s	d
Standard copper, spot	58	12	6	*..	.	.
Standard copper, futures	59	2	6	*..	.	.
Market		Firm.				
Sales of spot						100 tons
Sales of futures						300 tons

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*Closed until Tuesday.

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	61	0	0

The declaration of the regular quarterly dividend by the Amalgamated Company was expected, but there is some doubt expressed as to the likelihood of the regular dividend being declared at the end of the next quarter. Certainly during the last three months Amalgamated has not been earning 50 cents a share, and unless the copper situation improves considerably the company will either have to reduce the dividend or draw upon the surplus. It is stated on good authority that the Guggenheims are planning to sell their own copper, and that their contract with the United Metals Selling Company, which, it is understood, expires next June, will not be renewed. The Metals Selling Company has never handled the entire output of the American Smelting & Refining Company, but a change in the arrangements between the two interests would involve about 40,000,000 pounds of copper a year. The Arizona Copper Company made a new high production record for March, when the output amounted to 3,096,000 pounds of Bessemer copper. This is at the rate of 37,000,000 pounds a year, as compared with a previous annual production of 28,000,000 pounds.

ELECTRIC COMPANIES MOVING.—The general offices of the Westinghouse Electric & Manufacturing Company at 111 Broadway, the sales offices and export department at 11 Pine Street, and the offices of the Westinghouse Machine Company at 10 Bridge Street, will after April 20, occupy the entire twenty-second floor of the City Investing Building, 165 Broadway. The Westinghouse Air Brake Company will occupy the entire twenty-first floor. Other electric companies moving into the City Investing Building are the American Electrical Works and the Electric Properties Company. On April 23 the General Electric Company occupied its new quarters comprising the entire seventeenth floor of the Cortlandt Building of the Hudson Terminal Buildings at Dey and Fulton Streets, having moved from the Edison Building at 44 Broad Street, where its quarters have been during the last seventeen years. Other companies moving into the Terminal Buildings are the Crocker-Wheeler Company, L. K. Comstock & Co., the American Gas & Electric Company, the National Tube Company, the American Bridge Company, the Electric Controller Supply Company, the Emerson Electric Company, the Electric Service & Supply Company, the Morse Chain Company, the Wagner Electric Manufacturing Company and the Ball & Wood Company.

FOREIGN INDEPENDENTS CUT ALUMINUM PRICES.—Extensive cutting of prices by foreign aluminum producers has resulted in foreign aluminum selling here lower than the home product, although the latter has the advantage of a tariff of 8 cents a pound. The foreign quotations for the white metal delivered here is under 30 cents a pound, while the price of American aluminum is 33 cents a pound. The Aluminum Company of America controls the sole right, under certain patents, to manufacture in this country and Canada, and also has the exclusive right of the International Aluminum Syndicate to sell on this side of the Atlantic for some years to come. The "gentlemen's agreement" in force for the last few years between most of the American and European producers has recently been renewed, but the foreign independents have cut under the market. Last year's production on this side was about 8000 tons of a total world production of 20,000 tons.

IMPROVING MACHINERY BUSINESS.—A canvass of the trade in machine tools, etc., has just been made by *Machinery* that gives plenty of encouragement as to trade conditions. The answers from 723 concerns showed that sales since Jan. 1 had increased with 486, and had not increased with 189, while 48 were indefinite. Collections with the same number had increased in 503 cases and were satisfactory, and were not good in 96 cases, 124 giving no information. The editor, from this and the other data before him, says that the returns show that the corner has been turned. The large makers and dealers are optimistic, while with the smaller makers of light machines and special tools "orders are coming in sufficient volume to show that the manufacturers are making ready for better times."

LARGE LAMP SHIPMENT TO SOUTH AMERICA.—An order for 50,000 incandescent lamps was placed with the Westinghouse Lamp Company by Mr. John B. Orr, an electrical supply importer at Rio de Janeiro, Brazil, last week. This is said to be the largest single lamp contract for South America on record. American goods have an excellent standing in Brazil, Mr. Orr writes, and states that during the last nine months he has sold more than 45,000 lamps in the face of strong German competition.

FOREIGN TELEPHONE OPPORTUNITIES.—An American consular officer writing to the Bureau of Manufactures, states that the time is opportune for the introduction of American telephones in the country which he represents. It is his belief that an American company which means business and will take the proper steps, in all probability may obtain a profitable concession from the government of the country in question. Manufacturers interested should communicate with the consular officer mentioned, who will put them in touch with the proper persons. The consul's address may be obtained from the Bureau of Manufactures.

THE ELECTRICAL TRADES SOCIETY, of New York, is making a vigorous effort to extend its membership. At present the corresponding Chicago society is much in the lead with respect to membership, the claim being made that it exceeds in membership the combined lists of the affiliated societies in Boston, New York, Philadelphia, San Francisco and Montreal. Mr. Franz Neilson, 80 Wall Street, is secretary of the New York Society.

BETHLEHEM STEEL COMPANY ENTERS PRIME MOVER FIELD.—It is announced that the Bethlehem Steel Company will take up the manufacture of gas engines and steam turbines. For this purpose a power department is being organized, headed by Mr. Arthur West, formerly assistant chief engineer of the Allis-Chalmers Company and chief engineer of the Westinghouse Machine Company.

TELEPHONE SUPPLIES.—An American consular officer of one of the Latin-American countries reports that the owners of the telephone system in the city where he is stationed, are contemplating the purchase of a new switchboard and a change of system. He states that dealers in telephone supplies might do well to communicate with them. Particulars may be obtained by writing to the Bureau of Manufactures.

Financial Intelligence.

NEW YORK.

	Apr. 13.	Apr. 20.	Shares Sold.		Apr. 13.	Apr. 20.	Shares Sold.
All-Ch.	7⅝	7½*	500	Int.-Met., com.	10⅝	10½	40,210
All-Ch. pfd.	20¼	19*	200	Int.-Met., pfd.	28⅜	27¾	51,100
Amal. Cop.	57¼	57	79,830	Mackay Cos.	59⅞	59¾	425
Am. D. T.	39*	39*	———	Mackay Cos., pfd.	65*	64½	300
Am. Loc.	44¼	44¼	2,450	Met. St. Ry.	33	29	700
Am. Loc. Pfd.	91⅜	93½	500	N.Y. & N.J. Tel.	100*	100*	———
Am. Tel & C'bl.	50*	50*	———	Steel, com.	33⅝	37⅞	108,410
Am. T. & T.	113	116½	1,500	Steel, pfd.	91¼	98¼	10,226
B. R. T.	46⅞	46½	37,035	W. U. T.	51	50	1,645
Gen. Elec.	131	132½	600	West'h com.	54¼	55	7,000
Hud. R. Tel.	—	—	———	West'h, pfd.	60*	60*	———

PHILADELPHIA.

	Apr. 13.	Apr. 20.	Shares Sold.		Apr. 13.	Apr. 20.	Shares Sold.
Am. Rys.	42½	42½	———	Phila. Elec.	8	7⅞	———
Elec. Co. of Am.	9 1/16	9½	———	Phila. R. T.	17⅝	17½	———
Elec. Stor. B'ty	28	28	———	Phila. Traction.	86½	89	———
E. S. B'ty pfd.	—	—	———				

CHICAGO.

	Apr. 13.	Apr. 20.	Shares Sold.		Apr. 13.	Apr. 20.	Shares Sold.
Chicago City Ry.	155	155	———	Met. Elec. Com.	16	15	———
Com. Edison	91¾	—	———	Met. Elec. pfd.	47	47½	———
Chicago Subw'y.	18	—	———	National Carbon.	58	56	———
Chicago Tel. Co.	119	118	———	Nat. Carbon pfd.	109	108	———

*Last price quoted.
Shares sold are for week April 12-16.

THE WEEK IN WALL STREET.—Two holidays immediately before Easter and the tendency of the stock market to mark time rendered last week in the financial district the dullest of the year, the sales for the four days amounting to little more than the business of an ordinary active day. The feature of the week was the activity in the traction shares. The Interborough-Metropolitan 4½ per cent bonds and the preferred stock and the Third Avenue stock made new high records for the year under heavy and continuous buying. With a tendency to decline somewhat in spots, the market on the whole was firm. Among the stocks which showed gains for the week were Canadian Pacific, Union Pacific, Reading, the Steel shares, American Ice and New York Airbrake. Amalgamated was not active, but held well in the face of the depressed copper situation. Money has accumulated in New York in such quantities that the engagement of $2,000,000 gold for shipment to Paris produced no unfavorable impression, and heavier shipments will be viewed without alarm. The general improvement of electrical business conditions is reflected in the advance in prices of the electric shares. The following table shows the net change in the leading electrical securities since the beginning of this year:

	Low for 1908.	April 16.	Net increase.
Allis-Chalmers	5	7½	2½
Allis-Chalmers, pfd.	14	19	5
Am. Tel. & Tel.	101	115½	14½
Gen Electric	111	132	21
Int.-Met., com.	6¾	10⅝	3⅞
Int.-Met., pfd.	17⅛	29⅛	12
Mackay Cos.	52	59⅞	7⅞
Mackay Cos., pfd.	59⅞	64½	4⅝
Met. St. Railway	15	31	16
W. U. Tel.	41	52	11
Westinghouse, com.	38	56¼	18¼

The trading in Monday's market was little different in character from the trading of last week, except that the volume of business transacted was somewhat larger. Interborough-Metropolitan stocks and bonds and Third Avenue fell, along with other pool favorites. Closing prices on Monday were as given on this page.

In Boston the 19th of April, Patriots' Day, was celebrated on Monday, which was therefore a holiday.

WESTINGHOUSE ELECTRIC.—*The Wall Street Journal*, in an editorial on the Westinghouse reorganization plan, pays a high tribute to Mr. Westinghouse. "Equal to the achievement of saving the big banks from panic," it says, "will be the achievement of saving George Westinghouse from insolvency. Mr. Westinghouse is an inventive genius whose contributions to his country entitle him to the regard and support of all. His financial troubles are the result of the very largeness of his plans and not of any defect in the plans themselves. If his business foresight did not equal his scientific insight, so that he was caught in a panic which other men far less gifted than he foresaw and prepared for—well, no man can be all things at all times, in all emergencies."

Referring to the reorganization plan, it says: "If the plan goes through the Westinghouse Company will be amply supplied with working capital and for the first time in several years will be given an opportunity to demonstrate what it is capable of doing from the standpoint of earnings when free and unincumbered by debt. The receivership of the Westinghouse Company was due more to an overabundance of prosperity than anything else. In order to keep pace with the growth of the country and the extraordinary demand for its products, it was forced to burden itself with debts running into the millions. Comparing the financial statements of the Westinghouse Company over the last several years it will be found that earnings were increasing and that operating costs were being gradually reduced. The financial panic came at a time when the Westinghouse Company was at the height of its prosperity. The banks and other creditors demanded a settlement which the Westinghouse Company could not meet and a receivership could not be avoided. From present indications the plan of reorganization will be a success. The larger creditors have given it their approval, and it has also received the endorsement of the prominent stockholders. Creditors and stockholders are working in harmony with Mr. Westinghouse in an effort to free the company from receivership and thereby place it on its feet once more. The receivership of the Westinghouse Company does not mean that the corporation is not making a good showing in the matter of earnings. Its earnings for years past have been in excess of dividend requirements. While the company is suffering as a result of the current depression the prospects are that with ample working capital it will be able to make some new high records from the standpoint of income when business conditions become normal, and that stockholders will not have to wait a great while for a restoration of dividends. The successful conclusion of the present reorganization plan will unquestionably result in a material enhancement in the value of the company's securities."

In conclusion the *Journal* says: "Few companies have contributed more toward the development of the country than the Westinghouse Electric & Manufacturing Company and it is because of this that business men hold that a continual receivership and the sale of the property at a sacrifice could be regarded in the light of a national, perhaps international, business calamity."

THE CONSUMERS ELECTRIC COMPANY OF NEW ORLEANS, LA., has been placed in the hands of Samuel Insull, president of the Commonwealth Edison Company, of Chicago, as receiver, following proceedings brought by the National Conduit & Cable Company, of New York, a holder of mortgage bonds. The company was organized three years ago, with Jules Dreyfus as president.

NORTH AMERICAN COMPANY DENIES REPORTED LAWSUIT.—Officers and counsel for the North American Company say that there is no truth in the recent report from St. Louis to the effect that Assistant Attorney General Kennish will institute proceedings within the next month, to determine whether or not the North American Company, which controls the Laclede Gas Light Campany and the Union Electric Light & Power Company, is a combination in restraint of trade. "We have received no notice of any such proceedings," said Secretary Burt, of the North American Company, "and I am certain that there is nothing in the report. As a matter of fact, there is a certain newspaper in St. Louis which has made a point of attacking our company by publishing just such rumors, at every opportunity, with no reason that I can discover, except, perhaps, to gain publicity. There is nothing to prevent any one from entering upon just such a suit, but we do not bother ourselves about the outcome in such cases. We do regret such litigation, however, because we are compelled to make answer and that entails considerable expense, and because such litigation might injure our credit with persons who do not fully understand the situation." Mr. A. Jaretzki, of the firm of Sullivan & Cromwell, counsel for the North American Company, was even more certain that no action against the company was contemplated by the Attorney General. He said: "I think I can say positively that the Attorney General will take no steps in that direction. A year ago the District Attorney began some such action against the Union Company, but it never went beyond the mere service of papers. In the first place, the North American Company is a New Jersey corporation and is not amenable to the laws of Missouri. The North American Company owns most of the stock of the Laclede Company and minority holdings in the Union Company, but that in no way constitutes a combination in restraint of trade. We have always been in favor of Public Service Commissions and rate regulations. Our efforts have been to raise our companies to the highest degree of efficiency and economy. If such litigation is contemplated, which I do not believe, it comes rather late, as there is nothing doing in the anti-corporation line in St. Louis at present. Last fall the spasm of so-called reform was at its height and then would have been the psychological moment. Those waves against corporations come along just so often and must be weathered and counted along with other business drawbacks."

MEETINGS AND DIVIDENDS.—The directors of the American District Telegraph Company of New Jersey have declared the regular quarterly dividend of 1 per cent, payable April 22. The annual meeting of the New England Telephone Company will be held May 14, at 11 a. m., at 15 Dey Street. A special meeting of stockholders will be held on the same day, preceding the regular meeting, to vote on certain routine matters. The directors of the Michigan State Telephone Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable August 1. Quarterly dividends of 1 per cent, or at the rate of 4 per cent a year, were declared on the common stock, payable June 1. At the annual meeting in Detroit, D. W. Briggs, vice-president of the Bank of Saginaw, Mich., and Russell A. Alger, of Detroit, were elected directors, to succeed Elwood T. Hance, deceased, and W. A. Jackson, who declined re-election. John T. Shaw, president of the First National Bank of Detroit, was elected chairman of the executive committee. The directors of the Electrical Securities Corporation have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, payable May 1. The directors of the Amherst Gas Company have declared a semi-annual dividend of 3 per cent. The East St. Louis & Suburban Company has declared a quarterly dividend of 1¼ per cent on the preferred stock. The Lowell Electric Light Corporation has declared a quarterly dividend of $2 a share on the capital stock. The Houston Co. Electric Light Company has declared a semi-annual dividend of 75 cents per share on the preferred stock and 62½ cents a share on the common stock. The directors of the Montreal Light, Heat & Power Company have declared the regular quarterly dividend of 1½ per cent, payable May 15.

WESTINGHOUSE MERCHANDISE CREDITORS' PLAN.—Judging by the number of responses which have already been received from stockholders in answer to the letter sent out last Thursday by the Stockholders' Committee of the Westinghouse Electric & Manufacturing Company, the result so far has been very gratifying. Not only do the shares already taken up mount into the thousands, but in many cases the stockholders are subscribing for more than their pro rata share of one-fourth. Said one of the members of the committee, while speaking of the progress made so far: "The committee is well pleased with the manner in which the Merchandise Creditors' plan is being received by the stockholders. It shows that they have come to a thorough realization of their position in recognizing that, unless they come forward and do their share toward making this plan a success, they will be the losers. While it is true that for many stockholders it will be hard at this time to find money for the purchase of stock, it must be remembered that in this case they are doing so to preserve the holdings which they already own, and in addition they are giving material aid toward the rehabilitation of a company which has unsurpassed prospects for reimbursing the stockholders for any sacrifice they may be making at the present time. But, as I told you the other day, this plan of the Merchandise Creditors' Committee, while is it a very good one, one thing must not be forgotten, and that is that all the stockholders will have to co-operate and subscribe for their pro rata amount of stock. If they do not, the amount of $10,000,000 which the committee asks for will not be realized, the plan will have to be abandoned, and the future of one of the greatest industrial enterprises in this country, the Westinghouse Electric & Manufacturing Company, will be a very grave one."

INTERBOROUGH NOTES SOLD.—One of the reasons advanced to account for the recent activity in traction shares is the report that J. P. Morgan & Company have taken $25,000,000 of the three-year notes of the Interborough-Metropolitan Rapid Transit Company. A syndicate will be formed by the Morgan interests, it is said, to underwrite the notes, and the issue will be secured by the deposit of the bonds recently authorized by the Public Service Commission. Proceeds from the sale of the notes will be used to take up the $15,000,000 in notes due May 1, and also for other floating debts. It was rumored in Wall Street last week that some of the State Senators who voted against the race-track bills were favored with advance information regarding the success of the Interborough financing. According to the stories circulated, many political obligations have been discharged in the past by market "tips" on traction stocks.

WESTERN UNION DIVIDEND.—Stockholders of the Western Union Telegraph Company will receive as a quarterly dividend of 1¼ per cent, the $1,230,000 capital stock which the governing committee of the Stock Exchange admitted to the list last week. The authorized capital stock of the companv is now $125,000,000, of which $10,000,000 is reserved to take care of the $10,000,000 convertible 4 per cent bonds and $15,000,000 will be reserved to take care of $15,000,000 of the same bond issue not yet put forth. There is now outstanding $99,817,000 stock and there remains but $183,000 free stock, allowing for the $25,000,000 to care for the bond issue. The payment of the last stock dividend weakened the market position of the Western Union by bringing into the market a floating supply of stock which had been closely held.

BROOKLYN RAPID TRANSIT.—For the six months ending Dec. 31, 1907, the Brooklyn Rapid Transit Company reports passenger earnings of $9,919,366; freight, mail and express, $191,251; advertising, $77,553; American Railway Traffic Company, $211,401, giving a total earnings from operation of $10,399,571. The total operating expenses were $5,940,726, and the total income $4,817,409. Deducting $3,253,499 for taxes, interest and rentals, leaves a net income of $1,563,910, and deducting special appropriations of $211,705 leaves a surplus of $1,352,205, equal to 3 per cent on the $45,000,000 capital stock.

CHICAGO RAILWAYS.—The Chicago City Railway has been ordered by the Board of Supervising Engineers to spend $2,112,000 on 43¼ miles of track this year and $316,000 on conduit work. Its cars must be taken off Michigan Avenue. No order for new equipment was issued. The Chicago Railways Company was ordered some time ago to spend about $2,000,000 this year, largely for new equipment, and another order will be issued covering track construction work.

WHITNEY COMPANY ATTACHMENT VACATED.—The attachment on the property of the contracting firm of E. A. Gillespie Company, at Whitney, N. C., which was obtained by the receiver of the Whitney Company, was vacated last week by Judge Boyd, at Greensboro, N. C., the receiver having failed to furnish the bond as required by the court.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

BAY MINETTE, ALA.—The City Ice & Light Company contemplates establishing a lighting plant to furnish light for the streets and residences of the town. E. G. Nelson is president of the company.

BIRMINGHAM, ALA.—The City Council of West End has granted the Peoples Home Telephone Company a franchise to install and operate a telephone system in that city.

HARTSELLE, ALA.—The city of Hartselle has purchased the equipment of the old municipal electric light plant at Athens. The machinery will be shipped at once from Athens to Hartselle where it will be installed.

SELMA, ALA.—A company is being organized in this city to furnish electricity for lighting the city. E. C. Melvin, V. B. Atkins, Isaac Schwarz and W. C. Agee are interested in the project.

BISBEE, ARIZ.—The Bisbee Improvement Company has completed the rebuilding of its plant and has installed additional equipment as follows: One Allis-Chalmers, 500-kw, two-phase, 2300-volt, 60-cycle steam turbo-generator set; one 400-hp Stirling water tube boiler; two Alberger condensers, and a nine-panel General Electric alternating-current switchboard. The company will, in the near future, rebuild its transmission lines. C. S. Thompson is manager and I. A. Rosok is electrical engineer.

LITTLE ROCK, ARK.—Plans are being made by the Little Rock & Hot Springs Electric Company to commence work on the construction of its road within 90 days. The company expects to erect its own power station. As yet no contracts have been awarded for material or equipment. The company is capitalized at $2,000,000 and the officers are: C. J. Kramer, president; L. Garrett, vice-president and general manager; J. C. Marshall, secretary; George W. Rogers, treasurer; J. F. Russ, superintendent, and P. M. Pierce, electrical engineer.

FOLSOM, CAL.—The State Board of Prison Directors has decided to issue $6,000 in bonds to install an entirely new electric light plant for the penitentiary at Folsom.

SAN DIEGO, CAL.—The City Council has passed an ordinance for erecting and maintenance of ornamental iron posts carrying clusters of incandescent electric lamps on Sixth Street, between C and F Streets.

SAN FRANCISCO, CAL.—The estimate of expenses for the next fiscal year prepared by the Department of Electricity for the Board of Supervisors is $275,450, of which $70,588 will be required for restoration of police-signal system, $19,867; restoration of the overhead fire- and police-alarm systems, $9,844; underground, $93,700.

SAN ANSELMO, CAL.—The third-rail electric system of the Northwestern Pacific Company's North Shore system has been extended from San Anselmo to Fairfax. Steam cars will be operated in addition to the electric service until the large power house in San Anselmo is completed, as the present power plant of the company is unable to furnish energy to transport the increasing traffic from Fairfax to this place.

SANTA CRUZ, CAL.—The Coast Counties Power Company is planning to install another unit of 750 kilowatts in the power plant at the Beach. The company expects to have its Soquel extension completed to the city limits by next fall. F. E. Fitzpatrick is general manager.

SONORA, CAL.—The Stanislaus Electric Power Company has filed a notice of appropriation of 8,000 in. of water in the Stanislaus River, two miles below Baker's Crossing, to be used to generate electricity and for mining, irrigation and domestic purposes.

WHITTIER, CAL.—Plans are being considered by the city for the construction of a municipal electric light plant. A committee, consisting of N. T. Edwards, C. F. Klingberg and H. E. Humphrey, has been appointed by the Board of Trade to investigate the matter. It is estimated that a plant can be installed in connection with the present municipal pumping plant for about $75,000.

COLORADO SPRINGS, COL.—A company has been formed by J. A. Hayes, president of the First National Bank of Colorado Springs, for the purpose of utilizing the water power of the Grand River to generate electricity to pump water for irrigating a large tract of land east of Grand Junction.

DENVER, COLO.—Plans are being considered for equipping the Denver, Northwestern & Pacific Railroad to be operated by electricity over the Continental Divide, and if plans are consummated the six-mile tunnel now projected will be abandoned. Estimates of the cost are now being prepared by the Central Colorado Power Company. D. H. Moffatt is president of the electric company.

DANIELSON, CONN.—The Wauregan Company is making arrangements to light its entire plant with electricty, and has placed an order for a generator with sufficient output to operate 1500 lamps. The mill will be rewired, and the gas lighting system will be discarded.

MIDDLETOWN, CONN.—The Middletown Electric Light Company is considering the construction of an entirely new plant. The company contemplates installing steam turbines.

WASHINGTON, D. C.—We are informed that the Washington Railway & Electric Company contemplates increasing the output of its power station and will install one 900-kw turbine; one 1000-kw frequency set and a 1000-kw railway rotary converter. The company also expects to award a contract for the construction of a car barn; about 3100 ft. of new track and the purchase of a new suburban car. H. W. Fuller is general manager.

ATLANTA, GA.—The Atlanta & Carolina Railway Company has been authorized by the State Railroad Commission to issue $6,000,000 in bonds. The proposed railway will be 200 miles long and will connect Atlanta and Augusta. James W. English, of Atlanta, is president of the company.

BLUE RIDGE, GA.—The city is making arrangements to commence work on the construction of an electric light plant, water works system and other improvements. W. C. Boling is Mayor.

CEDARTOWN, GA.—The citizens will vote on the proposition to issue $30,000 in bonds for extensions to the light, water and sewer systems and street improvements. R. O. Pitts is Mayor.

MILLEDGEVILLE, GA.—The capital stock of the Oconee River Mills has been increased to $250,000. The company is planning the construction of a hydro-electric plant from 500 to 1000 horse-power. F. D. Milstead, of Atlanta, is preparing estimates of the work.

REYNOLDS, GA.—Plans are being considered by D. S. Sanders for the installation of an electric light plant, for which the following equipment will be required: A dynamo, a 10-hp gasoline engine, switchboard, 4000 ft. No. 8 insulated wire, lamps and accessories.

SPARKS, GA.—Contracts for the construction of an electric light plant and water works system have been placed by the City Council with J. B. McCrary & Company, of Atlanta, work on which will commence at once.

CALDWELL, IDAHO.—Plans are being made by the Long Distance Independent Telephone Company to make extensive improvements to its system throughout Ada and Canyon Counties.

WEISER, IDAHO.—The City Council is considering the proposition sumbitted by O. G. F. Markus, general manager of the Oxbow Power & Light Company. The company proposes to erect a substation near the municipal electric plant to furnish electricity to operate the pumping plant.

BARTONVILLE, ILL.—The Interstate Telephone Company has applied to the City Council for a franchise to operate a telephone system in this city.

CHICAGO, ILL.—We are informed that the Woodstock & Sycamore Electric Railway Company is planning to commence construction of its railway in June. The road will be 25 miles in length and will connect Woodstock, Franklinville, Marengo, Geneva, Sycamore and De Kalb. The power station will be located at Marengo. Charles A. Spenny, Tacoma Building, Chicago, is secretary and treasurer.

CHICAGO, ILL.—Plans are being considered by the Chicago & Oak Park Elevated Railroad Company for the construction of an extension to Elmhurst, a distance of five miles. It is said that the extension is to be built by a new company, controlled by the same interests.

EAST ST. LOUIS, ILL.—We are informed that practically all the right of way and franchises have been secured for the proposed electric railway, which the Woodriver, East Alton & Bunker Hill Traction Company proposes to construct between Woodriver and Litchfield and intervening towns. The road will be 60 miles in length. The power station and repair shops will be located at Bethalto. The company also proposes to furnish electricity for lamps and other purposes to the towns along the route. The company is capitalized at $250,000, and the officers are J. T. W. Rudisell, president; R. A. Mavey, vice-president; S. B. Kueffer, secretary, and R. M. Smith, treasurer, all of East St. Louis.

SHAWNEETOWN, ILL.—The Independent Telephone Company contemplates installing a new telephone system in this city.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company is making plans for the construction of a concrete dam on the St. Joseph River at Robison Park.

LIBERTY, IND.—G. E. Stevenson, chairman of the light committee of the Town Council, writes that the town does not intend to install a municipal plant, but invites the establishment of a central station by private capital.

SPENCER, IND.—The Reliance Engineering Company, of Columbus, Ohio, will have charge of the construction of electric light plant and water works system for Spencer. The cost of the plants is estimated at $35,000. The lighting plant will have an output of 200 kilowatts.

KIOWA, KAN.—Plans have been prepared by Burns & McDonnell, Kansas City, Mo., for a water works system, to cost $40,000, and an electric light plant to cost $12,000. An election will be held on April 30 to vote on the proposition to issue bonds for construction of these plants.

LEAVENWORTH, KAN.—The People's Home Telephone Company is contemplating the installation of a telephone system at Fort Leavenworth, which will involve an expenditure of about $30,000. The company is also erecting lines to Kickapoo and other points.

McPHERSON, KAN.—An appraisal of the water works system and electric light plant is being made by Burns & McDonnell, of Kansas City, Mo., with a view of their being purchased by the city. Estimates and plans for improvements to the water and lighting systems are also being made.

SALINA, KAN.—Contracts have been placed by the Salina Street & Interurban Company for equipping the local street car system to be operated by electricity. The present system is operated by gasoline motors.

ELKTON, KY.—The switchboard of the Home Telephone Company in this city was recently destroyed by fire.

FRANKFORT, KY.—The Capitol Commissioners will consider plans for construction of a power house and equipping a plant to furnish electricity for lamps, etc., and for heating the building. Governor Augustus Wilson recently approved a bill appropriating $460,000 for completing and furnishing the new capitol.

EUNICE, LA.—The Council is considering the question of establishing a municipal electric light plant.

NEW ORLEANS, LA.—The Consumers' Electric Company, of which Samuel Insull, of Chicago, Ill., was recently appointed receiver, is planning large extensions to its business. It is proposed to extend its service to the residence section of the city. Its territory is now limited to the commercial district.

NEW ORLEANS, LA.—Bids will be received until May 20 by the vice-president of the Board Solvent for the construction and equipment of a steam power house, boiler plant, etc., for the Charity Hospital, in accordance with plans and specifications on file with John Ponder, chief engineer of the hospital. The plans call for a 600-hp plant, the cost of which is estimated at $52,000. Edwin Marks is secretary and treasurer.

NEW ORLEANS, LA.—Bids will be received at the office of the Sewerage and Water Board until June 30 for furnishing and installing the following machinery: Two 100-kw, 250-volt, direct-current generators; two 75-hp, 250-volt motors; one 2,500,000-gal. turbine pump, to work against a 125-ft. head, direct connected to an electric motor; one 1,000,000-gal. triplex pump, to work against a 125-ft. head, geared to an electric motor; one 2,000,000-gal. centrifugal pump unit, to work against a 20-ft. head; two 4,000,000-gal. centrifugal pump units, to work against a 20-ft. head; two 5-hp, 250-volt motors; one surface condenser, capable of condensing 6500 lb. of steam per hour, together with air pump. Also all exhaust and water piping, valves, wiring, switchboard, lamps and other appurtenances, completely installed. Specifications with blank form of proposals may be obtained at the office of the board, 602 Carondelet Street. Plans will be furnished only upon personal application. F. S. Shields is secretary of the board.

PEMBROKE, MAINE.—The plant of the Pembroke Light & Power Company was destroyed by fire on April 11, causing a loss of about $10,000.

RICHMOND, MAINE.—The citizens have voted to authorize the Selectmen to make a contract for lighting the streets of the village with electricity for a term of five years.

AMHERST, MASS.—The directors of the Amherst Gas Company have decided to install two new boilers in its electric power plant and to make additions to the switchboards.

MARBLEHEAD, MASS.—The Electric Light Commissioners have placed a contract for the new boiler for the electric light plant.

SOMERVILLE, MASS.—The Edison Electric Illuminating Company has petitioned the Board of Aldermen for permission to locate and maintain conduits for its wires in Willow Avenue, Highland Avenue, Davis Square and Holland Street, for the purpose of carrying its high-tension wires from the electric light station on Willow Avenue on to Arlington, where a substation is to be established. The company has notified the Council that this work will be done, in addition to the $20,000 which the company is required by law to spend on underground work each year.

CLOQUET, MICH.—The Great Northern Power Company, of Duluth, is making surveys in the vicinity of Cloquet Dam on the Cloquet River, in Section 15, 52-54. It is stated that the company contemplates the construction of a concrete dam 45 ft. high to replace the present 15-ft. dam. E. P. Coleman, of Duluth, is manager and chief engineer.

DETROIT, MICH.—At the annual meeting of the Michigan State Telephone Company, held recently, D. W. Briggs, of Saginaw, and Russell Alger, of Detroit, were elected directors to succeed Elwood T. Hance, deceased, and W. A. Jackson, who declined re-election. The other directors were re-elected. John T. Shaw, of Detroit, was elected chairman of the executive committee.

GRAND RAPIDS, MICH.—The East Side Power Company is contemplating changing its power plant from water to electrical power, the energy to be generated from the present water-power rights of the company. The company is considering the question of applying to the Council for permission to erect transmission lines to distribute electricity throughout the city. R. W. Irwin is president of the company.

IRON RIVER, MICH.—Plans are being prepared by Edward P. Burch, consulting engineer, Minneapolis, Minn., for a 400-hp water power development for the Menomonee Range Power & Development Company.

COLERAINE, MINN.—A telephone company has been organized in this city to install an Independent telephone system, work on which will begin at once. The company is capitalized at $10,000.

CROOKSTON, MINN.—Plans have been prepared by the Ambursen Hydraulic Construction Company for the construction of the proposed dam across the Red River, near Climax, the cost of which is estimated at $250,000. Elias Steenerson, of Crookston, is interested in the project.

LITTLE FALLS, MINN.—A rural telephone company is being formed in this place to construct a rural line to connect with the exchange at Little Falls. Barney Burton is interested in the project.

ST. PETER, MINN.—Plans are being considered by the City Council for making improvements and increasing the output of the municipal electric light plant, which include the installation of a new generator and engine. F. H. Silverton is superintendent.

SAUK RAPIDS, MINN.—The Village Council has placed contracts with the General Electric Company, of Schenectady, N. Y., for two generators for the municipal electric light plant.

BILOXI, MISS.—The City Council has entered into an agreement with the Gulfport & Mississippi Coast Traction Company for lighting the streets of the city. By terms of the agreement the company is to furnish 12 arc lamps at $8 each per month, 100-cp tungsten lamps at $3 each per month, and as many 32-cp incandescent lamps as the city may call for at the rate of $1.87½ each per month.

NATCHEZ, MISS.—Bids will be received at the office of the city clerk until May 6 for lighting the streets of the city for a term of five years, from March 1, 1909. George T. Eisele is city clerk.

WIGGINS, MISS.—The Town Council on April 9 revoked the franchise of the Cumberland Telephone & Telegraph Company and granted a franchise to Mr. Fougolson and others to erect a telephone system in the town.

ALVA, MO.—The Alva Electric Railway is making arrangements to construct a power house, the equipment of which will include a 300-kw, three-phase, 60-cycle, 6600-volt alternator, direct connected to water turbine and two motor generator sets. Contracts for rails, ties, water power plant, auxiliary steam plant with an output of 200 kilowatts, will be awarded within 30 days. J. B. Quigley is chief engineer.

DORA, MO.—The Martin Power Company contemplates the construction of a dam and power plant on the Big North Fork River near Dora, and erecting transmission lines to West Plains, a distance of 200 miles, to furnish electricity for lamps and motors. Charles K. Martin will have charge of the work.

ST. LOUIS, MO.—The King Electric Light Company and the Suburban Electric & Power Company have both filed petitions in the St. Louis County Court recently asking that their franchises be extended. The former company asks that it be allowed to furnish service in all of the county north of the Clayton, the Conway and the Wild Horse Creek roads, while the latter company wants to furnish electricity in the rest of the county.

GLENDIVE, MONT.—The Hughes Electric Telephone Company contemplates the construction of a telephone line to Miles City.

HELENA, MONT.—The Hauser Lake Dam across the Missouri River, owned by the Helena Power Transmission Company, was partially washed away on April 15 by the flood. The dam was completed last year and furnishes electrical energy for smelters and manufacturing plants in Helena, Butte and Anaconda. It is estimated that the dam can be rebuilt for $250,000. The company now supplies electricity from the Canyon Ferry Dam and its steam station in Butte. M. H. Gerry, Jr., is manager.

CONCORD, N. H.—G. W. Lincoln, of Hillsboro, has acquired the telephone lines of the New England Telephone & Telegraph Company between this city and Peterboro, which will be known as the Contoocook Valley line. Mr. Lincoln contemplates the purchase of several other lines.

LEBANON, N. H.—Plans are being made by H. W. Carter & Sons to equip their factory to be operated by electricity. Energy for operating the plant will be furnished by the local electric company.

WOLFBORO, N. H.—The village fire precinct has voted to contract with S. W. & J. L. Clow to furnish power for the municipal electric light plant at the rate of $2,750 per year for five years, or for any portion of said term, pro rata, if the precinct shall see fit to install a plant of its own. It was also voted to purchase the old shoe factory property at a cost not to exceed $4,000. A committee was appointed, consisting of Henry B. Furber, George W. Berry, Fred Mayhew, Harry L. Miles and Chester Hawkins to take charge of the shoe factory property and investigate all matters pertaining to the new plant and the removal of the present plant to the new location.

FRANKLIN, N. C.—A proposition for installing an electric light plant has been submitted to the town authorities by J. F. Palmer.

FULLERTON, N. C.—A contract has been awarded by the Gulf Lumber Company to the General Electric Company, of Schenectady, N. Y., for three 500-kw generators and other equipment necessary for an electric power plant to furnish electricity for lamps and motors in the town.

GOLDSBORO, N. C.—A franchise has been awarded to E. T. Oliver, of Raleigh, to construct and operate a street railway in this city.

HICKORY, N. C.—It is reported that the Water Power Electric Company will soon commence work on the construction of its proposed hydro-electric plant on the Catawba River, three miles from Hickory. The work includes the construction of a concrete dam 18 ft. high and 400 ft. long, with penstocks and power house, etc. About 3000 horse-power will be developed at first, which will be transmitted to Hickory and surrounding country. M. E. Thornton, of Hickory, is president of the company.

NEWARK, N. J.—A committee has been appointed by the Freeholders of Essex County to investigate the question of installing an electric light plant in the court house. The present contract with the Public Service Corporation, under which it costs the county from $900 to $1,200 per year to light the building, will expire in September.

TRENTON, N. J.—The House of Representatives passed the bill allowing the Atlantic County Traction Company to extend its railway through the camp grounds at Sea Girt, with the permission of the Governor and quartermaster-general.

TRENTON, N. J.—The Trenton Iron Company, during the past year, has increased the equipment of its power station by the installation of an Allis-Chalmers 24 in. x 32 in. double-acting tandem gas engine, direct connected to a 350-kw, 550-volt, direct-current generator; also a gas producing plant, including a coal handling device, furnished by R. D. Wood & Company, of Philadelphia, Pa.

WOODBURY, N. J.—The Pitman Electric Light Company has petitioned the town officials for a franchise to establish an electric light plant. The Public Service Corporation is now furnishing electricity for lighting the town.

TUCUMCARI, N. M.—The Tucumcari Telephone Company contemplates the installation of a new telephone system in this city, the cost of which is estimated at $20,000. H. Gerhardt is interested in the company.

BROOKLYN, N. Y.—In the naval appropriation bill passed by Congress extensive improvements are planned for the Brooklyn Navy Yard, among which are included $46,000 for extension to electric light plant, $25,000 for extension to underground conduits, $115,000 for completing heating plant and $12,000 for telephone system.

GENEVA, N. Y.—The Economic Power & Construction Company has been granted permission to enter the extension of the conduit system, which is to be built through Franklin Street to connect with the city's system on Seneca and Exchange Streets, at the rate of five cents per duct foot.

GOSHEN, N. Y.—The Goshen Light & Power Company contemplates making application to the Public Service Commission, Second District, for permission to issue $15,000 in bonds, of which the proceeds of $6,000 will be used to take up an issue of bonds falling due in June, and the balance to be used for the construction of a transmission line to Monroe, and to change the present generating plant at Goshen to a transformer station. The company proposes to obtain electrical energy for operating its system from the Orange & Rockland Electric Company at Monroe.

INTERLAKEN, N. Y.—Plans are being considered for the merger of the Trumansburg Home Telephone Company's system and the plant of the Bell Telephone Company, which will be operated from one exchange.

LOCKPORT, N. Y.—The International Power & Transmission Company, a subsidiary of the Niagara, Lockport & Ontario Power Company, which recently applied to the City Council for a franchise to furnish electricity for light, heat and power, has withdrawn its application. It is stated that the Public Service Commission has granted the Lockport Light, Heat & Power Company a non-competitive field in this city as long as it did not raise its present rates.

MT. SINAI, N. Y.—The citizens of this place and Millers Falls and vicinity are contemplating having an electric system installed in the different villages.

NEW YORK, N. Y.—Bids will be received until April 27 by C. B. J. Snyder, superintendent school buildings, for installing electrical equipment in Public School No. 155, and in new Public School No. 117, corner of Herkimer Street and Eastern Parkway, Borough of Brooklyn.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has made application to the Public Service Commission, Second District, for permission to issue $1,474.000 in bonds, for the purpose of refunding obligations of the company.

WEST POINT, N. Y.—Bids will be received until May 11 for furnishing and installing electric and combination gas and electric light fixtures for officers' quarters, as per plans and specifications in this office. Forms of proposals furnished on application. For further information address the quartermaster, West Point.

LIDGERWOOD, N. D.—The Lidgerwood Rural Telephone Company is making arrangements to erect a number of rural telephone lines in the near future.

ANNA, OHIO.—The Village Council is advertising for bids for the construction of a municipal electric light plant. H. G. Hagelberger is clerk.

CINCINNATI, OHIO.—Plans are being considered for the construction of a new boiler and power house for the Bethesda Hospital, to cost about $35.000.

CLEVELAND, OHIO.—The Board of Public Service has approved the franchises for the Cuyahoga Lighting Company and the Cleveland Electric Illuminating Company. The downtown streets only were covered by the approved franchises, as the conduits had been laid in that section of the city under permits granted by the board.

COLUMBUS, OHIO.—Announcement has been made that the Gold Mines & Power Company, with offices in the New First National Bank Building, Columbus, which is developing a water power proposition in central Colorado, will commence work on the construction of a second power plant this season. It is said that the new plant will develop about 2000 horse-power.

MONTPELIER, OHIO.—Bids will be received by C. D. Clark, Clerk of Board of Public Affairs, until April 28, for improvements to the municipal water and light plant. George Champ, The Nashy, Toledo, is consulting engineer.

NEW LEXINGTON, OHIO.—Plans are being made by the Citizens' Independent Telephone Company to erect lines throughout the entire county and to establish exchanges in several of the principal towns.

PIQUA, OHIO.—The Piqua Home Telephone Company contemplates making extensive extensions to its system, including the erection of over 12,000 ft. of new cable.

SPRINGFIELD, OHIO.—At the annual meeting of the Springfield & Xenia Telephone Company the following named officers were elected: John L. Bushnell, president; J. F. McGrew, vice-president; Delos O'Dell, secretary and general manager, and R. R. Mills, treasurer.

TROY, OHIO.—The Troy Independent Telephone Company is planning many extensions and improvements to its system, including the entire overhauling of its lines.

WOOSTER, OHIO.—Arrangements are being made by the Massillon, Wooster & Western Railway Company to commence work on the construction of its proposed railway during the coming summer. The railway will be 51 miles in length and will connect Massillon and Mansfield and intervening towns. The company will secure electricity for operating the road from the Cleveland Southwestern Railway Company. C. V. Hard, of Wooster, is president.

YOUNGSTOWN, OHIO.—The capital stock of the Lake Erie & Youngstown Railroad Company has been increased from $10,000 to $3,500,000, the proceeds to be used for the construction of the road between Youngstown and Conneaut. John L. Ruhlman is promoter of the road.

PORTLAND, ORE.—The Portland Railway, Light & Power Company is planning to make application for franchises to extend its street car lines in the outlying districts of the city. Orders have recently been placed for $50,000 worth of copper wire, which is to be used for the new lines. Plans are also being drawn for a new substation on Northern Hill to furnish electricity to St. John, the Columbia and Willamette River bridges now being erected by the Spokane, Portland & Seattle Railway, the Swift and other packing establishments on the Peninsular and surrounding district. The substation, including machinery and feed wires, will cost about $50,000. P. S. Josselyn is president.

PORTLAND, ORE.—J. S. N. Smith, of Coos Bay, consulting engineer of the recently organized Coquills Valley Power Company, states that the surveys for the pipe line, power house and flumes have been completed and that work on the plant will begin about May 1. The power house will be located between Marshport and Roseburg at the gorge near Brewster Valley. The transmission line will be 33 miles in length. Contracts for electricity have already been placed in Myrtle Point, Bandon, Marshfield and North Bend. The plant will have a minimum output of 4000 horse-power, which can be increased to 12.000 horse-power.

BLUE RIDGE SUMMIT, PA.—The Chesapeake & Potomac Telephone Company is planning to install a new exchange in this city.

NORRISTOWN, PA.—The city has issued $300,000 in bonds, the proceeds to be used for sewers, highways, park and extension to the municipal electric light plant. S. Cameron Corson is city engineer

CAMPOBELLO, S. C.—D. B. Caldwell is reported to be interested in the construction of an electric light and power plant.

FLORENCE, S. C.—The City Council has entered into a new contract with the Florence Light & Power Company, whereby the city will receive an improved lighting service at a saving of $22.50 per lamp per year. Under the new contract the company is to furnish arc lamps at the rate of $77.50 per lamp instead of $100. The contract calls for 30 arc lamps and 25 incandescent lamps of 75 candle-power at a cost of $2,949 per year.

ST. MATTHEW, S. C.—Plans are being prepared by D. Z. Zeigler & Company, of Atlanta, Ga., for the construction of a power plant on High Hill Creek. It is proposed to organize a company to be capitalized at $400,000, to build a cotton mill and construct an electric railway to utilize the power. The proposed plant will have an output of 2068 horse power. D. D. Buyck, J. S. Wanamaker, J. A. Banks and others are interested in the enterprise.

MITCHELL, S. D.—Plans are being considered by the Mitchell Illuminating & Power Company for improvements to its plant, which include the purchase of new machinery.

WATERTOWN, S. D.—The installation of a new exchange in this city is under consideration by the Dakota Central Telephone Company

WOLSEY, S. D.—The citizens are considering the question of establishing a municipal electric light plant.

MEMPHIS, TENN.—We are informed that the Lake View Traction Company expects to begin the construction of its road this coming summer. The proposed electric railway will be 150 miles in length and will connect Memphis, Covington, Collierville and Clarksdale and intermediate towns. The company plans to erect its power house and repair shop at Lake View and also to operate an amusement park at that place. The capital stock of the company is placed at $2,500,000. H. E. Craft is vice-president.

CLEBURNE, TEX.—Receiver William Battle, of the Cleburne Water, Ice & Lighting Company, has been granted permission by the court to issue $35,000 in certificates for improvements to the plant.

CORPUS CHRISTI, TEX.—The City Council has granted a franchise to Clark Pease and associates to construct and operate an electric light plant in this city.

TYLER, TEX.—Bids will be received until May 20 at the office of the supervising architect, Treasury Department, Washington, D. C., for the installation of a conduit and electric wiring system for the United States post office and court house building and extension at Tyler, in accordance with drawing and specifications, copies of which may be had at the above office, or at the office of the superintendent of construction, Tyler, Tex. James Knox Taylor is supervising architect.

SALT LAKE CITY, UTAH.—The Board of County Commissioners has granted franchises to the Utah Light & Railway Company to lay double tracks on several streets. The company is planning to make extensive improvements to its system outside of the city.

LEXINGTON, VA.—The heating and power plant of the Washington and Lee University was damaged by fire on April 11, causing a loss of about $5,000.

PULASKI, VA.—Plans are being considered by the City Council for improving the municipal electric light plant.

RICHMOND, VA.—The City Council is considering the matter of submitting to the voters at the June election the question of a bond issue for a municipal electric lighting plant. The Council has already appropriated the sum of $6,000 to determine the cost of the plant, plans for which are now being prepared by E. W. Trafford.

RICHMOND, VA.—During the past year the Virginia Passenger & Power Company has installed a 3250-kw, Allis-Chalmers turbine and a 750-kw Allis-Chalmers alternator, driven by Leffel water wheels in the Twelfth Street power house, and a 900-kw General Electric alternator driven by Holyoke Machine Company water wheels, in the Locks power house, near Petersburg. The company has also installed 250 magnetite lamps in Petersburg, operated by rectifiers. The receivers of the company have received permission from the United States courts to place its wires in underground conduits in certain portions of the city. Plans have also been prepared by the receivers for the construction of a substation on Church Street, which is to be a duplicate of the one recently completed on West Broad Street, the cost of which is estimated at $70,000. George H. Whitfield is general superintendent of light and power.

SPANISH OAKS, VA.—The Appomattox Telephone Company contemplates extending its lines from Appomattox to Spout Spring, thence to Oakville, Spanish Oaks and Karl, and also to extend a line from Spout Spring to Concord Depot.

BLAINE, WASH.—It is reported that the British Columbia Electric Company has leased or purchased the Great Northern Railway Company's track from Cloverdale to Blaine, a distance of six miles, and when the Great Northern abandons the line for its water front road the electric company will equip the road to be operated by electricity.

CHEHALIS, WASH.—The Washington Home Telephone Company contemplates installing a local telephone system in this city.

ENTAIT, WASH.—Bids are being received by Gray & Barash, People's Bank Building, Seattle, Wash., for the construction of the power house and also for cedar poles for transmission line for the Entait Power Company.

GRANGER, WASH.—It is reported that an electric light plant will be installed here in the near future.

LOOMIS, WASH.—The Nighthawk Mining Company has nearly completed the reconstruction of the electric lighting and power plant, stamp mill and tramway on its property at the base of Mountain Ellemehan, near Loomis.

OROVILLE, WASH.—The Dividend Mine, located on the Okanogan River, about four miles north of Oroville, is reported to have been purchased by a New York syndicate. It is understood that the mine will soon be in operation and that the new company will secure electrical service from the Similkameen Power Company for lighting and operating its plant.

SEATTLE, WASH.—Plans for the new power plant for the State University have been approved by the Board of Regents. The cost of the plant is estimated from $75,000 to $100,000.

WALLA WALLA, WASH.—The County Commissioners have granted a franchise to the Oregon Traction Company for an electric railway along the east side of the city to the Washington Cemetery.

MARTIN, W. VA.—Plans are being considered by the Mutual Telephone Company for the construction of a telephone system in this city, work on which will commence soon.

BUFFALO (COCHRANE, P. O.), WIS.—The capital stock of the Diamond Telephone company has been increased from $500 to $1,500. Walter Reid is secretary.

THERMOPOLIS, WYO.—H. J. Thompson, of Billings, has taken an option on the plant and holdings of the Hot Springs Electric Light & Power Company. It is understood that the price to be paid for the plant is $30,000. If taken over, it is said that extensive improvements will be made to the system.

EDMONTON, ALB., CAN.—Sealed tenders will be received by John Stocks, deputy minister of the Department of Works, until April 30 for the necessary equipment for the installation of 700 miles of rural telephone line to be built by the government.

EDMONTON, ALB., CAN.—Bids will be received until May 1, by R. R. Keely, city engineer, for the construction of a power house for the municipal electric light plant, to be operated by producer-gas engines, the cost of which is estimated at $20,000. The plant will have an output of 700 kilowatts.

PINCHER CREEK, ALB., CAN.—The citizens are considering the installation of an electric lighting plant here. Mayor Scott is making investigations to determine the equipment for the plant.

CRANBROOK, B. C., CAN.—The Bull River Power Company is now constructing a plant on the Bull River near here. George Henderson, manager, states the ultimate output of the plant will be about 9000 horse-power.

KILLARNEY, MAN., CAN.—Messrs. Skinner & Colison, of Estevan, Sask., are considering the advisability of installing an electric lighting plant here.

WINNIPEG, MAN., CAN.—The Civic Board of Control has decided to notify all companies having wires on the streets of Winnipeg that they must be placed underground within a year from date. Only a certain area in the center of the city is affected.

WINNIPEG, MAN., CAN.—The Manitoba Iron Works Company has completed the installation of electric motors throughout its works, which were formerly operated by steam. The company will require about 250 horse-power of electrical energy to operate its plant, which will be supplied by the Winnipeg Electric Company.

New Industrial Companies.

THE DURBAN ELECTRICAL SUPPLY COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $10,000. The incorporators are G. B. Stone, T. E. Durban and S. L. Lawless.

THE JUST-TUNGSTEN ILLUMINATING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $250,000, by Michael Moran, of Brooklyn, and Pasquale Mastrorelli, of New York, N. Y.

THE X-RAY ELECTRIC LAMP COMPANY, of Augusta, Me., has been incorporated, with a capital stock of $500,000, for the purpose of manufacturing electrical appliances. J. Berry, of Augusta, is president and treasurer.

THE ELECTRIC WELDING COMPANY, of Brooklyn, N. Y., has filed articles of incorporation. The company is capitalized at $24,000, and the directors are Ove Lange, Christian Nielsen and Herman O. Mundsen, all of Brooklyn.

THE MARSHAL ELECTRIC COMPANY, of Kittery, Maine, has been incorporated with a capital stock of $50,200, for the purpose of manufacturing electrical appliances. H. Mitchell, of Kittery, is president and clerk, and S. J. Morrison, of Portsmouth, N. H., treasurer.

THE NEW BRIDGE INCANDESCENT LIGHT COMPANY, of New York, N. Y., has filed articles of incorporation with the Secretary of State. The company is capitalized at $20,000, and the incorporators are: Bernard Rudolph, Abraham Rudolf and Louis Rudorfer, all of New York, N. Y.

THE GAS PRESSURE REGULATING & EQUIPMENT COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $100,000, by Louis W. Jacobs, Albert H. Gindele and Peter H. James, of Jersey City, N. J. The company proposes to manufacture gas and other lamps; gas and electrical works, etc.

THE STANDARD INSTRUMENT COMPANY, of Newark, N. J., has filed articles of incorporation, with a capital stock of $100,000. The incorporators are: Irving K. Loveless, of Orange; Charles O. Nillson, of Brooklyn, N. Y., and George L. Taylor, of Belleville, N. Y. The company proposes to do a general electrical and mechanical engineering business.

THE TERRY TENCH & PROCTOR TUNNELING MACHINE COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $1,500,000, for the purpose of manufacturing tunneling machinery, engines, motors, etc., and also to construct tunnels. The incorporators are: J. J. Banks, of Denver, Col.; A. S. Luria and E. E. Morris, of New York, N. Y.

THE ATLANTA ILLUMINATING & ELECTRICAL ENGINEERING COMPANY has recently been organized, with offices at 218 Peters Building, Atlanta, Ga. The company proposes to make a specialty of electrical and illuminating engineering, and would like to receive publications, descriptive matter and catalogues pertaining to electrical and illuminating subjects. Lewis L. Barnes is interested in the company.

THE RIDGWAY COMPANY, of Columbus, Ohio, will be incorporated soon, with a capital stock of $25,000, for the purpose of handling mechanical and electrical machinery and apparatus. This is an outgrowth of Ridgway & Company, a firm which has been doing business in the Columbus Savings & Trust Building for some time. The new location will be at 422 North High Street, where quarters are being fitted up. Harry G. Ridgway, who was with the Westinghouse Company for 22 years, will be the head of the new corporation. Among the different concerns which the company will represent are the following: Platt Iron Works, Buffalo Forge Company, Ohio Injector Company, Western Electrical Company, Dunlap Manufacturing Company, Valley Iron Works, Jacobson Gas Engine Works, Ohio Blower Company, Pulsometer Steam Pump Company, Ames Iron Works, Edge-Moor Boiler Company and the Link Chain Belt Company. A telephone department will be a feature of the company. A full line of motors, generators, arc lamps, engines and compressors will be handled.

Company Elections.

DENVER, COL.—At the annual meeting of the Northern Colorado Power Company the following-named officers were elected: W. J. Barker, president; George C. Smith, vice-president; George Best, secretary, and Thomas Keeley, treasurer.

SPRINGFIELD, OHIO.—At the annual meeting of the stockholders of the People's Light, Heat & Power Company the old board of directors was re-elected and was organized by choosing the same officers who served last year.

PHILADELPHIA, PA.—At the annual meeting of the Philadelphia Electric Company the retiring board of directors was re-elected.

LIVINGSTON, MONT.—At the annual election of the New World Reduction & Power Company the following officers were elected: J. R. Brown, of Spokane, Wash., president; Sir Walter Gillis, of Hexham, Eng., vice-president, and H. H. Farber, of Seattle, Wash., secretary. The company has under construction at Cook City a 200-ton smelter with a 6000-hp electric power plant.

New Incorporations.

BAKERSFIELD, CAL.—The Kern County Mutual Telephone Company has been incorporated. The officers of the company are F. G. Munzer, president; T. Spellacy, vice-president; H. W. Thomas, secretary, and James T. Maguire, treasurer.

LOS ANGELES, CAL.—The Glendora Light & Power Company has been incorporated, with a capital stock of $20,000.

SALINAS, CAL.—The Pacific Grove Heat, Light & Power Company, with a capital stock of $25,000, has been incorporated by H. E. Hales, S. J. Evans and W. Smith, all of Los Angeles.

SAN JOSE, CAL.—The Alviso Electric Light & Power Company, with a capital stock of $100,000, has been incorporated by G. L. Donovan, J. N. Thane, J. A. Belloli, Jr., Theodore Belloli and L. E. Munier.

WASHINGTON, D. C.—A bill has been introduced into the State Legislature of Maryland to incorporate the Washington, Patuxet & Drum Point Railroad to build a railroad to be operated by either steam or electricity from a point on the Chesapeake Beach Railway to Soloman's Island, passing through Calvert, Prince George, and Arundel Counties. The capital stock of the company is placed at $250,000, and the incoroprators are: Ira J. Baker, Charles C. Mayer, of Washington, D. C.; C. A. M. Wells, Joseph R. Owens, Rexford M. Smith, Wallace A. Barlett and Charles A. Wells.

Legal.

NEGLIGENT MAINTENANCE OF GUY WIRE.—It is negligent to maintain a guy wire from a telephone post to the ground some 25 feet therefrom, and within the line of travel between a street and railroad station grounds, without anything to attract attention of one approaching the station in the dark. This, in brief, is a recent holding of the Court of Appeals of California. The gist of the liability consists in the fact that the person injured did not act merely for his own convenience and pleasure, but from motives to which no act or sign of the owner or occupant contributed, and that he entered the premises because he was led to believe that they were intended to be used by visitors. The case would be no different in principle if defendant had stretched a barbed wire or dug a ditch across a part of the traveled way, although the danger of accident might have been somewhat increased. Grant v. Sunset Telephone & Telegraph Co., 94 Pac. 368.

MUNICIPAL LIGHTING IN BAY CITY RESTRAINED.—By a decision handed down by Judge Wisner in the Genesee County Court, the city of Bay City, Mich., is restrained from building and equipping a new electric lighting plant for the purpose of engaging in commercial lighting. Judge Wisner made permanent the temporary injunction issued several weeks ago by the Circuit Court Commissioner, D. H. Thompson, in the case of the Bay City, Traction Company vs. Bay City, seeking to restrain the city from building its proposed municipal lighting plant. At the conclusion of the argument the judge held that the proceedings of the Common Council in the matter were irregular, in that a resolution declaring the new plant a necessity was not adopted; that the Board of Estimates had not provided for the necessary expenditures and that if the city went on with the work, it would find itself behind financially at the close of the year.

TROLLEY POLES HELD NOT TO BE NUISANCES.—The poles belonging to an electric street railway, located along a street, are not in themselves nuisances; but permission to place its poles along a public street does not authorize the company to locate its poles so as unduly and unnecessarily to interfere with the public streets. Thus the New York Court of Appeals holds that a street railway company is legally responsible for the injuries of a fireman, injured by collision with one of its poles, while responding to a fire. The pole was located at the edge of the paved way near the fire house, and the injured fireman was standing on the side step of the patrol wagon, waiting for one who was ahead of him to get inside so that he could follow, when the accident occurred. The trial court held as matter of law that the defendant was not guilty of any negligence in locating the pole as it did, and that the plaintiff was guilty of contributory negligence in endeavoring to get into the wagon as he did. The Appellate Division, on the contrary, held that both of these questions were for the jury, and this holding was affirmed by the Court of Appeals, the Court taking occasion to say: "A piece of fire apparatus going to a fire is not only permitted, but expected, to go rapidly, and especially as the horses first came out of the barn it should be anticipated that they would not be under perfect control or in a regular gait, or that in making a right-angle turn from the driveway into the street towards the pole, as was being done on this occasion, mathematical accuracy could be observed in keeping the apparatus in the centre of the driveway." Lambert v. Westchester Electric Ry. Co., 83 N. E. Rep. 977.

TELEPHONE COMPANY ENTITLED TO INJUNCTION PROTECTING ITS LINES.—A Michigan telephone company instituted a bill for an injunction to prevent the cutting of its wires by a person engaged in the business of moving buildings. It was shown that the defendant contemplated moving a large barn along one of the streets of the village of Paw Paw, and that, to this end, it would be necessary to remove 28 of the company's wires which were so located as to interfere with the progress of the barn. The company proposed to the defendant that the work of cutting the wires be done by its linemen and that the defendant secure the company in some way against the actual expense which would have amounted to about $15. This the defendant refused to do and shortly thereafter he notified the telephone company that he was about to move the structure and that he would tear down as many of the company's wires as would be found necessary to provide a free passage for the building along the highway. A statute of the state of Michigan provides that every telephone company organized thereunder shall have the power to construct and maintain lines for the transmission of telephone messages through public streets and highways, with all necessary erections and fixtures therefor, provided that the same shall not injuriously interfere with "other public uses" of such places. The defense was that the telephone company, by the maintenance of its wires, was interfering with "other public uses" of the highway, one of which was the defendant's right to use the highway for purposes of house moving. It was held that the use to which the defendant wished to put the highway an extraordinary one and a "public use" within the meaning of the statute. The telephone company, having organized under an act of legislature and erected its lines pursuant to the direction of the authorities of the village in such a manner as not to interfere with all ordinary uses of the streets, gained vested rights therein paramount to the defendant's right to convey buildings through those streets. And the cutting of its wires by the defendant, if allowed, would have amounted to an appropriation of the company's property without due process of law. On these grounds the injunction was granted. Kibbie Telephone Co. v. Sandphere, Supreme Court of Michigan, 115 N. W. Rep. 244.

Obituary.

MR. CHARLES A. MURPHY, of Brooklyn, N. Y., one of the promoters of the Key West Electric & Railway Company, of Key West, Fla., and a former president of the Brooklyn Heights Improvement Company died recently.

MR. CHARLES WILLIAMS, a prominent manufacturer of electrical goods, died April 14, in Somerville, Mass., of bronchial pneumonia. With Professor Bell he erected the first telephone line used in Boston. He was an original stockholder of the Bell Telephone Company.

MR. SAMUEL B. RAWSON, president of the Dean Electric Company, of Elyria, Ohio, died April 10, from heart disease He was 59 years old, and was president of the Dean Electric Company and head of the so-called Rawson syndicate of independent telephone men, which has financed telephone companies in many American cities. He is survived by a widow and one daughter.

MR. JAMES HISLOP, president of the New London Gas & Electric Light Company, New London, Conn., died in that city March 30. He was born in Peebles, Scotland, Feb. 9, 1847, and came to America in 1807, and settled in New London in 1878, to engage in the dry goods business as Hislop, Porteons & Mitchell, which subsequently became the firm of James Hislop & Company. He was a prominent citizen of New London, and was noted for his charities, which were mostly devoted to bettering the condition of the poor. He is survived by his wife, daughter and two sons.

MR. HOSMER BUCKINGHAM PARSONS, president of the Wells-Fargo Bank and director of the Knickerbocker Trust Company and other financial institutions, died April 16 at his home, 168 Lincoln Place, Brooklyn, N. Y., of pneumonia. He was born in Houvelton, N. Y., Jan. 6, 1846. Mr. Parsons was director of the Augusta-Aiken Electric Railway Company, the Knickerhocker Express Company, the North Augusta Electric & Improvement Company, and other companies. He was trustee of the Brooklyn Institute of Arts and Sciences, and a member of the Lawyers Club, the Society of Colonial Wars and the New York Chamber of Commerce.

Personal.

MR. GEORGE B. SPRING has been appointed superintendent of the Ayer Electric Light & Power Company, Ayer, Mass., succeeding Mr. A. H. Paine, resigned.

MR. WILLIAM G. CHAMBERLAIN, recently in the mechanical department of the Whitney Electrical Instrument Company, has become connected with the Hoyt Electrical Instrument Works, of Penacook, N. H.

MR. BURTON FRENCH, formerly superintendent of overhead and underground lines for the Commonwealth-Edison Company, of Chicago, Ill., has been appointed superintendent of the Consumers' Electric Company, of New Orleans, La.

MR. OSCAR A. FRICK has severed his connection as electrical engineer with the Westinghouse Electric & Manufacturing Company and has accepted a position as assistant to the general manager of the Presumpscot Electric Company, of Westbrooke, Maine.

MR. GEORGE L. COLGATE, of Batavia, N. Y., instead of Mr. George L. Collins, as reported in the issue of April 18, was appointed general manager of the Ontario Light & Traction Company and the Canandaigua Gas Light Company of Canandaigua, N. Y.

MR. LEWIS R. POMEROY, who for a number of years has been a special representative of the General Electric Company in the railway field, has joined the Safety Car Heating & Lighting Company as assistant to the president, with offices at 2 Rector St., New York.

MR. B. A. BEHREND, who for eight years past has been chief engineer of the Bullock Electric Manufacturing Company, and for the past four years chief electrical engineer of the Allis-Chalmers Company, has moved to Milwaukee, Wis., where his address will be 2102 Grand Ave.

MR. JAMES WILSON, who has been superintendent of Victoria Park, Canadian side at Niagara, ever since it was instituted, and who has had much to do with the power development plans on that side of the river, has tendered his resignation. Mr. Wilson, more than any other man, made Victoria Park the beauty spot it is.

MR. W. P. WHITTEMORE, manager of the municipal electric light plant and water works system at North Attleboro, Mass., has notified the Water and Electric Light Commissioners that he will not accept a reappointment. His term expires this month. Mr. Whittemore has been in the service of the town for the past 23 years.

MR. FRED. T. DODGE has resigned from the electrical department of the Whitney Electrical Instrument Company to accept a position with the Hoyt Electrical Instrument Company, of Penacook, N. H. Mr. Dodge had been with the Whitney Company since 1892, with the exception of a short period on the staff of the General Electric Company.

MR. NORMAN G. MEADE, the electrical engineer, who was formerly associated with the Westinghouse interests, is to be the editor of the new series of the New York Edison Company's *Bulletin*, and in charge of the department of publicity. A book on practical motor work by Mr. Meade is soon to be issued by the McGraw Publishing Company.

MR. CHARLES HENRY DAVIS is the subject of a biographical sketch printed in a supplement to the April 10 issue of *The Harlan Enterprise*, of Harlan, Kentucky. The supplement is probably the most sumptuous publication of the kind ever published by an American journal. It is from the press of the John A. Lowell Bank Note Co., of Boston, and consists of a cover and 42 pages, 15 x 21 in., of engravers plate paper containing more than two hundred excellent half-tone engravings. The greater portion of the text and illustrations relate to the Kentenia Corporation, of which Mr. Davis is president and principal owner. The corporation has a capital of $10,000,000 and owns 75,000 acres of land.

Unclassified Items.

CLEVELAND, OHIO.—The North Electric Company has increased its capital stock from $1,750,000 to $2,250,000.

RED KEY, IND.—An election will be held to vote on the proposition to issue $12,000 electric light bonds.

CLEVELAND, OHIO.—The capital stock of the Forest City Railway Company has been increased from $2,000,000 to $6,000,000.

WELCH, W. VA.—The Welch Ice & Cold Storage Company has been granted a franchise to furnish the city with electricity for lamps and motors.

EDINBURG, VA.—H. A. Whissen & Brother have been granted a franchise to erect an electric light plant in this city. J. D. Lemmon is mayor.

NEW LONDON, WIS.—A new 100-hp engine and alternator will be added to the equipment of the municipal electric light plant during the coming year.

ORIENT, WASH.—H. D. Merritt, of Spokane, has applied to the Commissioners of Ferry County for permission to install electric lamps and lay water mains in the town of Orient.

LEAKSVILLE, N. C.—The Leaksville Light, Power & Milling Company, recently incorporated, will establish an electric light and power plant, work on which will hegin within a few months.

PLACERVILLE, CAL.—The Board of Trustees has engaged J. W. White, engineer, of San Francisco, to prepare plans and estimates of the cost of the proposed municipal electric light and power plant.

WARREN, PA.—At the annual meeting of the Warren Street Railway Company the following named officers were elected: D. H. Siggins, president; J. D. Woodard, secretary, and H. A. Siggins, treasurer.

HELENA, MONT.—The Helena Light & Railway Company is considering an extension of its railway to the State Fair Grounds, an addition to the car barns and the purchase of ten new open cars, which will involve an expenditure of about $70,000.

WARREN, PA.—At the annual meeting of the Warren-Jamestown Railway Company the following named officers were elected: D. H. Siggins, president; Homer M. Preston, vice-president; Samuel Q. Smith, secretary, and John M. Siegfried, treasurer.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway Company has been granted a franchise for its proposed railway from this city west to the county line at Grand Rapids. The company proposes to build as far as Tontogany, seven miles distant, this summer.

HONESDALE, PA.—The Honesdale & Hawley Trolley Railroad Company has heen reorganized under the name of the Lackawaxon Valley Railway Company and the following named officers elected: E. B. Hardenbergh, president; Henry W. Dunning, of Wilkes-Barre, secretary, and Charles E. Dodge, treasurer.

NEWVILLE, PA.—Arrangements are being made by the Newville Electric Light Company for the Construction of a dam above the former Wade Mill, north of Newville, recently purchased hy the company. The mill will be converted into a power plant. A steam engine will be installed to furnish power to the generators until the water power can be utilized.

WAUKESHA, WIS.—The Waukesha Gas & Electric Company has adopted an amendment to its articles of incorporation, providing for the construction and operation of a heating plant. The company will erect a larger plant, with new machinery throughout, with sufficient boiler capacity to furnish heat to the business section of the city.

HARRISBURG, PA.—Application will soon be made to Governor Stuart for a charter for the Schuylkill & Dauphin Traction Company by J. W. Moyer, Edgar D. Rank, Malcolm G. Stewart, Louis H. Schappell and N. D. Yoder. The company proposes to build an electric railway system connecting the more important towns in Lykens Valley and western Schuylkill County.

COLUMBIA, S. C.—The Columbia Electric Street Railway Comapny is making arrangements to install a new 1000-kw generator in its water-power plant and would like to receive bids on the same. The company is also in the market for an exciter set for the above, governors for the water wheels, and a new set of water wheels for the water-power station. William Elliott is general manager.

REDLANDS, CAL.—The Yucaipa & Oakglen Railroad Company has been organized, and will construct at once an electric railway from this city to the Yucaipa, seven miles distant. By fall the road will be completed to Oakglen, 22 miles from Redlands, and will eventually be extended to Beaumont and San Jacinto. The officers of the company are J. F. Neeland, of Los Angeles, president; C. S. Chesnut, of Redlands, vice-president; M. N. Newmark, of Los Angeles, treasurer.

ST. LOUIS, MO.—Bids will be received at the office of the Board of Public Improvements until May 1 for furnishing designs, plans, tools, labor and material, building foundations and erecting in boiler house No. 2, Bissell's Point, four 350-hp boilers, with Roney mechanical stokers, Foster superheaters, setting valves, etc. Plans may be seen and specifications and form of contract may he obtained upon application at the office of the Water Comissioner, room 312, new city hall. Andrew J. O'Reilly is president.

Removals.

THE CHAS. J. BOGUE ELECTRIC CO. will move May 1 to 513 West Twenty-ninth Street, New York.

MR. HENRY FLOY, consulting engineer, has removed his offices from the St. Paul Building, 220 Broadway, to a suite on the 14th floor of the new City Investing Building, 165 Broadway.

NEW WESTINGHOUSE OFFICES.—The executive offices of the Westinghouse Electric & Manufacturing Company, now at 111 Broadway, New York, N. Y., and the New York sales offices and export offices of that company, now at 11 Pine Street, will be removed on Monday, April 20, 1908, to the new City Investing Building, No. 165 Broadway, New York.

THE EXCELLO ARC LAMP COMPANY, of New York, moved this week to 30-32 East Twentieth Street, near Broadway, where it has taken a floor store and basement. The ground floor will be used for exhibit rooms and offices and the basement for storage and workshop.

The move was made necessary by the increasing demand for Excello arc lamps, compelling the company to remove to larger quarters.

BULLOCK ELECTRIC MFG. CO.—On April 23, the sales, patent, engineering, drafting and order departments of the Bullock Electric Manufacturing Company, which for the past nine years have been at the Bullock Company's offices at Norwood, Ohio, were moved to the general offices of the Allis-Chalmers Company at West Allis, Milwaukee, Wis., thus concentrating the different executive departments at Milwaukee. Among the men transferred to Milwaukee are Mr. J. R. Jeffrey, assistant secretary of the Bullock Company and assistant manager of the electrical department, Mr. C. E. Lord, patent counsel, Mr. H. A. Behrend, chief engineer, Mr. D. Hall, assistant chief engineer and the other important members of the electrical departments of the Allis-Chalmers Company. A special Pullman vestibule train conveyed the party of almost 100 persons from Cincinnati to Milwaukee.

Business Notes.

MR. J. M. SCHILLING, formerly traveling in the retail and supply department for Illinois territory of the Westinghouse Electric & Manufacturing Company, at Chicago, has been appointed in charge of lamp sales for the Westinghouse Lamp Company at the Chicago office.

MR. WILLIAM L. CUMMISKEY, formerly with the Ewing-Merkle Electric Co., of St. Louis, as sales manager, has joined the staff of W. N. Matthews & Brother as sales representative in the state of Illinois, where he has entered on an active campaign pushing Stombaugh guy anchors and the well-known Matthews line of cable joints and fittings and arc lamp fittings.

THE JOHN A. STEWART ELECTRIC CO., of Cincinnati, Ohio, has supplied to the Interurban Railway & Terminal Co., Cincinnati & Eastern Division, two 300-kw 25-cycle rotary converters complete with switchboards and oil cooled transformers for installation at the main power house near Coney Island, Ohio.

THE CARLISLE & FINCH COMPANY, Cincinnati, Ohio, has developed a large business in search lights, both in the home and foreign markets, shipments being made to Japan, Australia, South America, Canada and Europe. Its line of search lights is in sizes from 9 in. to 38 in., the former being for yachts and small vessels.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, from all reports, is doing a much more satisfactory business than at any time since the financial strigency began. New orders are coming in at a very satisfactory rate and collections have improved wonderfully. These facts indicate that business over the country is showing up in an encouraging manner.

APPLE ELECTRIC COMPANY.—Messrs. H. F. Apple, O. D. Apple and V. G. Apple have withdrawn from the Dayton Electrical Manufacturing Company and have gone in business on their own account as the Apple Electric Company. The new company has already on the market an improved storage battery and will shortly announce a new dynamo-floating storage-battery ignition system, which will contain a number of up-to-date improvements not found in other apparatus now on the market. Mr. V. G. Apple still retains his interest in the Dayton Electrical Manufacturing Company and will continue to serve as its vice-president.

McADAMITE.—Mr. R. L. Johnston, secretary of the United States McAdamite Metal Co., of Brooklyn, N. Y., recently delivered an address before the members of the Aero Club of America, having for his subject the new aluminum alloy, McAdamite, which roughly speaking, is 2 to 4 times stronger and very much lighter than ordinary brasses in general use to-day. During the course of his talk, Mr. Johnston demonstrated the strength of this alloy by screwing into a bar of McAdamite a ½ in. steel bolt, under the bead of which were placed enough washers to allow the bolt to enter the bar of metal only three threads. When the bolt was tightened up to the washers additional turning broke the bolt right off without affecting the threads in the bar of McAdamite. The aim of this test was to strip if possible the threads cut in the McAdamite. The National Sales Corporation, 296 Broadway, New York, is factory sales manager for McAdamite metal.

THE WHEELER CONDENSER & ENGINEERING CO., Cartaret, N. J., has made arrangements with Charles S. Lewis & Company, Granite Building, Fourth and Market Streets, St. Louis, Mo., to handle "Wheeler" apparatus in the state of Missouri. This includes the well-known "Wheeler" surface, jet and barometric condensers, feed-water heaters, re-heaters and receivers, vertical engines, centrifugal pumps, rotating dry vacuum pumps, and vacuum pans and multiple effects. It also covers the "Voltz" combined condenser and feed-water heater, "Barnard-Wheeler" water cooling towers and the "Edwards" air pump, which has the unique distinction of replacing wet vacuum pump, dry vocuum pump and pre-cooler in condenser equipment. As the "Edwards" pump contains no suction valves, the pump is as effective in removing air as a dry vacuum pump having mechanically operated admission valves. This pump is widely applied for other vacuum work, as well as with condensers. It is built in various combinations, single, duplex and triplex for steam and electric drive, etc.

CIRCULAR LOOM IN CHELSEA FIRE.—In the recent disastrous conflagration at Chelsea, Mass., the plant in that place of the American Circular Loom Company, consisting of its Circular Loom factory, warehouse, stables and home offices, was completely destroyed. The plant was fully covered by insurance. The factory employees suffered severely, nearly all lived in the vicinity of the factory, and lost house and home and all they possessed. Some were injured and one—a young woman—was burned to death. The Circular Loom Company has already secured a new factory, excellently adapted to its needs, in North Cambridge, Mass., and has established new permenant offices in the International Trust Bldg., in the City of Boston. It is now actively engaged in assembling with all possible speed new machinery for the manufacturing of "circular loom," and hopes to be able to supply the demand again regularly and promptly within a very short time. Until new general offices were established, there was some delay in transacting business connected with the company's "Electroduct" factory at Kenilworth, N. J., which is in full operation, and its new metal-molding factory, also located at Kenilworth, N. J. The latter is now fully completed, including a large electro-galvanizing plant, and metal molding will be offered to the trade as soon as the necessary printed matter, which was stored at the home offices and burned up, can be duplicated.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 14, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

884,353. ELECTRIC SWITCH; Herbert Henry Berry, Enfield, Eng. App. filed Dec. 16, 1905. Electric switch device enclosed in a metal or other protective case and having a hinged lid or cover which must be first closed down before the switch fuse can be brought into contact with the live circuit.

884,367. ELECTRICAL WATER HEATER; Edward J. Condon, New York, N. Y. App. filed June 8, 1907. Water heater of the type having a plurality of serially connected tubes through which the water flows and in which the electric current is carried by pipes within the tubes and constituting resistance elements. Has a varied control which may be accomplished through a single operating handle.

884,381. TELEGRAPH TRANSMITTER; Mark S. Haling, Weaver, Minn. App. filed May 22, 1906. Transmitter of the type making use of two keys fulcrumed on vertical axes and which operate to transmit dots and dashes successively in a continuous succession as long as depressed.

884,397. OVERHEAD TROLLEY; Allen P. Lord and Nathaniel Wilkens, Bradford, Pa. App. filed Jan. 11, 1907. Construction of trolley wheel having fixed webs or flanges on the harp, which extend above the rim of the trolley wheel to serve in place of the usual guiding flanges of the wheel.

884,424. ELECTRICAL FLUID HEATER; Mark T. Seymour, Bemus Point, and Alton W. Ball, Stowe, N. Y. App. filed Dec. 2, 1907. A tool for heating oil wells, making use of a cylindrical casing which is dropped into the well so as to permit a circulation of fluid therethrough. Includes a central rod formed of serially connected resistance elements to heat the fluid within the cylinder.

884,458. ELECTRIC CURRENT REGULATOR; Arthur W. Brice, Rochester, N. Y. App. filed March 20, 1905. A form of rheostat or controller adapted to be embodied in a lamp socket for the purpose of controlling the illumination of miniature electric lamps and other devices which require only a few volts for their use.

884,463. METHOD OF MAKING REFRACTORY ARTICLES; Charles F. Burgess, Madison, Wis. App. filed May 31, 1906. An electric furnace for making crucibles and the like of refractory materials, and including two concentric electrodes between which the refractory crucible material is molded and vitrified.

884,466. SWITCH BOX; Thomas J. Cleland, Chicago, Ill. App. filed June 3, 1905. Provides a switch comprising two members entirely separable from one another, but which, when fastened together, entirely enclose the contact parts in a box-like structure.

884,499. ELECTRIC SPARK GAP FOR INTERRUPTERS; Thomas B. Kinraide, Jamaica Plain, Mass. App. filed April 24, 1906. Automatic means for blowing out the spark of a circuit breaker quickly, which consists in interposing between the discharge surfaces an explosive gas which detonates and blows out the arc which is formed. Makes use of water vapor which explodes into steam.

884,500. TELEPHONE DESK-STAND; Anton M. Knudsen, Chicago, Ill. App. filed Sept. 2, 1904. In a desk stand, the combination with a hollow standard and a thin metal supporting base, of an interior base having an aperture through which the lower end of said standard extends, said base providing means to secure apparatus within the base without marring the exterior surface of the outer base, substantially as described.

884,501. MEANS FOR MEASURING THE DEGREE OF EXPOSURE OF A SELENIUM-CELL; Arthur Korn, Munich, Germany. App. filed Aug. 1, 1906. Makes use of a galvanometer for indicating the degree of exposure of a selenium cell to light. Intended to equalize the influence of the inertia after the effect of light produced in the selenium cell. Apparatus for use in photometry and other applications.

884,511. SELF STARTER; Walter O. Lum, Schenectady, N. Y. App. filed Aug. 6, 1906. A series of switches arranged to successively short-circuit sections of starting resistance, and actuated by solenoids or other electromagnetic means, each solenoid having two windings, one for holding the switch in a closed position, and the other to operate the switch.

884,514. AUTOMATIC ELECTRIC SWITCH; Andrew H. Miller, Chesaning, Mich. App. filed March 30, 1903. A means for periodically flashing a lamp for signs and the like, making use of a heating element in the base of the lamp, which shunts the filament whenever it becomes cool, and vice versa.

884,517. CONDUIT ELECTRIC RAILWAY; Lewis Wells Musick, Crescent City, Cal. App. filed Aug. 9, 1906. The patentee makes use of specially constructed depending rollers on the car truck, which engage a trolley supported in the form of a conduit beneath the track surface.

884,519. FUSE HOLDER FOR ELECTRIC CIRCUIT CONDUCTORS; Patrick McDonald, Rochester, N. Y. App. filed Oct. 2, 1905. The fuse element is contained between a pair of metallic cups having a spring member in one side wall and engaging a notched portion of the insulating tube of the fuse.

884,540. ELECTRIC HEATER; Elihu Thomson, Swampscott, Mass. App. filed Oct. 13, 1906. An electric heater for use with comparatively high potentials. The heating resistance is immersed in oil having a high flashing point. In order to circulate the oil the patentee makes use of a pump which flows the oil through a form of water-cooled condenser.

884,541. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Leonard A. Tirrill, Lynn, Mass. App. filed Feb. 8, 1906. Control system for eelectric motors adapted to be reversed frequently and quickly under load, for example, in operating a planing machine. This service is very severe on the motor on account of the momentum and inertia and other reasons. Provides a type of controller adapted to make the reversing action as easy on the motor as possible.

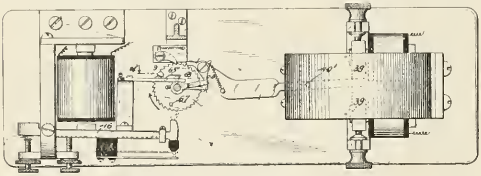
884,546. TROLLEY WHEEL; Frederick G. Walker, Cleveland, Ohio. App. filed May 12, 1906. The trolley wheel is made in two longitudinally divided sections or parts between which oil may exude from a chamber within the trolley wheel, so as to keep the tread lubricated.

884,555. REGULATION OF DYNAMO ELECTRIC MACHINES; Charles E. Barry, Schenectady, N. Y. App. filed Sept. 20, 1905. A construction of dynamo electric machine having a main field winding, an iron resistance in series therewith, and an opposing field winding in shunt to said resistance.

884,563. PROCESS OF FUSING MATERIALS; George F. Brindley, Niagara Falls, Ontario, Canada. App. filed March 13, 1906. A process of fusing corrosive material consisting in fusing without decomposing the same in the presence of air by the maintaining of an alternating current of low density in the fused material in contact with the electrodes and of a high density in that part of the bath where the unfused material is added to the mass.

884,595. CARRIER SYSTEM; Sam H. Libby, East Orange, N. J. App. filed June 17, 1905. A carrier system in which each carrier is provided, not only with a driving motor, but also with a hoisting motor and with a control system adapted to control both the driving and the hoisting motors.

884,607. TELEPHONE FIRE-ALARM SYSTEM; William S. McLewee, Yardley, Pa. App. filed April 9, 1906. Diagram of circuits adapted to telephone subscribers in order to give a fire-alarm signal over usual telephone circuits.



884,737.—Signaling System.

884,624. SOCKET CAP; W. S. Stapley, Bridgeport, Conn. App. filed Oct. 22, 1907. Socket cap, comprising an internally threaded metallic sleeve with a reduced portion, which is riveted over the shell so as to form a unitary structure therewith.

884,630. TROLLEY POLE AND HEAD; August F. Bauer, Philadelphia, Pa. App. filed Nov. 27, 1907. In place of the usual trolley pole and harp, the patentee has an upright on the car roof with a pair of pivoted arms, which are spring impelled toward one another, and which carry separate trolley wheels.

884,641. HANGING INSULATOR; Walter G. Clark, New York, N. Y. App. filed Oct. 6, 1906. An insulator for high potential currents, making use of a series of petticoats which are self-supporting from a cross arm above. The conductor is attached to the lowermost insulator.

884,644. SYSTEM FOR ELECTRIC RAILWAYS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Oct. 25, 1906. A control conductor arranged along a track and divided into sections of such length that two trains cannot be operated upon the same section at the same time.

884,645. SYSTEM FOR ELECTRIC RAILWAYS; Arthur C. Eastwood, Cleveland, Ohio. App. filed Feb. 2, 1907. Provides an electric railway, which may be operated without the use of large central power plants and without the necessity of installing an expensive system of transmission conductors. Makes use of a turbine-driven generator in a special car, operated by a steam connection from the locomotive.

884,646. ELECTRIC RAILWAY; Arthur C. Eastwood, Cleveland, Ohio. App. filed Feb. 23, 1907. Provides means whereby neighboring sections of a control conductor will be automatically coupled together with the train in passing from one section to another, and will be automatically uncoupled when the transition from one section to another is completed.

884,653. ELECTROLYTIC CELL; George A. Gabriel, New York, N. Y. App. filed Nov. 23, 1906. In an electrolytic cell, metallic plates forming the sides of said cell, said plates having offset or outwardly extending portions forming closed cathode chambers, the cathodes being situated over the recesses formed by said offset portions.

884,664. DEPOLARIZER FOR GALVANIC BATTERIES; Ernest Waldemar Junger, Kneippbaden, Norrkoping, Sweden. App. filed May 14, 1907. A depolarizer for galvanic elements, comprising nitrosulfuric acid dissolved in concentrated sulfuric acid.

884,681. SHOE; Adam Reed and David A. Reed, Los Angeles, Cal. App. filed June 29, 1907. A construction for the sole of a shoe, making use of copper and zinc plates and a cement forming an electrolyte therefor.

884,684. TROLLEY HARP AND WHEEL; Edward D. Rockwell, Bristol, Conn. App. filed June 1, 1906. The patentee has a trolley harp with square journal boxes in which are removably received the bearings for the wheel. The latter have special lubricating features and spring blades to establish a good contact with the wheel.

884,705. SOLVENT FOR METALS; Edward C. Broadwell, Chicago, Ill. App. filed Feb. 28, 1906. A metal solvent, comprising a mononitrosulfonic acid and a suitable haloid salt.

884,737. SIGNALING SYSTEM; Edward E. Kleinschmidt, New York, N. Y. App. filed March 7, 1906. Has track signal with two circuits directly controlling and setting said signal, and a switch, comprising rotatably mounted fingers, and means to position said fingers to close the corresponding circuit to set the signal at danger or safety.

884,738. SIGNALING SYSTEM; Edward E. Kleinschmidt, New York, N. Y. App. filed Sept. 1, 1906. Selective signal switches included in a single line circuit, and only set by the controller at the dispatcher's office, instead of being both set and cleared as in previous systems. When a signal is set, the motorman receives his instructions by telephone and manually clears the signal when told to do so, provision being made to advise the dispatcher by signal when the track has been cleared.

884,750. TROLLEY; Louis C. W. Mitchell and John A. Fretz, Philadelphia, Pa. App. filed March 27, 1906. The trolley harp is swiveled on a vertical axis at the top of the pole by a ball-bearing connection.

884,763. ELECTROLYTIC REDUCTION OF METALLIC COMPOUNDS; Hugh Rodman, Philadelphia, Pa. App. filed May 17, 1902. The process of reducing iron oxid, which consists in subjecting the same to electrolysis as a cathode in an electrolyte containing a soluble sulfid, substantially as described.

884,775. ELECTRIC SWITCH; Adolph R. Swoboda, Louisville, Ky. App. filed March 8, 1905. A knife blade switch constructed of sheet metal stampings and designed to give a wedging engagement between the blade and the spring clips.

884,783. SIGNAL SYSTEM FOR RAILWAYS; Maximillian G. Voigtlander, Harrison, Ohio. App. filed Aug. 9, 1906. A signal alarm system for use with an installation in which contacts on the car make periodical contacting engagement with conductors along the track.

884,784. SIGNAL SYSTEM FOR RAILWAYS; Maximillian G. Voigtlander, Harrison, Ohio. App. filed Aug. 9, 1906. Relates to modifications of the above.

884,831. ALTERNATING CURRENT GENERATOR. Carl A. Lohr, Wilkinsburg, Pa. App. filed Feb. 2, 1906. In combination with two alternating current lines of different frequency, and an alternating current generator having alternating current windings on both of its members, means for alternately connecting at will the windings of both members of said generator to one of said alternating current lines, or the winding of one member of said generator to the other of said alternating current lines, having the winding of the other member of said generator closed upon itself.

884,843. MONEY DRAWER ALARM; Sillus Da Costa Newman, Jellico, Tenn. App. filed June 3, 1907. Makes use of a specially constructed circuit closing device in connection with a money drawer, and which is capable of use by authorized persons without giving an alarm, by special manipulation.

884,969. THERMOSTATIC CIRCUIT CLOSER; Jay O. Woods, Riverside, Wash. App. filed Oct. 5, 1906. A controller for incubators, making use of a thermometer with a plug in the bore, which closes a circuit in case a predetermined temperature is exceeded, which circuit energizes a magnet to deflect the hot air from the lamp into a flue outside the chamber of the incubator.

884,978. CUT-OUT; John H. Booth, Frank E. Blausey and Arthur M. Smith, San Pedro, Cal. App. filed Jan. 19, 1906. Protective apparatus for telephone and other low-tension circuit apparatus, to guard against lightning and other currents. Includes a pair of hinged sheet metal arms with forked extremities, in which may be engaged the ends of specially constructed fuse elements.

884,981. SEPARABLE ATTACHMENT PLUG; Owen E. Kenny, Toledo, Ohio. App. filed March 16, 1906. A plug for drop or extension cord, having two separable parts with metallic sheet metal hooks, which engage to make an electrical and mechanical connection by a manipulation analogous to fastening a bayonet joint.

884,919. PROCESS FOR MAKING NITROGEN OXIDS FROM AIR; August Grau and Franz Russ, Vienna, Austria. App. filed Oct. 8, 1907. The process of making nitrogen oxids from the air by passing air into an electric arc flame and withdrawing the treated gases directly from the central zone of the electric flame, substantially to the exclusion of gases from the outer zones and immediately cooling the said gases.

884,920. APPARATUS FOR MAKING NITROGEN OXIDS FROM AIR; August Grau and Franz Russ, Vienna, Austria. App. filed Oct. 8, 1907. In apparatus for the manufacture of nitrogen oxids from the air in combination with the rest of an electric furnace for producing the arc flame, a tubular electrode and exit tube for the treated gases of substantially the same diameter as the inner zone of the arc flame.

884,930. ELECTRODE FOR REVERSING GALVANIC BATTERIES; Ernst W. Jungner, Knippbaden, Norrköping, Sweden. App. filed Sept. 20, 1904. An electrode for secondary batteries having an alkaline electrolyte, said electrode containing an active mass mixed with small particles of carbon having a thin coating of a metal that does not occlude oxygen and that is insoluble in the electrolyte.

884,986. WIRELESS TELEGRAPHY; Guglielmo Marconi, London, England. App. filed Nov. 28, 1902. At a receiving station in a wireless telegraph system, the combination of a core of magnetic material, means for producing a varying magnetic field in said core, and means inductively affected by the core for receiving oscillations.

884,987. WIRELESS TELEGRAPHY; Guglielmo Marconi, London, England. App. filed Feb. 2, 1903. At a receiving station in a wireless telegraph system, an oscillation receiving conductor, a magnet for creating a magnetic field, a magnetizable member located in said magnetic field and connected to said conductor, means for moving the magnet to and from the magnetizable member, and a receiving instrument affected by the changes in magnetism of the magnetizable member, whereby oscillations received from a distant transmitting station are rendered intelligible as signals.

884,988. DETECTING ELECTRICAL OSCILLATIONS; Guglielmo Marconi, London, England. App. filed Feb. 2, 1903. The method of detecting electrical oscillations, which consists in receiving said oscillations by means of a coil maintained in a magnetic field, which field is created independently of received oscillations and of the apparatus which renders received oscillations intelligible.

884,989. WIRELESS TELEGRAPHY; Guglielmo Marconi, London, England. App. filed Feb. 9, 1904. In a wireless telegraph system, the method of detecting electrical oscillations of high frequency, which consists in creating a rotating magnetic field at a receiving station, abruptly varying said field by the received oscillations, and utilizing the variations in said field to create intelligible signals.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, MAY 2, 1908. No. 18.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE..............................1015 Schofield Building
PHILADELPHIA OFFICE..............................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico..............................per year, $3.00
Dominion of Canada..............................4.50
Other Foreign Countries within the Postal Union..............................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 21,000 copies are printed.*

NEW YORK, SATURDAY, MAY 2, 1908.

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FIVE THOUSAND CENTRAL-STATION SYSTEMS.

The central-station industry in this country has signalized the month of April by passing the high watermark of 5000 companies. In other words, the total for the end of March was 5015, and as the number grows on the average about 10 per week, it is perfectly safe to take 5000 as the present irreducible minimum. The mere number gives an impressive idea of the growth of the industry, especially when coupled with the statement that the capitalization is at least $1,000,000,000. The number in 1902 was 3620, which would give an average yearly gain up to the end of 1907 of 275. The gross gain in the past 12 months has been 485, but there is, of course, a constant tendency to diminish this gross owing to consolidations, so that in large cities and large areas one company exists where possibly a score were previously in independent operation. It is interesting to note the distribution of these companies and plants, many of which are, of course, under municipal ownership. The largest number is in Illinois, which has 419, while New York has 345 and Pennsylvania 331. Ohio has no fewer than 282, but Texas has the surprising number of 221 or more than Indiana with 210 and nearly as many as Michigan with 247. Oklahoma shows up already with 63. During the past year, Illinois has gained 20 net, but New York has gained no fewer than 30, showing that the Public Service law has been no check to enterprise. In other cases large gains have apparently been made, but they are often statistical rather than real, some of the plants having been already in existence but not brought to account before. The drop in the cost of copper seems to have been a decided stimulus

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Another notable feature is the extent to which the central-station companies carry lines of electrical supplies. It appears that of the 5015 companies and plants, the large number of 2698, or more than half, are thus in the supply business; but there are interesting variations in this respect. For example, of the 345 New York companies only 140 carry supplies, but in Illinois 254 of the 419 do so. In Iowa 143 out of 203 make this a practice, in Texas 135 out of 221, and in Wisconsin 123 out of 186. This would imply a certain lack of supply and wiring firms in the various localities, and doubtless has its justification in other respects. Such a close relation to the consumer and the market would imply an ability to control new conditions and to keep a firm finger on prices and the pulse of the market. All told, in the United States, Mexico, Canada and the West Indies there are now 5404 companies or systems, of which 449 are outside this country. The National Electric Light Association should derive much encouragement from these figures, for large as its membership actually is, it has evidently plenty of room for growth. Probably it will never have all the companies in membership, but it may reasonably expect to have ultimately 50 per cent of the private companies within its organization—say, 2500 company memberships. With that number it would exert an even greater influence than it does to-day on the art, and its policies would become irresistible. The Association has other elements of membership, but must obviously be based upon the central station companies to promote whose welfare and to protect whose interests it was created. On the other hand, we venture to suggest to some of these numerous new companies not over well acquainted with the history of the lighting art and of the Association, that they could not do a better or more profitable thing than to join the organization and attend the Chicago convention now so near at hand.

THE IOWA AND MISSOURI CONVENTIONS.

The State electric light conventions of Iowa and Missouri, held last week, are briefly reported elsewhere in this issue. At the present time, when new developments are rapidly taking place in the central station field, the advance of the art as noted in the few months' interval between one State convention and another is sometimes rather startling. When it is considered that the beginning of 1908 marked the first real introduction of American-made tungsten lamps on the market and that up to that time the tungsten lamp was not a factor in small central stations, it is remarkable to note how many small companies reported practical experience with them at last week's conventions.

The 75,000 tungsten lamps reported as sold by one of the two commercial American tungsten lamp factories during the past few months, together with the products of the other factory, seem to have been well scattered over the country and to have been made good use of by central station men in driving out gas and gasoline competition and in retaining dissatisfied customers. It is also significant that a considerable percentage of the tungsten lamps have been shipped to small dealers and contractors who usually sell only a few lamps. Evidently these dealers are losing no time in pointing out to the user how much he can gain by installing tungsten lamps. Moreover, it is of value to note that in some cases the lowering of a consumer's maximum demand by the use of tungsten lamps has been accompanied by increased consumption at other than peak periods so that the bills remain the same, the consumption being spread over more hours per day. This change is certainly one earnestly to be desired by the central station man, for it means better net earnings per dollar invested.

At both conventions the possibility of vacuum cleaning becoming a good source of day load came up. In most of the small towns of Iowa and Missouri the prospect of supplying energy to many stationary outfits of this kind is not alluring because there are few if any in a small town that can afford them. Some of the enterprising managers of small companies, however, are thinking of purchasing portable, electrically-driven, vacuum-cleaning machines and renting them to men who do carpet cleaning in the town for use in houses where electrical energy is available. Such a plan seems entirely feasible. It will provide not only a constant source of revenue, but an excellent standing inducement to householders to adopt electricity. In connection with day loads in small towns it is observable that the consensus of opinion places the minimum size of town where a 24-hour service can be made to pay much lower than formerly, several maintaining that in a town having a population of 1500 or more, a "day circuit" can usually be made worth while.

THE LONG-DISTANCE TRANSMISSION RECORD.

Niagara as a source of power is gradually coming into its own. Despite its enormous resources and its early development, the energy of Niagara was for a long time distributed over very moderate distances, and as a whole the plants about the great cataract have lately contributed very little that is striking to the progress of the art. The time has come, however, when the long lines have begun to appear and from now on they are likely to stretch further and further. The supply over 163 miles nearly straightaway is, as our description indicates, probably the longest 24-hour-a-day transmission yet in use, although it is so far surpassed in length by the great California lines, as frequently connected and used, that its victory is open to the imputation of being a barren one. Still it is a great record from any point of view. The Auburn branch of the great system takes the main line energy at 60,000 volts and diverts it to the existing Auburn station in which the necessary reducing and converting apparatus is located. It is one of the many cases in which one instinctively raises the question of the great inconvenience of the low periodicity of the Niagara plant, since frequency changers must have and elsewhere form part of the equipment. Despite the often made proclamations of earlier days that the 25 gave successful incandescent lighting, it is noticeable that few companies have had the temerity to try it, and the modern high-efficiency incandescents make it doubly inexpedient. Still, on a long line a frequency changer is not an unmixed evil, since if worked by a synchronous motor it gives a good chance for holding the power factor to a good value.

The system of purchasing power on a one-minute peak basis leads to the very free use of the old steam equipment during the peak period. It would be interesting to know the exact effect of this on the cost of energy. Auburn, being one of the few places where central plants heating from exhaust steam is carried on by the electricity supply company, is in better condition than most places with respect to this peak requirement. The problem of equitable rates in this wholesale supply of power from transmission systems is a very knotty one. The standby charges become a serious item in the costs to ordinary stations, while they are likely to be a very important consideration in the plans of the transmitting company. Unless the latter protects itself pretty thoroughly in this respect, the distributing company will be under stronger temptation to take on much short-hour business which it would dodge were it running its own steam plant single handed. Looking at the matter from the other side, there is always a question whether the generating company actually does hold the reserve capacity on which it is collecting standby charges, the temptation being to sell it several times over and take chances on getting caught short of power when no good excuse is available. There is this element of illusion in the standby charge proposition which it is difficult to eliminate. How many supply companies actually keep themselves in position to deliver simultaneously all the capacity-peaks for which they are theoretically receiving payment? Some, undoubtedly, but by no means all. From any point of view, the policy of the Auburn local company in keeping down its peak demand is a sensible one. Its substation plant, considering the service, is a comparatively simple one and the switchboard in particular lacks the complication that has become altogether too common in recent plants. When the switchboard becomes a serious item in the plant, it is time not to mourn the complicated requirements of modern service, but to get down to the simple life. This whole long transmission from Niagara, by the way, is to be commended for its comparatively simple equipment. It is only by adopting simple and economical methods that long distance transmission can fulfill its destiny. Niagara, to be interlinked probably with other sources of power, is just fairly started upon its larger field, and has enormous possibilities before it.

Economical Pressures for Power Transmission by Underground Cable.

The question of how high a voltage should be used in transmission is to-day answered easily enough for distances not exceeding 50 miles, and for an overhead pole line, i. e., for transmission over air-insulated conductors. In such cases we do not require to employ pressures above 50 kilovolts, and the line insulators, as well as the line transformers, are of standard types. The only drawback to aerial transmission is atmospheric electric disturbance, i. e., lightning troubles. As long as we have transmission wires above ground, so long must we expect to suffer trouble and inconvenience from *Jupiter tonans.* However, this difficulty tends to diminish steadily as experience increases with various constructions and devices for lightning protection. When, however, the conditions of occupation and development of the land over which power has to be transmitted are such as to make underground cables worth discussing, as for example when transmitting power over a thickly-settled town and city district, the question of how high a voltage should be used is more difficult to answer. The factor of safety required from the cable has to be carefully considered, and the expense of the cable increases rapidly with this factor of safety. The difficulty, delay and expense in repairing accidents to buried cables will be much greater than in the case of wires above ground. The only advantages are freedom from atmospheric disturbances and freedom from danger of accidental contact, injury to persons or property, or of interference, accidental or otherwise, by the actions of individuals, such as shooting at line insulators or short circuits, due to objects thrown across the wires.

The selection of the most economical conductor for the transmission of direct currents is relatively simple, and the rule governing this case was enunciated by Lord Kelvin long ago. When alternating current transmission is employed the rule requires modification, because the waste of power in transmission is not limited to I^2R loss. There is in addition a loss due to E^2G, produced by dielectric hysteresis or imperfect electric elasticity in the insulator. This loss increases as the square of the voltage and occurs at all hours of the day and night, whereas the copper loss disappears as the load disappears. In some high-tension cables the annual dialectric loss of energy in kw-hours considerably exceeds the annual copper loss. It is easy to show that once a cable has been purchased and laid, the most economical voltage to employ, with respect to power saving, in transmitting a given annual amount of energy over it, is such that the dielectric and copper losses are equal, provided, of course, that this voltage does not cause either the dielectric or the copper to be unduly stressed and heated.

An article on the economical pressures for underground power cables, by Mr. J. B. Sparks, has recently appeared in London *Electrical Engineering* and is abstracted in the Digest. This article confines its inquiry to copper losses and leaves the consideration of dielectric losses in reserve as a clinching argument for the main proposition. The proposition is that it will rarely pay to use cables for pressures between conductors exceeding 25 kilovolts. Curves and tables are produced which show that in the particular case of a 31 mile transmission of 50 million kw-hours per annum by underground cable, it would be more economical to select a cable for 25 kilovolts, than to use a higher pressure and a correspondingly more expensive cable.

In practice, the question does not usually present itself in this form. When power has to be carried to a considerable distance, it is usually from some big waterfall to a big city. The waterfall is usually situated in a comparative wilderness, where it would be a sin and shame to put the high-tension transmission wires underground. Consequently, overhead transmission lines are erected and carried to city limits, where it becomes necessary to go underground in order to reach the high-tension receiving station at which distribution commences. Then the question arises, should a high-tension cable be used so as to go underground at full pressure; or should a transformer station be placed at the city limit to reduce the pressure to an intermediate value between that of transmission and that of distribution? In answering such a question, much will depend on local conditions, and no rigid rule can be prescribed. Among the determining factors will be the magnitude of the transmission pressure on the aerial line, the length of city cable required, the frequency of atmospheric electric disturbances, etc. The article above referred to indicates that on the Moutiers-Lyon 112 mile overhead transmission line using a direct-current, 60-kilovolt system for transmission, and an alternating distributing system, the last three miles are underground, and employ 60-kilovolt, direct-current cables. Under such conditions, there will always be a demand for high-tension cables.

Modern Protective Devices Against Dangerous Currents in Distributing Systems.

The development of high-tension distributing systems has brought about the introduction of special forms of automatic switches, the duty of which is the cutting out of any defective section as soon as the current flowing into it becomes excessive. This is usually accomplished by automatic time-relays which are set to release oil-switches after a current overload of definite strength has acted unchecked for a definite number of seconds. These time relays are so located and adjusted that the particular branch cable in defect shall be cut out promptly. If it fails to be cut off within a certain prescribed interval, the main conductor supplying it should be disconnected, and finally if that fails to be cut off within a certain greater interval, the high-tension feeder should be disconnected. A long article on this subject (abstracted in the Digest), by Herr Karl Kuhlmann, has recently appeared in the *Elektrotechnische Zeitscrift,* dealing with a variety of conditions in high tension distributing systems. One of the interesting features of this discussion is the determination of allowance that must be made for the normal charging current of an alternating-current high tension system. It is necessary that an automatic switch should disconnect a conductor when the load current is dangerously great, but it should not operate by reason of the normal charg ing current that flows over the conductor. Some measurements of charging currents on cables at 6000 volts are recorded, for the case of a particular central station, from which it appears that the total length of cable conductors under excitation was some 320 miles, representing a joint capacity of 74 microfarads, and a total charging current of 240 amperes, or 0.8 ampere per mile. This represents a total charging power of 830 kilovolt-amperes, or 2.6 kilovolt-amperes per mile of underground wire. A number of relays are described, together with their method of connection to the circuit and to the disconnecting circuit switches. It is evident from a perusal of the paper that there is plenty of room for invention and design in simplifying and further developing these high-tension automatic devices.

Trials of the Illuminating Engineer.

Much has been accomplished in the past three years in the way of stirring up interest in the proper design of electric-lighting installations so as to produce good illuminating results from both a commercial and artistic standpoint. If the experiences of those engaged in planning and trying to have carried out work of this kind could be collected together in book form, it should have a large sale among engineers as a work of humor. At the present time, unless the man who designs the illumination watches the job at every stage of the game, it is likely to be unrecognizable as an engineering attempt by the time it is installed. This is largely due to the slipshod conditions surrounding the work of supplying fixtures and glassware in the past. The job must pass through the hands of so many persons after it leaves the designer that the chances for mistake or substitution as well as for wilful tampering with original ideas are very great. Until there is a more general education of fixture makers and hangers, as well as of the owners, it is to be expected that there will continue to be the laughable attempts at illumination which we now see on every hand, even though the original adviser may be fully competent. Matters of detail which sometimes appear very unimportant frequently make considerable difference in illuminating results as well as appearances.

Anyone who has followed the matter closely can doubtless recall cases where a ludicrous appearance has been produced by the use of the wrong shade holders, to say nothing of the illuminating effect being considerably changed from what it should have been, and this in spite of the fact that the most expert advice obtainable had been originally sought. In another case a complete floor of a large building originally planned on the basis of 2 watts per sq. ft. was, by a series of oversights combined with considerable tampering with original designs, finally reduced to 1 watt per sq. ft., when the actual installation was made, giving results which would have been disastrous had not the tungsten lamp appeared on the market about that time. In another case, through an entire building, shade holders, intended for use with Gem lamps, were used only on 16-cp lamps, while all the Gem lamps had common standard shade holders. A specification for show-window lighting recently drawn up called for the lamps to be pointed about 10 deg. from the vertical. The wiring foreman modified this so that when the job was finished concentrating reflectors were found pointed at the top of the show window back, thus giving the greatest intensity where it was least needed. Changes in arrangement of rooms are frequently made after the original lighting plans are drawn, but seldom is the one who draws lighting plans consulted about these changes. The results are frequently ludicrous, appearing either in the shape of absurd location of fixtures or arrangements entirely unsuited to the case in hand. There is only one moral to be drawn from these numerous little incidents, which seem to be the rule rather than the exception where good illuminating work is attempted. If it is a central-station company that is attempting to improve illuminating results in its community, it is necessary not only to look after the proper designs, but to have wiremen, foremen and the whole organization sufficiently educated to the importance of details that designs can be correctly carried out and that substitutions will be largely eliminated. In the meantime, it is a safe practice for every man who is engaged in trying to produce better illuminating results than the ordinary to watch every installation with which he is connected until it is finished.

New Lamps and Renewal Rates.

One of the exasperating problems confronting the central-station manager to-day is the proper method of dealing with the new high-efficiency lamps where free renewals have been the practice. The 100-watt tungsten lamps are now coming into fairly common use, 60 and 40-watt lamps are in production and seen occasionally, and even 25-watt lamps of foreign manufacture are making their way into service. In the long run, as in the case of every other improvement, increased efficiency will mean more business and more profits, but during the formative period of high-efficiency lamp practice, the ordinary system of charging leads to some rather troublesome situations. The fundamental trouble is the present very high first cost of the lamps—in this country—$1.25 to $2.00, according to size, make and discounts. Of course, candle-power to candle-power the new lamps are cheaper sources of light than the old, including renewals, in the ratio of more than two to one at ordinary prices of current. The consumer actually wins out on any customary method of changing, but in a territory where free renewals have been the rule, he dislikes to assume the renewals even though he gains thereby, and especially if some of the lamps are, as is inevitable, of considerably shorter life than the average.

Tungsten lamps, worked even at 1.25 watts per candle, are upon the whole very long-lived. Tests abroad have indicated a life four or five times greater than that of the carbon-filament lamp, and at present 1000 hours is not an unreasonable expectation of life before dropping 20 per cent in candle-power, although manufacturers are slow in guarantees of so much. But it not infrequently happens that individual lamps break or blacken at a few hundred hours and demand costly renewals, to the consumer's sorrow, if he supplies his own lamps. What should be the policy of the central station in dealing with this matter? Can it afford to go in at the present time for actual free renewals, or should it guarantee renewals for a fixed charge, or a corresponding additional charge for current? On the face of the returns, the free renewal system is a considerable burden, equivalent not only to giving the consumer much cheaper light, but giving it to him at a cut rate for current. Yet, on examination, the difference in average renewals per candle-power is not so great as it seems. It takes about five 16-cp incandescents to give the light of one 100-watt tungsten lamp, and their life is on the average considerably shorter. When the tungsten lamps get down to the plane of cost which may fairly be expected, renewals per candle-hour will be as low or lower than with carbon lamps. But until the high-efficiency lamp has stimulated consumption so as to hold up the central-station income, free renewals will be a losing game.

This existing condition must be met in some way. Perhaps the most obvious scheme aside from throwing renewals upon the consumer, is that of assuming renewals at a fixed charge per lamp based on average life. In this way the station using many lamps can average up the losses from short life against the gains from long life, and come out square. Such is the policy often adopted by gas companies in putting out the so-called gas arcs, and it seems to work very well. This is one good reason for trying it in case of the new lamps. Or, again, one could put the same amount in the form of an extra charge per kw-hour, in which case the consumer would get only his ordinary meter bills. This extra rate method perhaps does not look as well on paper as the former. At first sight it appears like a discrimination against efficiency, as if a gas company should charge one rate for gas used in flat flame burners, and another for gas used in Welsbachs. It also complicates things if one works new and old incandescents on the same meter. In the last resort one must realize too that there is a considerable chance of still other high-efficiency incandescents appearing in the near future, having still other characteristics of life and economy, which will take still more time to evaluate. It therefore seems as though the safe course for the present would to be say frankly to the consumer: "Put on high-efficiency lamps if you want to—we are glad to furnish current for anything that comes along—but you will have to stand the expense until the costs of renewal become accurately determinable so that we can, in fairness to ourselves and to you, assume them." Of course, the exigencies of sharp competition may justify a company in taking some long chances, but, save for these, a waiting policy would seem to be the wise one until the situation, as regards the new lamps, is far more stable than at present.

The Switchboard Rampant.

The growth of the switchboard is one of the sensational features of electrical history. Originally the switchboard was regarded as a necessary evil, to be confined in expense and extent to the narrowest feasible limits. It was an adjunct to the generators existing for the purpose of connecting them to the lines, and having no other reason for being. At the present time all this has changed, and the board has pretty nearly become the end instead of the means. The tail is wagging the dog, and costs nearly as much to keep. The growth which has resulted in this state of things has been a perfectly natural one in a way, a gradual evolution from the simplest appliances, which has gone on, however, until the switchboard has become not only a very serious item of cost, rising to no inconsiderable fraction of the cost of the generators themselves, but a source of serious expense for repairs and maintenance, and one of the most vulnerable points of the system. The list of shutdowns from trouble here or in the leads thereto would be a very long one, indeed. Meanwhile, the appliances themselves have been greatly improved and refined so that the trouble seems to be mainly with the combination rather than with the component parts. The switchboard designer seems too often to ask himself how many permutations and combinations he can make with a given number of generators and feeders, rather than how the required service can be given in the simplest and safest manner.

It is, of course, true that high-voltage circuits have necessitated the use of far more elaborate and costly switches than were once needed. As another factor in the situation the size of recent power houses has compelled the adoption of remote control, in itself undesirable on the score of its complication. A remote-control oil switch, however, may in itself result in simplification of the system if it be judiciously used. But it is common enough to find remote control resorted to in cases where it is not in the least necessary and is apparently merely for the sake of a superficial uniformity of design. Such fetish-worship of uniformity is a common failing of the human mind. Nothing is more difficult, for instance, than to get an intricate piece of scientific apparatus built with strict regard to efficiency and economy, exquisite precision of fitting being introduced just where it is necessary and nowhere else. A recent scientific paper describes a struggle of this sort which ended in the maker leaving off only his nameplate. In a similar fashion apparatus is not infrequently furnished with innumerable attachments, many of which are seldom used, and are generally in the way. Now switchboard design has a similar failing, resulting in an attempt to provide in a perfectly systematic way for remote contingencies which, when they arise, are often best dealt with by abrupt departure from the system. In fact, the system is sometimes developed at the expense of safety.

The first function planned for a switchboard is the connection of the generators to the busbars; the second is the connection of the latter to the out-going lines. From this point on the functions are chiefly protective, to guard against various probable or remote contingencies, and one can go on almost indefinitely in adding devices to meet the requirements of intricate combinations of circumstances. There have been a good many debates among engineers as to the extent to which the various refinements should be carried, without very definite results. The main thing in planning them is a proper sense of proportion, a sound judgment of the relative importance of things, not in general, but in relation to the plant under consideration. Each system has peculiarities of its own resulting from the number and kinds of units, from the number and use of the lines, and upon the nature and amount of the auxiliary power available. It must not be forgotten that in switchboard operation the human element is a very important one, and that intricacy, in itself unobjectionable, may for this reason become a source of danger rather than of safety. One is at present rather tempted to preach the simple life in switchboard design. There is at present a good deal of construction which reminds one forcibly of the time-honored anecdote of Newton, who is veraciously reported to have cut a fair-sized hole in his study door for the convenience of the cat, and then another smaller one for the kittens. The important thing is that the construction shall, whether simple or more complex, be thoroughly and well done; that the appliances installed shall be of the best quality from an operative standpoint, and that they shall themselves decrease rather than increase the total chances of trouble. Automatic devices that require a man to watch them are rarely more effective than if they were non-automatic, and in the end are more costly.

Iowa Electrical Association Convention.

The Iowa Electrical Association convention, held this year at Des Moines, Ia., April 22 and 23, was by far the largest in the eight years that this very successful central station organization has been holding conventions. The activity of the officers and the central location of the meeting place combined to make a large attendance. The Iowa Street & Interurban Railway Association held its convention during the same week, on April 23 and 24. The meetings and exhibits were at the Savery Hotel. The two associations prevented the usual extortionate charges of exhibitors by the hotel people by renting the old main dining room of the hotel and offering it to exhibitors free. This resulted in a much more instructive and complete exhibit than would have been brought out had exhibitors been obliged to pay big prices for hotel parlor exhibit space.

The first session of the convention was called to order on Wednesday by President George S. Carson, of Iowa City. In his address he referred to the tendency at present by commissions and arbitration boards to consider the value of an electric light property as the duplication value without regard to good will or the expense attached to bring the business to its present conditions. He said, however, that he felt that justice would be done to corporations by courts even if not by legislative bodies. In noting the advent of the tungsten lamp he said it would be able even to compete in cost with such cheap illuminants as gasoline and gas lamps.

Secretary W. N. Keiser, of Des Moines, presented as his report the printed proceedings of the last convention. Reports of executive committee meetings were read.

Mr. A. W. Zahm, chairman of the committee on co-operation, reported that the Co-operative Electrical Development Association expects to publish after the National Electric Light Convention a book for solicitors, which will be of great value. The material will be compiled from matter submitted for the solicitor's handbook prize competition.

The membership committee reported applications for membership from the central stations at Williams, Anamosa, Pella, Keokuk, Storm Lake, Ida Grove, Council Bluffs and Osage.

A nominating committee was elected by ballot, consisting of Messrs. L. D. Mathes, of Dubuque; Austin Burt, of Waterloo; John T. Moffitt, of Tipton; E. W. Hoag, of Manchester, and Thomas Crawford, of Clinton.

Mr. E. L. Callahan, of Chicago, presented a paper on popularizing the use of electricity, in which he dealt especially with the introduction of heating devices. This paper was discussed at length, especially with reference to the operation of "day circuits" in small towns.

It was announced that on Thursday evening, by the courtesy of the Des Moines Edison Light Company and the Des Moines City Railway Company, the convention would be entertained at the Majestic Theater.

On Wednesday afternoon the convention listened to an address by Mr. J. W. Ferguson, assistant contract agent of the Commonwealth Edison Company, of Chicago, on "Fact and System."

"The Economical Operation of a 200-kw Station" was taken up by Mr. Austin Burt, of Waterloo, who gave some figures on results attained in securing a day load which proved very interesting.

"Grounded Secondaries" was discussed in a paper by Mr. Thomas Sloss, of Cedar Rapids, in which the advantages of grounding were well brought out. The discussion dwelt principally on the best method of securing a ground, and finally a committee was appointed to investigate and report upon the best method of grounding. Mr. Sloss, Prof. T. A. Fish, of Ames, and J. A. Inness, of Eagle Grove, were appointed as this committee.

"Incandescent Lamp Development," a paper by Mr. F. W. Willcox, was read by Mr. George C. Osborne, of the General Electric Company. This paper treated the tungsten lamp situation very thoroughly, and brought out an extended discussion, taken part in by Mr. Geo. Loring, of the National Electric Lamp Association; Mr. L. D. Mathes, of Dubuque, President Carson and others.

On Thursday morning short talks on meeting gas and gasolene competition were given by Messrs. Gus Lundgren, of Cherokee, and M. A. Harrison, of Nevada. After a profitable discussion of these subjects, Prof. A. H. Ford, of Iowa City, read a paper on "Electric Motor Characteristics."

The question of freight rates was taken up in two papers, one being the report of Mr. Thomas Crawford, of Clinton, chairman of a committee appointed on that subject at the last convention, and the other a paper by Mr. E. G. Wylie, of Des Moines, on the freight rate situation as regards Des Moines and the recent controversy over it.

On Thursday afternoon, new business methods were dealt with in a number of short talks, participated in by Messrs. J. F. Porter, of Davenport; A. L. Dodd, of Charles City, and C. E. Walters, of Toledo; Thomas Ferris, of Osage; Austin Burt, of Waterloo, and O. E. Brownell, of Lake City.

The convention went into executive session to discuss various matters, and fixed upon the third Wednesday in April as the regular date for the convention hereafter. The next convention is to be held at Cedar Rapids.

Officers elected for the coming year are as follows: President, L. D. Mathes, of Dubuque; vice-president, O. E. Brownell, of Lake City; treasurer, W. A. Mall, of Belle Plaine; secretary, W. N. Keiser, of Des Moines; executive committee, Thomas Sloss, of Cedar Rapids; F. L. White, of Traer, and J. F. Porter, of Davenport.

The timely papers and discussions at this convention were of the practical character which has given the Iowa Electrical Association its high place among state associations of this kind.

Committees of the Underwriters' National Electric Association.

At the annual meeting of the Underwriters' National Electric Association various suggestions and proposed rules are given into the hands of special committees appointed by the chairman, who report their recommendations and findings either to the electrical committee or to the association at its annual meeting. Chairman Cabot has appointed the various committees called for at the annual meeting, which are given below, together with the respective chairmen:

Committee on signs and outline wiring, Mr. J. C. Forsyth, 32 Nassau Street, New York; committee on Rule 64, signaling systems, Mr. F. E. Cabot, 55 Kilby Street, Boston; committee on transformers, Mr. C. H. Hill, 316 Walnut Street, Philadelphia; committee on telephone switchboard lighting, Mr. R. P. Strong, 809 Hibernia Building, New Orleans; committee on electric cranes, Mr. G. S. Lawler, 31 Milk Street, Boston; committee on Rule *2a*, Mr. G. E. Bruen, 135 William Street, New York; committee on switches and cut-outs, Mr. H. O. Lacount, 31 Milk Street, Boston; committee on variable-speed motors, Mr. H. O. Lacount, 31 Milk Street, Boston; committee on approval of laboratory reports, Mr. George E. Bruen, 135 William Street, New York; committee on fixture wire, Mr. Dana Pierce, 382 Ohio Street, Chicago; committee on auto starters, Mr. C. H. Hill, 316 Walnut Street, Philadelphia; committee on re-codification of the Code, Mr. C. M. Coddard, 55 Kilby Street, Boston; committee on details of switchboard, Mr. Ralph Sweetland, 55 Kilby Street, Boston; committee on cut-out cabinets, Mr. A. R. Small, 382 Ohio Street, Chicago; committee on Rule 13*a*, Mr. C. M. Coddard, 55 Kilby Street, Boston; committee on specifications for stage and elevator cables, Mr. J. E. Cole, 11 Wareham Street, Boston; committee on rheostats, Mr. George E. Bruen, 135 William Street, New York; committee on induction motors as to wires and fusing, Mr. F. E. Cabot, 55 Kilby Street, Boston; committee on circuit-breakers, Mr. S. N. Schoen, 339 Equitable Building, Atlanta; committee on mercury-vapor lamps, Mr. J. C. Forsyth, 32 Nassau Street, New York; committee on street railway property, Mr. Ralph Sweetland, 55 Kilby Street, Boston; committee on theater wiring, Mr. J. E. Cole, 11 Wareham Street, Boston.

Missouri Electric Light Convention.

The Missouri Electric Light, Gas & Street Railway Association, which was organized in 1907, held its annual convention at the Marquette Hotel, St. Louis, Mo., April 23, 24 and 25, 1908.

The meetings were presided over by Dr. J. D. Porterfield, of Cape Girardeau. Mr. C. L. Clary, of Sikeston, Mo., acted as secretary in place of Secretary C. Z. Pierson, who removed from the State during the year.

The first session was opened on Thursday morning by an address of welcome by Mr. W. A. Layman, of St. Louis, responded to by President Porterfield. The reading of the report of the secretary and the holding of an executive session occupied the balance of the morning.

At 2 p. m. Mr. Hugo Wurdack, of St. Louis, gave an address on economical secondary distribution and Mr. R. L. Lanphier an address on watt-hour meters. At 8:30 p. m. a smoker was given at the Marquette Hotel.

On Friday morning Mr. E. W. Houghton, of Chicago, reviewed the incandescent lamp situation with especial attention to the present status of the tungsten lamp. Mr. Geo. C. Osborne and Mr. Geo. Loring then talked on the same subject and a general discussion by central station men followed. On Friday afternoon Mr. Horace W. Beck, of St. Louis, addressed the convention on "Central Station System and Records." "Popularizing the Use of Electricity" was the subject of a paper by Mr. E. L. Callahan, of Chicago. The Sons of Jove held a rejuvenation and smoker in the evening.

Saturday morning an executive session was held, after which a paper on "Alternating Current Motors," written by Mr. W. Robbins, of St. Louis, was read by Mr. A. H. Timmerman for the author. This paper showed the proper types of alternating-current motor for various kinds of service.

The meeting was then thrown open for the answering of various questions asked by members, which resulted in a profitable discussion of various topics.

The officers elected for the ensuing year are: W. B. Hays, of Poplar Bluff, president; Ralph Irvine, of Marshall, first vice-president; F. E. Murray, of Louisiana, second vice-president; P. A. Bertrand, of Jefferson City, third vice-president; C. L. Clary, of Sikeston, secretary and treasurer. Executive committee: W. A. Bixby, Springfield; H. D. Hibbeler, of Washington. Finance committee: P. A. Bertrand, of Jefferson City; Thomas Fox, of Cape Girardeau, and Ralph Irvine, of Marshall. Advisory committee: O. M. Munroe, of De Soto; W. A. Bixby, of Springfield, and B. S. Bertrand, of Jefferson City.

A rule was adopted to make the date of the convention the first Thursday after April 10, each year. On Saturday evening the electrical supply men of St. Louis gave a banquet to the members.

The convention was one in which the interest never lagged and the 20 central stations which sent representatives were well repaid.

Exhibition of Safety Devices.

Much interest has been manifested in the exhibition of safety devices which is being made under the auspices of the American Institute of Social Science at 231 West Thirty ninth Street, New York, and which will continue for over another month. The exhibition, which is open to the public, contains a number of electrical devices. A working model of an automatic gate for railroad crossings is shown by the Automatic Gate & Signal Company. The gates close on the approach of a train and open after the train has passed, at the same time ringing an alarm. The electricity for operating the gates is furnished from a storage battery or by direct supply. The actuating relay is thrown by the current taken from an insulated section located about two miles from the crossing.

A model of the Nachod automatic signal for electric railways is shown by the United States Engineering Company. This signal system is designed to prevent head-on collisions on single-track lines, and indicates automatically the presence and direction of the car on the block by a system of lamps and semaphores at turn-outs.

The Rich marine fire indicating system also forms an interesting feature of the exhibit. In this system pipes connected to the various parts of a ship terminate in a case in which is an electric exhaust fan set in motion by clock contacts every 15 minutes. Should a fire occur smoke will be sucked up through the pipe into the chamber by the fan, whereupon a steam connection is made and steam under pressure is forced down the pipe into the compartment where the fire is. Another electrical means for indicating fire and giving an alarm is shown in the exhibit of the Montauk Fire Detecting Wire Company. Thermostatic wires close a circuit which sounds an alarm as soon as the temperature has reached a certain value.

Poulsen on Wireless Telephony.

Prof. Valdemar Poulsen, the Danish inventor, read a paper before the Royal Institution in London two weeks ago on his system of wireless telephony. After detailing how he had succeeded in carrying the human voice through the air a distance of about 200 miles, that is to say, between Copenhagen and Berlin, Mr. Poulsen is reported to have spoken as follows:

"The essence of my discovery is its simplicity, and it resulted from another discovery I made several years ago that the rapid passage of electricity to and fro produces an effect known as the 'singing air.' This singing I found produced notes too low for the air to hear and some that were too high to be understood, so in order to make the notes understandable I arranged an apparatus consisting of coils of wire, joined in series to a condenser with leads to the source of the current, joined by two carbons in parallel.

"I found that the current flowed rapidly in the arc between the carbons, oscillating to and fro, and the oscillation was enormously improved by occupying the intervals between the carbons with hydrogen gas. This resulted in continuous undamped waves which can easily be tuned to any desired plan, so that they will only influence those instruments which are arranged to correspond with the sending instrument."

Coming to the pure telephone and efforts to establish wireless communication, Mr. Poulsen said that the waves that Bell had harnessed by the use of mirrors had proved to be without value, but with the undamped waves, each exactly like its predecessors, the problem had been solved. These regular waves transmitted sound perfectly, and by means of them it had been possible to telephone a tune, without wires, 290 miles, and to make a human voice recognizable at a receiving station 170 miles away from the person speaking. At the close of the paper some interesting demonstrations of the new method of communication were given.

Equipment for Nevada-California Power Company.

The Nevada-California Power Company is installing an additional generating station on Bishop Creek. This will be the third plant located on this stream, all three to use the same water and to operate in parallel to transmit energy 120 miles to the southern Nevada gold fields.

The new installation will consist of three 2000-kw, 2200-volt, three-phase, 60-cycle generators connected to over-hung tangential waterwheels operating at 300 r.p.m. The wheels will receive water through a 48 in. steel pressure pipe 2800 ft. long. The pressure pipe is joined to a 48-in. wooden-stave pipe line 10,000 ft. in length. Six 1000-kw transformers will be used to raise the generated e.m.f. to 55,000 volts for the transmission system.

International Acheson Graphite Company Improvements.

Additions to cost about $100,000 are about to be made to the plant of the International Acheson Graphite Company in Niagara Falls. Ground has been broken and work is under way on a new switchboard building. This building will be of brick, 36 ft. long by 20 ft. wide. It will house all the receiving and distributing panels, the present switchboard to be transferred to it when it is ready. The electrical apparatus, transformers, regulators, busbar system, etc., will cost about $20,000. The energy is supplied by the Niagara Falls Power Company at an e.m.f. of 2200 volts.

Other very important features of the improvements in progress will be a new furnace room, and a new grinding and storage building. The new furnace room building will be a one-story structure 120 ft. long by 100 ft. wide. The frame will be of steel, the walls of brick. It will provide room for 12 additional furnaces, which will make it possible to double the output of the plant.

The new grinding and storage building will be of steel and brick, 100 ft. long, 50 ft. wide and three stories high. When the improvement is completed the present grinding room will be merged in this new building. A portion of the new structure will be devoted to the storage of graphite and stock goods in general, particularly electrodes. It was in 1897 that the manufacture of graphite on a commercial scale began in Niagara Falls, and since then there has been a splendid increase in the business. It is stated that despite the industrial depression that prevailed, the Acheson company booked more orders during the first quarter of 1908 than during the corresponding period in 1907. This appears to be particularly true of "Oildag."

Japanese Electrical Science Association.

At present there are three organizations in Japan which are directly connected with the electrical science. These are the Telegraphic Science Association, Electrical Association and Electrical Science Association. The last named is the largest and strongest and occupies the position in Japan that the American Institute of Electrical Engineers does in this country. The objects of the association are also similar to those of the institute.

The members of the society are divided into four classes—full members, associate members, honorary members, and "sustaining" members. An engineer who has graduated from a college, or has been in a responsible position for three years and is familiar with the electrical science, or has extensive practical experience and knowledge in electrical engineering, or who is closely connected with the electrical science and is likely to contribute something to the science, may be admitted as a full member.

One who has studied and is connected with electrical science, but not qualified to be a full member, may be an associate member. Persons very prominent in the electrical field may be elected to honorary membership. A sustaining member is one who has contributed $25 or more to the association. The board of directors, which consists of twelve members, has the power to accept or reject applications for membership.

The officers are a president, two secretaries, twelve directors, two recording secretaries, two treasurers and an editing committee, consisting of six members. The present president is Baron Otori.

A meeting is held at Tokio every month, except July and August. Papers are presented at these meetings, and at times the discussions on papers are lively and interesting. The papers and discussions thereon are published and distributed to the members.

In the January issue Mr. S. Kanda, an authority on the telegraph, has an original paper entitled "The Sag of a Wire Suspended at Two Points of Support at Different Levels." Annual meeting is held, which is largely of a social nature, the greater portion of time being devoted to excursions, dinner parties and social diversions.

The association has been in existence for twenty years, and almost all Japanese electrical engineers are members. According to the report of last December, the number of the full members is 641; associate members, 610; honorary members, 6; "sustaining" members, 20.

Convention of the Southwestern Electrical & Gas Association.

The annual convention of the Southwestern Electrical & Gas Association will be held at El Paso, Tex., on May 5 and will continue in session for three days. The headquarters of the association will be at the St. Regis Hotel and the business sessions will be held in one of the rooms of that hostelry. The exhibits of the manufacturers and supply houses will be given space in one of the sample rooms of the hotel.

The following program of papers has been prepared: "Track Construction," Mr. Mark Lowd, of Dallas; "Gas Engines and Producers," Mr. W. B. Tuttle, of San Antonio; "Wood Preservation," Prof. E. P. Schoch, of Austin; "Testing and Proving Gas Meters," Mr. J. A. Myler, Jr., of Dallas; "Various Forms of Electric Illumination and Their Efficiency," Mr. C. W. Kellogg, Jr., of El Paso. There will be a general discussion of the question, "What Policy Should be Pursued by Public Service Corporations in Making Extensions?" Mr. E. T. Moore, of Dallas, and Mr. J. A. Porter, of Paris, Tex., will present the question for the electric-light companies; Mr. H. M. Moore, of Austin, and Mr. C. H. Dunbar, of Houston, for the gas companies; Mr. H. S. Cooper, of Galveston, and Mr. F. E. Scovill, of Laredo, for the street-railway companies, and Mr. J. E. Farnsworth, of Dallas, for the telephone companies. Other papers in addition to those embraced in the program above will be read.

The entertainment program consists of a tally-ho ride through El Paso and Juarez, Mexico; a visit to the big smelter; a trolley ride over the city, followed by reception and luncheon; a visit to Fort Bliss, followed by reception and band concert. On Friday, May 8, there will be a grand rejuvenation of the Sons of Jove.

Daylight and Artificial Light.

At the May meeting of the New York section of the Illuminating Engineering Society, to be held on Thursday, May 14, at 8:15 p. m. at the Engineering Societies Building, Dr. E. L. Nichols, of Cornell University, will present an illustrated paper on "Daylight and Artificial Light." Dr. Nichols recently traveled extensively throughout Europe and northern Africa, making spectro-photometric determinations of the quality of daylight under widely varying conditions, involving about 150 sets of observations. Deducing from these an average value for daylight, he will compare various artificial illuminants to such value through spectro-photometric measurements. The meeting will be open to all who wish to attend.

May Meeting of the A. S. M. E..

The next meeting of the American Society of Mechanical Engineers will be held Tuesday evening, May 12, in the Engineering Societies Building, New York. The paper will be by Mr. Henry Souther, of the Henry Souther Engineering Corporation, Hartford, Conn., on the subject of "Clutches," with special reference to the types used on automobiles. Their development will be shown by lantern slides. The meeting will be important not only to those directly interested in automobile construction, but to all who have to do with the use of clutches for machine tool work, power transmission, hoisting machinery, textile and other classes of machinery. The meeting will afford an opportunity for the full discussion of their design and use. The discussion will be continued at the semi-annual meeting of the society at Detroit, Mich., June 23 to 26.

Tests of Fuels for Producer-Gas Plants.

The accompanying table shows the results obtained on a wide range of fuels tested by the technologic branch of the United States Geological Survey, under the direction of Mr. Joseph A. Holmes, expert in charge, and Mr. Robert Heywood Fernald, engineer in charge. These tests were made at St. Louis, Mo., at the fuel-testing plant which was located on the grounds of the Louisiana Purchase Exposition. At the time this plant was erected there were but few gas-producer plants in the country burning any class of bituminous coals, and many prominent engineers were in doubt as to the possibility of operating a gas engine on gas produced from coals such as are mined in the Central and Western States.

This branch has done a valuable service to the country in demonstrating the possibility of burning nearly all classes of low-grade fuels with good economy. As will be noted in the table the poorer coals required a correspondingly greater quantity of the fuel to produce a horse-power.

DATA AND RESULTS ON REPRESENTATIVE FUELS BURNED IN A PRODUCER GAS PLANT

Fuel.	Proximate analysis, per cent. Moisture.	 Volatile matter.	 Fixed carbon.	 Ash.	B.t.u. per pound of fuel. As fired.	 Dry.	Cu. ft. standard gas produced per pound of equivalent* fuel consumed by producer plant. As fired.	 Dry.	B.t.u. per cu. ft. of standard gas	Pounds of equivalent* fuel per B.H.P. hr. As fired.	 Dry.
Florida peat	21.03	51.72	22.11	5.17	8,127	10,289	28.5	36.1	175.2	2.57	2.03
Average of four lignites.....	35.05	28.96	27.72	8.27	7,164	11,038	26.3	40.3	169.9	2.43	1.73
Avg. of four Penna. coals..	11.51	31.81	43.46	15.22	10,651	12,030	49.6	56.1	153.2	1.66	1.47
Avg. of four Penna. coals...	3.47	19.68	67.31	9.54	13,651	14,136	71.4	74.0	141.6	1.16	1.12
Avg. of four W. Va. coals..	2.47	32.12	60.24	5.17	14,248	14,610	77.5	79.5	140.6	1.03	[illegible]

*Equivalent fuel includes that used in the producer, and also the amount required to generate the steam necessary for operating the producer.

Of the four Pennsylvania coals tested, two came from the lower Kittanning bed, one from the Lower Freeport and the fourth from the Pittsburg bed. Of the West Virginia coals, one came from the Ansted bed, another from the Eagle, both of these being in the New River district; a third from the Pittsburg and the fourth from the Keystone bed.

The equipment used was a 250-hp pressure producer with a centrifugal tar extractor and gas holder. A 235-hp, three-cylinder, vertical gas engine belted to a generator-produced power which was measured by electric instruments connected with the switchboard. As will be seen, the results are much better than those from steam plants of corresponding size.

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German Wireless Rates.

Consul Wilbur T. Gracey, of Tsingtau, transmits the following information regarding wireless telegraph installations which have recently been placed on the ships of the Hamburg-America Line running between Shanghai, Tsingtau and Tientsin:

"Sea telegrams are those which are exchanged between ships at sea and the stations situated on land. They must, when forwarded by way of wireless stations, be either in plain words or in code terms contained in commercial cable codes. If intended for ships at sea, the address must contain, in addition to its usual contents, the name or official number of the ship and its nationality.

"The rates from Tsingtau to ships at sea or vice versa are 5 cents Mexican (approximately 2½ cents gold) per word, with a minimum charge of 10 words. For messages from ships at sea to other places or countries the rates of the German post-office as published are applicable. In addition to this word rate, a fixed sumptuary sea rate of 40 cents per message will be added. Total charges on messages sent to ships are payable by the sender, on messages received from ships by recipient.

"Telegrams sent to ships at sea are, like all other telegrams, sent through the German post and telegraph office, and messages from ships at sea are delivered to recipients in the same way. A wireless station is situated at Tsingtau, and instruments have been installed on the *Admiral von Tirpitz* and the *Staatssekretar Kraeike*, of the Hamburg-America Line."

Side Lights on the Fuel Problem.

At the annual meeting of the National Association of Cotton Manufacturers, held in Boston, Mass., April 16-17, Mr. E. G. Bailey read a paper entitled "Some Things a Manufacturer Should Know About Coal," in which the following points bearing upon boiler room operation were brought out: There are yet many things to be learned about coal, and one of the most baffling phenomena so far investigated is the spontaneous combustion of coal under storage. When a plant is located at any great distance from the mines, coal storage is a necessity, and this inevitably involves additional expense due to the extra handling, value of storage space, and loss of coal, both mechanically and chemically. There are many theories as to the cause of spontaneous combustion, the presence of sulphur being generally charged with this trouble, but many cases of combustion occur in piles of coal that contain less than one per cent of sulphur, and analyses of coal from heated piles show that only a small percentage of sulphur has been oxidized. It appears that the rate of circulation of air through the coal has more to do with this question than the presence of sulphur, pyrites, excessive moisture, variations in the height of the pile, or any other condition outside the character of the coal. The heating of a pile is usually so irregular that the ordinary temperature measurements made by letting down a thermometer in pipes scattered through a pile are liable to miss entirely the hottest spot. Storing coal under water seems to be the only method of absolute prevention known at present.

It is not always the better or higher-priced coals that give the most satisfaction in plants that are very limited in boiler capacity, that have such poor draft or some kind of stoker that it is possible for the boiler room force to keep steam only with certain kinds of fuel. The percentage of volatile matter amount of ash, and coking properties are very important factors in the rate of combustion. In buying steam coal the amount of heat that may be developed is the measure of its value, but two coals at the same price and containing the same number of heat units may not be equally desirable It is a very common practice to buy coal in these days on the strength of heat units, but there are other factors to be considered. The difference in volatile matter may cause one coal of the same calorific power to be preferable to another on account of smoke restriction, while a higher volatile coal would probably be more useful in a plant with fluctuating loads. The liability of a coal to spontaneous combustion may make it advisable to pay several cents a ton more for one coal containing no more heat units than the other. For steam purposes sulphur is of little importance below two per cent at least, so that a coal containing less ash might in a given case be selected on its cost of five or ten cents a ton less on the heat unit basis, even though its sulphur were nearly double that of its competitor.

In case a plant has a limited draft and boiler capacity a coal with 30.5 per cent volatile matter might be selected in place of one containing 22 per cent more fixed carbon, 13 per cent less volatile matter, and 100 more heat units per pound, even though the former cost 8 cents per ton more than the latter, or $2,500 on a year's order of 50,000 tons. A difference of 28 cents per ton f. o. b. the plant, or 4 cents per ton on the basis of heat units would scarcely pay the extra cost of handling ashes with a coal of 700 more heat units per ton and 4 per cent less ash, especially if there is a danger of not being able to carry the load without the use of more boilers and other expenses that are greater with a poorer coal. A coal that when compared with half a dozen others is the best all-around fuel might not be the best to buy if one of the competitors could be obtained for 20 cents per ton cheaper on the heat unit basis, and 19 cents per ton cheaper on the evaporation basis. Again, a coal might appear to be superior on account of less ash and sulphur in its analysis, but if it had a high percentage of moisture, say, 3.7 compared with from 1.25 to 1.4 in its competitors, the purchaser might be paying as much as 20 cents per ton less for the former, and yet he would have to burn so much more of it to develop the same horse-power that he would actually be losing 32 cents per ton, or $16,000 per year on a 50,000-ton contract.

The analysis of flue gases is the best criterion for regulating the conditions of a furnace so as to obtain nearly complete combustion with a minimum of air excess. The perfecting of automatic gas indicators and flue gas recorders will do much toward increasing the boiler room efficiency. In operation, the important point is to cool the gases as much as possible with a minimum of boiler heating surface. Too much emphasis cannot be laid upon keeping the heating surface clean inside and out. There is an opportunity in many plants to save thousands of dollars per year by merely reducing the draft or regulating it more carefully. The choice of stokers, design of furnaces, determination of ratios between heating and grate surface, testing of fuel saving devices and smoke preventers, and the determination of the best way to fire different kinds of coal under different boilers is still open to the widest investigation. The plea for evaporative tests because they are practical is counterbalanced by their frequent failure to burn coal under equally comparable conditions in two or more cases. Chemical analysis and calorimetric determination will represent the value of coal within 1 per cent, if the samples are properly taken, and the fact that a coal company knows its coal is being systematically analyzed is generally sufficient to insure the delivery of a coal of uniform quality.

Death of the Oldest Telephone Manufacturer.

The present generation of electrical engineers is not particularly familiar with Mr. Charles Williams, Jr., who died on April 15 at Somerville, Mass.; but it is a fact that he was in his day one of the foremost electrical manufacturers in this country, and one whose work on early telephonic apparatus, in association with Prof. A. G. Bell, gives him a place in the history of the electrical arts. Mr. Williams began his career in the electrical field in Boston in the early forties, and was a member of the firm of Hinds & Williams, dealers in and makers of electrical apparatus and supplies. After a time Mr. Hinds retired, leaving the business in the hands of Mr. Williams. It was in his workshop on Court Street, Boston, that much of the early work on the telephone was done by Prof. Alexander Graham Bell, and by Mr. T. A. Watson, who was appointed by Mr. Williams to take charge of this work for Bell. The testimony and briefs in all the earlier telephonic litigations, as well as the histories dealing with the subject, are full of data with regard to this early experimental work. The following typical passage may be quoted from Mr. Watson's evidence:

"We had a line running from the attic to Mr. Williams' factory to the third story. In the attic we connected a harmonic receiver. I shouted into the membrane telephone. Mr. Bell listened at the receiver. I think he heard nothing. We changed places. He shouted at the telephone and I listened at the receiver. I could hear a faint sound.

"On Saturday, July 5, I tried the membrane telephones. . . . I carried on conversation with Professor Bell successfully. On Monday, July 7, I placed the instruments in circuit between the attic and third story of Mr. Williams' factory under almost precisely the same conditions as the experiment of July 2, 1875. I could occasionally hear very faint sounds."

In April, 1877, the first telephone line, properly speaking, was stretched from the Court Street factory to the residence of Mr. Williams in Somerville, and before the end of the month other lines were put into operation. From this time on the art of telephony and the business of telephonic manufacturing developed with leaps and bounds. Mr. Williams himself contributed no small amount of energy and skill to the perfection of the apparatus. His factory supplied for a long time all the material needed by the National Bell Telephone Company, and he was for several years the sole licensed manufacturer of the company. The Williams magneto call bell and the Williams switchboard were leading elements in the early art, and are remembered to this day as standards of excellence and utility.

It is a curious fact that Mr. Williams was paid for much of his earlier work in Bell telephone stock, which he took with considerable reluctance, but it was practically the only available asset of the struggling parent company. Soon afterward that which had been looked upon with hesitation and doubt became extremely valuable, and the exchange of the old stock for new. as well as the dividends earned and the profits of his manufacturing business soon made Mr. Williams a wealthy man.

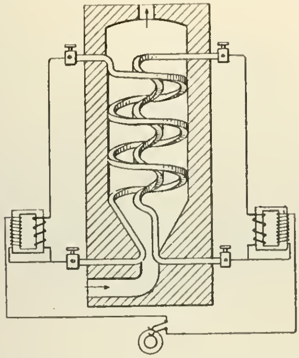
In 1886 he retired from the field as licensed manufacturer for the American Bell Telephone Company, and the famous Western Electric Company came into existence, with its huge factories in New York and Chicago, as well as in Europe. Mr. Williams again benefited by the transaction and became a very large stockholder in the Western Electric Company, of which, until the time of his death, he remained a director. He also took an active share in the development of other Bell telephone interests and was for a time president of the Tropical American Telephone Company. His later years had, however, been passed in more or less retirement, until his death, which was due to bronchial pneumonia. Mr. Williams was one of the earliest members of the American Institute of Electrical Engineers, joining in 1884—the date of his membership being that of his death, April 15. He did not, however, take any conspicuous part in electrical affairs outside of his business interests, and to-day, to the great majority of electricians, had become little more than a name; although his share in the creation of a great art can never be overlooked or forgotten.

Phenomena of Mercury-Vapor Lamps.

A United States patent issued to Richard Kuch, of Hanau, Germany, on April 7, the application for which was filed on Dec. 7, 1905, describes some interesting phenomena of mercury-vapor lamps. The inventor states that on increasing the e.m.f. impressed on the lamp far beyond the point hitherto tested an unexpected change takes place. The curve of efficiency of the lamp then changes its direction and the efficiency will quickly rise, so that its value will be far more favorable than the most favorable values hitherto attained for a low electric potential. The consumption reduces to 0.17 watt per candle-power and no limit appears to have been as yet reached in this reduction. The electric potential of the lamp was in this case increased up to about 25 or 30 volts per centimeter of the length of the column of light; in other words it was from 25 to 30 times that potential which has hitherto been employed for attaining the most favorable efficiency. This entirely unexpected behavior of the gas or vapor electric lamps with mercury electrodes the inventor explains by the following theory: For a certain potential of the lamp the light furnished by the radiation of the luminescence of the dissociated mercury vapor is supplied by a further radiation, presumably that of the temperature in consequence of the temperature increasing with the specific weight of the vapor. The radiation of the temperature produces a rapidly increasing efficiency, which compensates for the decrease of the efficiency of the radiation of the luminescence and moreover it produces a very considerable improvement in the total efficiency. The inventor states that a lamp for 110 volts need be only 6 cm in length as compared with the usual 50 cm.

Electric Gas Apparatus.

The accompanying illustration shows an apparatus for treating gases by means of electric arcs, for which a patent was issued to Mr. A. J. Peterson on Feb. 25. The apparatus is so arranged that the gas is acted upon by a large number of arcs, each arc being forced upward by electrodynamic action. In order to render the latter action as effective as possible the current which reaches the arc is passed through series transformers so that the secondary currents bear a certain large ratio to the arc current; the secondary circuits, which are used as the electrodes, are spirally wound with the same pitch, but with different diameters. During operation the arcs run along the spirals and act upon the gas at many points. It is claimed that the compounds obtained by reason of the ironizing action of the arcs are thus prevented from being again dissociated.



PETERSON ELECTRIC GAS APPARATUS.

Commercial Day at the N. E. L. A. Convention.

One of the subjects on the program for Commercial Day (May 21) at the convention of the National Electric Light Association in Chicago, will be "Advertising," which will be handled by Mr. Chas. A. Parker, formerly editor of the *Booster*, which was started by the Co-operative Electrical Development Association. An illustrated lecture will be delivered by Mr. V. R. Lansingh, dealing particularly with store illumination.

Cleveland's Three-Cent Fare.

The seven-year contest that has been waged in Cleveland, Ohio, for lower street railway fare and public control of urban transportation seems at last to have ended. The Municipal Traction Company, which has leased the various railways for 50 years, expects to inaugurate the three-cent fare during the first week in May. This company obtained possession of the property of the Cleveland Railway Company, a new corporation, which took over the consolidated properties of the old companies.

Bottled Gas.

Prof. Hallock lectured before the Chemists' Club, in New York City, April 24, on "Blaugas." This is liquid illuminating gas discovered by Professor Blau, of Germany, and while it is not manufactured in this country, it has found an extensive use in Germany, where it is sold by weight. A 22-lb. cylinder contains enough liquid gas to supply a 50-cp burner for four months if used four hours a day. Very small copper tubes, about the size of an electric light wire and just as flexible, connect the burners with the reservoir.

CURRENT NEWS AND NOTES.

CONTROL OF WIRELESS COMMUNICATION.—The President has sent to the Senate the reports of the War and Navy Departments and the Department of Commerce and Labor on the international wireless telegraph convention signed at Berlin Nov. 3, 1906. All three departments recognize the necessity for some rules governing the exchange of aerial messages and applaud the convention. The need is urgent, for the reason that there are now in the United States 97 wireless shore stations. Of these 40 are operated by the navy, 16 by the army and 41 by private concerns. A bill is now under consideration by Congress providing for rigid governmental control of wireless communication, and fixing penalties for private persons who interfere with government messages or indulge in "fake" messages. This bill was referred to in these columns at the time of its introduction.

PURE WATER FOR NIAGARA FALLS CITY.—Governor Hughes, of New York, has signed the bill that provides for the appointment of a board of water commissioners for the city of Niagara Falls. The duty of this commission will be to determine upon a plan for providing the entire city with a supply of pure water for fire, domestic and industrial purposes. The commission will have seven members, including the mayor in office. It is suggested that a tunnel be driven out under the river to the Canadian channel, where it is alleged that the water is of better quality than along the American side. As yet filtration is not suggested, but those who look ahead realize the necessity. The plans, after being perfected, must be ratified by the taxpayers at a special election. All the electrical companies and industries are in favor of a better water supply. At present there are two plants, one being operated by the Western New York Water Company, the pumps of which installation are in the wheel-pit under power house No. 2 of the Niagara Falls Power Company, and a municipal plant operated by water from the hydraulic canal basin. The entire project will cost the citizens of Niagara Falls several million dollars.

A GLANCE AT CONDITIONS.—It is interesting to note that the representatives and correspondents of Spencer Trask & Company returned recently from their trip of inspection of the properties of the Milwaukee Electric Railway & Light Company, the Milwaukee Light, Heat & Traction Company, the Detroit Edison Company and the Cleveland Electric Illuminating Company very much pleased with the outlook. One prominent member of the party said: "In each case the party was greatly impressed with the excellent condition of the plants, and the broad and comprehensive plans on which the construction has been carried out. The improvements in modern machinery are so rapid that it is necessary to maintain the operating efficiency of public utility properties at the highest standard in order to obtain the best results. A large part of the machinery inspected has been in operation for only two or three years. With every degree of conservatism, the various companies are planning additions and improvements to provide for the increased requirements which are already evidenced, and which may reasonably be expected to be upon a constantly increasing scale. In the investment field there seems to be an abundance of funds awaiting investment in the best class of securities of sound properties, but owing to the recent panic, individual investors are evidently, and quite naturally, more determined than ever to place their funds only in securities combining safety of principal and interest, and promising reasonably large appreciation in value. It is not unlikely, therefore, that this feeling will have its effect on local legislation pending, the country over, making it apparent that in order to raise the necessary cash to provide ample facilities for the convenience and comfort of the public the laws governing utility corporations must not be burdensome, but reasonably fair to both the corporations and the public."

WIRELESS MOTOR CAR.—According to a newspaper dispatch an Omaha inventor has devised an apparatus whereby a motor car can be started and stopped from a distance by wireless telegraphy.

NATIONAL ARCHITECTURAL EXPOSITION.—A National Architectural Exposition will be held during the week of Sept. 14-19 at Madison Square Garden. The scope of the exposition will include building engineering, construction and equipment, interior and exterior decorations and furnishings

FUEL TESTING.—Bulletin No. 332 of the U. S. Geological Survey consists of a report by Mr. Joseph A. Holmes of the U. S. fuel-testing plant at St. Louis. Descriptions in detail are given of the various tests applied to fuel, and tables give the results of tests upon coal from mines in various parts of the country.

INCREASE IN ELECTRIC RAILWAY FARE IN MASSACHUSETTS.—The Massachusetts Railroad Commission in the matter of a protest entered by the patrons of the Blue Hill Street Railway Company against an increase in fare to 6 cents, has decided that this increase was justifiable and dismissed the petition.

LAMP PATENTS.—An additional development in the condition of the Patent Office contention between the government and Mr. John A. Heany, noted in our first issue for March, was recorded on April 13, when a bill was filed to annul the Heany tungsten lamp patent, it being alleged that the patent was fraudulently obtained.

ELECTRIC METER INSPECTION IN THE DISTRICT OF COLUMBIA.—A bill has been introduced into Congress to establish a system of electric-light meter inspection in the District of Columbia, one of the provisions of which is that all meters are to be considered correct which do not depart more than 3 per cent from accuracy.

FIRES DUE TO LIGHTNING.—The Continental Fire Insurance Company has published statistics giving the number of fires and their causes in connection with claims paid by the company for the period 1899 to 1907 inclusive. The total number of fires ascribed to lightning during this period is 5771, or 7.22 per cent of the grand total.

LEHIGH GRADUATES.—The probable number of graduates in June from Lehigh University is 128, distributed as follows: Electrical engineers, 18; electrometallurgist, 1; mechanical engineers, 28; civil engineers, 40; chemical engineers, 3; master of science, 6; bachelor of science in chemistry, 3; engineer of mines, 19; master of arts, 2; bachelor of arts, 8.

LISBON TELEGRAPHIC CONFERENCE.—The International telegraphic conference, which will be held in Lisbon, Portugal, beginning May 4, will have three representatives from the United States. These will be the Hon. Charles Page Bryan, United States Minister to Portugal; Mr. Roland R. Dennis, of the Department of Commerce and Labor, now located in Berlin, and a representative of the signal corps of the War Department.

NEW YORK STATE REGULATION OF TELEPHONES AND TELEGRAPHS DEFEATED.—The bill passed by the New York State Senate placing the telephone and telegraph under the jurisdiction of the Public Service Commissions was defeated in the House. The reason given by Speaker Wadsworth was that the passage of the bill would add unduly to the present work of the commissions. The influence of pool rooms was strongly exerted against the measure.

NEW PLANT FOR GOLDFIELDS.—The Nevada-California Power Company is installing an additional plant on Bishop Creek for the generation of electrical power for transmission to the southern Nevada gold fields, a distance of 120 miles. This will be the third plant on Bishop Creek, all using the same water. It will comprise three 2000-kw, 2200-volt, three-phase, 60-cycle, 300-r.p.m. generators, driven by overhung tangential waterwheels, supplied through a 48-in. pressure pipe 2800 ft. long, which in turn is supplied by a 48-in. woodenstave conduit 10,000 ft. long. The working head is 860 ft. The voltage will be stepped-up by six 1000-kw transformers to 55,000 volts for transmission.

CREOSOTES.—Messrs. Arthur L. Dean and Ernest Bateman, United States government experts in the Forest Service, have written an excellent discussion of the analysis and grading of creosote, which has been published by the Department of Agriculture as Circular No. 112. This circular contains a large amount of experimental data and presents conclusions that will prove of value to those interested in the preservation of pole lines. The present circular covers in detail certain subjects not so fully treated in circular No. 80, previously issued, dealing with the fractional distillation of coal-tar creosote, since the publication of which laboratory work on the composition of creosotes has been continued, and a considerable quantity of data has been gathered.

ELECTRIC TRUCKS FOR DOCKS.—The New York Dock Company, which controls almost all the docks on the Brooklyn water front, has displaced the old three-wheeled trucks heretofore used for carting material from the steamships to the storehouses by electric trucks. The old trucks were pulled by horses and aside from the slowness with which the work was performed, the item of dock repairs owing to the cutting action of the horses' shoes was considerable. The electric trucks carry three times as much as the horse-pulled trucks and do the work much quicker besides reducing the item of dock repairs to a minimum. Storage batteries are used, and one charge is said to furnish enough energy to operate the truck 10 hours.

GOVERNMENT ELECTRICIANS.—The United States Civil Service Commission announces an examination on May 13, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of electrician, $1,000 per annum, Quartermaster's Department at Large, Columbus Barracks, Ohio, and vacancies requiring similar qualifications as they may occur in any branch of the service. The duties of the specific position to be filled require thorough knowledge of and experience in house wiring, installation of electric lighting fixtures, and construction of pole lines; ability to read and test wattmeters and to care for and make slight repairs to transformers and arc lamps. The age limit is 20 years or over on the date of the examination. Applicants should apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at any place where civil service examinations are held.

WIRELESS TELEPHONY.—Advices from Paris of April 11 say: "For the last few weeks the French War Office has been experimenting at the Eiffel Tower with the system of wireless telephony invented by Lee de Forest, and this fact has been made known through the cable dispatches. But the success of the experiments and their scope have just been published. Sets of apparatus were installed at the tower, in the Fort of Mont Valérien, and at Villejuif, a southern suburb of Paris. The experiment for telephonic communication between Villejuif and the Eiffel Tower succeeded excellently. Mrs. de Forest, using the apparatus at Villejuif, spoke quite easily to her husband at the Eiffel Tower, more than six miles away. By means of the apparatus at the Eiffel Tower and in Fort Mont Valérien, a conversation was carried on at a distance of three and a half miles with equal ease. The experiments were carried on before several officers of the French army and navy.

Distribution of Niagara Energy in Auburn.

ALTHOUGH the longest transmission circuits in America are to be found in the Rocky Mountains, the fact remains that the longest distance over which energy is directly transmitted in this country is covered by circuits of the Niagara, Lockport & Ontario Power Company. These circuits serve for the direct transmission of energy 163 miles from the generating station of the Ontario Power Company, at Niagara Falls, while in the case of the long circuits in the Western States there are connected to the same system several generating stations from no one of which is energy transmitted normally over so great a distance. The many engineering features of the above-mentioned 163-mile transmission system were described in our issues for April 14 and July 21, 1906, and they need not be discussed in this article, which deals with the distribution of the transmitted energy.

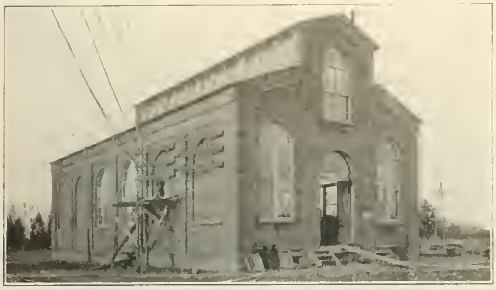


FIG. 1.—SUBSTATION, SHOWING ENTERING AND LEAVING WIRES.

One of the most interesting secondary systems for distributing the energy transmited from Niagara is located at Auburn, N. Y., where substation apparatus has been installed to supersede and supplement steam-engine driven generating apparatus. This substation is owned and operated by the Auburn Light, Heat & Power Company, which conducts business under franchises granted to the old Brush-Swan Electric Company. This company purchases energy according to a system of charge based on one-minute peak loads, so that it is advantageous for it to maintain a high load factor. For this purpose it has retained a large portion of the early steam-engine driven equipment for use during the period of maximum load. The efficacy of this set in reducing the peak load and thereby increasing the load factor, as may be imagined, is of greatest value.

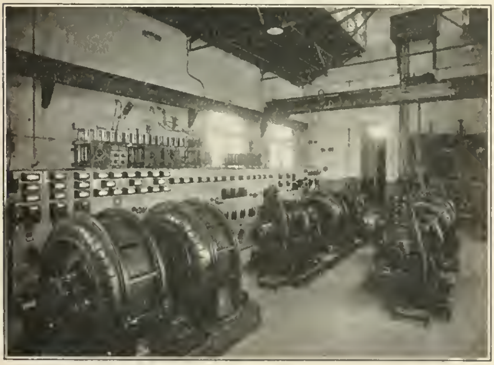


FIG. 2.—VIEW OF INTERIOR OF SUBSTATION.

The substation building is placed just within the city limits so that no high-voltage circuits are erected within the populated district of Auburn. Energy reaches this building over a single three-wire, 50,000-volt circuit mounted on wooden A-frame poles, as shown in Fig. 1. This circuit is a four-mile branch which is joined by means of open-air fuses and air-break switches to the main line from Niagara to Syracuse. The main line consists of two distinct circuits along separate routes; one of these is constructed of aluminum cables mounted on wooden A-frames along the West Shore Railroad, while the other consists of copper wires held on steel towers erected along private right-of-way. A view of open-air disconnecting switches on a double A-frame structure, a set of which is placed near the substation, is shown in Fig. 3.

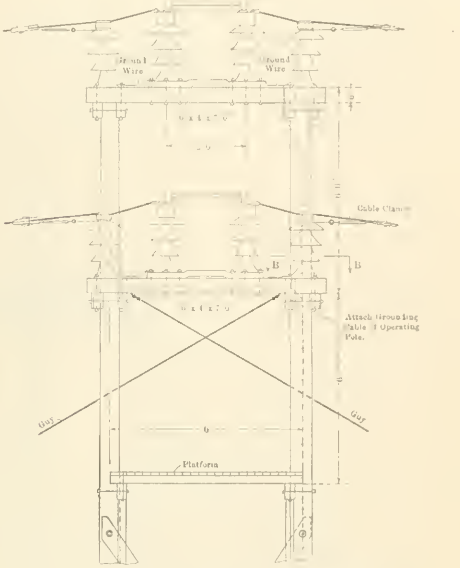


FIG. 3.—OPEN AIR DISCONNECTING SWITCHES.

The 60,000-volt circuits enter the substation building from sheltered line insulators through three tiles 4 ft. in diameter to insulators of the line type mounted within a special high-tension arrester and switch room. The lightning protection equipment consists of a star-connected low-equivalent arrester, the neutral being joined to ground through multigap arrester units. After passing through hour glass shaped choke coils the circuit continues as 1¼-in. brass pipe, which is used for mechanical strength and presents a very attractive appearance, to a three-phase, 60,000-volt oil-immersed, motor-operated remote-control switch built into a special concrete structure.

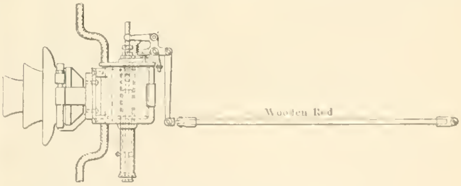


FIG. 4.—SELF-CONTAINED SERIES RELAY.

An interesting detail of the high-tension circuits is the series relay, illustrated in Fig. 4, for opening the oil switch on over load. In this relay there are combined maximum simplicity and minimum cost. It consists of a solenoid acting upon a plunger magnet which moves a lever for opening (indirectly) the main oil switch when the current exceeds a predetermined safe value. The lever is made of wood and serves for insulating the relay from the switch mechanism, but no attempt is made to insulate the relay from the main high-potential circuit.

The lack of high-voltage insulation in the relay mechanism accounts for the simplicity and cheapness mentioned above.

In each high-potential line there is inserted one hook-type knife disconnecting switch, so that each element of the three-pole oil-switch may be isolated in case repairs become necessary. The so-called "motor-operated" switch is, in fact, operated by springs which are released by trips, the motor serving merely to store energy in the springs. Thus a failure of the motor would not prevent the switch from being opened under overload. Moreover, the switch can be closed by hand in case of necessity. The central switch for operating the motor is mounted on the main switchboard described later, and energy for driving the motor is obtained from a storage battery.

The high-tension circuits terminate at the primary leads of three 500-kw transformers, Y-connected; the secondary coils of these transformers are △-connected and deliver energy to the main substation busbars at 2300 volts. Each of these transformers, which is located in its own concrete cell, is placed on a wheel-truck so that it may be disconnected from service and replaced by a similar transformer which is kept in a fourth cell as reserve. The secondary coils of the transformers are provided with a mid-voltage point so that synchronous motors may be started from rest at half-voltage.

A partial view of the interior of the machine room of the substation is given in Fig. 2. There are three 300-kw, 25- to 60-cycle frequency changers, each driven by a 2300-volt synchronous motor. The machines are started from rest by impressing one-half voltage across the armature circuit, as intimated above.

The substation equipment includes also six 6.6-Brush arc machines, each designed for operating 125 lamps in series. These machines are driven in pairs, through rubber-compression couplings by three 2300-volt motors. Two of these motors are of the synchronous type, rated at 150 kilowatts, and arranged for starting at one-half voltage. The third motor is a 200-hp induction machine provided with a coil-wound rotor so that resistance may be inserted during the starting period.

The direct-current apparatus consists of a 50-kw, 125-volt exciter direct-connected to a 2300-volt induction motor, a 30-kw Edison bipolar generator held as reserve for excitation, and a 200-kw, three-phase rotary converter for supplying energy to 500-volt, direct-current motors. The converter receives its energy from three delta-connected 2300-volt to 360-volt transformers, and is started from rest at half-voltage obtained from central taps on the secondary coils of two of the transformers.

For the operation and control of the substation machinery there has been installed a 22-panel blue Vermont marble switchboard, as shown in Fig. 7. The most prominent feature of this board is its simplicity, which has been obtained by locating all rheostats overhead, and all 2300-volt circuits in the

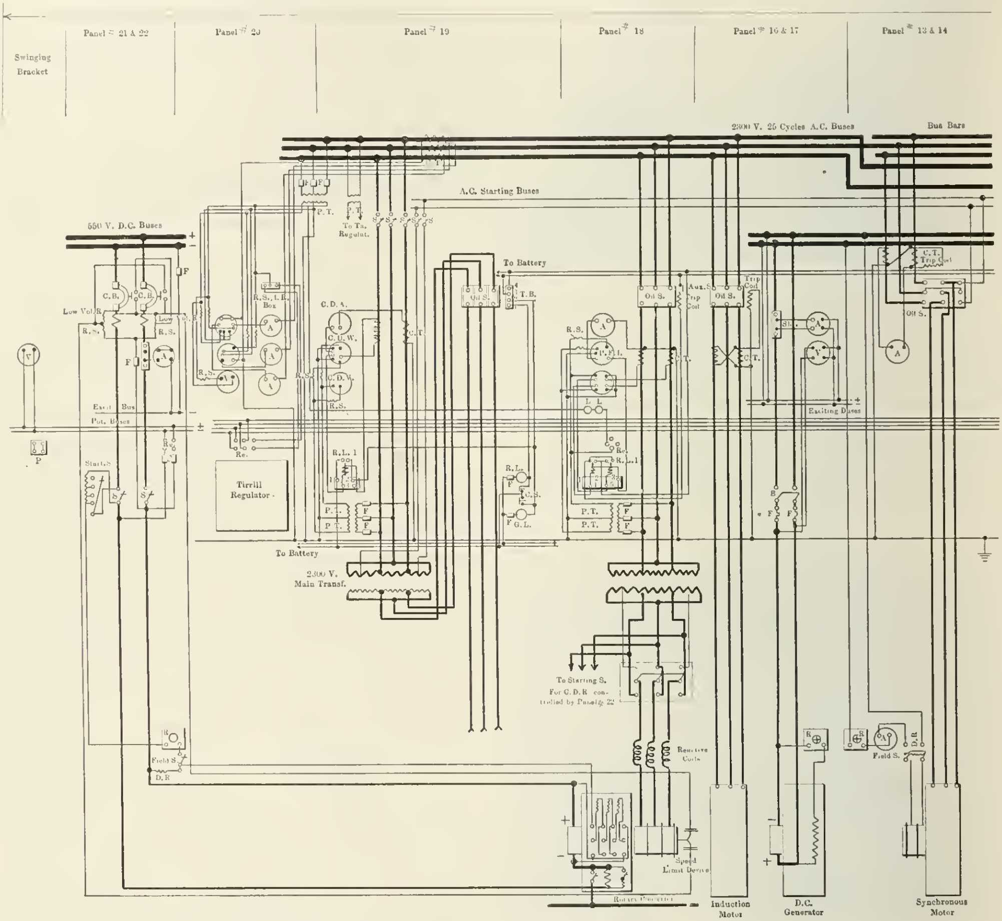


FIG. 5.—COMPLETE WIRING DIAGRAM OF SWITCHBOARD PANELS NOS. 22 TO 13, OMITTING NO. 15.

cellar below. The rheostats are operated by means of chain gearings and the main circuit switches by lever systems.

A Tirrill regulator serves for maintaining the voltage delivered by the 60-cycle generators at the desired value. On account of the presence of the synchronous motors and converters, the power factor of the load on the transmission system is wholly under control of the substation operator. The power factor is kept quite high, but no attempt is made to draw leading wattless current. In fact, it is recognized that stability of synchronous apparatus is best obtained by allowing the machine to draw a lagging current. No trouble whatever has been experienced with the synchronous machines during either the starting or the running period.

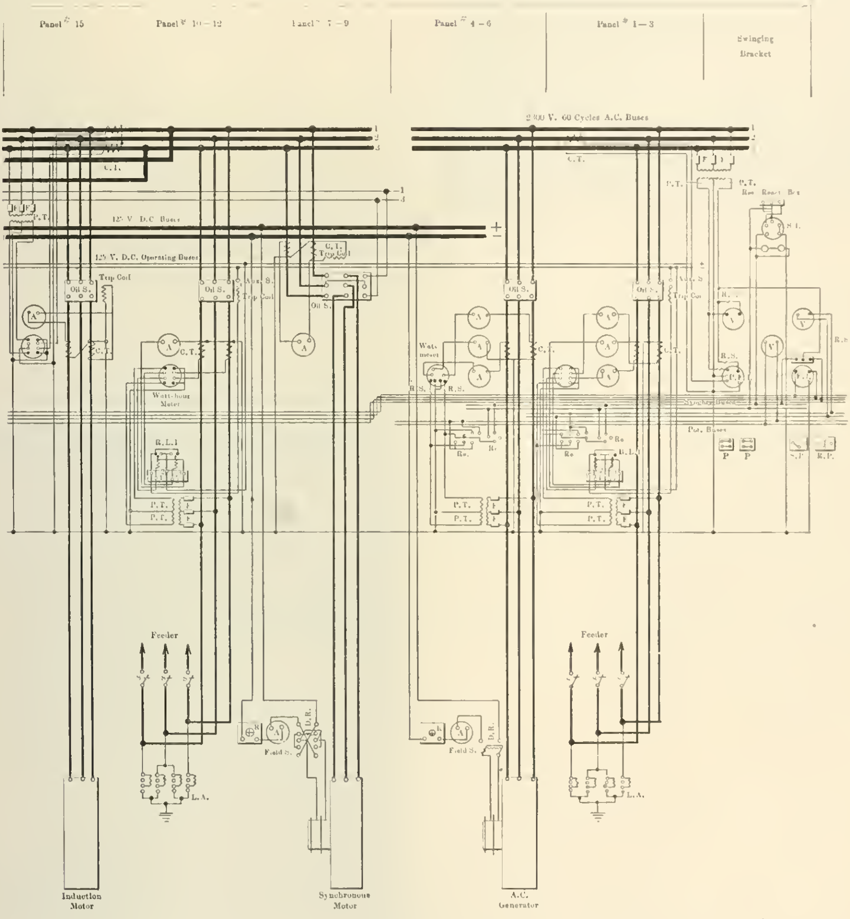


FIG. 6.—COMPLETE WIRING DIAGRAM OF SWITCHBOARD PANELS NOS. 15 TO 1, OMITTING NOS. 13 AND 14.

A complete diagram of the circuits of the substation apparatus, as viewed from the rear of the switchboard, is given in Figs. 5 and 6. On this diagram panels that are in duplicate are represented by a single panel. Energy reaches the board over 2300-volt busbars at 25 cycles and is distributed from the board directly at 2300 volts, 25 cycles, and over 2300-volt, 60-cycle and 300-volt direct-current busbars. The arc-lamp circuits are connected to a special distributing board, not indicated in Figs. 5 and 6.

The company has connected to its circuits 524 municipal arc lamps, for each of which it receives $68 per year. About one-sixth of these lamps are run on an all-night schedule, while the others are extinguished at 1 o'clock. It also operates a number of commercial arc lamps, 15 of which are effectively arranged over the center of the sidewalk along one block. The company has conducted an energetic and effective campaign to increase its commercial load and has secured contracts for illuminating a large number of signs and display windows.

The average 24-hour load on the whole system is about 350 kilowatts, while the maximum one-minute peak is kept slightly less than 700 kilowatts, so that the load factor on the substation exceeds 50 per cent. The reserve steam station, which assists during the peak load, has already been mentioned. This station contains a 500-kw, 60-cycle, 2300-volt alternator directly connected to, and mounted between, two Lake Erie vertical cross-compound condensing engines. Steam is taken from the exhaust of the high pressure cylinders for use in a heating system which the company maintains in the business portion of the town. Since there is always a demand for steam heat during the peak of the electrical load, the arrangement employed gives very satisfactory results. It has been found that almost no additional coal is required to supply energy to the generator than is necessary to furnish merely the live steam for heating. In other words the high-pressure cylinder is used simply as a reducing valve. The amount of load taken by the engines can be governed by the admission of steam to the low-pressure cylinders, so that by regulating the valves in the steam heating main and the low-pressure cylinder, sufficient load can be taken to give the required pressure on the steam main. Since the generator runs in parallel with the other machines, its load can be varied at will.

The Auburn Light, Heat & Power Company is owned by the American Gas & Electric Company, of which Mr. H. L. Doherty, of New York City, is president and Mr. H. T. Hartman, of Philadelphia, is vice-president and general manager. The superintendent is Mr. M. C. Turpin, under whose direction the improved apparatus has been installed. Mr. J. S. Wise, Jr., of Hazleton, Pa., formerly superintendent, acted as consulting engineer in connection with Mr. Hartman. The electrical equipment has been supplied by the General Electric Co.

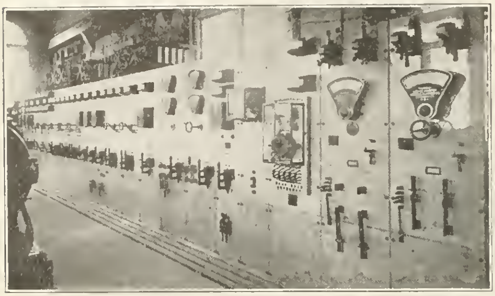


FIG. 7.—MAIN SWITCHBOARD IN SUBSTATION.

The Lighting of a Small Chicago Church.

The lighting of St. Paul's Evangelical Church, at Beverly Hills, a suburban district in Chicago, was recently overhauled and presents some new features of interest both to illuminating engineers and architects. In fact, it is a good practical example of the benefits to be derived from illuminating engineers and architects working in full harmony and co-operation with each other. The church is a small one, the floor dimensions being given in the drawing, Fig. 1. Consideration was at first given to the possibility of concealing lamps in box fixtures so that no direct rays could fall in the eyes of the audience. It was found, however, that in order to carry out this scheme properly a number of fixtures would have to be provided which would not look well in such a small church. The construction of the church seemed to call for a large central fixture. It was, therefore, decided to design a large wooden fixture which would be in keeping with the general interior finish and design. The design of this fixture and that of the choir-board, to be described later, were suggested and carried out by Mr. H. K. Holsman, architect of the church, in such a manner as to be entirely in keeping with the rest of the structure and in conformance with the requirements of the illuminating engineer.

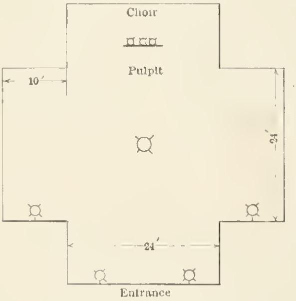


FIG. 1.—PLAN OF CHURCH.

This wooden fixture is shown in Figs. 2 and 3. It presents several advantages over a metal fixture in this case. It is more in harmony with the church interior than any metal fixture which could have been obtained at a price which would have been within reason for such a small building. Its finish corresponds with that of the rafters and ceiling. It was easy to make it of sufficient size so that it would not seem to be out of proper proportion. Its size also made it possible to obtain two advantages from an illuminating standpoint. One of these is that the lamps are brought nearer to the side wings, which receive part of their light from this chandelier, and the other reason is that the 48-cp lamps, with which this chandelier is equipped, are less trying to the eye if scattered over a large chandelier like this than if placed in a more compact cluster.

Inasmuch as it was not possible completely to screen the lamps from the eyes of the audience, the next best course was adopted, namely, to use frosted tip lamps and place them in deep bowl reflectors enameled white on the outside. The lamps are tungsten, of 48 candle-power, with frosted tips. The Holophane enameled bowl reflectors used are of a size larger than that usually specified for 48-cp tungsten or 40-cp Gem lamps. This larger size was selected in order more completely to cover the lamp than would the size commonly used with this lamp. The enameling of the bowl reflector, together with the frosting of the tip of the lamp, beautifully diffuses the rays so as to produce a handsome appearance and the minimum injurious effect on the eye. It is not as good for the eye as having the lamps entirely concealed, but is a fairly effective compromise, giving both good diffusion and fair efficiency. The loss of efficiency due to the enameling (if considered on the basis of the flux of light downward within a zone 73 deg. from the vertical) is estimated to be from 15 to 20 per cent.

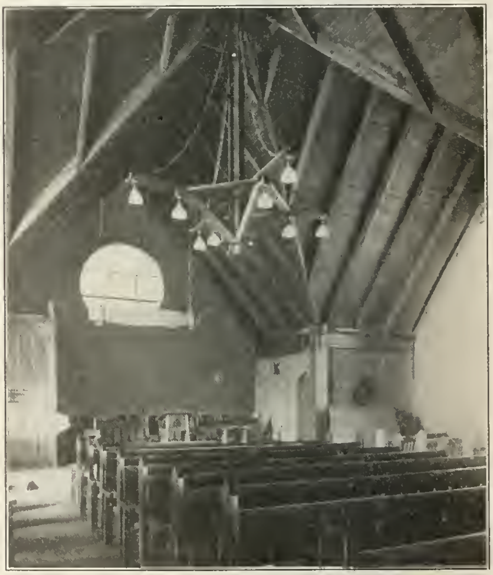


FIG. 2.—WOODEN CHANDELIER AND CHOIR LAMP SCREEN.

The lighting of the choir presented another problem which, at first, seemed difficult, since it was desired to conceal the sources of light altogether from the eyes of the audience and at the same time give ample illumination on choir and organ. Furthermore, since the organ is soon to be moved into an alcove which will be built back of the pulpit, the scheme had to be adapted both to the present position of the organ and to its future position. The architect came to the rescue with a plan which seemed at first rather radical, but which worked out to the satisfaction of all concerned, and is in full harmony with the surroundings. A board suspended in wooden slings is hung by chains 7 ft. from the wall, as shown in Figs. 2 and 3. Behind this board were placed three 40-cp lamps with prismatic reflectors. A section through this board and one of the lamps is shown in Fig. 4. The lamps are entirely invisible from the audience and there is a flood of light for the choir and organist. The lantern fixtures seen in Figs. 2 and 3 are part of a former lighting scheme, which has been abandoned because of its inefficiency, and because of the location of the lamps where they could not be avoided by the eyes of the audience. The cost of the two wood fixtures complete, ready for use, not including lamps or reflectors, was about $50. Of this, half was for the mill work and assembling, and the remainder for iron chains, electric wiring and supplies, and hanging and staining the fixtures. The fixture is of pine stained to match the other woodwork. The arms have a spreak of about 9 ft. The height of the lamps is about 14 ft. The lighting from the central chandelier is supplemented by lights on the rear walls of the wings and main part of the church. The total area of the church is 1536 sq. ft. To light this area there are 480 watts expended in the tungsten lamps on the central chandelier, and 700 watts in Gem lamps behind the choir board and on the rear wall. The total wattage is, therefore, 1180, or 0.77 watt per square foot. The illumination is ample to suit the most exacting, and the users are well pleased with the general effect.

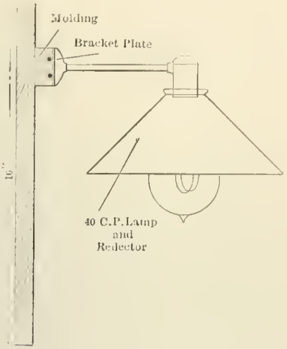


FIG. 4.—SECTION THROUGH BOARD OVER CHOIR.

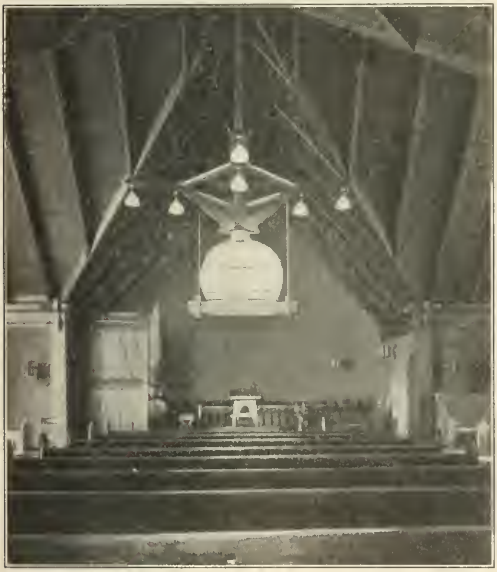


FIG. 3.—WOODEN CHANDELIER AND BOARD OVER CHOIR.

Capitalization of Public Utilities.

By Chas. M. Brown.

The quotation from the last report of the Interstate Commerce Commission in Mr. W. H. Winslow's article in the first issue of April states in official language a condition and not a theory. The quotation is: "We are aware that in the construction of new lines of railway, developing new territory, it has been necessary in many instances to sell railway securities at large discount and to sell bonds with stock bonuses, and, even in such cases, it has many times been difficult to raise the necessary capital."

To this quotation one might well add: "Furthermore, it will undoubtedly continue to be more than difficult to raise capital by other than these means for new ventures, for extensions and for rehabilitations, if the public is to secure the extension and improvement of service which is desirable at the minimum increase in fixed charges and hence at the minimum 'investment charge' in the rates."

But how contrary to popular belief it sounds to say that by stock watering the extension and improvement of public services is obtainable at the minimum increase in the "investment charge."

This raises the basic question involved in the regulation of the capitalization of public utilities. Assuming any given equipment and service, are the public, and especially the patrons of the service, most interested in having the par value of its securities not exceed its tangible assets, or are they most interested in having the total annual capital charges due to necessary investment for equipment and other facilities as small in amount as possible and hence but a minimum item in the costs making up the rate for service? Obviously their interest is primarily and directly in having the rate for a given service as low as possible. Other things being equal, this end is attained by having the amount of the annual capital charges as low as possible. Those of the public who are or may be users of the service are, therefore, interested in the question of capitalization only insofar as it may now or in the future affect the amount of the annual capital charges and the rôle they play as an item of the rate for a given service. Therefore, any legitimate means which will secure the investment money necessary for equipment and facilities for the smallest amount of annual capital charge now and in the future will best serve the public interest.

The popular theory is that only by limiting the par value of a given capitalization to an amount equal to the capital money put in can the value of the property be determined and the amount of annual capital charges kept down to a minimum commensurate with the investment. So popular interest is centered on the par value of capitalization instead of on the amount of annual capital charges, and without regard to the fact that the ways and means taken to prevent "stock watering," while keeping down the par value of capitalization, raise the amount of annual capital charges necessary to induce any investment and militate against the ready obtaining of additional money for investment whenever necessary.

That the theory that thus limiting capitalization makes it possible to see at a glance the value of a property is contrary to the facts is well shown by the present conditions of the public lighting companies in Massachusetts. There it has been applied for many years and has resulted in an extraordinary state of affairs. Presumably its object was to prevent values appearing as greater than investments. Practically its effect has been to reduce the total par value of securities very much below the investment they represent and which their sale secured. Thus, instead of the securities of a company indicating in their par value its tangible assets plus its present or prospective intangible assets or its total fair value, as is the usual commercial practice, the par value of Massachusetts public-lighting companies' securities usually represent but a fraction of their fixed tangible assets and do not in any way on their face allow for any intangible value. In fact, more than one instance exists where the par value of a company's securities is but one-half the cost and value of its fixed tangible assets, and where the total fair value of the company as a going concern is about three times the par value of all of its outstanding securities.

With such conditions as the result of arbitrarily limiting the par value of capitalizations, as shown in the only State where these theories have for a period of years been worked out to their inevitable conclusions, it is obviously impossible to look to any arbitrary method of limiting capitalizations as an automatic means of indicating values.

The second purpose of this theory, as previously suggested, would seem to be to keep down to a minimum the amount of the annual capital charge necessary to induce the investment of a given amount of money. Experience has shown that if the par value of capitalization is to be limited not to exceed the amounts of money actually invested, not only must securities never be disposed of below par, but also in the ordinary course of business relative equity to original and subsequent issue of securities demands that the latter be sold at some upset price above par.

To illustrate how this works, assume that a hundred dollars of capital is needed for which one share of $100 par value is issued and on which dividends are payable at the rate of 10 per cent or in the amount of $10 per annum. Observation of the idiosyncrasies of the investing public, the court of last resort for all investments, shows that it will practically without exception pay relatively more for low-priced, low-interest bearing securities than for high-priced, high-interest bearing securities. If one $100 share paying $10 per annum will sell for $100, two $100 shares each paying but $4 per annum would probably sell for at least $50 each. In other words, if we disregard the par value fallacy, which is the popular cry, $100 can be obtained at an annual cost of $8 instead of $10. And this is shown by the history of sound underwritings and reorganizations.

It would seem that failure to recognize these simple conditions has led to this fostering a system for capitalizing public utilities and obtaining the money needed in their equipment by the requirements of the public for service which militates against this investment money being obtained in the cheapest way.

But at this point it may be objected that while selling low-rate securities below par may be the cheapest way of meeting present needs for capital money, it is but mortgaging the future, since some day every share of stock of the par value of $100 sold for $50 and paying only $4 as interest will claim to be worth $100 and to be entitled to receive at least $6 as interest. It is obviously perfectly natural that these latter conditions should arise where public service companies are not subjected to continuous and detailed public supervision and control of an enlightened nature, but they are entirely unnecessary where such supervision exists.

If legislators and supervising commissions were to address themselves directly to the main feature affecting the rate for service in the capital question—the amount of annual capital charges currently necessary to secure the investment of any given amount of capital—instead of trying to reach this by the circuitous and inefficient means of limiting the par value of capitalizations, great improvements, both in public services and in their financing, might be expected.

Frankly admitting, as every clerk knows, that par values of securities have nothing to do with values and may understate values as well as overstate them, public supervisory officers should rather consider in detail the amounts of investment money represented at least in part by outstanding securities and the amounts of annual capital charges necessarily and properly payable for the investment and use of this money. Regulation and control of the relation of the total fixed charges or contractual payments and earnings to the amount of money invested would directly accomplish the end indifferently attained and with very great drawbacks by limiting capitalization. Untrammeled, the latter could then be adjusted to best meet the money market conditions, to obtain the maximum amount of investment money at the cheapest net rate.

Moreover, investors would undoubtedly be more inclined to buy low-priced public lighting securities at a present very low net rate of return if assurance was given that the return on these would increase in the future by the operation of some logical device like the "London Sliding Scale." Nor could the public object to such future increase in return when realized, as it would be, but the just reward coming to the company for cheapening and extending its service of the public.

Central Station Notes from Atlanta.

One of the most active central station business organizations in the South is that of the Georgia Railway & Electric Company of Atlanta. This company serves a population of about 150,000, its territory including Atlanta, Oakland City, Fort McPherson, East Lake, East Point and Decatur. The area of the district covered by the company's lines is about 15 sq. miles. On the first of this year the company's total connected load was 154,964 16-cp lamps or their equivalent, 1063 7.5-amp. series arc lamps, 518 series incandescent lamps, 1541 commercial arcs of the 5.5-amp. size, 4239 hp in direct current motors, and 2215 hp in alternating motors, with 289,795 sq. ft. of radiation on the mains of the steam heating system operated by the company.

The officers of the company are, president, Mr. P. S. Arkwright; vice-president and manager, Mr. G. W. Brine; secretary, Mr. W. H. Glenn. The operation of the system is under the jurisdiction of Mr. S. A. Redding, and the sale of light, heat, and power, with the supervision of the meter department, is under Mr. W. R. Collier. The company occupies a handsome office building of its own in the heart of the business district, the contract department being on the street floor with the gas and cashier's offices. On the upper floors are the executive offices and the engineering department. The inside furnishings of the building are of the permanent and substantial character found in banking houses. Liberal space was allotted on the first floor for the exhibition of new appliances in both the electric and the gas fields.

The power rates of the company begin with a 2-hp motor, the charge for the first 75 kw-hours being 6 cents, and all consumption in excess of this is at the rate of 3 cents. This charge for the different sizes of motors up to 10 hp continues with a variation in the number of kw-hours that apply to the higher rate per unit, so that at 5 hp the first 275 units are billed at 6 cents and at 9 hp the first 435. With a 10-hp motor the first 465 units are billed at 6 cents and all in excess of this at 2 cents. With a 25-hp motor the first 700 kw-hours take the 6-cent rate and the rest are billed at 2 cents. There is a net guarantee of $1 per horse-power per month. A discount of 10 per cent in allowed inside of 10 days from the date of the bill.

The lighting rate for an installation of from one to fifty 16-cp lamps is 10 cents for the first 150 kw-hours, with the excess at 6 cents. The primary rate of 10 cents holds as the size of installation increases, but the number of primary kw-hours gradually decreases in proportion to the connected load, so that with from 300 to 400 lamps connected, the first 800 units receive a rate of 10 cents, and the excess above this a rate of 6 cents. The minimum guarantee is $2 net per month up to 20 16-cp equivalent; above this 10 cents net is added for each 16-cp equivalent.

The sale of current for electric signs is on a flat rate, the charge being 15 cents per lamp per month, the lamps being of 2 cp each. This figure includes renewals. The purchaser buys the sign and puts on an automatic time switch. The signs usually burn four hours per night. Fans are put on a power rate and are rated at 1/5 hp per fan.

The company has installed a large number of Gem lamps in 50, 75 and 100-cp sizes, and it renews these free. Last year 513 electric flat irons were sold, weighing from 3 to 8 lb. The total connected heating load on electric circuits is now about 300 kw. Electric cooking devices are in use in two restaurants on the company's lines. Two notable electric heating installations are in binderies, where 18 kw of connected load are in service. There are 16 heaters in these establishments and the peak load of the concerns comes from 6.30 to 7 a. m. daily. This amounts to about 30 kw. The peak consumption is required to heat up the glue baths for the run of the day, and after the first heat is accomplished a low heat is run the rest of the day until 6 p. m., when the establishment shuts down for the night. This is a very desirable class of off-peak business.

In the power field the company has about half a dozen refrigerating-plant customers whose loads connected vary from 2 to 25 hp. Other power users of prominence are the J. K. Orr Shoe Company, 70 hp; the Dowman-Dozier Mfg. Company (tin and metal), 42 hp; the Kimball House, 117 hp; the Piedmont Hotel, 155 hp; Schlesinger-Meyer Bakery, 93 hp; Southern Spring Bed Company, 91 hp; *Sunny South* Publishing Company, 83 hp (individual motor drive); *Atlanta Constitution*, 103 hp; *Atlanta Journal*, 175 hp; National Duck Mills, 75 hp; Southern Saw Works, 80 hp; Atlanta Agricultural Works, 80 hp. The largest single-phase motor allowed on the company's lines is 5 hp.

The central portion of the city is supplied with steam heat from the company's power plant on Butler Street. There are about 156 customers for this service, which extends from Nov. 1 to May 1. Both flat and meter rates are in use by the company. To secure a meter rate a customer must have at least 400 sq. ft. of radiation. The minimum rate must exceed $8 gros per month, based on 200 lb. of steam condensed per sq. ft. of radiating surface per season at 80 cents gross per thousand pounds. The resulting rates are as follows:

80 cents per 1000 lb. for first 10,000 lb. per month.
70 cents per 1000 lb. for next 10,000 lb. per month.
60 cents per 1000 lb. for next 10,000 lb. per month.
55 cents per 1000 lb. for next 20,000 lb. per month.
50 cents per 1000 lb. for next 20,000 lb. per month.
45 cents per 1000 lb. for next 30,000 lb. per month.
40 cents per 1000 lb. for all above 100,000 lb. per month.

The flat rate is based on 600 lb. condensation per sq. ft. per season on the above scale. The company guarantees 1 lb. pressure at the service. The system is that of the American District Steam Heating Company and the pressure at the power plant averages about 9 lb. The distribution system consists of an interconnected set of mains starting from the Butler Street plant as a 14-in. and a 16-in line, and carried under the principal streets of the downtown district.

Electrical Developments at Chattanooga, Tenn.

Chattanooga, with its magnificent factory sites and superior railroad facilities, has been growing rapidly as a manufacturing center for some years and the promise of the completion of the Tennessee River water power development at Hales Bar, 12 miles from Chattanooga, within two years, promises a still more rapid future growth.

The Chattanooga Electric Company, which controls the present central-station lighting and power business, rebuilt its steam plant in 1904 and installed 2000 kilowatts in 2300-volt, 60-cycle, three-phase Curtis turbo-alternators, high-pressure water-tube boilers with superheaters, Worthington condensers and a system of spray nozzles for cooling circulating water. Since that time the capacity of the plant has been doubled and plans for a further increase are now under way. This rapid development, while largely to keep pace with the rapid growth of its lighting business, is in a greater degree due to the power requirements of its customers.

The largest customer is the Chattanooga Electric Railway Company, operating the consolidated railway lines, and 2300 kilowatts of direct-current power are now supplied through rotary converters, entirely from the electric company's station. As high-tension distribution will be more economical, substations will be established by the railway company to meet its growing demands.

While there is a direct-current, 500-volt power circuit in the retail section, the principal power customers are on the special three-phase high-tension circuits. The largest customer at this time is the American Brake Shoe & Foundry Company, which requires 300 horse-power.

The policy of the company is to take all new business on a combined service and meter rate. Very little difficulty is experienced in demonstrating to customers that the company can make the lowest possible rate in this manner. The general rate is $18 per hp year on the customer's demand and 2½ cents per kw-hour for actual consumption of energy, but a reduction is made in the service charge for off-peak use and in the meter rate for wholesale use, the maximum discounts reaching 30 per cent. The average cost per annum to all power customers on the December, 1907, figures is under $20 per horse power connected.

The company has given its lighting customers the benefit of reduced operating costs, and on May 1, 1907, reduced the rates for lighting to 12½ and 6½ cents per kw-hour, less a 5 per cent discount for prompt payment within 15 days. The high initial rate is charged for the first kw-hour per month per 25 watts of connected load, and beyond that the lower rate goes into effect. This is subject to general rules modifying the application to residence lighting. A considerable amount of flat rate sign, window and outline lighting is in use. About 60 signs are in use, many of which contain several hundred lamps each.

The manufacturing interests of Chattanooga are ably represented by the Chattanooga Manufacturers' Association, having some 130 individual members and listing some 240 different manufactured articles. This organization in its general care for the interests of members is greatly interested in the cost of power, which recently led the Chattanooga Electric Company to propose a series of tests of steam plants by outside parties, representative manufacturing plants to be picked by the association. The proposal was accepted and seven factories named.

Arrangements were made with Professor Ferris, of the University of Tennessee, to supply a corps of professors and students for the work, and the tests were made during the month of October. The manufacturers, in their anxiety to have a good load, planned, in most cases, to work their factories at greater than the average output and thus considerably lessened the apparent cost of power per hp-hour through a material improvement in load factor. The actual cost of plant, the labor, oil and waste and engine-room supply figures were not in most cases available at the time of the test and were generally estimated. Slide-valve engine plants with return tubular boilers were estimated to cost $30 per indicated horse-power, and high-grade Corliss engines, with water-tube boilers, etc., $60 per indicated horse-power. Interest was figured at 6 per cent, depreciation 5 per cent, repairs 1½ per cent, insurance and taxes 2½ per cent, making a total annual charge of 15 per cent for these items. In the plant showing the lowest cost there was an item of slabs from a saw-mill on the premises and a large steam pump which could not be indicated, bringing in elements of uncertainty.

It is a matter of general regret that actual figures on cost of plant, repairs, labor and supplies were not available for the original report, and that the operating conditions were not more normal to add to the commercial value of the data, by showing more closely the actual operating costs. It is hoped the tests may be repeated at a future date with such figures available, but in the meantime the results obtained, while indicating a possible minimum cost, are of great practical value. The figures which were given to the local press in Chattanooga and were published in circular form by the Manufacturers' Association, are given in the accompanying tabulation, omitting the names of the plants tested.

It should be borne in mind that the costs are in indicated horse-power and that engine, dynamo and belt and shaft transmission efficiencies should be taken into consideration for comparison with electrical power for distribution to individual motors. In the case of the plant showing the lowest cost per indicated horse-power in the table, the annual cost per switchboard kilowatt for 10 hours, 300 days per year, is given in the report as $40.

In this connection it may be well to call attention to the fact that ordinary central-station conditions of service involve a reserve capacity equal to the largest unit regularly in service, which in a private plant means 25 to 50 per cent and sometimes 100 per cent or more increase per indicated horse-power on the investment charges; while by doing away largely with belting and shafting it was estimated in one of these tests the demand for power would be cut down over 40 per cent.

Boilers and Engines	Water Tube, 145 lbs. Pressure, and Corliss, 20 x 36, No. 1.	Water Tube, 145 lbs. Pressure, and Corliss, No. 2.	Return Tubular, 87 lbs. Pressure, and Corliss, 16 x 30.	Return Tubular, 110 lbs. Pressure, and Corliss Type, 24 x 48.	Return Tubular, 100 lbs. Pressure, and Corliss, 22 x 46.	Return Tubular, 95 lbs. Pressure, and Slide Valve, 11 x 13.	Return Tubular, 80 lbs. Pressure, and 2 Slide Valves, 10 x 10 and 10 x 12.
Length of run	10½ hours	24 hours	10.6 hours	12 hours	9¾ hours	10.16 hours	9.51 hours
Av. r.p.m.	118	93.3	120	79	70	154.5	150.3—159.1
Av. mean eff. pressure h. e.	51.7 lbs.	42.2 lbs.	38.8 lbs.	49.36 lbs.	30.7 lbs.	17.2 lbs.	18.6—10.5 lbs.
Av. mean eff. pressure c. e.	50.3	38.9	34.3	49.91	30.2	17.5	18.99—10.20 lbs.
Total horse-power	340	201.1	131.8	422	193.9	16.6	....
Total hp. hours developed	3,570	4,366.6	1,395	5,107.6	1,890	107.5	183
Total coal used	10,683 lbs.	13,751 lbs.	5,304 lbs.	19,423 lbs.	12,020 lbs.	2,194 lbs.	2,696 lbs.
Coal charged to engine	9,180	....	4,691 lbs.	....	10.680 lbs.	....	....
Coal used per hp. per hr	2.57	3.15	3.56	3.85	5.6	13.1	14.7
Cost of coal per hp	3½ cents	....	3.8 cents	4½ cents	5 cents	9.6 cents	....
Total ash	461 lbs.	2,229 lbs.	490 lbs.	....	2,426 lbs.	492 lbs.	....
Per cent ash	4.3	16.2	9.24	....	20.2	22.5	....
Total water used	85,000	....	....	....	....	....	....
Apparent evap. per lb. coal	7.93	....	....	....	....	....	....
Eff. of engine and dynamo	81 per cent	....	72 per cent	....	....	....	....
Cost of hp. per year	$24.15	$45.00	$26.88	$25.48	$28.90	$68.62	$75.14

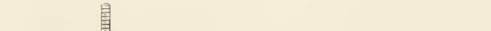
The staff of the Chattanooga Electric Company is Mr. W. E. Boileau, general manager, and Mr. F. W. Lawrence, general superintendent. The new business department is in general charge of Mr. R. C. Holley, and Mr. C. T. Reiss is in general charge of power soliciting.

Direct Current Motors—Their Action and Control—VII.

By F. B. Crocker and M. Arendt.

The article in the first issue of April dealt with the problem of shunt-motor speed control by variation of the field-exciting current; this article is descriptive of those methods of speed regulation which depend upon the *variation of the reluctance of the magnetic circuit*, being based upon the fundamental fact that:

$\text{flux} = \frac{\text{magnetomotive force}}{\text{reluctance}}$. Thus, if the m.m.f. be maintained constant and the reluctance be varied, we obtain a variable flux, and because $\text{r.p.m.} = \frac{e\,10^8\,60b}{\phi n 2p}$ it is evident that the speed varies inversely as the flux (ϕ). Among the earlier methods tried were those of T. A. Edison and the Diehl Company.



FIGS. 1 AND 2.—METHODS OF VARYING RELUCTANCE OF THE MAGNETIC CIRCUIT.

Edison's Variable Reluctance Method.

The reluctance of the magnetic circuit in this instance was varied as shown in Fig. 1 by decreasing the amount of metal in the yoke of the machine, the wedge-shaped piece, *A*, being raised, thus decreasing the total flux. The range of speed is not very great, as excessive sparking develops when the field is weakened because there is no feature of design to prevent flux distortion. This method was primarily intended for voltage regulation in connection with generators, and is of historical rather than commercial importance.

The Diehl Method.

In this instance the flux reduction was obtained by lengthening the air-gap, the pole pieces which were mounted on hinges, being moved away from the armature as indicated in Fig. 2. This construction was not very successful and was, like the preceding one, originally intended as a means of regulating the voltage of generators.

The two modern methods of speed control by variation of reluctance are those of the Stow Electric Company and the Lincoln Manufacturing Company.

The Stow Variable-Speed Motor.

This design* also depends upon the removal of iron from the magnetic circuit, the pole cores being made hollow and provided with iron or steel plungers, the position of which is adjustable through worm gears and pinions operated by a large hand wheel. (Fig. 3.) When the plungers are withdrawn, the total flux decreases due to the lengthening and re-

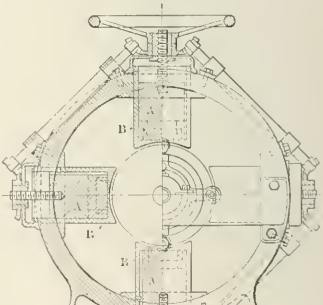


FIG. 3.—STOW VARIABLE SPEED MOTOR.

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*U. S. Patents Nos. 666,315 and 672,419, January and April, 1901.

duction of area of the effective air-gap and also the decrease of effective metal in the field cores. The flux is now along the polar edges (in varying degree according to the position of the plungers), the field for commutation is maintained strong, and sparking thereby prevented. The concentration of flux at the polar edges is well shown by the flux distribution curves (Fig. 7) of this machine. It is also a fact that since metal is removed the effect of armature reaction for a given current is reduced because the reluctance of the path of the armature flux is increased. The data of a 3 to 1 adjustable-speed 4-hp motor of this type are as follows:

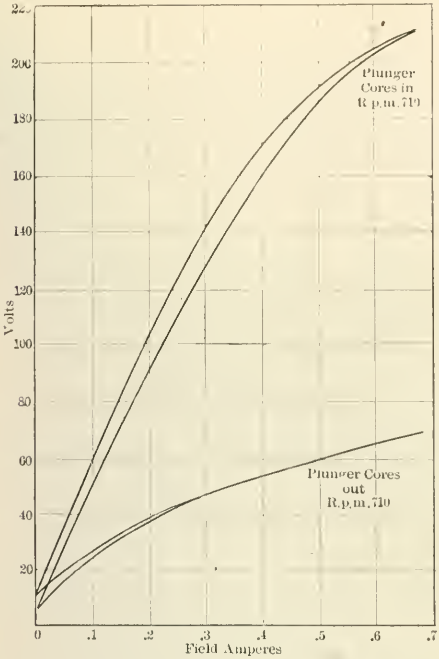

FIG. 4.—MAGNETIZATION CURVES OF 4-HP STOW MOTOR.

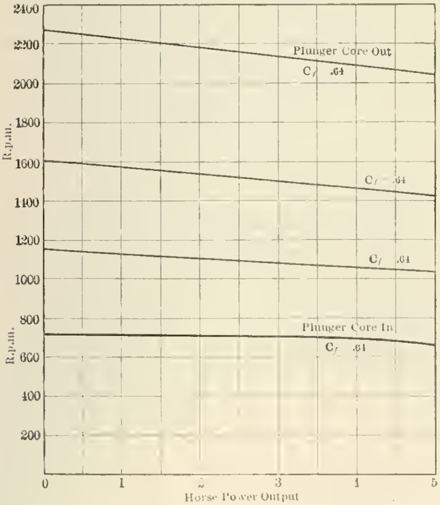

FIG. 5.—SPEED-LOAD CURVES OF 4-HP STOW MOTOR.

Rated pressure, 220 volts.

Armature current at rated load, 16.75 to 17.0 amperes, depending upon the speed.

Field current, .64 ampere.

No-load armature current, 1.3 to 2.2 amperes, depending upon the speed.

Field resistance, 344 ohms.

Speed, 700 r.p.m. min. to 2100 r.p.m. max.

Weight, 800 lb.

Its operation under various loads and speeds is shown in the curves, Figs. 4, 5, 6 and 7, which are, respectively, magnetization, speed-load, efficiency, flux distribution and curves.

The Lincoln Variable-Speed Motor.

The variation in reluctance of the magnetic circuit of this design* is obtained both by lengthening the air-gap and by decreasing its effective area. The armature is formed as a truncated cone with corresponding polar surfaces as represented in Fig. 8. The armature is movable in the direction of its axis, so that movement one way increases the length of the air-gap, thus decreasing the flux and raising the motor speed.

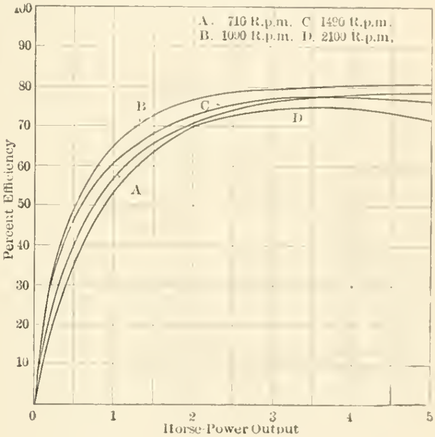

FIG. 6.—EFFICIENCY CURVES OF 4-HP STOW MOTOR.

The characteristic working curve of a machine of 10 horse power and 5 to 1 speed range are given in Figs. 9 and 10, being those of speed-load and efficiency at various loads, respectively. The principal objections to this design are the extra space required for the armature and the large force required to move it. The flux distribution curves of the motors are similar to those of ordinary single-speed machines, the distortion at high speeds being limited on account of the increase of air gap length. However, to ensure sparkless operation at the high speeds, interpoles in series with the armature are employed.

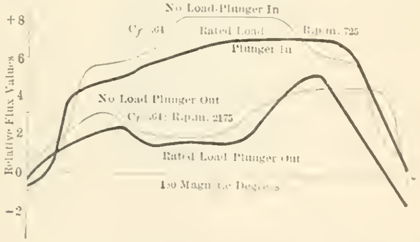

FIG. 7.—FLUX DISTRIBUTION OF 4 HP STOW MOTOR.

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*U. S. Patent No. 829,974, September, 1906.

Multi-Voltage Speed Control.

The remaining methods of direct-current shunt motor speed control differ from those heretofore given in that they depend upon variation of the impressed voltage, and are therefore called *variable* or *multi-voltage* systems in contradistinction to the *single* or *constant voltage* systems already described. In other words, the speed variation is due to changes *external* to instead of *internal* with respect to the motor. The following methods also differ in the fact that they can produce a *constant torque* in place of a *constant output* in horse-power. The general classification of these constant torque methods is as follows:

d. Armature rheostat—already described.
e. Multiple voltage (multiple-wire) systems.
f. Motor-dynamo control.
g. Boost and retard system.
h. Teaser system.
i. Double armature methods.
j. Variation of number of poles.

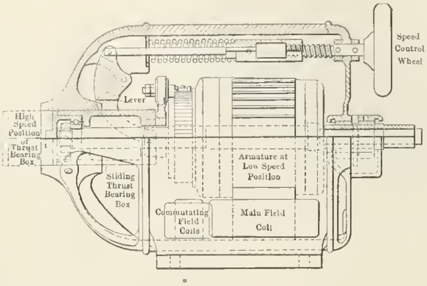

Speed Control Wheel
Lever
High Speed Position of Thrust Bearing Box
Sliding Thrust Bearing Box
Armature at Low Speed Position
Commutating Field Coils
Main Field Coil

FIG. 8.—LINCOLN VARIABLE SPEED MOTOR.

The latter methods, i and j, are constant-torque, but single-voltage supply systems. Nevertheless, in all these types the voltage available for a given armature is varied or an equivalent effect is produced.

In the discussion of the relation between speed and c. e. m. f. it was shown that if other conditions remain constant, the speed varies directly as the c. e. m. f. If we now examine the equation $V = c.e.m.f. + (I_aR_a + D_b)$ it is evident if I_aR_a and D_b are very small with respect to the c. e. m. f. (as is usually the case with an efficient motor) that increase in V will produce, at constant torque, a nearly proportionate increase in c. e. m. f., or a variation of impressed e. m. f. produces a practically proportional change in speed. This is the principle of adjustable or multi-voltage systems.

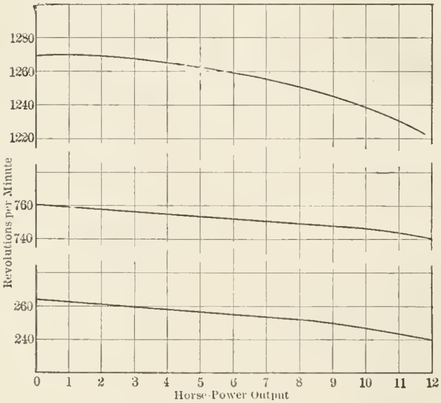


FIG. 9.—SPEED-LOAD CURVES OF 10-HP LINCOLN MOTOR.

Three-Wire Systems.

The simplest multiple-voltage system is the ordinary three-wire circuit, with 115 volts between either outer and the neutral conductor, and 230 volts between the outer conductors. Thus a 230-volt shunt motor connected so that its field winding is supplied with 230 volts and its armature with 115 volts develops a certain speed, X. If the armature terminals are then connected to the 230 volt supply, the speed will be approximately $2X$. The two efficient or running points are one-half and full speed, while those intermediate may be obtained by the introduction of armature rheostat or "field-weakening" control. Assume the 10-hp motor, the data of which were given in the first issue of December, having armature resistance, hot, .28 ohm; brush drop at rated load, 1.4 volts; armature current at rated load, 37 amperes; voltage, 115 and 230.

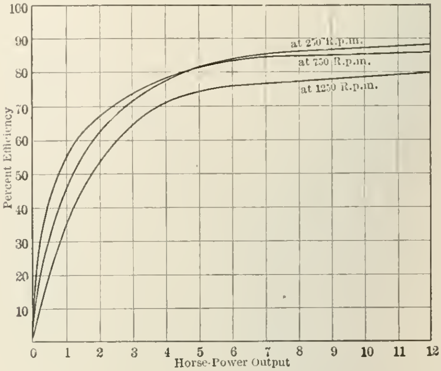


FIG. 10.—EFFICIENCY CURVES OF 10-HP LINCOLN MOTOR.

$IR + D_b = .28 \times 37 + 1.4 = 11.8$ volts. With $V = 115$, the c. e. m. f. is $115 - 11.8 = 103.2$. With $V = 230$, the c. e. m. f. is $230 - 11.8 = 218.2$.

Hence the speed ratio at these voltages is as 103.2 : 218.2, or nearly a 1 to 2 speed change. The objection to this method is that while three wires are necessary, only two running speeds are obtained. An additional speed could be secured from an unsymmetrical three-wire system, *i. e.*, one in which one of the sides has a voltage of x and the other side a voltage of $2x$; but even then only three running speeds corresponding to $x:2x:3x$ could be obtained with three wires. To obtain a much greater range with only one-third larger number of wires, the four-wire systems were developed, and these will be considered in the next article.

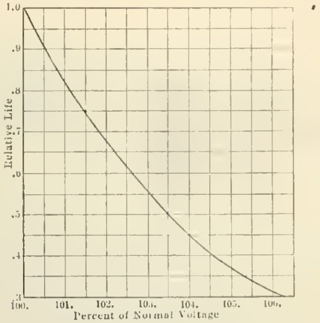
The Choice of Transformers for Central Stations.

By L. A. Starrett.

During the last few years, the central-station manager has chosen his transformers according to the arguments that have been put forth by the manufacturer's representatives, and of late these arguments have been invariably along the line of low-core loss and high all-day efficiency, irrespective of other valuable points that have been entirely overlooked in the mad rush toward that end. It must be admitted that a low-core loss is desirable, but only when the copper loss has been determined for that particular core loss; and it is the intention of this article to show in plain dollars and cents that the stand taken by three-fourths of the central stations is entirely wrong.

Since the average central-station load is made up largely of incandescent lamps, a transformer with the best possible regulation should be used and this transformer is *not* the one with the high all-day efficiency. The arguments in favor of the transformer with a low-core loss were along the line of lower operating cost because of the reduced-core losses, which in some cases amounted to hundreds of dollars annually.

Since for high all-day efficiency low-core loss is absolutely necessary, the copper loss must be relatively high. Take for example a 10-kw high-efficiency type. The core loss will be approximately 100 watts and the copper loss 150 watts. The low-efficiency type will have a core loss of about 125 watts and a copper loss of 130 watts. The full-load efficiency of the first transformer will be $\frac{10,000}{10,250}$ or about 97.56 per cent, and of the second, $\frac{10,000}{10,255}$ or about 97.51 per cent. Estimating 4 hours full load and 20 hours no-load the all-day efficiency is 93.02 per cent for the former and 91.91 per cent for the latter type—apparently a very favorable showing for the high-efficiency type.



VARIATION OF LIFE WITH CHANGE IN VOLTAGE.

As the copper loss of the second transformer is less than that of the first, the per cent regulation will be less, since the regulation is merely the ohmic drop across the winding; and the regulation will be proportional to the copper loss, neglecting a slight difference due to the different number of turns and the length of mean turn. In the present case, the regulation of the high-efficiency type will be approximately 1.60 per cent, and for the low-efficiency type 1.50 per cent, and this means increased length of life for the lamps.

For purpose of illustration assume that the central station in question is operating 100 10-kw transformers and is able to produce energy for 1 cent per kw-hour. The cost of supplying the increased core loss for one year will be

$$\frac{365 \times 24 \times 100 \times (125 - 100)}{1000} \times 1$$

or $219.00. In the past this item has been the only one that has been considered, and it should be offset by the saving due to better regulation and the decreased cost of the transformer and the corresponding saving on the investment.

If the full-load e.m.f. of the transformers is 110 volts, the no-load e.m.f. of the first transformer will be 111.76 volts, and of the second, 111.65 volts. If 112-volt lamps are used to avoid burn-outs when the voltage is high with only a small number of lamps in use, the consumer is getting only about 14 candle power when all the lamps are in service. If the central station supplies 110 or 111-volt lamps, the question resolves itself into more renewals, but satisfied consumers. If the central station is supplying 110-volt lamps and is renewing on the basis of 600 hours at 100 per cent of normal voltage, the first transformer would cause the smaller number of lamps to operate at 101.6 per cent of their normal voltage, and they would have to be renewed at the end of about 441 hours. The second transformer would operate the smaller number of lamps at 101.5 per cent of their normal voltage and their life would be about 447 hours.

The 100 10-kw transformers are supplying energy to 20,000 lamps, and if they are renewed at the end of 441 hours, they must be renewed $\frac{365 \times 4}{441}$ or 3.31 times per year; the second transformer gives a useful life of 447 hours and this requires $\frac{365 \times 4}{447}$ or 3.27 renewals, a saving of 800 lamps per year. Estimating the lamps to cost 18 cents each, to cover the testing, renewing, time, labor, etc., there is a saving of $144. The low efficiency transformer costs less than the high efficiency type, the saving in first cost being $1,000, and allowing 15 per cent on the investment, there is $150 per year, which added to the $144 from less renewals, making a total annual saving of $294, from this must be taken $219, which is the cost of supplying the increased core loss, showing a net saving of $75. These figures are variable because the total number of lamps saved on renewing might be less than the 800, because not all the lamps would be in use when the voltage was at the higher point.

Assuming the plant to operate only 12 hours per day, the total saving would be more because the cost of the additional energy would be cut in half. Thus it has been shown that the low all-day efficiency is not economical, and that the best service and cheapest operation are gained by buying the transformer with the best regulation. Even the temperature rise is not a vital point, because the transformers operate at full load for only a small part of the time.

Electrically Operated Switchboards—II.

By S. Q. Hayes

PANELS, pedestals and control desks having been described in the previous article, circuit-breakers, switches and auxiliary apparatus operated from the panels, etc., will be taken up for consideration. The apparatus may be considered under the following headings: General features of electrical operation; electrically operated oil circuit breakers; electrically operated carbon circuit-breakers; electrically-operated field switches; electrically operated field rheostats, and auxiliary apparatus. While it will be obviously impossible to go very thoroughly into all of the subjects covered by these headings, it is the intention to touch briefly on the most prominent features

GENERAL FEATURES OF ELECTRICAL OPERATION.

The earliest electrical power plants containing a few machines of small output and moderate voltage were easily controlled from switchboards where all of the switches, meters, etc., were placed on panels. As the voltage and output increased it became necessary to utilize more space for the switching devices and to operate them by mechanical means from a central point. When the plant of the Niagara Falls Power Company was installed, the 5000-hp generators required switches of such size that hand operation was impossible and the switches were worked by compressed air The plants of the St. Lawrence Construction Company at Massena, N. Y., and the Kingsbridge and Metropolitan stations of the Metropolitan Street Railway System in New York City adopted an electro-pneumatic type of control for the circuit breakers. Since that time, practically every large station has installed the straight elec

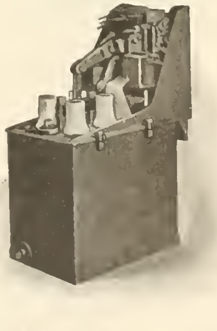


FIG. 1.—TWO-POLE CIRCUIT-BREAKER

trical control operating the circuit-breakers, rheostat face plates, etc., by direct-current solenoids or motors.

Most of this apparatus is designed for use on a 125-volt direct-current circuit, although 250, 550 or any other available direct-current voltage can be used. In generating stations the exciter bus is often the source of the direct-current supply, but, where a regulator is employed that causes the voltage of this bus to fluctuate, it is often advisable to install a small storage battery of about 40 ampere-hours rating in order to have a constant, operating voltage. This battery can be charged from one of the exciters, a small motor-generator set, or by using suitable resistances from a trolley or other direct-current circuit.

Where for any reason it is not desired to install a battery and it is necessary to operate the devices from an exciter bus with fluctuating voltage, the solenoids or motors can be specially designed to saturate at the lowest direct-current voltage, so that the increase in voltage will not materially increase the pull of the solenoid or the speed of the motor.

In rotary-converter sub-stations, the circuit-breakers, etc., are often designed for operation from the 550-volt direct-current bus, and if the station has been completely shut down, the first one or two circuit-breakers must be closed by hand. A small battery can often be used to advantage in such a station and may be charged through a resistance from the railway bus. In transformer substations a small battery charged from a 5-kw motor-generator set is nearly always installed.

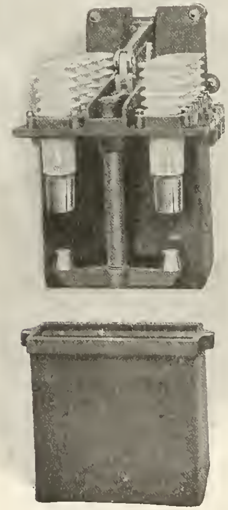


FIG. 2.—FOUR-POLE CIRCUIT-BREAKER.

From time to time, it has been proposed to operate the various devices from alternating-current circuits, and while induction regulators are sometimes operated by small alternating-current motors and special circuit-breakers, such as those for the overhead trolley lines of the New York, New Haven & Hartford Railroad, have been operated from alternating-current solenoids, the direct-current operation is so much cheaper and the additional complication due to its use is so small that operation on alternating-current circuits has made very little headway.

With distant-control apparatus it is necessary for the operator to know whether the apparatus has actually closed or opened or performed the function assigned to it. Some very ingenious methods of signaling have been designed. For a circuit-breaker of any sort, a mechanically-operated switch is usually provided and this switch is thrown from one position to the other by the movement of some part of the mechanism of the main circuit-breaker. A certain amount of lost motion is usually provided so that unless the circuit-breaker goes all of the way in or out the position of the signal switch is not altered. From these signal switches, circuits are run back to the switchboard to operate electro-mechanical indicators, signal lamps or some other similar device. These indicators or lamps are often arranged to form part of a miniature bus circuit to show the connections that have been made by the circuit-breakers.

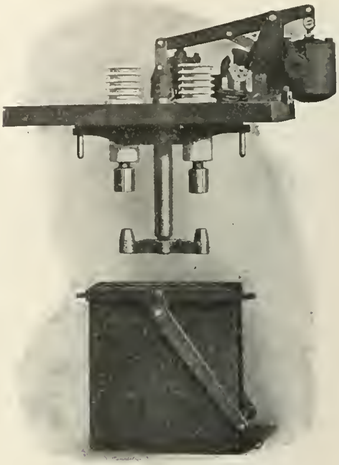


FIG. 3.—SINGLE-POLE OF CIRCUIT-BREAKER.

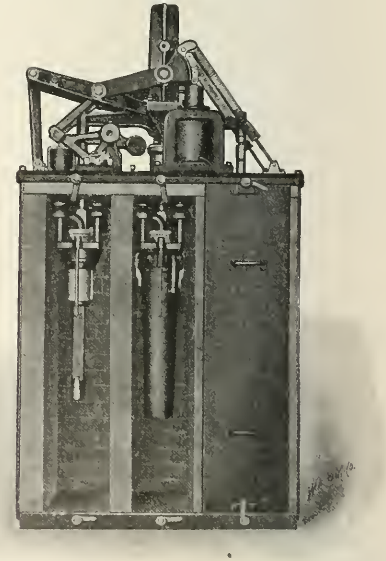


FIG. 4.—OIL CIRCUIT-BREAKER.

In addition to the indicator or the pair of red and green lens signal lamps, that show whether a circuit-breaker is open or closed, a lamp is often supplied that will light up only when a circuit-breaker has been tripped out automatically, but will not be illuminated if the circuit-breaker has been intentionally tripped by the operator at the switchboard.

Where motor-operated, rheostat face-plates are used, a device is placed on the face-plate that closes the circuit of an indicating lamp on the switchboard when the arm is bridging two contacts. With motor operated governors, induction regulators, valves, etc., lamps are sometimes provided on the switchboard and so connected that they will light when the motor has reached the limit of its travel in one direction or the other. Similar signaling devices have been designed to take care of all of the conditions arising in power plants of various kinds.

ELECTRICALLY-OPERATED, OIL CIRCUIT-BREAKERS.

The terms "oil switch" and "oil circuit-breaker" as used by various manufacturers are practically synonymous, although some makers draw different distinctions between the two pieces of apparatus. In this article the name "oil circuit-breaker" is used as covering a device for opening the circuit under oil with any condition of overload that may exist at the time. These circuit-breakers may be either automatic or non-automatic and the automatic ones may be provided with relays for overload, underload, reverse power, etc., which may be made instantaneous, adjustable time limit, inverse time limit, etc.

Practically all of the small electrically-operated circuit-breakers employ solenoids, while with the larger circuit-breakers some of the manufacturers use solenoids and others use motors. Each type has advantages claimed for it, and as it is impossible to describe all of the electrically-operated circuit-breakers made by all of the manufacturers in the space of a short article, the practice of one particular manufacturer using solenoid operation throughout for circuit-breakers of 2500 kilowatts rating to those of 200,000 kilowatts will be described.

As the type of circuit-breaker to be employed depends on the amount of energy to be handled, the question of the ultimate breaking capacity of an oil circuit-breaker is one requiring very careful consideration.

With a non-automatic circuit-breaker, such as is usually employed on generator circuits, the chances are very remote that such a piece of apparatus will ever have to open very much more than the overload capacity of the generator or, at the worst, the amount of energy it can develop under short-circuit conditions. With an automatic circuit-breaker, however, which will trip out, due to an overload or short circuit on a feeder, it is possible in some cases to have the entire energy of the station concentrated on that short circuit and opened by the circuit-breaker. The momentary energy at the point of trouble may far exceed that which the machines could continuously develop even under short-circuit conditions, so an automatic circuit-breaker has exceedingly severe conditions to meet. While it is practically impossible to calculate the exact amount of energy which a circuit-breaker might be called upon to open in a given station, it is known from tests and long experience in design that certain circuit-breakers have a reasonable factor of safety when connected to busbars fed from generators with a certain combined kilowatt rating and this has been termed the "ultimate breaking capacity," for which a circuit-breaker can be guaranteed. Under very favorable conditions, the circuit-breakers may be used on busbars having a somewhat greater load, while under extremely adverse conditions of poor oil, etc., it is possible that a circuit-breaker might fail satisfactorily to open the circuit when pushed to the extreme limits; but taken all in all, the ratings are conservative.

Where a double set of busbars is installed or the busbars sectionalized, it is sometimes possible to use smaller circuit-breakers, although the rated output of the station may exceed the "maximum breaking capacity" of the circuit-breakers. Usually water-wheel-driven units have not the same overload capacities as steam-driven units and smaller circuit-breakers might answer in a water-power plant than would be considered safe in a steam plant. For substation work where there will be a certain amount of drop in the feeders from the generating station, smaller circuit-breakers can often be used. It is also occasionally feasible to use a few large circuit-breakers and the rest small ones. As a general rule, however, it is not well to overrate the circuit-breakers without submitting the entire proposition to very careful consideration.

The figures given in the descriptions of the various oil circuit-breakers as the ultimate breaking capacity are those considered safe and conservative by their designers; but it should be stated that few of the circuit-breakers, particularly of the larger sizes, have been tested to the point of break-down as it is practically impossible to obtain the necessary amount of energy for testing purposes even in the largest plants. It should also be noted in connection with the smaller circuit-breakers that seldom can a circuit breaker be supplied which is good for the maximum current and maximum voltage for which that type is built, and the product of maximum current and maximum voltage will sometimes exceed the ultimate breaking capacity.

Fig. 1 shows a two pole circuit breaker that is built in sizes up to 300 amperes at 3300 volts, 200 amperes at 6600 volts with an ultimate breaking capacity of 1500 kilowatts on single-phase, 2500 kilowatts on three-phase, and 3000 kilowatts on two-phase circuits. This circuit-breaker is operated from two solenoids, one of which closes the toggle mechanism and the other of which trips the toggle. A small single-pole double-throw signal switch is mounted on the frame and operated by the moving mechanism. The main contacts are wedge-shaped and renewable arcing tips are provided. All poles of the circuit-breaker are completely submerged in the oil contained in a single, sheet-metal tank lined with wood, having wooden barriers between the poles and provided with filling and draining plugs.

Fig. 2 shows the next larger size of circuit-breaker, which is built in sizes up to 1200 amperes at 3300 volts and 200 amperes at 22,000 volts with an ultimate breaking capacity of 5000 kilowatts on single-phase, 8500 kilowatts on three-phase and 10,000 kilowatts on two-phase circuits. This circuit-breaker, like the one already described, is operated by solenoids that are hidden in the engraving by the mounting frame and the tanks. Through a very simple system of levers the operating solenoids are connected to a cast-iron cross bar, to which are fastened the movable contact arms. To the lower end of a wooden arm is fastened a metal yoke with a conical contact on either end. When the circuit is closed, these contacts engage with two stationary contacts forming one pole of the circuit-breaker. Each stationary contact is supported by a porcelain insulator rigidly secured to the frame. Each pole of the circuit-breaker has an independent tank in which its live metal parts are submerged in oil. These tanks are provided with insulated linings so shaped as to reduce the quantity of oil to a minimum and with the aid of the wooden arm to which the movable contacts are connected, form a barrier between the stationary contacts.

The two circuit-breakers described are self-contained and can be mounted on a wall, framework, or suitable support or may be placed in a masonry structure if desired. The independent cellular construction is not ordinarily required in plants having an output that would permit of their use

Fig. 3 shows a circuit-breaker built in single-pole units in sizes up to 1200 amperes at 3500 volts and 100 amperes at 33,000 volts and having an ultimate breaking capacity of 6000 kilowatts for two units on a single phase circuit, 10,400 kilowatts for three units on a three-phase circuit and 12,000 kilowatts for four units on a two-phase circuit. Each pole of the circuit-breaker is intended for mounting in a masonry compartment and two, three, or four-pole units are made by connecting the solenoids of two, three or four poles in the same operating circuit. The mechanism is mounted on a treated soapstone base and a simple system of toggles operated by a powerful solenoid is used for closing the circuit-breaker. A second solenoid is used to upset the toggle and trip the circuit-breaker. A small, single-pole, double-throw switch is mounted on the circuit-breaker and is operated by the motion of the levers in opening or closing the device. This switch controls the signals on the switchboard.

Fig. 4 shows a circuit-breaker built in sizes up to 2000 amperes and voltages up to 33,000 and having an "ultimate breaking capacity" beyond the limits of any power plant now installed or contemplated. Each pole of the circuit-breaker is enclosed in a separate, fire-proof, masonry structure and a single powerful mechanism mounted on a cast-iron base that rests on a treated soapstone slab is used with a two, three, or four-pole circuit-breaker. Like all of the other circuit-breakers described, the contacts are so shaped that the tendency is to open rather than to stick, and as the open position is maintained by gravity, failure of the mechanism, breakage of the operating rods or any other unforeseen contingency will cause the circuit-breaker to fall open rather than to fall closed. Each tank of the circuit-breaker is provided with a gage glass for observing the height and condition of the oil. The doors of the circuit-breaker compartments are sometimes provided with panes of clear, wire-glass to permit of ready inspection. The leads of this circuit-breaker leave the top of the tank and pass out through porcelain bushings set in soapstone blocks in the back wall of the structure. These leads usually come out in separate compartments that keep them isolated from each other. The leads to the busbars and to the feeder or generator may all run upward or all downward or some up and some down. The disconnecting switches for isolating the oil circuit-breakers can easily be mounted on the back wall of the circuit-breaker structure, and when so located there is far less chance of an attendant closing these switches while a second attendant is working on the circuit-breaker than if the switches were on one floor and the circuit-breaker on another.

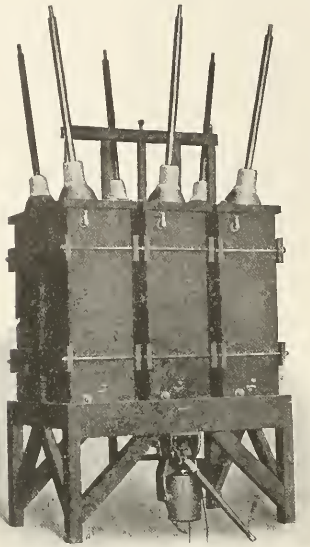


FIG. 5.—HIGH-TENSION CIRCUIT-BREAKER.

The circuit-breakers shown in Fig. 3 and Fig. 4 are primarily intended for use in power plants where the cellular construction for the busbars, wiring, etc., is needed or desired. In generating stations of about 6000-kw output and upward where the generators feed the busbars and the entire output of the station may be concentrated on a ground or short circuit, it has been found of the utmost importance to isolate the busbars, wiring and connections in fireproof, masonry compartments in such a manner that leads of opposite polarity are separated by soapstone, concrete, brick or similar material. These fireproof walls, barriers, septums, etc., prevent an arc starting in one place and communicating to adjacent conductors. The amount of energy available momentarily at the point of trouble in large stations where the generators are connected to a bus is something enormous and every precaution must be taken to prevent the trouble from spreading. For voltages as high as 13,200 the question of suitable distances and insulation is comparatively simple.

Where the generators are connected to step-up transformers giving voltages from 33,000 to 88,000 or even higher, the question of enclosing the busbars and wiring for the high-tension circuits becomes an entirely different proposition for the following reasons:

First, the violence of an arc and the destructive effect of a short circuit depend on the amount of current available at that point or are inversely proportional to the voltage, for the same amount of power, and while fireproof barriers and cellular construction are required in large plants generating electricity at comparatively low voltage, they are unnecessary for higher voltage plants of the same or even greater rating.

Second, the striking distance from wire to ground has to be greatly reduced over what could be obtained with open wiring in the same space, as the fireproof barriers offer a more or less perfect ground for high-voltage circuits, and the higher the voltage the more perfect the ground.

Third, a more expensive building and more costly structure are needed with enclosed busbars and wiring than for open wiring.

Fourth, inspection and repair are more difficult for busbars, wiring, disconnecting switches, lightning arresters, etc., that are boxed in masonry compartments and only visible and accessible by the removal of doors than if everything was in plain sight. Inspection will be more frequent and thorough and incipient trouble will be noticed far sooner with open wiring than with enclosed wiring, as the station attendant in a few minutes' walk can see everything and does not have to remove many doors and visit two or three floors to examine the condition of the apparatus.

For the foregoing reasons the high-tension, oil circuit-breakers shown in Fig. 5 and Fig. 6 have been made entirely self-contained, requiring no masonry structure and have been designed for use with open, overhead wiring for the busbars and connections. These circuit-breakers are provided with thoroughly grounded metal tanks with oil gages and the operation mechanism is located near the floor where it is readily accessible for adjustment without any danger of coming near the high-tension, live-metal parts of the circuit-breaker. Provision is usually made for mounting the disconnecting switches in plain sight directly above the circuit-breakers on a suitable support.

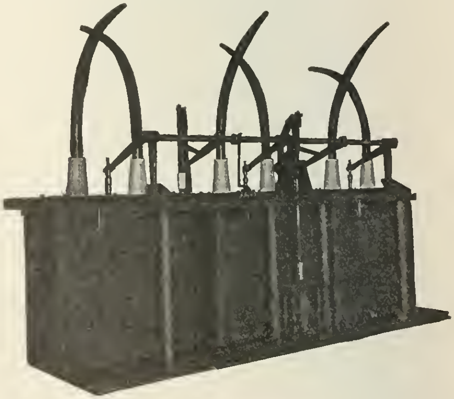


FIG. 6.—HIGH-TENSION THREE-POLE CIRCUIT-BREAKER.

Fig. 5 shows a circuit-breaker built in sizes up to 200 amperes and 60,000 volts for an ultimate breaking capacity of 12,000 kilowatts on single-phase and 20,000 kilowatts on three-phase circuits, while a modification of this circuit-breaker is built in sizes up to 200 amperes and 88,000 volts with ultimate breaking capacities up to 25,000 kilowatts on single-phase and 40,000 kilowatts on three-phase circuits. The hand-closing device used with the electrically-operated circuit-breaker is shown directly over the closing solenoid, and where electrical operation is not desired a hand-closing mechanism with suitable bell cranks, levers, etc., is used and the handle with its trip coils, latches, etc., is placed on the switchboard panels or in some other suitable location.

Fig. 6 shows a three-pole circuit-breaker built for potentials up to 60,000 volts which operates under any conditions of overload or short circuit in a power plant having an output of 200,000 kilowatts. This circuit-breaker is ruggedly constructed throughout. The mechanism is operated by a single, direct-pull, solenoid located at the floor level in front of the circuit-breaker.

Oil circuit-breakers have been designed for operation on voltages of 132,000 and even higher, but as no plants are in operation at these voltages they have not yet been tested under actual working conditions.

Subway and Cable Records for Electric Light Companies.

By Charles Holmberg.

It is desirable that all subway and cable records should be drawn to a scale which should be maintained throughout the entire record system. Diagrams and drawings should be made on a sheet of paper of standard size, say, 24 in. x 36 in., and each sheet should be provided with faint black cross-section lines spaced so that the distance between each line represents 25 ft. on a scale of 100 ft. to the inch. A margin of 1 in. should be left at the bottom of the sheet for the title. The faint black lines serve as a guide in laying out the work, and the paper can be ruled in this manner at any first-class printing establishment. These lines are not shown on the engravings herewith.

Having provided himself with paper of the above description, the draftsman lays off four spaces 2¼ in. high; above these a space 3 in., and above this four spaces 2¼ in. high. The spaces should be bounded with heavy black lines drawn across the sheet. Basing an illustration on New York City service, suppose the owner of a large apartment house at 512 West 146th Street has signed a contract for electric-lighting service, and that the necessary pipes have been laid and the cables pulled in. The record would then be made as follows:

It is essential for the department to have an atlas of New York City in order to accomplish the work set before it. Having located the house number in the atlas, the draftsman makes a scale drawing of the entire block in the 3-in. space. It is the custom in topographical drafting to have all work drawn in such a manner as to indicate north at the upper end of the sheet. This rule simply applies to the streets running east and west. Streets running north and south should be drawn with west at the upper end.

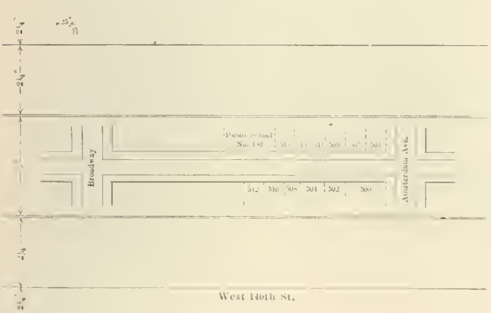


FIG. 1.—SURVEY SHEET.

The survey having been illustrated, as shown in Fig. 1, the subway and cable diagram will be taken up. It may be remarked that the electric-light companies of New York City do not build the conduit or duct system; this is done by a separate company. The electric-light company specifies the location where to build, giving the approximate distance in feet, and the subway company charges the electric company rental for the use of subways on the basis of the number of feet built. The smaller connections coming from the subway proper, known as subsidiary connections, are also built by the subway company, but are the property of the electric-light company, which pays for the work done.

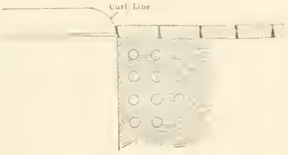


FIG. 2.—DUCTS IN STREET.

The spaces above and below the center space of Fig 1 are used for ducts that may be assigned to the electric-light company. It is possible to have one or a dozen ducts on a street or avenue between the same points assigned to one electric-light company. If such is the case, the ducts should read away from the curb, and from top to bottom. For example, assuming there are 12 ducts under assignment on the same street, and between the same points, the ducts are named, referring to Fig. 2 as follows: 1, curb duct; 2, second curb duct; 3, third curb duct; 4, curb second bottom; 5, second curb second bottom; 6, third curb second bottom; 7, curb third bottom; 8, second curb, third bottom; 9, third curb, third bottom; 10, curb fourth bottom; 11 second fourth bottom; 12, third curb, fourth bottom. Having the proper location of the ducts, they are now placed in rotation on the extreme left end of the diagram sheet opposite the vacant spaces, as illustrated in Fig. 3. Should the ducts be assigned on the north side of the street, they appear north of the diagram; if the assignment reads south, they appear south of the diagram.

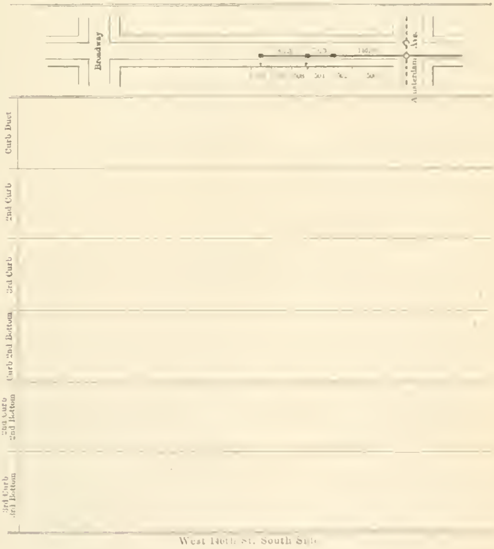


FIG. 3.—DATA SHEET WITH DUCTS LOCATED IN ROTATION.

Before drawing the diagram of the street it is essential t find out the number of ducts assigned in the system in order that allowance may be made for the additional ducts. The draftsman then places the diagram or the survey drawing at the extreme upper end of the sheet, leaving the lower eight spaces for duct space. In drawing the diagram or survey at the upper end of the sheet, the buildings and subway on both sides of the street, including subsidiary connections, are indicated, but in the duct spaces only cable work appertaining to the north side is shown. The title of this sheet will read "West 146th Street, North Side." The same rule applies to the south side, omitting all buildings and subway on the north side, having simply the skeleton drawing of the north side, as shown in Fig. 3. This sheet will read "West 146th Street, South Side." Having still four more ducts to add and not being able to care for them on the sheets just completed, the drawing is duplicated for either the north or south sides, as the case may be.

Referring to Fig. 2, and assuming the subway has been built and measured, a blue-print is made and sent to the electric-light company showing what has been done as to cutting-in boxes or manholes on the line, tapping subsidiary connections from the mains, etc. Having the blue-print of West 146th Street subway, the desired information is entered in solid black in the drawing of Fig. 4, the distances being shown in black figures between manhole and boxes, the same scale is used as in the diagram work. All intersecting subways should be indicated by dotted black lines.

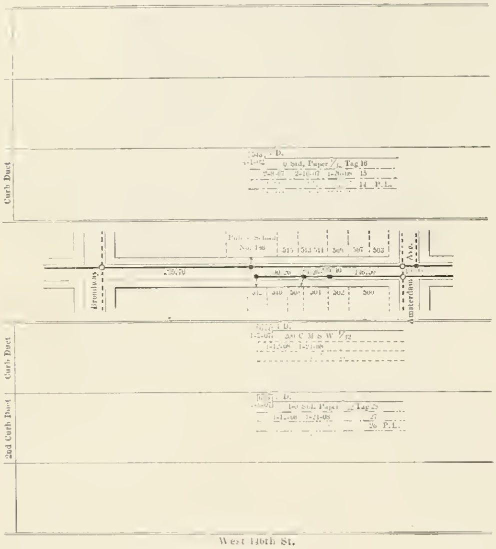


FIG. 4.—COMPLETE RECORD.

The records, thus far, having been made, the foreman of the electric-light company has the cable pulled through the subway and subsidiary pipes. A great deal depends upon the outside foreman in writing up his weekly reports giving in detail the nature of the cable, the number of feet of cable used, the date of installing same in conduit, also the date when energy passed over it. When the foreman's report is plotted it should show that there had been rodded and drawn in on the south side of West 146th Street, in the curb ducts, from the manhole located at the southwest corner of Amsterdam Avenue and 146th Street, to service box in front of 512 West 146th Street, three 200,000 circ. mil steel and wire 4/32 secondary cables. In the second curb duct should be indicated that three legs of primary cable had been drawn in from the southwest corner of Amsterdam Avenue (225.80 ft.) consisting of three 4-0 standard paper 7/32, Tag 28, 27, 26 cables. The cable tagged 26 is the power leg. The record should also indicate that the above cables, secondaries and primaries, were pulled in on Jan. 19, 1908, and made alive on Jan. 24, 1908. Also on the north side of West 146th Street from manhole northwest corner Amsterdam Avenue to box in front of Public School No. 186, cut dead on Jan. 26, 1908, the three primary cables supplying the above premises, taking for granted the previous report stated that three primary cables were pulled in.

Symbols should be used to indicate the various wiring places, etc. All secondary cable matter should be indicated by a dotted black line; primary cables by a dash and three-dot line; cutting cables dead, a dot and dash line. All one-year assignments should be shown in a dotted black line, placing the assignment number and date when assigned, at the starting point of the duct. The five-year assignments are indicated in solid black. The date of pulling in cables is shown in black figures as indicated in Fig. 5; the second set of figures shows the date when the circuit was turned on. Should the cable be cut dead the date should appear following the second set of figures.

In drawing the cable report in the spaces designated as duct space, care should be taken to follow the run of the duct in which the cable has been pulled in. For instance, from manhole at southwest corner of Amsterdam Avenue and 146th Street to service box in front of No. 512 cables were pulled in Follow below, using the service box in front of 512 as a base into the duct space opposite the curb duct, starting the assignment at that point and ending at the manhole southwest corner of Amsterdam Avenue and 146th Street. All ducts assigned should read from left to right. Abbreviations in the body of cable work and small lettering are advisable. A reference sheet should be made and placed at the beginning of the diagram sheet. A complete record system is shown in Fig. 4.

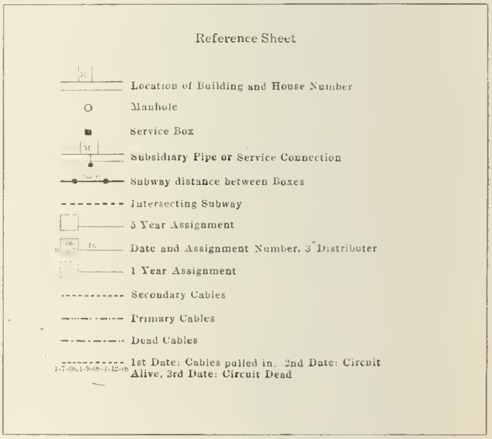

Reference Sheet
Location of Building and House Number
Manhole
Service Box
Subsidiary Pipe or Service Connection
Subway distance between Boxes
Intersecting Subway
5 Year Assignment
Date and Assignment Number. 3" Distributer
1 Year Assignment
Secondary Cables
Primary Cables
Dead Cables
1-7-08. 1-9-08. 1-12-08
1st Date: Cables pulled in. 2nd Date: Circuit Alive, 3rd Date: Circuit Dead

FIG. 5.—SYMBOLS FOR SUBWAY AND CABLE RECORDS.

The drawing must be plain, direct and all-sufficient. It might be added that to make it so, the draftsman must place himself in touch with the outside foreman, and follow implicitly his reports from time to time. Regarding the smaller connections, known as subsidiary connections, they appear on the diagram sheet, but the details should be shown on a card system.

Electric Wiring of New and Old Buildings.

By J. E. WeisMandel.

With such great prospects before us in the development of new lamps and electric power, the wiring of new buildings today, whether it be a dwelling, apartment house, factory, stable, store or any class of building, is an important factor.

Every electric light and power company should have a "New Building" department, whether the company be a large or small one, with a man in charge who is capable of consulting architects and builders in the matter of equipping new buildings for electric service. Very few first-class buildings are being erected to-day without being wired throughout for light and power. Not so many years ago builders thought nothing of erecting a mansion, large office or factory building, or elegant apartment house without electric service. But to-day with tungsten and tantalum lamps and electric power that can be used for all purposes it is different.

Electric wiring in a building is one of its best assets and is a great selling factor. The man or woman of to-day who buys or rents a building wants every modern improvement. As electric light and power is within reach of all, it is necessary in most instances to have buildings equipped electrically in order to sell or rent them.

It is almost two years since the building department of the Edison Electric Illuminating Company, of Brooklyn, was organized and the writer placed in charge, and at the beginning it was hard work and pulling up-hill to get builders and architects to wire all modern buildings, but the writer can say that to-day the task is easier.

With all the talk of money stringency, building has been going right along in Brooklyn, and since spring has arrived the Brooklyn building business has increased tremendously, while stores, apartment houses, private dwellings, factories and, in fact, all classes of buildings have been and are being wired for electric service.

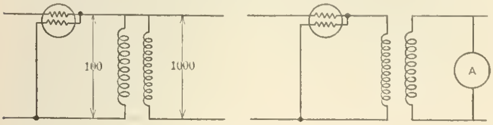
When old buildings are being altered and remodeled it is most important for a representative of the electric company to call at once and consult the architect and builder in reference to wiring. That is the time to induce them to make a modern building out of an old one, by equipping it for electric service. It is safe to say that the majority of old buildings being remodeled are being wired, which proves that electric service is in demand.

The building agent or salesman meets so many different kinds of people in his daily work that in order to be successful he must be able to present his talk in a tactful and logical way, must be courteous and sincere and be ready at all times to give the people he is doing business with any information they desire. When he has accomplished this he gains their good will and friendship, and with these assets his work becomes a pleasure instead of a burden to him.

Transformer Testing.

By W. M. Hollis

The full-load efficiency of a transformer may be determined quite accurately by the following method and without employing full load. The efficiency, of course, is the ratio of the output to the input and if these values are measured at full load several measuring instruments are required in the primary and secondary circuits. If the transformer is a large one, considerable energy is required in making the tests and also measuring instruments of large capacity.



FIGS. 1 AND 2.—TESTING TRANSFORMERS.

With the method outlined below, only a fraction of the full-load energy is required and few instruments.

The primary is considered as the high-potential coil and the secondary as the low-potential coil. The losses may be considered as being made up of the core losses, iron losses, including hysteresis and eddy currents, and the copper losses. The core losses are substantially the same at all loads. With the primary open-circuited, measure the watts supplied to the secondary at its normal voltage, or the open-circuit or core losses. See Fig. 1. Short-circuit the secondary windings and gradually increase the voltage on the primary until full-load secondary current is obtained. The watts supplied to the primary will then equal the full-load copper losses. See Fig. 2. The input at full load is equal to the output at full load plus the sum of the copper losses, hysteresis losses and eddy current losses. The efficiency is equal to the output divided by the input or to the output divided by the sum of the output and the losses.

If a pair of similar transformers is to be tested or a number of similar transformers, a method may be used for testing them in pairs, an additional transformer, which may be smaller than those under tests, being employed during the tests. The method outlined is applicable where transformers of large size are to be tested either with full load or partial load. As was the case with the dynamo and motor tests in a previous article, the losses only are supplied from the mains, so that not only is much energy saved, but large transformers can be tested under full-load conditions with only a comparatively small amount of energy being taken from the mains. In Fig. 3 similar transformers to be tested are represented by *X* and *Y*. Similar ends of the secondaries are connected to the mains, as shown. Of the other pair of similar secondary ends, one is connected to the other main wire through an ammeter, while the other secondary lead is connected to the same main wire through a wattmeter and the secondary of a small transformer. The primary of this small transformer is connected to the main wires through a regulating rheostat *R*. The secondary of the transformer *X*, in whose leads the small transformer is connected, thus has a smaller impressed voltage across it than the secondary of the other transformer under test. The primaries of both transformers are connected so that their e.m.fs. are in opposition, and if the voltages impressed upon the secondaries were the same, no current would flow in these primary windings.

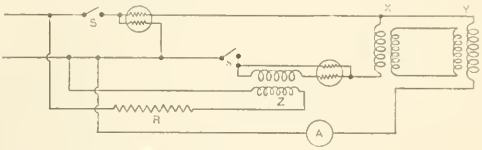


FIG. 3.—TESTING SIMILAR TRANSFORMERS.

By varying the resistance in the primary of the small transformer, its secondary voltage may be varied, and as a consequence the voltage of the branch lead, including the secondary of the transformer *Y*, is also varied. Hence, there are set up circulatory currents in the circuit including the secondaries and in the circuit of the primaries of both transformers *X* and *Y*. The resistance may be varied until the current is such as to give the load at which the losses or efficiency is desired. Switches *s* and *S* are provided, the first in the secondary circuit of the transformer *X* and the other in the lead from the mains. An ammeter is inserted in the secondary circuit of the transformer *Y* and a wattmeter is connected in one of the main leads to measure the power input to the system. Another wattmeter is connected in the secondary circuit of transformer *X*.

Considering the secondaries to have similar ends connected to the mains, and the primaries to be connected in series so as normally to oppose each other, then with equal voltages impressed on the secondaries there will be no current flowing in the primaries, since the induced e.m.fs. will then be equal and opposite at each instant. The effect is, therefore, substantially the same, so far as the effect of voltage of the mains is concerned, as if the secondaries were connected to the line and the primaries were open-circuited.

Considering the pairs of transformers from the secondary side, the small transformer *Z* sends a current through the circuit, including both secondaries, and such current induces in each of the primaries in such direction as to cause circulatory current to flow in the circuit including the primaries, the effect being similar to a secondary excited with the primary short-circuited. Hence only a small voltage suffices to induce full-load circulatory current in both secondary and primary circuits.

Therefore, the losses only need be supplied from the mains and the small transformer Z to give full-load current values in both transformers. Such losses would ordinarily be less than 10 per cent of the full load of either transformer, and would thus determine the capacity of the small transformer, which must, however, have a secondary capable of carrying the full-load current of the large transformer. The current in the secondary may thus be regulated by varying the resistance R in series with the primary of the small transformer. The power loss equals the sum of the readings of the wattmeters minus the loss in the instruments and leads in the secondary circuit. The latter loss may be found and subtracted, if it is of such a value as to affect the results appreciably, by placing a heavy lead around the secondary transformer coils and measuring the watts when the same current as before is passing, switch S being open and switch s closed. If V is the full-load secondary voltage, I the full-load secondary current, W the watts from the mains, and W' the watts from the small transformer, then VI is the full load watts on non-inductive load, and by letting W'' represent the power loss in leads, instruments, etc., where such loss is so large as to affect the results, the efficiency of both transformers is equal to VI divided by VI plus W plus W' minus W'', and the efficiency of either transformer is equal to the square root of this quantity.

A similar method for testing a pair of transformers is shown in Fig. 4. In this case the primaries are connected to the mains, while the secondaries are connected in series through the secondary of a small transformer. The wattmeter connected in one of the mains shows the power supplied from the mains, and the wattmeter connected across the small transformer shows the power supplied by that apparatus. The ammeter shows the current in the secondary circuit. The primary of the transformer Z is energized from the mains and is provided with a regulating resistance R for varying the current. The wattmeter across the small transformer then measures approximately the copper loss for the current indicated by the ammeter and that of the leads and instruments. The wattmeter connected in the main circuit measures approximately the iron losses for the two transformers.

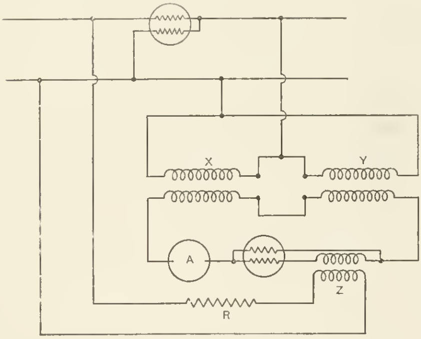


FIG. 4.—TESTING TWO TRANSFORMERS.

As shown in the sketches, the primaries are connected to the mains and the exciting current for the cores circulates through them. The secondaries are connected so that their e.m.fs. are normally in opposition, due to the excitation from the mains through the primaries, and hence no current flows through the secondaries. The only power furnished to the primaries, therefore, is that due to the core losses or open-circuit losses. Now the transformer Z in the secondary circuit sets up an e.m.f. which tends to circulate current in the circuit through the secondaries in series. Such current induces a corresponding circulatory current in the primaries and the connecting lead, the effect being the same, as far as the excitation from the secondary sides is concerned, as though the primaries are short-circuited. Hence a comparatively small voltage is required to cause full-load current to flow in the secondaries and primaries in such including circuits. By measuring the power supplied to the secondary by the transformer Z, minus the losses in the instruments and leads, the full-load copper losses corresponding to the value of I are obtained approximately. From these values the efficiency may be calculated.

The wattmeter measurements represent the losses for the two transformers, and half of the sum of the readings represents the loss of each transformer. The efficiency, as before, is represented by the quotient of the output divided by the input, or to the watts output divided by the watts output, plus the losses for each transformer. To make a heat run upon a pair of transformers, the primaries and secondaries may be connected as shown in Fig. 4, though the primaries need not be connected to the mains, and an ammeter should be connected in either the primary or secondary circuits.

Construction of a Spark Coil.

By F. C. Mason.

Owing to the growing importance of the gas engine, the subject of spark coils for ignition purposes is becoming one of considerable interest. The general principles of induction coils are generally quite well understood, but if an amateur undertook to build a spark coil without a precedent, he would meet with many difficulties. An auto-spark coil resembles in principle a physician's induction coil (or battery, as it is commonly called), but differs in that it has not the brass tube which slides over the core inside the primary coil to regulate the intensity, is provided with a condenser, and the secondary coil contains more wire, thereby creating a higher potential or voltage. The accompanying illustration shows an auto-coil in section and side elevation, end view, top view and component parts in detail.

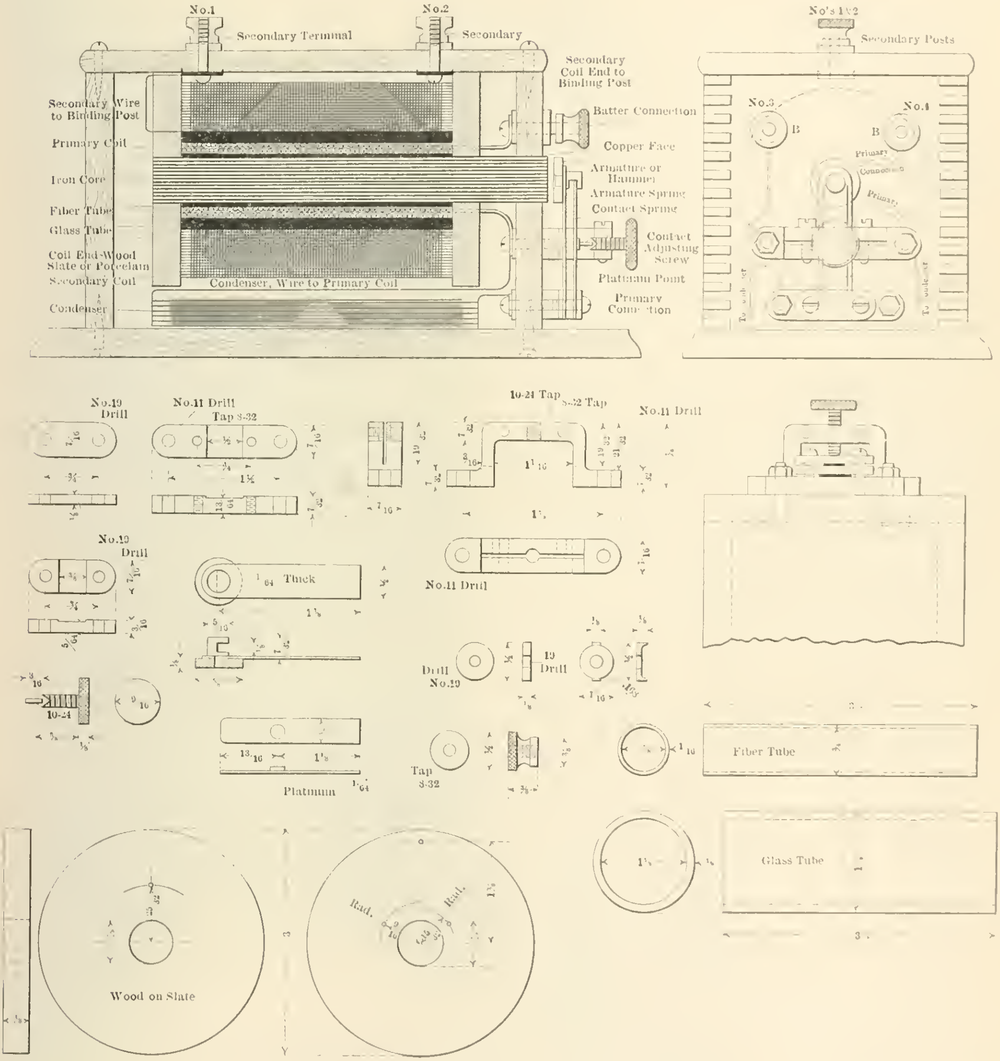
In order to build a coil such as that shown, procure some No. 18 annealed iron wire and cut off sufficient 5 3/16 lengths to fill a fiber tube of ⅝ inside diameter. File off the ends square and solder a plate of copper on one end not over 1/64 in. thick, the purpose of which is to keep the vibrator from sticking, due to residual magnetism in the core.

On the fiber sleeve wind two layers of No. 12 double-covered magnet wire and encase the whole in a glass insulating tube of 1⅛ in. inside diameter. The thickness of the glass tube is not important, but a tube ⅛ in. thick or more is advisable. Since the glass tube insulates the primary from the secondary coil, its mission is important.

The secondary coil is wound with No. 36 silk double-covered magnet wire, which should be of the best quality; for if the insulation is defective the coil will be useless. Before winding have a ladle of melted parafine at hand and a brush. Wind one layer of the wire on the glass tube, starting the winding about ¼ in. from the end of the tube and discontinuing ¼ from the opposite; then brush on hot parafine and cover with an envelope of paper. The paper should be fairly thick and of a quality that will absorb hot parafine readily. Return the wire to the paper envelope and wind another layer of wire, starting ¼ in. from the end and stopping ¼ in. at the opposite end. Continue this process, layer by layer, coating each time with parafine and a layer of paper, until the coil is of the proper size. The secondary terminals should be on opposite ends, and both primary terminals on the same end. When the coil is completed, soak it in very hot melted parafine for an hour, and then let the coil cool in the parafine until the latter has a mushy consistency, when the coil should be removed and the surplus of parafine wiped off. The coil head may be made of wood, fiber, slate or porcelain; fiber will be entirely suitable.

For the condenser, procure a strip of paper 4 in. wide and about 120 in. long, and cut 40 sheets of tin foil 2½ in. wide by 4 in. long. Fold the paper strip 2⅝ in. wide and lay in a sheet of foil, leaving the end protruding 3/16 of an inch; fold again and put in another sheet of the foil, allowing the end to protrude on the opposite end of the paper, and continue this process until 40 sheets of foil are used up. When finished there will be 20 sheets on each end to connect to. As the tin foil is too delicate for soldering, the connection may be made by forcing a wire against the ends of the foil. The several parts when finished are connected according to the accompanying drawing. Then pour melted parafine in the box until the coil is submerged; allow this to set and then fill the shrinkage. Place the condenser in position, make the condenser connections and then fill the case entirely full with parafine; smooth off and put on the bottom of case and the coil is complete.

If the reader never made a spark coil, this description will give him some ideas as to the repair of such coils. The coil, of course, has to be melted out, and should then be placed in a pan in an oven with the door left open, in order that it shall not heat up too rapidly. If the coil does not work and the vibrator is in good condition, ninety-nine times out of a hundred the secondary terminal is broken, and, of course, this is the most difficult part to get at in most coils.



COMPLETE DETAILS OF AUTO-COIL

Automatic Damper Regulators.

By W. H. Wakeman.

In a previous article dealing with the regulation of the draft of steam boiler furnaces, the writer showed that the time spent in regulating a damper by hand so as to keep the steam pressure in a boiler constant costs enough in a short while to pay for a good automatic regulator that will last many years. There are quite a number of automatic damper regulators on the market and it is the purpose of the present article to explain the principles by which many of these operate.

Fig. 1 illustrates the first damper regulator that the writer has had experience with. It is a simple and inexpensive appliance, but owing to the fact that it requires a variation of from 5 lb. to 10 lb. in the steam pressure to operate it, engineers do not look upon it with favor. However, if more intelligent attention is given to the way in which such a regulator is connected at first and cared for afterward, much better results would be secured from it in every-day service. Connection should be made to the extreme end of the regulator lever as shown, and this lever should move through the whole stroke given to it by its designer, in opening and closing the damper. On the other hand, the damper lever ought to be made as long as the stroke of the regulator will admit, with a damper designed so that the least possible movement of it will either shut off the draft completely or give a free passage for the products of combustion. This is such a comparatively rough class of work that it does not always receive the attention that its importance demands.

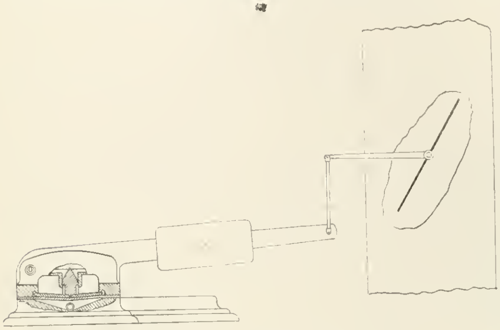


FIG. 1.—AUTOMATIC DAMPER REGULATOR.

To illustrate this point, a certain plant that the writer had charge of several years ago is mentioned. The damper did not work easily, although there was nothing to prevent its operation when sufficient force was applied to the lever. At the first opportunity an investigation was made of the inside of the nearly horizontal smoke pipe. The damper was made of cast-iron and its great weight accounted for the force required to move it. It was circular in form, and its diameter was about 2 in. less than the smoke pipe, hence it could not be shut tight. As the chimney gave a strong draft, this space of about 1 in. wide completely around the damper, allowed much heat to escape and this lowered the steam temperature to about 20 lb. during the night, although there was 60-lb. pressure when the engine was shut down.

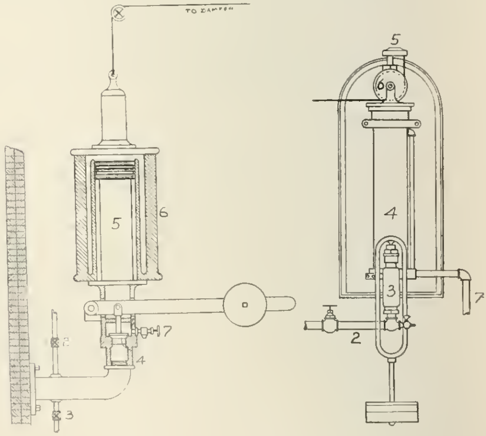
The cast-iron damper was broken into many pieces with a hammer and removed. It was replaced by a larger one made of steel plate about ¼-in. thick, which did not require nearly as much force to move it. The form of it was oblong instead of circular, hence a much less movement of the lever was sufficient to operate it, as a circular damper must be moved through the fourth part of a circle to open or close it.

Where the most economical results from the combustion of fuel are desired, it is necessary to keep the steam pressure steady, but if a so-called regulator is in use that is set to close at 90 lb. and will not open until it has fallen to 75 lb., there is not much satisfaction derived from the operation, and something better is demanded.

Fig. 2 is a very sensitive regulator as it will move before an ordinary steam gage indicates much change in the pressure. Steam is admitted by the valve 2, and 3 is left open enough to allow water to escape to the ash-pit. Pressure acts on 4, which is similar to an ordinary safety valve, hence when it opens steam passes to the chamber 5 and acting on the upper internal surface of the heavy sliding weight or casing 6 throws it quickly upward and closes the damper, or allows it to close as the small wire cable can only draw it open, while a weight that is not shown closes it when the regulator rises. When the pressure falls less than 1 lb. the valve 4 closes and the steam trapped above it begins to escape through the small drip valve 7, which is always open for this purpose. This allows 6 to fall quickly and thus open the damper.

This regulator operates so quickly and is so sensitive to changes in the steam pressure that the damper to which it is attached is either closed tightly or else is wide open, therefore as soon as the fire is deadened by the closed damper enough to make the pressure begin to fall the full draft is put on again and the rapid combustion of coal begins promptly. Engineers who favor the idea of burning coal as quickly as possible in order to obtain the greatest amount of heat from it adopt this style of regulator for obvious reasons. As it opens quickly the full force of the draft is realized at once, and this draws much of the light soot and ashes entirely through the tubes of a boiler, leaving only the heavier parts to remain and choke the draft. This regulator can be connected rigidly to the damper lever by means of an iron rod, provided this kind is preferred, if the regulator is located near the damper. Steam pressure moves the damper in one direction in this case, while the heavy sliding weight 6 carries it in the opposite direction. It is generally considered best to locate the regulator in a desirable place, usually in the engine room, and use a small wire cable running over pulleys to form the connection.

As a general rule, damper regulators are designed so that an upward movement of some part closes the damper, but that shown by Fig. 4 acts in the opposite direction. With a low pressure on the boiler, the damper is held open by the weight shown, and the regulator piston is in its highest position also by action of the weight. Steam enters at 2 and is exhausted through 3, when its work is done. As soon as the highest desired boiler pressure is secured, it is sufficient to force the piston in the cylinder 4 downward, raising the weight and closing the damper. When it falls about 1 lb. the weight predominates and the draft is put on again. The above explanation shows that full boiler pressure is utilized to close the damper, which gives a large excess of force over what is required to overbalance the weight. There are no weights directly on this regulator, but provision is made for varying the pressure at which the damper will be closed, by means of a hand-wheel at the top.

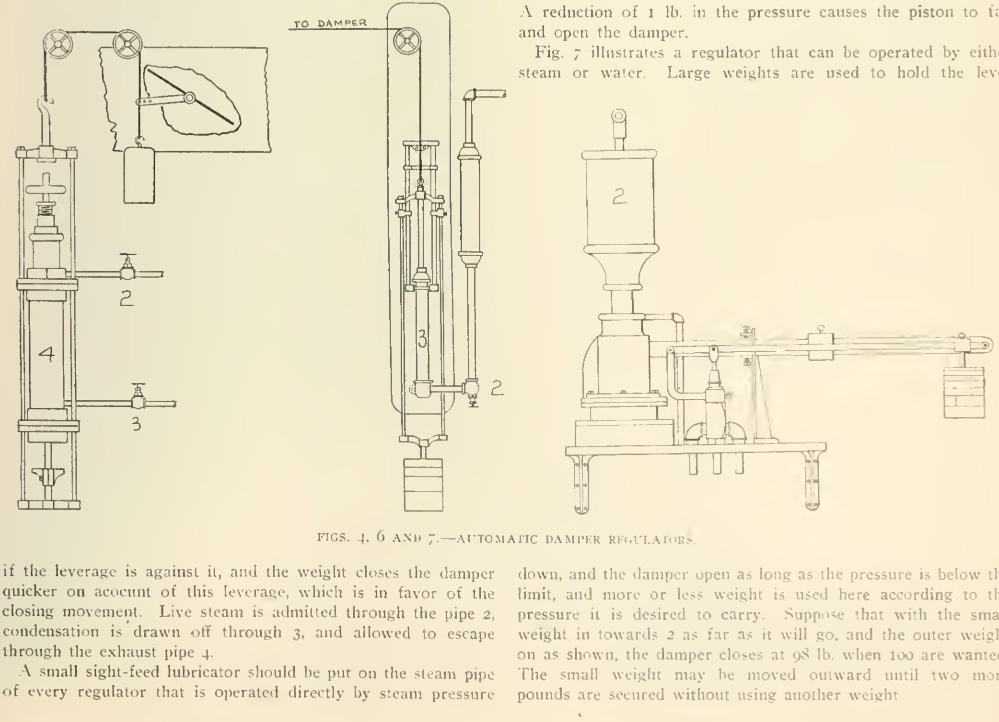


FIGS. 2 AND 3.—DAMPER REGULATORS.

Fig. 3 illustrates another regulator in which steam is used directly. As long as the boiler pressure is below the desired limit, the damper is held open by action of a weighted lever in the usual way, and the regulator remains in the position shown. Suppose that it is desired to carry 90 lb. pressure. As soon as this point is reached steam entering the pipe 2 opens the pilot valve 3 against the weights, which appear below it, and admits pressure to the main cylinder 4. Here it forces a piston upward carrying with it the piston rod and connection 5 to one end of which is attached a small wire cable that passes under the pulley 6. This drawing action on the wire cable pulls the damper shut and holds it there until the boiler pressure falls 1 lb. The lower weights now close the pilot valve 3, shutting steam off from 4 and exhausting it through 7 to the ash pit. This allows 5 to move downward, assisted by the weighted lever on the damper, until the full force of draft is available for the fire. If a rigid connection is desired and it is practicable to locate the regulator near the smoke pipe or stack, the lower end of a connecting rod can be pivoted at 5 and then carried upward to the damper lever. However, there is no special advantage gained by this plan.

Every regulator that is designed to be operated by steam ought to be connected so that only dry steam will be taken from the boiler, and the steam pipe should be well covered with a first-class non-conductor of heat, in order to prevent condensation, for if this is excessive on account of a long pipe in an exposed location, it will probably interfere with the sensitiveness of the machine. Furthermore, there may be more or less investigation to determine the amount of steam that it uses per hour, and this can easily be determined by letting the exhaust steam go into a pail of cold water. By weighing this water before and after the test, it is possible to determine the exact weight of steam used. This should include only what is actually necessary to operate the regulator, and not the weight uselessly condensed in the steam pipe. The pipe should drip back to the boiler until a point above the regulator is reached, when it can be brought straight down to the place designed to receive it.

Fig. 5 is similar to the regulator shown in Fig. 3, except that a lever is employed at the top instead of a direct connection. As boiler pressure is available for the operation of this regulator, there is plenty of force to move the main piston upward even if the leverage is against it, and the weight closes the damper quicker on account of this leverage, which is in favor of the closing movement. Live steam is admitted through the pipe 2, condensation is drawn off through 3, and allowed to escape through the exhaust pipe 4.



FIGS. 4, 6 AND 7.—AUTOMATIC DAMPER REGULATORS.

A small sight-feed lubricator should be put on the steam pipe of every regulator that is operated directly by steam pressure in order that a few drops of first-class cylinder oil may be supplied to the piston once or twice a week. In this case there is one shown, but they are seldom found in practice.

The regulator shown by Fig. 6 uses the direct pressure of steam without any complication in the valve mechanism.

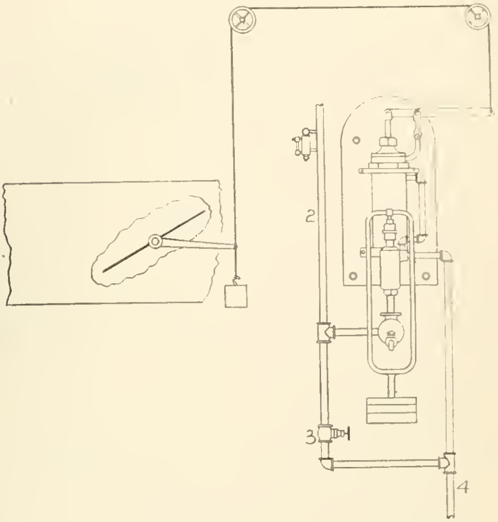


FIG. 5.—DAMPER REGULATOR USING STEAM DIRECTLY

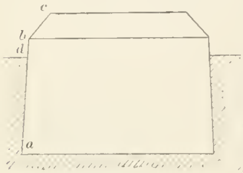
Steam is admitted through the inverted angle valve 2 into the cylinder 3, where it forces a piston upward when the maximum pressure is secured, and closes the damper, or allows it to close as the connection is made by means of a small wire cable. A reduction of 1 lb. in the pressure causes the piston to fall and open the damper.

Fig. 7 illustrates a regulator that can be operated by either steam or water. Large weights are used to hold the lever down, and the damper open as long as the pressure is below the limit, and more or less weight is used here according to the pressure it is desired to carry. Suppose that with the small weight in towards 2 as far as it will go, and the outer weight on as shown, the damper closes at 98 lb. when 100 are wanted The small weight may be moved outward until two more pounds are secured without using another weight

LETTERS ON PRACTICAL SUBJECTS

ENGINE AND GENERATOR FOUNDATIONS.

Will you add your influence toward correcting a practice followed by some designing engineers which proves an unmitigated nuisance to the erecting engineer and a source of useless expense to the owner? The point directly referred to is the practice of laying concrete foundations with taper sides. Examples of this form of engine, generator and motor foundations are shown by Fig. 1 and Fig. 2, and the same foundations, redesigned to conform to the principles of simple and economical construction, are shown by Fig. 3 and Fig. 4, respectively.



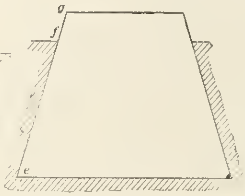
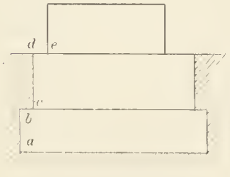


FIG. 1.—BEVEL SIDE FOUNDATION AND TOP TAPER. FIG. 2.—SLOPE SIDE FOUNDATION.

In the tapering foundation, the expense and trouble involved in making the form wherein the concrete is to be poured, much more than offsets the saving in material possible thereby. The usual function of a foundation is to afford such an area of surface to support the load to be carried that the particular soil met with can carry the load placed upon it. If a given soil will not carry more than 1500 lb. to the square foot, and there are 10 tons of dead weight to be carried upon a space of 12 in. square, it stands to reason that a foundation must be put in with a footing so large that the pressure between foundation and soil will not exceed the load permitted, in addition to the weight of the foundation.

A load of 10 tons, upon soil good for 1500 lb. to the square foot, means that $10 \times 2000 + 1500 = 13.7$, or about 14 sq. ft. of footing will be necessary under the load. This means a footing about 3 ft. 8 in. square, and as the bottom only needs to be of the stated size, it is the usual custom of the draftsman to draw straight lines from the desired width at the bottom to the 12-in. requirement at the top of the foundation. This means that the foundation tapers 26 in. from top to bottom, or 13 in. on each side. The depth of any foundation is due entirely to the requirements of the location, as far as the level of the bottom is concerned, and to the desired height of the machine for the level of the top of the concrete work.

The kind of soil and its profile, together with frost-line requirements, must determine the distance between top of foundation and the footing, but that requirement makes no difference with my plea for foundations with straight sides. Consider how much cheaper and easier it is to build and to fill and ram a form built according to Fig. 3 or Fig. 4 than a form built like Fig. 1 or Fig. 2. Fig. 1 must have a form with continuous smooth and tight sheathing from top to bottom, and after that is completed, from *a* to the height of *c*, a facier, *b-c*, must be mitered inside the outer form, and this facier must be made so strong and so well supported that it can withstand the rough usage of handling and tamping several tons of concrete, without being knocked to pieces.



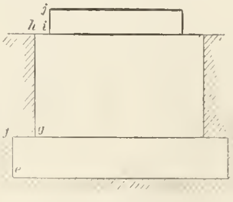


FIG. 3.—FIG. 1 REDESIGNED. FIG. 4.—FIG. 2 PROPERLY LAID OUT.

Compare the cost of a form for Fig. 1 with that of the very simple forms required by Fig. 3. The width, depth and requirements of the two foundations are precisely the same, but the form shown by Fig. 3 requires much less lumber and labor, only three plain, shallow boxes, without top or bottom, being required. Unless too large, these boxes may be made elsewhere and brought ready for use to the site of the foundation and laid down ready for filling. Good, strong corners, a few wires from each side to the opposite side, and the form is ready. Each successive box-form may be laid on top of the filling in the preceding box, and perhaps connected thereto by means of a few strips of wood at the middle of the sides or at the corners—just enough to keep the form in place until the first layer of concrete has been placed—and it is ready for use and half filled before the form shown in Fig. 1 could have been half constructed.

The beveled top shown in Fig. 1 seems to have been placed there merely to give occupation to the draftsman, and there seems no reason why the shape shown by Fig. 2 should not have been used instead of that shown in Fig. 1, had the draftsman stopped to think at all of the shape given the concrete work.

In Fig. 3 the same dimensions are worked to as in Fig. 1. The footing at *a* is the same size in both illustrations, the ground line *d* is located at the same place, and the only appreciable difference between the two foundations are the off-sets at *f*, *c* and at *d*, *c*. There is, however, one other difference, and one which will delight the owner: much less concrete is required by the form shown in Fig. 3 than is required by the form shown in Fig. 2.

The point to be looked after closely, in foundations of this character, is that the width of each successive layer or level is not so great that the pressure cannot be transmitted from the course above without breaking off the extensions of the next lower course. That is, in Fig. 4, the projecting course *f*, *g* shall not be so great, compared with the depth of *e*, *f*, that the piece *f*, *g* will be broken off. In other words, the angle made by *c*, *g* must be little enough so that the carrying power of the footing *c*, *f* is safely transmitted to the next course, *g*, *h*. The angle *c*, *g* shall not be greater than is called for by good engineering practice, and in changing the design of foundations and footings, in the field, to conform to the common-sense method as depicted by Figs. 3 and 4 (and the change is made oftener than the draftsman who made the drawings is aware) care should be taken to keep within safe limits in making projections of square blocks instead of the beveled continuous sides as shown by Figs. 1 and 2.

The writer, in making such changes, never permits the angle made by the *e*, *f* to be greater than 45 deg., and in nearly every instance the angle is kept at about 60 deg. Either angle is safe, but the 60-deg. angle has a better factor of safety and should be used whenever possible.

NEW YORK CITY. JAMES FRANCIS.

THERMIT FOR STEAM-PIPE REPAIRS.

Will some of your readers who are acquainted with thermit advise me if that substance can be used for making emergency repairs to large steam pipes, fittings or heaters, etc.? Could a broken casting be mended with thermit in a few hours in such a manner as to enable steam machinery to be used until permanent repairs could be made? Or, are repairs made with that material of a permanent nature? As understood by the writer, thermit is a mixture of substances which permits combustion to proceed in the mixture under certain conditions, the heat of combustion thus obtained being sufficient to melt iron and some other substances when mixed with or in contact with the thermit, the oxygen necessary for combustion being supplied by the materials composing thermit ingredients. If thermit is available for mending castings, it would be invaluable when frost has knocked the bottom out of a power pump, or cracked an elbow. It would prove very satisfying to be able to mend a split place in one side of a water pipe; and to the marine engineer, thermit would be a godsend for everything, from patching a hole in a Scotch boiler to repairing a broken wheel-shaft. They can mend rubber posts with thermit without taking the part from its place in the vessel. As that is possible, why cannot the substance be used for emergency repairs in the engine room and in the boiler house? Why is not the electric worker equipped with thermit as a part of his regular working material?

Boston, Mass. John Jackson.

DYNAMOMETER DYNAMO BELTS.

A central station engineer recently said to the writer: "I wish someone would invent a dynamometer belt which could be put on any pair of pulleys and indicate the exact amount of power which is being transmitted." After considerable study, the writer found that by the proper observance of the conditions under which a belt is working at any given time, the power being transmitted can be calculated with a considerable degree of accuracy. In Fig. 1, a belt is shown under supposedly working conditions, the pulleys being located on shafts level with each other. It will be observed that when the belt is working, the upper, or idle fold sags 6 in. from a line drawn across the top of each pulley. The lower, or working fold of the belt sags 3 in. The belt is of double leather, 10 in. wide, and weighs 2 lb. to the square foot. It is possible to determine the power of this belt from the simple factors of suspended belt length, weight and the amount of drop. The curve formed by any belt suspended between two fixed points is known as the catenary, and its functions are as shown by Fig. 2, which represents a string or a chain hung between two nails. Ordinarily, the equations for the catenary are very hard to manage because of the angle v, which must be measured with considerable accuracy, and until that angle is known little can be done toward making the necessary calculations. But by the aid of a table given in Nystrom's "Elements of Mechanics," the catenary curve as manifest in a suspended belt may be easily and quickly handled. For convenience, the table in question is reproduced in full herewith:

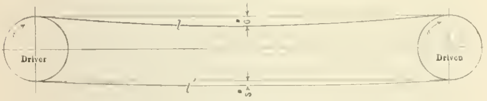


FIG. 1.—WORKING AND STANDING STRESS IN A BELT.

TABLE FOR THE CATENARY CURVE.

Angle v	Abscissa x	Ordinate y	Curve l	$\frac{y}{x}$	$\frac{l}{y}$
30	1.00000	1.31690	1.73210	1.3169	1.3153
40	0.55573	1.01068	1.19175	1.8186	1.1792
45	0.41421	0.88137	1.00000	2.1278	1.1346
50	0.30540	0.76291	0.83910	2.4981	1.1000
54	0.22078	0.65284	0.70021	2.9570	1.0725
60	0.15470	0.54930	0.57735	3.5507	1.0511
62	0.13257	0.50940	0.53171	3.8425	1.0438
64	0.11260	0.47021	0.48773	4.1759	1.0372
66	0.09484	0.43169	0.44523	4.5518	1.0314
68	0.07853	0.39376	0.40403	5.0141	1.0261
70	0.06418	0.35637	0.36397	5.5527	1.0213
71	0.05762	0.33786	0.34433	5.8636	1.0192
72	0.05146	0.31946	0.32492	6.2079	1.0171
73	0.04569	0.30116	0.30573	6.5914	1.0152
74	0.04030	0.28296	0.28675	7.0213	1.0134
75	0.03528	0.26484	0.26795	7.5068	1.0117
76	0.03061	0.24681	0.24933	8.0631	1.0102
77	0.02630	0.22887	0.23087	8.7023	1.0088
78	0.02234	0.21099	0.21256	9.4445	1.0073
79	0.01872	0.19318	0.19438	10.820	1.0062
80	0.01543	0.17542	0.17633	11.372	1.0052
81	0.01247	0.15773	0.15838	12.654	1.0041
82	0.00983	0.14008	0.14054	14.254	1.0033
83	0.00751	0.12248	0.12278	16.309	1.0025
84	0.00551	0.10491	0.10510	19.046	1.0018
85	0.00382	0.08738	0.08749	22.874	1.0013
86	0.00244	0.06987	0.06993	28.613	1.0008
87	0.00137	0.05238	0.05241	38.171	1.0005
88	0.00061	0.03491	0.03492	57.270	1.0002
89	0.00015	0.01745	0.01745	114.586	1.0000

Referring to Fig. 2, it will be seen that there is a half-length of span, y, and a depth of curve, x, both of which are given in Fig. 1, where y is 150 ft., the half distance between the pulleys, and x is 6 in. for the idle, and 3 in. for the working fold of the belt. There is a column in the table which gives the values of $y : x$, and for the idle fold of the belt $y \div x = 150 \div 6 = 25$. For the working fold, $y \div x = 150 \div 3 = 50$.

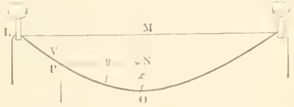


FIG. 2—CATENARY CURVE.

Looking up these quantities in the table, it is found that in the column $y \div x$, by interpolation, $25 = 85.5$ deg. and $50 = 87.8$ deg., nearly. The above calculations neglect the slight shortening and lengthening of the distances l, and l^1, Fig. 1, caused by the belt hanging a very few degrees on either side of the vertical center line of the pulleys. There is also neglected the slight variation in the length of the belt folds due to the sag of the belt between the pulleys. In case of the upper, or idle fold, the two neglected quantities will nearly balance each other. In the working fold, they are very small, hence both are neglected and the shaft distance is taken for the length l of the catenary curve, Fig. 2. Or, one-half the belt length

The strain at the supports may be found directly the angle of the angles v and v^1 are known, together with the weight W of the 12.5 ft. of double belt, which, taken as l in. wide and 3 oz. to the foot = 18 oz. to the square foot (16 oz. is a minimum weight for single leather belting) making the weight of the 12.5-ft. x l-in. strip equal to 2.33 lb., therefore, $W = 2.33$.

Using the formula: $F = (W \sin v) \div (\sin 2v)$, and having found that: $W = 2.33$; $v = 85.5$; $v^1 = 87.8$; F = strain on the belt at L, Fig. 2: $\sin v = .99692$; $\sin v^1 = .99926$; $\sin 2v = .15643$; $\sin 2v^1 = .07642$. Then by substitution: $F = 2.33 \times 0.99692 \div 0.15643 = 14.94$ lb.

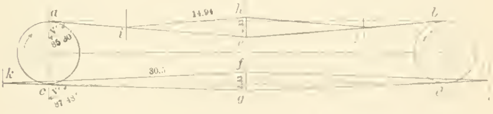


FIG. 3.—GRAPHIC METHOD OF CALCULATING BELT PULLS.

The pull on the idle fold of the belt is, therefore, 14.94 lb. (slide rule calculations) to the inch of belt width. For the working fold of the belt, the angle v, = 87.8, the pull on the belt will be: $F = 2.33 \times 0.99926 \div 0.07642 = 30.5$ lb. The difference between the pull of the working and idle folds of the belt: $30.5 - 14.04 = 15.56$ lb. to the inch of belt width, and it is at once evident that the belt is not loaded to its full capacity.

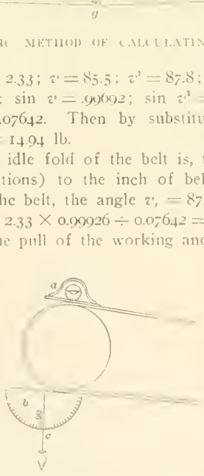


FIG. 4.—MEASURING BELT ANGLES.

The tension of the belt when at rest may now be found, for the sum of the pulls upon both folds of the belt is the same, no matter whether the belt is working or standing still. The sum of the pulls: $30.5 + 14.04 = 45.44$, which, divided by

$2 = 22.72$ lb. for the initial strain in the belt to the inch of width when standing idle. It is evident that this belt is underloaded and can stand being tightened provided there is need of it—so as to do twice as much work.

There is another way of obtaining the load on the dynamometer belt, and that is by the graphic method. Fig. 3 illustrates this method, the pulleys being drawn to scale and placed the actual distance apart and on the same level. It is not necessary to draw the catenary of the belt, the tangents formed by the belt at the points where it reaches and leaves the pulleys, as shown at *a b c* and *d* sufficing. The lines *a* and *b* intersect at *e*, from which the weight of the belt is laid off vertically, $e\,h = 2.33$, by any convenient scale. It is not necessary that the same scale be used as was employed for laying out the drawing of the pulleys, for any convenient scale will answer.

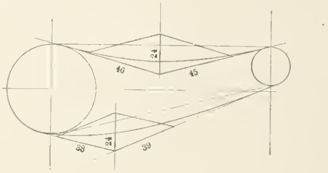


FIG. 5.—PULL OF LOOSE BELT.

Having laid off the distance $e\,h = 2.33$, the line *h i* is drawn parallel to *e b* until it intersects line *a e*, at *i*. Then line *h j* is drawn parallel with line *a c*, intersecting at *j*. With the same scale used in laying off *e h*, the lines *h i* and *h j* are measured and found to be 14.94, the belt tension at *a* and at *b*, as was calculated.

In a similar manner tangents *c g* and *d g* are drawn at the angle upon which the working fold leaves and reaches the pulleys. These lines intersect each other at *g*, upon which a perpendicular 2.33 long is erected, as before described, and the lines *f k* and *f l*, drawn from the point *f*, as described for the lines of the idle fold of the belt. It is found that the lines do not come together until past the centers of the pulleys. This makes no difference, the tangents are produced to *k* and *l*, where the lines actually intersect. Measuring the lines *g k* and *g l* shows them to be 30.5 long, and this quantity is the belt pull in pounds to the inch width of belt as found by the calculations, thereby checking the figures obtained in that manner. There are several ways of obtaining the angles of the belt, and two simple ways are shown by Fig. 4. The method shown at *a* calls for the use of one of the little iron levels in which there is a loose disk which carries the bubble vial. The disk is graduated in degrees, and has a movement of 90 deg., so that the tool may be used for indicating horizontals and perpendiculars, and any included angle, by simply turning the loose disk until its position against the graduated circle indicates the angle desired. It is, then, only necessary to place a strip of wood or metal parallel with the direction of the belt where it leaves the pulley. Once the strip is erected correctly, it is only necessary to take its angle with the little instrument described, and lay that angle down upon the drawing.

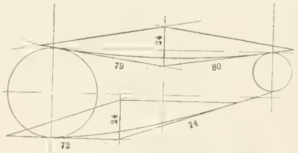


FIG. 6.—EFFECT OF TIGHTENING THE BELT.

Another method, shown at *b*, Fig. 4, makes use of a half-round piece of board, a plumb bob, a string to hang the bob, and means for supporting the half-round board parallel with the belt, as shown at *b*. The board is graduated into degrees. This can be done with sufficient accuracy by using a pair of sharp-pointed dividers, a square, and, if at hand, a set of triangles. The board is sighted along the tangent line, as shown at *b*, and the angle of the belt is read directly from the string *c* and the graduation on the board. This rig is known as the "Goniometer," and it is a very handy instrument where grading and simple leveling have to be done without an engineer's level.

Fig. 5 shows a pair of pulleys of different diameters which are connected with a very loose belt. The upper side of the pulleys are level, but the lower belt, which is the driving fold, runs at a considerable angle. It will be noted that the pull of the idle fold of the belt is 45 lb. and 46 lb., being more at the larger pulley. The belt load, or weight, in this and subsequent examples, is taken as 24 lb. to the inch of belt width. The manner of drawing the strains representing the working fold is very clearly shown and needs no further description. In Fig. 6 the same arrangement is shown as in Fig. 5, with the exception that the belt has been tightened and shows a working pull of 72 lb. and 74 lb. on the large and small pulleys, respectively, against 38 lb. and 39 lb. for the very loose belt shown by Fig. 5. It should be noted that the level fold of the belt shows a greater strain than the inclined fold—a very convincing argument in favor of the level belt whenever it can be thus arranged. The effect of a much greater inclination of the folds of a belt is shown by Fig. 7, the two transmissions, *A* and *B*, being identical, the shafts the same distance apart, the pulleys the same size, and the angle made by the two shafts the same in either sketch. With the small pulley uppermost, as in sketch A, there is, with the same 24-lb. belt load, only 16 lb. and 29 lb. pull in the belt at the large and small pulleys on the working fold, respectively, and 39 lb. and 57 lb. pull on the driving fold of the belt. Sketch B shows about the same pulling strain, but the stress in the idle fold of the belt is very small on the smaller pulley—only 11 lb. Evidently this arrangement should be fitted with a tighter belt if work of any account is to be done.

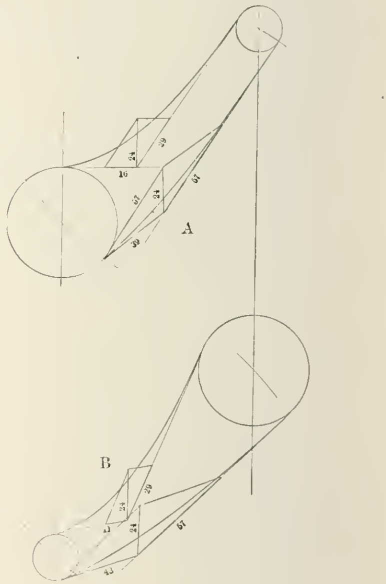


FIG. 7.—POWER OF INCLINED AND VERTICAL BELTS.

The graphical method of ascertaining belt pull may be employed to show the benefit of making the upper fold the working fold of the belt. As shown by Fig. 8, sketch A, the strain in the belt is 38 lb. and 67 lb., idle and working folds, respectively; useful stress of 67 — 38 = 29 lb. With the direction of rotation reversed, as shown by sketch B, the working strain goes up to 73 lb., the idle fold pull increasing to 45 lb., against 38 lb. and 67 lb. The total pull on the belt, as in sketch A, is 105 lb. The total pull with the loose bottom fold is 118 lb., an increase of 13 lb. to the inch width of belt. The working strain, the net useful pull, is less by 1 lb. than with the loose belt fold properly arranged on top of the pulleys.

To return to the reading of the dynamometer belt depicted by Fig. 1. Assuming that the pulleys are revolving at 200 r.p.m., the horse-power transmitted to the belt may be found as follows: Belt velocity = 2520 ft. a minute; belt pull = 15.56 lb. to inch of width; belt width = 10 in. Then 2520 + 15.56 × 10 ÷ 33,000 = 11.9 horse-power. Were there a greater load to be carried, there would be a greater difference in sag of the folds of the belt, and the difference in the amount of sag for any belt may be made a constant by means of which the power being transmitted at the time the sag is measured may be ascertained with exactness.

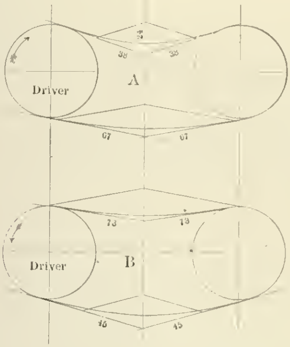


FIG. 8.—ARRANGEMENT OF WORKING AND IDLE FOLDS OF BELT.

Thus the power-transmitting capacity of any given belt depends entirely upon the weight of that belt between the points of suspension. These points are where the belt leaves the pulleys. There is, however, another factor which comes into calculation when a belt is strained to its utmost, or where a vertical belt is used. In the latter case the pull on the upper pulley will equal the width of the belt, and the strain on the belt at the lower pulley will be 0. The driving power of such a belt must, therefore, be obtained by the elasticity of the belt material, as if the belt were an elastic band; hence the poor driving power of vertical belts.

Willoughby, Ohio. James F. Hobart.

THAWING CONDUITS BY ELECTRICITY.

We are all acquainted with the process of thawing water pipes electrically, but it may be of some interest to readers to know of a case of thawing ice in telephone conduits by electricity.

A dip in a 3-in. iron conduit for telephone wires having frozen up in Stockbridge, Mass., the telephone men went to work with a thawing outfit, consisting of a block-tin tube, a force pump and hot salt water. They were, however, only able to push the tube 50 ft. into the conduit owing to its bending when they tried to enter it further. Our foreman having suggested the use of current from the street lighting mains, the central station company was finally asked to allow the method to be tried. A few lighting transformers were connected in multiple and a current of 250 amperes was sent through the 296 ft. of conduit, the sheathing of the 60-pair cable being connected to the conduit at each end in order to avoid any possible arc between the lead and the conduit. After the current had been on a half-hour only three pairs out of the 40 pairs of wire in trouble remained short-circuited, but to make certain, the current was kept on two hours longer. Unfortunately, shortly after the lines came clear all the 60 pairs of telephone wires became grounded, which was due, as was discovered later, to a crack in the sheathing, caused by the freezing of the water in the cable. It was also found that the current did not thaw out all the ice, and therefore a strong solution of hot salt water was pumped into the conduit until it ran out quite freely at the distant manhole. The salt water remaining in the conduit will, in the opinion of the cable man, prevent further freezing up. The old cable was pulled out and found to be flat in several places, one flat section being 25 ft. in length. A new cable was then pulled in in its place.

We are greatly indebted to Mr. Stephen W. Field for encouraging and assisting our experimental work.

Lenox, Mass. Rogers Electric Company.

PAINTING GALVANIZED ELECTRICAL SIGNS.

I have noticed in recent issues numerous requests relative to painting electric signs, and having had experience in this class of work, the following method of painting the signs by means of which the paint will not peel off, may be of interest to your readers. A pound and a half of crude gutta percha should be carefully dissolved in 5 gal. of turpentine. To do this a large iron kettle should be placed over a good fire and watched so that the contents will not boil over and start a fire that could not be easily extinguished. If a vessel of generous size is employed, there will be no danger, and it is best to be on the safe side. When the contents are dissolved the mixture should be strained through several folds of coarse cheese cloth. Enough of the solution should then be mixed with burnt umber ground in oil to give a paint of the proper consistency which will work easily. This should be used as a first coat. To prepare the galvanized iron for this first coat, it should be thoroughly washed in strong, boiling soda water. This will remove all grease and acid from the metal, and as the water is hot the metal dries very quickly after being washed. If there is any small scale on the metal it should be removed with emery cloth. After being washed the metal should not be touched with the bare hands because where the hands touch it a little moisture remains and it is in such spots that the paint is liable to peel off. The sign may then be given its first coat of burnt-umber paint and afterward baked in a japanner's oven at a temperature of about 300 deg. Fahr. with a quick fire taking one and one-half hours, or at a temperature of 275 deg. with a slow fire taking three hours. The first coat is the most important, because if it sticks on the other coats will stay on. For a clear white sign, two coats of French zinc are usually sufficient if the sign is afterward finished with a good coat of white demar varnish. This makes the sign proof against weather, and galvanized signs painted as outlined above will withstand very severe climatic changes without peeling.

Chicopee Falls, Mass. Peter Ransom.

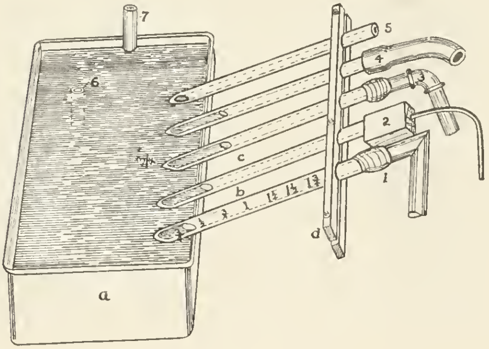
A MULTIPLE-DRAFT GAGE.

An engineer who had become interested in the reduction of the amount of draft between the base of a stack and the firebox made a number of experiments with a draft gage which he attached in succession to different portions of the boiler setting with the result that some very interesting things were observed from time to time. Among other things he noted the variation of pressure in the base of the stack when the fires were being forced, owing to the greater heat delivered to the stack with the products of combustion. He also observed that an increase in the height of the water column which was sustained by the negative pressure (below the pressure of the atmosphere—in this letter the height of water in the draft gage glass will be alluded to as "pressure" for facility of description) took place in a gage connected with the firebox whenever the fires became dirty and in need of cleaning.

It was also observed that the pressure fell when the tubes became very dirty, thus preventing the full effect of the draft being felt in the firebox. Several openings in the shape of cracks developed in the setting and the pressure of draft was sensibly affected by the closing of these holes. In another instance, with another boiler which was supposed to have too much tube area for the amount of opening in the grate, the engineer proved his contention by demonstrating by the draft gage that two or three of the tubes could be plugged without in the least reducing the draft pressure, while an increase in the area of grate opening increased the draft pressure.

Considerable experimenting with the draft gage, in one position and another, led the engineer to very much desire to have the gage attached in two places at the same time. He then fitted up two gages, and soon felt the need of a third and a fourth, each connected to a different portion of the interior of the boiler setting. Finally the engineer decided to construct a multiple gage which could remain permanently attached to the boiler setting, and to as many portions thereof as might be found necessary. To this end a gage was made as shown herewith, a heavy galvanized-iron tank *a* being impressed for duty as the body of the gage and fitted with a water-supply pipe *7* and an overflow pipe *6*. By means of this arrangement water would be always at the same level in the tank *a* as long as the smallest possible quantity of water was permitted to flow from pipe *7*. For the gages plain glass tubes were used, some 18-in. x ¾-in. water-line glasses being requisitioned for the purpose. A wooden clamp *d* was rigged up to hold the tubes securely in place and when the three carriage bolts in *d* were screwed lightly home the tubes were held in position as shown at *b*, *c*, etc.

The tank in this instance was located in the engine room nearly 20 ft. from the boiler, and the engineer evidently found it very hard to secure sufficient piping to connect up the different gage tubes. In the gage shown by the engraving, glass *3* was connected into the base of the stack, while glass *2* was connected into the back combustion chamber just below the back arch. Glass *4* was connected into the up-take just above the front end of the tubes, while glass *1* was connected with the interior of the firebox. Glass *5*, not yet connected, is in communication with the inside of the ashpit in order that the effect caused by closing the ashpit doors may be fully studied.



MULTIPLE-DRAFT GAGE.

The variety of connecting tubes and the ingenuity of the engineer in adapting so many different articles to his use is an example of "getting there" which could be studied to advantage by the few engineers who do nothing to improve their conditions or surroundings. This draft gage furnishes a splendid example of how one engineer made things work even though they were not especially suited for the work. It was useless to ask the owner for 100 ft. of pipe for connecting-up the several gages, so the engineer laid hands upon everything he could find around the premises which had a hole through it and which did not leak. Gage *3* is piped with ⅜-in. gas pipe; glass *1* was connected by means of a tin speaking-tube soldered to make it air-tight; glass *2* was conected by means of some seamless-drawn copper tubing less than ⅛ in. in diameter; glass *4* was connected by means of pieces of rubber hose joined together by short pieces of steam pipe forced into the ends. The hose was simply slipped over the end of one of the glass tubes, but the other connections were made by means of a piece of tin to cover the joint between the glass and the connecting tubes, then adhesive tape was wound over the tin and a short distance upon both glass and connecting tube, thus making a strong, though homely, air-tight connection. To connect the small copper tubing a block of wood was bored to fit the glass and the copper tube, both of which were liberally dosed with shellac and slipped into place and daubed with more shellac until air-tight. The glasses were graduated to quarter inches of vertical distance between the level of the water in tank *a* and the point to which the water rose diagonally in the glasses. Thus in glass *3*, as shown at *c*, the water advanced several inches into the glass tube, while its vertical height was just ¾ in.—a fairly good draft for the base of a stack. Some of the glasses were marked with a file to ¼ in., but the engineer intends to supply a more convenient means of graduating by placing adjacent to each glass a nicely marked and figured scale which will be well shellaced to protect it from moisture and dirt.

The engineer who has arranged this gage claims that it has resulted in saving at least two tons of coal each week besides adding considerably to the probable life of the boiler and lessening his labor when firing and when wheeling ashes and cleaning fires.

Columbus, Ohio. J. H. Franklin.

EXCITER UNITS IN LARGE PLANTS.

While in every large plant there should be two exciters of such size that either can carry the entire direct-current load of the station, there are many other points about the exciter circuits that should call for thoughtful consideration. The question of duplicate exciter buses has little effect on the efficiency of the equipment. The advantages are few, and hardly to be compared with the disadvantage of the resulting switchboard complication, requiring a double-throw field switch on each generator, as well as double-throw exciter switches, or a large tie switch to tie the buses together. It would also be very inconvenient to change the generator field circuit from one bus to the other without cutting the machine out of service. The exciter bus may be made short, and if well located and protected, the chance of trouble will be negligible.

The exciter switches necessarily carry heavy currents, and should be made of ample capacity. The clips should be carefully lined up so as to make good contact, or there will be a tendency to heat. If the switchboard is not too far distant, the equalizer connection may be brought to the board; or it can be placed on a stand near the machine. Single-pole switches are preferable to double or triple pole switches, because in case it is necessary to cut the other exciter into circuit, and the machine refuses to build up or builds up reversed, some delay would result in disconnecting the armature lead on the machine terminal board in order that the field magnets might be energized from the busbars. In the case of single-pole switches, it would only be necessary to leave the armature lead switch open, closing the equalizer and the other switch. This would put the series-field coils in parallel with the series-field coils of the running machine, and be sufficient to cause the machine to pick up properly. In an emergency, when the spare exciter would be needed immediately, this might save much delay and prevent loss of load. Although a machine of this class rarely refuses to pick up, it is still possible and of great enough importance to invite serious consideration. There should be a reliable circuit-breaker in one lead of the exciter, preferably the lead coming direct from the armature; this circuit-breaker should be set to open only on an extremely high overload, as it is very undesirable for the exciter circuit to open, except in extreme cases, as the entire load would be lost.

Philadelphia, Pa. F. E. Conrad.

QUESTIONS AND ANSWERS

Is it safe to ground the secondaries of transformers on water pipes?
R. P.

Yes. Use a grounding clamp as recommended in the National Electrical Code.

How does a polyphase meter differ from a single-phase meter?
S. I. N.

A polyphase meter consists practically of two single-phase meters driving one common shaft so as to record at the total rate of the two driving elements on a single train.

In installing transformers for stepping down the voltage for a motor load, what ratio of transformer rating to motor rating it is usual to follow?
J. L.

It is usual to allow one kilowatt of transformer rating for each horse-power of motor in use. In elevator work and for variable-speed motors 1½-kw transformer rating to 1-hp motor rating is sometimes installed.

Can a three-wire load be accurately measured by two two-wire meters?
H. P. T.

Yes, if the load on the three-wire system is very much unbalanced, the two meters will give a more accurate result than a regular three-wire meter. On heavy three-wire loads it is usual to install suitable two-wire meters, one in each outer with pressure taps to the neutral.

Can two transformers of the same make be operated in parallel, and will they divide the load properly?
S. S.

If two transformers, either of the same or different ratings, have the same inductive drop at a given current, the transformers will divide the load proportionately to their ratings. The chief requirement of transformers operating with proper division of load is the equality of impedance volts.

In shutting down a generator, how low should the voltage be before disconnecting the field circuit?
W. O. M.

As a general rule all of the resistance in the field rheostat is placed in circuit before the field circuit is broken. The field switch is usually provided with a discharge resistance to absorb the kick so that no harm results when the field circuit is opened even if all of the field rheostat has not been cut in. It would be better, however, to reduce the voltage as low as the rheostat will permit.

We have a three-wire generator with a balancing transformer designed for 110-220 volt operation. We also have a 220-volt two-wire system in operation, and would like to know if the three-wire generator could be used at times to carry the load on this system. If so, what change would be necessary?
H. L. M.

Insert a switch in the circuit leading to the balancing transformer so as to cut this out of circuit when not needed. The three-wire machine may then be used as an ordinary two-wire generator. The transformer might be left in circuit if necessary without detrimental results; but it is better to take it out of circuit completely.

What is the construction, use and operation of the Pupin coil?
C. C. D.

The Pupin self-induction coil is employed on overhead and underground telephone circuits. The coils are inserted at intervals in the underground or overhead circuits, and serve to diminish the damping effects of the line upon the talking current. The arrangement and dimensions of the coils are so chosen that a certain decrease in the damping effect and a considerable improvement in the clearness and strength of the sound take place. For cable lines, the coils are wound on one round iron core for both wires of the circuit, and the cores with the coils are mounted in a water-tight, cast-iron box. The beginning and the end of the coils are brought out separately to a joint, so that the whole apparatus can be directly inserted in the cable line. For overhead lines the coils for the two wires of the circuit are constructed separately and each is mounted on top of an insulator. The insulator bearing the Pupin coil, together with a lightning arrester, is fastened to an iron bracket resting on an iron cross-arm. Other details of construction are not available.

How may the ratio of transformation of a transformer be determined?
T. I.

Connect the two windings to be compared in parallel with a couple of cells through variable resistances of known value: as, for instance, through two arms of a Wheatstone bridge. A millivoltmeter is connected to another winding on the same magnetic circuit and the resistances adjusted until no throw of the voltmeter needle is produced on closing the battery circuit The ratio of the windings will then be the same as the ratio of the resistances in series with them. The resistances should be large enough to make the resistances of the transformer windings negligible in comparison with them and the windings should be so connected that the fields due to the currents in them are oppositely directed.

I have been told that extremely cold weather affects the oil in oil transformers and makes them dangerous to operate. Kindly advise me if I was correctly informed?
G. D.

Almost all transformer oils are said to precipitate paraffine in extremely cold weather. When this occurs the oil is robbed of its dielectric strength. However, cold weather does not affect ordinary line transformers that are always in circuit. It is only in cold climates where the plant runs all night, for instance, and is shut down during the day that such trouble is likely to occur. Moreover, no evil results have been reported on distribution networks operating at 2200 volts. It is on 10,000 up to 50,000-volt circuits that such transformer troubles usually exist, although it is not uncommon to find transformers which have been out of circuit for a couple of months during severe winter weather completely frozen up.

In Behrend's "Induction Motor" the formula for a concentrated winding is given as $E = 2.22 \times \text{frequency} \times Z \times \phi \times 10^{-8}$. I have always understood that constant in this formula is 4.44, instead of 2.22, and would be obliged if you would inform me why 2.22 is used. Will you also inform me how a lap-wound, single-phase stator winding should be connected for a given number of poles? How many slots should there be in the stator of a four-pole field with five slots per pole, assuming that a uniformly distributed lap winding is to be used (single-phase)? Define the pole pitch of such a winding.
C. T. V.

In the e.m.f. formula of Mr. Behrend, the constant 2.22 is the exact equivalent of the usual constant 4.44, because with the former constant use is made of the conductors, while with the latter formula use is made of the turns, each turn having two conductors. Commercial single-phase induction motors are wound just as though they were intended to be used as polyphased machines; in fact, one large company uses a three phase induction motor for this purpose. Another large company uses a two-phase induction motor with twice as many coils in one phase as in the other. The latter phase winding is used for starting purposes only. Your question as to the number of slots in the four-pole field with five slots per pole, answers itself because $4 \times 5 = 20$. However, a four-pole induction motor would ordinarily have more than a total of 20 slots; 48 would be more nearly correct for a small machine. In single-phase induction motors, as well as in polyphase machines, the coil-throw is ordinarily somewhat less than the pole pitch, the value varying from 60 to 80 per cent. Assuming a four-pole, 48-slot stator, quite independent of whether the machine is to be wound single phase, two phase, symmetrical or unsymmetrical, or three phase, there could be 48 coils, and each coil could be placed in slots numbered 1 to 10 throughout. If this machine is to be connected as a three-phase motor or as a single phase motor started as an unsymmetrical three-phase machine, the coils should be connected in 12 groups, each containing four coils These groups should then be designated as: a_1, b_1, c_1, a_2, b_2, c_2, a_3, b_3, c_3, a_4, b_4, c_4. Group a_1 should be connected in series with group a_3, and group a_2 should be connected in series with group a_4. These two series connections should then be connected in reverse series to form the windings of one phase The windings of phase "b" and phase "c" should be similarly connected The three separate phase windings can then be joined in either star or delta. If the machine is to be used as an unsymmetrical two-phase motor, phases "a" and "b" can be connected permanently in series to form the main winding of the machine and phase-winding "c" can be used as a starting circuit.

Central Station Publicity.

By Andrew J. Haire, Jr.

ADVERTISING LITERATURE.

The power company in a city of 5000 population, by a well-organized advertising campaign, succeeded in increasing its business just 46.38 per cent. In 1906 the gross income of this company was $21,521.00; and in 1907 it was $31,540.14, representing a gross income "per capita" of $6.30. The main part of the publicity efforts of this company consisted in direct-by-mail advertising, supplemented by some local newspaper advertising and some personal solicitation.

In a city of 100,000 population, the power company upon an outlay in advertising of 5 per cent of its gross income realized an increase in business of 66.1 per cent. In 1905 this company did a business amounting to $137,924.65. In 1906 these figures were increased to $225,000; while the statistics for 1907 are not available at the time of writing, it is believed that this ratio of gain will be maintained, or, perhaps, even increased. To bring about this extraordinary increase, the company employed eight solicitors, advertised in the newspapers and by mail, maintained display and demonstration rooms and operated five electric signs for self-advertising purposes.

In a city of 300,000 population, the power company by judicious advertising increased its gross income in one year from $542,377 to $702,744, a total gain of 29.5 per cent. The methods followed by this company were similar to those outlined directly above. Solicitors, newspaper and mail advertising display and demonstration rooms and electric signs were responsible for the increase in business.

The general spread throughout the electrical field of the publicity spirit has been succinctly summed up by one in intimate touch with the facts and results. The report was made some months ago before the figures for the period of 1907 were compiled. The situation outlined, therefore, represents conditions only as they existed about a year ago. Since then the movement has gained even greater headway. The report reads in part as follows:

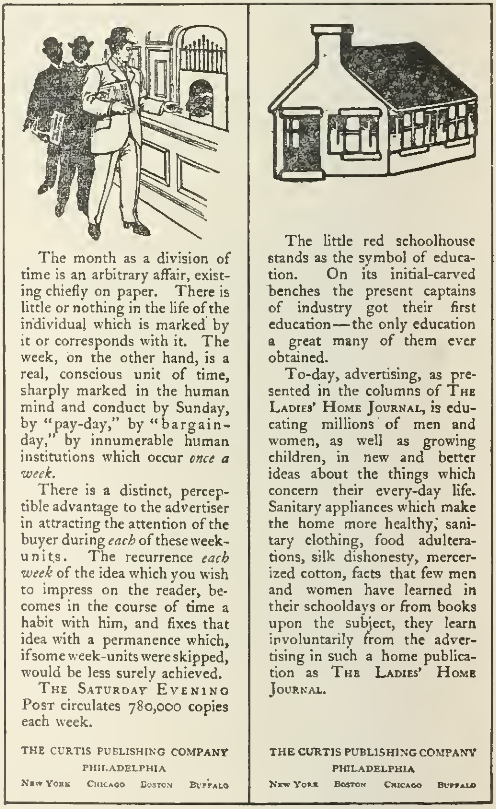
"According to reports obtained from 943 plants throughout the United States, there has been an increase of 65 per cent in the number of 'new business' departments organized in 1906 over 1905. One hundred and sixty-five plants added solicitors in 1906, totaling 331. These solicitors were employed to follow and back up the newspaper and other advertising of these plants. During the year eleven times as many plants began direct advertising as did previously, and eight times as many began newspaper advertising. During 1906 the advertising appropriations were increased by 195 of the plants reporting. For the 43 plants reporting an increase in appropriation in dollars and cents, the total is $43,250; and 33 plants reported increase of appropriations for the year in percentages varying from 25 to 615 per cent for the different states in which the plants are located."

One of the most striking features of these reports is the comparatively small outlay which produced these remarkable results. One to three per cent of the gross income is given by some experts as a sufficient expenditure on advertising to produce in this field the desired results. Others state that a maximum of 5 per cent, if judiciously expended, will bring about extraordinary returns. In one instance, as shown above, an appropriation of 5 per cent of the gross income produced an increase in business of over 60 per cent. In what other branch of business would an appropriation of 5 per cent do so much work? In the retail field it is generally necessary to devote to advertising an appropriation of from 3 to 10 per cent of the total sales to maintain business at its normal level. In the general field even a greater percentage is probably devoted to advertising. Assuredly, the electrical field is rich in commercial possibilities.

Perhaps one reason why the sums devoted to advertising purposes by central stations is comparatively so small is owing to the fact that the newspaper as a medium plays only a minor part in the campaign. Newspaper rates are everywhere admittedly high, and unless every fraction of the circulation may be depended upon for possible results it is accepted as a principle in electric power advertising that almost any other medium is generally as effective and almost always more economical.

The advertising manager of a power company whose business each year runs up into the millions said recently:

"In the average big city the character of the population is such that out of a circulation of, say, 100,000 that some newspapers may have, only one or two thousand may be possible customers. In advertising, the company must, therefore, pay to reach the 98,000 unprofitable ones along with the 2,000 prospects, and it is, as a general proposition, uneconomical to pay for all this surplus publicity. In the average small city conditions are different. Circulations are not so large, nor mediums so numerous; advertising charges are not so heavy and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less, I would utilize the newspapers to a considerable extent.



The month as a division of time is an arbitrary affair, existing chiefly on paper. There is little or nothing in the life of the individual which is marked by it or corresponds with it. The week, on the other hand, is a real, conscious unit of time, sharply marked in the human mind and conduct by Sunday, by "pay-day," by "bargain-day," by innumerable human institutions which occur *once a week*.

There is a distinct, perceptible advantage to the advertiser in attracting the attention of the buyer during *each* of these week-units. The recurrence *each week* of the idea which you wish to impress on the reader, becomes in the course of time a habit with him, and fixes that idea with a permanence which, if some week-units were skipped, would be less surely achieved.

The Saturday Evening Post circulates 780,000 copies each week.

THE CURTIS PUBLISHING COMPANY
PHILADELPHIA
New York Chicago Boston Buffalo

The little red schoolhouse stands as the symbol of education. On its initial-carved benches the present captains of industry got their first education—the only education a great many of them ever obtained.

To-day, advertising, as presented in the columns of The Ladies' Home Journal, is educating millions of men and women, as well as growing children, in new and better ideas about the things which concern their every-day life. Sanitary appliances which make the home more healthy, sanitary clothing, food adulterations, silk dishonesty, mercerized cotton, facts that few men and women have learned in their schooldays or from books upon the subject, they learn involuntarily from the advertising in such a home publication as The Ladies' Home Journal.

THE CURTIS PUBLISHING COMPANY
PHILADELPHIA
New York Boston Chicago Buffalo

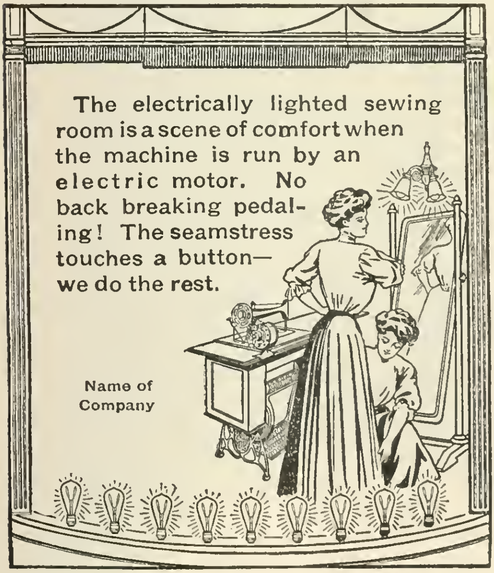
FIG. I.—SPECIMEN ADVERTISEMENT; IDEAS APPLICABLE TO ELECTRIC PUBLICITY.

"Take a whole page or a half-page once in a while on some special occasion, such, for instance, as a reduction in rate, or the inauguration of some new policy or special proposition, or a marked addition to station capacity. At other times use an advertisement each week in weekly papers and about three times a week in dailies, not all the year round, but for certain months in the year, pausing now and again to take breath and gather renewed energy for a new campaign. The size of these advertisements should not be fixed hard and fast, but should vary up from a minimum of five inches single column or four inches double, according to the particular message it is desired to convey."

A series of advertisements published some time ago by the Curtis Publishing Company, of Philadelphia, for the solicitation of the business of prospective advertisers, strikes the writer as containing several good ideas especially applicable to electric power publicity. These advertisements occupied spaces averaging from 75 to 100 lines, single column. In smaller cities it is probable that a rate for this space could be obtained which would bring the price to an average of, say, $10. At this latter figure, such advertisements published about twice a week should not represent too great an outlay, and if the circulation of the paper among property holders was large, the specific educational effect of such advertisements should be exceedingly valuable.

The specific advertisements referred to above were published in the interest of *The Ladies' Home Journal* and *The Saturday Evening Post*. Each advertisement exploited a distinct feature of the service which these publications offered to general advertisers, and in each case at the top of the advertisement was a rough, sketchy drawing which very neatly illustrated the spirit of the advertisement. In one case, for example, where the subject of the advertisement treated of the general uplifting and educational influence of the advertisements published in these two journals, the illustration was of the little red schoolhouse so famous as the symbol of American education. In the case of the other advertisements of the series, the text matter and illustration dove-tailed together with quite the same facility and convincing aptness.

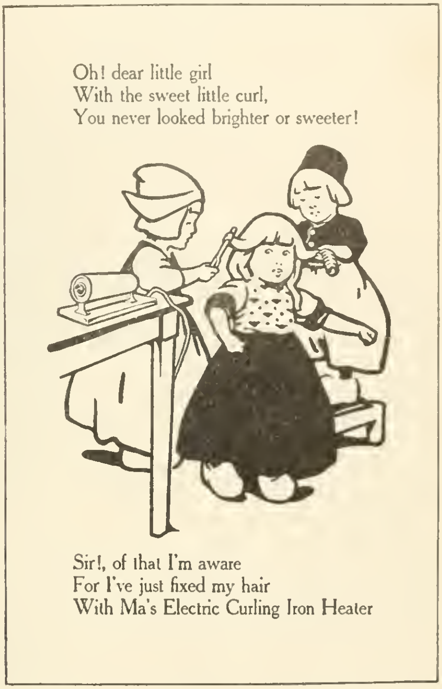
While, as a usual thing, general publicity advertisements are too vague and indefinite to be resultive of any but the most indirect results, it is yet considered advisable for the central station occasionally to devote spaces to this style of advertising. One of the best examples of this character of advertisements that the writer has seen was published by the New York Edison Company. The purpose of the advertisement was to exploit the wonderful elasticity and applicability of the electric current. It measured about 10 in. on two columns, and was illustrated at the top with a rough line drawing showing a section of New York's famous skyline. An irregular border of electric wires, extending down the left-hand side of the advertisement, connected the head-line drawing with a number of knife switches at the bottom of the advertisement and then continued up to about the center point of the right-hand side, where it terminated in a small electric fan, thus aptly illustrating the claim made in text matter that the power supplied by the New York Edison Company lights a whole city with the same ease that it revolves a small electric fan. The advertisement was especially well written; and as advertisers may find it interesting, the text is reprinted below:



The electrically lighted sewing room is a scene of comfort when the machine is run by an electric motor. No back breaking pedaling! The seamstress touches a button—we do the rest.

Name of Company

FIG. 2.—ELECTRIC SEWING MACHINE ADVERTISEMENT.



Oh! dear little girl
With the sweet little curl,
You never looked brighter or sweeter!

Sir!, of that I'm aware
For I've just fixed my hair
With Ma's Electric Curling Iron Heater

FIG. 3.—ELECTRIC CURLING-IRON HEATER ADVERTISEMENT.

"The New York Edison Company supplies light for everything, from the great illuminated signs up and down Broadway to the 1-cp night light in a sick room. It supplies power that whirls the great printing presses in Newspaper Row or revolves an electric fan to keep the sick room cool. It lights the whole city with the same ease that it lights a single light. It whirls a million wheels with the same ease that it turns one. This wonderful service is at the immediate disposal of any Manhattanite for any purpose for a cost much less than he probably supposes. The New York Edison rates are the lowest of any of the world's great cities."

The character of advertising which central stations, as a rule, have found most economical, most effective and most satisfactory generally is direct-by mail advertising, consisting of form letters, booklets, folders and cards. The names of prospects to whom this mailing literature may most profitable be sent are secured in various ways. Telephone and business directories and social "blue books" often contain good workable prospects. The most productive lists, however, are generally those which are supplied by the solicitors themselves. The Brooklyn Edison Company, for instance, realizing this fact, furnishes its solicitors with blanks on which each one is required to send in three names daily, indicating also the character of the advertising to be used, whether power, signs, residence lighting, window lighting, store lighting, etc. A record card is made out for each name, and the cards are filed away in cabinets under convenient classifications. Many companies employ with considerable success this method of securing names of possible consumers of electricity.

Each different phase of the central station's activities should have its own special series of follow-up, form letters, booklets and circulars. There should be a series devoted to the manufacturer who is a prospective consumer of electricity for operating purpose, to the merchant who is a prospective consumer of electricity for lighting and display purposes, to the housekeeper who is a prospective consumer of electricity for lighting and heating purposes and to operate the many labor-saving appliances now exploited by every central station. There should also be a series devoted to the builder or contractor who may be interested in the wiring of new buildings.

As a general rule, the advertising matter which is gotten out by the large power companies compares favorably with the publicity efforts of any branch of business, wholesale or retail. That principle which is known as "incident in advertising" is exceedingly well exercised by the advertising writers of large central stations. For the benefit of those who are not familiar with this theory of "incident in advertising"—one of the fundamentals of good advertising—it may be explained that, reduced to its essence, the idea constitutes the inclusion in an advertisement of some incident in the shape of a comparison, metaphor, simile or other figure of speech or of some reference to a well-understood fact or condition which serves as an introduction to or as an effective peg upon which to hang the "moral" of the advertisment. This "incident" may or may not be extraneous to the subject matter of the advertisement, but when properly applied, it always aids, by contrast, antithesis, suggestion, or direct illustration in making more clear and definite the argument and purpose of the advertisement. In the advertisement referred to in a foregoing paragraph as having been published by the Curtis Publishing Company, this "incident" was supplied by the reference to the "little red schoolhouse."

The writer has before him several pieces of advertising literature which were recently published by the Edison Electric Illuminating Company of Brooklyn. In every case the subject matter of the advertisement is introduced by some "incident." For example, in one folder, which is styled "Increased Cost of Living in Brooklyn" the text opens with the query, "Has the cost of living in the Borough of Brooklyn increased in the last 10 years?" Facts and figures are next quoted to show that the price of all commodities has increased in that period just 29.2 per cent and the advertisement is concluded with more figures to show that the cost of Edison service, on the contrary, has dropped 40 per cent in two years. In another folder, styled "WHY?" the opening line reads, "Why did you discard kerosene for gas?" And still another begins, "When you undertake to supply your family with food, clothing, medicine, nothing but the best and finest articles are good enough. Second rate food or medicine wouldn't suit you at all, now would it?—Then why put up with second-rate light?" In each case, the advertiser stating the "incident" as a premise, logically, though concisely, develops his argument, and the text matter always concludes with some such proposition as, "Write us to-day and our man will call to-morrow," or "Let us tell you how much it will cost to wire your house," or "We will be glad to take up the matter with you. Write us about it."

There are few points more important for any advertisement writer to master than this principle of "incident in advertising." It affords an engaging means of opening an advertisement, and, when fully understood, it effectively holds down the writer to the specific argument at hand and prevents that aimless circumlocution which represents the work of so many advertisers.

It is believed that the best advertisement for the central station is one that is crisp, terse and brief. Sentences should be simple and not intended to convey more than one single thought—in other words, avoid conjunctions. The paragraphs generally should not contain more than three or four sentences, and, whenever possible, the entire advertisement should be restricted to as few paragraphs as possible.

Good printing and good stock are always essential in electric power publicity. Electricity is a commodity of interest mostly to business men and property holders. It is, in many senses, even yet more or less of a luxury, and its advertising, therefore, should be high-grade to correspond with the probable tastes of its possible consumers.

The Advantages of Electric Drive for Textile Mill Equipments.

By Norman G. Meade.

At the present time there are very few industries that do not use electric motors to some extent, and textile mills are rapidly coming to the front as exponents of this modern drive. The large hydro-electric plants recently built in the South find the largest outlet for their energy in the cotton industry. Some of the reasons for the adoption of electric drive are that under certain conditions it is much more economical, owing chiefly to the possibility of connecting the motor to the machine to be driven, or placing it in close proximity to the work, dividing the machines into groups and driving each group by short lines of shafting. The former arrangement eliminates shafting and belting entirely, and the latter reduces the size and length of the shafting, ensuring better alignment and less friction loss compared with long lines of heavy shafting and main belts as in the older forms of engine-driven mills.

Electric drive has the advantage that power distribution is subdivided into many units, each of which is independent of the others. The units or groups are easily controlled and may be stopped for repairs if necessary, or if not producing may be cut out of service, thus stopping all expense on the section. To a certain degree the grouped method of electric driving permits a better arrangement of manufacturing conditions—the location of machines without respect to other groups, so that each set may be placed in the direct line of production. It permits the use of power anywhere within the ordinary limits of an industrial plant, it only being necessary to locate a motor and to connect it to a source of supply by relatively small wires which are capable of unlimited additions and extensions, and when once installed do not require expensive maintenance as is the case with steam pipes, compressed-air pipes, ropes, belts or other mechanical methods.

When the motor forms an integral part of the machine, as with individual drive, the ideal method is found, and this method is coming more prominently to the front as the advantages become more generally known. There is a general reduction in cost on account of the elimination of a number of parts required when belt driven, such as line shafts, belts and pulleys, which in a degree offsets the cost of the motor and controller.

Some important advantages of individual drive are: lighter construction of building, due to absence of shafting, better diffusion of light, both natural and artificial, due to the absence of belts, and full and positive power at the machine. The belt is a flexible method of drive at its best, and when called upon for heavy service, slips and introduces an uncertain factor in the power system, whereas, on the other hand, the electric motor is automatic in its regulation, requiring and delivering power in direct proportion to the demand upon it, and will, in case of emergency, sustain large overloads for a reasonable length of time. Thus, a properly designed machine is capable of maximum production when motor-driven. The most important feature of the individually-driven machine is increased productive capacity, due to an even and easily manipulated speed control. Another important feature is the elimination of oil and dirt common to belted installations, as a single spot caused by a drop of oil falling upon a piece of velvet or silk in the process of weaving is enough to ruin the goods, and on this score alone it is safe to say that the use of direct-connected motors is often justified.

For manufacturing processes where constancy of speed is an essential requisite, motor-drive will be found to be of great service as a means of increasing production, due to uniform speed under constant or varying loads. This is partly accomplished by an elimination process whereby the flexible members of the transmission are omitted. It will be at once apparant that a device as flexible as a belt must have a tendency to slip; that is, to tighten or loosen with changes of load. This introduces certain irregular fluctuations which, if avoided, insures an increase in output.

The induction motor is best suited for textile and other work where the machines operate at a fixed speed, as its revolutions are maintained fairly constant with changes of load. As to the control, where motors are direct-connected to textile machinery, it is customary to connect the switch or clutch controlling the motor to the standard shipper lever of the machinery in question, so that the operators have nothing new to learn in this respect, the machines being started and stopped exactly as they would be in case of belt drive.

There are certain machines in bleacheries and in calico printing plants that require a varying speed of the machines, such as tentering machines, drying cans and printing machines. It has been the custom to operate this class of machinery by means of a steam engine, the speed changes being effected by throttling the steam. This, in a way, is effective, but very uneconomical, for the reason that the small engines require several times as much steam per horse-power as would be required by a large engine. It may be argued that in the case, for instance, of drying cans, the exhaust steam is used for heating; the objection to using the exhaust steam for heating this class of machinery is the detrimental effect upon the cans of more or less oil and foreign matter which it contains. The latest and most approved practice is to use low-pressure steam from boilers designed to furnish steam for heating purposes, and to operate the cans by electric motors.

The facility with which an electric motor may be controlled permits a very much more exact operation, and in the particular instance of a calico printing machine offers a means of abtaining finer register, the exact speed required for the work in hand, and in the "making ready" process considerable economy is effected, it being possible to move the rolls just sufficiently to indicate to the operator that the right register has been obtained, whereas with a steam engine the awkwardness of control usually involves considerable waste. The motor as applied to this class of apparatus is much more compact than the engine; it can be placed out of the way, and the controller being a comparatively small piece of apparatus can be located at a point which, while entirely accessible to the operator, will not in any way interfere with his movements. There will be no dripping pipes to take care of and no oil thrown on the machine or on the goods, as with an engine-driven machine.

The advantages of electric drive for textile mills can, in general, be summarized as follows: Electricity may be readily distributed to any mill section by the installation of the necessary wires, which may be easily and quickly erected. It is not required that the wires follow any predetermined direction or occupy any definite location. The motor can be located at the most convenient point for the driving of a section of machines, room or floor, thus reducing to a minimum the number of belts between the motor and the driving head of a machine. The motor may be located upon the machine, thus eliminating all belts and flexible factors in the power system, applying direct and positive power to the machines at a constant rotative speed. Uniformity of speed is secured, due to the even rotating speed of the prime mover, which is transmitted with exactness to the motors. In cases where the motors are distributed on the group system, the improvement in the producing capacity is very noticeable. Where motors are directly applied to the machines the improvement in the quality and the amount of the product, as well as the decreased attendance, is very marked, it being a great improvement over the group system of motor driving. With a motor directly attached to the textile machine the speeds are maintained at the theoretical maximum, thus accounting for the increase in production. Extension to the mill may be made without reference to the power requirements other than to provide additional motors. The machines may be located with the length of the mill or across the mill, as may be desired. Liability of stopping the mill due to breakdown of the power system is reduced to a minimum. Independent operation of any section can be had if the production is out of balance, if overtime work is required, or in case of breakdown without reference to any other section. Records may be kept of the consumption of each motor, and any deviation from the normal operation of the machine will be immediately indicated, thus showing the mechanical department the necessity for an examination of the producing machinery.

Concentrated Effort in Central-Station Advertising.

By J. O. Little.

The general who picks out a weak spot in the enemy's fortifications and keeps hammering away at it stands a much better chance of success than one who attacks first here, then there, and gives the enemy a chance to recover while he is moving from point to point.

So it is in advertising. The advertiser who out of several propositions selects the one whose acceptance by the public offers the least resistance and keeps hammering away at it, stands a better chance of success than one who distributes his efforts and skips from one proposition to another. After a demand has been created for one thing and people find it a profitable investment, confidence in the advertiser is established and half the battle is already won for his other propositions of a kindred nature.

Take the case of motor-drive and central-station service. Naturally one who is thinking about adopting motors wants to do some experimenting on his own account, and he wants to experiment on a small scale instead of a large. He doesn't want to try a half dozen different applications at once, but a single one. If he finds that this application means economy and convenience, he is in a mood to take other applications into consideration.

He wants to make a trial of some one application. Therefore it is better for the central station to pick out some application that makes a good demonstration and concentrate its advertising efforts upon it. A small expenditure so concentrated means more than a large expenditure spread over the whole field of application. One who is told every week for six weeks of a different motor application is liable to become confused by the magnitude of the proposition, and to decide that he cannot afford to consider it. On the other hand, one who is told every week for six weeks of the same application, and impressed with one or two points in its favor at a time, is very liable to decide that he'll try it just for luck. After he has tried one application and found it to his liking, then is the time to approach him with another and another. What the central station wants is to sell energy, but what it must advertise are motors and their applications. After the motors have been sold, the energy sells itself.

A motor that offers a simple, everyday application and that can be attached to the lighting circuit, offers the greatest possibilities in advertising. Moreover, a motor that goes into the home is preferable to one that goes into the factory, for the reason that a man has more leisure at home and is more likely to form an intimate acquaintance with it. Even if your ultimate object is to get him to use motors in his factory, the best place to begin on him is at home. Let him see what a motor will do there and it will not take very much argument to persuade him that it will not do less in the factory.

If it were not for the fact that the fan motor is looked upon by the layman more as a fan than as a motor, it would undoubtedly be the best application upon which to concentrate advertising. Few people ever saw the blades of a fan driven by anything but a motor and so they do not think of it as a substitute for hand or mechanical power. The fan has almost outgrown its parentage. Many people look upon it as belong ing to the electric light rather than to the motor family. If you were to ask the average man who has used electric power only in connection with his fan what he knows about motor drive, he would perhaps answer "nothing." But ask a man whose wife has a sewing-machine motor the same question, and he will be apt to entertain you half an hour.

For many reasons the sewing-machine motor is an ideal application for a central station to advertise. Sewing machines are used everywhere and almost every family has one. Every woman who sews knows of the backaches and fatigue constant pedaling produces, and is thankful for the complete emancipation the motor affords. Any one can use the sewing-machine motor. Through the use of a motor which will fit any type, the sewing machine becomes the simplest and most economical of machines to equip.

It is a splendid example of the convenience and economy of electricity. An advertisement of the sewing-machine motor appeals to both men and women, and thus its force is doubled. If a man is interested in electric drive at all, he won't mind spending a few dollars to try a motor on the sewing machine. If he is not yet interested in it for his own purposes, he may have enough thought for his wife's welfare to get her a sewing-machine motor. When she once has it, he will become interested in electric drive in spite of himself.

Few men are so lacking in curiosity or interest as not to want to "monkey" around the sewing-machine motor a few times at first, and this "monkeying" has real advertising value to the central station. It's an introduction to the use of electric power that should, by proper follow-up methods, lead to many other applications, both in the home and in the factory.

The sewing-machine motor is one that serves as a good basis for comparison. With proper care, one should last long enough to reduce the investment to less than a cent a day. The energy consumption of a good motor is about that of a standard lamp. These figures make a strong argument in advertising, and when the motor becomes a fixture in the household, other applications can be compared to it in cost and energy consumption.

Then the influence of a sewing-machine motor goes far beyond the immediate family. No woman who gets one ever keeps that fact to herself. She exhibits it to her friends and callers and shows them how it operates. She is proud of it, and when she goes to the card club she refers in the most casual manner to "my sewing-machine motor." When she goes to the sewing circle she pauses in her work, heaves a sigh and says, "My, I wish I had my sewing-machine motor here; it's such a help." To say with the poet, "Our loving friends advertise us" is putting it mildly.

The central station that makes such an application the central figure of its advertising and fails to get people's attention, can't expect to get them interested in anything electrical very soon. Let them once get interested to the extent of trying the sewing-machine motor, and the percentage that actually become enthusiastic over it will be surprising high. When people once become enthusiastic over one application it in itself is the best advertisement the central station can have.

A Sensational Advertising Scheme in Denver.

The following quotation from a recent issue of the Denver *Post* describes a remarkable advertising scheme recently worked by the Denver Gas & Electric Company:

"The mysterious Mr. Bountiful, impersonated by Mr. C. N. Stannard, secretary of the Denver Gas & Electric Company, last night ran the gauntlet of an unusually large crowd between the offices of the Denver Gas & Electric Company and the downtown store of the Scholtz Drug Company with $50 in his outside left-hand pocket within the reach of all and offered the first man or woman who should indentify him the privilege of simply reaching up and getting the money.

"As the exploit had been previously advertised, the crowd which filled Curtis Street at Sixteenth for the space of a block each way was as great as if Bryan, instead of coming to town on Monday next, had come by balloon and dropped suddenly into the midst of the metropolis.

"'There he goes!' 'That's him!' 'Wait a minute, partner!' 'Oh, I've got you, Mr. Bountiful!' The air was full of such exclamations. And at the same time hundreds were exploring the outside pockets of other hundreds without avail. It was a pleasant, jocular crowd, but there was real excitement when shortly after the clock struck 8 a half dozen young fellows shouting, 'Here he is; he's got the money,' rushed upon an inoffensive young chap who almost breathlessly declared he had only car fare. It wasn't any use. The gang had been laying for him, and from plans and specifications which they had received they felt certain of their prey. It was useless for the young man to protest. They swooped down upon him and were 'frisking' him properly when Detectives McNeil and Kenney, assisted by Sergeant McIntyre and a squad of police, tore them away from their victim, called the patrol wagon and bundled them off to jail.

"Taking advantage of this diversion the real Mr. Bountiful hastened along, clinging closely to the walls as he went down Curtis Street, until he reached the corner of Sixteenth, when he hastily bobbed into the drug store where, seeing Mr. Scholtz, he rushed up to the waiting proprietor and shouted, 'Take it; it's in my outside pocket'; whereupon Mr. Scholtz deliberately drew forth the money which, by these devious ways, the Denver Gas & Electric Company made its contribution to charity.

"A large part of the excitement of the occasion grew out of the fact that the Denver Gas & Electric Company, in order to emphasize the value of its products and its universal necessity for direct advertising, caused the lights on the block between Sixteenth and Seventeenth Streets on Curtis to be completely turned off for a short time."

New Business in Jersey City, N. J.

By William H. Stuart.

In the year 1882 the Baxter Electric Light Company, of Jersey City, was incorporated with the object of "establishing and building electric-lighting stations and furnish electric lights for public and private use." Its object was never accomplished, for in the following year, Nov. 20, 1883, the Baxter Company was reorganized under the title of "The Jersey City Electric Light Company." A small station was built on Bay Street and was known as the Bay Street Plant. This plant became overloaded and the company built a new station on a larger piece of property, at the corner of Wayne and Fremont Streets. A description of the business and the station equipment is given by an old pamphlet issued by the company in 1890 and distributed throughout the city by them. "This station is said by experts to be one of the best working plants in the state. The station has 3100 connected incandescent lamps of 16-cp equivalent, a switchboard capacity of 9600 16-cp equivalent, a machine capacity of 4800 16-cp equivalent; 313 arc lamps are connected with a machine capacity of 430. There are 40 miles of arc wires, 12 miles of incandescent wires, and six miles of power wires."

In the following year, 1891, a solicitor was engaged and put to work securing business which required no line extensions. Considerable progress was made by the solicitor in the lighting end, power at that time not being the thing it is to-day. An effort was made to further his efforts by advertising matter printed in circular form and also using the daily newspapers. This campaign of education met with fairly good results.

About the year 1900 the company changed hands and became a part of the "People's Light & Power Company," operating electric-light and power companies in Northern New Jersey. The new company, immediately reorganized the new-business department and installed a new commercial department. The working force consisted of a contract agent, one power and appliance solicititor and four light solicitors. The city was finally divided up into four districts, and each district was the exclusive territory of the solicitor apointed to it. The power solicitor was given the run of the whole territory and all "bites" uncovered by the lighting solicitors were turned over to him. The contract agent covered the whole territory once every two weeks, noting building operations and growth especially. A contract register was drawn up, in which was entered the signed contracts, which were given a number. The register contained the name of the solicitor, the number of lamps or size of motor connected, and the name and address of the consumer. At the end of each month a summary was made of the month's business, and each solicitor informed of his standing in the amount of business done. The plan of morning meetings was introduced, at which occasionally men with a reputation gained in the mechanical and commercial fields of the electrical business were asked to address the solicitors in a short, practical talk. At the ordinary morning meeting, methods were discussed, new ideas were presented, and any particular opposition met with by the solicitors during the day was presented and discussed for the benefit of the others. At one time, to instil additional or new energy and life in the contract department, cash prizes were offered the solicitors in amount of $5 for the first, $3 for the second, and $2 for the third man at the end of each month, based on the number of new contracts he had signed up and turned in. This plan was used three months and then stopped.

Advertising became an important part of the work. Descriptive matter was prepared and distributed by mail or in person by the solicitor. Various methods were used or one scheme was used in various forms. Small pamphlets, the back of the monthly bills, pasters which were placed on the bills, newspapers, the wagons and other property of the company were all used. The advertising forms were generally illustrated and drawn up in as catchy and attractive a form as it was possible to do. The various uses of electric energy were each fully taken up and brought out by these circulars.

About 1905 the company moved its office to a very commodious and centrally located building on Newark Avenue, running through to Montgomery Street. More persons passed here in cars and on foot than perhaps any other point in the city. There was no change in the new-business work, as it was carried on at the old office, with the exception of the show windows. In the new office there were four very fine windows for the display of goods, two on each street. The windows were kept in as inviting and attractive a manner as systematic and intelligent display could make them. One window contained an electrically-driven pump with a glass tank and was kept running all day and during the evening. In the opposite window a display of lamps was alternated with displays of novel electrical devices, such as a large windmill containing 100 or more small colored lamps, the arms of the mill being turned by a small motor. In the third window small motors were displayed, which were changed often. One week a sewing machine in operation was displayed, next week a meat chopper, etc. The fourth window contained exhibitions of heating and cooking appliances, which were constantly changed about.

In the show room proper, everything electrical is kept, neatly arranged and in a manner for easy and quick connection, so that a practical demonstration can be easily made. On the outside of the building over the door a large sign has been erected reading "Light and Power," which is operated on a time switch.

Lately the company has been consolidated with the gas company under the name of the "Public Service Corporation." The two offices are now occupying the same building. This has necessitated the allowing of the gas exhibits an equal space, but the methods have not been changed. In the soliciting, the territories allotted to each solicitor were rearranged and the men shifted around. A card record has been made and kept of every house in each man's district.

That the company has hit the right method in attaining new business is evident in the rapid increase in the amount of business and the fact that there has never been from the start any agitation politically or otherwise against the policy of the company, which has succeeded in gaining the good will and confidence of the citizens. The rate for energy has been steadily pushed down from 18 cents to 10 cents per kw-hour as a basic rate for lighting service.

Along the free sign proposition the company has for some time given both the panel and the block letter sign, although lately the block letter sign has been done away with. The signs were hung free with all the necessary wiring, lamps, etc., ready to light. This policy was instrumental in filling Jersey City with signs, which are built and painted in novel ways. Several of the largest merchants have installed large "talking" monogram signs and large ornamental and unique signs worked by a flasher. One enterprising merchant has erected a large sign, operated by a flasher, showing a sky-rocket effect with colored lamps. It is placed in a vertical position at right angles with the building. A streak of white runs zigzag up the sign and bursts into a flood of dropping colors as the rocket bursts; then after a fraction of a second of darkness the name of the store flashes up and remains 30 seconds.

In the motor business a very creditable increase has been made. Very liberal power rates are in force and motors are sold and all wiring under 100 ft. is included in the cost of the motor. Standard sizes and makes of motors are kept in stock and are ready to set up in quick order so that rush orders can be accommodated. Appliances, cooking, heating and flat irons are put out on trial for 30 days, and if not wanted can be returned and energy charges are made only.

Tungsten Lamps in Competition with Gas.

Mr. H. A. Fee, manager of the Citizens' Light & Power Company, of Adrian, Mich., has recently replaced gas arcs in a drug store with tungsten lamps, which give much more illumination and reduce the cost, including the cost of lamps, from $67.69 for 1000 hours to $52.96, the lamps burning the same number of hours. The store was formerly lighted by 24 8-cp lamps in ceiling receptacles, taking 711 watts and giving an average candle-power for 1000 hours below 180. This installation was replaced by three 3 burner gas arcs, consuming gas at $1.40 per 1000 cu. ft. The cost of gas for 1000 hours was thus $61.69, and adding to this $6 for maintenance (25 cents per month per lamp), the total cost for 1000 hours was $67.69. The tungsten installation consists of 12 40-watt lamps in ceiling receptacles, each taking 437 watts and giving a light averaging considerably over 32 candle-power. The rate for this business to 9 p. m. is 8 cents per kw-hour, making a cost per 1000 hours of $34.96 for energy, and adding the cost of the lamps—$18—makes the total cost $52.96. Tests covering 570 hours of burning under voltages 5 per cent normal during two-thirds of the time, show that tungsten lamps will stand such variations and maintain their candle-power

LETTER TO THE EDITORS.

Ice Storms in Georgia.

To the Editors of Electrical World.

Sirs: In your editorial on "The Use of High Voltages" appearing in the first issue of April, you state that "one does not have ice storms in the South." You are in error so far as this section of the South is concerned, as we have very severe ice storms in this portion of the country, and it is here that one finds the most extensive and highest voltage transmissions

The writer has for several years past been constructing and operating high-tension lines in this vicinity, one of which is the highest voltage transmission in the South, and we have to provide against ice when laying out the steel towers and lines.

On Feb. 5, 1908, there occurred one of the most severe ice storms ever experienced, the cables of the 50,000 volt tower line being swollen to 2¼ in. in diameter with ice and the insulators were also heavily covered with ice The average span in the line is 500 ft., though there are two 1000-ft. spans, the line being designed for 1-in. coating of ice at 10 deg. below zero with wind at 40 miles per hour and a factor of safety of two under these extreme conditions.

We did not have a break in the line during the ice storm, but undoubtedly it would have been disabled if provision had not been made for such storms.

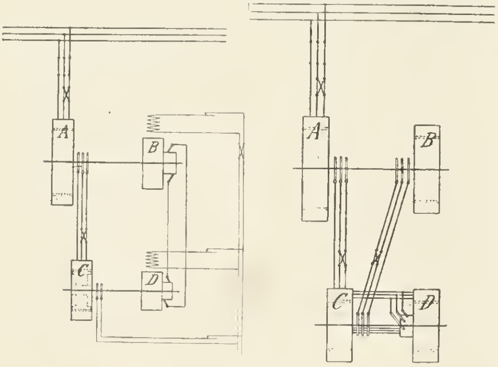
The charging current of this line represents 750 apparent kilowatts, and when the insulators were ice-covered the ammeters showed twice as much current as normally demanded to charge the line, the extra current probably being due to leakage over the ice-covered insulators, as the current became normal when the ice melted off.

GAINESVILLE, GA. F. P. CATCHINGS.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Modified Cascade Systems.—A. HEYLAND.—The first part of an illustrated article discussing his so-called "modified cascade systems" (which have already been noticed in the Digest) and their use for locomotives, elevators and rolling mills. There are three different methods possible, but the common principle is that the armature of a slip-ring alternating-current motor is connected with a mechanically independent auxiliary motor. The latter impresses the voltage corresponding to its excitation on the armature of the first motor, and at the same time this auxiliary motor transforms the power taken from the first motor into direct current or into alternating current of variable frequency and delivers it to a second motor which is the working machine. The first system is shown in Fig. 1. *A* is the main or primary motor. *B* is the second motor or the working motor. *C* is the auxiliary motor which is coupled with the direct-current machine *D*, so that the alternating current taken from *A* is transformed into direct current which is supplied to *B*. The auxiliary motor *C* is a synchronous machine, which is excited with direct current so that the voltage impressed on the armature of *A*, the field flux, the phase difference and the torque of *A* can be regulated at will. The disadvantage of this arrangement is the fact that *C* is a synchronous motor which may present difficulties in reversing the direction of rotation. The second system is illustrated in Fig. 2. *A* is the main motor. *B* is the working motor, both being normal induction machines. *C* is the auxiliary motor which acts simultaneously as a frequency transformer, and *D* is an auxiliary machine coupled to *C*. The two auxiliary machines, *C* and *D*, consist of a slip-ring machine and an alternating-current commutator machine. Alternating current of variable frequency is taken from the slip rings *C* supplied to *D*, while the current taken from the armature *A* may be supplied either to *C* or *D*, according to the arrangement. The third method which the author begins to describe is intended to combine the advantages of the first two methods. The object of the whole arrangement is to provide ideal speed regulation, any desired torque in starting or reversing the working motor, and compensation of the phase difference, with the main motor connected directly to the net work. The article is to be concluded.—*Elek. Zeit.*, April 2.



FIGS. 1 AND 2.—MODIFIED CASCADE SYSTEMS.

Commutation.—R. GOLDSCHMIDT.—A further reply to Menges' criticism as to the commutation problem and the covering of armature slots. The writer points out that the saturation of the bridge pieces is due to fringe lines from the poles and tooth saturation, and not only due to the fact that they are in parallel with the rest of the armature. This only produces an initial flux in them. It is also pointed out that iron bridges over a certain thickness influence the commutation unfavorably, and it is asked whether this agrees with Menges' theory.—Lond. *Elec.*, April 3.

Lamps and Lighting.

Osram Lamp.—Some notes on patents of the German Welsbach Company for making the osram (tungsten) lamp. Some incidental information is very interesting, for instance, that the leading-in wires which support the filaments give off steam. This is due to the fact that the leading-in wires become oxidized when heated, and if a formation process by means of reducing agents (hydrocarbons, etc.), takes place, steam is set free, the hydrogen combining with the oxygen of the oxide. This steam is always detrimental and must be avoided. Another interesting observation is that when the raw filaments are heated by means of direct current in order to sinter them, the filaments are often distorted in a certain direction. This has been found to be due to the action of the magnetic field of the earth or to the magnetic field within the working room, and the distortions of the filament are avoided if the magnetic field is screened off.—*Zeit. f. Beleucht*, March 20.

Tungsten Lamp.—The method of J. Lux for making tungsten filaments consists in mixing finely powdered metallic tungsten with powdered zinc oxide or zinc sulphide and an organic binding material. The quantity of the latter must be limited so that the finished filament contains no carbon. The mixture is made up into a paste which is pressed into filaments which are heated in absence of air. These filaments are then brought to incandescence by means of an electric current in an inert atmosphere or in vacuo, whereby the zinc oxide or zinc sulphide reacts with the carbon, and carbon monoxide and zinc vapor are given off. The filament thereby contracts considerably and sinters together. Filaments which have originally a diameter of 0.1 mm get a diameter of only 0.01 mm after having been formed.—*Zeit. f. Beleucht*, March 10.

Tungsten Lamp.—The Siemens & Halske Company is now taking up tungsten lamps. One of the methods patented by it is to heat ammonium tungstate to about 300 deg. whereby ammonia is given off. After treatment for a certain time the product obtained is boiled for a short time in a limited amount of water whereby a tough paste, which is as sticky as glue and can be formed into filaments, is produced.—*Zeit. f. Beleucht*, March 30.

Boron Lamp.—After describing Kuzel's colloidal method for making tungsten lamps, etc. (which has been noted repeatedly in the Digest), it is stated that boron and silicon may also be made into filaments by an analogous method. Moreover, filaments of nitrogen compounds with boron or silicon may be made.—*Zeit. f. Beleucht*, Feb. 29.—The German Welsbach Company has also taken out patents for boron filaments. One method of changing boron which is a non-conductor, into an allotropic modification which is an electric conductor, is by pressing the pure amorphous boron without any binding material into a rod form and then fusing it in a vacuum or in an indifferent atmosphere by means of a mercury arc which may be magnetically directed upon the boron.—*Zeit. f. Beleucht*, March 20.

Increasing the Specific Resistance of Metallic Filaments.—A note on a method of H. Kuzel for increasing the specific resistance of a metallic filament of tungsten, etc., by producing a solid solution of boron or silicon or carbon in the metallic filament. For this purpose the tungsten filament is brought into contact with a limited and relatively small amount of boron or silicon or carbon and heated to white heat. It absorbs the boron, etc., but the metallic surface remains as bright as before. The electric specific resistance may be increased in this way to 3, 4, 10 or more times its former value. While the consumption in watts per cp is not changed, the color of the light emitted by the filament is changed; for instance, a tungsten filament the resistance of which has been increased by carbon is of golden or orange tinge, while if the resistance is increased by means of boron the light has a green tinge.—*Zeit. f. Beleucht*, March 10.

Increasing the Specific Resistance of Metallic Filament Lamps.—The Allgem. Elek. Ges. increases the resistance of tantalum, tungsten, etc., filaments by adding an oxide of yttrium, ytterbium, etc. The ytterbium oxide is said to be especially suitable. If other oxides, like zirconium oxide are used, the oxide is electrically decomposed when in use and the vacuum in the lamp is reduced. If ytterbium oxide is used the vacuum remains excellent and the life of the lamp is long. Such filaments may be used with direct current as well as alternating current. They have a positive temperature-resistance coefficient. To obtain a considerable increase of resistance the addition must be at least 5 per cent and may be brought up to about 40 per cent.—*Zeit. f. Beleucht*, March 30.

Increasing the Ductility of Brittle Metals Like Tungsten, Thorium Filament.—The Siemens & Halske Company surrounds the tungsten wire with a cover of a more ductile metal like copper or iron and then rolls and draws the wire in a highly heated state. Electric heating may be employed. The tungsten is thereby protected against the influence of the atmosphere and is prevented from cooling quickly. Further, its mechanical strength is increased and greater uniformity and reliability during drawing is obtained. Simultaneous heating is favorable, since tungsten is in general much more ductile when hot than when cold. After the drawing process the copper or iron cover may be removed chemically or by other means. In the same way it is possible to first make a tantalum core, surround it by tungsten, and cover the whole with copper or iron. In this way a filament with a core of tantalum and a cover of tungsten or an alloy of tungsten is produced. Thorium filaments can be made in the same way by stamping thorium containing more or less oxide into a hollow tube of ductile metal and subjecting it to a rolling and drawing process. In the same way alloys or thorium with tungsten or tantalum may be treated.—*Zeit. f. Beleucht*, March 30.

Pitch Blende for Incandescent Lamps.—A note on a method of A. Bourdos and R. Rothschild for making filaments from pitch blende. The pitch blende after having been treated, as will be described below, is mixed with india rubber so as to obtain a plastic mass from which the filaments are formed. The plastic mass may also be used as a cover for ordinary carbon filaments. The treatment of the pitch blende consists in first immersing it in a solution of potassium or sodium chloride or hydrochloric acid, until gases no longer escape, due to the reaction. The pitch blende thereby becomes a porous mass, while a fine powder settles on the bottom of the vessel. This porous mass and powder are thoroughly washed and heated electrically to red heat until vapors cease to escape. Any lead or tin, etc., is removed by further heating from the refractory residue, and this is then powdered and mixed with india rubber and the filaments are prepared. They are heated in an air-tight chamber containing powdered charcoal and graphite so as to reduce any oxide. The final formation of the filament is carried out by heating it in a hydrocarbon gas in the usual way.—*Zeit. f. Beleucht*, Feb. 29.

Combined Carbon-Filament and Mercury-Vapor Lamp.—A note on a lamp patented by W. Modrow. The carbon filament is brought to incandescence in an atmosphere of mercury vapor and an indifferent gas. For this purpose a drop of mercury is put into the incandescent lamp, together with such an amount of an indifferent gas that when cold the gas pressure corresponds to from 5 to 30 mm of mercury. When the mercury drop is in the hottest zone of the incandescent lamp it evaporates, and simultaneously the candle-power of the carbon filament lamp is increased by from 50 to 80 per cent. *Zeit. f. Belucht*, Feb. 29.

Cost of Electric Lighting.—A note on a case recently decided in court in England between a municipality and a lighting company. According to the contract the city had to pay to the company a return equal to 10 per cent over "the actual cost of generating the light." The question was what to include within the actual cost. The court decided that it includes not only the generation of energy, but also its transmission to the points where the light is finally produced; further, that it also includes depreciation. Concerning the latter point the decision reads as follows: "The cost of the plant forms part of the actual cost of generating the light, but as the use of that plant would extend over several years, it could obviously not have been intended that the whole of that cost shall be charged during the first quarter of the contract. But the same objection does not exist to a distribution of the actual cost of the plant over the whole period of the life of such plant. The effect of allowing a certain sum for depreciation in the quarterly accounts of the plaintiffs would simply be to distribute the actual cost of the plant over the whole period during which it would, in the ordinary course, be of any service in the generation of electricity and light." The cost of insurance was also allowed.—*Lond. Elec. Rev.*, April 3.

Store Lighting.—G. H. Stickney.—An illustrated article on store lighting. The author recommends the use of simple, inconspicuous fixtures, with units of an output well proportioned to the size of the room; the light sources should be high and of a relatively low intrinsic brilliancy and so arranged as to distribute a soft white light throughout the store. High-current enclosed arc lamps, fitted with a proper diffusing device, appear to form at present the best equipment for the general illumination of large dry goods and department stores. However, it may be that in the future the tungsten lamp will be more suitable in some places where previous to its development the arc lamp would have been selected. Just where the dividing line will ultimately lie still remains to be worked out.—*Gen. Elec. Rev.*, April.

Generation and Transmission.

Generating Station Improvements.—An illustrated description of some original improvements in the Penn Station at Connellsville, Pa. They relate especially to the installation of a 3250 kw steam turbine and the general overhauling of the switchboard apparatus with installation of remote control high-tension switches. Probably the most extraordinary feature in connection with the condensers installation is that the hot well pump is dispensed with. In its place a specially designed boiler feed pump is used to draw the water from the vacuum in the hot well and force it into the boilers. The tendency of water to be thrown out against and flow along the walls of a pipe in a steam line has been taken advantage of in the construction of a separator for the new turbine of somewhat novel form. It is a small horizontal drum placed on the end of the steam pipe on the engine room side of the boiler room wall. The pipe is brought to the diameter of the drum by a gradual enlargement or trumpet-shaped head on one end of the drum. The turbine supply pipe is taken off the top of the opposite end of the drum. A hand-hole is provided at the end for examining the interior of the drum. This separator is reported as giving unusually dry steam. The rotary converters in the station are provided with a specially designed brush holder. Special vacuum pump-discharge valves and other devices have also been designed.—*St. R'y Jour.*, April 4.

Electric Motors.—C. F. Lawrence.—A discussion of the adaptability of different kinds of electric motors for different problems in driving machines and tools. At present there is a tendency toward both the group and the individual drive, it being generally agreed that the larger tools should be equipped with individual motors, such as machines that are intermittently driven, or where they are started and stopped to make ready or take off work. The direct-current series motor is ideal, when direct connected to a centrifugal pump. The direct-current shunt motor may be used to run all machines where a steady constant speed is required, such as small printing presses, ventilating fans, group driving and those machines which do not demand a heavy starting torque. The proper speed control is obtained by the insertion of resistance in the field coil circuits. The shunt-wound variable-speed motor is ideal for engine lathes, scrapers and all machines where it is necessary to run steadily at any one value of speed from no-load to full-load. The larger sizes of shunt-wound variable-speed motors are built with commutating poles. When a machine with a reciprocating motion, which reverses and tends to lower the speed, is to be electrically driven or when a machine is required to start with a heavy load, a compound-wound motor is necessary. Finally, the use of induction motors is discussed.—*Gen. Elec. Rev.*, April.

Steam Turbines.—S. L. Pearce.—A paper read before the Manchester Association of Engineers. The author deals briefly with some of the elementary principles of steam turbine design and with the development of the many types. A short description of the leading practical examples of the various types is then given, together with some data of their performances, and a comparison between turbine and reciprocating units.—Lond. *Elec.*, March 27.

Traction.

Railway Calculations.—M. Mac Laren.—An article on the methods for calculating the performance of railway equipments under service conditions. Illustrations are given from tests on the N. Y., N. H. & H. R. R. which show a close agreement between predetermination and practice. It is usual in such calculations to simplify the work by substituting for the irregular profile of the road a uniform grade equal to the average grade between terminal points; if curves are not sufficiently severe to require slow-speed running, the effect of these is also averaged, and instead of figuring out each individual run for a train making frequent stops, the service is studied by a single typical run equal in length to the average distance between stops. While some discretion has to be used in applying this method, since it does not hold good over too wide limits, yet it gives accurate results with proper precautions, especially as to the running times, the heating, the energy consumption, etc. Diagrams are given showing a very good agreement between the calculated and the testing performance of a locomotive hauling a 296-ton train between New Rochelle and Larchmont. The remarkable steadiness of the line potential is pointed out. Even at the extreme end of the line, 18 miles from the generators, the line drop does not amount to 10 per cent at the time of heavy traffic. A diagram is given showing the performance of the locomotive when passing from the direct-current to the alternating-current system, only 20 seconds being required for the change. This change is ordinarily made when running at from 40 to 50 miles per hour.—*Elec. Jour.*, April.

Car Equipment.—A very long and fully illustrated description of the car equipment department of the Interborough Rapid Transit Company in New York City, its methods of car inspection, lubrication practice, car cleaning and labor payment. —*St. R'y Jour.*, April 4.—An account of the new method of maintaining the car equipment on the Chicago City Railway, which became necessary by the complete change from cable to electric traction, is given in *St. R'y Jour.*, April 11.

Electrolytic Effects of Stray Currents.—E. Nourtier.—A report on the electrolytic destruction of underground metal pipes by the stray currents from the rail return circuit of electric railways. The author thinks the only system which would completely overcome the trouble at present is that of a double overhead trolley wire. The conditions in Roubaix-Tourcoing, in France, are described. Within six years 60 cases of destruction of cast-iron water pipes by electrolysis occurred, while the thin tarred wrought-iron gas pipes were not damaged. The author thinks this is due to their higher resistance. On the other hand, telephone cables have been found badly damaged one year after they had been placed in the ground, the lead cover being completely eaten up so that serious service troubles were experienced and several kilometer length of cables had to be replaced.—*Jour. des Usines a. Gas*, 1907, Nos. 10, 11, 14, 15; *Jour. f. Gasbel.*, March 7.

Tracks.—H. L. Weber.—A discussion of the methods of proper construction and maintenance of tracks in electric railway service.—*St. R'y Jour.*, April 4.

Installations, Systems and Appliances.

Protective Devices.—K. Kuhlmann.—A long illustrated paper read before the Berlin Electrical Society on modern protective devices against excessive currents in electric networks. The author recommends the use of circuit breakers with a time element even for low-voltage networks, instead of fuses. He then deals especially with systems in which the neutral point of the generator or transformer windings feeding the network is insulated from earth. It is shown by calculation as well as by experiments that in this case in extended cable networks of large capacity the earthing of one phase may cause very considerable excessive currents. These are pure charging currents. They are 90 time-degrees in advance of the phase of the e.m.f. If such an earth occurs there is danger of electric resonance with resulting excessive voltages. Every phase insulated from earth should, therefore, be protected by a circuit breaker. For smaller networks the danger is not so great, but in order to be independent of the size of the network it is recommended to apply the principle of continually earthing the neutral points of the generators or transformer stations. The resistor through which the neutral point is connected to earth should have a resistance of only a few ohms and should be so dimensioned that the current passing through it causes the potential of the neutral point to differ by not more than 10 per cent of the line voltage from the potential of the earth. The author then gives examples of networks in which protective devices are employed and emphasizes the difficulties arising in cable networks arranged in ring form. The differential protective system of Merz and Price, which has been developed by the Allgem. Elek. Ges. and is in practical use in various distribution systems in Germany and England, is shown in Fig. 3 as applied to a three-phase cable. K is the main cable and k is an auxiliary cable. At the terminals of K, series transformers S_1 and S_1^1 are provided, the secondary windings $s_2 s_2^1$ being con-

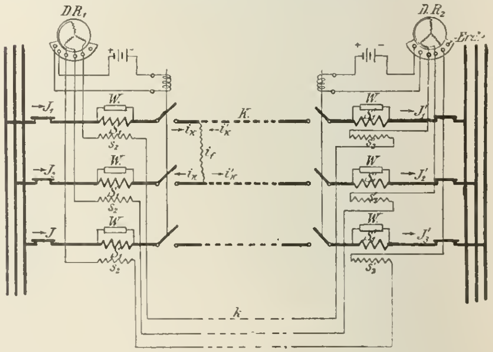


FIG. 3.—DIAGRAM OF CONNECTIONS.

nected together by the auxilary cable *k* in such a way that for equal time phases of J_1 and J_1^1, opposite e.m.f.'s are induced in same, their absolute values being equal for equal values of J_1 and J_1^1. The two diffenential relays $D R_1$ and $D R_2$ are inserted in the auxiliary circuit. As long as the cable *K* is sound, currents equal in amplitude and phase pass through S_1 and S_1^1 (if we do not take into consideration the charging current of the main cable). The auxiliary cable *K* and the two relays $D R_1$ and $D R_2$ are then without current, whatever may be the currents passing accidentally through the main cable; for instance, when there is a short circuit outside of the main cable. If, however, there occurs an earth or a short circuit within the piece of cable between the two series transformers, the currents J_1 and J_1^1 become different in phase or in amplitude, or both. The geometrical difference equals the fault current i_f. In the illustration the fault is shown as a short-circuit between two phases. The current J_1^1 differs now practically 180 deg. in time phase from J_1. There is also $J_2 = -J_1$ and $J_1^1 = -J_2^1$. The secondary voltages of the four series-transformers are, therefore, connected in series. The auxiliary cables and the relays carry current in two phases and disconnect the piece of cable within which the fault occurs, at both ends. The advantages of this system and various applications of it to many different cases are described.—*Elek. Zeit.*, March 19 and 26; April 2.

Circuit Breakers.—F. W. Harris.—The conclusion of his illustrated serial on circuit-interrupting devices. The author deals with the operation, installation and care of carbon-break circuit breakers. There is a need at present for the production of a circuit breaker at a reasonable price. In many industries, such as rolling mills and in general factory service, reliability even at a somewhat higher price is the main point. Improvements along this line are possible, but there is a probability that such designs will include magnetic blow-outs and omit carbon arcing tips. Oil circuit breakers also become more and more important as cost increases.—*Elec. Jour.*, April.

Lightning Arresters.—R. P. Jackson.—The conclusion of his illustrated serial on the protection of electric circuits and apparatus from lightning and similar disturbances. The author gives directions for specifying lightning arresters and choke coils. He also gives instructions for installing multigap lightning arresters and shows the importance for grounds for lightning arresters. He finally deals with choke coils and safety spark-gaps.—*Elec. Jour.*, April.

Three-Phase to Two-Phase Transformotion.—W. J. Wooldridge.—Troubles have been experienced in attempts to operate regular single-phase core-type transformers on three-phase primary, two-phase secondary circuits. This difficulty is due to the fact that in the transformation of power by means of the T-connection there arise certain peculiar current and voltage relations. The relation between the currents on the two sides of the primary winding of the main transformer make it absolutely necessary, if this distortion is to be avoided, to "balance" magnetically each half of the main winding on the legs. This is shown mathematically.—*Gen. Elec. Rev.*, April.

Wires, Wiring and Conduits.

Economical Limits of Voltage in Underground Cable Transmission.—J. B. Sparks.—Although it is possible to construct insulated cables for 50,000 volts or more, it may be more economical to employ cables of larger copper section and for lower pressures. The most economical pressure depends not only on the cost of the cable, but also on the cost of the transformers and the high-tension switchgear. Calculations are made for the special case of an annual transmission of 50,000,000 kilowatt-hours over a distance of 31 miles by three-phase alternating-current through two three-core insulated cables laid underground; power factor 0.9 and load factor 0.5; cost of energy at the generating end of the line 1 cent per kw-hour. Assuming that the load is equally divided between the two cables, the average load per cable is 2850 kilowatts. The calculation is made for four different working pressures; namely, 5000, 10,000, 20,000 and 40,000 volts between cores, and an annual loss of 5 per cent of the energy in all four cases is assumed. For 5000, 10,000, 20,000 and 40,000 volts the cost of copper in one cable will be $1,760,000, $440,000, $110,000 and $27,500 respectively (on the basis of $487 per ton of copper). In doubling the voltage from 5000 to 10,000 the saving in the cost of copper is $1,320,000, in doubling the voltage from 20,000 to 40,000, the saving is only $82,500. On the other hand, the increase in the extra cost of insulation due to the higher pressure is greatly increased. Fig. 4 gives the cost of three core cable for transmitting different amounts of power per cable at different voltages between cores and with a loss of 0.61 per cent per mile. The curve marked 2850 kilowatts per cable relates to the figures mentioned above, while the three other curves correspond to cables of 4500, 1500 and 300 kilowatts average load. Thus, for example, a cable corresponding to any point on the 1500-kw curve would be capable of transmitting 1500 kilowatts to a distance of 31 miles with an annual loss of 5 per cent of the energy delivered or a line efficiency of 95.2 per cent. Along this same cable half the energy could be transmitted over double the resistance at the same efficiency. In the calculations on which these curves are based the costs of the lead coverings (lead at $100 per ton) and impregnated paper insulation ($200 to $300 per ton) are, of course, included. If the energy is less than 1 cent (0.5 penny) per kw-hour at the generating end of the line, then one can afford to waste more in transmission, and the most economical efficiency will be lower or the loss per mile more. This means that a smaller section of copper will be required, and consequently the most economical voltage will be less than that corresponding to the higher line efficiency. In general, it will be rarely economical to employ a pressure higher than 25,000 volts between cores, since a higher pressure would be the most economical only in exceptional cases of large rates of energy transmitted per cable to very long distances. But for the sake of reliability it is advisable to keep down the rate of energy transmitted per cable and a very long-distance underground transmission is rarely practicable, since it evolves excessive capital cost. The effect of heavy capital cost of the line on the cost of the energy at the receiving end of the line is clearly shown in Fig. 5 in which curves are given of the cost per kw-hour at the receiving end of the line, expressed as a function of the e.m.f. in kilovolts

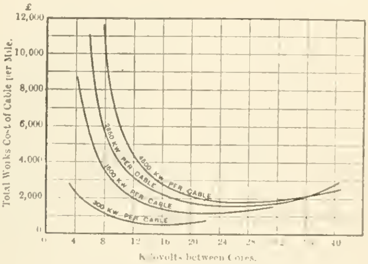


FIG. 4.—COST CURVES OF THREE-CORE CABLE.

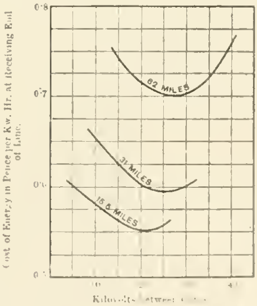
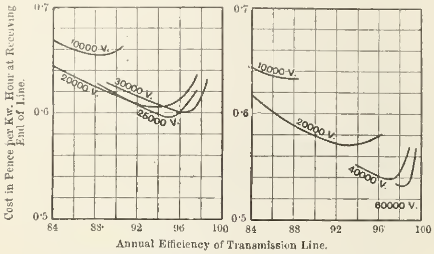


FIG. 5.—CURVES OF COST PER KW HOUR AT RECEIVING END

between cores and for distances of transmission of 15.5, 31 and 62 miles. For the 15.5 mile transmission, the minimum cost is obtained at an e.m.f. of 20,000 volts, for 31 miles at an e.m.f. of 25,000 volts, and for 62 miles at an e.m.f. of 27,000 volts. In all cases and at all voltages the cost per kw-hour, given in Fig. 5, is the minimum obtainable; that is, that corresponding to the most economical efficiency of the line. The influence of the "annual line efficiency" on the cost per kw-hour at the receiving end is shown graphically in the curves of Fig. 6.



Two-Cable Underground Conduit
31 Mile Transmission Line.

Two-Circuit Overhead Tower
31 Mile Transmission Line.

FIG. 6.—CURVES OF ANNUAL EFFICIENCY.

From these curves we find that the most economical line efficiency for the 31-mile transmission under consideration, is about 95 per cent for an e.m.f. of 25,000 volts. At a lower e.m.f.—for instance, 10,000 volts, which means a heavier capital cost—it is economical to waste more energy in transmission, and the efficiency for which the transmission cost is a minimum is about 89 per cent. The left-hand curves are for underground lines, the right-hand for overhead steel-tower lines. Comparing these curves, it is seen that whereas the most economical e.m.f. for an underground cable line, in the case considered, is about 25,000 volts, an e.m.f. of 60,000 volts or more will give the most economical results when an overhead steel-tower line is used. The capital cost in the latter case is also very much less, and the cost of transmission comes out at 0.064 cent (0.032 penny) per kw-hour at 60,000 volts against 0.190 cent (0.095 penny) per kw-hour for the 25,000-volt underground line. In neither case, however, has any allowance been made for the annual wayleaves or compensation charges, and these, of course, would be higher in the case of an overhead line passing through a populous district. The higher percentage charges for maintenance in the latter case were included.—Lond. *Elec. Eng'ing*, April 2.

Wires and Wiring.

Telephone and Power Wires on the Same Pole Line.—An editorial on dangerous wire plant conditions, pointing out that it is "the too frequent practice of power companies of stringing their wires with little regard to the previous location of telephone wires." They seem to rely on the principle that if anything happens it will be the telephone wire that is damaged, leaving their own clear. It should be made a fundamental principle to run telephone lines under power lines and never over them.—*Am. Tel. Jour.*, April 11.

Poles for Transmission Lines.—L. KALLIR.—The first part of a mathematical paper in which the author first calculates the stresses set up in an overhead transmission line when the line is intact and in the condition of maximum stress. The author then takes up the stresses set up in the poles when the line breaks somewhere. The paper is to be concluded.—*Elek. u. Masch.* (Vienna), March 22.

Electrophysics and Magnetism.

Formation of Concrete Matter from Atomic Origin.—LORD KELVIN.—A paper which was written by Lord Kelvin some months before his death and in which he was interested down to the last days of his life. Coalition, due to gravitational attraction between materials given originally in small parts widely distributed through space, is probably the most ancient history of all the bodies in the universe. "Were the primordial atoms relatively at rest in the most ancient time, or were they moving with velocities, relative to fixed axes, through the center of inertia of the whole, sufficiently great to give any considerable contribution to the present kinetic energy of the universe? It is conceivable that all the atoms were relatively at rest in the most ancient time, and that the potential energy of gravitation may be in reality the ultimate created antecedent of all the motion, heat and light at present in the universe." The paper deals at length especially with the gradual evolution of the earth from its gaseous stage to liquefaction at the center and with the birth of the moon. With respect to the latter he holds Geo. Darwin's theory to be the most probable.—*Phil. Mag.*, April.

Electrochemistry and Batteries.

Aluminium.—J. B. C. KERSHAW.—An article on the condition of the aluminium industry in England, with an account of the boom early in 1907 and the collapse of the boom at the end of 1907, with the result that a reduction in price of 50 per cent on the 1906 values has marked the opening of 1908 in Europe. Aluminium has proven a successful substitute for copper in the manufacture of busbars, switchboard connections, lamp reflectors and similar smaller parts of electrical apparatus, and large orders for aluminium wire have been given by leading European electrical engineering firms. The smaller sizes of insulated wire required for bells and telephones are now being made from aluminium and the use of bare overhead aluminium conductors is also receiving further trial in Europe. Two new companies have been formed in England for the manufacture of aluminium.—Lond. *Elec.*, March 27.

Units, Measurements and Instruments.

Meter Testing.—F. W. PRINCE.—An illustrated description of the very elaborate system of adjusting, calibrating, installing and treating watt-hour meters, used by the Hartford Electric Light Company. The equipment of the testing room, the standards used and the methods of installing the meters, keeping a very complete card record, and making regular tests are described. In an editorial note by H. W. Young on this article it is emphasized that a systematic method of handling the meter department should be a basic principle in every central station. With the recent development of the so-called "rotating" standard watt-hour meter, having several ampere and voltage connections, the question of expense is no longer serious even for smaller central stations, since the meters are reasonable in price and one standard will cover a large number of service meter ratings. Again the use of rotating standards materially reduces the time and expense of testing. Moreover, the load need not be kept constant and any desirable load, such as a lamp bank or a house load, may be used.—*Electric Jour.*, April.

Resistor of High Resistance.—G. W. STEWART.—A description of a convenient method of preparing a resistor of permanent high resistance by means of carbon and a transparent lacquer, called "Zapon." This lacquer consists of soluble cotton dissolved in certain mixed solvents, the chief ingredient of which is amyl acetate. When dry, there is left a film of pyroxyline which is elastic, is not subject to ordinary changes in temperature, does not evaporate, does not crack, and is a good insulator. If lamp black is mixed with this lacquer and sprayed with a brush upon an insulator a permanent and yet high resistance may be obtained. By a trial the author secured a variation in resistance from 3,000 to 3,000,000 ohms with a film approximately 3 mm long and 2 mm wide.—*Phys. Rev.*, April.

Alternating-Current Instruments.—An account of the extended discussion which followed Sumpner and Record's paper on alternating-current instruments with iron. Drysdale thought that their wattmeter is a development of the induction wattmeter, but Sumpner did not agree with him.—Lond. *Elec.*, April 3.

Telegraphy, Telephony and Signals.

Telephone Conventions.—An account of the recent Iowa convention in *Am. Tel. Jour.*, March 21, and *Tel'y*, April. Of papers presented at this convention that by A. C. Lindemuth, entitled "A Larger View," is reprinted in *Am. Tel. Jour.*, March 21; those by W. B. Burke on telephone river crossings, original and maintenance cost; by W. S. Hart on prevention and defence of damage suits, and by A. Herr on cost of city exchange service in *Am. Tel. Jour.*, April 4.—An account of the recent Ohio convention in *Am. Tel. Jour.*, March 28, and *Tel'y*, April; the paper by G. R. Johnson on possibilities of the telephone business is reprinted in *Am. Tel. Jour.*, March 28, and *Tel'y*, April; that by J. B. Hoge on comparative telephone conditions in *Am. Tel. Jour.*, April 4, and *Tel'y*, April.—An account of the Michigan convention in *Am. Tel. Jour.*, April 4, and *Tel'y*, April. The paper by F. V. Newman on collections is reprinted in *Am. Tel. Jour.*, March 28; T. Bromley, Jr., on dangers of free service in *Am. Tel. Jour.*, April 4, and E. B. Fisher on a review of the telephone situation in *Am. Tel. Jour.*, April 11.

Signals and Telephony in a Factory.—K. Koehler.—An article discussing the best arrangement of the signal and telephone system of a factory so as to save as much as possible in the number of instruments and the amount of material used. For instance, by means of a common and properly chosen accumulator battery, it is possible to supply several plants with energy. Further, an electric standard clock, which is used to control a series of secondary clocks, may also be used as control apparatus for watchmen. The telephone system may also be simplified by proper selection of apparatus.—*Elek. Zeit.*, March 19.

Telephone Cables.—G. E. Furnas.—While the installation of cables in a telephone plant reduces maintenance cost, troubles are also likely to occur. The author describes and illustrates various cases of damage which are likely to be done to telephone cables and the possibility of preventing them. The paper is to be concluded.—*Am. Tel. Jour.*, April 4.

Lord Kelvin.—A brief but interesting sketch, from the pen of W. Wien, of the chief tendencies in Lord Kelvin's work.—*Ann. d. Phys.*, 1908, No. 1.

BOOK REVIEWS.

Automatic Block Signals. By Ralph Scott. New York: McGraw Publishing Company. 243 pages, 207 illustrations. Price, $2.50 net.

In the preface it is stated that this book is intended for the signal and railway engineer, the electrician and the layman. It deals with American practice in the installation and maintenance of signals electrically controlled and operated by electric or other power, with descriptions of the accessories now regarded as standard. The author has selected a descriptive method of presentation, and the book consists largely of circuit diagrams and explanations thereof. However, the relative advantages of different schemes, as tried and either abandoned or further developed, are discussed briefly. The book furnishes much accurate information concerning modern block-signal systems, logically arranged and expressed in simple language.

The Mechanical Design and Construction of Commutators. By R. Livingstone. New York: D. Van Nostrand Company. 93 pages; 62 illustrations. Price, $2.50 net.

A careful examination of this little book will convince one that even in the seemingly simple problem of selecting the proper dimensions for a commutator complicated methods can be employed, and in certain instances such methods are desirable. The author has attempted to make the treatment absolutely accurate within the limits between which commutators built by the same workmen and assembled in the same shop are found to vary in practice. He gives a discussion in detail of the stresses caused by centrifugal force, initial tension, and expansion due to heating in V-ring and shrink-ring commutators, and shows how these two types of commutators should be assembled. Descriptions of various other types of construction are also given.

In the preface the author states that in dealing with certain stresses many short cuts have been avoided purposely. It seems to the reviewer that the only important defect possessed by the book lies in the omission of these "short cuts" and the substitution therefor of methods which give no better results while being far more complicated. For example, the appendix contains an elaborate proof of the location of the center of gravity of a triangle involving the use of calculus, when any one even slightly familiar with geometry can locate the center of gravity with the utmost ease, and any designer of commutators would willingly have accepted a mere statement of its position without proof. However, the error of unnecessary refinement is on the side of safety. The work will doubtless be found of assistance to designers of electrical machinery.

Mercury-Vapor Lamps in Silk Mills.

There are few, if any, industries requiring so great care in the selection of good quality and proper distribution of light as that of silk. If it were possible to operate the machinery of the average silk mill wholly by daylight illumination, it is hardly probable such mills would ever be equipped with any sort of artificial lighting apparatus. The waste and loss of time due to inadequate illumination, and the further loss due to the decreasing efficacy of many operators in the more exacting operations, due to eye strain and its usual accompaniment of nervous troubles, all combine to form a group of troubles the elimination of which cannot fail to interest any silk manufacturer in the improvement of artificial illumination.

An early application of mercury vapor lamps was made in illuminating silk throwing plants. The distribution of light obtained may be judged from Fig. 1, giving a view of the illumination by Cooper Hewitt lamps of spinning machines in the mill of the H. H. Seaton Company, Passaic, N. J., with absolutely no daylight; the photograph was taken late in the evening to avoid any possibility of the presence of daylight. The operators state that they can see every thread upon the machine from a position at the end of the machine. There is an almost entire absence of shadow in any part of the room, and the light from the mercury-vapor lamp clarifies or magnifies the thread so much that the twist is made extremely plain.

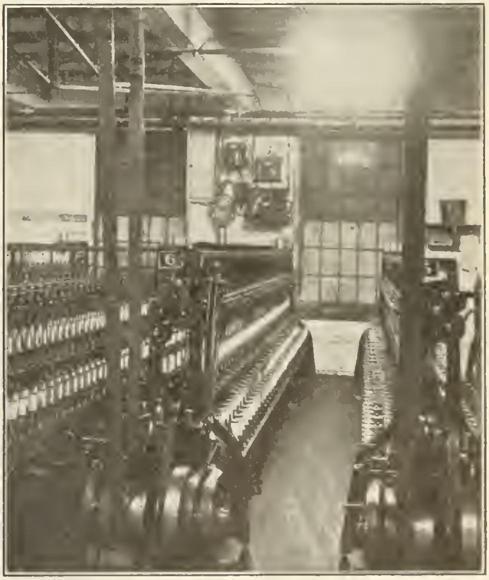


Fig. 1.—Silk-Spinning Machines Illuminated by Mercury-Vapor Lamps

This quality of seemingly magnifying the thread has proved of great advantage to the inspection department by the much greater amount of goods inspected by the light than was possible by daylight, with an added advantage of absolute uniformity of quality and quantity of illumination.

Fig. 2 shows a photograph of the ribbon looms in the mill of the Spiers Silk Company, Paterson, N. J., where every operation of production is successfully conducted under the light of Cooper Hewitt lamps. The processes include warping and quill-winding as well as the weaving of ribbons of all colors.

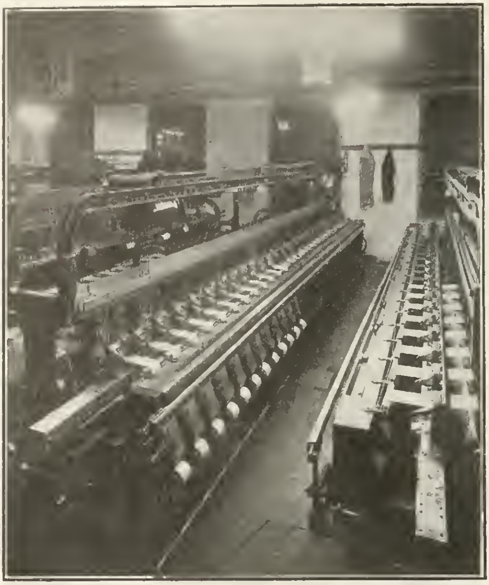


FIG. 2.—RIBBON LOOMS ILLUMINATED BY MERCURY-VAPOR LAMPS.

The detail view of the looms is especially successful in showing the distribution of light on the ribbons and back of the heddles, continuing through the harness and enabling the weaver to pick up and follow a broken thread in the warp with the least possible delay.

The weaver operating broad silk looms finds the lamp of especial advantage because it can be so placed that great volumes of light are thrown, not only on the woven goods, but directly into the loom harness.

The clarifying quality of the light with an absence of any black shadows is of especial advantage here.

With the cheap production of great volumes of light broadly diffused from a high point, due care being exercised in the location of lamps with reference to the points most needing light, a successful illumination of warping machines and Jacquard looms would be expected and has been accomplished with most gratifying results.

A brief statement regarding cost of energy for these lamps is of interest at this point. The type of Cooper Hewitt lamp having an approximate rating of 700 candle-power, operating upon 110 volts, consumes 3.5 amperes or 385 watts. At 10 cents per kw-hour the cost is $.0385 per hour. The average 16-cp incandescent lamp consumes 60 watts, costing 0.6 of a cent per hour.

In a throwing plant formerly using from 200 to 250 16-cp incandescent lamps, 20 300-cp mercury-vapor lamps were placed about two years ago.

	Light.	Power.
200 16-cp incandescents	= 3200 cp	12 kw
20 type H Hewitts	= 6000 cp	3.85 kw
At 10c. per kw-hour the cost of		
3200 cp incandescent	= $1.20 per hour	
6000 cp Vapor	= .385 " "	
Saving	= $ .815 " "	

Thus an illumination equivalent to twice the candle-power of the old illumination at one-third the cost.

Gas Engine for Driving Generator in Steel Mill.

The Carnegie Steel Company recently installed in the generating station of the Edgar Thomson Steel Works, at Bessemer, Pa., a 2000-kw direct-current generator driven at 84 r.p.m. by twin-tandem horizontal engines operating from blast-furnace gas, which possess many features of interest. The most striking details of the engines, which were built by the Westinghouse Machine Company, are the inlet-valve mechanism. A single eccentric operates both the inlet and outlet valves, the electromagnetic igniters and the automatic starting arrangements.

There are four 42 in. by 54 in. double-acting cylinders, each having at least two separate igniter plugs. Starting is accomplished by an automatic compressed-air system, controlled by a single valve, which continues in operation until all igniters are working properly.

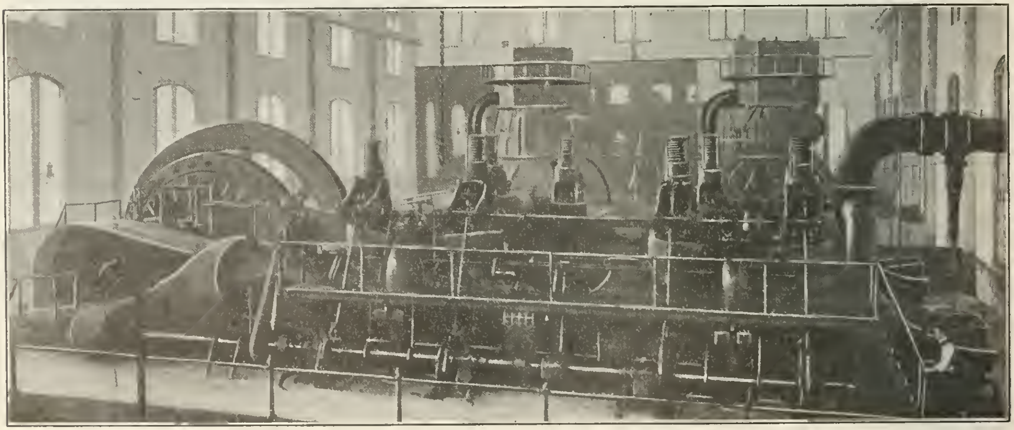


FIG. 1.—BLAST-FURNACE GAS ENGINE DIRECT-CONNECTED TO GENERATOR AT BESSEMER.

The inlet valves are of a novel design, which combines the functions of inlet, mixing and governor valves in a single mechanism by means of which it is claimed that a number of advantages are obtained. The mechanism consists of the spring-operated poppet valve, a stationary cage and bonnet in which it is housed, and a mixing or regulating valve sleeve that reciprocates within the cage and rotates on the inlet valve stem. The mechanism has, in fact, three distinct movements: first, the vertical movement of the valve transmitted from the eccentric; second, the vertical movement of the regulating sleeve, which is carried with the valve stem; and third, the rotation of this sleeve on the valve stem, as actuated by the governor mechanism. The regulating sleeve is a cylinder which has two sets of ports, one for gas and the other for air, which register with corresponding openings within the valve cage that connect with gas and air supplies; the action of the mechanism is such that, when the valve is closed, this sleeve is raised and closes both ports, but as the valve opens, it drops and uncovers the ports, the amount of the opening in either set of ports depending upon the angular position of the sleeve in its rotation about the valve stem as controlled by the governor. The result of this arrangement is that the gas and air are mixed directly at the point of entrance to the cylinder and only as needed by the engine, which avoids large quantities of idle mixed gases in intake connections and results in giving the governor absolute control over the engine. Incidentally a very small amount of mixed gas is involved in case of a back fire. An additional advantage is to be noted in that the constant movement of the valve mechanism, which results in this design, prevents any possibility of the governor valve sticking when the engine is run on constant loads for long periods. Furthermore, as the mixture at each end of each cylinder is independently controlled by the governor, a closer speed regulation has been found possible, the angular variation of the flywheel velocity being such that no difficulty has been experienced in the operation of alternating-current generators of standard frequencies, in parallel. The standard flywheels furnished on these engines are of such proportions that with one cylinder out of commission, the angular variation will be within the limits prescribed for steam practice. Thus, with all four cylinders in operation, the angular variation is less than in standard reciprocating steam-engine practice.

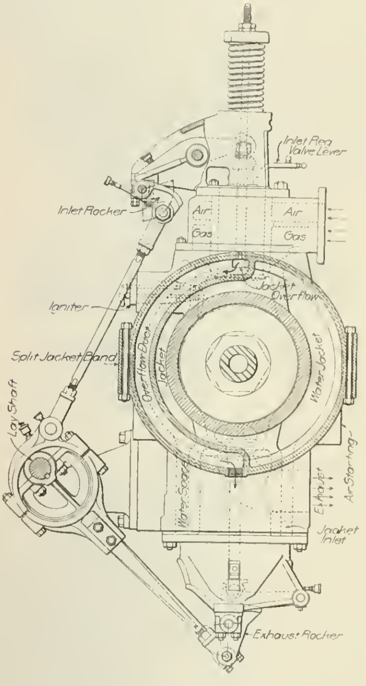


FIG. 2.—DETAILS OF CYLINDER AND VALVE GEAR.

The governor, which is of the centrifugal type, operates a small pilot valve which admits oil under pressure to either end of a small cylinder that forms a part of the governor mechanism, which cylinder actuates the mixing valves of the main cylinder through long-reach rods.

For the ignition, the make-and-break system has been adopted, as best suited for large engines and poor gas. The whole ignition system is insulated from the engine, so that "grounds" must occur at two sides of the system simultaneously to render it inoperative. The igniter mechanism is mechanically driven. It is provided with a magnetic indicator to show at all times the condition of the various igniter circuits. The indicators consist of small "sounders" inserted in the inductance coil circuit to each plug, having visible moving armatures, so that the failure of any igniter is indicated at once to the attendants by the failure of the sounder in its circuit to operate regularly. The ignition gear is provided with a mechanical device for advancing or retarding the spark to meet the requirements of gases of various richness. This device consists of a sleeve having internal spiral grooves engaging pins on the igniter lay shaft. This sleeve is free to revolve with the igniter lay shaft, but it can be moved backward and forward by a graduated hand wheel, so that the relative positions of the main and lay shafts may be changed.

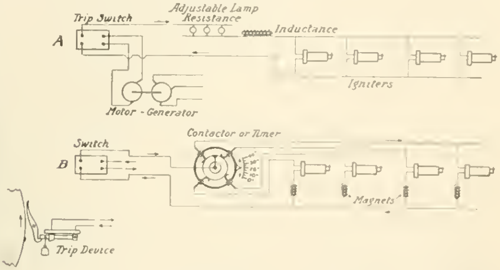


FIG. 3.—DIAGRAM OF WIRING PLANS. A, FOR MECHANICAL IGNITERS. B, FOR MAGNETIC IGNITERS.

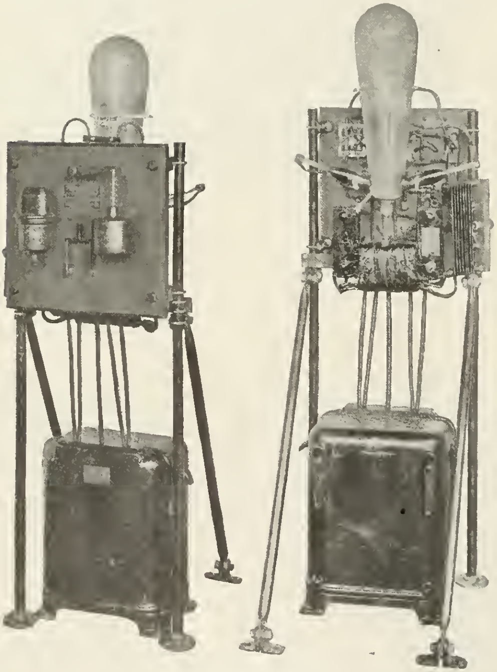
Mercury Arc Rectifier in Moving-Picture Shows.

One of the most recent applications for which mercury arc rectifiers have proved pre-eminently successful is in the operation of arc lamps for moving picture shows. The arc lamps which are used as the light source for moving pictures are usually required from 35 to 60 amp of alternating current and about 25 to 30 amp of direct current. Up to a few years ago they were operated in series with resistances on 115 or 220 volts to bring the lamps to the proper arc voltages. This makes a very wasteful consumption of energy, which is considerably more for the alternating current lamps on account of the higher amperage necessary for producing a light of sufficient intensity

Apparatus for efficiently cutting down the voltage on the direct-current lamps must of necessity be a much more expensive and elaborate outfit than a device designed for a similar purpose for alternating current. The initial cost of the former has prevented its general adoption except for locations where only 500-volt direct current is available, as in summer resorts operated by street railway interests. On the other hand, the problem for overcoming the waste of energy in rheostats on alternating-current lamps has been at least superficially overcome by use of compensators, choke coils and similar devices. While these devices are less wasteful than rheostats, they possess a very low power factor, which makes them undesirable from a central station standpoint. It is stated that some of the large central stations are ordering them removed from their lines, and at least one central station has made a different service rate for establishments using these devices. The direct-current arc lamp is a very much better source of light for moving pictures than the alternating-current arc, principally on account of the greater steadiness of its light, and the considerably lower watt consumption necessary to produce a sufficiently brilliant light.

The General Electric Company has recently designed and sold a number of rectifiers adapted especially for use in supplying direct current to moving picture arcs, where only alternating current is available. The back and front views of one of these rectifier sets are shown herewith. This rectifier set is designed for operation on a 220-volt alternating-current circuit, and has a continuous capacity of 30 amp direct current, and a capacity of 40 amps or slightly more during the starting of the arc. The rectifier is designed to deliver a direct-current voltage equal to that required across the arc, or from 45 to 50 volts. A reactance in series with the alternating-current supply serves to steady and regulate the current taken by the arc lamp. This eliminates the necessity of having a wasteful resistance in the arc circuit.

The rectifier set is similar in some particulars to the battery charging rectifier now in common use. The regulating features and other parts necessary for battery charging, but not required for this service, are omitted, and the rectifier equipment reduced to its simplest form. The apparatus may be installed at a distance from the picture-machine operator, for instance in the basement, and may be started by the operator without leaving his booth.

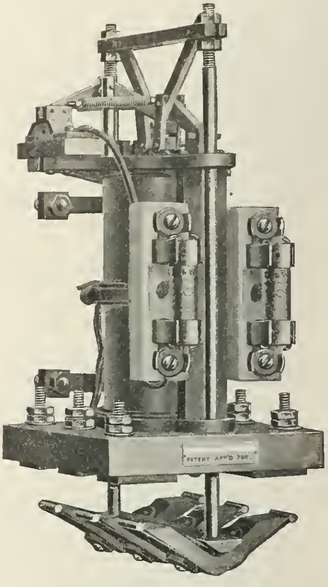


MERCURY-ARC RECTIFIER.

The only operation necessary to start the rectifier, after the supply switch is closed, is to touch the two carbons of the arc lamp together, hold them so for a second or two, and on separating the carbons a direct-current arc will be drawn. The closing of the carbons allows the current to flow through a coil on the panel, which tilts the tube once or twice and causes it to start. The rectifier not only enables a direct-current arc with its far better light to be used, but the cost of the operation is much less than with either alternating or direct current with inductances or resistances in series with the arc.

Remote-Control Switch.

The accompanying illustration shows a remote-control switch recently placed on the market by the Central Electric Company, Chicago, Ill. The switch is equipped with two coils acting upon a core attached to a toggle mechanism carrying the main brush contacts. When the circuit through the upper coil is completed the entire mechanism is drawn up until the switch toggle locks and firmly draws the laminative copper brushes against the stationary main contact. By completing the circuit through the lower coil, the heavy core is drown down, "breaking" the toggle, and the switch falls open by gravity.



REMOTE-CONTROL SWITCH OPEN.

The control switch is of "momentary-contact" type, so arranged that when the button is pressed a "snap" contact is made and a "snap" break is obtained when the button is released. The two buttons cannot be pressed together. As the switch fits a standard wall box and uses a standard gang plate, it can readily be installed and can be used either with a push button or a key. The switch is applicable to either direct or alternating current, is made for all e.m.fs. up to 250 volts and for current ratings up to 2500 amperes. The switches are very compact, the 50-ampere size occupying a space approximately 12 in. x 6 in. x 5 in.

Circuit-Breakers for Low-Tension Alternating-Current Circuits.

Oil-break circuit-breakers are now largely used for the protection of alternating-current circuits of 600 volts or less, as the same qualities which have brought the oil-break switch into almost universal use for interrupting high-tension circuits, have recommended it to engineers for low-tension work. A new type of circuit-breaker, manufactured by the Hartman Circuit Breaker Company, of Mansfield, Ohio, shown in the accompanying illustrations, has been designed especially with a view of furnishing a low-priced protective device for alternating-current circuits of 600 volts or less. They are made for capacities up to 600 amperes, for either switchboard or wall mounting, single- and double-throw, plain overload release or combined overload and low-voltage release. The wall mounting form, shown in Fig. 2, is especially well adapted for the protection of induction motors in mills and factories, as it can be installed on any convenient post or wall. One of the standard forms is a double-throw switch combining the features of an auto-starter with those of a circuit-breaker. This switch is automatic on the running side and also on the starting side under certain overload conditions. The auto-transformers used in connection with it are mounted on the supporting frame with the circuit-breaker, the layout being thus entirely self-contained and easy to install. Both transformer and switch parts are enclosed in a heavy sheet-metal case, which serves the double purpose of preventing the operator or workmen from coming in contact with the live parts and as a protection against dirt and dust. Three taps are provided on each transformer, so that the voltage on the starting side can be made 50-65 or 80 per cent of the full line voltage. When the switch is thrown over to the running side, the transformers are cut out of circuit. The device thus combines the features of an oil-immersed auto starter with those of an overload and low-voltage circuit-breaker.

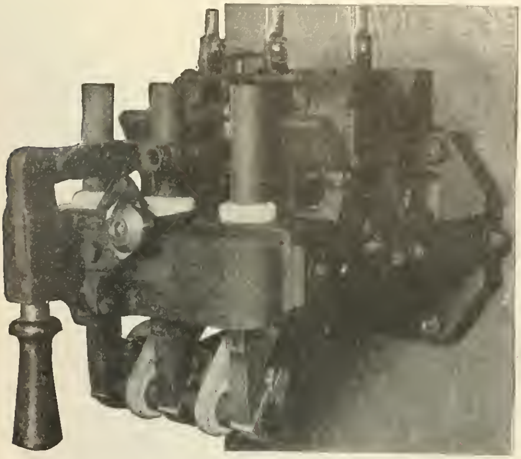


FIG. 1.—CIRCUIT-BREAKER FOR WALL OR POST MOUNTING.

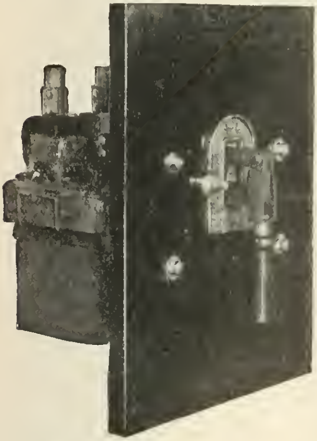
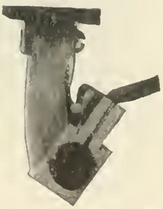



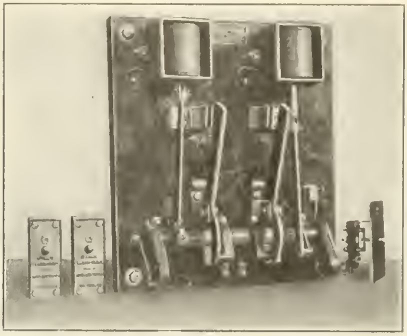
FIG. 2. CIRCUIT-BREAKER FOR SWITCHBOARD MOUNTING FIG. 3 — CIRCUIT-BREAKER CONTACT.

The contacts are of the laminated type, protected by auxiliary or arcing contacts which can be easily replaced, should they become burnt away in the course of time. A powerful toggle action is secured at the final closing movement, which brings the movable contacts tightly against the laminated brushes and produces the perfect self-cleaning contact shown in Fig. 3. In the construction of the operating mechanism the use of small, delicate parts has been avoided and the levers and toggles are amply large and strong. All bearings are of dissimilar metals so that they cannot rust tight. The construction is rugged throughout and made to withstand hard usage.

For single-phase circuits the circuit-breaker is provided with one overload coil; for two- and three phase circuits, it is furnished with an overload coil in one or two phases, as desired. Low-voltage release is furnished either alone or in combination with a single- or double-overload coil. The latter construction is used in the wall mounting form shown in Fig 2 Both overload and low-voltage release are arranged so that the circuit-breaker will trip should the operator attempt to close it while low-voltage or overload conditions exist

Double-Magnet, Quick-Break Switch for Remote Control.

The accompanying illustration shows a three-quarter view of a double-magnet, quick-break switch brought out by the Automatic Switch Company of New York City to meet the constantly growing requirement for heavy ampere-capacity, quick-break switches for remote control, with magnet circuit de-energized after the throw of the switch. In the switch shown the normal pull of the solenoid is increased sufficiently to insure a positive opening of the blades by storing the energy of the pull in the momentum of the weight and in the coil spring shown on each side of the weights. The result is that the quick blow effect in striking the blades in opening insures positive operation under all conditions. This form of switch can easily be made for various ampere capacities and number of poles by changing of the blades and contacts only, the other parts remaining the same for all sizes. It is shown mounted on a slate slab 1⅛ in. thick by 14 in. wide by 16 in. high, and is intended to go in a box at least 7 in. deep.


DOUBLE-MAGNET QUICK-BREAK SWITCH.

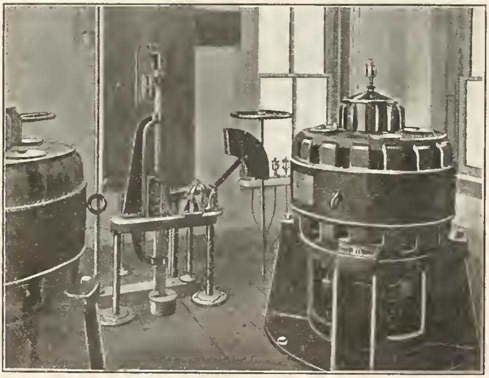
The controlling buttons shown are of the single-pole type, so that the switch can be opened only from the control point, it being necessary to place another button on the switchboard to close it. Another form of switch has two buttons in the same box, thus giving complete control of the switch both "on" and "off" from any number of buttons. These switches are supplied for alternating- or direct-current circuits where the number of operations per day is not sufficient to warrant the use of carbon and copper contacts, and they may be used successfully in connection with time clocks for cutting off the supply of electricity in a certain district at a predetermined time, cutting in again the next day. As the magnet circuits are broken on this switch, no special provision is required in the buttons or controlling points to offset the effect of arcing, since no arcing occurs.

Sewage Pumping Stations at Dayton, Ohio.

The city of Dayton lies in a valley surrounded by hills whose slopes drain very rapidly. At this point, several streams unite to form the Great Miami River. This stream in summer is of insignificant proportions, but in late winter and early spring, after a sudden rain or melting snow, it rises in a few hours to the proportions of a great river. To protect the city from inundation, levees are maintained, but a rise in the river cuts off the sewers and it is necessary to close the gates at the outfalls to prevent the river backing up into the streets and houses. At such times it is necessary to raise the sewage and discharge above the flood level. After careful investigation and some costly and unfortunate experiments with steam pumps and pneumatic ejectors, which either required too much attention or were too expensive or uncertain in operation, the city of Dayton decided to install automatic electric pumps and awarded the contracts to the Dayton Hydraulic Machinery Company, builders of the well-known "Brooks" and "Dayton" centrifugal pumps.

When electric motors were decided upon, central station service was accepted as the most satisfactory, since power can be obtained on a moment's notice at any time, night or day, there is an entire elimination of steam boiler and engine troubles, and the maintenance and operating charges are a minimum.

Three stations have so far been constructed in various sections of the city. The first is equipped with two vertical 2500-gal. Brooks submerged centrifugals, geared to 20-hp, horizontal, three-phase, 60-cycle Westinghouse motors. The motors are started and stopped by standard oil-switch compensators which are operated by hydraulic pistons controlled by float switches designed and built by the Dayton Hydraulic Machinery Company under its patents. The lift is variable, averaging about 20 ft. The discharge is through a check valve at a point below extreme high water. The operation of these pumps is entirely automatic, it being only necessary to inspect them occasionally and keep the oil receptacles filled. Upon notice of a rise in the river, the gates are closed and the current turned on, after which the pumps cut in and cut out automatically with the rise or fall of the sewage in the pits.



VIEW OF AUTOMATIC ELECTRIC SEWAGE PUMPS AND STARTER.

The second station, at Longworth Street, has three units, and the third station, at Lehman Street, two, each consisting of a double-suction vertical submerged 4500-gal. Brooks centrifugal, direct-connected to a 40-hp, vertical type, three-phase, 60-cycle, 2080-volt Westinghouse motor.

The starting apparatus at these last two stations consists of floats which operate the valves on a hydraulic piston, using water under pressure from the city mains. On starting, this piston raises the lever on a Westinghouse auto-starter to the starting position, at the same time rotating an arm carrying a heavy counterweight which, by the time the motors have picked up speed, falls, and by means of a pawl, drops the lever to the running position. On stopping, the reverse motion given the counterweights moves the lift to the cut-out position. The operation of this apparatus is extremely satisfactory and the motors cut in and cut out automatically with great regularity and smoothness. During a heavy rain, when the river was quite high, one pump was sufficient to take care of the flow in the sewers at the Lehman Street station when running three minutes out of each ten, being idle the remaining seven minutes.

Additions to D., L. & W. Shop and Mine Electrical Equipment.

During the past year the Delaware, Lackawanna & Western Railroad has made extensive additions to its electrical shop and mine equipment in the vicinity of Scranton, Pa.

At the Hampton power plant one 2000-kw Allis-Chalmers turbo-alternator has been installed, with barometric condenser and dry-vacuum air-pump. The building has been increased in size to accommodate another unit of the same size. A new switchboard and cellular oil-switches have also been installed in this plant.

The boiler plant at this same location, which was normally rated at 4500 horse-power, has been increased in capacity by 3800 horse-power, the new installation being in six units of the two-drum Stirling boilers.

Four substation equipments have been installed, consisting of 350-kw, three-phase, 60-cycle transformers and 300-kw, 275-volt rotary converters with necessary switchboard apparatus. One new substation, consisting of two 350-kw, three-phase, 60-cycle transformers and two 300-kw, 275-volt rotary converters, with necessary switchboard apparatus, has been installed. This substation is inside of a mine; the transmission line, 4150 volts, 60 cycles, is brought through a varnished cambric, lead-covered, iron-armored cable suspended in a borehole from the surface 700 ft. deep.

Twenty-two 6½-ton electric locomotives, equipped with a cable-reel device for running up into chambers, have been installed; also one 10-ton electric locomotive, without reel.

The following bronze centrifugal pumps have been installed at mines: One 500-gal., two-stage, 125-ft. head, driven by a 30-hp, 440-volt, 900-r.p.m. induction motor; two 500-gal., two-stage, 183-ft. head, driven by 40-hp, 2200-volt, 1200-r.p.m. induction motors; two 800-gal., four-stage, for 330-ft. head, one being driven by a 100-hp, 2200-volt induction motor at 1200 r.p.m., and the other by a 75-kw synchronous motor, having the same speed and voltage; three 450-gal., single-stage pumps, driven by 30-hp, 440-volt, 1800-r.p.m. induction motors; one 1200-gal., two-stage, 160-ft. head, driven by a 75-kw, 3800-volt, 1200-r.p.m. synchronous motor; two 150-gal., two-stage pumps, driven by 10-hp, 250-volt direct-current motors; two 250-gal., 500-ft. head plunger pumps, driven by 50-hp, 440-volt induction motors; eight 100-gal. triplex pumps, mounted on trucks for sinking purposes, four being driven by 10-hp, 440-volt induction motors and four by 10-hp, 250-volt direct-current motors.

There have also been installed one hoist, equipped with two 80-hp, 500-volt direct-current motors; four hoists equipped with 25-hp, 250-volt direct-current motors for sinking purposes; two hoists equipped with 112-hp, 440-volt induction motors, and one hoist equipped with a 200-hp, 440-volt induction motor. The hoists equipped with induction motors are fed through three-phase, 60-cycle transformers of 100- and 200-kw capacities, respectively, for the 112- and 200-hp motors. The primary connections of the transformers can be made for either 2400 volts or 4150 volts.

A rail-bond testing outfit has recently been installed, which is mounted on a flat car and used to locate bad bonds in the rails on the roads over which electric locomotives operate.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—While there were numerous developments during the last week which tended to increase the hopeful spirit in the commercial world, there was but little improvement noted in distributive trade and industry, and on the whole trade was quiet. Fine crop reports, a stronger securities market and very easy money, all combined to create a more confident feeling than for some time past. Wheat prices have advanced sharply on statistical grounds, also the new crop to a lesser extent, notwithstanding excellent crop reports. April railway earnings show a decrease of from 15 to 16 per cent from the values for the same period in 1907, as compared with a loss in March of 14 per cent. Accumulations of money at all the centers are reported, and there is a plethora of funds seeking investment. Collections continue behindhand, and extensions are constantly asked. The metal trades are reported at a low ebb. Pig iron is depressed, and price concessions rule, the independents seeming to get what little business is to be had. The success of the Pennsylvania Railroad in placing its bond issue means a great deal to the iron and steel trades, providing other roads meet with equal success. Demand for structural material continues fair. Failures for the last week, ended April 23, as reported by *Bradstreet's*, were 254, against 261 in the preceding week, 157 in the corresponding week in 1907, 177 in 1906, 193 in 1905, and 197 in 1904. Very little activity is to be reported among the electrical interests in New York City. No large orders are reported, and even export business, which has heretofore been excellent, has sagged, though several important foreign projects will be announced shortly in these columns. Reports from the various committees which have in charge the rehabilitation of the Westinghouse Electric & Manufacturing Company indicate that the plans are making encouraging progress.

CAPITAL CITY POWER COMPANY. Work has been begun on the Capital City Power Company's plant, the third and largest development of the United Missouri River Power Company, of Helena, Mont. This new development, which is to meet the growing business of the company, will be situated on the Missouri River about 25 miles below the Helena Power Company's generating station, and about 33 miles from the city of Helena, where the topographical condition is such as to enable the construction of a hydro-electric plant on the most economical basis. At this point, in the opinion of the company's engineers, there is available 300,000 hp under a head of 110 ft. The plans of the company include the erection of a dam and power house, and the initial installment of hydraulic and electrical equipment will be sufficient to generate 20,000 hp. High-potential transmission lines will be constructed from the station to a point 18 miles distant, where a connection will be made with the high-tension lines of the Helena Power Transmission Company, from which point the energy is delivered to the constantly increasing consuming centers of Butte and Anaconda. Reports from Helena state that the new dam will be the second largest in the world, and in addition to furnishing hydro-electric energy, will irrigate thousands of square miles in that section of the country. By July 1 more than 500 men will be at work on the new dam. The size of the enterprise is shown by the fact that 125,000 barrels of cement will be used, which, if loaded on cars, would compose a train nine miles long. One thousand tons of steel will be required for the construction work. The present developments of the United Missouri River Power Company consist of the first water-power plant, or the original development on the Missouri at Canyon Ferry, about 17 miles northeast of Helena, which has a rating of 9250 hp, and the second development (Helena Power Transmission Company) at Hauser Lake on the Missouri River about 16 miles below the Canyon Ferry plant, which has a total rating of 18,650 hp. With the operation of three hydro-electric stations the company will have practically a monopoly of the electric business in the mining region penetrated by its lines. Among the directors of the United Missouri Power Company are S. T. Hauser, president; Senator William A. Clark; F. P. Addicks and B. B. Thayer. The development of the Capital City Power Company is financed by an issue of $1,500,000, 30-year, first mortgage gold bonds, put forth by the banking firm of A. B. Leach & Company, of New York.

THE WIRE INSPECTION BUREAU has recently taken steps to enlarge its scope and its methods of operation and plans for increasing its efficiency. In addition to its factory inspection service, it has inaugurated a system of field inspection, through its own inspectors, so that frequently coils of wire are now purchased from jobbers throughout the country and subjected to rigorous tests as to material and insulation. This service is limited to National Electrical Code wires and all coils conforming to this standard bear the certificate of the bureau in the form of a stamp. The following manufacturers avail themselves of the service of the bureau: Atlantic Insulated Wire & Cable Company; American Electrical Works; American Steel & Wire Company; Bishop Gutta Percha Company; Boston Insulated Wire & Cable Company; Bourn Rubber Company; W. R. Brixey Company; Collyer Insulated Wire Company; Consumers' Rubber Company; Crescent Insulated Wire & Cable Company; Detroit Insulated Wire Company; General Electric Company; Hazard Manufacturing Company; Home Rubber Company; Habirshaw Wire Company; Indiana Rubber & Insulated Wire Company; Marion Insulated Wire Company; Alfred F. Moore; New York Insulated Wire Company; National India Rubber Company; Phillips Insulated Wire Company; John A Roeblings' Sons Company; Safety Insulated Wire & Cable Company; Simplex Electric Company; Standard Underground Cable Company; Waterbury Company.

WESTINGHOUSE TURBO-GENERATORS FOR THE FAR EAST.—Ten machines, aggregating 25,000 horse-power, are included in a large shipment of Westinghouse turbo-electric power equipment from East Pittsburg to the Far East. Most of these machines will go to Japan for the equipment of railway, lighting and manufacturing plants. One of the first machines to be put in service will be a 1500-kw turbine unit for Manila, to be installed in a railway power house with four other machines of like construction put into service several years ago. The Manila railway system was engineered and constructed by J. G. White & Company. Three machines of 5000 hp each go to the Osaka Electric Company, Osaka, Japan, for its new station, which will be one of the largest power stations in Japanese territory and will initially contain 15,000 kilowatts in five units, the remainder of which will follow as fast as they can be built and tested. The Osaka installation is under direct charge of Messrs. Takata & Company, of New York and Tokio. For installations in process of erection at the Imperial Steel Works of the Japanese government and the ship yards of the Hakkaido Tanko Steamship Company there are four 500-kw turbo units, two of which will comprise an initial installation in each of these plants.

INDUCTION MOTORS FOR BREWERY.—The Pabst Brewing Company, Milwaukee, recently placed contracts for a line of 25-cycle Allis-Chalmers induction motors of standard and special design ranging in capacity from 5 to 50 horse-power. These motors, which are three-phase, 440-volt machines, are to be driven from three Allis-Chalmers engine units installed some months ago to replace a number of small isolated power plants in various parts of the plant. The electrical equipment, also furnished by Allis-Chalmers Company, comprises three revolving-field alternators wound for 25 cycles, one of 300-kw and two of 400-kw capacity.

ROSSITER-MACGOVERN COMPANY.—We noted recently in this department the formation of a new company, the MacGovern-Archer Company, of New York City, the members of which were the vice-president and sales manager, respectively, of the Rossiter-MacGovern Company We are authoritatively informed that the Rossiter-MacGovern Company is now reorganizing with new capital, which will be ample for its operations, and that it will be active and prominent in the field in the same line as heretofore

STATUS OF THE COPPER MARKET.—Dulness and sagging prices characterized the week in copper, prices declining at the increase of the visible supply. It was reported that the General Electric Company had purchased several million pounds of the metal at 12⅞ cents for delivery within 30 days, but, as a rule, the big companies are keeping away from the market, buying only for immediate needs. Until the securities market improves, and the demand for finished material increases, there is little likelihood of the large consumers changing their policy. Since Easter there have been unusually heavy shipments abroad, but the foreign consumption is not as large as the demand seems to indicate. On Monday the local market eased off in sympathy with the London market, where it was reported that Japanese producers were offering large blocks of the metal in competition with American producers. It is said that the Japanese have not been able to sell as much of the metal to China as formerly, and are obliged to seek new outlets for their production. Unless the home demand has increased immensely over the present demand by June, when the Amalgamated production will come on the market, there will have to be considerable reduction in export prices in the face of the Japanese supply, in order to maintain the status of the metal market here. Exports from the port of New York since April 24, totaled 700 tons, making the total shipments since the first day of April 24,646 tons. Closing prices on the Metal Exchange, Monday, were as follows:

Lake	12⅝	@	12⅞
Electrolytic	12½	@	12¾
Castings	12¼	@	12½

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	57	15	0	57	12	6
Standard copper, futures	58	5	0	58	5	0
Market		Easy.			Easy.	
Sales of spot					150 tons	
Sales of futures					700 tons	

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	61	0	0

ELECTRIC CAR LINE FOR PRETORIA, TRANSVAAL.—According to the report of Consul John H. Snodgrass, of Pretoria, Transvaal, the Town Council of Pretoria is considering changing the street-car line to an electric system and requests American manufacturers of street cars, overhead wires and iron and steel rails to furnish information as to the probable cost of an equipment of from 9 to 15 miles. Specific information is desired from the manufacturers by the Council as to the cost per mile for track, the cost of the overhead wire and the cost per car for ten or more. The type of car preferred is the ordinary light car that is used in the smaller cities of America. Letters or catalogues may be addressed to Dr. S. R. Savage, Mayor of Pretoria, or to the American Consul, P. O. Box 952, Pretoria, Transvaal, South Africa.

WILLIAMSBURG BRIDGE CABLES.—Dossert & Company, 242 West Forty-first Street, New York, have designed a special extension fitting for the solderless cable taps which are used as equalizers on the feeder cables supplying energy to Brooklyn Rapid Transit trains which are to run over the new loop connecting the Williamsburg and Brooklyn Bridges. The area of the cables ranges from 2,500,000 to 500,000 circ. mils. The work is under the direction of Latey & Slater, consulting engineers. The Gore Engineering & Contracting Company has placed orders for 244 sets of these large double taps. 164 regular taps and a number of two-way Dossert joints, including 134 connecting aluminum to copper.

HABIRSHAW WIRE COMPANY ELECTS OFFICERS.—At the annual election of the Habirshaw Wire Company, which was held on April 15, the following officers were chosen: Herbert L. Satterlee, president; Richard Irvin, first vice-president; R. S. Satterlee, second vice-president; F. J. Hall, treasurer, and J. B. Olson, secretary in charge of the sales department. Dr. W. M. Habirshaw was chosen chairman of the board of trustees.

PASSENGER SUBWAY FOR CHICAGO.—It is stated on good authority that Mayor Busse, in his coming message to the City Council, will advocate the building of a Chicago passenger subway which will cost about $30,000,000.

SANDUSKY, OHIO, CARBON PLANT ABANDONED.—The plant of the National Carbon Company, established at Sandusky, Ohio, 20 years ago, will be abandoned and the machinery shipped to Fostoria.

LIBERTY, IND., LIGHTING PLANT.—Mr. G. E. Stevenson, chairman of the Light Committee of the Council of Liberty, Ind., writes that the town invites the establishment there, by private capital, of a central station plant.

Financial Intelligence.

THE WEEK IN WALL STREET.—Developments of a favorable character during the week gave a new impetus to the stock market, and brought securities to record levels for the year. The principal bullish feature was the announcement of the Pennsylvania 4 per cent long-term bond issue for $40,000,000, coupled with the information that foreign bankers of importance had combined with local interests to carry out the operation. Before the end of the week the subscriptions to the American allotment of $20,000,000, amounted to more than 200,000,000, and the effect on the general bond market was stimulating. The stubborn steadiness of the stock market during the present month, even in the face of the most bearish news, has created a strong impression that Wall Street, in the vernacular, is "bare of stocks," and also the impression that the end of the present upward movement is not yet in sight. From Wednesday afternoon, when the Pennsylvania plans became known, the market gained decidedly, Pennsylvania shares advancing from 116¾ to 119⅛. Reading and Union Pacific shared in the upward movement, and Steel issues were well supported. Amalgamated and American Smelting also advanced, while more or less strength was developed in Atchison, St. Paul, Southern Pacific, etc. Gold engagements by foreign houses, amounting to $5,000,000, caused no unfavorable comment, as money received from the interior continues to accumulate in the banks. The higher price of wheat, owing to a world scarcity, and the prospects of fine crops, point to a speedy recovery from the influences which have been dominating the country for the last few months. Shortly after the market opened on Monday, it was announced that subscriptions to the Pennsylvania bond issue had been closed, the number of subscriptions already received being more than 20,000, and amounting to hundreds of millions. This news, construed as forecasting the reception which would be meted to other bond issues, gave the market another upward lift, and closing prices on Monday were as follows:

NEW YORK.

	Apr. 20.	Apr. 27.	Shares Sold.		Apr. 20.	Apr. 27.	Shares Sold.
All-Ch.	7½*	8	2,000	Int-Met., com.	10½	10½	14,550
All-Ch., pfd.	19*	20⅞	4,180	Int.-Met., pfd.	27¾	28¼	20,300
Amal. Cop.	57	60⅛	108,200	Mackay Cos.	59¾	61½	1,000
Am. D. T.	39*	39*	———	MackayCos.,pfd.	64½	65½	100
Am. Loc.	44¼	47	9,645	Met. St. Ry.	29	20	300
Am. Loc. Pfd.	93½	100	2,000	N.Y. & N.J. Tel.	100*	100*	———
Am. Tel. & C'bl.	50*	50*	———	Steel, com.	37⅞	35⅞	340,370
Am. T. & T.	116½	118¾	7,200	Steel, pfd.	98¼	100⅜	34,370
B. R. T.	46½	47½	41,235	W. U. T.	50	51½	1,800
Gen. Elec.	132½	134	4,118	West'h. com.	55	56	9,900
Hud. R. Tel.	—	—	———	West'h. pfd.	60*	68*	100

PHILADELPHIA.

	Apr. 20.	Apr. 27.	Shares Sold.		Apr. 20.	Apr. 27.	Shares Sold.
Am. Rys.	42½	44¾	———	Phila. Elec.	7⅞	7 15/16	———
Elec. Co. of Am.	9½	9½	———	Phila. R. T.	17½	18⅛	———
Elec. Stor. B'ty.	28	30	———	Phila. Traction.	89	—	———
E. S. B'ty pfd.	—	—	—				

CHICAGO.

	Apr. 20.	Apr. 27.	Shares Sold.		Apr. 20.	Apr. 27.	Shares Sold.
Chicago City Ry.	155	160	———	Met. Elec. com.	15	17	———
Com. Edison	—	92	———	Met. Elec., pfd	47½	47	———
Chicago Subw'y.	—	18⅛	———	National Carbon.	56	57¾	———
Chicago Tel. Co.	118	118¼	———	Nat. Carbon pfd.	108	109¼	———

BOSTON.

	Apr. 20.	Apr. 27.	Shares Sold.		Apr. 20.	Apr. 27.	Shares Sold.
Am. Tel. & Te.	—	119	———	Mass E. R., pfd.	—	46½	———
Comb'ind Tel.	—	109	———	Mex. Tel., pfd.	—	—	———
Edison El. Ill.	—	213	———	New Eng. Tel'p.	—	114	———
Gen. Elec.	—	134½	———	W'st Tel. & Tel.	—	6	———
Mass. Elec. Ry.	—	9½	———	W. T. & T. pfd	—	66½	———

*Last price quoted.

Shares sold are for week April 20-25

BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.—The Birmingham Railway, Light & Power Company reports gross earnings for March of $177,003, and expenses and taxes of $112,686, leaving a net of $64,317. Deducting interest charges of $41,822, there remains a surplus of $22,495, and, deducting a reserve fund of $1,041, a balance of $21,454.

ELECTRICAL DEVELOPMENT IN WASHINGTON.—Col. A. M. Dewey, president and general manager of the Okanogan Electric Railway Company, has received advices that a $3,000,000 bond issue will be taken over by foreign investors. The money will be used in the construction of a standard gage electric railroad between Nighthawk and Brewster in Okanogan County, Wash. The road will extend from Nighthawk, in the northern part of Okanogan County, to Brewster, in the extreme southern part of the county, the head of navigation of the Columbia River. Construction work will be started at the middle and at both ends of the line before July 1, if the necessary labor can be procured, and it is expected that passenger and freight trains will be running in 18 months from the time work is begun. The road, including equipment, will cost $30,000 a mile. The company has already secured contracts for a large part of the right of way, and has a site for a power plant at Blue Lake, where it can develop 5,600 horse-power. An auxiliary plant will be erected at the conjunction of the two forks of Simon Creek, near Conconully. The stream has a fall of 1200 feet in the Peacock Mountains. After the water is used to drive electric generators it will be turned back into a reservoir for irrigation purposes. The territory covered has within its confines several of the largest mines in Washington. Ten thousand acres of land are already under the ditch on government and private irrigation projects, and there are 28,000 acres outside of these plants, while 40,000 acres more will be available within two years. The company plans to supply electrical energy to irrigate 6000 acres on the Okanogan River by lifting the water 100 feet to reach the land on two benches.

MERCHANDISE CREDITORS' COMMITTEE. The secretary of the Merchandise Creditors' Committee of the Westinghouse Electric & Manufacturing Company has issued a letter to the creditors which says that a majority of the creditors have assented to the Merchandise Creditors' plan, but that the success of the plan depends largely upon the willingness of the creditors who have not yet signed the agreement to give the matter their immediate attention. "Unless it can be shown within a short time," the letter reads, "that the support of practically all of the merchandise creditors can be obtained, other and less desirable steps will necessarily have to be taken to secure a settlement of the company's outstanding obligations." Mr. J. W. Marsh, chairman of the Merchandise Creditors' Committee, said, in speaking of the work of the committee, "We are making very good progress and the outlook is encouraging. The committee represents $4,250,000. Of this amount more than $3,000,000 has been signed, or promised before the end of April. In the Pittsburg district alone the amount represented is more than $1,120,000. Of this amount $700,000 has been signed up and $300,000 additional promised by the end of April. The remainder of the creditors, representing about $1,000,000, the committee has not yet had the time to see, but reports indicate that the plan is approved generally. Naturally the Creditors' Committee is depending largely upon the present stockholders to do their share, and the Stockholders' Committee feel that it is making fairly good progress." An order authorizing the receivers for the Electric Company to return 2,500,000 francs (par value) debentures of the Société Anonyme of Paris to the society has been issued by Judge Young in the United States Circuit Court. The 2,500,000 francs is to be credited on the balance due on the Westinghouse subscription to 10,000,000 francs debentures of the Société Anonyme.

DIVIDENDS.—The directors of the Portland Electric Company have declared the regular quarterly dividend of 1½ per cent, payable April 30. The Automatic Electric Company has delayed dividend action until July 31; three months ago a dividend of 1½ per cent was declared. The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable May 15. The directors of the American Gas & Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 1. The directors of the Cambridge Electric Light Company have declared the regular quarterly dividend of 2½ per cent, payable May 1 to stock of record, April 21. The regular quarterly dividend of 1 per cent on the capital stock, payable May 15 to stock of record May 1, has been declared by the directors of the American District Telegraph Company. The directors of the Western Electric Company have declared the regular quarterly dividend of 2 per cent, payable May 1. The Connecticut Railway & Lighting Company has declared the regular quarterly dividends of 1 per cent on both its preferred and its common stock, payable May 1. The directors of the Ohio Traction Company have declared the regular quarterly dividend of 1¼ per cent, payable May 1. The Butte Electric & Power Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1.

ATLANTIC CITY LIGHTING BONDS.—The Atlantic City Electric Company, which controls the public lighting business of Atlantic City, has sold $1,000,000 first mortgage, refunding 5 per cent bonds to the banking house of Edward B. Smith & Company. The bonds are guaranteed, principal and interest, by the American Gas & Electric Company, which is controlled by persons affiliated with the General Electric Company. These bonds are part of an authorized issue of $6,000,000, of which $3,750,000 will be reserved for future extensions, and the remainder to take up a small amount of underlying bonds. The Atlantic City Company is a consolidation of four companies, three of which have perpetual franchises, and one has a franchise for 100 years. The net earnings of the company in 1907 were $131,846, or more than twice the interest charges.

EAST STROUDSBURG LIGHT, HEAT & POWER COMPANY.—The East Stroudsburg Light, Heat & Power Company, of East Stroudsburg, Pa., which has been formed recently, will erect a power plant on the Bushkill Creek. A concrete dam 470 ft. long will be constructed, and will reach 30 ft. above the creek level. A reinforced concrete flume about 1000 ft. long, giving 10 ft. more head will make 40 ft. head in all, which will furnish 10,000 hp during nine or ten months of the year. During the dry season it is figured that the power will fall as low as 120 hp and in all probability in addition to the hydraulic plant there will be an auxiliary steam plant. Mr. William H. Loder, of East Stroudsburg, is secretary of the company, and Mr. Lewis H. Grossart and Henry A. Kent, of the firm of Grossart & Kent, Stroudsburg, are the engineers.

NATIONAL ELECTRIC COMPANY.—Mr. John I. Beggs has made his final report as trustee of the National Electric Company, of Milwaukee, which was forced into bankruptcy by the defalcations of Frank G. Bigelow, now in prison. Dividends of a total value of 40½ per cent have been paid to creditors, and a final dividend of 1/3 per cent will be allotted. The winding up of the affairs of the concern was made possible by a recent decision of the United States Court of Appeals relative to the action begun against the bankrupt by the General Electric Company, for an alleged infringement of patent rights. The lower court decided in favor of the plaintiff, but the trustee appealed and the verdict was set aside. The settlement solved the last of the many difficult problems encountered in the administration of the affairs.

OFFICERS OF MARCONI WIRELESS COMPANY ELECTED.—At the annual meeting of the stockholders of the Marconi Wireless Company of America, held in Jersey City on April 21, Mr. John W. Griggs, of New Jersey, was elected president of the company; Mr. Guglielmo Marconi and Mr. John Bottomley (general manager), vice-presidents; Mr. W. W. Bradfield, treasurer, and Mr. George S. De Sousa, assistant treasurer. The new executive committee includes the president and vice presidents and Mr. John D. Oppe, Mr. James M. Townsend and Mr. James W. Pyke. The following were elected directors for five years: Messrs. John W. Griggs, John D. Oppe, of Montreal, and James W. Townsend, of New York.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report for February of the American Telephone & Telegraph Company, which covers all except one of its associated operating companies, not including long distance lines, shows a telephone revenue of $9,384,400, and general operating and maintenance expenses of $7,074,100. The balance from operation was $2,310,300; sundry earnings (net), $395,700; total net earnings, $2,706,000. The interest charges were $648,100, leaving a balance available for dividends of $2,057,000. Deducting dividends declared of $20,400, leaving $2,037,500.

NORTHERN OHIO TRACTION & LIGHT COMPANY.—The Northern Ohio Traction & Light Company reports gross earnings for March, $129,659, as compared with $133,834 for 1907; expenses of $81,273, against $83,215, making the March net $48,386, as compared with the net for the same period last year of $50,619; the March surplus was $4,433, a decrease from the $9,320 of March last year. The three months' net was $133,454, as compared with $140,377 for the same three months of 1907, and the three months' surplus was $4,594, against a surplus of $16,348 for 1907. In 1906 the surplus for the three months showed a deficit of $9,605.

NORTH AMERICAN COMPANY TO ISSUE $5,000,000 IN BONDS.—The North American Company is preparing to place on the market about $5,000,000 bonds of certain of its subsidiary companies, and it is probable that the issue will appear within a month. "The North American Company has been negotiating with several well-known banking firms for some time," said Secretary Burt, "with a view to putting out a bond issue of probably not more than $5,000,000. The question as to the rate of interest has delayed matters somewhat, but the proper steps in the matter of arranging for mortgages have been taken, and as soon as the rate of interest has been decided the negotiations will be speedily concluded. But we are in no haste, as the bond market is improving each day. Just which of the companies will appear on the bonds is still undecided, and an effort is being made to discover which of the 12 companies in whose names the bonds might be issued would appeal the most to bankers and investors. Spencer Trask & Company have found a good market in the West for the $2,000,000 bond issue of the Milwaukee Light & Traction Company, which was put out about two weeks ago, and it is expected that the coming bond issue, under the improved conditions, will have an even better sale." Announcement was made later by N. W. Harris & Company that they had completed arrangements with the North American Company for the purchase of $5,500,000 refunding mortgage 5 per cent bonds of the Union Electric & Power Company, of St. Louis, which is controlled by the North American Company, and has practically a monopoly of the lighting and industrial business in St. Louis. On Dec. 2, 1907, this company increased its authorized bond issue from $10,000,000 to $18,000,000, which was done to help finance in part the purchase by it of the Edison Electric Illuminating Company and the Laclede Power Company. At the same time its authorized stock was increased from $10,000,000 to $18,000,000. The North American Company itself has done no financing since last May, when it issued $5,000,000 5 per cent notes to a syndicate headed by Redmond & Company, and Lee, Higginson & Company. Recently notice was given that all of these notes had been sold.

REPORT ON INTERBOROUGH MORTGAGE.—Chairman William R. Willcox, of the Public Service Commission, has issued a report of the hearings held on the application of the Interborough Rapid Transit Company to issue $25,000,000 of three-year 6 per cent gold notes, and $30,000,000 of bonds. The report discusses the existing indebtedness of the company, its available assets and its present earning capacity in detail, and the Commissioner concludes that the net income is more than ample to meet the notes and bonds, without reference to the dividends on the stock. A number of changes in the form of the bond issue were suggested by the Commissioner, and acquiesced in by the company. Six hearings on the application were held, and there were no objections advanced against the bond issue, except on the part of the Continental Securities Company, which holds 300 shares of stock. These objections were overruled by the Commissioner. Following the Commissioner's report the commission formally approved a mortgage on all the property of the Interborough Rapid Transit Company for $55,000,000. For the present only $30,000,000 in bonds will be issued to secure an issue of notes for $25,000,000 running for three years and bearing 6 per cent interest. J. P. Morgan & Company have undertaken to form a syndicate to underwrite the notes, which will be taken at 97 plus accrued interest from Nov. 1, 1907, the date of the bonds. The proceeds of the note issue will be used to refund another issue of $15,000,000, maturing on May 1, and to wipe out certain floating indebtedness. At the end of two years and a half the holders of the notes will be allowed to exchange them for bonds at 99. The commission inserted a stipulation, the first of its kind in connection with railway bonds in this state, that with the exception of the bonds exchanged for the $25,000,000 note issue, no bonds may be issued by the company at less than par, except after advertising for bids. Arrangements are made for a sinking fund of not less than $300,000 a year, beginning on Nov. 1, 1910.

STONE & WEBSTER PROPERTIES.—Below are given the gross earnings for February, 1908, of each of the companies controlled by Stone & Webster, and the increase or decrease in net earnings, as compared with February, 1907: Cape Breton Electric Company, Limited, $18,024.43, inc. $2,312.75; Edison Electric Illuminating Company, of Brockton, Mass., $18,601.28, inc. $871.13; Electric Light & Power Company, of Abington and Rockland, $5,037.62, dec. $1.64; Fall River Gas Works Company, $31,325.35, dec. $444.44; Minneapolis General Electric Company, $84,583.83, inc. $4,160.73; Lowell Electric Light Corporation, $28,906.15, dec. $1,596.80; Houghton County Electric Light Company, $21,909.80, dec. $1,551.91; Tampa Electric Company, $48,568, inc. $7,466.15; Puget Sound Electric Railway, $117,502, inc. $847.61; Seattle Electric Company, $346,127, dec. $5,141.30; Savannah Electric Company, $43,718, dec. $11,393.93; Brockton & Plymouth Street Railway Company, $6,341, dec. $563.03; Whatcom County Railway & Light Company, $27,569, inc. $284.40; Properties of Columbus Electric Company, $28,844, inc. $1,955.59; Dallas Electric Corporation and Subsidiary Companies, $84,186, inc. $7,269.80; El Paso Electric Company and Subsidiary Company, $43,863, inc. $6,283.41; Northern Texas Electric Company and Subsidiary Company, $71,311, inc. $2,848.79; Galveston-Houston Electric Company, $74,715, inc. $195.67; Houghton County Street Railway Company, $17,336, inc. $1,488.10; Pensacola Electric Company, $15,378, dec. $4,589.03; Jacksonville Electric Company, $31,378, dec. $1,721.30.

NEW ORLEANS RAILWAY & LIGHT COMPANY.—The annual report for the year ended Dec. 31, 1907, of the New Orleans Railway & Light Company shows gross earnings of $6,041,301, an increase of $268,110.87, or 4.6 per cent over the previous year. Operating expenses were $3,270,396.93, an increase of $196,381.84 over the previous year, due mostly to an increased volume of business in the railway and gas departments and to an increase of ½ cent per hour in wages to employees. After paying $312,500 to the preferred stockholders, there remained a surplus of $432,766.56.

CHICAGO CITY RAILWAY.—The report of the Chicago City Railway for the year ended Jan. 31, 1908, gives a gross income of $8,215,196, as compared with $7,871,126 for 1907, and a net of $2,464,559, as against $1,724,822 for 1907. Deducting interest of 5 per cent on the valuation from the net leaves a surplus of $1,228,550, as compared with $104,822 for the previous year. Of this surplus $675,703, or 55 per cent, went to the city of Chicago, and the remainder, $552,847, to the City Railway Company. The total valuation of the property, as of Jan. 31, 1908, was $29,052,145.

UNITED RAILWAYS OF ST. LOUIS.—The report of the United Railways of St. Louis gives a March gross of $858,908, a decrease of $44,237 from last year. The net for March was $299,773, a decrease of $7,125 from March, 1907. After deducting charges there remained a surplus of $66,483, which is a decrease of $9,547 from the corresponding month last year. The net for the three months ending March 31 was $828,716, an increase of $57,160 over the same period last year. The three months' surplus was $128,554, an increase of $50,732 over the same three months in 1907.

MICHIGAN STATE TELEPHONE COMPANY.—The report of the Michigan State Telephone Company for the two months ended Feb. 29, 1908, gives a gross income of $528,166, and expenses of $397,755, making a net of $130,411. Interest charges were $69,686, and the surplus $60,725. Deducting the preferred dividend of $22,832, there is a net surplus of $37,893. The earnings, as given, after providing for the payment of interest charges and preferred dividends, are at the rate of 6.4 per cent on the $6,000,000 common stock.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.—The report for March of the Cumberland Telephone & Telegraph Company gives gross earnings of $506,300, an increase of $31,320 over March, 1907, leaving a surplus, after deducting charges, of $173,164, which shows an increase of $22,350 over the corresponding month in 1907.

MEMPHIS STREET RAILWAY.—For the year ending December 31, 1907, the report of the Memphis Street Railway Company gives gross earnings of $1,604,384, against $428,935 for 1906, and a net of $597,233 against $590,708 for 1906. The net surplus for 1907 was $67,411, which is equal to 2.68 per cent on the $2,500,000 common stock.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.—The gross earnings of the New York & New Jersey Telephone Company for the quarter ending March 31, 1908, (March estimated) were $2,207,202, and the net earnings $581,264. The surplus for the quarter was $108,264, and the surplus on hand March 31, 1908, $4,940,478.

UNITED RAILWAYS & ELECTRIC COMPANY.—The United Railways & Electric Company, of Baltimore, Md., reports gross earnings for the quarter ended March 31, of $1,517,662, a decrease of $13,680 from the corresponding quarter of last year.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

FOLEY, ALA.—Plans are being considered by the Consumers' Service Corporation for the construction of an electric light and power plant and municipal water works system. For further information address John Walker, of Magnolia Springs.

NORTH BIRMINGHAM, ALA.—The citizens on April 20 voted to issue $5,000,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system.

SLOCOMB, ALA.—The contract for the construction of the municipal electric light plant has been awarded to J. B. McCrary & Company, of Atlanta, for $6,000.

ARKADELPHIA, ARK.—A 50-year franchise has been granted to R. E. L. Eagle, of Lonoke, who is interested in the organization of an independent telephone company in this city.

OSCEOLA, ARK.—The Mississippi Valley Telephone Association has decided to expend about $30,000 in improving its long-distance service.

ARTESIA, CAL.—A telephone company is being formed for the purpose of installing a telephone system covering this city, Norwalk and Los Alamitos.

CHICO, CAL.—J. W. Roper, of the Midas Gold Mining Company, of Shasta, announces that the company will expend between $40,000 and $50,000 in the erection of a power plant on Bee Gum Creek to furnish power for the mine. Mr. Roper and L. A. McIntosh have filed a notice of appropriation of 5000 in. of water in Bee Gum Creek.

EUREKA, CAL.—Messrs. Swanson & Pererson, proprietors of the Western Hotel, are planning to install an electric plant.

JUNCTION CITY, CAL.—The North Mountain Power Company, which was recently merged with the Eureka Lighting Company, is planning to build a power plant at Big Flat, on Trinity River, about 15 miles from Junction City, and will develop 4000 horse-power, for which surveys have been made and plans drawn. It is proposed to utilize the water of Cut Throat Gulch. A dam will be thrown across the gulch, making a large storage reservoir. The transmission line from Eureka to Junction City is 80 miles in length.

GOLDFIELD, CAL.—The Nevada-California Power Company is preparing to install a fourth Allis-Chalmers 1500-kw hydro-turbo-generator set to meet the increasing demand for electricity, pending the completion of its new hydro-electric stations on Bishop Creek, Cal. Electricity from the present Bishop Creek plant is transmitted to Tonopah and Goldfield, a distance of 113 miles, at 60,000 volts.

PETALUMA, CAL.—The Petaluma & Santa Rosa Railway Company may extend its electric railway to Healdsburg and Cloverdale.

REDLANDS, CAL.—The Yucaipa & Oakglen Railroad has been reorganized and plans have been completed for the construction of an electric railway from Redlands to Yucaipa, a distance of seven miles. Later it is expected to extend the railway to Oakglen, 22 miles from Redlands, and eventually the road will be extended to Beaumont and San Jacinto. The officers of the company are: J. F. Neeland, of Los Angeles, president; C. S. Chesnut, of Redding, vice-president; M. N. Newmarket, of Los Angeles, treasurer.

UKIAH, CAL.—The Ukiah Water & Improvement Company is contemplating the installation of a 60-hp electric pumping plant at its station on the Russian River.

WOODLAND, CAL.—A meeting of the stockholders of the Jeanette, Montclair & Woodland Traction Company will be held in Washington, D. C., to reorganize the company. The company is planning to construct an electric railway from Woodland to Brawley, Cal., work on which will begin this summer. We have been advised that the company will be in the market for equipment in the near future. The officers of the company are: Albert Mollizal, president; Ladd Veitt, of Tulsa, Okla., vice-president; Bruce Clark, of El Reno, Okla., treasurer, and A. E. Culley, New York, N. Y., secretary and manager.

DENVER, COLO.—The Intermountain Railroad, formerly the Denver, Lakewood & Golden, which is now equipping its line to be operated by electricity, expects to have the electric service in operation within 30 days.

PUEBLO, COLO.—Plans are being considered by the Northern Electric Company, of Madison, Wis., for the construction of a large electric plant at the Cañon City coal fields to furnish electricity for railway purposes, irrigation, etc. A. B. Hulit is interested in the enterprise.

HARTFORD, CONN.—The New York, New Haven & Hartford Railroad Company has petitioned the State Railroad Commissioners for an approval of the layout and method of construction of the proposed electric railway between Hartford and Middletown.

MERIDEN, CONN.—The Meriden Electric Light Company has installed in its plant a 500-kw, Allis-Chalmers turbo-generator set and a 400-hp Hazleton boiler equipped with a Murphy mechanical stoker. Charles A. Learned is superintendent

DOVER, DEL.—The Board of Water Commissioners has petitioned the Council for authority to spend $1,000 to equip the pumping station to be operated by electricity. A gasoline engine is being used at present

ATLANTA, GA.—D. G. Zeigler & Company, of this city, are considering a proposition to establish a hydro-electric plant on the Sewanee River, where 25,000 horse power can be developed at a minimum cost of about $130,000. It is proposed to furnish electricity within a radius of 60 miles for electric railways, motors and lamps. Among the towns within this radius are Jacksonville, Fla.; Lake City, Fla.; Valdosta and Waycross, Ga.

MACON, GA.—The Macon Railway & Light Company is making improvements to its system and is planning to install a 3000-hp turbo-generator set in its power house.

MACON, GA.—The Bibb Power Company has let the contract for the construction of a large dam near Jackson. The machinery for the plant has been purchased. W. Jordan Massee is president of the company.

SPARTA, GA.—J. B. McCrary & Co., of Atlanta, have secured a contract from the town of Sparta to install an electric light plant, in connection with a water-works system.

CAIRO, ILL.—The Home Telephone Company will rebuild its lines to Mound City.

CHICAGO, ILL.—The Interstate Automatic Telephone Company has been granted a franchise in East Chicago, Ind. The company has also made application for a franchise in Gary.

CHICAGO, ILL.—Arrangements are being made to have the Northwestern Elevated Railroad Company handle freight between Evanston and Wilson Avenue by electricity. The elevated road extension runs over the right of way of the St. Paul Railroad to Evanston, and rather than have the locomotives in the way the Northwestern Elevated will haul the freight cars of the other road.

PINCKNEYVILLE, ILL.—Surveys and estimates have practically been completed for the proposed electric railway of the Belleville-Pinckneyville Traction Company. The line will be about 46 miles in length. The company is capitalized at $100,000 and expects to issue $1,250,000 in bonds. L. D. Turner, of Belleville, is president of the company

ROCK ISLAND, ILL.—The City Council has granted the Union Electric Telephone & Telegraph Company a 25-year franchise.

BROOKVILLE, IND.—The citizens are considering the question of establishing a municipal electric light plant in this place.

COLUMBUS, IND.—Extensive improvements are contemplated by the Central Indiana Lighting Company during the summer, which include the construction of a new power plant, the partial rebuilding of the street car lines and extension of the electric light service. The company also proposes to furnish steam heat to local consumers. New street cars will also be purchased.

CRAWFORDSVILLE, IND.—C. F. Street, president of Street, Wykes & Company, of New York, N. Y., has purchased the Crawfordsville Water & Light Company's property at a sale by master in chancery, who acted upon the order of the Federal Court. The consideration was $76,000. The property sold covers the entire holdings of the company in this city, including the water works and artificial gas plant. S. C. Rowland, who has been receiver of the company, will continue to act as general manage. of the plant.

DANVILLE, IND.—The Farmers' Mutual Telephone Company has been granted a franchise to install and operate a telephone system in this city

DECKER, IND.—Senator Hemenway has notified Eugene Rush, head of the Decker Power Dam Company, that an amended bill permitting the building of a large dam in White River at Decker would go through, but would limit it to a term of years, and that the Government shall receive pay for the franchise. This settled, work will begin soon

EVANSVILLE, IND.—The Evansville Terminal Railway Company will soon let the contract for grading its entire road. No arrangements have yet been made in regard to the location of the power house A F Hayes, of Evansville, is president of the company

GREENFIELD, IND.—A company is being formed to take over the Hannah-Jackson telephone system, which has been in the hands of a receiver, and out of use for some time The system extends throughout the city and the surrounding country. The new company contemplates making many extensions to the lines and installing new equipment R. L. Mason is interested in the project.

HAMMOND, IND.—The Citizens' Light & Power Company, recently incorporated, bas applied for a franchise to operate electric light and gas plants. The company proposes to erect a steam plant. A. J. Campbell is interested in the company.

MARION, IND.—Plans are being considered by the United Telephone Company to rebuild its plant in this city.

ATLANTIC, IA.—It is reported that bids will be received about May 15 for reconstructing the municipal electric light plant and water works system at a cost of about $5[illegible],000. I. L Darnell, Nelson Building, Kansas City, Mo., is engineer.

MUSCATINE, IOWA.—The City Council is considering the construction of a municipal electric light plant.

OELWEIN, IA.—The Corn Belt Telephone Company contemplates the construction of several metallic lines out of Oelwein.

CONWAY SPRINGS, KAN.—The question of installing an electric light plant is under consideration here to cost $10,000.

SANTE FE, KAN.—Plans are being considered for the organization of an Independent telephone company to erect lines throughout the county and to make connections with Garden City and Plains. The capital stock of the company is placed at $3,000, and about 100 miles of line will be erected.

LOUISVILLE, KY.—Bids will be received by the Board of Public Works until May 12 for the so-called Fetter franchise for electric lighting.

LOUISVILLE, KY.—The Louisville Railway Company is contemplating the extension of the Okolona line to connect Mt. Washington with Shepherdsville, a distance of 16 miles.

SCOTTSVILLE, KY.—The plant and franchises of the Gainesboro Telephone Company in this city have been purchased by the Farmers' Home Telephone Company, recently organized. The new company will connect at once with 18 independent exchanges, having in all about 1500 subscribers in nine counties in Kentucky and Tennessee. The officers of the new company are: G. C. Hicks, president, C. E. Hanes, secretary, and J. M. Slate, treasurer.

SHREVEPORT, LA.—J. W. Atkins, secretary and treasurer of the Shreveport Suburban Railway Company, has purchased the franchise permitting the operation of a street-car line from the city limits to the intersection of Grimmer Avenue and King's Highway. The company is building a line from the terminus of the Marshall Street line to Gladstone.

PEMBROKE, MAINE.—The city electric lighting system was not interfered with by the destruction of the Pembroke plant; the old station of the Eastport Electric Light Company is supplying the system for the present. The plant at Pembroke will be rebuilt at an early date, it is said.

PORTLAND, MAINE.—The City Council has authorized the committee on street lighting to contract with the Portland Lighting & Power Company for lighting the streets, squares, etc., and public building, including the Deering district, for a period of five years from April 1, 1908, with the right to renew for another five years. Under the terms of the contract the company is to furnish not less than 330 arc lamps of 1200 candle-power each at $60 per lamp per year; not less than 150 incandescent street lamps of 65 candle-power at $30 each per year; not less than 25 incandescent street lamps of 30 candle-power at $18 per lamp per year; for incandescent street lamps of 25 candle-power at $16 per lamp per year and not less than 540 incandescent street lamps of 16 candle-power at $9 per lamp per year; and for electrical energy required by the city at a rate of 4½ cents per kw-hour.

BALTIMORE, MD.—The Maryland Electric Railways Company, which now owns and operates the Annapolis Short Line Road, will continue its service into the Camden station over the tracks of the Baltimore & Ohio Railroad, which will be electrically equipped for that purpose.

BALTIMORE, MD.—The residents and property holders along the Philadelphia Road have taken steps to build an electric railway from the city line to Grange Hall, a distance of six miles. The cost of the road is estimated at $60,000, and it is proposed to lease the rolling stock and secure electricity from the United Railways & Electric Company. John J. Hurst and C. Ross Mace are interested in the project.

COWENTOWN, MD.—The rolling-mill property has been purchased by the Newark Electric Company, of Newark, Del. The company proposes to build a hydro-electric plant at this place.

ATTLEBORO, MASS.—The contract for the construction of the extension of the Interstate Railway to South Attleboro has been awarded to Eveline Brothers for $65,000. The contract includes the construction and complete equipment of the road.

DOUGLASS, MASS.—The Selectmen have entered into a contract with the Douglass Electric Company for lighting the streets of the town for a term of three years at the rate of $13.50 per lamp per year for incandescent lamps of 32 candle-power, to be operated on a moonlight schedule.

NEW BEDFORD, MASS.—A new schedule of rates for electricity for motors has been adopted by the New Bedford Gas & Edison Light Company, to go into effect May 1. Under the new schedule the rate is 12 cents per kw-hour for the first 15 days of each month. All additional energy will be furnished at the following rates: First 200 kw-hours at five cents per kw-hour; next 200 kw-hours at four cents per kw-hour, and all additional at the rate of three cents per kw-hour; subject to a discount of five per cent on all bills if paid on or before the tenth of the month. The company has under consideration a new schedule of lighting rates.

PEABODY, MASS.—At the annual town meeting held April 11 the proposition to appropriate $58,000 for remodeling the municipal electric light plant was defeated.

DETROIT, MICH.—The Ontario Power Company is said to be considering a proposition to construct a high-tension transmission line from Niagara Falls to the Detroit River. Gen. F. V. Greene is vice-president.

GRAND RAPIDS, MICH.—The Grand Rapids Street Railway Company is planning to build three extensions on different lines this year. J. C. Madigan is superintendent of the company.

LANSING, MICH.—The new hydro-electric plant of the Michigan Power Company at the old Piatt Dam is practically completed at a cost of nearly $200,000. The new plant will have an output of nearly 2000 hp, divided into two units consisting of two 50-in. Leffel water turbines connected to a 540-kw generator. Electricity from this plant will be transmitted to Lansing by four circuits, one of which is now in operation and extends to the Washtenaw Street power plant; one of the circuits will be used exclusively for lighting; an additional circuit will be built to replace the old circuits for supplying energy to the Leo Motor Car Company and Hugh Lyons Company, and will be extended north to connect with the circuit now in operation on Kalamazoo Street. The company has authorized plans and specifications prepared for the construction of a hydro-electric plant at Diamondale, and for a new steam power plant of 2350 hp, which the company proposes to construct on the banks of the Grand River, and which will be used as an auxiliary to the hydro-electric plants. The cost of the plant and equipment is estimated at $150,000. W. H. Zimmerman is general manager of the company.

MARQUETTE, MICH.—We are informed that the Marquette, Negaunee & Ishpeming Interurban Railway Company is making plans to begin construction work on its proposed railway. The railway will be about 14 miles in length and will be operated by electricity, but as yet the site for the power station has not been located. L. M. Sigler, of Cleveland, Ohio, is president, and the Roberts & Abbott Company, of Cleveland, Ohio, will have charge of the engineering work.

CLOQUET, MINN.—E. P. Coleman, of Duluth, general manager of the Great Northern Power Company, writes that there is no probability of any construction work being undertaken by this company this year.

FERGUS FALLS, MINN.—Plans are being prepared by Edward Burch, consulting engineer, of Minneapolis, for the construction of a 28-mile, 25,000-volt transmission line between Wahpeton, N. D., and Fergus Falls for the Otter Trail Power Company.

LUVERNE, MINN.—E. C. Schwartz, city recorder, writes that the city does not contemplate making any changes to the municipal electric light plant or water works system.

NATCHEZ, MISS.—Plans for installing electrical machinery in the water works plant to generate electricity for lighting the streets and public buildings will be prepared by Krumbhaar & Aiken, Denegre Building, New Orleans, La., engineers.

OXFORD, MISS.—The University of Mississippi will receive competitive designs, plans and specifications for a $50,000 dormitory, $25,000 dining hall and $35,000 electric light and power plant, to be submitted on or before May 20, 1908. For particulars apply to D. M. Kimbrough, chairman building committee.

CENTRALIA, MO.—The city has voted to buy the electric light plant, but on some technicality the Town Board refuses to pay the money. E. H. Baldefige, head of the system, declares the plant belongs to the city and he refuses to wire any buildings. As a result several buildings are in darkness.

POMONA, MO.—A telephone line is being erected from Pomona to Cordez and a central exchange is to be established at Monroe. C. H. Duckett and Monroe Woods are interested in the project.

BUTTE, MONT.—The North Butte Extension Copper Company has made a contract with the Butte Electric & Power Company to supply electricity for lamps and motors for its mines.

HELENA, MONT.—M. H. Gerry, Jr., manager of the Helena Power Transmission Company, has announced that the material has been ordered for the construction of a large dam, which will be known as the third dam on the Missouri River, 30 miles from Helena. When completed it will furnish water to irrigate thousands of acres of land in this section and also will furnish power for plants in Helena, Butte and Anaconda.

SUTHERLAND, NEB.—The Village Board has granted a franchise to the Sutherland Telephone Company to install a local telephone system.

RENO, NEV.—Among the improvements to be made at the State Insane Asylum is the installation of a new laundry, a cold-storage plant and a power plant. The last Legislature appropriated $18,000 for improvements to the institution.

NEWARK, N. J.—Two estimates have been submitted to the public buildings committee of the Board of Freeholders for electric light plants, one to be installed at the court house and the other at the jail. The estimate for the court house was submitted by Runyon & Carey. The cost of the plant was estimated at $26,497, and the cost of operation would be $5,261 per year. The Public Service Corporation now furnishes electricity for the building for which the county pays approximately $10,000 per year. The estimate on the plant for the jail was submitted by James Seymour, and the cost of installation placed at $6,000, which could be reduced by $1,000 if the present boilers are used.

WASHINGTON, N. J.—The Easton & Washington Transit Company is said to be contemplating the extension of its system to Lake Hopatcong, a distance of about 20 miles, this summer. The company is also planning to extend the road from Lake Hopatcong to Hoboken, a distance of 24 miles, in 1909.

BERGEN, N. Y.—The Genesee County Electric Light, Power & Gas Company, of Batavia, has been granted permission by the Public Service Commission to furnish electricity in Bergen. The company will also supply electricity for the pumps at the water works plant, as well as for lighting. R. M. Walker is secretary of the company.

HOOSICK FALLS, N. Y.—Plans are being made for extensive improvements to the Bennington & Hoosick Valley Railway, which will involve an expenditure of about $100,000.

HORNELL, N. Y.—Surveys are being made for the Dansville branch of the Rochester, Elmira & Corning Electric Railway.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, until May 4, for installing electric equipment in new Public School No. 56, Richmond Hill, Borough of Queens.

PATCHOGUE, N. Y.—The South Shore Traction Company is planning to begin work on the construction of its road within the village of Babylon. The company, it is understood, will purchase electricity from the Long Island Traction Company for operating the road for the present.

SPENCERPORT, N. Y.—Plans are being made by the Ogden Telephone Company to commence work on the construction of its system, which will include about 45 miles of pole line and exchanges in this city and Adams Basin, involving an expenditure of about $16,000.

CASSELTON, N. D.—Surveys are being made for the proposed extension of the Northwestern Interurban Railway Company connecting with the Soo line on the west at Enderlin. James J. Lumbrecht is president.

KENSAL, N. D.—A company has been formed by L. C. Lane and others to install an electric light plant and to take over the telephone system.

LIMA, OHIO.—The offer of W. Kelsey Schoepf for a new contract for street lighting at $70 per arc lamp was refused by the Council, which voted to issue bonds to the amount of $80,000 for the erection of a municipal lighting plant. It is intended to equip the plant to furnish electricity for commercial lighting, in competition with the local company, which is controlled by the Lima & Toledo Traction Company. The company's contract with the city calls for $85 per year for each arc lamp and does not expire until 1910.

NEWARK, OHIO.—Arrangements have been made for financing the construction of the Newark, Martinsburg & Mt. Vernon Electric Railway Company's road from Newark to Mt. Vernon. The company is to be reincorporated with a capital stock of $2,000,000. Frank E. Elliott, of Martinsburg, is president and secretary of the company.

SPRINGFIELD, OHIO.—The Washington Traction Company, which is a successor to the Springfield, Charleston, Washington & Chillicothe Railway Company, will be sold at a receiver's sale May 11. The company at present operates an electric railway from Springfield to Charleston, a distance of 14 miles, and when completed will extend to Chillicothe, a distance of about 54 miles. S. B. Lankin is receiver.

BEULAH (P. O. DOXEY), OKLA.—J. A. Corbell is reported to be interested in a project to establish an electric light plant in this place, which will have an output equivalent to 200 lamps.

GRANTS PASS, ORE.—A rural telephone company has been formed in this city for the purpose of building a telephone line to Fruitdale. G. A. Hamilton, Prof. Turner and Robert Huck are interested in the enterprise.

LENTS, ORE.—The Mount Scott Telephone Company has been granted a franchise to construct a telephone line from Lents to Happy Hollow.

PENDLETON, ORE.—Plans are being considered for the construction of an electric railway from Pendleton to Irrigon and intervening towns. The proposed road will be about 50 miles in length. Dr. Henry Waldo Coe is interested in the enterprise.

WOODBURN, ORE.—The Monitor Mutual Telephone Company has petitioned the County Commissioners for permission to erect a telephone line from Monitor to Woodburn, McKee and Mount Angel.

ETTERS, PA. Plans are being made by the Borough Council for the construction of an electric light plant, for which a site on the Little Conewago Creek has been donated by Charles Williams, of Goldsboro. An ordinance has been passed by the Council appropriating $9,000 to erect the power house and install the machinery. A dam will be built across the creek to utilize the water power to operate the plant. The street lighting system will consist of 25 arc lamps of 2000 candle-power each.

SLATINGTON, PA.—The Franklin & Towamensing Street Railway Company has completed preliminary surveys and secured the right of way for its proposed electric railway between Slatington and Lehighton, a distance of about 10 miles. It is expected that work on the construction of the railway will begin this spring. A. P. Berlin is president.

CHESTER, S. C.—The citizens on May 5 will vote on the proposition to issue $26,000 in bonds to extend the light and water systems and for street improvements.

LAURENS, S. C.—The City Council has entered into a contract with the Reedy River Power Company for supplying the city of Laurens with electricity for a term of ten years. The contract calls for a minimum of 133 horse-power at a rate of $50 per horse-power per year, with a 24-hour service. The city, it is understood, will distribute electricity in amounts of 3 horse-power and under, while the power company will be permitted to make contracts for larger amounts. The municipal plant will be held in reserve for emergency.

ALCESTER, S. D.—A telephone company has been organized by August Ludwig, John Bergdale, L. Erickson, J. G. Hoard, and others, to furnish a telephone service in this city and surrounding country. The company has submitted a proposition to the Hawarden company to purchase its South Dakota lines, with a view of making them part of the proposed system.

HEATON, S. D.—An independent telephone company has been organized in this city and proposes to install a local exchange and build telephone lines into the surrounding country.

CEDAR GROVE, TENN.—An independent telephone company has been formed in this city and the following named officers elected: G. C. Clark, president; C. M. Montague, vice-president; A. L. Smight, secretary; John W. Barham, treasurer, and J. W. Witherspoon, general manager.

BANDERA, TEX.—The capital stock of the Bandera Telephone Company has been increased from $4,000 to $7,000.

GAINESVILLE, TEX.—The Gainesville-Whitesboro-Sherman Interurban Railway Company has awarded the contract for the construction of its road to the Tennessee Construction Company.

GONZALES, TEX. The capital stock of the Citizens' Light & Power Company has been increased from $10,000 to $15,000.

KIRBYVILLE, TEX.—An electric light company is being organized here. Mr. Simmons, editor of the Kirbyville *Banner*, is interested in the project.

TEMPLE, TEX.—The citizens are agitating the question of purchasing the local electric light plant to be operated by the municipality or the construction of a new plant. It is said that the plan meets the approval of Mayor Hamill.

HARRISONBURG, VA.—The Harrisonburg Mutual Telephone Company contemplates placing its wires in underground conduits in the business section of the city.

ONANCOCK, VA.—Plans are being made by the Accomac Traction & Power Company to commence work on the construction of its proposed railway in about 60 days. The road will be about ten miles in length and will connect Anancock, Tasley, Accomac and Metomphim Bay. T. W. Taylor is secretary.

PULASKI, VA.—The question of improving the municipal electric light plant is being considered by the City Council.

SPRAGUE, WASH. The plant and holdings of the Sprague Light Company have been purchased by Eugene Enloe, of the Big Bend Light Company, a subsidiary of the Washington Water Power Company. Work will commence at once connecting the transmission line from Sprague with the line from Harrington to Ritzville.

VANCOUVER, WASH. The Washington Railway & Power Company, a local organization which owns the franchise and has built part of the street railway system, has turned over its property and holdings to the citizens of Vancouver. It is proposed to raise $20,000 to complete the system and put it in operation. Bonds will be issued to pay for the company's interest. Temporary trustees have been appointed, as follows: G. R. Percival, S. W. Thompson and J. M. Lay.

WASHOUGAL, WASH.—The County Commissioners have granted a franchise for an electric lighting system to C. L. Pritchard.

WENATCHEE, WASH. The Valley Power Company has placed orders for machinery for its power plant, which it will install in the Wenatchee Valley this summer. The company proposes to furnish electricity to pump water for irrigation purposes, and will furnish energy to the Wenatchee Canal Company for drilling through Shotwell Hill. The plant will have an output of 4000 horse power, the cost of which is estimated at $100,000. W. T. Clark, Marvin Chase and ex-Mayor Scheble are interested in the enterprise.

FAIRMONT, W. VA.—The Fairmont & Clarksburg Traction Company is contemplating the construction of a power plant at Clarksburg.

MASONTOWN, W. VA.—Work has commenced on the construction of a new traction system connecting Morgantown, W. Va., and Pittsburg, Pa., a distance of 120 miles, by the Brownsville, Masontown & Smithfield Street Railway Company. The contract for the construction of the road has been awarded to the Pennsylvania Railroad Construction Company. The power plant will be located at West Masontown, on the Monongahela River. E. C. McCullough, of Uniontown, is chief engineer of the company.

WHEELING, W. VA. Plans have been made for extensive improvements to the system of the City & Elm Grove Railway Company, which will include increasing the equipment of the power house, building of several miles of double track and installation of feed wires, etc., the cost of which is estimated at from $60,000 to $75,000. The company contemplates installing steam turbines.

MENOMINEE, WIS.—The telephone lines of the Daggett-Nathan Telephone Company will be extended from Nathan to Faithorn Junction.

MENOMINEE FALLS, WIS.—The State Railroad Commission has authorized the Menominee Falls Electric Light Company to issue $10,000 in capital stock and $6,000 in bonds. J. G. Kremers, of Milwaukee, is president of the company.

WATERTOWN, WIS. Plans are being prepared by the Milwaukee Light, Heat & Traction Company for the construction of a power house at Watertown to furnish electricity to operate the electric railway now under construction from this city to Oconomowoc. The company has also decided to make improvements to the Rough and Ready Dam, which will include the raising of the dam, the erection of a new building and installing new machinery.

CALGARY, ALB., CAN.—P. A. G. Rodrique has applied to the City Council for a franchise for a street railway system.

CRANBROOK, B. C., CAN.—It is stated that capital has been secured for the Bull River Power & Light Company, which proposes to develop 10,000 horse-power on the Bull River near Cranbrook.

LADYSMITH, B. C., CAN.—The Council has decided to introduce a by-law providing for the sale of $25,000 in debentures for the purpose of building a municipal electric lighting system. Address Mayor Nicholson.

NEW WESTMINSTER, B. C., CAN.—J. Buntzen, managing director of the British Columbia Electric Street Railroad Company, states that the company will rebuild the Coquitlam Dam.

SELKIRK, MAN., CAN.—The Town Council has decided to purchase the electric plant of the Selkirk Electric Light & Power Company.

WINNIPEG, MAN., CAN.—The city solicitor has received word from the Ottawa Government to the effect that a lease will be given the city for the power plant site at Lac du Bonnet, and later the Government will give a title for the property. Cecil B. Smith is civic power expert.

FERGUS, ONT., CAN.—A rural telephone company is being formed to install a local telephone system to connect with the towns of Eramosa, Nichol and Larafrade. J. C. Templin is interested in the project.

GLENCOE, ONT., CAN.—A municipal electric lighting plant will be installed here. George Wilson is clerk.

NORTH BAY, ONT., CAN.—The North Bay Electric Light, Heat & Power Company offers to supply electric energy at 12 cents per kw-hour. Certain reductions are offered for prompt payments and no competition, which brings the rate down to 10¾ cents per kw-hour.

RAINY RIVER, ONT., CAN.—The International Rainy River Telephone Company contemplates several extensions this summer and the installation of a local system at Emo.

TORONTO, ONT., CAN.—The Weber Gas Engine Company, of Kansas City, Mo., has submitted a proposition to the Board of Control for the installation of producer gas plants. It claims to be able to generate electricity at about $8 per horse-power per year, and wishes to install various central stations of from 500 to 2000 horse-power in the factory districts.

MONTREAL, QUE., CAN.—The Montreal Southern Counties Electric Railway Company will soon commence the construction of the St. Lambert section at Montreal South and at Longueuil. The contract for marine cables across the Lachine Canal was awarded to the United States Steel Corporation.

INDIAN HEAD, SASK., CAN.—The citizens on April 13 voted in favor of issuing $10,000 in debentures, the proceeds to be used for extensions to electric light plant.

LANG, SASK., CAN.—Plans are being considered for the organization of a rural telephone company. C. W. Franks is the promoter.

MOOSEJAW, SASK., CAN.—The City Council has decided to return the tenders for the 500-kw generating unit and call for new tenders, to be opened May 17. John D. Simpson is city clerk.

HONOLULU, HAWAII.—The directors of the Hawaiian Electric Company have decided to increase the output of its present plant.

TORREON, MEX.—Plans are being considered for the construction of a new electric railway in this city. Foon Chuck and Dr. Wong Lim are interested in the project. The company will be capitalized at $1,000,000.

New Industrial Companies.

THE ELECTRIC EQUIPMENT COMPANY, of Los Angeles, Cal., has been incorporated, with a capital stock of $20,000.

THE ELECTRIC CLOCK COMPANY, of Baltimore, Md., has been incorporated with a capital stock of $40,000 by Charles H. White and others.

THE ELECTRIC MUSIC COMPANY has been incorporated with a capital stock of $100,000, by I. W. Goodhue, M. Eisner, of New York, N. Y., and M. L. Blake, of Brooklyn, N. Y.

THE LEGNARD BROTHERS COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000, by H. M. Legnard, B. L. Steele and A. B. Legnard. The company proposes to manufacture gas and gasoline engines.

THE PROTECUS ELECTRICAL MANUFACTURING COMPANY, of Pittsburg, Pa., has filed articles of incorporation with a capital stock of $125,000. The incorporators are: E. L. Kern, J. K. Neagley, and N. F. Bicking, all of Pittsburg, Pa.

THE HERCULEVEN COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000, for the purpose of manufacturing motors, engines, cars, boats, etc. The incorporators are: Fred K. Felt, of Brooklyn; E. B. Goding and Sharon Graham, of New York, N. Y.

THE ATWOOD-REARICK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000, by George D. Atwood, L. R. Atwood, of Brooklyn; Charles B. Rearick and A. J. Rearick, of New York, N. Y. The company proposes to do an engineering and contracting business.

THE EXCEL ELECTRIC HEATING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $40,000 by Richard W. Osland, Plainfield, N. J.; Edgar B. Drake, of Newark, N. J., and Edwin G. Russell, of Brooklyn, N. Y. The purpose of the company is to manufacture electric appliances.

THE FRANK L. PATTERSON & COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000, by Frank L. Patterson, Arthur B. Grant, of New York, N. Y., and Isaac M. Patterson, of Trenton, N. J. The company proposes to manufacture heating apparatus, steam, electrical and hydraulic machinery, etc.

THE STANDARD JEWELLED BEARINGS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000, for the purpose of manufacturing jewels for electrical and mechanical purposes. The incorporators are: William Houser, of New York, N. Y.; Catherine F. Calahan, of Brooklyn, N. Y., and Louis S. Levy, of New York, N. Y.

THE INTERNATIONAL TRACTION & POWER COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $5,000,000, and proposes to erect a large plant on the Delaware River in or near Philadelphia, for the purpose of manufacturing engines for railway cars, automobiles, omnibuses, etc.; also full equipment for railway systems. The company will take over the auto car system of John C. Reuter, as well as the exclusive use of his crank engine for stationary engines, trucks, railroad cars and automobiles in United States, Mexico and Canada. The incorporators are: Carl M. Gage, J. A. Pfout, Thomas F. Deegan, all of Philadelphia; J. C. Reuter, J. C. Eccleston, of New York, N. Y., and S. V. Wardell, of Kansas City. Carl M. Gage will be president of the company.

Company Elections.

COLUMBUS, GA.—At the annual meeting of the Columbus Automatic Telephone Company the following named officers were elected: J. A. Hart, president; Rhodes Browne, vice-president; F. R. Quayles, secretary and treasurer.

CHICAGO, ILL.—The Chicago Railways Company has completed its reorganization by the election of a new board of directors. Henry A. Blair was elected chairman of the board, and the other directors are: John M. Roach, Frederick H. Rawson, W. M. Eisendrath, Hempstead Washburne, A. B. Jones, J. W. Gary and Wallace Heckman.

LINCOLNVILLE, ME.—At the annual meeting of the Lincolnville Telephone Company the following named officers were elected: J. S. Mullin, president and manager; A. S. Young, vice-president; A. W. Knight, treasurer.

PENN YAN, N. Y.—At the annual meeting of the Yates County Telephone Company the following named officers were elected: C. E. Guile, president; Fred Culver, vice-president; David Miller, secretary, and F. E. Spencer, treasurer.

SPRINGFIELD, OHIO.—At the annual meeting of the Springfield & Xenia Telephone Company the following named officers were elected: J. L. Bushnell, president; J. F. McGrew, vice-president; Delos O'Dell, secretary and general manager, and R. R. Mills, treasurer.

PORTLAND, ORE.—At the annual meeting of the Portland Home Telephone Company the following named officers were elected: B. L. Willis, president; I. N. Fleischner, vice-president; A. A. Andrews, secretary and treasurer.

New Incorporations.

DOUGLASS, ARIZ.—Articles of incorporation have been filed for the Cochise County Electric Railroad Company, by James S. Douglas, W. H. Brophy, M. J. Cunningham, M. J. Brophy and George H. Neale. The company is capitalized at $500,000, and proposes to construct an interurban traction line from Bisbee to Douglass.

REDLANDS, CAL.—The Standard Gas & Electric Company recently filed articles of incorporation here. It is capitalized at $50,000, has its principal place of business at Los Angeles and the directors are: Walter S. Cramp, Horace Slater and R. J. Dunn.

WILMINGTON, DEL.—The Mexican Electric Power & Tramway Company has been incorporated with a capital stock of $500,000.

WILMINGTON, DEL.—The Landers Power Company has been incorporated, with a capital stock of $100,000, by F. M. Shive, S. E. Roberson and Harry W. Davis, of Wilmington.

WILMINGTON, DEL.—Articles of incorporation have been filed for the Eastern Oregon Power Company, by S. B. Merrick, of Ivy, Va.; F. A. Bingham, of Chicago, Ill., and H. W. Davis, of Wilmington.

MULBERRY, FLA.—The Mulberry Electric Company has been incorporated with a capital stock of $4,000. The officers are R. H. Pratt, president and general manager; O. O. Hubbard, vice-president, and A. B. Hull, Jr., secretary and treasurer.

DAMASCUS, GA.—The Laurel Railway Company has been chartered with a capital stock of $10,000 to construct a five-mile road in Washington County. The officers of the company are A. A. Mock, of Damascus, president; G. W. Clements, of New York, N. Y., vice-president; F. G. Clements, of New York, N. Y., treasurer, and B. W. Mock, of Damascus, secretary.

BELLEVILLE, ILL.—The Alton, St. Louis & Cairo Electric Railway has filed articles of incorporation with a capital stock of $100,000. The directors are Thomas N. Chase, D. W. Young, J. F. Albrecht, Frank E. Orvis, William L. Ensel, B. L. Renfrow, E. L. Cragen, George M. Switzer and William R. Brown.

CHAMPAIGN, ILL.—The Somer Township Telephone Company has been incorporated, with a capital stock of $8,000, by O. B. Flatt, M. C. Busey and P. P. Dunn.

CHICAGO, ILL.—The Woodstock & Sycamore Traction Company has been chartered with a capital stock of $1,000,000, by Clinton G. Lumley, E. C. Spinney, Irving V. Stephens, E. B. Harang, S. H. Rhodes, William L. Abbott and others.

FALL CREEK, ILL.—The Fall Creek & Payson Telephone Company has been incorporated, with a capital stock of $1,380, by C. Fred Reinebach, William H. Watson and John C. Thompson.

MARISSA, ILL.—The Short Line Telephone Company has filed articles of incorporation with a capital stock of $150. The incorporators are: Philip Krebs, Otto Ochs and Gustave Kunze.

PIPER CITY, ILL.—The Piper City Telephone & Telegraph Company has been incorporated, with a capital stock of $10,000, by James P. Glass, W. H. Roberts and J. A. Montelius.

SHELBYVILLE, ILL.—The East Salem & Shelbyville Mutual Telephone Company has been chartered, with a capital stock of $1,050, by D. Y. Milligan, Simon J. Kensil, Jonas Strohe and others.

BEDFORD, IND.—The Bedford Power Company has filed articles of incorporation. The capital stock is $50,000. The object of the corporation is to construct a dam in White River and build a power plant to generate electricity, which will be transmitted to towns and cities. H. A. Mansfield, James B. Nelson, Harry S. New, S. A. Tescher and J. W. Holtzman are the incorporators.

FRANKFORT, IND.—The Indianapolis, Frankfort, Delphi & Chicago Traction Company has been incorporated, with a capital stock of $100,000. The company will succeed the Frankfort, Delphi & Northern Traction Company, incorporated last year to build an interurban and street railway from Frankfort to Hammond by the way of Delphi and Monticello. The company will improve the water power at Monticello, which will be used to generate electricity to operate the railway system and for lamps and motors.

GOLDSMITH, IND.—Articles of incorporation have been filed for the Goldsmith Co-operative Telephone Company with a capital stock of $10,000, by A. H. Hinkle, W. F. Cole, E. W. Allen and James Kessler.

NEW MARION, IND.—The New Marion, Rexville & Graff Telephone Company has been chartered for the purpose of constructing and operating a telephone system in New Marion and Ripley Counties. The directors are: B. D. Sands, W. W. McCoy and J. F. Holzer.

SOUTH BEND, IND.—The South Bend & Logansport Railway Company has filed articles of incorporation with the Secretary of State to construct and operate a street and interurban railway from South Bend to Logansport, a distance of 70 miles. The incorporators are Alexis Coquillard, Thomas P. Moredock, H. C. Onell and R. J. Hanlihan.

AMES, IA.—The Iowa Railroad Company has filed articles of incorporation with the Secretary of State. The company proposes to construct an electric railway from Waterloo to Perry, via Story City and Ames, where it will connect with the Des Moines & Fort Dodge Electric Railway. The officers of the company are: Henry S. Osborne, president; James F. Hardin, of Eldora, vice-president and treasurer, and George W. Scott, of Chicago, Ill., consulting engineer.

MUSCATINE, IA.—Articles of incorporation have been filed for the Evergreen Rural Telephone Company. The company is capitalized at $400, and the officers are: J. F. Maurer, president; J. W. Miller, vice-president; F. A. Duffer, secretary, and W. F. Marolf, treasurer.

PORTLAND, IA.—Articles of incorporation have been filed for the Portland Center Telephone Company, with a capital stock of $9,990, by A. H. Bauer, George Steiner, Charles W. Rippert, Jacob Bauer, E. A. Krause and others.

VALENCIA, KAN.—The Topeka & Valencia Toll Line Company has been organized and the following named officers elected: F. A. Keine, president and W. M. Purdy, secretary. The company proposes to erect a full copper circuit between Topeka and Valencia; also to erect another line from Auburn to Richland and other points in the southeastern part of the county.

HARLAN, KY.—The Pennington Gap Telephone Company has been organized by George W. Green, Henry Green and H. L. Howard. The company is capitalized at $3,000, and proposes to construct a telephone line from Harlan, via Rose Hill to Pennington Gap, a distance of about 20 miles.

HAZARD, KY.—The Hazard-Hyden Telephone Company has been organized, with a capital stock of $4,000, for the purpose of constructing an independent telephone system from Hazard, via Cornettsville to Hyden, a distance of 40 miles. The incorporators are: D. Y. Combs, of Hazard, and others.

ONO, KY.—The Ono Telephone Company has filed articles of incorporation with a capital stock of $500. The incorporators are W. S. Hughes, T. G. Smith and D. G. Coffee.

FARMINGTON, MAINE.—Articles of incorporation have been filed for the Rangeley Light & Power Company with a capital stock of $10,000. The officers of the company are D. D. Elliot, of Monmouth, president, and H. A. Furbich, of Rangeley, treasurer and clerk.

LEIGHTON, MICH.—The Leighton Farmers' Telephone Company has been organized and the following-named officers elected: Robert Smith, president, and J. F. Steeby, secretary and treasurer.

CLARA CITY, MINN.—The Northern Farmers' Telephone Company has been incorporated, with a capital stock of $20,000, by John Weeland, C. Busch, E. Miller, H. Worringer, E. Steffens, L. Gerdes and W. F. Reiner.

CLARA CITY, MINN.—Articles of incorporation have been filed for the Rheiderland Telephone Company, with a capital stock of $10,000, by J. F. Kray, Henry Fokkem, J. W. Caspers, George Van Hoven, E. J. Peterson, T. A. Hoff and A. Skonborg.

MAPLETON, MINN.—The Medo Central Telephone Company has been organized for the purpose of building and operating a telephone line to the new town of Pemberton. The officers of the company are: George Hussey, president; W. B. McKibben, vice-president; J. E. Anderson, secretary, and Jacob Groll, treasurer.

OWATONNA, MINN.—The Lemond Rural Telephone Company has been organized and the following named officers elected: C. A. Tincher, president; A. Christianson, vice-president; Haldor Paulson, secretary, and W. W. Day, Jr., treasurer.

WADENA, MINN.—The Menahga Telephone Company has been incorporated, with a capital stock of $5,000, by P. McCoy, J. F. Ericson, W. H. Miller and others.

IBERIA, MO.—Articles of incorporation have been filed for the Iberia Mill & Electric Light Company with a capital stock of $9,000, by M. J. Davidson, J. S. Casey, J. L. Irwin and others.

ALDER, MONT.—The Ruby Valley Telephone Company has been organized, with a capital stock of $5,000. The officers of the company are: Frank S. Metzel, president; C. H. Bufford, vice-president; W. C. Metzel, secretary and treasurer.

BOZEMAN, MONT.—Articles of incorporation have been filed for the Hallatin Valley Electric Company, by W. S. Hartman, C. D. Hartman, of Bozeman, and W. H. Winfree, of Spokane The company proposes to construct an electric railway 26 miles long, from Bozeman into the agricultural sections.

NORFOLK, NEB. The Grant-Bell Telephone Company has been incorporated here and the following named officers elected: Henry Ertzner, president; G. Wagner, vice-president; Robert Pribnow, secretary and treasurer.

ROY, N. M.—The Roy Telephone Company, which has obtained a 50-year franchise to install a telephone system in Precinct No. 22, will file articles of incorporation under the territorial laws. The company also plans to establish long-distance service with Springer. A. S. Bushkevitz, Frank A. Roy, E. P. Brown and F. S. Brown are interested in the company.

ALBANY, N. Y.—Articles of incorporation have been filed for the Champlain & Sanford Railroad Company, with a capital stock of $600,000 The company proposes to operate a steam or electric railway from Addison Junction to Sanford Hill, a distance of 18 miles.

CHATEAUGAY, N. Y.—The Chateaugay Telephone Company has filed articles of incorporation with a capital stock of $2,000 with the following directors: M. J. McCoy, Charles H. Keefe, John G. Wells, Nathan A. Douglass, W. H. Thompson, Henry B. Smith and Herbert T Earl

SAND LAKE, N. Y.—Articles of incorporation have been filed for the Crystal Lake Home Telephone Company with a capital stock of $10,000. The directors are: Edward L. Grawelm, W. Lewis Burk, John M. O'Donnell, of Troy; William Eckes, of West Sand Lake, and Samuel McNay, of Sand Lake.

BROCKET, N. D.—A farmers' telephone company is being organized in this city. Fred Lemke is interested in the enterprise.

EMERDO, N. D.—A telephone company is being formed in this city to install a local system. John Hempstead is interested in the project.

MINOT, N. D. The Berthold Telephone Company has been incorporated with a capital stock of $35,000 by T. F. Russel, C. D. Aaker and S. A. Finberg, all of Minot.

SHERWOOD, N. D.—The Whitney Farmers Telephone Company has been incorporated, with a capital stock of $6,050, by W. D. Brown, Thomas Spain, E. Quanstrum and others, all of Sherwood.

CLEVELAND, OHIO.—The Excelsior Electric Company has been incorporated with a capital stock of $10,000, by Fred Desberg, O. N. Smith, F. A. Waddell, Annette Newman and L. S. Desberg.

GOSHEN, OHIO.—The Wayne & Goshen Telephone Company has been incorporated with a capital stock of $2,500, by W. R. King, J. F Shry, M. D. Frazier and others.

HARDIN, OHIO.—The Mutual Telephone Company has been organized to operate a telephone system in Shelby County and will connect with the long distance lines of the Central Union Company

RICHMOND, OHIO—The Farmers Telephone Company has been organized and the following named officers elected: N. L Meffitt, of York, president; Charles M. Van Hyning, of East Liberty, vice-president; B. Jolliff, of Lunda, secretary, and J C. Thomas, of Lunda, treasurer.

WARREN, OHIO.—The Hydro Electric Company has been incorporated, with a capital stock of $100,000, by C. M Wilkins, O. D. Morgan, D. E. Hoover, C. K. Siegfried and Henry He bert.

LONE WOLF, OKLA.—The New State Mutual Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The directors are Charles Patterson, Joseph Altriger and W. E. Hunt.

MAY, OKLA.—The May Springs Telephone Company has been incorporated with a capital stock of $2,000, by T. J. Sewar and others.

MAYSVILLE, OKLA.—The Oklahoma Telephone, Electric Light & Power Company has been incorporated with a capital stock of $20,000 by A. P. Cash, Joseph Keller and others.

OKLAHOMA CITY, OKLA.—The Oklahoma-Shawnee Interurban Company has been chartered with a capital stock of $300,000, by H. M. Wyatt, A. M. Spencer, Stephen Brown, Joseph Brown and J. A. Stevenson, all of Oklahoma City.

WEATHERFORD, OKLA.—The Federal Telephone Company has filed articles of incorporation. The capital stock of the company is placed at $5,000, and the directors are C. E. Huber, E. DeWitt and H. H. Curry, all of Weatherford.

PORTLAND, ORE.—Articles of incorporation have been filed for the Valley Power Company by Frank Robertson, Charles H. Carey and William S. Turner, of Portland. The capital stock of the company is placed at $100,000 and it proposes to construct an electric railway from West Woodburn, three miles, and thence through Monitor to Scott Mills and on to Wilhoit Springs. Work on the construction of the road will begin about May 15.

COUDERSPORT, PA.—The Inter-ocean Telephone Company has been organized by John F. Stone, Frank Raymond and A. L. Curtis. The company proposes to construct a telephone line between Olean and Port Allegheny, work on which will soon begin.

WESTERLY, R. I.—The Ashaway & Westerly Railway Company has been organized and the following-named officers elected: A. B. Briggs, president; John W. Sweeney, vice-president, and Frank Hill, secretary and treasurer. The company has decided to have a preliminary survey made at once of the proposed road.

GREENVILLE, S. C.—The Greenville & Carolina Railway Company has been organized to build an electric railway from Greenville to Asheville, a distance of about 70 miles. The contract for the construction of the road will be let to the Carolina Construction Company, of Asheville. The company has purchased water-power rights and will develop 6000 horse-power. Work on the construction of the power plant will soon commence. The cost of the road is estimated at about $2,000,000. T. E. Smith, of Greer, is president, and L. W. Walker, of Hendersonville, secretary and treasurer.

WINFRED, S. D.—An Independent telephone company has been organized in this city, for the purpose of installing a local exchange and erecting a number of rural lines, work on which will commence at once.

DEFEATED, TENN.—Articles of incorporation have been filed for the Defeated Home Telephone Company with a capital stock of $500 by N. Cardwell, J. H. Dillaby, T. T. Kemp and N. B. West.

HICKMAN, TENN.—A charter has been granted to the Hickman Telephone Company, with a capital stock of $1,000. The incorporators are W. T. Jones, S. T. Tubbs, W. R. Agee, H. T. Moss and others.

HUMBLE, TEX.—The Mutual Telephone Company has been chartered with a capital stock of $4,000, by W. M. Abbey, F. M. Burton and J. E. Shankland.

ARLEE, W. VA.—The Mountain Rose Telephone Company has been incorporated, with a capital stock of $3,000, by J. M. Wallis, H. C. Bateman, Thomas Bateman, Mercers Bottom, Z. Plants, of Arlee, and Isaac Schloss, of Ino.

JUNEAU, WIS.—The Juneau Telephone Company has been incorporated with a capital stock of $10,000 by Peter Peters, Nathan Scott and A. McCollow.

OSHKOSH, WIS.—Articles of incorporation have been filed for the Little Wolf River Power Company with a capital stock of $250,000. The officers of the company are Leander Choate, president; Casper Faust, vice-president; Frank H. Joslyn, secretary, and E. H. Steiger, treasurer. The company owns water power rights on the Little Wolf River and proposes to erect a hydro-electric plant and furnish electricity in Oshkosh.

OWEN, WIS.—The Owen Telephone Company has been incorporated with a capital stock of $2,000 by H. C. Fickes, H. B. Crane and J. P. Weirich.

MALLORYTOWN, ONT., CAN.—Application has been made for a charter for the Mallorytown Independent Telephone Company by W. A. Lewis.

MILESTONE, SASK., CAN.—The Milestone Southwestern Telephone Company has been incorporated.

SEAFORTH, CAN.—The McKillop Telephone Company has been organized and the following-named officers elected: R. Scarlett, president, and James Kerr, secretary.

WAPELLA, SASK., CAN.—Articles of incorporation have been filed for the Wapella-Harris Telephone & Supply Company.

MORELIA, MEX.—The Compañia de Telefinos Comerciales has been organized at Morelia, state of Michoacan, for the purpose of installing a telephone system in this city and the neighboring towns of Uruapan and Tacambaro. The incorporators are: Antonio Gutierrez, Balbuena; Enrique Arreguin and L. E. Suzan. A. B. Adams, of New York, N. Y., F. Holbrook and W. S. Patton, of Boston, Mass., who hold concession from the Mexican Government for the building of long-distance telephone lines in the state of Vera Cruz, are interested in the project.

Legal.

RIGHTS TO A RIVER CURRENT.—The United States Circuit Court of Appeals at San Francisco has affirmed the decision of the Idaho court in the case of Henry Schodde against the Twin Falls Light & Water Company. Schodde had been using the waters of Snake River in Idaho for the irrigation of his property and alleged that the subsequent building of the dam of the defendant company and the consequent impounding of the water deprived him of the use of his irrigation plant. He therefore asked for $56,650 damages. The lower court decided that the plaintiff did not own the current of the stream, as he claimed, therefore he had no cause for action against the defendant.

SUIT TO PREVENT THE PURCHASE OF NEW EQUIPMENT.—Suit has been entered by injunction proceeding in the Common Pleas Court of Ohio against the Mansfield Light & Power Company to prevent the purchase of new equipment amounting to $100,000. The plaintiffs claim that the omission of the preferred stock dividend in February was made to secure additional funds for improvements, in order to supply power for the Ohio Central Traction Company and other interurban lines. The action is taken to protect the credit of the company against contracts with the Westinghouse Electric & Manufacturing Company, with which negotiations had been in progress for equipment valued at from $70,000 to $90,000.

CONSTRUCTION OF FRANCHISE TO OPERATE TELEPHONE SYSTEM.—An action was brought against the city of Lathrop, Mo., to restrain that municipality from interfering with the plaintiffs in the work of erecting a telephone system. The plaintiffs were going ahead with the work under the assumed authority of a franchise which empowered them to erect, maintain and operate a telephone system. But it was shown that, by virtue of that franchise, the plaintiffs had purchased a telephone system already in operation. This was held to be an accomplishment of the purpose of the franchise, and the plaintiffs, having become the owner of one telephone system under the franchise, could not legally erect and operate another one thereunder. Ely v. City of Lathrop, Kansas City Court of Appeals, 107 S. W., 410.

INJUNCTION.—An injunction has been served on the Economic & Construction Company restraining them from placing its wires in the city conduits of Geneva, N. Y. The city officials were also served with papers restraining the city from permitting the new company to occupy the conduits. The papers were served by the Geneva-Seneca Electric Company, which alleges that the Economic Power & Construction Company has never obtained any right or privilege under any franchise granted by the city to furnish electricity in Geneva, except that of the Geneva Steam Heating Company, which it acquired by purchase. It further alleges that the defendant company is not authorized by law to carry on the business of electric lighting and has not secured the consent of the local municipal authorities to use the streets for electrical purposes; also that it has not made application to the Public Service Commission, nor has it obtained the permission and certificate from the commission, which would enable it to conduct such business as planned.

LIGHTING COMPANY NOT RESPONSIBLE FOR POOR INSULATION.—Judge Mumford, of the Superior Court, Providence, R. I., has filed a rescript in the suit of the Corliss Steam Engine Company vs. Narragansett Electric Lighting Company, of Providence, granting a decision for the defendant, with costs. The action was brought to recover the amount of two judgments against the Corliss Engine Company to recover damages for an accident which occurred at the company's works on Feb. 6, 1896, one in favor of William Moran, who was severely injured and awarded $1.500 and costs. William Houghton was killed on the same date, and his administratrix, Sarah C. Houghton, was awarded a verdict for $7,000 and costs. The plaintiff had in its foundry several jib cranes which were operated by electric motors. It was alleged that the electricity for operating the motors was supplied by the Narragansett Electric Lighting Company, under a contract to furnish the energy at 500 volts, and no more, and that on the day of the fatality the wire which transmitted the energy came in contact with a high-tension wire, which caused the machine to be overcharged. The Corliss Engine Company accordingly brought suit against the lighting company to recover for the two verdicts, on the ground that the real negligence was on part of the company furnishing the electricity. The court, however, found from the evidence that sufficient warning had been given the engine company of the fact that its machine was not properly insulated, and that even if the electric company was responsible for an unusual voltage on the wires, still it could not be held responsible for the accident, which could not have happened had the machine been in proper order.

CONCURRENT NEGLIGENCE OF TWO ELECTRIC COMPANIES.—In an action against an electric light company and a telephone company it was claimed that the two companies were jointly liable for the death of a person which resulted from a dangerously charged guy wire. It was shown that the telephone company had attached a guy wire to the top of a pole belonging to the electric light company and had allowed the guy wire to rest upon the electric light wires attached to the pole and hang down into the street. The electric light wires, not being properly insulated, the broken guy wire became charged and caused the death for which the action was brought, when the deceased leaned against the pole and touched the wire in so doing. It was held that both companies were guilty of negligence, the telephone company by reason of its act in attaching the guy wire and allowing it to remain in a dangerous position, and the electric light company by reason of its failure to remove the wire. On behalf of the electric light company it was argued that the other defendant was the active wrongdoer, and that its own negligence, if any, was, in a sense, passive. Conceding this to be true, it was said by the court: "The fact that the guy wire was permitted to remain in contact with the post, so that a bystander in placing his hand against the post, might touch the wire, was the essential element of negligence in this case, and the testimony shows that both defendants were responsible for that fact. If the telephone company had not connected the wire with the post, it never would have been there; and, if the electric light company had not been guilty of negligence in their failure to remove it, it would not have been there when Compton placed his hand against the post. In reference to that guy wire, the law imposed certain duties upon each company; and, if either had performed its duty, Compton would not have been hurt. The telephone company committed a negligent and wrongful act when it attached the guy wire to the post; and if it had not done so, no injury would have been sustained. The electric light company was guilty of negligence in failing to remove the wire from the post." San Marcos Electric Light & Power Company v. Compton, Court of Civil Appeals of Texas, 107 S. W., 1151.

Personal.

MR. JAMES R. LEAGUE has been appointed general manager of the Augusta Railway & Electric Company, of Augusta, Ga.

MR. TEISHIRO OTAKI, of the municipal electric works, Kyobo, Japan, is on a visit to this country, during which he will inspect some of our more important power stations and hydro-electric plants.

MR. TIMOTHY L. LYNCH has been appointed manager of the municipal electric light plant of Danvers, Mass. Mr. Lynch has been one of the electric light commissioners for some time and is familiar with the plant.

MR. T. C. ROBERTS., master mechanic of the American Smelting and Refining Company's Pueblo plant, has been appointed superintendent of power and shops for the Pueblo and Suburban Traction & Lighting Company, Pueblo, Col.

MR. ROSCOE HOWARD, of Tacoma, Wash., has been appointed general manager of the Deschutes Irrigation & Power Company, of Bend, Ore., to succeed Mr. F. S. Stanley, who is now first vice-president of the company. Mr. Howard will make his headquarters at Bend.

MR. EDWARD B. MERRILL, formerly chief electrical engineer of the Winnipeg hydro-electric power scheme, has opened offices in Winnipeg, Man., Can. He will make a specialty of power developments, electric railways and lighting and municipal engineering.

COL. C. A. BOYNTON, superintendent of the Southern division of the Associated Press, has had conferred on him the decoration of the fourth class of the Imperial Order of the Rising Sun as a token of the high esteem for him entertained by the Emperor of Japan and as a mark of appreciation of his services.

MR. E. W. MUZZY, for the past seven years apparatus salesman for the General Electric Company, has resigned to become vice-president and sales manager of the Spencer Turbine Cleaner Company, Hartford, Conn., manufacturer of vacuum cleaning apparatus. Mr. Muzzy enjoys the very high esteem of his old associates and executive chiefs.

GEORGE H. SHUMAN, contracting electrical engineer, has disposed of his interest in the E-J Electric Company to the other members of the firm. Mr. Shuman will continue in the electrical contracting business at the same address, 15 East Thirtieth Street, New York, and Mr. N. C. Solomon, consulting engineer, will superintend and direct the work.

MR. J. F. GEISER, formerly superintendent and electrical engineer of the Waynesboro Electric Light & Power Company and the Chambersburg & Waynesboro Street Railway Company, of Waynesboro, Pa., has severed his connection with the above companies and has entered the field of kinetic engineering as consulting engineer. Mr. Geiser has opened an office in Waynesboro, Pa.

MR. L. R. McBROON, who has been connected with the General Electric Company, of Schenectady, N. Y., has been appointed general superintendent of the Rutland Railway, Light & Power Company, of Rutland, Vt. Mr. McBroon is to have charge of the operating and street railway departments, succeeding Mr. Henry W. Brow, electrical engineer, and Mr. W. H. Horton, superintendent of the street railway, recently resigned.

PROF. W. KENT.—A special dispatch from Syracuse, N. Y., of April 22 says: "Acting in accordance with the wishes of Chancellor James R. Day, the executive committee of the board of trustees of Syracuse University have voted not to retain Mr. William Kent as Dean of the College of Applied Science. This decision becomes operative if ratified by the board of trustees at their June meeting, which will be presided over by Mr. John D. Archbold, of New York. Chancellor Day is said to have requested this action on the part of the executive committee on the ground that the Dean had, during the Chancellor's absence in New York recently, overstepped his authority in making inspections of the university buildings in order to prevent a recurrence of any such disaster as the Collinwood fire."

MR. HORATIO A. FOSTER, resident engineer in Baltimore, Md., for L. B. Stillwell, has been transferred to the New York office, 100 Broadway, joining the forces at that point. He will still continue to look after the work in Baltimore, spending such time there as may be necessary, sharing this supervision with Mr. H. S. Putnam on electrical work and with Mr. Van Vleck on the steam end. Mr. Foster has been in charge of the work in Baltimore since it was started, a year and a half ago, and has carried through to completion the many additions and changes made to the power plants of the United Railways & Electric Company, under the contract with Mr. Stillwell. These included the construction of a power station at Bay Shore, a new summer resort; a new substation in the central part of the city; an addition to one of the outlying substations; rearranging and reinforcing of three existing substations, and the construction and reconstruction of the Pratt Street power station. During this period of building the operation of all power plants came under his supervision, and the forces were all thoroughly reorganized.

Obituary.

MR. SIDNEY ADLER, an electrical engineer, of Philadelphia, Pa., died April 15 in the German Hospital following an operation. He was 23 years of age and a graduate of the Sheffield Scientific School of Yale University, New Haven, Conn., in 1905.

MR. EUGENE MUNSELL, president of the Mica Insulator Cmpany, New York, met sudden death last week by jumping from a window of his apartments at the Hotel Van Dyke, New York. Ill health of long duration is said to have led him to commit the act. Deceased was 56 years of age, and came from a family long connected with the American stove industry. He was a man of culture, traveled considerably and was a lover and purchaser of works of art.

MR. CHARLES H. NEWHALL, president of the Lyon Gas & Electric Light Company, of Lynn, Mass., died at his home April 22. He was 62 years old. Mr. Newhall had been president of the Lyon Gas & Electric Company for 25 years. He was a director of the old Thomson-Houston Electric Company, which later was merged with the General Electric Company, and was one of those instrumental in bringing that plant to Lynn in 1888. He was also vice-president of the Central National Bank and a director of the Security Safe Deposit & Trust Company, a member of the investment committee of the Lynn Five Cents Savings Bank, a trustee of the Lynn Public Library and a prominent member of the First Unitarian Church.

Removals.

THE WELLMAN-SEAVER-MORGAN COMPANY has moved its New York office to the Hudson Terminal, 50 Church Street

THE BALL & WOOD COMPANY has moved its sales office to 1422 Cortlandt Building, Hudson Terminal, 30 Church Street, New York

THE POWER AND MINING MACHINERY COMPANY has removed its San Francisco office from 148 First Street to Room 217, Sheldon Building.

J. G. ROSSMAN, consulting engineer, who makes a specialty of the development and reorganization of water-power, lighting and traction properties, has removed his offices from 80 Wall Street to 140 Nassau Street (P. O. Box 1565), New York.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has decided to remove its manufacturing plant from this city to Anderson. It is understood the company is a beneficiary of the big factory fund recently raised in Anderson. A site is also to be donated.

THE EMERSON ELECTRIC MANUFACTURING COMPANY has moved its New York office from 136 Liberty Street to much more convenient and commodious quarters on the fourteenth floor of the new Hudson Terminal Building, 50 Church Street, from which office the company will be able to give its customers improved service.

THE GREGORY ELECTRIC COMPANY, of Chicago, will be represented at the convention of the National Electric Light Association at the Auditorium, Chicago, and will have an exhibit in space No. 5. Representatives of the company will welcome its patrons at the convention, and a cordial invitation is extended to all visitors to inspect the company's new works.

THE ELECTRIC SERVICE SUPPLIES COMPANY has moved its offices from the United States Express Building, 2 Rector Street, to the eighteenth floor of the Hudson Terminal Bldg., 50 Church Street, New York. In the new location the offices are more commodious and a newly arranged sample room is being fitted out, and visitors will be cordially welcomed. The Pittsburg office of this company has also been removed from the Terminal Warehouse to the Farmers' Bank Building. A sample room has also been fitted up in this office.

N. E. L. A. EXHIBITION.—The Exhibition Committee of the National Electric Light Association reports that nearly all of the available exhibition space has been taken. The color scheme decided upon is a combination of a peculiar shade of dark green, and white containing a tinge of green. The lettering of the sign board will be in gold or aluminum. Additions to the list of those who will exhibit, which was printed in these columns last week, are the following: German-American Electric Company, Condit Electric Manufacturing Company and the Gregory Electric Company.

CROSBY, CRAFT & COMPANY, 723 Williamson Building, Cleveland, O., have recently taken the agency for the State of Ohio for the Hartman Circuit Breaker Company, manufacturers of oil switches, circuit breakers and transformers. Crosby, Craft & Company are to make a specialty of instruments and circuit breakers, and, in addition to the Hartman line, they represent in Ohio the Whitney Electrical Instrument Company, the Sangamo Electric Company, Machado & Roller and the Switchboard Equipment Company. This concern is under the management of Mr. G. L. Crosby, who for several years has made a specialty of circuit breakers and instruments in the territory in which he is now located.

THE OHIO BRASS COMPANY, whose main offices and works are located at Mansfield, Ohio, will, on May 8, move its New York offices from their present location in the Wall Street Exchange Building, 43 Exchange Place, to Room 1022 of the new Cortlandt Building, Hudson Terminal, with entrances at 32 Cortlandt Street and 30 Church Street. The telephone number in the new quarters will be 6658 Cortlandt. On May 1 the Chicago office of the same company was removed to the Fisher Building, corner Dearborn and Van Buren Streets, just one block north of the present location, at 321 Dearborn Street. The present telephone number, Harrison 4344, will be retained in the new quarters. The new location is very conveniently situated with respect to the leading hotels, and within a few minutes' ride of all railway depots. A "loop" station, at which all elevated trains stop, is located at this corner.

Trade Publications.

CREDIT.—The E. Bissell Company, Toledo, Ohio, is sending out in neat pamphlet form, a reprint of an article entitled "Credit," written by Col. W. C. Hunter, which points out how essential a factor credit is in building up a business, and also how essential truth is in building up credit.

WIRES AND CABLES.—The Habirshaw Wire Company, 253 Broadway, New York City, has just issued a new and complete catalogue and price-list of its wires and cables. This catalogue includes all the variety of product in different lines, and gives a full set of prices with copper from 12 cents up to 25. It contains also a good deal of other useful data and information. It is a valuable handbook for the trade, and copies can be had on application.

GRAPHITE BRUSHES.—The April issue of *Graphite*, the monthly publication of the Joseph Dixon Crucible Company, Jersey City, N. J., contains an article pointing out the advantages of graphite dynamo brushes.

VACUUM APPARATUS.—Catalogue No. 8, of the Alberger Condenser Company, 95 Liberty Street, New York, deals with Alberger high-vacuum apparatus especially adapted to vacuum pans, multiple effects, evaporators and stills.

ELECTRIC MEASURING INSTRUMENTS for direct and alternating-current circuits, in both portable and switchboard types, are described in a well-illustrated 64-page catalogue issued by the International Electrical Meter Company, Chicago, Ill.

HIGH-TENSION CIRCUIT BREAKERS.—J. H. Kelman, 1000 N. Main Street, Los Angeles, Cal., has issued folder No. 3, calling attention to his oil-immersed automatic circuit breaker for electromotive forces of from 15,000 to 100,000 volts.

GAS ENGINES.—An artistic catalogue has been issued by the National Meter Company, 84 Chambers Street, New York, is devoted to a description of Nash gas and gasoline engines for electric lighting, pumping, fire protection and industrial purposes generally.

ARC LAMPS.—Bulletin No. 32A, of the Helios Manufacturing Company, 18 East Forty-second Street, New York, describes series alternating-current arc-lighting systems. Information is given concerning lamps, constant-current regulators, insulating transformers and connecting circuits.

POWER EQUIPMENT FOR CEMENT MILLS.—Bulletin No. 5910 of the Western Electric Company has for its subject the electrical power equipment of cement mills. A number of excellent engravings show equipment of this kind installed by the Western Electric Company in a number of mills.

ELECTRIC FANS.—Bulletin No. 1105 of the Fort Wayne Electric Works, Fort Wayne, Ind., gives a complete description of direct-current and alternating-current fans. A commutator type of motor is used with direct-current and 60-cycle fans, while a self-starting shaded-pole induction motor is used with 140-cycle fans.

MAGNETO TELEPHONES.—The Stromberg-Carlson Telephone Mfg. Company has issued an eight-page pamphlet preparatory to the issue of a bulletin descriptive of the Stromberg-Carlson "Mine-a-Phone" system, which describes and illustrates by means of five different views a new type (No. 890) of iron-clad magneto telephone.

RECORDING INSTRUMENTS.—Vol. 1, No. 1, of "The Recorder," published by the Bristol Company, Waterbury, Conn., has reached us, dated March, 1908. This magazine is being issued as a house organ in an effort to shed light upon the subject of recording instruments and their applications. The magazine is being distributed free of charge to those interested.

PORTABLE AIR COMPRESSORS.—Bulletin No. 1,512 of the Allis-Chalmers Company describes in detail, with illustrations, the portable air compressor of its manufacture. These compressors are built for capacities of 11, 16, 20 and 50 cubic feet of free air per minute. Each is constructed throughout with sufficient strength to withstand a working pressure of 100 lb. per square inch.

AN ELECTRICAL MENU.—At a dinner of the Trumbull Electric Manufacturing Company's forces at the Heublein, Hartford, Conn., on April 4, a very amusing menu card was employed based on the phraseology of the company's product, each item thus receiving a subtitle not unually recognized by the culinary art. There were also some humorous verses aimed at the factory staff and at the salesmen.

ELECTRIC SWITCH INDICATOR.—Among the special characteristic improvements to be found in the switch indicator, described in Bulletin No. 4563 of the General Electric Company, is a resistor having a resistance amounting to twice that of the operating coils. When the indicator is in the "clear" position, the resistor is placed in series with them, thereby reducing the power consumption by two-thirds.

FRANKLIN BULLETIN.—The Franklin Electric Manufacturing Company, Hartford, Conn., in its Bulletin No. 6 gives many interesting facts about its Franklin Gem, tantalum and tungsten lamps, and figures are submitted making a favorable showing for these lamps compared with carbon filament lamps of the same class. The bulletin, which has eight pages, is attractively gotten up and contains several interesting illustrations.

ISOLATED PLANT SWITCHBOARD PANELS.—The General Electric Company has issued Bulletin No. 4558, in which the equipment of isolated plant feeder panels and the combination generator and feeder panels are described, details of the instruments, circuit breakers, switches, mounting of rheostats, etc., are given, and the dimensioned drawings with diagrams of connections and tabulations of the various ratings included. The panels provide for controlling 125-volt generators rated at from 5 to 240 kilowatts, and 250-volt generators for from 10-kw to 240-kw rating.

PORCELAIN ELECTRICAL SPECIALITIES.—The E. H. Freeman Electric Company, of Trenton, N. J., has issued, in convenient form, a catalogue of its long line of porcelain electrical specialties, all of which are shown in illustrations. The Freeman Company has its own pottery, which enables it not only to control the grade of its material, but allows improvements to appliances to be readily made when these are indicated. Among its manufactures are complete lines of sockets, receptacles, rosettes, attachment plugs, plug cut-outs, fuse plugs, wiring-circuit fittings, porcelain knobs, tubes, etc.

TUNGSTEN LAMP FOR STREET LIGHTING.—Bulletin No. 4571 of the General Electric Company is devoted to the tungsten lamp as applied to street lighting. Data and prices, candle-power, distribution curves and illustrations of the lamp and ornamental brackets used in street lighting are given. The lamps are rated at an efficiency of 1¼ watts per candle-power with an estimated life of approximately 1000 hours. The ampere range of the various types of lamps is from 3.7 to 8 and the candle-power from 32 to 60. The 32-cp lamp has an average total watts of 40, and the 60-cp lamp of 75.

ASBESTOS WOOD.—The H. W. Johns-Manville Company, of 100 William Street, New York, has issued Catalogue No. 107, having for its subject "Asbestos Wood," a fireproof substitute for wood, slate, marble and fibre, for building construction and electrical installation. This material is the invention of Prof. Charles L. Norton, of the Massachusetts Institute of Technology. It is claimed that "ebony" asbestos wood is far superior to either slate or marble for electrical purposes, having much higher electrical resistance than either of these and being almost equal, in this respect, to hard rubber or sheet mica. One of the distinct advantages is that it may be worked almost as easily as ordinary wood.

RAILWAY SWITCHBOARDS.—Bulletin No. 4544, of the General Electric Company, Schenectady, N. Y., covers several classes of switchboard panels for 600-volt, direct-current railway service. The following types are described: Generator panels, including circuit breakers and equalizer switch panels, rotary converter panels, feeder panels for one circuit, feeder panels for two circuits with one ammeter per panel, and feeder panels for two circuits with two ammeters per panel. The various forms of apparatus used in connection with the panels, details of construction, etc., are described and illustrated, and complete tables containing catalogue numbers, ratings, etc., and dimension sketches are given.

ECONOMIZERS.—The Green Fuel & Economizer Company, Matteawan, N. Y., has issued a 66-page publication, which takes up not only the history and merits of its devices, but also such engineering topics as the absorption of heat by different parts of the boiler surface; the relative economy of boiler surface and economizer surface under various conditions, methods of determining the economy of additional heating surface from the load curve; the effects of oil fuel, high steam pressures and superheat on boiler economy; methods of measuring the temperature of flue gases; and reports of various tests of boiler plants containing economizers. The general scope of the whole may be inferred from the following chapter headings: The economizer and its inventor; elementary theory of the economizer; forcing capacity of boilers; profit from an economizer; secondary advantages of the economizer; the economizer in small boiler plants; calculating the performance of an economizer; simple method of figuring the saving; actual saving greater than theoretical saving; measuring the temperature of the flue gases; actual results obtained in economy tests of economizers; design and construction of the fuel-economizer; waste-heat air heater; air heater and economizer in water-gas manufacture; chimneys, mechanical draft, steam and fan tables.

RADIATOR VALVES and union elbows are illustrated and described in Catalogue D, recently issued by the Ohio Brass Company, Mansfield, Ohio.

MOTOR EQUIPMENTS for boot and shoe factories are thoroughly treated in Bulletin No. 5910-2 of the Western Electric Company, Chicago, Ill.

LIGHTING SPECIALTIES are dealt with in an instructive manner in the April issue of "Paistery," published by the H. T. Paiste Company, Philadelphia, Pa.

PACKING.—Sheet and rope packing made of asbestos is treated in Folder No. 7705 of the H. W. Johns-Manville Company, 100 William Street, New York.

LAMP GUARDS.—"Never Break" lamp guards made of steel wire are thoroughly described in a 28-page booklet issued by the F. Bissell Company, Toledo, Ohio.

OUTLET BOXES.—Circular No. 428 of the Sprague Electric Company, 527 West Thirty-fourth Street, New York, is devoted to stamped steel outlet boxes and fittings.

BOILER-TUBE CLEANERS are listed in a leaflet devoted to the "National" steel cleaner issued by the H. W. Johns-Manville Company, 100 William Street, New York.

THE BISSELL FROG.—The F. Bissell Company, Toledo, Ohio, is issuing a series of souvenir post cards indicating that the "Bissell Frog" is on the way to visit a customer.

PANEL BOARDS for all kinds of electric lighting installations are dealt with fully in Bulletin No. 20 of the H. Krantz Manufacturing Company, 160 Seventh Street, Brooklyn, N. Y.

BELTED ALTERNATORS.—Polyphase belt-driven revolving-field alternators are described in detail and fully explained in Bulletin No. 1104 of the Fort Wayne Electric Works, Fort Wayne, Ind.

AIR COMPRESSORS of the motor-driven type for operating air brakes are treated in an instructive manner in Bulletin No. 384 of the National Brake & Electric Company, Milwaukee, Wis.

PANEL BOARDS.—A catalog recently issued by the Electric Manufacturing Company, 926 Lafayette St., New Orleans, La., gives a complete price list of panel boards, together with dimensional illustrations.

ELECTRIC FANS.—The "Standard" fan catalogue for 1908, published by The Robbins & Meyers Company, Springfield, Ohio, is an artistic production dealing with well-designed fans for direct-current and alternating-current circuits.

LOCOMOTIVE CRANES.—The Brown Hoisting Machinery Company, Cleveland, Ohio, has issued Bulletin K dealing with locomotive cranes for handling coal, ore, sand, ashes, etc. These cranes are operated by means of steam engines or electric motors.

VALVES.—Catalog 8, Section C, of the Schutte & Koerting Company, Philadelphia, Pa., contains illustrations and descriptions of extra heavy balanced valves of the stop and throttle types. Section D of the same catalog deals with balanced-trip and trip-throttle valves.

IGNITION BATTERY.—The Apple Electric Company, Dayton, Ohio, has issued Bulletin No. 1A devoted to portable storage batteries for automobile, motor boat and stationary gas engine electric ignition and lighting or for any purpose requiring direct current at low voltage.

SETTING CORLISS ENGINE VALVES.—The Allis-Chalmers Company have issued a pamphlet containing directions for setting the valves of the Reynolds heavy duty reliance Corliss engines, a copy of which will be sent upon application to those interested.

TUNGSTEN AND TANTALUM CLUSTERS.—The Federal Electric Company, of Chicago, has recently brought out some new clusters which are designed especially to take tungsten lamps. These are simple in construction and designed to meet the competition of gas and electric arcs. Its regular clusters are also suited to this use in a higher grade of work. Bulletin No. 80B describes the simpler clusters and No. 80 the regular clusters.

FORGE BLOWERS.—Bulletin No. 3305, of the Emerson Electric Manufacturing Company, St. Louis, Mo., is devoted to forge blowers direct-connected to alternating-current or direct-current motors. The direct-current motors are arranged for variable speed, but the alternating-current motors are of the constant speed type; when the latter motors are used blast gates are installed for regulating the flow of air and preventing waste of electrical energy.

LIGHTNING ARRESTERS.—Graded shunt resistance multigap lightning arresters are described in Bulletin No. 4573 of the General Electric Company. The bulletin also contains detailed descriptions of low-voltage arresters, static dischargers, constant-current horn arresters, disconnecting switches, choke coils and direct-current arrester for voltages up to 6000. Tables of general data regarding the apparatus, connection and dimension diagrams, etc., are included. The bulletin is bound in an artistic cover.

INSULATED STAPLES.—The Blake Signal & Manufacturing Company, 246 Summer Street, Boston, Mass., has issued a folder illustrating and describing the Blake insulated staple and compressed cleat. The insulation of the staple is of fibre so attached that it cannot come off in driving. The compressed cleats are used where staples cannot be employed; their advantages are less cost than fibre or porcelain cleats and ability to withstand the blow of a hammer, so that wire nails can be used as well as screws.

TUNGSTEN LAMP FOR STANDARD LIGHTING SERVICE.—Bulletin No. 4570, recently issued by the General Electric Company, Schenectady, N. Y., describes and illustrates the General Electric tungsten lamp for 100 to 125-volt circuits. The lamp is made in 40, 60 and 100 watts and has a life of approximately 800 hours when used on either alternating or direct current. Some of the illustrations show the tungsten incandescent units, combined with standard Holophane globes, which can be used to excellent advantage in this manner.

Unclassified Items.

HOUGHTON, MICH.—Extensive improvements are contemplated this summer for the properties of the Houghton County Street Railway and the Houghton County Electric Light Companies, which will involve an expenditure of about $1,000,000. The more important work will include the six-mile extension to Mohawk; erection of a new substation at Larium; rebuilding of the overhead electric system at Calumet, new transmission line from Calumet to Mohawk to supply electricity for mines, enlargement of car barns at Larium and Hancock, and improvements to coal handling apparatus at Hancock and Houghton. Stone & Webster, of Boston, Mass., are managers of the companies.

HUDSON, WIS.—The interior of the substation of the local electric light system was destroyed by fire April 19, causing a loss of several thousand dollars. The lighting system will be crippled for several days.

MANITO, ILL.—The Village Board has voted to bond the town for $3,500 and assume control of the electric light plant, which was started by J. N. Smith. With the poles in place and part of the machinery installed work on the construction of the plant was stopped. The village will pay Mr. Smith about $1,600 for his interest and advertise for bids for the completion of the plant.

BROCKTON, MASS.—The Gas and Electric Light Commissioners have authorized the Edison Electric Illuminating Company of Brockton to issue $100,000 in bonds, the proceeds to be used to cancel outstanding promissory notes.

LOWELL, MASS.—The Lowell Electric Light Corporation has received permission from the State Gas and Electric Light Commissioners to issue $93,000 in additional capital stock at $150 per share, the proceeds to be used to cancel outstanding notes.

MEMPHIS, TENN.—The City Council is considering the question of installing a municipal electric light plant to cost $750,000. J. H. Weatherford is city engineer.

HAVERHILL, MASS.—The Haverhill Electric Company will soon commence work on the construction of its underground conduits on several streets in the city.

GREENWICH, CONN.—It is reported that the Westchester Electric Company contemplates extending its transmission lines to Greenwich to furnish electricity throughout the town, reaching to the Stamford boundary. The company's lines now extend to East Port Chester.

MANCHESTER, MASS.—The citizens are considering the proposition of purchasing the electric plant of the Manchester Electric Company, and have appointed a committee, consisting of E. S. Knight, F. K. Swett and James Hoare, to investigate the matter. The company has offered to sell the plant to the town for $100,000, which is $50,000 less than the cost of the system. The privilege of extending the option on the plant has been refused by the company.

RICHMOND, MAINE.—The Richmond Electric Light Company has been organized and the following officers elected: C. D. Newell, president. George Fish, vice-president; Hnry E. Houdlett, treasurer, and Henry C. Reed, clerk.

BRATTLEBORO, VT.—The citizens are considering the question of establishing a municipal electric light plant.

COLORADO CITY, COL.—Articles of incorporation have been filed for the Colorado City Power & Light Company with a capital stock of $35,000 by W. P. Epperson, M. V. Watson and others. The company proposes to develop the water power of Bear Creek to generate electricity.

DAYTONIA, FLA.—The electric light plant, and cold storage plant owned by the estate of Adam Schantz was destroyed by fire April 22. The electric plant was insured for $25,000.

DENVER, COL.—The Orchard Construction Company has filed articles of incorporation with a capital stock of $25,000. The company proposes to construct irrigating ditches, reservoirs and power plants near Palisades, at a cost of about $700,000.

PARK RIDGE, N. J.—The citizens on April 21 voted to issue $30,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant.

LOUDON, TENN.—The City Council is considering the question of establishing a municipal electric lighting plant.

HENNING, TENN.—It is proposed to install an electric light plant and water works system in this town. Mr. Page, of Millington, is interested in the enterprise.

MT. AYR, IA.—Plans are being considered to establish an electric light plant in this town. A company has been formed by W. J. Bell and others to build the same.

PLAQUEMINE, LA.—It is reported that the plant and holdings of the Plaquemine Electric Light & Power Company have been purchased by M. P. Conery, superintendent of the Consumers Electric Company, of New Orleans.

LEWISBURG, TENN.—Plans are being considered for the construction of a large electric light and power plant in this city. The plant will be located at Lillard's Mill on Duck River, 10 miles north of the city.

Business Notes.

CEILING AND DESK FANS.—The Dayton Fan & Motor Company, Dayton, Ohio, has issued a well-illustrated catalogue covering direct-current and alternating-current ceiling and desk fans.

THE P. M. FLETCHER COMPANY, 32 Frankfort Street, New York, on April 23, changed its name to the Fletcher-Stanley Company, which will conduct the business carried on under the former name.

THE UNITED STATES STANDARD ELECTRICAL WORKS COMPANY, of Racine, Wis., has filed an amendment to its articles of incorporation, changing its name to the Standard Electric Works Company.

ELECTRIC LAMP FITTINGS.—Publication No. 56¾ of Verilys, Ltd., Aston, Birmingham, England, illustrates and describes artistic lamp fixtures for decorative purposes and substantial watertight fittings for use on ships and docks.

FIBRE CONDUIT.—The Fibre Conduit Company, Orangeburg, N. Y., has issued a neat folder dealing with conduit made of extremely compact wood-pulp, which is non-conductive, light in weight and practically imperishable.

MOTOR EQUIPMENT FOR RAILROAD SHOPS.—Bulletin No. 5910-1 of the Western Electric Company, Chicago, Ill., is a well-illustrated publication giving much information concerning the motor equipments in various railroad shops.

AUTOMOBILE DEVICES, including clutches, reversing gears, brakes, speed-changing gears, axles, springs and chassis frames are illustrated and described in a catalogue issued by the Merchant & Evans Company, 517 Arch Street, Philadelphia, Pa.

BATTERY-TESTING INSTRUMENTS, consisting of pocket voltmeter, ammeters, voltmeters, spark-coil current indicators and miniature switchboard instruments, are treated in an illustrated catalogue of the Eldredge Electric Manufacturing Company, Springfield, Mass.

GREENAWAY SEPARATORS.—The Liberty Manufacturing Company, Pittsburg, Pa., has purchased the Greenaway Separator business from Greenaway & Company, of Detroit, Mich., and in the future will fill orders for steam, oil, ammonia and air separators manufactured under the Greenaway patents.

ENGLISH MANUFACTURING. — Spagnoletti, Limited, Goldhawk Road, London, who are known as experienced manufacturers with a large English and Colonial connection, are taking up the subject of manufacturing for Americans under the British patent law, which aims to cancel a patent if the protected article is not made exclusively in England. The effect of this law appears to be rather sweeping, and it is certain that many American manufacturers it would reach will desire to keep their patent rights intact.

THE SOUTHERN EXCHANGE COMPANY, of New York, makes a specialty of octagonal and square sawed yellow pine poles, and reports that the demand for poles of this class has increased over 100 per cent in the past three years. These poles are made to any size, base or top, and in lengths from 25 ft. to 65 ft. The butts are usually tarred 6 ft. from the base, or the entire pole is creosoted. Poles of this kind are desirable for trolley, electric light and telephone lines in towns or cities, where a shapely pole is favored.

CANADIAN CROCKER-WHEELER COMPANY, LTD.—One of the signs of returning confidence in the business situation is the organization of the Canadian Crocker-Wheeler Company, Ltd., for the manufacture and sale in Canada of the Crocker-Wheeler apparatus. Mr. F. E. Lovell, president of the new company, is a member of the old-established lumbering firm of H. Lovell & Sons, of Coaticooke, Que., who have extensive interests in mills and timber limits throughout the Province of Quebec. Russell A. Stinson and F. Jno. Bell, vice-president and secretary-treasurer, respectively, have been identified with the manufacturing, construction and sales ends of the electrical trade in Canada for the past 15 years, and are particularly well known in Montreal, where the head office of the company has recently been opened in the Street Railway Chambers, Place d'Armes Hill.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual meeting Albany, N. Y., April 30, May 1 and 2.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Atlantic City, N. J., June 29-July 2.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting at Toronto, June 10, 11 and 12.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Electrical Association. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, Kansas City, May 6 and 7.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. Z. Pierson, St. Charles, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers. Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman. Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York. Next meeting at Chicago, May 19, 20, 21 and 22, 1908.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

National Electrical Trades Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, May 4 to 9.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio. Next meeting at Columbus, May 15 and 16.

Oklahoma Electric Light, Railway & Gas Association. Secretary, Galen Crow, Guthrie. Next meeting at Guthrie, May 25, 26 and 27.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex. Next meeting at El Paso, Tex., May 7, 8 and 9.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electric Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

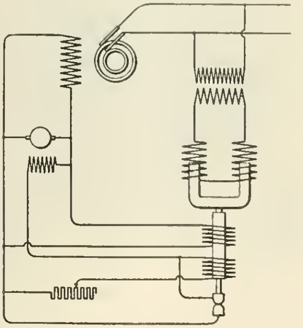
UNITED STATES PATENTS ISSUED APRIL 21, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

885,007. TELEPHONE-TRANSMITTER; Alberta E. Beachum, Polkton, N. C. App. filed Aug. 7, 1907. A telephone transmitter including a diaphragm and a microphonic element comprising a vacuum tube connected to the diaphragm and extending parallel therefrom, said tube inclosing circuit terminals and a mass of conducting granules for bridging said terminals.

885,009. INDUCTION MOTOR; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 29, 1905. In a rotor for induction motors, a spider, radial fan-blades integral with said spider, a slotted core mounted on the rim of the spider, conductors mounted in the slots of the core, and short-circuiting rings for said conductors mounted on said fan-blades.

885,031. REGULATOR FOR DYNAMO-ELECTRIC MACHINES; Richard Fleming, Lynn, Mass. App. filed Oct. 20, 1904. Regulator having a single continuously vibrating member acted on by a coil which is responsive to the voltage to be regulated. A second coil is provided in opposition to the first and short circuited by the vibration of said member.



885,031.—Regulator for Dynamo-Electric Machines.

885,034. TRANSFORMER; John J. Frank, Schenectady, N. Y. App. filed Sept. 26, 1907. A means for insulating the coils from one another so that the high voltage stresses to which the insulation is subjected may be better withstood. Has means for equalizing the potential stresses due to one of the windings over a large area of insulation between the windings.

885,054. GAS ELEMENT FOR CONVERTING THE ENERGY OF COMBUSTIBLE OR OTHER SUITABLE REDUCING SUBSTANCES TO ELECTRIC CURRENT; Ernest W. Jungner, Kneippbaden, Norrkoping, Sweden, App. filed May 15, 1907. A galvanic gas element producing sulfuric acid comprising sulfurous acid, a suitable reducing substance and oxygen as a generating medium, and an electrolyte of sulfuric acid of such concentration as to be capable of reduction to sulfurous acid by reducing agents.

885,055. ERNEST C. KETCHUM, Boston, Mass. App. filed July 3, 1907. Has a car with a platform carrying a boiler and a steam turbine driving a generator. Also includes a form of radiator condenser at the front end of the car.

885,061. INTERLOCKING RELAY; Thomas L. Lee, Westfield, N. J. App. filed June 6, 1907. Relay for use in connection with an electrical apparatus in which it is necessary to arrange for automatically preventing the contemporaneous opening or closing of two or more circuits, for example, in connection with an electric alarm bell for signaling the approach of trains on a single track railroad. Makes use of a form of interlocking relay.

885,063. TROLLEY STAND; William A. Loudon, Chicago, Ill. App filed Aug. 9, 1905. A trolley stand particularly adapted to mining locomotives and having a fixed vertical standard with a hinged pole which is impelled upward by a spring and plunger longitudinally movable within the standard.

885,083. ELECTROLYTIC APPARATUS; Brodde E. F Rhodin, Sault Ste. Marie, Ontario, Canada. App. filed Oct. 30, 1906. A cell for electrolytic processes, having a series of concentric retaining ridges arranged stepwise, each of said ridges being separate from the others.

885,106. SYSTEM OF DISTRIBUTION; Lewis L. Tatum, Norwood, Ohio. App. filed Apr. 16, 1906. Multiple voltage system of distribution in which balancers are employed for maintaining the differences in voltage between the several conductors at their predetermined values when the currents in the various branches of the system are unbalanced or unequal.

885,121. PUNCTURE TELLTALE; Charles A. Winter, New York, N. Y. App. filed Aug. 14, 1906. The patentee has a spring impelled plunger movable radially through the felly so as to engage the inner tube. In case the tire collapses this device moves to establish an alarm circuit.

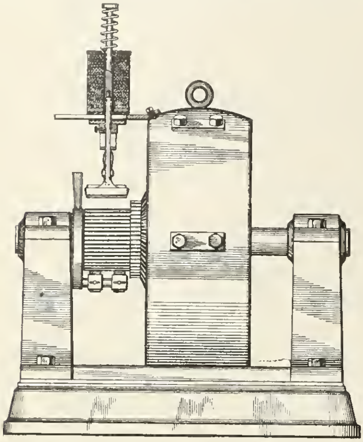
885,128. MOTOR CONTROL. Ernest F W Alexanderson, Schenectady, N. Y. App filed Jan. 26, 1907. Relates to the control of commutator motors designed to be operated as series motors on direct currents and as repulsion motors on alternating currents. Provides a novel control system for such motors designed to avoid commutator troubles, and so arranged that the alternating current voltage may be made about twice that of the direct current without increasing the strain on the insulation of the motors.

885,134. ELECTRIC GAS LIGHTING MACHINE; David A. Barlow, Orange, Conn. App. filed Feb 2[illegible], 1907 The patentee has a plurality of sliders with laterally projecting arms extending over the several burners. The sliders can be separately manipulated to ignite any burner.

885,143. AUTOMATIC SYNCHRONIZER; Frank Conrad, Swissvale, Pa. App filed Feb. 2, 1907. A means for automatically connecting an alternating current generator to a circuit when the currents generated thereby agree in phase and frequency with those in the circuit.

885,147. CONTROLLING DEVICE FOR ELECTRIC MOTORS; Charles A. Dresser, Chicago, Ill. App. filed Oct. 24, 1903. Particularly adapted for controlling motors in connection with any driven mechanism, particularly with motors for driving flat bed and other printing presses. Has a solenoid with a hollow core containing a contact bar, and which is prevented from moving under certain circumstances by a magnet-operated detent.

885,163. ARMATURE WINDING FOR HIGH SPEED DYNAMO ELECTRIC MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed June 2, 1905. Has a slotted armature core and a commutator cylinder and a winding comprising a plurality of coils located in the armature slots. Includes conductors located in the armature slots for connecting the terminals of the coils with alternating commutator segments.



885,278.—Commutator Wiper and Oiler.

885,168. AUTOMATIC SIGNALING DEVICE; Guy Mulburn, Baltimore, Md. App. filed May 11, 1906. Relates to train signaling mechanism and provides a block system in which signals are automatically displayed in the cab of the locomotive by means of circuits which are completed between the different trucks of the train when the latter passes sectionally electrified track rails.

885,180. TELEPHONE TRUNKING SYSTEM; Edwin H. Rupe, Chicago, Ill. App. filed Nov. 15, 1906. In a telephone system, the combination with a cord circuit, of a ringing key, and a relay, the actuation of which depends upon the character of the jack with which the cord is connected, for governing the connection with said key, and jacks of different character with which the cord may be connected.

885,184. WINDING FOR DYNAMO ELECTRIC MACHINES; Walter Schmidt, Pittsburg, Pa. App. filed July 17, 1905. Provides a form of winding adapted to be applied to the rotatable core of an induction machine to occupy a minimum amount of space outside of the core slots. The winding comprises two groups of coils at right angles to one another and having end connectors which are disposed in two substantially parallel planes. Includes a plurality of insulating blocks for supporting the different groups of end connectors.

885,186. THREE-WIRE CENTRAL-ENERGY TELEPHONE SYSTEM; Charles A. Simpson, Chicago, Ill. App. filed Feb. 26, 1906. Includes complete diagram of cord, signal and testing circuits.

885,223. RECEIVER; Wiley T. Boyd, Ellenton, Fla. App. filed Feb. 12, 1907. The combination with a receiver provided with a removable cap, of divergent nipples projecting from said cap and communicating with the interior of the receiver, flexible tubes secured at one end to said nipples, rigid ear tubes secured to the other ends of said flexible tubes, and a ring embracing and movable on the flexible tubes and cooperating therewith to form flexible adjustable clamping means for the rigid ear tubes.

885,245. DEVICE FOR SEPARATING IRON PARTICLES FROM CHAFF AND THE LIKE BY MEANS OF MAGNETS; Joseph Hagmüller, Allensbach, Germany. App. filed Jan. 2, 1908. Includes a plurality of permanent magnets attached to the cutter arms adjacent to the blades so as to attract and hold the iron particles in the chaff.

885,270. TELEPHONE SYSTEM; Frank E. Mayberry, West Medford, and Newman H. Hollard, Brookline, Mass. App. filed April 12, 1902. Form of vibrator bell for telephone sets having a switch hook and a recorder associated therewith.

885,278. COMMUTATOR WIPER AND OILER; Daniel D. Neville, George H. Clay and John H. Clewer, Kansas City, Mo. App. filed Nov. 16, 1905. A commutator wiper and oiler designed to be applied to any dynamo and including a depressible frame carrying the wiping devices and which is lowered when required by the action of the solenoid.

885,338. ARC LAMP; Johannes Härden, Schenectady, N. Y. App. filed Dec. 12, 1903. In an alternating-current arc lamp having one electrode, which is freely depressible, the patentee provides a protecting hood for the combustible electro, so as to prevent its too rapid burning away in the atmosphere.

885,345. ELECTRIC SWITCH; Benjamin Hughes, of Montreal, and Herbert Noel Young, Rockfield, Quebec, Canada. App. filed Oct. 1, 1904. A complete track switch making use of magnets on the car which selectively attract amatures constituting a circuit controller and which act to selectively energize solenoids which move the switch point through a reciprocating plunger.

885,348. TELEPHONE-HOOK SWITCH; Herbert L. Knight, Cleveland, Ohio. App. filed April 13, 1906. Mechanical details of hook switch for desk telephones.

885,367. RAILWAY SIGNAL AND TELEPHONE SYSTEM; Frederick L. Odenbach, Cleveland, Ohio. App. filed July 10, 1907. In a railway signal system, the combination with a track rail, a line conductor, and a train unit provided with an electric generator, of a rotatable switch upon said train unit adapted to alternate the connection of said line conductor between said generator and said track rail and an electric signal device connected between said track rail and said generator, substantially as set forth.

885,368. ICE-CLEANER FOR TROLLEY POLES; Jacob M. Olinger, Springfield, Ohio. App. filed Nov. 23, 1906. In place of the usual trolley wheel, the patentee fixes a Y-shaped casting to the trolley pole and which has edges constituting cutters to scrape the ice off of the wire.

885,394. APPARATUS FOR CONVERTING DIRECT CURRENT INTO ALTERNATING CURRENT; Frederick F. Strong, Boston, Mass. App. filed Feb. 16, 1906. A revolving commutator appliance adapted to perodically cut resistance into and out of a circuit and reverse the polarity thereof, so that the direct current is transformed into approximately a true sinusoidal wave.

885,400. ELECTRIC ARC LAMP FOR ALTERNATING CURRENTS; Geza Szuk and Wenzel Hackl, of Budapest, Austria-Hungary. App. filed Feb. 24, 1904. Arc lamps designed for alternating currents in which a magnet coil is used for controlling the separation and feed of the carbons by means of an armature formed by a ring movable in the field of force of said magnet coil and connected with a clutch mechanism acting upon the upper carbon.

885,430. THERMO-ELECTRIC COUPLE; William H. Bristol, New York, N. Y. App. filed Dec. 27, 1907. A thermo-electric couple, the two elements of which consist of graphite.

885,446. CONTROLLER; Arthur T. Crocker, Schenectady, N. Y. App. filed Aug. 1, 1906. The master controller has a movable member which is preferably operated by means of a main solenoid, controlled in such a manner that the master controller may be operated step by step in either direction or be caused to return quickly to the off position at the will of the operator.

885,476. MOTOR CONTROLLING SYSTEM; Arthur E. Hogrebe and Victor O. Strobel, Philadelphia, Pa. App. filed Jan. 14, 1907. A controlling system for motors requiring to be frequently started and stopped and reversed, as, for instance, where a metal planer is operated by a reversing motor automatically controlled by the planer dogs to produce a slow cutting travel and fast backing travel for the table. The device can be applied to an ordinary planing machine.

885,519. ELECTRIC SIGNAL; John Rebar, Smithdale, Pa. App. filed Nov. 11, 1907. Electric signaling system for railway trains designed to provide a simple and inexpensive device whereby the engineer may be communicated with from convenient points throughout the length of the train. Has resiliently supported contacts carried by the car couplers and having a wiping frictional contact with one another.

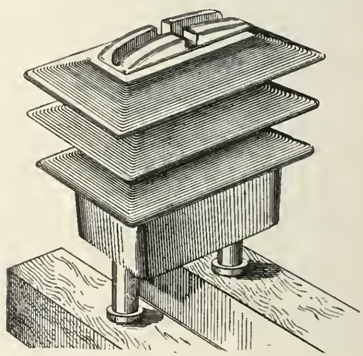
885,545. TELEGRAPH SOUNDER; James J. Thomas, Whiting, Iowa, and Albert G. Christopherson, Scribner, Neb. App. filed Jan. 23, 1907. The patentee has a pivotally mounted electromagnet the poles of which move toward and from the fixed poles of a permanent magnet. Is intended to be more sensitive than the present type of sounder.

885,562. SECONDARY BATTERY; William A. F. Alt, Brooklyn, N. Y. App. filed April 1, 1907. In a secondary battery, a plate of one sign, and a plurality of plates of the opposite sign, the aggregate area of said plurality of plates being substantially equal to the area of the single plate, means insulating the plates one from another, contact means carried by the plurality of plates adapted to engage like means, and means for separating the contact means.

885,622. PROCESS FOR OBTAINING PURE COPPER; Lucien Jumau, Paris, France. App. filed May 31, 1906. The herein-described process for obtaining pure copper from a solution containing salts of copper, which consists in treating said solution with a sulfite for producing a precipitate containing cuprous sulfite, and treating said cuprous sulfite with an acid to reduce a portion thereof to metallic copper.

885,631. HOUSING FOR ELECTRIC ALARM MECHANISM; James Blount Mayberry, Houston, Tex. App. filed Aug. 13, 1907. A semaphore signal for use on railways, making use of a housing containing batteries and alarm bells and designed to display an indication when a switch is thrown.

885,678. INSULATOR FOR HEAVY CURRENTS; Louis Steinberger, New York, N. Y. App. filed Jan. 26, 1906. In place of a single supporting pin for the insulator, the patentee makes use of a form having two supporting pins spaced apart in the direction of the line of strain of the conductor.



885,678.—Insulator for Heavy Currents.

885,688. RELAY; Archibald S. Cubitt, Schenectady, N. Y. App. filed Aug. 24, 1907. Relay having current carrying coil and a core movable in the magnetic field thereof, and a frame serving as a path for the flux and as a magnetic shunt around said core. Includes means for varying the reluctance of the shunt path.

12,782. ELECTRIC HEATER; Moise Landry, San Francisco, Cal. App. filed Jan. 20, 1908. An electric heater comprising two parts hinged together and having an asbestos covering on their inner surface, and a high resistance wire arranged to lie between said coverings when the parts are closed.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, MAY 9, 1908. No. 19.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.
239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office..............................590 Old Colony Building
Cleveland Office..............................1015 Schofield Building
Philadelphia Office.......................Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico........................per year, $3.00
Dominion of Canada..4.50
Other Foreign Countries within the Postal Union...................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,750 copies are printed.*

NEW YORK, SATURDAY, MAY 9, 1908.

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The General Electric Report.

We give elsewhere an abstract of the figures of the annual report of the General Electric Company, received as we go to press. This sixteenth report is, all things considered, a most encouraging document, for it shows the company to have weathered the fierce storm of last October with a success in notable contrast to the disasters in which it became involved during the bad times of 1893-7. The statistics of business done are impressive—orders of $59,000,000; sales billed of over $70,000,000; earnings of over $72,000,000. Moreover, as against obligations of $80,000,000 in stock and debentures, the company shows firm assets of $98,000,000, with patents, franchises and good will valued at one dollar. It is interesting to note that sales have gained over 19 per cent annually for 10 years past. Hence, while they may not do so this "off" year, there is no reason to doubt that the rate will be maintained, although it becomes, of course, increasingly more difficult as the vast totals grow. In this connection it may be noted that the company holds its own, for the general growth of electrical business of all kinds throughout the country seems to have averaged 15 to 20 per cent annually for the last two decades. The variety of product and the increasing size of units are emphasized in this report, so commendable in its fulness and frankness of statement, and we cannot but congratulate the management upon the record of these results achieved under such conditions as have lately darkened the skies of all American industries.

* * *

Instruments and Methods of Radiometry.

The last number of the *Bulletin* of the Bureau of Standards contains an extended paper on a comparative study of the different instruments employed in the measurement of radiant energy. There are five such instruments, all but one electrical or involving electricity, namely, the microradiometer, the radiomicrometer, the radiometer, the thermopile and the bolometer. The microradiometer is virtually a differential air-thermometer, with a small tube connecting two large air-bulbs, one of which is exposed to the radiation examined. The connecting tube contains a drop of mercury and columns of zinc sulphate solution. A Wheatstone bridge balance of the resistance in these columns enables minute displacements of air to be determined. This instrument is, however, regarded as the least sensitive of all. The radiomicrometer consists of a single delicately suspended loop of wire forming a closed D'Arsonval galvanometer coil, and containing two thermo-electric junctions, one of which is exposed to the observed radiation. Temperature elevations of one millionth of one degree Centigrade, or even less, can, it is said, be detected by this instrument. The radiometer was devised by Crookes and has been developed in recent researches. It consists essentially of a pair of small vanes suspended by a quartz fiber in a vessel containing gas at a low pressure. One of the vanes being exposed to radiation, tends to rotate the suspended system. A sensitiveness of one millionth of a degree is also claimed for this instrument, which is not electrical. The microthermopile is the best known of all the instruments used in measuring radiation, and was the earliest to be employed for that purpose. It requires a very sensitive galvanometer for its best work, and also responds to about one millionth of a degree. The bolometer consists essentially of a very thin strip of metal which changes its temperature when exposed to radiation, and, by a correspondingly small change in resistance, enables the change in temperature to be rendered evident. A sensitiveness of a millionth of a degree is also claimed for this instrument.

It is pointed out that the degree of sensibility that can be reached, in practice, for each of the four instruments is about the same, and requires great care to elicit. It is, of course, only in astrophysical work that the highest degree of sensitiveness is called for. Interest is lent to the subject of comparative sensitiveness of radiomicrometers from the fact that in wireless telegraphy it is radiation that is received at the distant station. It is believed that radiation differs only from the ordinary thermal radiation in respect to wave length, the wave of long-distance wireless telegraphy radiation being usually measured in hectometers or kilometers, while the wave of thermal radiation is measured in microns. Thermal radiation also varies its electromagnetic axes with respect to the direction of propagation, and is rhythmically sustained, whereas wireless telegraphy radiation keeps the magnetic axis parallel to the horizon and the electric axis vertical thereto, besides usually employing heavily damped, or rapidly decaying, wave-trains. But if we plane-polarise the thermal radiation, as is not difficult, and if we maintain sustained oscillations at the transmitting mast, which is now possible, these differences disappear. The length of the waves in wireless radiation give great advantage to the responsive apparatus, and the electric receivers, taken together with the receiving antennas, are already much more sensitive to incident radiation intensity than are the radiomicrometers of thermal energy measurements. This greater sensibility is not due to the instruments themselves, but to the fact that the great wave length makes large receiving conductors and conducting areas possible, which accumulate their effects and discharge the accumulated incident energy into the receiving instrument.

The Stockholder's Opportunity.

We have already commented more than once on the brilliant and energetic manner in which the Westinghouse interests have been righted since the October storm of financial panic, and restored to the hands of the stockholders. Such results warrant thoroughgoing optimism and belief that the process will now be carried along until the whole situation has been cleaned up, and proofs given of the entire restoration of confidence as to the future of the great industries that have taken the name of Westinghouse and the prestige of American industrial skill around the world. Note is made elsewhere in this issue of the appeal to the stockholders of the Westinghouse Electric & Manufacturing Company to support the proposed financial policy by which it is to be completely rehabilitated and provided with funds for its business, while avoiding the risks and losses of reorganization. The public has heard a good deal the last year or two about the moral responsibilities of corporations, but this higher sense of what is involved in financial relationships is broadening out to include the stockholder himself, whose duties surely are not ended when he becomes partner in an enterprise by merely putting some money into it. If it were his own business, he would prepare for and shoulder losses as well as gains, and would not expect vicariously to gather in nothing but profits. Recently in these stringent times we have seen great heads of corporations staggering under burdens of responsibility they did not assume voluntarily, and the staffs and executives submitting to ruthless cuts in salary while working harder than ever with gallant esprit de corps to "keep the property together" for the stockholders. There is an admonition for the stockholder in this, and we trust most sincerely that the stockholders in the Westinghouse Electric—possibly some five thousand—will give evidence of their solidarity in this case. It is up to them to show how well worth while it is to keep a great profitable industrial institution intact, with its compacted organism and its traditions and good will. If they fail, the shock will be felt all along the line of electrical development. If they support the plan for which Mr. George Westinghouse, with justifiable personal pride ringing in every line, makes so strong an appeal, they will never, in our humble opinion, have any cause or reason to regret it.

The Belin System of Telephotography.

A new method of reproducing pictures at a distance by electric currents over a connecting telegraph wire has recently been discussed in telegraphic and photographic circles. The method has been devised by M. Edouard Belin, of Nancy, France. It depends upon the fact that a photographic film of bichromate gelatin loses its power of swelling in water after it has been exposed to actinic light. Such a photographic film, after being exposed, developed and fixed, presents a rugged surface or variable contour, the ridges or salient points, which have swollen most, corresponding to the darkest portions of the picture, and the valleys or deepest points being those which have received the brightest lights. The photographic print is mounted on a revolving drum at the sending station, and a stylus rides on its surface like the pin of a phonograph. The up and down movement of the stylus as it rides across the ridges and valleys, corresponding to the light and dark streaks of the picture, are mechanically magnified and serve to operate a small but effective rheostat so as to modify the current in the line circuit. At the receiving end of the line is a synchronously driven cylinder. A small but strong beam of light falls on this revolving drum and produces a controlled photographic action on the sensitized drum surface. The variations in line current produce corresponding variations in luminous intensity in a rather ingenious manner. Each of the two cylinders makes about 18 revolutions per minute, and the pitch of the helical thread is 1/6th of a millimeter. Consequently a strip 3 mm wide will be reproduced in each minute. A picture 9 x 12 cms is said to occupy about 30 minutes in transmission.

Up to the present time the apparatus is only described as having been tried either on short lines or on artificial lines. Nevertheless, it is to be hoped that the apparatus will be developed so as to be capable of operation on actual lines of ordinary length, if only to show what can be accomplished in the art of accurate telephotographic reproduction. It is of course no novelty at this date to reproduce pictures in some manner over a telegraph line. There have been, in fact, a number of such telepictorial methods suggested and tried at different times during the last 60 years, the efforts of one inventor after another having come to fruition and to record apparently without attaining commercial application. Two distinct types of operation have been employed, namely, electromagnetic and electrochemical. In both methods the receiving pen has operated in synchronism with the transmitting pen. Selenium transmitters and contact-makers, mechanical, chemical and electrochemical, have all been tried at the sending station. So far as we are aware, however, the up-and-down motion of a stylus upon photographically indented paper has not been brought out before. The reason that none of the preceding methods of facsimile teleprinting has come into use is that there has not been sufficient demand for the operation of telereproduction of pictures to make the effort worth while. Any such method naturally involves skilled manipulation, and in the past there has been no demand for the commodity sufficient to overcome its cost in expert service and in telegraph line toll. There are many other possibilities in this category. For example, it has been demonstrated many times that it is quite practicable to communicate with moving railroad trains by means of electromagnetic induction from neighboring telegraph wires suspended in the ordinary way, near to and along the railroad line, but the method seems never to have come into commercial use, because it does not pay to employ a special operator on board a train when a telegram can always be forwarded from the next stopping place.

On Catalogue Engineering.

This is a plea for progress in the face of certain tendencies that are becoming rather obvious in electrical and mechanical engineering. Progress is made not by drowsy acquiescence in the order of accepted "standards," but by keen initiative in improvements that later may develop or rather crystallize into new "standards." If one with an archeological turn of mind digs down into the electrical field he finds successive strata of abandoned standards overlayed one upon another like the deserted cities of Asia Minor. In its earlier history each of those cities represented active, vital growth and achievement; in its later, stagnation, decadence and oblivion. The bane of engineering at the present moment is a certain slavish conservatism that asks concerning every new plan or device not "Is it good?" but "Has it been long in use?" or has some distinguished engineering firm taken it up as standard practice? The present tendency in this country, despite much enterprise in construction, is toward an easy-going acceptance of what some other fellow has done, irrespective of whether it is the best thing for the purpose in hand or not. Considering the number of really able and well-trained engineers in our country, such a situation is both curious and deplorable.

It has been produced by the combination of various influences, many of them good in themselves but evil in combination. There is, along large lines, very little competition in this country, and, therefore, a very strong tendency to adhere to canonical methods of practice and take the resulting profits. And as might be expected, only part of the product is wholly satisfactory. American manufacturers have always been able and willing to turn out in certain lines the best product in the world. To-day American apparatus of particular kinds is sought all over the world and recognized as the very best obtainable. Yet in other things, American practice is stumbling along at the wrong end of the procession. It is the failure to appreciate this situation that leads to bad engineering. An elaborately built and thoroughly operated plant is not necessarily an example of good engineering. On the contrary, if the results cost half as much again as they ought, the engineering has been most emphatically bad, and it becomes time for the man who pays the bills to wake up and take notice. The "catalogue engineer" finds it very easy and impressive to lay out a plant from the blue-prints of one located elsewhere and to fill it up with all the necessary and unnecessary apparatus that he finds recommended in the catalogues. The ensemble, so to speak, is dignified and impressive, and the catalogue engineer finds plenty of people ready to pat him on the back and commend him for his sound and conservative methods. It never dawns upon him that he has been remiss in his duty to his clients if he has led them into heavy, needless expenditures and has given them a plant unsuitable for their purposes, however good in itself.

To give the catalogue engineer his due, he is often tempted into his bad habits by the implied attitude of his clients. It is a fact that many a plant has gone into useless and foolish extravangance for the purpose of impressing the bondholders. Some so-called engineers are chiefly promoters and look to promotion for their real profits; and some promoters want the funds put where they will make a brave showing. For these cases, catalogue engineering fills the bill most admirably. Our outcry against it is due to its pernicious influence on the art, by the suppression of all independent improvements. Now, some of the best talent in the country is engaged in manufacturing; and, first and last, improvements are many, but they are too often suspended for purely commercial reasons. Many examples of this will occur to anyone who is familiar with the progress of events, and there will be many more in the future. There is evidence too of an active element bent on steering popular enthusiasm away from radical changes into the safer and more profitable lines of canonical practice. If any evidence were required, we need only point to the code of ethics suggested for the American Institute of Electrical Engineers with its attempt to check individual initiative in favor of so-called standard practice, and to certain resolutions at the Washington National Electric Light Association convention, which we criticized at the time.

Fortunately, American initiative cannot be easily held in check, and there are always many who push forward and get results. To them we need not speak, but rather to those who fall only too easily under the spell of circumstances and wait for somebody in due season to promulgate new standards. It is for them a game of bowls and a deep potation with Hendrick and his crew in the sleepy hollow of the hills; and then the first they know they will wake out of their over-long naps to find themselves years behind the times. It is to the potential Rip Van Winkles that we would pass up the advice to quit their easy-going ways and get down to the hard work that is needed to keep one at the front in these "strenuous" days.

Annual Meeting of the A. I. E. E.

The annual meeting of the American Institute of Electrical Engineers, at which reports of all officers and of the standing committees will be presented, and the vote for officers for the ensuing year will be announced, will be held in the Engineering Societies Building, New York, on May 19, 1908. In addition to the above reports, two papers relating to lightning will be presented. Mr. J. F. Vaughan will read a paper entitled "Comparative Tests of Lightning Protection Devices on the Taylor Falls System." A paper by Mr. N. J. Neall will describe "Studies in Lightning Performance, Season of 1907."

The annual convention of the institute will be held at Atlantic City from June 29 to July 2.

Exhibits at Marseilles Exposition.

The General Electric Company is well represented at the Marseilles International Exposition of Electricity just opened. It has made through the Compagnie Française Thomson-Houston, of Paris, a fine display of railroad equipment and high transmission apparatus. The transmission of electricity for great distances across the country, the electrification of steam railroads and the development of new and better trolley roads are of great interest in the French engineering world to-day. The General Electric Company exhibit is largely historical. The development of the trolley equipment from the time of its inception, 25 years ago, to the latest single-phase equipment is shown. The very latest developments in high tension transmission is also on exhibition.

Besides these important features the company exhibits such devices as the new mercury arc rectifiers, rheostats, motors, lightning arresters and a large number of photographs of the Schenectady, Lynn and Pittsfield plants showing interior views of the great shops.

The Brooklyn Edison Company and the Tungsten Lamp.

The Edison Illuminating Company, of Brooklyn, has decided on the policy it will pursue with reference to the tungsten lamp and has issued a circular calling the attention of its patrons to the lamp and the benefits to be derived from its use.

The company states that on account of the new methods of manufacture of these lamps and the limited quantity in which they can be produced at present, the prices are necessarily high and that it is manifestly impossible for it to furnish them upon the same basis as the carbon lamps. The policy of the company, however, is to furnish such special lamps at cost, after an allowance covering the present cost of the carbon lamps furnished without charge to free renewal customers. In this way the customer will secure all the benefit of the economy of the new lamps.

The 50-watt, 25-cp tantalum lamp has been furnished to free-renewal customers of this company at an extra charge of 35 cents each. This lamp, as also the 40-watt tantalum lamp, will be supplied hereafter to free-renewal customers at 25 cents, subject to the return of the burned-out lamps. The following special prices have also been fixed for the several types of tungsten lamps to free-renewal customers, all subject to the return of the burned-out lamps: 40-watt, 32-cp, $1; 60-watt, 48-cp, $1.25, and 100-watt 80-cp, $1.50.

To customers who are not entitled to free-carbon renewals the tantalum and tungsten lamps are supplied at 15 and 25 cents, respectively, in excess of the above prices.

In order that as much publicity as possible might be given to the announcement the Edison company entertained the electrical contractors of Brooklyn at its club rooms, where representatives explained the situation to the contractors and demonstrated to them the immense possibilities of the tungsten lamp for securing business hitherto unattainable, especially in the gas field. The company's relations with the electrical contractors are very harmonious, and it is expected that with the information concerning the lamp given to the contractors an energetic campaign against the so-called gas-arc lamp will be waged. The Edison company is endeavoring to secure as large a supply of the new lamps as possible, and will fill the orders of its patrons as received, subject to its ability to obtain the lamps from the manufacturers.

Progress in Elevator Practice.

The 276th meeting of the New York Electrical Society was held in the United Engineering Societies Building, at 29 West Thirty-ninth Street, on Wednesday evening, April 29. Mr. W. N. Dickinson, Jr., manager foreign department, Otis Elevator Company, lectured on "Modern Progress in Elevator Practice."

The lecture was arranged with a view to illustrating the pronounced tendency toward the operation of elevators from electric circuits, the degree of perfection which has been attained in direct-current elevators, and the outlook for the duplication on alternating-current circuits of all classes of service now possible on direct-current circuits. With an introduction read from manuscript, something over 120 photographs were shown on the screen; the dissertation during the showing of the photographs being extemporaneous. It was evident that the lecture had been logically arranged to bring out the points as outlined, but apparently his abundance of matter caused him to give a large part of the evening before reaching the alternating-current section, in which branch of the subject the main part of the audience was manifestly interested. The society is endeavoring to have this excellent address prepared in such form that it may be published. It is to be hoped that this will be done.

After establishing the fact that any elevator service yet demanded is now possible with direct-current machines, it was shown that similar service, except that required for high office buildings in the direct-current section of the large cities, could be accomplished with polyphase alternating-current machines, simple and neat in appearance and presumably satisfactory in operation. Two hundred and fifty feet per minute, with a load of 2500 lb., was the highest speed installation mentioned, but it was indicated that higher speeds could even now be taken care of by complicating the control, and there is, of course, no limit with respect to load at low speeds. In single-phase operation it would seem that machines now installed have been confined to the smaller sizes, but the photographs of single-phase controllers showed quite as simple apparatus as for polyphase control.

Data of the Trolley in Germany.

The latest statistics available for the trolley in Germany are those of 1907. The German Ministry of Public Works has recently issued street railway statistics covering the Empire for that year ending March 31. The number of undertakings was 235, an increase of 10, while the length of all the lines was 3745.6 kilometers (2332.3 miles), an increase of 213.8 kilometers (132.5 miles), or 6.05 per cent. The total number of cars in Prussia was 11,918, equivalent to seating and standing room for 390,630 passengers; the corresponding figures for the rest of Germany were 5152 and 160,427.

In Prussia 32.5 per cent of the lines are of 1.435 meters (4 ft. 8½ in.) gage, 61.1 per cent of meter (3 ft. 3 in.) gage and the remainder are of less gage; in the rest of Germany the corresponding percentages are 10.3 per cent, 64.7 per cent and 25 per cent. Of the street railways which have not yet been electrified 17 are operated wholly or in part by steam locomotives, 27 by horses and eight by cable. Most of these lines are only one to two miles long, but there is one line in Magdeburg 14.15 kilometers (8.7 miles), which also is unique in using oxen as well as horses for motive power. Seventy-two railways handle both freight and passengers, 149 are for passengers exclusively and four only for freight.

There were 47,667 permanent employees, equal to 13 per kilometer (eight per mile), in Prussia and 13.9 kilometer (8.6 per mile) in the rest of the Empire.

Carnival at Manila, P. I.

Every year a grand carnival is held in the city of Manila, Philippine Islands, which lasts several days. During the carnival practically all business ceases and everyone devotes himself to entertaining and to being entertained. A monster parade is held, in which are many floats. The accompanying illustration shows the float of the Manila Electric Railroad & Light Company. This was called "Electra, Queen of Light." The float shows the world among the clouds with the sun in the background and lightning flashes proceeding out of the clouds. Seated on top of the world is "Electra," while among the clouds are other symbolic figures. The design displays much ingenuity and was the feature of the parade.

FLOAT "ELECTRA, QUEEN OF LIGHT."

Electric Projects in Italy.

A bill recently introduced into the Italian Parliament provides for an extensive plan of new railway construction. The most important of the proposed lines are those from Rome to Naples, from Bologna to Florence and from Genoa to Milan. It is stated that these lines are intended for fast-passenger traffic and that electric energy, in all probability, will be used in the operation of all of them. They will be double lines and will follow the shortest routes. The entire length of the lines to be built will be about 1000 miles and the capital involved will be more than $100,000,000. The bill also provides for better facilities for tramway and motor car lines, in the shape of increased subsidies to private enterprises. Despatches from Rome state that the measure will be passed by a great majority. Another government project deals with drainage works and improvements in the Pontine marshes, which will cost about $2,000,000. When the drainage works have been completed, it is expected the soil will be found to be most fertile, and that a certain amount of hydro-electric power will be available.

Knudsen Wireless Inventions in Europe.

According to a special cable dispatch from London, of April 28, some very sensational "stunts" with the wireless are being attempted by Mr. Knudsen. The exact utility is not quite apparent, but the story is nevertheless interesting. The message says: "That he has already perfected an invention by which he can set type in an ordinary linotype machine in Paris by wireless waves thrown from London was the surprising statement made at the Hotel Cecil to-night by Hans Knudsen, the Danish inventor, famous for his achievements with liquid air, after giving the first public demonstration of long-distance wireless photography. "I shall publicly demonstrate my new wireless typesetting invention within a few weeks," said Mr. Knudsen. "I have already had the first machine constructed, and it has proved successful, setting 3000 words an hour, at a distance, just as if the operator were working the machine. The time is not far distant when, with my invention, the London correspondents of the New York newspapers will be able to send their news straight to the printing press through the Marconi operator."

In the course of his demonstration of wireless photography Mr. Knudsen to-night sent photographs of the king, queen and kaiser from one room in the hotel through the wall into another without wires, the pictures proving recognizable. He had constructed in the first room a transmitter with a needle point passing over a picture prepared on a glass plate from a photograph. The needle continually vibrated over the plate, according to the roughness or smoothness of the surface. A succession of electric waves was accurately recorded by a plate on the wall. These waves were in turn caught by another receiving plate in the adjoining room after passing through the wall, the picture being again accurately recorded by the receiving instrument on a smoked glass plate. From this plate recognizable photographs were printed on sensitized paper.

"I claim I can send pictures wherever Marconi can send messages," said Mr. Knudsen. "Within a short time I shall be sending pictures of criminals and finger prints from England to New York."

Annual Report of the General Electric.

The annual report of the General Electric Company has just been issued, and is on the whole a most satisfactory document from whatever point of view it is regarded. The sales billed for the year ending Jan. 31 were $70,977,168 as compared with $60,071,883 in 1906; and the orders were $59,301,040 as compared with $60,483,659, the slight falling off in orders being due, of course, to the financial panic of last October. During the past 10 years, the sales billed have increased annually about 19.8 per cent, and in 1907 were 18.2 per cent over the previous year. While the orders in the last six months fell off 23 per cent, they had gained 22 per cent during the first six months, which gives a crisp idea of the sharp industrial change. The report of President Coffin shows that the gross profits for the year were $6,586,653, after writing off $3,745,989 for factory depreciation, etc. Dividends were paid to the amount of $5,183,614, and $1,403,039 was carried to surplus account, making a total surplus at the end of the fiscal year of $16,513,836 The total receipts for the year were $72,484,988. Mr. Coffin says: "Late in the year there was a sudden and severe shrinkage in the value of all merchandise and materials used by your company, notably copper. All said materials, whether raw, manufactured, or in process of manufacture, which were on hand Jan. 31, 1908, were inventoried at the lower prices then prevailing. The book value of such inventories was thereby reduced by about $2,000,000. In valuing the notes and accounts receivable, in amount the largest in your company's history, great care has been exercised and liberal reserves have been established to provide for possible losses thereon. These reserves, and allowances for depreciation of factory plants, and the shrinkage in inventory values have greatly reduced the profits of your company. As a result the amount in excess of dividends upon the share capital, which is carried forward to surplus account is relatively small."

The various securities owned by the company after a careful revaluation are carried at $18,000,089, but this does not include $2,701,975 in copper properties. The factories are carried at a valuation of $12,900,000, or only $2 per square foot of floor space, inclusive of land and equipment. Patents are carried at $1. Cash in hand was $12,250,720 and there was $20,857,726 in notes and accounts receivable. Merchandise inventories and work in hand total up $22,273,349. On the other hand accounts payable were only $1,759,517. The capital stock issued is $65,167,400, and there are not quite $15,000,000 of gold debentures out. Interesting reports are given in detail as to features of the work by Mr. E. W. Rice, Jr., vice-president, and Mr. H. W. Darling, treasurer.

Albany Meeting of the American Electrochemical Society.

The thirteenth general meeting of the American Electrochemical Society was held in Albany, Schenectady and Troy on April 30 and May 1 and 2. The general headquarters were at the Hotel Ten Eyck in Albany, where the three sessions on the morning, afternoon and evening of Thursday, April 30, were held. The session of Friday morning was held at Union University, Schenectady, and after a lunch tendered by the General Electric Company, the whole afternoon was devoted to an inspection of its works. An informal dinner in the evening united the whole party at the Ten Eyck. The session of Saturday morning was held at the Rensselaer Polytechnic Institute in Troy, and after lunch at the Rensselaer Inn various visits were paid by different parties to points of interest in and near Troy, the chief attractions being the Watervliet Arsenal, the Duncan paper mill of the West Virginia Pulp & Paper Company at Mechanicville (where the Hargreaves-Bird electrolytic chlorine plant for the preparation of bleaching liquor was shown in actual operation), the Earl & Wilson linen factories, the Burden Iron Works, and Gurley's factory for making scientific instruments.

With respect to the interest and value of the papers presented the meeting was as successful as any previous one held by the society, while the social functions and excursions were very enjoyable. The number of members and guests registered was 151.

At the business meeting the result of the election of officers was announced. Mr. E. G. Acheson, of Niagara Falls, is the new president. Messrs. C. A. Doremus, C. P. Townsend and W. R. Whitney were elected vice-presidents; Messrs. F. A. J. Fitzgerald, A. von Isakovics and S. A. Tucker, managers; Mr. T. G. Salom, treasurer, and Dr. J. W. Richards, secretary. The number of members is now 715.

The Pacific Coast Borax Company offers a prize of $500 for a process of making ferroboron from borate of lime, the prize to be awarded by the board of directors of the society.

Director Stratton, of the Bureau of Standards, communicated to the society a request to appoint a committee on units and standards to co-operate with committees of the American Institute of Electrical Engineers and the American Physical Society. The object of the Bureau of Standards is to get an expression of American opinion in regard to the questions to be taken up by the next International Congress on Electrical Units. An abstract of a paper presented in this connection by Dr. Frank A. Wolff, of the bureau (as well as an abstract of another paper by Dr. Wolff on the Weston cell) will be found below. In compliance with this suggestion a committee, consisting of the following gentlemen, was appointed: Mr. Carl Hering, chairman; Dr. Theo. W. Richards, Dr. H. T. Barnes and Dr. Edward Weston.

In the following we give abstracts of some of the papers presented at the meeting:

RESISTORS OF HIGH RESISTANCE.

The first paper of the Thursday session was presented by Dr. Howard L. Bronson on the construction and accurate measurements of resistors having resistance of the order of 100,000 megohms. In the study of radioactivity and kindred subjects it is important to measure instantaneously ionization currents varying from 10^{-15} amp up to currents which can be measured with a sensitive galvanometer. Further, the apparatus should be capable of a considerable range of measurement without serious readjustment. This is possible with Rutherford's "constant deflection method," but its application requires the use of resistor of permanent high resistance of the order of 10^{11} ohms.

The author uses for this purpose an ebonite vessel filled with an ionized gas, with aluminum electrodes. About 0.1 milligram of radium bromide is the active material which produces ionization. In general it is possible so to adjust the distance between the aluminum plates that for a considerable range of potential a linear relation exists between the ionization current in the vessel and the potential difference between the plates, or in other words, that the resistance is constant. Nevertheless it is necessary to get a calibration curve for every such vessel.

The author suggests the possibility of making standard vessels of this type and preserving them as permanent high resistance standards. They would have a much higher resistance than any of the usual standards and ought to remain constant in resistance over a long period. They would be found very useful for insulation testing or any very high resistance measurements. The paper was briefly discussed by Messrs. Wolff, Hering and Bancroft.

PRESIDENT E. G. ACHESON.

ABSORPTION OF RADIOACTIVE EMANATIONS.

A paper by Dr. R. W. Boyle gave an account of an experimental investigation of the absorption of the radioactive emanations by cocoanut charcoal at temperatures varying from very low values up to about 200 deg. C. The chief object was to compare radioactive emanations in this respect with ordinary gases, the absorption of which by charcoal at low temperatures was studied by Dewar. The chief result is that in this respect, as in others, radioactive emanations behave just like ordinary gases.

TEMPERATURE-E.M.F. COEFFICIENT OF WESTON CELL.

Dr. Frank A. Wolff, of the Bureau of Standards, gave a preliminary report on some observations on the temperature coefficient of the e.m.f. of the Weston cell between 0 and 40 deg. C. Measurements were made for every five degrees, and in each case a complete cycle was carried out, passing, for instance, from 5 deg. C. down to 0 deg., maintaining the cell at this temperature for about two days and then returning to 5 deg.

The most interesting observation made was to the effect that some cells exhibited very considerable hysteresis, especially those with abnormal initial values and also cells which were normal initially, but subsequently developed irregularities.

The following new approximate formula for the change of the e.m.f. e_t of the Weston cell at the temperature t degrees C. in volts with varying temperature was determined:

$$e_t = e_{20} - 0.00004\ (t-20) - 0.0000009\ (t-20)^2 + 0.000000009\ (t-20)^3$$

It was found necessary to use a third term in this equation, while the usual formula contains only two terms. According to the above formula the e.m.f. has a maximum within the region between 0 and 5 deg. C., while this is not the case according to the usual formula. It is interesting to note that the maximum solubility of cadmium sulphate lies within the same region of temperature and that the portable cells of the Weston type are saturated at the same temperature.

The paper was discussed by Messrs Carhart, Hering and Lidbury. In reply to a question by Professor Carhart, Dr. Wolff stated that in the temperature cycle to which the cells were subjected, those which showed hysteresis showed greater deviations from the normal values in the descending branch of the temperature cycle than in the ascending branch.

Dr. Carhart expressed the opinion that hysteresis is due to the size of the cadmium sulphate and to delay of diffusion. According to Dr. Carhart, mercurous sulphate when chemically precipitated gives better results than where electrolytically prepared. On the other hand, Dr. Wolff stated that the size of the grains of the cadmium sulphate appears not to have any effect, and that the cause of hysteresis must be found in the paste limb. Further, according to Dr. Wolff, it does not matter whether the mercurous sulphate is electrolytically or chemically prepared; no real difference was found when the mercurous sulphate was made by six or seven different methods.

MERCURY CATHODES IN NITRIC ACID SOLUTION.

A paper by Mr. J. A. Wilkinson on this subject was presented briefly in abstract by Professor Bancroft. It referred to an alleged discrepancy claimed by Tafel to exist in this case between purely chemical and electrolytic action. It is shown that this discrepancy is only apparent and that complete parallelism exists between the two cases, if only the conditions, under which the two processes are carried out, are exactly the same. The rule appears to hold true generally that it is possible to get exactly the same products either by chemical or electrolytic action if the conditions of the experiment are exactly the same.

JOSEPH HENRY IN ALBANY.

Mr. Jas. F. McElroy spoke on the early work of Henry in Albany. Joseph Henry was born on Dec. 17, 1797. In 1826 he became instructor in mathematics in the Boys' Academy in Albany. On April 6, 1829, he described before the Albany Academy the construction of his new electromagnet, which was enormously superior to former designs. Formerly bare wire was used for the magnet windings. Henry employed cotton-covered wire and was thus enabled to use several layers of wire, so as to increase the magnetizing force enormously over former constructions.

Henry also clearly understood the difference between series and parallel connection of cells. This was of importance in his first installation of an electromagnetic telegraph system in the Boys' Academy. (Dr. Carhart remarked in the discussion that this was also the first case of electric energy transmission and that one essential requirement was clearly understood by Henry, namely, the advantages of a high voltage, which he obtained by series connections of the cells.)

In the spring of 1831, Henry discovered that the galvanometer which he had in series with his magnet windings showed a momentary current when the armature was suddenly removed from the electromagnet. Faraday followed with his corresponding fundamental discovery in the autumn of the same year.

Henry left Albany in 1832 to become professor at Princeton, and later director of the Smithsonian Institution.

In the discussion which followed Mr. McElroy's paper, Dr. Carhart related some incidents of the selection of the name henry for the unit of inductance at the International Electrical Congress in Chicago.

FUNDAMENTAL UNITS OF ELECTRICITY.

It was noted above that in connection with the appointment of a committee on units by the society at the request of the Bureau of Standards, a paper was presented by Dr. Frank A. Wolff, of the bureau, reviewing concisely the present situation.

An informal international conference which had been called by the German Reichsanstalt was held in October, 1905. This conference decided on three things: first, that there should be only two fundamental units; second, that the international ohm and the international ampere should be these two units; third, that the international volt should be defined by the ohm and the ampere. The conference rejected the recommendations of the Bureau of Standards and of Prof. Carhart, who advocated the adoption of the standard cell instead of the coulometer for the definition of the second fundamental unit.

Dr. Wolff pointed out, however, that this action of the conference can only be considered as preliminary, since the conference had not yet seen fit to draw up the necessary specifications.

It will be the duty of the next international congress to adopt definitely the two fundamental units and to formulate the specifications and agree upon the values to be used in the definitions.

There is universal agreement that the ohm should be one fundamental unit. The chief question is, therefore, whether the ampere or the volt should be the second fundamental unit. In deciding this question, three points are to be taken into consideration.

First, accuracy of reproduction. (*a*) As to the fundamental principle involved, the definition of the ampere is based on Faraday's law. But, while this law may be considered as absolutely true, the weight of the silver deposit may not agree exactly with the law on account of secondary reactions. On the other hand, the definition of the volt is based on an equally fundamental principle, though it has no generally accepted name; this principle states that the loss of energy of a galvanic battery equals the coulombs multiplied by $e - T\dfrac{de}{dT}$ where e is the e.m.f. in volts and T the absolute temperature (Gibbs-Helmholtz equation). With respect to the fundamental character of the principle on which the units ampere and volt are based, there is no preference of one unit over the other. (*b*) As to the purity of the materials to be employed in the reproduction of the units, it should be taken into consideration that the materials can be supplied by the national bureaus or laboratories. Hence, this point may be neglected. (*c*) As to the number of measurements required, the coulometer is at a great disadvantage compared with the standard cell. The cell automatically takes up its value.

Second, concreteness is the second point to be considered. There is no such thing in a silver coulometer. When a measurement has been made, there is nothing left but a silver deposit which is of no use for further measurements. The cell, on the other hand, is always ready for further measurements.

Third, ease of reproducibility is the third important factor and here the standard cell is again at a great advantage.

If the attribute of constancy of the standard cell would be established, then taking this together with its reproducibility, the volt seems even better than the ohm as to suitability for a fundamental unit.

The German law legalizes the ohm and the ampere, but on account of the fact that the Germans have used a particular value for the e.m.f. of the standard cell since 1898, the result is equivalent to legalizing that value in the first place.

While the accuracy of reproduction by different investigators has been satisfactorily established in the case of the cell, this has not been done in the case of the coulometer, for which only relative accuracy of reproducibility has been determined.

Although in the light of the present evidence, the adoption of the standard cell may be favored, yet the Bureau of Standards, in Washington, advocates a systematic international cooperation looking toward establishing the accuracy of reproduction of both the cell and the coulometer.

CORROSION OF IRON.

Prof. Charles F. Burgess' presidential address dealt in a very interesting way with "the corrosion of iron from the electrochemical standpoint." Prof. Burgess referred to the investigations of Whitney, Walker and Cushman on iron corrosion as an electrolytic phenomenon and discussed the corrosion of underground steel pipes by the stray return currents from tramways, as well as corrosion without any external source of current, and simply due to lack of homogeneity of the steel surface, which results in the formation of galvanic couples. The more electronegative the impurity in the iron, the greater is the latter effect.

A large part of Prof. Burgess' address dealt with the effects of strain on corrosion. After reviewing the very contradictory results obtained by former investigators, he described tests made by himself. Test bars were subjected to tension to a point just before rupture. The tension was then released and the surfaces ground down and polished. They were then subjected to corrosion, and it was found that the part which had been strained corroded to a much greater degree. This effect was very clearly shown by the lantern slides exhibited.

In the same way portions of test bars were subjected to torsion strains. The strained parts corroded eagerly, and the electrolytic nature of the corrosion manifested itself by the fact that the surface of the strained part acting as anode remained bright (though corrosion started here), while the unstrained part which acted as cathode was covered with gas bubbles, there being a sharp line of demarkation between the anode and cathode parts.

It is generally true that strained iron has a greater tendency to go into solution. For this reason boiler plates should be drilled, not punched. Mechanical strains weaken the metal and subject it to more corrosion along the lines of weakness. The corrosion moves in certain rays or lines according to the strain lines, as was clearly shown in some lantern slides. The strains produced in tempering steel also show up in corrosion.

Owing to space limitations abstracts of several papers are held over until next week.

CURRENT NEWS AND NOTES.

CANADIAN WIRELESS STATIONS.—U. S. Consul L. Edwin Dudley reports that two wireless telegraph stations have been established in the vicinity of Vancouver. One station is situated at North Vancouver just across Burrard Inlet. The other is at Point Gray, a peninsula, seven or eight miles distant. These stations promise to be of great service to the coastwise trade between Vancouver, Puget Sound ports and Alaska.

ENGINEERING AT RUTGERS.—At its recent session the Legislature of New Jersey appropriated $20,000 for furnishing and equipping the new engineering building which is being erected on the Neilson campus of Rutgers College. Robert H. C. Heck, professor of experimental engineering at Lehigh University, has accepted the chair of mechanical engineering at Rutgers, and will begin his work in the fall. It is expected that the new building will be completed in time for occupancy next year.

TRIESTE-MONFALCONE RAILWAY.—A single-phase railway is projected to extend from Trieste, Austria, to Monfalcone, a distance of 17 miles. A survey is being made for a further length of 13 miles. The trolley line will be of catenary construction on iron poles. The power station will contain three steam turbo-generators of 500 to 800 kw each. American manufacturers are invited to submit proposals for the construction of the railway or for any parts of its equipment. Dr. Gino Dompieri, civil and electrical engineer, of Trieste, will supply information in detail.

CONDITIONS IN KOREA.—A special cable dispatch from London of May 2 says: "Andrew McKinley, who arrived Tuesday with his wife after an 18-months' tour in the Philippines, China, Japan and Korea, told the New York *Times* correspondent that Americans were having a hard time in Korea. 'At Seoul,' said Mr. McKinley, 'the manager of the New York company owning the water, electric lighting and street railway concessions told me the Japanese had made things so hot for the company that it was going out of business this summer. The result will be that the Japanese will get the concessions. The Japanese are going on the principle that Korea is for the Japanese and are pushing out Americans, English and Germans with a high hand.'"

FATHER AND SON.—The brilliant versatility of the German Emperor is well known. The following cable dispatch from Berlin indicates that his eldest son is a chip of the old block: "The German Crown Prince bids fair to become even more eclectic in his occupations than his versatile father. In addition to his numerous other occupations the following are some of the subjects to which he devotes attention: Lectures by Professor Kammerer at the Charles Neuberg Technical School on elementary mechanics and hydraulic machinery; lectures by Professor Riedler on automobiles and carburetors; lectures by Professor Slaby on electro-technics and wireless telegraphy; lectures by Dr. Schlesinger on installation of factory machinery. Dr. Reichel is also giving the Prince private lessons on electrical water power and machinery, and Professor Fraz on the groundwork of building machinery."

THE TECHNICAL PUBLICITY ASSOCIATION at its annual meeting, April 30, 1908, elected the following officers to serve during the ensuing year: President, C. S. Redfield, advertising manager, Yale & Towne Manufacturing Company, N. Y.; first vice-president, Rodman Gilder, publicity manager, Crocker-Wheeler Company, Ampere, N. J.; second vice-president, C. N. Manfred, manager advertising department, H. W. Johns-Manville Company, N. Y.; secretary, H. H. Kress, publicity department, A. S. Cameron Steam Pump Works, New York; treasurer, H. M. Davis, advertising manager, Sprague Electric Company, New York; members of executive committee, F. H. Gale, Advertising Department, General Electric Company, Schenectady, N. Y., and C. W. Beaver, special representative, Yale & Towne Manufacturing Company, New York. Twenty new members have joined the association since the last annual meeting.

LOW RATES FOR LAFAYETTE, IND.—The city of LaFayette, Ind., has just closed a contract with the Merchants' Electric Light Association, for lighting the streets, alleys and public buildings for a period of 10 years. For the last 20 years the city has been paying $66 per lamp-year, for 2200 hours of lighting, with 6.6 ampere, direct-current, open arc lamps. Under the new contract, which goes into effect Sept. 1, 1908, the company will furnish and light 300 metallic flame arc lamps, 2500 hours for $37.98 per lamp-year, and extra lighting at one cent per lamp per hour. This will amount to a saving of about $100,000 to the city in 10 years. The engineering work, preparation of specifications and contracts, has been done by Mr. J. Walter Esterline, consulting engineer. After tests made at the Photometric Laboratories at Purdue University, the Westinghouse 4-amp, metallic-flame arc lamp was selected by the Board of Works.

NEW YORK FIRE ALARMS.—In the course of the investigation of the New York fire department before the commissioners of accounts, Superintendent Martin testified last week as to the extremely bad and dangerous condition of the circuits and boxes. Mr. Kempster B. Miller, of Chicago, who made an examination of the fire-alarm telegraph system at the instigation of the Board of Fire Underwriters, testified to the generally poor condition of the system, corroborating the testimony given by Superintendent Martin, and asserting that a slight accident might, at any minute, put the system out of business and seriously endanger millions of dollars' worth of property. He believed the telegraph system was the worst thing about the department at this time; that there ought to be twice as many alarm boxes as there are, and that they should all be of a modern type. He suggested a site in Central Park as the proper place for a new building to house the central station of the system.

ELECTRIC RAILWAYS IN PRUSSIA.—The railroad administration of Prussia has decided to change to a standard gage the existing railroads between Magdeburg and Leipsic and Halle and Leipsic, and to equip these routes electrically. The total distance is 100 miles.

NATURAL RESOURCES.—The convention of governors invited by President Roosevelt to consider the preservation of the natural resources of America will begin in Washington on May 13, being preceded on Tuesday evening by a dinner at the White House. On Wednesday the conference will be opened by the President in the East Room. There will be sessions also on Thursday and Friday. Among the addresses will be one by Mr Andrew Carnegie on the mineral resources of the country. Mr. J. J. Hill will also speak, and Mr. H. St. Clair Putnam will read a paper on waterpower.

N. E. L. A. SPECIAL TRAIN.—Mr. G. F. Porter, master of transportation of the National Electric Light Association, announces that a special train for Chicago will leave New York over the Pennsylvania system on Sunday morning, May 17, arriving in Chicago at 8:30 a. m. Monday. This convention special will be limited, and applications for berths should be sent in at once. The train will be lighted electrically, and will include observation and dining cars. Reservations should be made at once by addressing Mr. Porter at the association offices, 29 West Thirty-ninth Street, New York.

REMOTE CONTROL OF ELECTRIC TRUCK.—Advices from Omaha, Neb., state that Dr. Frederick H. Millener, working under the direction of Mr. W. R. McKeen, superintendent of motive power and machinery of the Union Pacific Railroad, has built an electrically-operated truck, the movements of which can be controlled from a distance. The control devices, which are selectively actuated, are not associated with the driving machinery of the truck which latter may receive energy from either an external or a self-contained source. It is stated that the principles of wireless telegraphy are applied in the circuits of the control devices.

NEW INDUSTRY AT NIAGARA.—The Niagara Pulp Board Company has begun operating its new plant in Niagara Falls. It is located on the former site of the Acker Process Company's plant, and the electrical energy is supplied by the Niagara Falls Hydraulic Power & Manufacturing Company. The product of the plant will be pulp board that is expected to supplant lumber in the manufacture of packing cases, thus assisting in the reserve of the timber supply of the country. The plant consists of four buildings having a floor space of 20,000 ft. The output will be 18 tons every 24 hours. It is understood that the pulp board will be cut in required sizes and then nailed by machines to wooden frames.

THE COUNCIL OF PROGRESS.—One of the latest features of the N. E. L. A. Convention in Chicago, May 19-20-21-22, is the Council of Progress which the Committee on the Commercial Day program are arranging for Friday morning's overflow session. At this Council of Progress several men of national repute will give short talks on commercial subjects. Elbert Hubbard, familiarly known as Fra Elbertus, the editor of the *Philistine* and the originator of the Roycroft shop, will speak. Mr. J. R. Morron, of the Diamond Glue Company, of Chicago, and Mr. George Macbeth, of the Macbeth-Evans Glass Company, have also been secured for this meeting. There will be others. All talks will be short and a very spirited and enthusiastic council is anticipated.

SNAKE RIVER POWER.—According to advices from Washington, after a conference on May 2 with Representative Jones, of the State of Washington, President Roosevelt wrote a letter to Chairman Burton, of the Rivers and Harbors Committee, advising that he would sign the bill for the construction of a dam on the Snake River provided certain amendments are made. The basis of the proposed compromise is that there shall be no charge and no limit of time upon water used for irrigation. If over 25 per cent of the water is used for power it shall be within the discretion of the Secretary of War to fix the charge to be paid the government. Discretion is also to be vested in the War Department to terminate the right to use water for power, after 50 years. This will be the President's position on all bills relating to the building of dams across navigable streams.

RAMSEY IN VIENNA.—A special cable dispatch from Europe of May 2 says: "Sir William Ramsey's recent visit to Vienna has confirmed the results obtained by the English workers and radium experimenters in the Vienna laboratory. Possessing two grammes of almost pure radium bromide and a gramme of impure material, they are able to speak with greater authority as to their results. They have found that a given weight of radium would raise the temperature of one and one-sixth times more than their weight of water from the freezing to the boiling point. Referring to the transmutation of metals, Sir William says: 'There are different orders of certainty. I am positive that radium emanation is transmuted into neon, and in respect to the change of copper to lithium and sodium I have been successful in my four experiments. If these are as they seem, the deduction is obvious; the transmutation of the elements is proved. At the moment I am attempting the degradation of silver, which is of the same family as copper.'"

TUNGSTEN CLUSTERS ON FLAT RATE.—The Commonwealth Edison Company, of Chicago, recently formulated a proposition designed to meet the needs of consumers who have formerly used gas arc lamps. The plan is to put out tungsten lamp clusters on a flat rate to be maintained and turned on and off by the company's patrolmen in the same manner as the large number of flat rate electric signs which the company now has in circuit scattered all over the city of Chicago. These clusters consist of four 60-watt, 48-cp tungsten lamps. Under a two-year contract the company will furnish, install and maintain clusters and lamps for $1.15 per week: lamps to be lighted from dusk until 10 p. m. six days of the week, and dusk until midnight one day of the week. Under another contract lamps will be lighted from dusk until midnight seven days per week for $1.50 per week. For clusters lighted from dusk until 1 a. m. seven days a week the rate is $1.75 per week. Special care has to be taken in delivering and maintaining lamps on these clusters. At present they are not delivered in the ordinary lamp wagon, but are taken in a suit case. The company's solicitors get an extra bonus for this class of work because of its long-hour character.

N. E. L. A. CONVENTION.—Most of the final arrangements have been completed for the National Electric Light Association convention, and the exhibition will open Monday evenning, May 18, at 8 o'clock. Owing to the reception at 9 o'clock on that evening in the Gold Room of the Annex, adjoining the Auditorium Hotel, it has been deemed advisable to make this a private view for Class "A" and Class "B" members, closing the exhibition on that day at 9 o'clock, thus assuring a good attendance for the exhibition without interfering with the reception. Engraved invitation cards will be placed among the papers handed to each delegate upon arriving. Arrangements have been made with a contracting firm to do additional wiring for the convenience of exhibitors. The exhibition committee reports that nearly all the available exhibition space has been taken. The color scheme decided upon is a combination of a peculiar shade of dark green, and white containing a tinge of green. The lettering of the sign boards will be in gold and aluminum. Additions to the list of those who will exhibit, which was printed in these columns on April 25, are the Studebaker Brothers Manufacturing Company, the German-American Electric Company, the Condit Electric Manufacturing Company and the Gregory Electric Company.

ENGINEERING BUILDING FOR U. OF N.—The board of regents of the University of Nebraska at a recent meeting authorized the erection of an engineering building to cost about $125,000.

A CORRECTION.—In the article by Mr. G. M. Dyott in the issue dated April 25, Figs. 8 and 9 should have their order changed. Fig. 9 is a reproduction of a photograph taken several minutes after the arc had started, and Fig. 8 represents the conditions at the instant of closing the circuit.

ELECTRICAL ENERGY.—According to a consular report a Hamburg joint stock company has purchased a large tract of land along the mouth of the River Elbe at Coxhaven, where works will be erected for the purpose of generating electrical energy from the ebb and flow of the tide. It is stated that the capacity of the plant will reach 14,000 horse-power.

INTERNATIONAL PATENT WORKING.—A special cable dispatch from Berlin of April 28 says: "It is understood here that the German government has taken the preliminary steps to negotiate a patent agreement with the United States. This action is in consequence of the prospect of federal legislation requiring foreign patentees to manufacture in the United States, otherwise their patents will be forfeited. The German law provides for forfeiture in the event of a patent remaining unused for three years if a German subject makes application to have it set aside."

ENERGY TRANSMISSION MACHINERY.—From eastern Europe an American consul reports that an officer of the local government wishes to obtain from American manufacturers full information in reference to machinery for the transmission of energy. In the region a river offers possibilities for developing a great amount of power, which at present is going to waste, and the local government wishes to utilize this power in developing manufacturing plants. If this plan is practical, it should result in the sale of a large amount of American machinery. Concerns interested can obtain the name and address of the consul mentioned by writing to the Bureau of Manufactures.

CIVIL SERVICE LABORATORY ASSISTANT.—The United States Civil Service Commission announces an examination on June 3, 1908, to secure eligibles from which to make certification to fill such vacancies as may occur in the positions of laboratory assistant in the Bureau of Standards, at salaries varying from $900 to $1,200 per annum. The duties in connection with these positions are identical with those of the assistants in the physical laboratories of scientific and technical institutions. As far as practicable, appointees are assigned to work in the subjects for which they are best fitted. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 1312. No application will be accepted unless properly executed and filed with the commission at Washington prior to May 23, 1908.

CHECKING TROLLEY ACCIDENTS.—It will hereafter be required that the New York City street-railway companies file with the Public Service Commission a complete statement of the number and kind of trucks used, the weight of the car, length, style of fender, brake, and numerous other details. The commission took formal action to this effect last week in an effort to reduce the number of accidents on street railways in Greater New York. Commissioner Maltbie, who presented the resolution, is authority for the statement that in the six months ending Feb. 1 the street railways of this city killed 299 persons and seriously injured 944. The total number of accidents due to collisions of street cars was 1196, and the number of vehicles and persons struck by cars was 7059. According to him, at this rate in an entire year about 600 persons will be killed and 2000 seriously injured. For injuries and damages the street railways last year paid out over $2,500,000.

CHICAGO MUNICIPAL LIGHTING.—Mayor Busse, of Chicago, in a recent message to the City Council of Chicago, asks that expert accountants be employed to find out what it really costs the city to supply its own electric light. To quote from his message: "The city of Chicago has been in the electric lighting business for about 20 years, yet I have been unable to acquire from the city records exact information as to the municipal lighting plant's value or the cost of the electric lighting which the city does for itself. The records simply show from year to year the cash appropriated and expended for material and labor in the maintenance and operation of the electric lighting plants. No attempt has been made apparently to ascertain the exact cost. The city should know how much its municipally owned and operated utilities are costing and how much it has invested in such undertakings." This request was referred to the finance committee.

ITALIAN HYDRAULIC CONCESSIONS.—Confirming statements made recently in these pages, a correspondent at Rome of the London *Times* states that applications for water-power concessions are being rapidly sent in to the Minister of Public Works, and that private companies and manufacturers throughout northern Italy especially are looking forward to the possibility of "white coal" as a means of reducing the cost of production of power, which may enable industries to be carried on profitably that are in direct competition with those of other countries supplied with comparatively cheap fuel. It is estimated that Italian rivers would yield between four and five million horse-power, of which scarcely 20 per cent is at present turned to account. The city of Rome has obtained a concession which will mean an addition of 25,000 horse-power, and Naples also adds 16,000 horse-power to her supply. The American consul at Milan, Mr. Dunning, recently wrote a report on the exploitation of this matter in northern Italy.

PENNSYLVANIA TROLLEYS.—It would appear that not less than $500,000,000 is represented in the capital of the electric railways of Pennsylvania according to the annual report of the State bureau of railways, which just has been completed by Chief James W. Craig. Incidentally there is shown a heavy increase in 1907 covered in the report, not only in capital, but in assets. The total capital amounts to $464,553,942, divided between $240,224,061, the capitalization and current liabilities of companies engaged in direct operation and $224,329.881 reported by companies which have leased their lines and equipment. The capital and liabilities of the former show an increase of $36,570,620. Other increases follow, all figures being comparative and taken from reports made directly to the bureau: Capital and liabilities, $56,570,620; assets, $57,348,978; income. $3,558,260; disbursements, $3,968,397; passengers carried, 87,935,058; employees, 3396; wages, $2,098,537. More than 300 miles of new track were laid than in the previous year and the increase in cars was 690.

INTERNATIONAL CONGRESS OF INVENTORS.—With regard to the recent discussion in our columns on the relation of the United States government with inventors, and the suggestion that there should be a national society of patentees, we have a letter from Mr. Ralph T. Olcott, secretary and treasurer of the International Congress of Inventors, of Rochester, N. Y. He points out that the points raised in the discussion are those within the province of the congress, with headquarters at Rochester, N. Y., established in February, 1906, incorporated under the laws of the State of New York in February, 1907, with members in several States of the Union, a branch council in Texas, and another forming in New York City. "This is the only national organization of inventors in America. Its purpose is the advancement of the interests of inventors generally, their protection in matters of legislation, improvement in Patent Office conditions, etc. This organization is for the benefit of inventors as a class." Mr. Olcott states that an earnest endeavor is made continually by this organization on behalf of the inventor.

Generating and Distributing Systems of the United Railways & Electric Company of Baltimore.

On Sept. 1, 1906, the United Railways & Electric Company, of Baltimore, entered into a contract with Mr. L. B. Stillwell, of New York, under which he assumed responsibility for construction work and for the operation of the plants and distributing systems of the company. Certain changes that were under way at this time had been rendered necessary by reason of the growth of the company's business and on account of the great fire in 1904, which damaged the company's largest generating station at Pratt Street, and resulted in the widening of this street when the burnt district of the city was being rebuilt. In order to conduct the work of reconstruction and operation most effectively Mr. Stillwell opened an office in Baltimore and placed Horatio A. Foster in immediate charge of the work as resident engineer. Mr. C. F. Baker was appointed superintendent of the motive-power department in immediate charge of operation and of the field work of construction.

When plants already overloaded are reconstructed and extended under conditions of steadily increasing load, new units must be placed in service before old ones can be overhauled or moved to new locations, and work of this kind can never be pushed through to conclusion with the rapidity possible in the construction of a new generating station. The results which have been accomplished in 18 months, therefore, are striking evidence of the ability and energy of the force organized by Mr. Stillwell to carry out this work.

The present article will describe and illustrate in some detail the work of reconstruction and extension as thus far completed. The results attained may be summarized as follows:

(1) At Pratt Street power house reconstruction incident to the widening of the street has been accomplished.

(2) Switch galleries designed for the ultimate control from this central location of plants aggregating in rating 120,000 horse-power have been completed and switch gear installed to the extent necessary to permit operation of the new substations.

(3) A 5000-kw Westinghouse generator driven by a McIntosh & Seymour engine ordered by the company prior to the date of Mr. Stillwell's contract has been erected and placed in service.

(4) A 5500-kw Curtis turbine unit has been installed and put to work.

(5) The steam plant has been increased by the addition of eight 450-hp B. & W. boilers.

(6) A new substation has been built on Lombard Street, near Penn Street.

(7) An addition to the Harford Road substation has been constructed.

(8) A new generating station has been built for Bay Shore Park.

PRATT STREET STATION EXTENSION AND IMPROVEMENTS.

The main generating station on Pratt Street consists of two engine rooms, between which is a double-decked boiler room. For convenience in designating, the engine rooms are numbered one and two, No. 1 being that nearest Pratt Street.

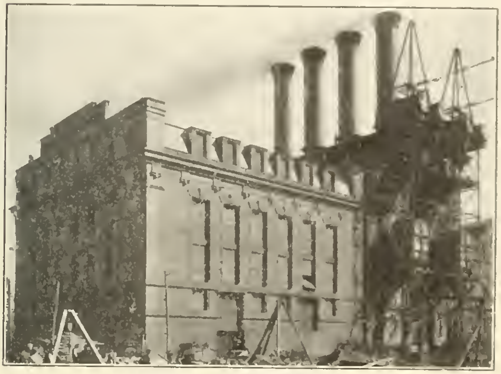

FIG. 2.—COAL-HANDLING EQUIPMENT.

The walls of the new building between the street and the boiler room had been practically completed, and a new 5000-kw engine-driven unit had been installed when Mr. Stillwell took charge. Since that time a second 5000-kw engine, which was already under order, has been erected, a 5500-kw Curtis steam-turbine unit has been installed, and the three 1800-kw direct-current machines have been moved from the position now occu-

FIG. I.—VIEW OF INTERIOR OF PRATT STREET STATION DURING ERECTION

pied by the street into the new engine room. In addition, numerous changes in the piping and wiring have been made, a new direct-current switch gallery constructed, a new and comprehensive switching gallery, designed to control the alternating and exciting current from all sources, was planned and is nearing completion.

The total rating of the machines in the new generator room is 20,400 kilowatts, and provision has been made for the installation of an additional 5000-kw turbine. The three 5000-kw units are located in a row adjacent to the boiler-room wall. On the opposite side of a passageway and in the center of the room are two of the 1800-kw units. The third 1800-kw unit is at present in the westerly corner near the north wall of the building, but on the extension of the switchboard galleries it will be moved in line with the other two. A cross-sectional elevation of the south side of the generator station is shown in Fig. 3.

Each of the 5000-kw reciprocating units consists of a McIntosh-Seymour horizontal-vertical double-compound engine and a 13,200-volt, three-phase, 25-cycle Westinghouse generator. Each engine has twin barometric condensers located against the boiler-room wall. Independent 12-in. centrifugal pumps supply the condensing water. The pumps for one of the engines are at present driven by 500-volt direct-current motors, while the others are driven by vertical Buckeye engines.

The 1800-kw units consist of McIntosh-Seymour vertical cross-compound engines and General Electric direct-current generators. They are equipped with barometric condensers, supplied with water by centrifugal pumps in the basement driven by Buckeye vertical engines.

The turbo unit consists of a Curtis turbine and a 5500-kw, 13,200-volt, three-phase, 25-cycle generator. Fig. 1, taken during construction, shows in a marked way the difference in size of the turbine and reciprocating units. The turbine exhausts into a Worthington jet condenser placed below the floor. An independent atmospheric exhaust pipe extends from the condenser connections out through the roof of the engine room. Condenser water is furnished by a 26-in. centrifugal pump located in the basement and driven by a single Harrisburg horizontal engine. A 10-in. x 24-in. x 13-in. dry-vacuum pump is installed on the main floor for use in connection with this condenser.

The oiling system for the turbine step-bearing includes duplex oil pumps in duplicate, a receiver containing cooling coils and a Turner filter. No accumulator is at present employed. The pressure on the step-bearing is maintained at about 700 lb. The steady bearings for the vertical shaft are supplied with oil from an entirely separate system of pumps installed in duplicate, pressure being maintained at about 100 lb. at the pumps.

The Holly drip system is installed in connection with the steam piping, all drips draining to three pots located in the basement.

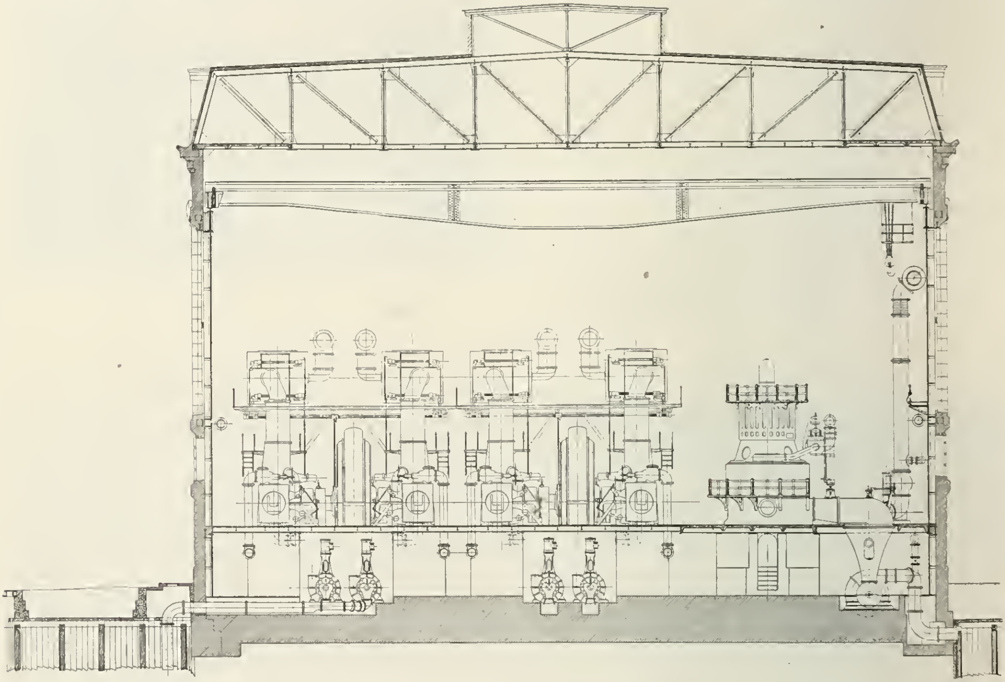
FIG. 3.—CROSS-SECTIONAL ELEVATION OF THE GENERATING STATION.

ALTERNATING-CURRENT SWITCHBOARD AND WIRING.

All alternating-current apparatus in the entire station will ultimately be controlled from a gallery built against the north wall of the building. At the present time, however, the alternators in the old engine room are controlled from the old switchboard in that room.

The plans provide for high-tension buses in both Nos. 1 and 2 engine houses, connected by heavy bus ties, in duplicate, with generators feeding energy to both buses, all controlled from the bench-board in the No. 1 engine house. When the contemplated changes are made in the buses in engine house No. 2, the high-tension system of buses and switches will be capable of handling generators having a total rating of 100,000 kilowatts, which, with certain changes in small units, could be increased to 125,000 kilowatts.

The buses, switching apparatus, controlling switchboards and wiring have all been furnished and installed by the Westinghouse Electric & Manufacturing Company.

DIRECT-CURRENT SWITCHBOARD.

The three 1800-kw, 600-volt, direct-current generators in the No. 1 engine room are controlled from a switchboard supported on a steel and concrete gallery suspended from the east wall of the building, about 25 ft. above the engine-room floor. The generator and feeder cables from this board are carried up the face of the wall in vitrified tile ducts secured to its face.

GROUNDED NEUTRALS.

The alternators are star-connected with grounded neutral, having an oil switch and resistance in series. If a "ground" occurs in the system, it is immediately indicated on the section of the benchboard controlling the neutral apparatus.

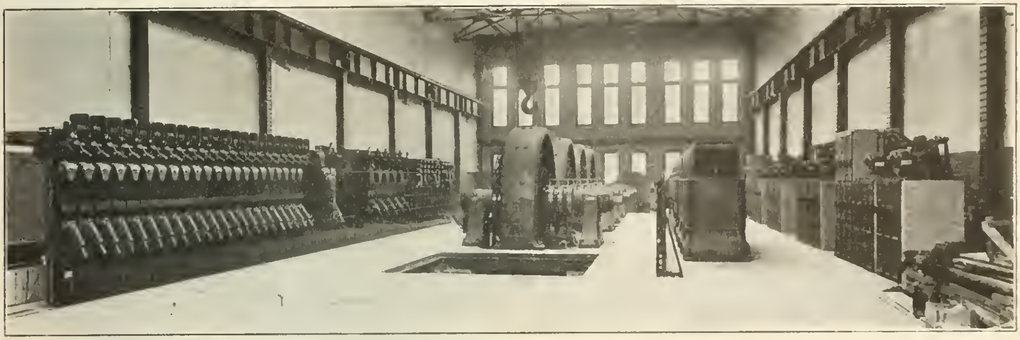

FIG. 4.—GENERAL VIEW OF INTERIOR OF CENTRAL SUBSTATION.

COMPRESSED-AIR CLEANING SYSTEM.

A complete system of air piping is run throughout the switchboard structure and in the engine rooms, with outlets equipped with valves on each floor and at every generator, to which a hose-pipe may be connected for cleaning purposes. All piping is concealed. A 15-hp motor-driven air compressor and tank automatically supply this system with air at 80-lb. pressure.

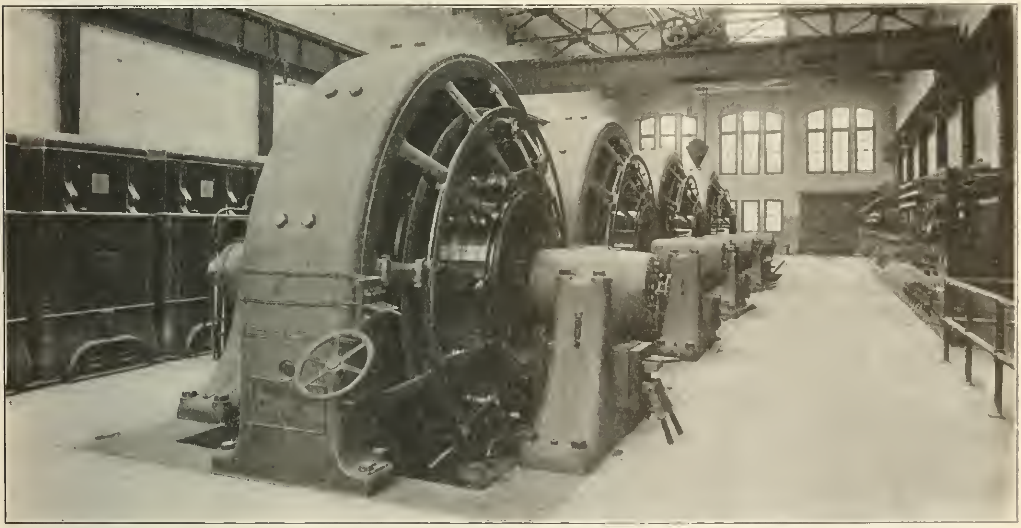

FIG. 5. SYNCHRONOUS CONVERTERS IN CENTRAL SUBSTATION

LIGHTING.

The lighting is at present accomplished by using four arc lamps in series in 550-volt circuits, but the plans provide that the general illumination in the boiler and engine rooms will be done by mercury-vapor lamps on two-wire, 110-volt, direct-current circuits, normally fed from the auxiliary bus, but which may be connected to either the exciter or battery busbars.

The electrical galleries, engines, boilers, etc., will be lighted by incandescent lamps, which will be fed normally by a 13,200- to 110-volt transformer, and may be thrown on the auxiliary bus or on the exciter or battery buses.

EXCITERS.

The alternators are excited by one 150-kw motor-driven, one 200-kw and one 150-kw engine-driven generators, located in engine house No. 2. Provision has also been made for the future installation of two 500-kw engine driven units in engine house No. 1.

THE BAY SHORE TRANSFORMER HOUSE.

Bay Shore Park is lighted by energy transmitted at 3300 volts from a substation nine miles away, or from the new Bay Shore power station a half mile distant. The 75 kw. 3300 110-volt transformers used for lighting are installed in an attractive structure of reinforced concrete. Three of the transformers are connected in delta, and a fourth has been provided as a reserve. The primary and secondary leads are connected to a cable bus by means of solderless clamps in such manner that a defective transformer may be replaced with very little delay.

THE BAY SHORE GENERATING STATION.

Bay Shore Park is located about 12 miles from the main station

The park and railway line, up to 1907, were supplied with energy from rotary converters in the Eastern Avenue substation, which is nine miles from the park. The positive necessity of providing adequate service for this place caused the adoption of some methods which under other circumstances would have been given better consideration. For instance, at the price then quoted for copper, which was about 25 cents per pound, it was found to be more economical to build a new generating station near the park than to erect a high-tension line and substation, or to run the extra copper for low-tension feeders from the existing substation. As the plant was to be operated only about one-third of the year, the fixed charges per kw-hour output on a station built with new and modern apparatus would have been excessive and would have been greater than the decrease in cost due to the better economy of such a station. These conditions led to the construction of a plant made up almost entirely of machinery from several of the company's abandoned direct-current stations; and practically everything in the station, including boilers, engines, generators, belts and piping, was taken from such plants, the only new apparatus being an alternating-current generator for the park lighting.

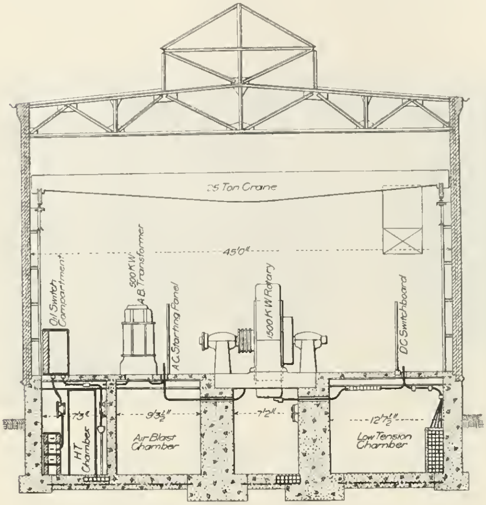

FIG. 6.—CROSS-SECTIONAL ELEVATION OF CENTRAL SUBSTATION.

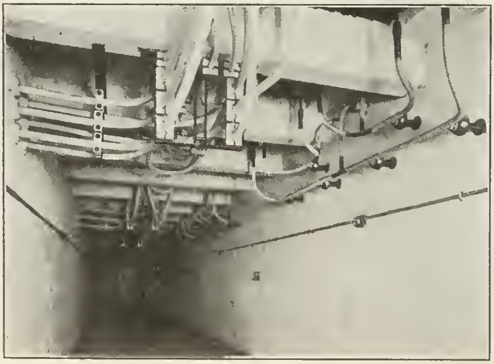

FIG. 7.—CONVERTER CONNECTION.

The boiler equipment consists of two 600-hp and two 300-hp Morrin Climax units with independent smoke stacks. Water is obtained from driven wells and is stored in two 10,000-gal. elevated tanks. Closed feed-water heaters are located in a recess of the building at each end. Feed water is supplied to the boilers by two 7½-in. x 4½-in. x 10-in. Worthington feed pumps. Two Pohl 8-in. x 8-in. x 7-in. air lifts are used to elevate the water from the wells into the tanks.

The boilers feed steam into a ring system of mains, one line of which is in the boiler room and the other in the engine room. The pipes are supported on roller bearings and at their middle points a U-bend is provided to allow for expansion.

The dynamo equipment consists of four 200-kw, 500-volt, four-pole, T. H. generators, belted to McIntosh & Seymour tandem-compound, non-condensing engines; a 250-kw, three-phase, 3300-volt, self-exciting General Electric generator, belted to an Armington & Sims engine; a 375-kw, 550-volt, direct-current generator, direct-connected to a Westinghouse kodak engine, and a 200-kw, 500-volt, direct-current generator of the same type and style, for supplying energy for miscellaneous purposes at the park.

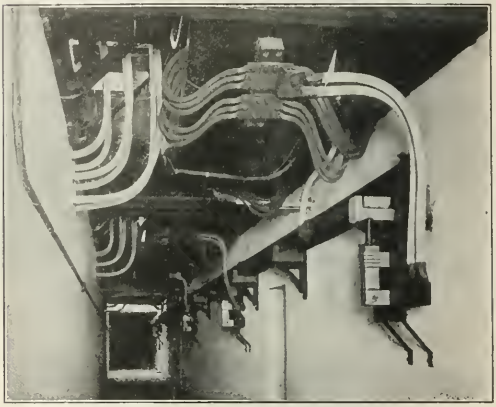

FIG. 8.—NEGATIVE BUS OF CONVERTER.

THE CENTRAL SUBSTATION.

The central substation at Lombard and Penn Streets, in a well-built-up district, is the only newly located substation erected since the reconstruction work was begun. The building, which is 154 ft. x 48 ft., is a fireproof brick and steel structure and is designed for the installation of eight 1500-kw rotary converters, five of which are now in place. Figs. 4 and 5 give general views of the interior of this station. All apparatus is on the main floor level. The underground high-tension feeders enter the building through the basement near the easterly wall and are carried up to the switches placed on the floor above. They then drop to high-tension buses in the basement. Leads from these buses are carried through oil switches, and

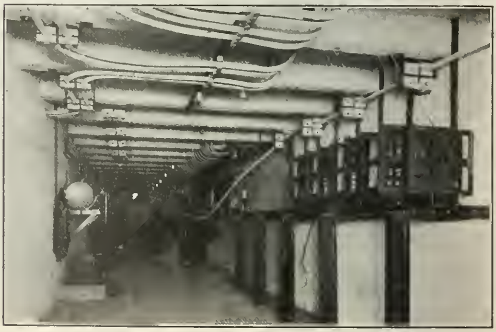

FIG. 9.—DIRECT-CURRENT COMPARTMENT IN BASEMENT.

thence on the ceiling of the basement to the transformers, all high-tension leads being kept separate by concrete barriers. The secondaries from the transformers are run across to the rotary converters, and the direct-current leads continue to the switchboard near the west wall of the building. From the direct-current swtichboard, leads drop to the basement and are carried out to the street in conduits. This arrangement, it may be seen, confines all the high-tension apparatus to one side of the building, and all low-tension apparatus to the other side. Fig. 7 shows, on the right, the arrangement of the high-tension deltas from the bus structure, and, on the left, the low-tension six-phase connections to the six rings of the converters. Fig. 8 shows, at the left, the continuation of the low-tension wiring from the transformers to the rotary, and, on the right, the arrangement of the positive and negative from the commutator of the rotary. Fig. 9 shows the positive connections as carried through the wall to the direct-current switchboard. It also shows the field rheostats for the rotary converters.

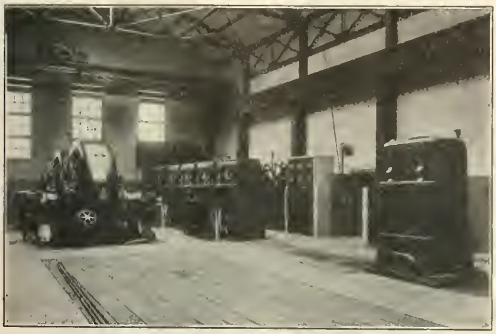

FIG. 10.—INTERIOR VIEW OF NORTHERN SUBSTATION.

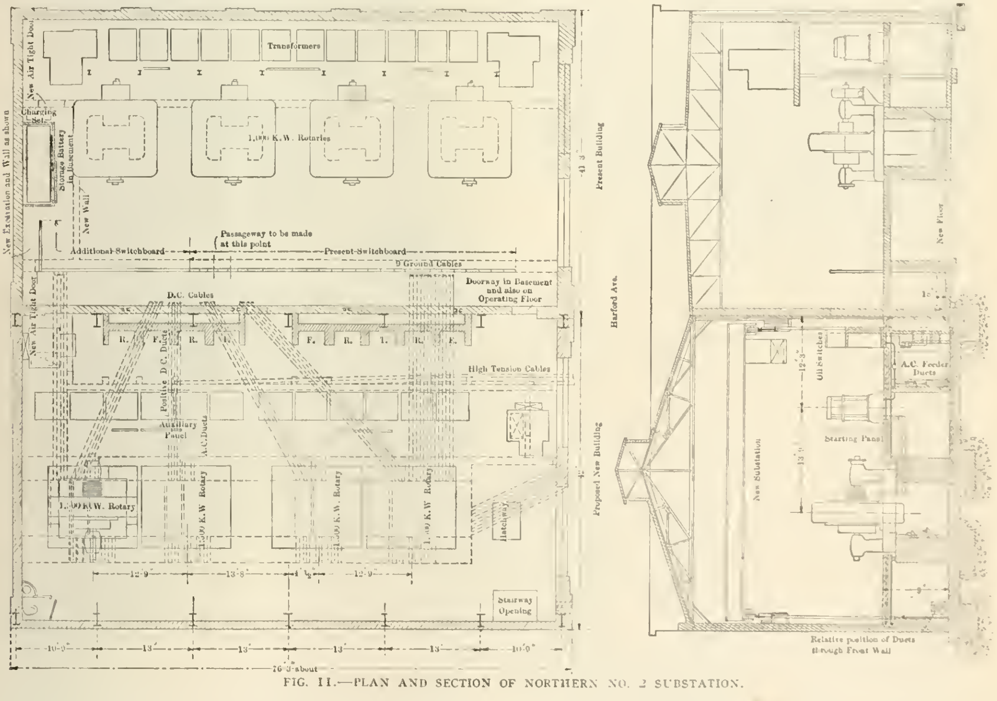

FIG. 11.—PLAN AND SECTION OF NORTHERN NO. 2 SUBSTATION.

The busbar and switch structures are built of light-colored shale brick and concrete slabs. Tests showed this brick to be well adapted for the purpose, as they withstand a comparatively high voltage test, are acid proof and do not absorb moisture. The busbar insulators are of such a design that the bars are free to move longitudinally, but are held rigid at disconnecting switches.

The transformers are of the General Electric air-cooled type and are of 550-kw capacity each. A pressure of ¾ oz. is maintained in the air-blast chamber by any two of the three motor-driven Buffalo Forge Company blowers. Each blower handles 20,000 cu. ft. of air per minute. Entrance to the chamber is provided for through an air lock at one end, equipped with air-tight refrigerator doors. Air for the blowers may be obtained from outside the building through ducts provided for the purpose, or, by opening dampers in the side of the ducts, it may be taken from the station.

The rotary converters rest on parallel concrete walls 3 ft. 6 in. thick. The base frames of the machines are cast with square corners and with vertical sides, to provide for setting the top of the frame flush with the floor, as shown in the cross-section. The rotaries are provided with electrical oscillators, and are started from the alternating-current side by means of 1/3 and 2/3 voltage taps on the transformers. The two double-throw, triple-pole starting switches for each machine are installed on panels between the transformers and rotaries. In the northwest corner of the building is a 300-kw booster for raising the e.m.f. for an outlying line, for which the regular e.m.f. of 575 volts is insufficient.

WIRING.

All wires and cables are run in conduit, vitrified tile being used in the basement for alternating-current and direct-current feeders, and loricated conduits in the floor, filling and walls for control and lighting wires.

The lead-sheathed, high-tension cables entering the building terminate in end bells, from which the leads are brought out to the terminals of the disconnecting switches, which are separated by concrete barriers. The middle switch is set higher than the two outside ones, so as to make the leads from the end bells the same length and thereby permit interchanging the connections without splicing.

THE SWITCHBOARD.

The switchboard, which was furnished by the General Electric Company, is composed of direct-current machine and feeder panels, special alternating-current control panels and special battery panels.

The special feature of these alternating-current control panels is the arrangement of the operating switches for control of the oil circuit-breakers and a miniature bus.

The station is equipped with a compressed-air cleaning system having outlets at all important points, and a complete grounding system, with outlets and flexible leads, has been installed.

THE NORTHERN SUBSTATION.

The addition to the Northern substation consists of a brick and steel building of practically the same dimensions as the original structure. The old building contains four 1000-kw rotary converters, while the new one is intended for four 1500-kw machines, two of which are now in place, as shown in the view of the interior, Fig. 10.

The new apparatus is controlled from an addition to the switchboard in the old building. In the old portion the high-tension bus and switch structures are located on a concrete gallery near the southerly wall and immediately over the transformers.

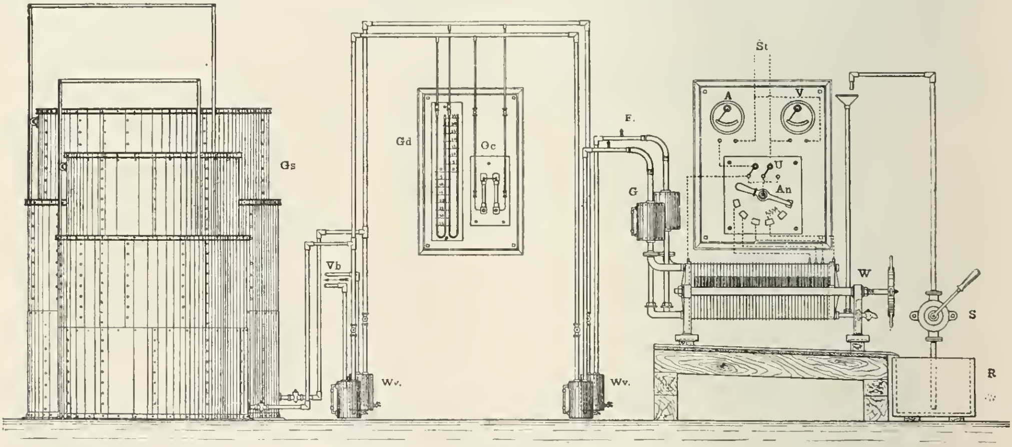

FIG. 1.—ARRANGEMENT OF AN ELECTRIC WATER-DISINTEGRATING PLANT.

SUBSTATION LIGHTING.

Both the Central and Northern substations are lighted by Cooper Hewitt mercury-vapor lamps placed five in series on the 550-volt circuits. The incandescent lamp circuits are arranged so that the lamps may normally receive energy from 430 to 110-volt transformers, or may be thrown on the control batteries. For emergencies, two arc lamps at the Central and four tungsten lamps at the Northern substation are connected through a relay to the battery, so that when current fails on the mercury lamps the relay closes the battery circuit through the tungsten lamps; thus the station is never without light.

ENGINEERING.

In addition to personal supervision on the part of Mr. Stillwell, the mechanical portion of the work has been under the care of Mr. John Van Vleck, and the electrical under that of Mr. H. S. Putnam, Mr. Stillwell's associates in New York.

The treatment of the entire matter of an unfailing supply of energy has necessarily been rather heroic, and the efforts of the engineers have been fully and promptly supported by President William A. House, the entire board of directors, and the engineering staff of the United Railways & Electric Company.

Oxy-Hydrogen Welding.

By Frank Koester.

THE custom of welding iron, steel, copper, etc., by mechanical means is rapidly being replaced by the process known as "autogenous welding," which has been in use for a number of years abroad and is now being introduced to some extent in this country.

Autogenous welding embraces all methods of welding in which the parts to be united are joined together in a homogeneous manner, the joint being made by the intermingling contact of the fibers of the material to be welded so that the finished piece is of uniform quality and properties throughout. The process is carried out by several methods, namely, the oxy-acetylene, the purely electrical and the oxy-hydrogen method. The latter, which is most extensively used, is the subject of this article.

Before discussing the process of oxy-hydrogen welding it might be well to describe the means by which oxy-hydrogen is produced. The disintegration of water by electrical means is a very old process, but since electricity is now generated so cheaply this process is extensively used in many industries, its use no longer being limited to laboratory work.

The water is usually disintegrated in iron vessels. with iron electrodes and the use of alkali solutions. This apparatus, however, besides being expensive, requires an enormous space for its installation. The following described apparatus, however, is of a very compact design, of very simple construction, requires a minimum of attention, is safe in its operation and permits the production of this gas under relatively high pressures. It consists of a number of ribbed iron plates, between each of which is placed an asbestos-woven slab. Several of these, the number depending upon the size of the apparatus, are mounted upon a frame, as seen in Fig. 1, and means are provided for compressing the slabs and plates between two heads. As is the case in a storage battery, the space between two plates, or electrodes, together with the asbestos slab or diaphragm, forms one cell. The electrodes are of cast iron, the surface being ribbed and the edges being raised to form a frame, thus enabling the plates to better compress the asbestos diaphragms. Each electrode is provided with three drilled holes, one edge of the electrode being provided with two holes, one at each corner, and the opposite edge with one hole located centrally between the two corners. These electrodes are arranged so as to alternately bring the single hole to the top and the bottom of the stack of plates. The two upper channels form passages through which the gases, the hydrogen and oxygen, flow. These channels are connected to so-called gas separators in which the gases are separated from the fluid.

The latter returns to the cells of the apparatus through the lower channel.

A vigorous circulation of fluid is accomplished by the process of gas generation, which circulation is essential for the proper working of the water disintegrating element.

In the following table the theoretical data are given for various sizes of water disintegrators, showing the electrical current required, the number of cells, the amount of water supply and the amount of both hydrogen and oxygen gas produced. Direct current is used, and as this is a wet process, it is not practical to use an e.m.f. higher than 250 volts.

				Supply of fluid	Gas Production. per hour.	
Current Amperes	e. m. f. Volts	Power Kilowatts	No. of Cells	in cu. ft. per hour	Hydrogen in cu. ft.	Oxygen in cu. ft.
20	65	1.3	28	1.43	7.41	3.53
40	65	2.6	28	2.45	14.82	7.41
75	65	4.9	28	6.65	27.88	13.76
125	65	8.1	28	10.50	46.59	23.29
20	110	2.2	48	2.17	12.70	6.35
40	110	4.4	48	3.53	24.41	12.70
75	110	8.2	48	10.54	47.65	23.65
125	110	13.8	48	17.50	79.37	39.53
20	220	4.4	96	3.85	24.41	12.70
40	220	8.8	96	7.08	51.18	24.41
75	220	16.5	96	20.30	105.31	47.65
125	220	27.5	96	31.56	158.85	79.37

The e.m.f. required per cell is about 2.7 volts with the fluid at the initial temperature, while with a temperature of 140 deg. Fahr., the e.m.f. required is 2.3 volts per cell.

So long as the generation of gas has not yet begun, the resistance in the disintegrating apparatus is low. For regulating the current a rheostat and cell switch are required so that any number of cells may be connected in succession.

The fluid supplied to the apparatus is a solution consisting of distilled water containing 10 per cent of pure potash (carbonate of potash). The use of pure water, particularly free from chlorine matter, is essential for the continuous proper operation of the plant. Artesian well water or water of condensation cannot be used advantageously.

For the production of 10 cu. ft. of hydrogen and 5 cu. ft. of oxygen, with a working temperature of about 100 deg. Fahr., about two kw-hours are necessary and about six-tenths of a gallon of water will be required. With an increase of temperature more economical operation may be secured, but the temperature should not exceed 160 deg. Fahr.

The process itself gives up heat to the fluid, but in order that the process of disintegration may begin with the proper temperature the fluid may be heated by steam.

Under ordinary conditions the pressure of gas produced is 3.5 lb. per square inch. However, by using an auxiliary device, a pressure of 35 lb. per square inch may be secured.

The principal requirement is to produce both pure hydrogen and oxygen gases. With uninterrupted operation and normal voltage, and with a temperature not exceeding 100 deg. Fahr., the oxygen will contain not more than 3 per cent of hydrogen, and the hydrogen will contain not more than 1 per cent of oxygen. Should the e.m.f. drop below the normal, each gas receiver will contain a greater percentage of the other gas than given. After every interruption of the service, and upon restarting, the gases are impure and should not be discharged into the receiver, but should first be exhausted into the atmosphere.

For the purpose of controlling the purity of the gases generated, the supply pipes are tapped and the gases ignited. The character of the flame indicates the purity. The gases are conducted through two water columns, and if the mixture is an impure one the flame will kick back to the water column and extinguish itself. The report resulting will show that the gases were explosive.

In large disintegrating plants it is more desirable to have an analyzing apparatus for testing the purity of the gases.

For the purpose of securing continuous and economical operation of the disintegrating apparatus, as the demand upon the latter is not always uniform, storage tanks or gasometers for the gases generated are made use of, the one for hydrogen being, of course, of greater size than the one for oxygen, since the latter is produced and required in greater proportions.

The cost for generating these gases by this process is governed by the price of the electric energy. As previously stated, 10 cu. ft. of hydrogen gas and 5 cu. ft. of oxygen gas require two kw-hours for their production. Assuming that a kw-hour can be had at from 1 cent to 6 cents, the quantities of hydrogen and oxygen gases as above given would cost from 2 to 12 cents for their production. When the gases are not used at the pressure of production they are compressed into pressure flasks up to about 3000 lb. per square inch for shipment. The cost of charging these tanks will, of course, depend upon the facilities at hand.

Where these gases are used in great quantities for the purpose of cutting, welding and other purposes, the manufacturer may install his own disintegrating apparatus. Special plants have been established abroad for producing these gases and supplying them to the various users, the pressure flasks when exhausted being returned to the disintegrating plant.

The disintegrating apparatus described above is manufactured by the "Oerlikon Company," of Switzerland, under the Dr. O. Schmidt patent. Fig. 1 shows the arrangement of the apparatus of an electric water disintegrating plant. The current enters at S_t, being controlled by the rheostat A_n. The fluid is taken from the reservoir R by the supply pump S. W is the water-disintegrating apparatus; G is the gas separator; E represents vents; W_v shows water seals; V_b indicates distributing pipes, and G_s shows gas storage tanks. Gas-testing apparatus are shown at G_o and G_d, while electrical measuring instruments are indicated at A and V. Fig. 2 shows disintegrating apparatus which, operated at 125 amperes and 220 volts, delivers 158.85 cu. ft. of hydrogen and 79.42 cu. ft. of oxygen per hour.

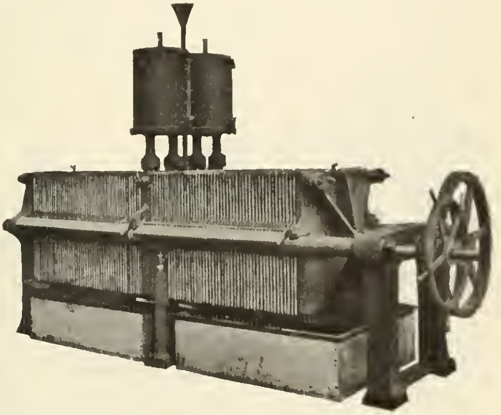

FIG. 2.—DISINTEGRATING APPARATUS.

THE PROCESS FOR CUTTING AND WELDING.

One advantage in welding by this process consists in doing away with all riveting, such as would be necessary in the manufacture of shell boilers, drums, tanks, etc. Another advantage is that the process will serve for cutting plates, pipes, etc., as these same gases may be used for this purpose, dispensing entirely with the great variety of tools required for cutting at present. Of the many other advantages one of the most important is that with this process, where additional connections are required to boilers, tanks and piping already installed, holes may be cut and nozzles welded on in a very short time and without dismantling any part of the installation. This process is of extraordinary importance in connection with the equipment of modern power plants.

Special tools have been designed, one for cutting circular and oval holes, such as handholes and manholes, another for cutting holes in pipes, another for cutting the end of the nozzle to the proper form for joining it to the pipe, etc. The cuts made are perfectly smooth and require no subsequent finishing.

In the manufacture of fittings by this process, such as tees, manifolds, Y's or elbows with outlets at any degree desired, much time may be saved in the filling of orders. The delivery of cast-iron fittings, either large or special fittings, is always delayed because of the time consumed in the pattern shop, foundry and machine shop.

Furthermore, the material used in these fittings is much more suitable for modern power-plant practice in which high pressures and superheat are essentials. The fittings are lighter than any cast fittings, since they are made up of standard wrought iron or steel pipe. The number of hangers, anchors, etc., as well as their weight, is reduced, as is also the labor necessary in erection. The number of flanges necessary is considerably reduced owing to the fact that all outlets may be made on a full length of pipe. The flanges themselves may also be welded to the pipe by this process, and where loose flanges are required shoulders may be welded on.

In the manufacture of boilers, drums for boilers and tanks, the longitudinal seams and other seams, as well as the heads and any outlets, may be welded in this manner. Certain types of superheaters may have heads and tubes welded together to form a single piece, doing away with the possibility of leaky joints. As a superheater of this kind is complete when delivered, it is necessary merely to connect it to the system of piping, as is done with valves, etc.

The process of cutting and welding material is an exceedingly simple one and may be done by unskilled mechanics after receiving slight instructions as to the handling of the apparatus.

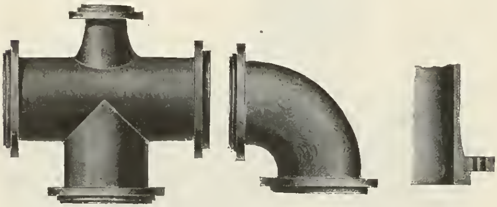

FIG. 3.—AUTOGENOUS WELDED STEEL PIPE-FITTINGS WITH LOOSE FLANGES.

As already pointed out, the hydrogen and oxygen is contained in two pressure flasks from which each is delivered to the blow pipe of the cutting or welding tool through rubber tubes, the pressure being regulated by special reducing valves. For cutting material, the gases may be used independently, one for heating and the other for cutting. The hydrogen gas flame is used for heating, it requiring only a few seconds to heat the surface to the desired degree of temperature, after which the oxygen is turned on and the cutting done. The cutting off of a 6-in. pipe being accomplished, after the tool is set, before one realizes that a start has been made. The cut will be about 3/16 in. in width. Cutting a 3-in. square bar requires about 90 seconds. Plates 0.04 in. in thickness to 12-in. armor plate may be cut, blower nozzles of different sizes being used for various thicknesses of materials. Material of 0.04 in. in thickness requires a blow-pipe outlet 1/16 in. in diameter, while that ⅜ in. in thickness requires an outlet ¼ in. in diameter. The cut will be equal in width to the blow-pipe outlet. If the material is of good quality, the joining surfaces need no finishing whatever in welding. This is true also of such pipe surfaces as are to be united in making a welded joint as the heat generated is such as to remove all objectionable substances from the surface.

To define more clearly the operation of cutting a circular or oval hole in a plate, the following description is given: A small hole is drilled in the plate as a center and for bolting on the apparatus, which is provided with a template acting as a guide for the blow-pipe nozzle in its travel along the circumference of the hole to be cut. The hydrogen gas first flows through its nozzle, and is ignited and followed closely by the oxygen delivered through its nozzle. The nozzles are placed a few inches apart on the same apparatus, and the former (hydrogen) heats the material, while the latter (oxygen) cuts it. The whole apparatus, which is a light instrument, is revolved by hand. When cutting an oval hole an oval template is used. All that is necessary for cutting holes of different sizes is to insert a different size of template.

Another apparatus for cutting holes, in pipes, for instance, is arranged to follow the line of intersection. An apparatus for cutting off pipes is also used.

The process of welding consists in mixing hydrogen and oxygen either at the nozzle of the blow pipe or within the chamber of the blow pipe. The latter form is preferable as it procures a more thorough mixture before the gases leave the nozzle of the blow pipe. In either case the hydrogen is first turned on and ignited. Then the oxygen is turned on, the cocks being located in the inlet pipes to the mixing chamber of the blow pipe, the flow of each gas being controlled as required for a proper mixture. If for any reason, after the proper mixture is established, the supply of hydrogen should be accidentally reduced, the flame would kick back into the blow pipe, and to prevent its backing up into the supply lines and tanks, safety devices may be inserted in the supply inlets to the blow pipe. In starting up again after such kick it is necessary that the blow pipe first be allowed to cool off so that the gases will not be ignited upon entering.

The temperatures created at the nozzle of the blow pipe ranges from 1500 deg. to 5000 deg. Fahr., the thickness of the material determining the temperature to be used and which is easily controlled by cocks for regulating the supply.

The process permits of lap-welding and butt-welding, and additional material for reinforcing may be added. In lap-welding a smaller quantity of hydrogen and oxygen is used than in butt-welding. The amount of gas used for welding a ⅛-in. plate per running foot is, in the former case, from 1.7 to 3 cu. ft. of hydrogen and from 0.6 to 1 cu. ft. of oxygen, and it requires from four to six minutes to make the weld.

The welded joints are equally as good, if not superior, to the material welded. If the proper mixture of gases has been employed welded parts are as easily machined as the material itself.

This process is utilized not only for new work, but also in making repairs at the plant which otherwise might have to be shut down until a new piece or the repaired part is secured from the maker. For example, a break in a connecting rod, eccentric rod or any other may be easily welded without even dismantling it. A split in a pipe line may also be patched without disconnecting the pipes. There are many other industries in which this process may be applied with great success.

Electricity in Rio de Janeiro.

Much has been written about the remarkable transformation undergone by the Brazilian capital during the past several years, but so far little has appeared concerning the electrical development which had just preceded and has since traveled hand in hand with it. Yet judging from results already attained and from tangible prospects of much greater things to come, it is safe to say that Rio de Janeiro will present before long one of the most interesting, and possibly for Americans above all other foreigners, one of the most profitable engineering undertakings of its kind in the world.

When one who knew Rio in the olden days of yellow fever fame, stirs up memories of the vast labyrinth of narrow, crooked, unsewered, boulder-cobbled and poorly lighted streets, with its legions of mosquitos and musket-carrying policemen, and then compares the vision with Rio of to-day, it must appeal to him like the realization of one of Scheherezade's tales in "Arabian Nights." Of course, the conquest of yellow fever, which came with the elimination of the mosquito and the reconstruction of underground sewers, will always be the greatest boon that could have happened to the city; but the most spectacular and unique and certainly one of the most far-reaching changes wrought will be the introduction of electricity on a large commercial scale.

The tallow candle, of which one of the largest factories in the world is located in Rio; the antiquated oil lamp, the gas jet and the more recent but none the less cumbersome acetylene lamp, are slowly going down before the incandescent and the arc. Induction motors are gradually replacing hand cranks in manually operated sugar refineries, tobacco shops, coffee trapiches, rice mills, etc., while more pretentious establishments are divesting themselves of steam and gas engines and are getting into the line of hydro-electric power users.

The first lighting and power plant in Rio de Janeiro, as in most other cities, was a gas concern. Years ago an Englishman acquired the concession and built an extensive system which, with modifications and additions, has ever since supplied public and private lighting and to some extent gas power. This plant is the nucleus of the American company now exploiting the lighting and transportation utilities of Rio de Janeiro. An owning and operating syndicate with engineering headquarters in New York, they control the exclusive concessions for the electric light, power and telephone service in Rio, and besides having purchased the gas company, own three of the four electric tram lines with a total of 42 miles of single track; all of the mule car lines with a total of 90 miles of single track, and one steam cog road. The mule cars are to be entirely removed and replaced with broad-gage electric trams, and work has already commenced on this project.

This company has in the course of construction a 30,000-kw hydro-electric power plant 81 kilometers (50 miles) from Rio, and it is expected that one of the new 5000-kw generators will be placed in commission about the first of March of this year. This organization is the one from which the babe of electricity in Rio de Janeiro is to receive its principal nourishment. With some of the best American engineering talent, imbued with considerable of the so-called American "hustle" (which, if it is genuine, has to be softened down a bit in Brazil or any other tropical country), and having absolute monopolies in its several commodities of from seven years, as for light, to 90 years for tram service, this company should, if the advantage is properly followed up, prove a strong wedge for American manufacturers desiring to enter the Brazilian market.

Power at present used is brought from a temporary hydro-electric plant of 1500 kilowatts at the head works and also from an old German steam plant of 1250-kw capacity, the latter being used, however, principally for street railway work. The main generating station of the Light & Power Company will be, when completed, the largest in South America, and probably one of the most carefully designed works of its kind in existence. Power is derived from the impounded flood waters of a small mountain stream having a fall of 900 ft. in less than a mile. The storage dam, which is built at the top of the rapids, has a maximum height of 151 ft. with a capacity of 224,000,000 cubic meters. This enormous storage capacity is made possible by a peculiar topographical formation of the mountains, the dam closing up a very narrow gorge at the lower end of a long valley extending a great distance up stream and having many ramifications.

The energy in this stored volume of water is extracted by means of six Escher-Wyss impact wheels of the vertical type.

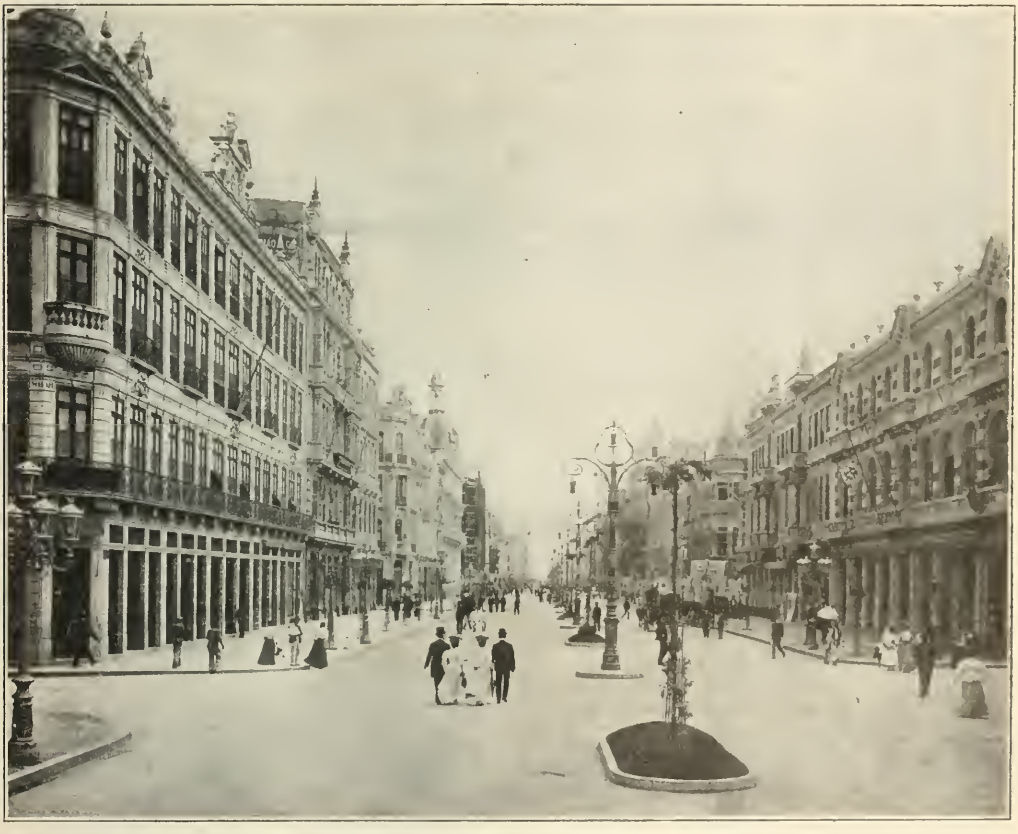
FIG. 1.—THE AVENIDA CENTRAL, SHOWING NEW METHOD OF ILLUMINATION.

direct-connected to six vertical shaft generators. The wheels operate under a head of 1000 ft., each wheel having four needle valves playing 90 deg. apart. The entire plant is of American manufacture with the exception of the turbines and their governors. The energy of this falling water when converted into electricity is transmitted to the city over a double steel tower transmission line. These lines follow a carefully selected route through the mountainous and thickly wooded country which everywhere surrounds Rio de Janeiro, and form a distinctly unique piece of that kind of engineering. There are 972 galvanized steel towers used in the two lines, each of some 46 ft. in height, and each tower line carries two three-phase circuits.

The main city substation will have, ultimately, a capacity considerably in excess of the main generating station, as it will include a gas-engine auxiliary plant of 10,000 horse-power. There will also be a storage battery with sufficient capacity to carry lighting and railway peaks, and a very complete rotary-converter equipment.

The city distribution system as it leaves the substation comprises 13 6000-volt, three-phase underground feeders supplying 80 transformer vaults scattered throughout the city. These vaults, varying greatly in their different capacities, in turn supply 200- and 400-volt secondaries connected three-phase star with neutral. The neutral on all circuits, high and low tension, is grounded. All power work is straight three-phase star, but lighting is carried across the neutral and the three-phase wires at 120 volts. Each of the high-tension feeders has an automatic subway switch which is also capable of being opened or closed from a central point in the city.

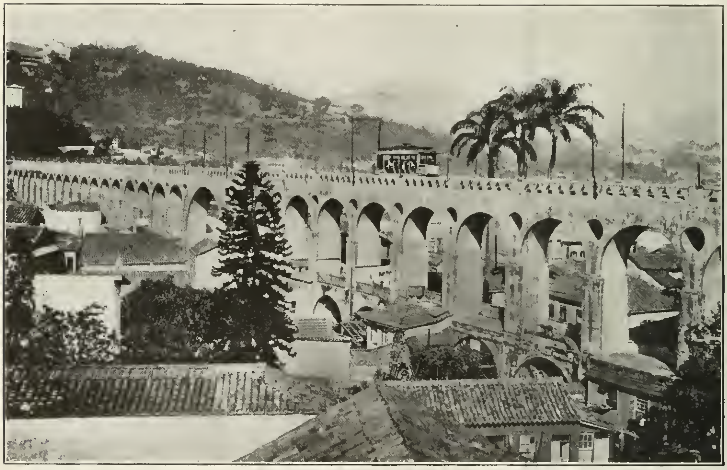

FIG. 2.—ELECTRIC RAILWAY ON 200-YEAR-OLD AQUEDUCT.

Aside from the American company there have been and still are several companies which sell direct current in small quantities. They charge about 15 cents per kw-hour from coal plants as against 24 cents per kw-hour of the American company from combined coal and hydro-electric plants.

Brazil, having practically no coal deposits of her own, is naturally dependent on other fields for her supply for railroad, steamship and manufacturing purposes, and Wales is the chief source. Welsh coal delivered in Rio de Janeiro costs about $9 per ton, and this price is materially increased before the coal has been used, the result being that, wherever possible to be obtained, hydro-electric power is by far the cheapest, and in every other respect the most desirable, for tropical work. Its supply in abundance cannot fail to work a complete revolution in the present economic as well as the engineering phase of Brazil's manufacturing and transportation facilities.

At present there are 60,000 buildings in Rio, less than 400 of which have electric light or power in any part of them; and of this number about 65 have private, direct-current coal or gas-driven plants. In a city of nearly a million inhabitants there are scarcely 15,000 incandescent equivalents in electric lighting. In the railway field there are in operation some 152 miles of single track, divided up as follows:

Jardim Botanico Company—Steam plant; Brazilian and English capital; American equipment; 120 motor cars and 100 miles of track. Villa Isabel Company—Steam plant; Canadian and European capital; American equipment; 71 motor cars and 42 miles of track. Carioca Company—Steam plant; Brazilian capital; American equipment, operating a few cars on about 10 miles of track. Tijuca Line—Steam plant; Canadian and European capital; American equipment; 5 miles of track.

There is also a very extensive system of broad and narrow gage mule car lines in the older portion of the city which must be electrified in the near future, to fulfil the American company's obligations to the municipality of Rio de Janeiro. Work has been commenced on this project and is to be pushed.

Until recently, with electricity costing the city government 24 cents per kw-hour for arc lamps, public lighting has been restricted to the more prominent streets. At present there are about 10,000 gas lamps on the streets of Rio, and it is safe to say that the next two years will see the installation of at least 2000 arc lamps for public lighting.

More than ordinarily good street lighting is necessary in Rio by reason of the vast hordes of restless and wholly irresponsible human beings composing the lower classes. It has been said that an arc lamp in a dark place in Rio de Janeiro is as good as a policeman toward making the city a safe place at night. The Avenida Central is an example of the generous manner in which the new régime is reconstructing the Federal capital. It is an entirely new street cut across the old part of the city, the central business districts, and in its lentgth of nearly a mile has 200 electric series alternating-current arc lamps and 660 gas lamps. This avenue has already cost the Government and individuals the immense sum of $36,000,000, and having been built on the most lavish scale, is naturally the center for the very best business houses. One might well expect to find there a fair representation of electric display and advertising illumination, but as a matter of fact it is conspicuous by its almost total absence.

It is only with the quite recent advent of the Parisian Cinematograph theaters, of which there are some 15, that the Brazilian merchant has had an opportunity of seeing the value of decorative or purely publicity lighting. In the past few days several large signs have been installed, breaking the ice, and considering the love of gay colors, bright light and dazzling splendor inherent in the Latin blood, Brazil should be a particularly good market for light-producing apparatus.

Heretofore most of the public buildings and churches have had their outlines marked with perforated gas pipes which at night, during festive occasions, were lighted, producing very pleasing effects; and it is quite a common occurrence to see flower beds and walks outlined with different colored glass cups containing burning wicks floating in oil.

So far electricity in Rio de Janeiro has been confined principally to the more prosperous, with less attention to economy than to the novelty of it. The really first step taken with the main idea in view to attain greater economy in operation was indicated recently by the signing of a contract by the owners of the Carioca Cotton Mills Company for the complete electrification of its mills, involving about 1600 horse-power. The substitution of coal by electricity in this instance is estimated to mean a saving of $20,000 per year in fuel bills alone, not to speak of the difference in depreciation, etc., in steam plants and motor equipment.

A French Transmission System.

By J. J. Green.

La Société Energie Electrique du Littoral Mediterranéen controls and operates the largest electric energy transmission installation in France. Its lines extend from Montpellier to Monaco near the Italian line, a distance of about 200 miles. There are seven small water power plants located on the rapid streams that come down from the mountains near the coast. In the larger cities, Nice, Marseilles and Toulon, they have steam plants which are usually operated in parallel with the transmission lines. The highest voltage used on the lines is 50,000. All are three-phase and the standard frequency is 25 cycles.

POWER HOUSE UNDER VIADUCT, NEAR NICE.

In this country one finds many odd combinations of the old and the new, as at Tarasçon, where a high-tension transformer is installed in a niche in a big square tower at the side of one of the gates in the fifteenth century wall which surrounds the city. At Nimes and Arles the poles and wires are close to the ruins of buildings constructed by the Romans. In little old towns like Vence the transformers are installed in old buildings on crooked, narrow streets. In most places, however, small transformer houses of stone have been built.

A typical plant is the one located on *le Loup*, a swift stream near Nice. The power house is built at the bottom of a gorge under the great stone viaduct of the Southern France Railroad. The water from this mountain stream is brought in stone conduits along the face of the cliffs a distance of about three miles, nearly all the way in tunnels, to a small reservoir half way up the cliff above the power house. In the power house we find the usual switchboards, lightning arresters, etc., which are of American design. There are four units of the same size, also of American design, and supplied by the French Thomson-Houston Company, each of 500-kw capacity, 12,000 volts. The turbines are of Swiss manufacture and are of the impulse type operating under a head of about 820 ft.

The viaduct, the gorge, with its many cascades, the picturesque mountains in this locality, make it one of the most interesting places near the winter resort on the "*Coté d'Azur.*" There are orange orchards and olive groves all along the hillsides below the power house. This indicates that they are never troubled with ice in the winter.

The Manufacture of Calcium Cyanamide.

By John B. C. Kershaw.

The population of the world and its demand for cereal foods grows unceasingly. One of the pressing problems which the modern scientist has to solve is how to increase the efficiency and yield of this earth, without unduly impoverishing it and rendering it valueless for future agricultural use. There are three substances essential to the life of plants, which are being continually taken from the soil by the crops grown upon it, namely, nitrogen, phosphoric acid and potassium. It is absolutely necessary, therefore, if the ground is not to be impoverished, that these substances should be supplied to the soil annually in some form in which they can be assimilated by the plant.

The frequent application and digging into the ground of artificial fertilizer is thus essential to the maintenance of the present population upon this earth. Should the supply of any of these fertilizers fail the results would be most disastrous. It is a curious fact that only a few plants can draw upon the immense reserves of free nitrogen existing in the atmosphere, and that the great majority are dependent upon the combined forms of nitrogen present in the soil for their supplies of this element. Even in the few cases named, the absorption of nitrogen is not direct, but is due to nodules on the roots containing bacteria, and the attempts to cultivate these bacteria artificially have not been very successful. The nitrogen required by the soil in the early days of agriculture was entirely supplied by animal fertilizer. This is of course still largely used, but it is supplemented by nitrogen in the form of two artificial fertilizers: nitrate of soda and sulphate of ammonia.

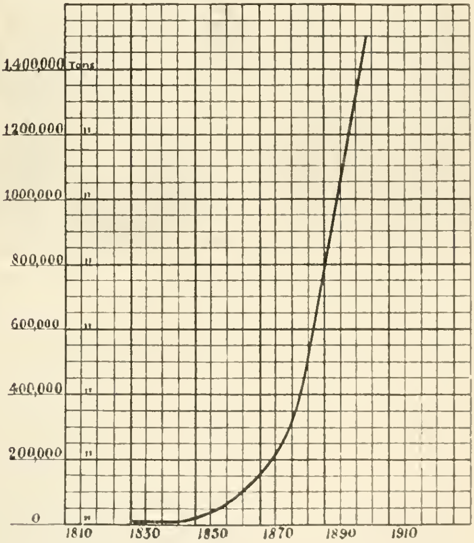

FIG. 1.—WORLD'S ANNUAL CONSUMPTION OF CHILI SALTPETER.

Nitrate of soda or Chili saltpeter, as it is known to the trade, is found as a natural incrustation on the surface of the ground in Chili, and the refined product is now imported in exceedingly large amounts into Europe. How large and important this importation has become is shown by Fig. 1,* in which the world's consumption of Chili saltpeter, for the period 1850-1903, is plotted in graphic form. The curve there drawn shows that the consumption has increased from 250,000 tons in 1850 to 1,540,000 tons in 1903—and that the figures have doubled within the last 13 years. Since these natural deposits of nitrate of soda occur only in Chili, and are of limited extent, it requires no prophet to foretell their exhaustion at an early date. In fact, Sir William Crookes, in his presidential address before the British Association at Bristol in 1898, uttered a solemn warning on this subject and pointed out the seriousness of our position unless some new source of nitrates could be discovered.

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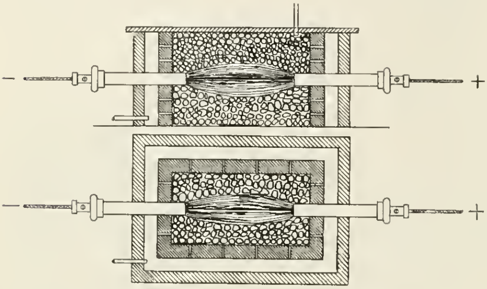
*Taken from a paper by Dr. Erlwein—read in Berlin in 1905.

Although the second artificial nitrogenous fertilizer named above, namely, sulphate of ammonia, is now manufactured in very large amounts as a by-product in gas works and also in the new Mond-Power-gas generating stations, it is quite unlikely that this source of combined nitrogen can ever take the place of Chili saltpeter. The ratio in which the two substances are used at the present time in Germany (the largest user in Europe of artificial fertilizers) is as 2 to 5; the consumption of ammonium sulphate in the year 1904 being estimated at 202,000 tons and that of Chili saltpeter at 500,000 tons. The production figures of sulphate of ammonia and nitrate of soda for the whole world are, however, in the ratio of 1 to 4.



FIGS. 2 AND 3.—FRANK'S CALCIUM CYANAMIDE FURNACE.

Even should the general adoption of Mond-gas, or other systems of the same kind for industrial purposes result in the recovery of more than 50 per cent of the nitrogen in the coal burned annually in all countries for industrial purposes, it is more than doubtful if the whole of the demand for nitrogen for the soil could be supplied from this source. Further, our coal reserves are themselves being rapidly depleted, and thus both sources from which at present we draw our supplies of combined nitrogen for agricultural purposes are failing, and are certain at some future date to be exhausted. The future for the electrical processes, by which the practically limitless store of nitrogen in the atmosphere is drawn upon for supplying this need, is therefore a great one.

Two distinct methods and processes have been devised for achieving this fixation of atmospheric nitrogen by the aid of electric heat, and are now working upon an industrial scale. In the first of these, an electric arc flame is employed to produce nitrous compounds by combustion of the nitrogen of the air, and the gaseous mixture of nitrous oxide and nitric oxide, after cooling, is absorbed in milk of lime to produce calcium nitrite and nitrate. The Birkeland and Eyde is the most promising of the processes of this class, and it is now being operated upon a fairly large scale at Notodden in Norway, where 2100 horse-power is being utilized in this manufacture.

The second type of process for the fixation of atmospheric nitrogen depends upon its absorption by carbides at a high temperature. The most successful process of this type is that of Frank and Caro, which is based upon the use of calcium carbide as the absorbing medium. The latest information concerning the manufacture of calcium cyanamide or "*Kalkstickstoff*" (lime nitrogen) as it is called in Europe, with some practical notes upon its use as an artificial fertilizer, will be given below.

THE FRANK AND CARO PROCESS FOR THE FIXATION OF NITROGEN.

As now carried out at the large works erected at Piano d'Orta in Italy, this process consists in leading nitrogen into closed retorts containing powdered calcium carbide heated to a temperature of 1100° C. The reaction between the carbide and the nitrogen is an exothermic one and yields free carbon in the form of graphite, which remains distributed in the mass of material and gives the product a black color. The chemical change is represented by the following equation:

$$CaC_2 + 2N = Ca\,CN_2 + C$$

(calcium carbide and nitrogen produce calcium cyanamide and carbon).

The calcium carbide required for the process is produced in the usual manner, by heating lime and coke to a temperature of 2000° C. in electric furnaces of the resistor type. At Piano d'Orta the carbide is obtained from a neighboring works and is not produced in the cyanamide factory; but Frank has patented a modification of the original process which permits lime and coke to be employed as raw materials in place of calcium carbide.

The chemical equation for the formation of calcium cyanamide then becomes:

$$CaO + 2C + 2N = Ca\,CN_2 + CO$$

(Lime and coke and nitrogen produce calcium cyanamide and carbon monoxide.)

Carbon monoxide gas is thus produced in addition to the nitrogen compound, as a result of the reaction. The furnace in which Frank proposed to carry out this reaction is shown diagrammatically in sectional elevation in Fig. 2 and in sectional plan in Fig. 3. It consisted of a brickwork chamber six meters in length by three meters in height and three meters in width, containing an inner chamber constructed with a pigeon-holed wall as shown most clearly in Fig. 3. This inner chamber was filled completely with the crushed and mixed raw materials, lime and coke in the required proportion, and electric heating was provided for by the carbon electrodes and core of finely crushed coke running through the center of the mass. The nitrogen was passed under pressure into the annular space surrounding the pigeon-holed chamber of the furnace and the carbonic oxide gas escaped by the vertical vent pipe from this inner chamber, as shown in Fig. 2.

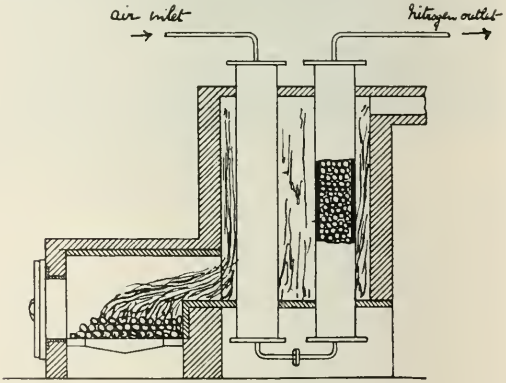


FIG. 4.—NITROGEN RETORT.

Although this method of producing calcium cyanamide is practicable, it has not been adopted at Piano d'Orta, the carbide of calcium required for this works being produced very cheaply by a neighboring carbide works. The nitrogen required for the process can be obtained either by passing air over heated copper (contained in retorts as shown diagrammatically in Fig. 4) or by the fractional distillation of liquid air produced by the Linde process. The latter method has been found the most successful and has been adopted at Piano d'Orta.

The air is freed from moisture and is then compressed and cooled to a temperature of 194° C.—under these conditions of great pressure and low temperature it assumes the liquid state.

The liquid air is now subjected to repeated fractional distillations in apparatus similar to that used in the spirit industry, and is separated by this treatment into its constituents, oxygen and nitrogen. The oxygen gas is compressed and sold in steel cylinders for various purposes, while the nitrogen is employed directly in the cyanamide manufacture. The furnace in which the absorption of nitrogen occurs is shown diagrammatically in Fig. 5. The carbide broken down to a suitable size is packed into an iron retort, provided at each end with removable covers for charging and discharging purposes. This retort is placed horizontally in a furnace, and the temperature is raised to the requisite value either by the combustion of the solid fuel or by electric heat.

Nitrogen gas is then passed under pressure into the closed retort and the absorption commences with a marked rise in the temperature due to the exothermic nature of the reaction. When no more nitrogen is absorbed, the contents of the retort are withdrawn and are allowed to cool in an inert atmosphere. The lumps of calcium cyanamide are finally crushed to a fine powder which is packed in sacks for sale.

The exact details of the method of manufacture and of the plant employed are at present withheld from publication, and the above are only the broad lines of the process as carried out at the large works erected at Piano d'Orta in Italy and put into operation in December, 1905. It is probable that the retorts and furnaces are of more complicated design and structure than shown in Fig. 5 and that mechanical methods of charging and discharging the retorts are employed in order to reduce labor costs.

The process of manufacture is in fact closely allied to that employed for the production of coal-gas, with the important difference that gas is absorbed in place of being evolved. The methods of work and design of plant suitable for the one manufacture would appear to be therefore suitable with modifications for the other. It is noteworthy, however, that some of the chief economies in coal-gas works in recent years have been connected with the design setting and working of the retorts used for distillation, and that mechanical methods are now largely employed for this latter work. That they will be ultimately adopted in cyanamide works is therefore certain.

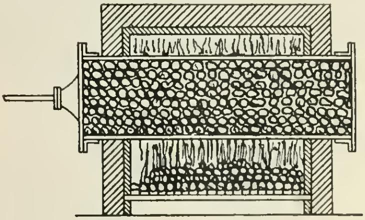


FIG. 5.—FURNACE FOR ABSORBING NITROGEN.

As regards the output of the Piano d'Orta Works, the writer is informed that six furnaces, each containing five retorts, have been erected, and that large extensions are in progress. Each retort is capable of utilizing three charges of 100 kgs. (220 lb.) of calcium carbide per day of 24 hours, the weight of the charge increasing one-fourth by the nitrogen absorbed, or to 125 kg. The present carbide consumption of the Piano d'Orta Works is therefore at the rate of about 3000 tons per annum, and the output of calcium cyanamide is one-fourth more, or about 3750 tons per annum.

As regards the industrial development of the calcium cyanamide process in Europe, it may be explained that the company owning the Frank and Caro patents and exploiting the process is the Societe Generale pour la Cianamide, of Rome, and that subsidiary companies for developing the process industrially have been formed in most of the countries of Europe and also in America.

The Italian company which has erected the Piano d'Orta Works is named the Societe Italienne per la Fabbricazione di Prodotti Azotati, and as already stated, this company has decided to largely increase the equipment of its present plant at this place. It is also stated to be planning the erection of factories at Fiume and at Sebenico upon the borders of the Adriatic.

In France a company named the Société Française des Produits Azotés has been formed, and works are to be erected at Notre Dame de Briançon, while another subsidiary company is about to introduce the manufacture into Switzerland at Martigny.

The English and Scandinavian patents have been bought by the Northwestern Cyanamide Company, and a large factory is now being erected by this company at Odda, upon the Haardanger Fiord, in Norway. The writer is informed that the initial output of the Adda Works will be at the rate of 12,000 tons per annum.

As regards Germany, the Bavarian government has granted a concession to the Cyanid Gesellschaft of Berlin for utilization of the waters of the Aly at Tustberg in southern Bavaria for this manufacture. The Siemens-Schuckert Company, as part owners of the patents, are interested also in this development, and it is expected that 15,000 horse-power will be ultimately devoted here for the manufacture. A second cyanamide factory is being erected by the same three companies at Bromberg, in Posen, where 2000 horse-power is available.

Negotiations have also been completed for introducing the manufacture into America, and the American Cyanamide Company is about to erect a factory at Mcesde Shoels in northern Alabama.

These facts relative to the projected industrial development of the Frank and Caro process for the manufacture of calcium cyanamide, prove that those financing and exploiting the process have faith in the profit-earning capacity of these works, and that they have expectations of a big future for the new industry. Time will prove whether these expectations are to be realized.

MODIFICATIONS OF THE ORIGINAL FRANK AND CARO PROCESS.

Polzeniusz has suggested the addition of calcium chloride ($Ca C_2$) to the carbide used in the retorts. A mixture of 23 per cent calcium chloride with 77 per cent carbide has been found to absorb the nitrogen at a much lower temperature—(from 700° to 750° C.)—and thus to reduce the operating costs of the process. The disadvantage of this addition is that the calcium chloride remains unchanged, and being hygroscopic it confers the same character upon the finished product. It is therefore impossible to keep dry the cyanamide made with this addition when stored unless packed in air-tight drums or kegs. Carlson, however, has improved upon the suggestion of Polzeniusz by substituting calcium fluoride or (fluor spar) for the chloride. This chemical has the same effect in lowering the temperature at which the absorption of nitrogen occurs, while it is free from the hygroscopic defect of the latter salt Whether this modification of the process will be adopted depends largely upon the relative costs of fuel, calcium fluoride and electricity generated from water-falls in the localities where the industry is started. In some localities it may pay to add calcium fluoride to the carbide while in others it may be more economical to use additional electric energy or fuel required to carry on the reaction at the higher temperature. No hard or fast rule can therefore be laid down as to which is the better process of manufacture.

It is a curious fact that pure calcium carbide does not absorb nitrogen, and that the presence of some other compound of lime is necessary to start the absorption process. In commercial calcium carbide this other compound is supplied by the lime ($Ca O$), which always exists as an impurity in the commercial product. Foerster and Bredig, who have sought to explain why these additions are necessary, assume that the chloride or fluoride acts as a solvent and enables the nitrogen to penetrate more easily the whole of the mass of carbide.

It has also been suggested that producer-gas, which contains up to 50 per cent nitrogen, would be cheaper than nitrogen obtained by the Linde process, for the manufacture of calcium cyanamide. The presence of 12 per cent of carbonic oxide in this gas, however, renders it unsuitable for the purpose, and there is no convenient or economical process known which would permit of the complete removal of this constituent of producer-gas.

The first modification of the original Frank and Caro process referred to above, in which calcium chloride is added to the carbide, has been employed at a factory in Germany situated at Westeregeln, and owned by the Gesellschaft für Stickstoffdunger. The product of this factory has been placed on the market and sold under the name of "nitrogen-lime," to distinguish it from the "lime-nitrogen" of the Italian works at Piano d'Orta. It has been stated by Hendrick that the output of the Westeregeln works is at the rate of 5000 tons per annum, and that the product is now being introduced into this country. The writer is informed, however, that the German courts have declared the modified process to be an infringement of the Frank and Caro patents and that the continuance of the manufacture of "nitrogen-lime" at Westeregeln is doubtful.

COMPOSITION AND COST.

Calcium cyanamide is a compound of the cyanide type, and its chemical formula shows that if it had retained the atom of carbon within the molecule which is set free as graphite during its formation, it would have been a true calcium cyanide or $Ca\ (CN)_2$. On fusing calcium cyanamide with sodium carbonate, this change is in fact brought about. As placed upon the market, calcium cyanamide is a fine, black, heavy powder, containing from 55 to 57 per cent of the cyanamide, and from 19 to 21 per cent of nitrogen. It is about equal in respect of its nitrogen content to sulphate of ammonia. The "nitrogen-lime," made at Westeregeln by the modified process, has a marked tendency to absorb moisture and increase in weight. The percentage of nitrogen in this product therefore will be lower the longer it is stored, although no actual loss of nitrogen is occurring. Hendrick has published an analysis of "nitrogen-lime" showing it to contain 18.35 per cent nitrogen and 5.81 per cent calcium chloride, while the average of two analyses of lime-nitrogen showed 19.35 per cent nitrogen. Both forms of calcium cyanamide have a peculiar odor due to the acetylene gas which is liberated from the undecomposed carbide, when they become damp, and both forms absorb carbonic acid from the atmosphere owing to the free lime which they contain.

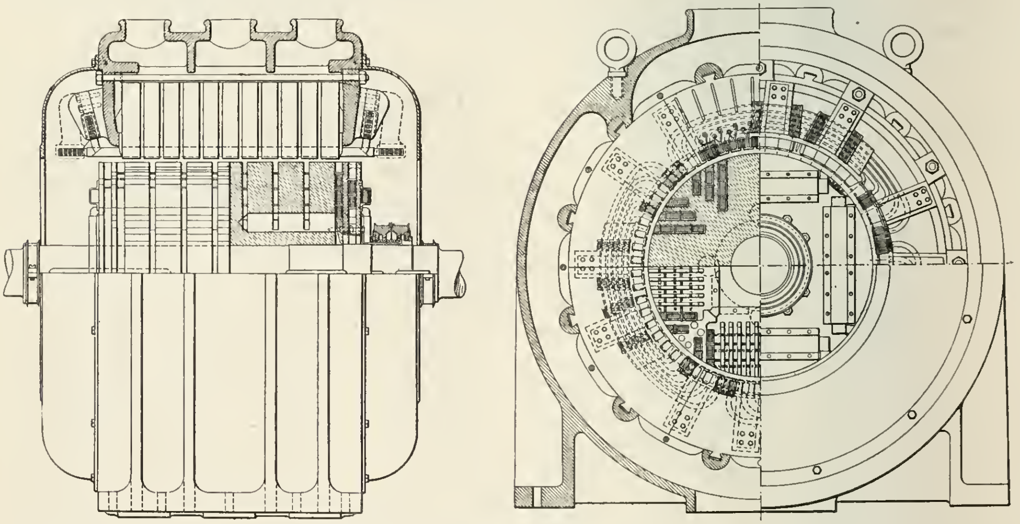
As regards costs, no very reliable figures based on actual working have yet been published.

The cost of energy is in fact the determining factor in the cost of the new product, and where this can be very cheaply devoloped, say for $10 per hp-year, the prospects for the new industry would appear to be promising. Dr. Erlwein has stated that one ton of nitrogen can be obtained in the form of calcium cyanamide by the Frank and Caro process for an expenditure of two kw-years, but whether this estimate covers all the energy requirements of the works is not clear. On the same authority the cost of producing nitrogen from liquid air at Piano d'Orta is about one cent per cubic meter, when using electric energy costing about six cents per kw-hour.

At present the chief aim of the promoters of the calcium cyanamide industry is to obtain a trial upon a widely-extended scale for the new artificial fertilizer, and to this end the selling price has been fixed so that it may be slightly cheaper than either sulphate of ammonia or nitrate of soda per unit of available nitrogen. No sales of the product are, however, being made in the United Kingdom, as there is no supply of cyanamide yet available. It is hoped that the Odde factory will commence to produce cyanamide early in 1908, and the price of the product is to be cheaper than ammonium sulphate of the same nitrogen contents. The present market price of the sulphate is $60 per ton.

Turbo-Alternators of the Corporation Electricity Works, Wolverhampton, England.

In the extension of its generating equipment, the Corporation Electricity Works, Wolverhampton, England, have installed two 1000-kw turbo-alternators which possess many points of interest. Special efforts have been made to obtain a solid construction of the rotor, so as to avoid wind friction and reduce the noise. The rotor is of the cylindrical smooth-core type, with distributed windings in open slots, and the actual core consists of a solid block of steel weighing about 8000 lb. A special feature of the design is that the slots are sunk in the direction shown in the sectional drawings of Figs. 1 and 2. One of the advantages of this method is that the former-wound coil can be placed directly in the parallel slots without disturbing the form of the coil. The winding in each slot is sub-divided into two or three sections, according to the depth of the slot, and each section is kept in position by phosphor-bronze wedges. The end connections of the field coils are secured by strong steel plates and phosphor-bronze keys, and each element is thus supported individually. The field winding consists of a flat strip wound on edge and compressed after having been placed in position.



FIGS. 1 AND 2.—SECTIONAL ELEVATION OF TURBO-ALTERNATOR SHOWING GENERAL CONSTRUCTION AND ARRANGEMENT OF WINDINGS.

This arrangement renders the rotor not only particularly strong mechanically, but it is capable of being very accurately balanced, and when once balanced there is little possibility of the distribution of weight altering.

The machine is protected by the strong cast-iron frame of the stator. This is provided with air suction and delivery openings, cold air being drawn in at the base and ends of the machine and discharged from chimney-shaped openings at the top. This scheme of ventilation is favorable to noiseless running.

The stationary armature winding does not differ materially from other designs of turbo-alternator, but it should be said that the arrangement of the end-connections is particularly neat, and at the same time great care has been taken to secure them rigidly in place, a question to which too little attention was paid in the early days of high-speed machinery. Each coil is held in position by two strong brass brackets. Speaking generally, the machines are compact for their output, and the attention that has been paid to their balancing is shown by their remarkably quiet running and freedom from vibration.

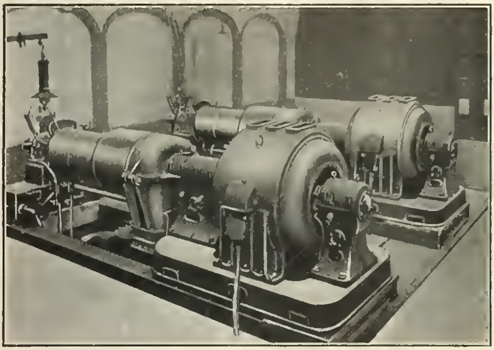


FIG. 3.—GENERAL VIEW OF TURBO-ALTERNATORS.

The above-described alternators were built by the Electric Construction Company, of Wolverhampton. They are directly-connected to Parsons turbines, built by Willans & Robinson, of Rugby, England. The turbines consume from 17.1 to 18.1 lb. of steam per kw-hour when the alternators are delivering full load at a power factor of 0.85, according to the temperature of the condensing water. The alternators are designed for 6600 volts and 50 cycles, the speed being 1500 r.p.m. It is stated that the efficiency at unity power factor the efficiency varies from 0.895 at half load, 0.92 at three-fourths load and 0.94 at full load to 0.95 at one and one-half full load.

New Telephone Patents.

CABLE TERMINAL.

Mr. F. B. Cook has obtained a patent for a new cable terminal. The cable is to be potheaded and placed within the metal frame of the terminal. This frame has an upper and lower ring, each carrying a ring of insulating material. These latter extend toward each other nearer than the metal rings and form mountings for the two ends of the various protectors. The protectors comprise a mounting carrying a fuse and carbon plate and are adapted to be mounted upon the rings. The pothead wires lead directly to the protector terminals. One of the special points of design lies in three radial, vertical flanges which hold the upper and lower rings in proper relation and at the same time afford a guide for the cylindrical cover.

SIGNALING SYSTEM FOR DIVIDED SWITCHBOARDS.

W. W. Dean has obtained a patent for a signaling system for a common-battery divided multiple switchboard. The system is suitable for an arrangement of the multiple in four sections, an answering jack and line signal for each line appearing at each section, and under selective control of the stations. Mr. Dean has provided four line relays, two in each side of the line. One of these relays is more sensitive than the other, and will work upon a current where the other fails. This affords a means of selection. Where both relays on one side work together, one signal is displayed, and when a resistance is included at the calling station, and one relay fails, another signal is displayed. The patent for the arrangement is assigned to the Kellogg Switchboard & Supply Company.

LINE PROTECTOR.

For a considerable time there has been upon the market a type of branch line fuse adapted to clamp directly to the open main line. These have been largely used, but recently their sphere has been limited because of the recognition of the necessity for an open space cut-out in addition to the fuse in many cases. To obviate this difficulty Mr. F. B. Cook, of Chicago, has produced and patented the line fuse shown in Fig. 1. A petticoat is formed upon the body of the fuse shell, beneath which is placed a conical metal ground plate. The carbons slip over the fuse. The outer fits the ground plate and has a tapered base. The inner is cylindrical, thus forming a V-section air gap affording a clear path for falling carbon dust.

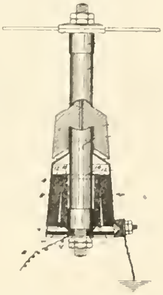


FIG. 1.—COOK PROTECTOR.

COMPOSITE SYSTEM.

While a practical solution of the problem of simultaneous transmission of telegraph and telephone messages over the same line has long been known, the adaptations of it to railway working have opened so large a field that great attention is now being paid to the subject. Railway working, of course, presents conditions far different from those of the general leased wire, principally because of the many intermediate stations and the calling-up requirements. Because of this, special sets have had to be devised for this service. Many different circuit schemes have been proposed. One of the most recent is shown in Fig. 2. This is the invention of H. O. Rugh, of Sandwich, Ill.

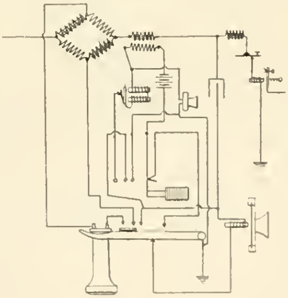


FIG. 2.—RUGH COMPOSITE SYSTEM.

It will be seen that a four-arm bridge is inserted in the telegraph line. Two diagonal arms are non-inductive and two inductive. The telephone and a condenser are connected across the middle. For telegraph currents which have passed through a smoothing impedance, the telephone connects virtual equipotential points. The alternating telephone currents meet such high impedance in the inductive windings of the bridge that practically all of them must pass through the telephone bridge.

The telephone signaling device includes a vibrator for sending out high-pitch currents for calling and a megaphone receiver for receiving the incoming calling currents.

Letters to the Editors.

Electromagnetic Force.

To the Editors of Electrical World:

Sirs:—In their "Letters to the Editors" in the issue of the Electrical World for April 25, Messrs. Hering and McAllister make use of the expression $f = H l i$ to represent the force on a conductor in a magnetic field. Although this formula is found in many text-books, it is not correct and should be discarded. The proper formula is $f = B l i$.

If the former formula were correct, one would always attempt to use diamagnetic materials as conductors and insulation for armature conductors, so that H might be made as large as possible for certain flux per unit area, B. We know that it is always B (and never H) that determines the force on conductors and the e.m.f. produced by moving conductors. B and H should not be confused. B and H are totally different kinds of quantities whose ratio μ is the permeability.

Ann Arbor, Mich. Geo. W. Patterson.

To the Editors of Electrical World:

Sirs:—The statement made by Prof. Patterson with reference to the distinction between magnetic force, magnetic flux and permeability is correct in every detail. However, his criticism seems not to apply with great emphasis to the letters mentioned above, because each of the writers stated definitely that the force varies with the *flux density* of the main field, thereby giving to the symbol H the exact physical significance that Prof. Patterson evidently assigns to B.

New York, N. Y. A. S. McAllister.

The Rights of the Inventor.

To the Editors of Electrical World:

Sirs:—I have taken no part in the interesting discussion of the patent system, because it seemed wiser to leave it to the inventors and manufacturers who have, or think they have, cause for complaint, so that real objections may be developed, and if possible remedied.

I am moved to break silence, however, by the letter of Mr. Chalmers, who complains that he cannot get for minor improvements the claims which seem to be granted for similar improvements to others. This involves two questions, the first of which is, whether Mr. Chalmers is entitled to the claims he seeks. The second question it may be permissible to suggest and to answer by the well-known anecdote concerning the famous Dr. Abernethy. It is related that a noble lord once attacked him at a social function, and describing his own symptoms as a hypothetical case, said: "Now, Doctor, what ought the patient to take?" "Take!" said the shrewd old Scot, "I should judge he ought to take medical advice."

New York City. T. J. Johnston.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Modified Cascade System.—A. Heyland.—The conclusion of his illustrated article, the first part of which was abstracted in the Digest last week. The author describes a third system which is intended to combine the advantages of the two systems described before. Its arrangement is shown in Fig. 1. A is the main working motor, B the secondary working motor which is a direct-current motor, but is equipped with three slip rings. C is an auxiliary motor which acts also as a frequency converter: it has three slip rings which are connected to the slip rings of B. Coupled with C is the auxiliary machine D, which is a direct-current machine connected to the commutator of B. If the two direct-current machines are not excited, the machine C runs as an induction motor with a small slip, the currents due to the slip being closed over the armature of B. For the first starting of C as an induction motor, the connection of its slip rings with B is broken and the slip rings are closed over the resistors. While A and B are at rest, the switches are then turned in one or the other direction of rotation and the direct-current machine D is excited to a certain amount. One-half of the current given off by this direct-current machine then passes over the armature of the direct-current motor B and the other half over the rotor of C and excites this machine. The slip of C is thereby reduced to zero and it then runs as an unloaded synchronous motor and the current supplied to the motor may then be chosen so that the phase difference in the primary circuit is just compensated. To start the two working motors A and B, the motor B is gradually excited to its full constant excitation and the exciting current of the direct-current machine D is increased. As soon as the working motors start, the speed of the two auxiliary machines C and D decreases and B runs simultaneously as a direct-current and an alternating-current motor, the direct current being supplied from D and the alternating current from the rotor of C. The machine C acts simultaneously as a motor and a frequency converter with variable transformation ratio. The advantages of this system are discussed with special reference to hoisting in mines, and to single-phase traction on railroads.—*Elek. Zeit.*, April 9.—A somewhat different discussion of the three systems is given in an article by A. Heyland on frequency transformers in Lond. *Elec.*, April 10.

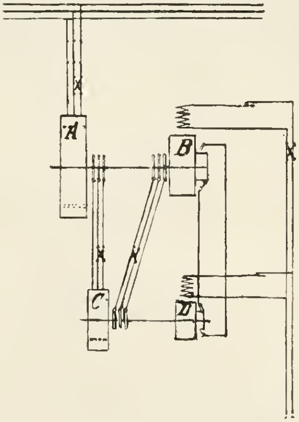


FIG. 1.—CASCADE SYSTEM.

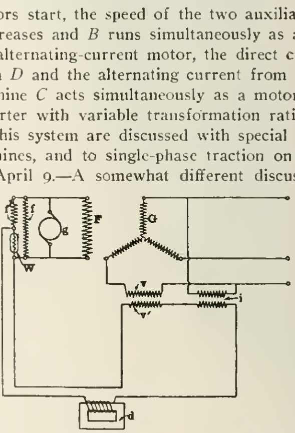


FIG. 2.—COMPOUNDING OF ALTERNATORS.

Compounding of Alternators.—An illustrated note on a method devised by Ganz & Company. It is shown in Fig. 2. G

is a generator the field circuit of which F is fed from the small exciter g. The field coils of the latter are made up of two winding f and f^1 connected in parallel, while a resistor W is placed in series with the coil f^1. The ends of this resistor are connected through a choking coil d to the secondary windings of the transformers i and v^1, these windings being in series. The former of these i operates as a shunt transformer, while the latter v works as a series transformer. When the load on the generator increases, the secondary current also rises and with it the drop across the resistor W. The result is that the effect of the second winding f^1 is diminished, so that the exci.ation of the generator and, therefore, its voltage, increases.—Lond. *Elec.*, April 10.

Three-Phase Motors.—A communication by Bragstad discussing some points in a recent article of Simons and Vollmer on the wave form of the currents in three-phase motors and the separation of the losses; with a reply by Simons.—*Elek. Zeit.*, April 2.

Lamps and Lighting.

Necessary Precautions in the Use of Artificial Illuminants.—Some further notes on the researches made by Schanz and Stockhausen, which have been noticed in the Digest, on the precautions which should be taken to protect the eye from detrimental defects of artificial light. As a result, it would appear that the disease known as "electric ophthalmia" ("arc eye") is caused by the ultra-violet rays, and that these rays, while not visible to the naked eye, are particularly energetic in their action, as is shown by photography. The ordinary lenses of spectacles, or the shades of lamps, absorb only ultra-violet rays of less wave-length than 300 microms; that is the least dangerous, while allowing those of greater wave-length to pass. Blue glasses are no protection, as the ultra-violet rays easily pass through, neither do dark glasses intercept, but only weaken them. The following recommendations are made: All lamps should be fitted with diffusing shades, so that illuminated parts whose brightness exceeds 0.75 hefner per square centimeter are not in the line of vision. The globes or shades should be made of a glass that will absorb the ultra-violet rays. They should be of sufficient thickness and constructed in such a way that they wholly surround the lamp, giving a uniform illumination. Incandescent lamps with clear globes should not be used for lighting workshops or schools. Indirect lighting is preferable to all other systems.—Lond. *Electrician*, April 10.

Generation and Transmission.

Water Storage for Energy Transmission.—A long and fully illustrated description of the Urft Valley water reservoir in Western Germany, which is at present the largest artificial basin for storing the rain deposits of a larger area (375 sq. km.) in order to prevent floods and to utilize the water power for the production of electrical energy for transmission over an industrial district. The power house is designed for eight 8000-hp generating sets, but only six have so far been installed. Each generator has a rating of 1600 kilowatt amperes, producing 50-cycle, three-phase currents at from 5000 to 5400 volts, the speed being 500 r.p.m. In the present installments the hydraulic plant, the machine plant and the switchboard are described. The transmission e.m.f is 35,000. The length of the high-tension lines was 166 kilometers in May, 1907, and that of the low-tension mains 238 kilometers. The total cost of the plant and transmission line is about $2,500,000. The storage basin alone costs $1,000,000; that is, 2.25 cents per cubic meter of water. The paper is to be concluded.—*Elek. Zeit.*, March 19, 26 and April 2.

Proposed Energy Distribution in Ireland; Use of Peat.—An account of the Dublin & Central Ireland Electric Power Bill which is now before a committee of the British House of Commons. The proposition is to supply electrical energy over three counties in Ireland. Gas engines will be used in connection with 500-kw generating sets, and the utilization of peat as fuel. The promoters estimate that the cost of fuel will be 0.1 cent per kw-hour, which is compared with the lowest cost for fuel in England at steam generating stations; namely, 0.26 cent at Newcastle and 0.38 cent at Salford. It is estimated that there is sufficient peat in the area to give 35,000 horsepower for 300 years. Capt. H. Riall Sankey, who gave evidence on behalf of the promoters, stated that whereas it was estimated that the cost of the peat would be $1.01 per ton, the return by the sale of the by-products, sulphate and ammonia, would be $0.97 per ton, and other minor by-products were estimated to produce a similar amount, but he thought it would not pay to install the plant necessary for dealing with the by-products unless a load of 10,000 kilowatts was obtained. In this event the quantity of peat burned would result in 650 tons of sulphate of ammonia.—Lond. *Elec. Eng'ing*, April 2.

Generating Station of Copper Refinery.—F. D. Easterbrooks.—A detailed and fully illustrated description of the generating station of the new addition of the Raritan Copper Works. In electrolytic copper refining cheap energy is important, since the energy cost is 40 per cent of the whole tank-house cost from anode to cathode with the present multiple system, while the energy cost is approximately 23 per cent of the total cost of refining copper from pig to wire. Relatively cheap energy can be obtained even with steam engines, since the load curve is absolutely uniform throughout the 24 hours. In the new addition to the Raritan works, the three electrolytic circuits in the tank house are supplied with energy from four steam-engine-driven 870-kw generators. The maximum current is 7500 to 8000 amperes.—*Electrochem. and Met. Ind.*, May.

Telpherage.—M. Buhle.—An illustrated article on modern systems of transportation of freight by means of suspended railways with a single rail. The electric system is preferable if the track has an irregular form, but for grades steeper than 1 to 20 it is not recommended. For steeper grades an endless cable should be used, which is also preferable when the track is quite regular, for instance, when it consists of two parallel straight roads. Several installations of this kind are described, especially with electromotives hauling a number of freight cars. —*Stahl u. Eisen*, Feb. 26.

Feed Water Heater.—J. Goodman and D. R. Maclachlan.—A paper read before the (Brit.) Inst. Mech. Eng. on tests made with respect to the advocacy by Wilkinson of the live-steam feed-water heater. The authors find that in the particular arrangement used by them, which was not that of Wilkinson, there was no gain in efficiency by the live steam method over the use of cold feed water, but there was an advantage in obtaining the scale outside the boiler instead of within.—Lond. *Elec.*, March 20.

Traction.

Booster.—W. Weissbach.—An illustrated description of the reversible booster of Pirani, as built by the Siemens-Schuckert Company. The arrangement is shown in Fig. 3. A is the railway generator, B is the battery, which is in series with the dynamo D of the motor-generator set of the Pirani booster system C D E. The exciter E has two excitation windings 1 and 2. No. 1 is connected to the terminals of the battery B, and 2 is connected to the terminals of a resistor r in the return circuit of the network. The two windings of 1 and 2 are so joined that their magnetizing effects are opposed to each other. If the network is unloaded the excitation winding 2 carries no current and the exciter E is excited by 1 alone. The battery B is then charged by D. If now the load on the network increases electricity will flow through 2, and the effect of 2 will be opposed

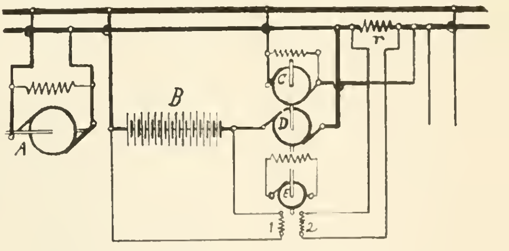


FIG. 3.—DIAGRAM OF BOOSTER CIRCUITS

to that of 1, so that less charging current exists in B. If the current in 2 further increases, a point will be reached at which the effects at 1 and 2 will just be balanced and the battery B will be neither charged nor discharged. If the current increases still further B will be discharged. If the current through r changes its sign, as is the case with roads employing recuperation of energy, the current through 2 will be reversed and the effects of 1 and 2 are added to each other, thus acting toward an increased charge of the battery. Since the voltage of the battery decreases during discharge and increases during charge, this variation of voltage of the battery aids the action of the booster toward stronger discharge or charge. With the former arrangement the booster generates the same positive or negative voltage when the exciter E has the same positive or negative voltage. It has, however, not been found satisfactory in practice to have the same positive and negative characteristics of the booster. To overcome this disadvantage an iron-aluminum cell is used in parallel with r. As is well known, it permits electricity to pass in one direction, but not in the other, so that in one case electricity will pass partly through r and partly through the iron-aluminum cell and in the other case only through r. According to the way in which the iron-aluminum cell is connected to r, it is possible to decrease the current in one direction at will and to leave the current in the other direction unchanged. Various diagrams show the results obtained with this arrangement in practice.—*Elek. Kraftbet. u. Bahnen*, March 24.

Berlin.—J. W. van Heys.—An article discussing possibilities of increasing the traffic capacity of the Berlin Stadt & Ring Bahn, especially by a modified construction of the cars.—*Elek. Kraftbet. u. Bahnen*, March 14, April 4.

Installations, Systems and Appliances.

Price of Electricity Supply and Hours of Burning Lamps.—G. Dettmar.—A reduction of the rate of charging for electrical energy results in an increase of connections and in a better utilization of the existing connections by increasing the number of hours for which they are used. The latter effect is discussed by the author on the basis of statistical data from 151 German central stations. These data show that the number of kw-hours sold per kw-rating of the station is practically independent of the size of the city and is also independent of the existence of a gas plant in the city. It naturally depends, however, on the character of the city (whether chiefly industrial or residential, etc.) and also depends greatly on the rates. The results of German stations have shown that it will often be advantageous for a station to considerably reduce the rates. While a station which charges a high rate would suffer a loss by reducing the rate only a little, it will feel the advantages of a low rate if quite a considerable reduction is made. The introduction of the metallic-filament lamp which consumes practically one-third the number of watts per candle-power, compared with the carbon lamp, is really equivalent to a reduction of the price of the energy. Nevertheless, the author thinks that many German stations could still further reduce the price. Since the new lamps at ordinary voltage are not made for small units of candle-power their introduction reduces the energy consumption practically only to one-half, instead of one-third. If, at the same time, the price for electrical energy (which is now in Germany generally from 9 to 11 cents for lamps and from 4 to 5 cents for motors) is reduced to from 60 or 70 per cent of the present price, no bad financial results will be experienced. On the other hand, statistics shows that there will be a large increase of the hours for which the existing connections are used, thus improving the load factor. Further, there will be a considerable increase in new connections. Of course, local conditions must be taken into account. It may then be possible to compete successfully with gas incandescent lamps, even of the inverted type.—*Elek. Kraftbet. u. Bahnen*, March 14.

Earth Return.—An account of the report of the earth-return commission appointed by the Swiss Association of Elec. Engs. The report, which is signed by Prof. Wyssling, discusses the use of the earth as return in direct-current circuits, with special reference to the transmission from Saint Maurice to Lausanne, where the Thury series constant-current system is used. The experiments were made with a constant earth-return current of 150 amperes. The chief results are as follows: By relatively simple means and with a relatively small cost it is possible to provide, even in a somewhat unsuitable location, satisfactory earth connections which have not too high a transition resistance (about 0.3 ohm). If the dimensions and number of the earth connections are not considered, the nature of their construction has little influence on their resistance, but it has a great influence on the lasting qualities of the connection, which is, of course, of great importance. These earth connections do not subject persons in the neighborhood to any danger, at least with direct current. The potential difference per meter distance is about 10 volts. The principal part of the resistance of the total earth circuit is in the neighborhood of the earth connections themselves. There seem to result, however, troublesome effects on railroad block-signal systems and on telegraph lines using earth return.—*L'Industrie Elec.*, March 25.

Protective Relays.—M. C. Rypinski.—A continuation of his illustrated serial, describing polyphase alternating-current overload relays for inverse-time-element action.—*Elec. Jour.*, April.

Price of Electric Energy in Sweden.—A note stating that the city of Gothenburg has recently contracted for a large supply of electric energy from the hydro-electric plant at Trollhättan, which is now being built by the Swedish government. The energy is to be delivered at the city limits in form of three-phase currents at a frequency of 25 cycles and at 6000 volts. For the first 7000 kilowatts taken a price of $13.75 per year per kilowatt of maximum demand plus 0.134 cent per kw-hour will be paid. If the city takes more than 7000 kilowatts the fixed yearly price will be raised 12 per cent for the amount in excess. The maximum demand is to be ascertained by a meter showing the highest load during a quarter of an hour. This instrument is to be read every week, and the mean of the four highest readings for the year is to be considered as the maximum demand during that period. The city's selling price to consumers has not yet been settled, for distribution will not commence until January, 1910. The Trollhättan plant at the waterfalls in the Gota River, 44 miles north of Gothenburg, is to be equipped with eight 7000-kw generators, four of which have been ordered from a Swedish company. The 10,000-hp turbines for a head of 100 ft. are also in course of construction by Swedish firms. The energy will be transmitted at a pressure of 50,000 volts on steel towers, the spans being from 500 ft. to 600 ft. For the construction of the plant a sum of $3,105.000 has been appropriated, while for the transmission lines $687,500 will be needed.—Lond. *Elec.*, March 20.

Central Station in South Africa.—P. A. Robbins.—An illustrated paper read before the Am. Inst. Min. Eng., describing in detail the central power station of the De Beers Consolidated Mines of Kimberly, South Africa. The local conditions, especially with respect to adequate water supply and cost of fuel and other supplies, are very onerous and the greatest economy in design, construction and operation was necessary. There are three Westinghouse steam turbines, each connected with a three-phase, 5000-volt, 50-period alternator. Two have a rating of 1000 kilowatts and a third of 1500 kilowatts.—*Bi-Monthly Bull. Am. Inst. Min. Eng.*, March.

Wires, Wiring and Conduits.

Mechanical Properties of Bronze Wires.—G. Nicholaus.—A paper communicated by the German Imperial Telegraph Experiment Station. When telegraph or telephone wries have been placed on poles it is found that after a certain time the sag increases, and there may be danger of two wires touching each other. This is partly due to the gradual straightening out of bends, etc., and partly to the fact of the electric properties of the wire chain. To avoid this it has been tried to subject the wire to a preliminary stretching treatment before placing it on the poles. Figures are given, together with diagrams, on the behavior of bronze wires in comparison with iron wires, and it is shown that there are two possible methods of causing a bronze wire to show perfect elasticity up to a certain maximum tension. Either the wire is subjected to repeated stretching to the desired maximum tension, or it is subjected to a single stretching operation beyond the desired maximum tension. It is shown that the latter way is unsuitable for practice. In practice the maximum is chosen at about two-thirds of the elastic limit, and a satisfactory preliminary treatment consists in stretching the wire twice slowly up to this maximum tension, which is kept constant for about two or three minutes. Practice has shown that bronze wires treated in this way do not increase their sag in time, while the changes in mechanical and electrical properties of the wire due to this treatment are practically insignificant. It is necessary to subject the wires to the preliminary treatment just before they are placed on the poles, since wires which have been treated that way and are left then without tension for a long time slowly assume their former properties.—*Elek Zeit.*, March 26.

Fuses.—A. Schwartz and W. H. N. James.—The conclusion of their illustrated paper on fuse phenomena. In the present installment the authors deal chiefly with the time element of fuses and their rating. The rating of a fuse may be determined from a consideration of the permissible temperature rise in the circuit to be protected; the time element of a fuse is, however, dependent upon the heat capacity of the fuse and its immediate surroundings. The time element of a fuse may be defined as the time lapse necessary for the heating of the fuse from the cold state to the fusing point with a given overload. The heat capacity of a fuse may be varied by change in the metal, shape and environment, and these variations may be made use of for altering the time element of a fuse for a fixed rating to a considerable extent. The greatest difference in time element will be between an open fuse of copper and an enclosed fuse of a sluggish metal such as tin or zinc. It is desirable that a definite basis for reference should be established, and the authors suggest the following definition: "The time element of a fuse is that time which is required to heat up the fuse from the cold state until it blows with an overload of 50 per cent reckoned on the normal fusing current of the fuse." For large-size enclosed fuses the time element as defined above would be of the order of four or five minutes. In enclosed cut-outs in which the fuse wire or strip is carried through a hole or slot in the end cap or ferrule and then secured by solder or in a terminal of some sort, it is necessary to protect these holes from damage from the arc. If the distance between the end caps is such that an arc can be set up between them, the hole or slot will either be considerably enlarged or damaged by fusion, or the wire or strip ends will become fused to the caps. This can be prevented by a device in which the fuse wire or strip before entering the hole or slot in the end cap or fuse contact makes contact with a washer or other easily renewable metal piece which is in electrical contact with the end caps or fuse contacts, and is, therefore, at the same electrical potential as they are. The damage will then be confined to the removable metal piece. It would appear advisable to do without free holes or openings in the end caps as far as this is possible as they not only allow of the emission of flame on short circuit, but seem to favor the persistence of the arc. An account is given of the extended discussion which followed the reading of this paper in London and Manchester. In the discussion it was brought out that a sub-committee of the (Brit.) Eng'ing Standards Committee is engaged on the question of the standardization of fuses.—Lond. *Elec.*, March 13.—The whole paper and discussion also in Lond. *Elec. Eng'ing*, March 12.

Standardization of Fuses.—Two letters concerning the advisability of standardization of fuses which is now being attempted in England. A. H. Dykes thinks there is no general demand for such standardization while F. Broadbent goes into the variations in the requirements of fuses for different classes of work, and points out that, before the fuses themselves can be standardized, a standard set of conditions to be complied with must be formulated. An English company has already standardized a series of no-voltage relays for polyphase motor switches.—Lond. *Elec. Eng'ing*, March 26.

Electrophysics and Magnetism.

Electric Discharges Through Gases.—J. J. Thomson.—His fourth Royal Inst. lecture on this subject, discussing further the mode of electric conduction through gases. The production of new ions by collisions between molecules and ions is dealt with. Reference is made to the fact that for any particular gas pressure there is a preferential easy spark gap. At ordinary (high) gas pressure the spark takes the short path, at very low pressure the long path is easier. A spark requires a certain minimum potential to pass at all, whatever the distance. The minimum potential is not the same for different gases. However, this law breaks down for gap distances comparable to the wave length of light, since two wires making what may be called a bad contact will allow a current to pass at any small potential, although there is always a layer of gas between the two wires. Here a new law comes in which is probably concerned in the phenomena of coherers.—Lond. *Elec.*, April 3.

Electrochemistry and Batteries.

Plating Iron and Steel with Zinc.—S. Cowper-Coles.—A fully illustrated paper on the protection of iron and steel surfaces by means of zinc. The methods of hot galvanizing or dipping, electrolytic zinc plating, "sherardizing" (treatment in zinc dust at a temperature below the vaporization point of solid zinc) and "cowperizing" (treatment in zinc vapor) are described and illustrated and their relative advantages for certain uses are discussed.—*Electrochem. and Met. Ind.*, May.

Electric Zinc Furnace.—J. W. Richards.—In a continuation of his serial on metallurgical calculations, the author discusses the reduction of zinc oxide in the electric furnace, with special reference to the work of Gin and Snyder.—*Electrochem. and Met. Ind.*, May.

Units, Measurements and Instruments.

Artificial Load for Testing.—N. C. Olin.—In a case of testing alternators connected to waterwheels it became necessary to provide an artificial load. A water rheostat was built as follows: Two frames were first constructed for the top and bottom, exactly alike and in the form of equilateral triangles. Rough pine "two-by-fours" were used for this purpose. Through each corner of these frames a hole somewhat over 2 in. in diameter was drilled, the distance between centers being 2 ft. Then the frames were slipped over three pieces of 2-in. iron pipe, 6 ft. long and securely pinned. Near the top frame each pipe was drilled and tapped for a machine screw to act as a binding post and from each binding post a rubber-covered wire was carried. The bottom of the frame, which was called a rheostat, was then heavily weighted and a tie was made at the top exactly in the center, so that an upright position was assured for the rheostat when in the water, and, therefore, a balanced load between phases. The total weight of the rheostat thus equipped was about 200 lb. A beam, on the end of which a pulley had been attached, was projected from a window and the rheostat was lowered into the tail race below by means of a rope through the pulley. Load regulation was attained by lowering and raising the rheostat; the load was steady and the balance between the phases nearly exact. The author was able to reach nearly 270 kilowatts, 7200 volts, with about two-thirds of the rheostat submerged and would have gone further had it been possible to keep the waterwheel up to speed with greater load. A testing table was rigged up so that the current in any phase could be read on one standard ammeter and the voltage across any phase could be checked on a standard voltmeter. As no cut-outs or circuit breakers were easily available a fuse block was rigged up by placing in each two insulators about 14 in. apart, breaking the wires at these insulators and turning them abruptly upward. Around the skinned ends of each wire, and across the opening between them, a one-ampere fuse wire was strung, giving enough turns to equal in capacity the ampere-load.—*Elec. Jour.*, April.

Selenium Cells.—F. C. Brown and J. Stebbins.—An account of an experimental investigation of the different factors which determine the change of electric resistance of selenium cells. The selenium cell changes its resistance with a change in the mechanical pressure on its surface. The pressure produces a real change in the resistance of the selenium itself. For the cases described the percentage change of resistance for one atmosphere lies between 0.05 and 0.30. This value is also a function of temperature and the e.m.f. applied in measuring resistance. An increase of pressure or a rise of temperature lowers the light-sensitiveness of the selenium cell. The light-sensitiveness is a function of the resistance of the given cell, whether this resistance be conditioned mainly by temperature, light, radium or hydrogen peroxide. The effect of radium and of hydrogen peroxide is to decrease the resistance very markedly, as much as 35 and 99 per cent, respectively.—*Physical Rev.*, April.

Metric System.—C. E. Guilleaume.—The first part of a serial on recent progress in the metric system. After a general introduction, the author deals with the measurement of fundamental wave lengths, the determination of the mass of a cubic decimeter of water, with standard thermometric scales and the coefficient of gravity.—*L'Ind. Elec.*, April 10.

Telegraphy, Telephony and Signals.

Manufacture of Magnet Coils.—F. Schnaubert.—An illustrated description of the equipment of a large factory for making electromagnet coils for telegraphy and telephony. For testing purposes a bridge is recommended which does not measure ohms, but the percentage deviation from a standard coil. The construction of the bridge and of the galvanoscope which belongs to it are described.—*Elek. Zeit.*, April 9.

Telephone Exchanges.—Stille.—The first part of an illustrated paper read before the Berlin Electrical Society on the equipment of modern telephone exchanges with the central battery system.—*Elek. Zeit.*, April 9.

Miscellaneous.

Commercial Research.—C. E. Skinner.—A review of the work of the research department of a large electrical company. "The addition of new knowledge on any subject is of both permanent and economical value, although the results of such additions may not be apparent until decades after the knowledge has been gained." In working for a large corporation, however, commercial results must be kept in view, no matter how absorbing the work may be from a purely scientific standpoint. The author then discusses different classes of work which fall into the domain of the research department. They are dealt with under the following headings: Investigation of the properties of materials; development and investigation of processes; investigation of phenomena affecting design; determination of results of design; development of new classes of apparatus; critical study of existing designs; investigation of the causes of failures; investigation of crank schemes, scientific fakes, etc. The author then discusses the methods of work. Each investigation, whether simple or elaborate, should begin where a previous one left off, and all the knowledge of the subject that can be gleaned from any source should be taken into consideration. The elaborateness and cost of an experiment should be governed by the necessity of the case and the probable value of the results. No general rule can be laid down for the conduct of commercial research work. Each problem must receive specific attention, and the necessary results must be arrived at with the least possible delay and expense. Some remarks are made on the following methods: Cut and try method; step by step method; try everything method; elimination method; checking theory method, and combinations of any two or more of the above. Whenever a result is obtained, be it positive or negative, its application must be kept in mind. The experimenter who has the most intimate knowledge of the products of his company will be the most likely to produce from his investigations results which can be applied to useful purposes. The keeping of full records of all research work is of fundamental importance, and it is absolutely necessary to make the records very complete. The personal element in the man carrying out a research also determines the success.—*Elec. Journal*, April.

Soldering Materials.—E. Hohler.—An article criticizing some points in a recent paper of Lippmann, with special reference to a comparison between two commercial soldering materials, called Tinol and Fludor.—*Elek. Zeit.*, April 2.

Electric Fire Alarm.—Auhagen.—An illustrated description of a system of acoustic signals for fire-alarm purposes, based on the principle of the phonograph. The transformation of the transmitted electrical energy into sound waves is accomplished by an electromagnetic interrupter.—*Elek. Zeit.*, March 5.

Electric Fires in London.—In a report of the London County Council Fire Brigade it is stated that the number of fires caused by defective circuits in London has fallen from 100 in 1906 to 88 in 1907. The total number of London fires attributed to electrical causes is given as 95, none of which had fatal results, as against 348 due to gas and 329 due to oil and alcohol lamps.—Lond. *Elec. Eng'ing,* March 12.

BOOK REVIEWS.

Aufgaben aus der Elektrotechnik Nebst deren Losungen. By Dr. E. Mullendorff. Second Edition. Berlin: Georg Siemens. 190 pages, 29 illustrations. Price, 3 marks.

The volume is a text-book on applied mathematics, directed to electrical engineering problems. The work is divided into 10 chapters. These deal successively with problems taken from mass-systems, potential theory, Ohm's law, conductor ramification, current distribution, miscellaneous questions, alternating currents, vector methods, least squares, and problems involving transcendentals. The methods employed are algebraical rather than graphical. The author has done good service in bringing to the notice of mathematicians the types of problem that present themselves in electrical applications.

Elektrische Beleuchtung. Volume VIII. By Dr. Berthold Monasch. Hannover: Dr. Max Janecke. 229 pages, 83 illustrations. Price, 5.60 marks.

This volume forms a good text-book on the general subject of electric lighting, including the use of arc lamps, carbon incandescent lamps, Nernst lamps, metallic-filament lamps, and the illumination which these provide. There is also a good general description of different photometers and photometrical methods. Owing to the large number of subjects included in the book it is impossible to develop any one of them very fully: nevertheless a fairly comprehensive theoretical and practical discussion is offered. The mathematics are elementary and the illustrations are simple and clear. The book will be useful to all students of electric lighting interested in German developments of the art and science.

Vorlesungen uber die Vektorenrechnung. By E. Jahnke. Leipzig: B. G. Teubner. 235 pages; 32 illustrations. Price, 5.6 marks.

Although this book deals almost exclusively with mathematics and just enough with physics to show that the mathematics is capable of practical application, yet it is not wholly without interest for electrical engineers. Probably no branch of mathematics is used more frequently by electrical engineers than that involving the vector representation of alternating quantities. It is this branch that the present volume covers. However, the treatment employed by the author is one that will appeal more strongly to the mathematical physicist than to the engineer. The first six chapters are devoted to vectors in a single plane, and the last 12 treat of vectors in space; the former are directly applicable to the ordinary single-frequency quantities, while the latter must be used when quantities of several frequencies are to be dealt with. It is customary either to neglect the vector-displacing effect of higher harmonics in alternating-current problems or to calculate the real effect without assigning a position in space to each vector, but for absolute accuracy certain of the vectors should be represented in the third dimension, certain in the fourth, etc. To those who wish to reach this higher degree of accuracy, the book will prove instructive and valuable.

The Jubilee of a Great German Electrical Company.

The largest German electrical manufacturing company, the Allgemeine Elektricitats Gesellschaft, commonly called the "A. E. G.," celebrated on April 20 the fact that 25 years ago the company was founded. The history of the A. E. G. begins in 1881, when Mr. Emil Rathenau, visiting the Paris international exposition of that year, was highly impressed by the Edison incandescent system and decided to introduce it into Germany.

In 1883 the "Edison-Gesellschaft" was formed in Berlin with a capital of 5,000,000 marks. In the following year this company made a contract with the city of Berlin, and thus secured a franchise for 30 years for light and power throughout that city. A subsidiary company (the Berlin Electricity Works) was formed for this purpose, which to-day possesses several large power houses and a complete cable network with substations throughout Berlin. The electrical apparatus, cables and steam turbines have been and are still furnished by the "A. E. G." The old Edison-Gesellschaft found it necessary to increase its capital gradually to 100,000,000 marks (fully paid up), or including the reserves and bonds, about 180,000,000 marks.

In 1887 the name was changed to "A. E. G.," which translated means General Electric Company. The A. E. G. has at all times been closely identified with the progress in electrical engineering. Soon after the experiments at the exposition of Frankfurt on Main in 1891, which showed the possibilities of three-phase transmission, the company did pioneer work in this direction, and among other things built the hydraulic power station with transmission lines at Rheinfelden.

It was the "A. E. G." that first developed the Nernst lamp, which was a considerable step in advance. Of late the Nernst lamp has been more or less overshadowed by the metallic filament lamps, the manufacture of which has also been taken up by the A. E. G. In wireless telegraphy, the A. E. G., in combination with Siemens & Halske, has developed the "Telefunken" system. During the famous high-speed electric railroad trials at Zossen the experimental A. E. G. electric locomotive won the world's record, making a speed of 210.2 km per hour.

During the bad times of 1900 and the two or three following years, many German electric manufacturing companies suffered. Some of them failed altogether and others had to get out of their troubles by means of an alliance with a stronger company. The A. E. G. suffered least of all, and has always been able to pay handsome dividends to its stockholders. In 1902 the former Union-Elektricitäts-Gesellschaft became a part of the A. E. G., and in 1903 a community of interests was established between the General Electric Company of America and the Allgemeine Elektricitats Gesellschaft.

The number of employes (not counting those outside of Germany, where the A. E. G. also owns several factories) is 30,700. The factories in Berlin occupy 272,800 square meters.

The value of the rough material necessary for manufacturing is 48.5 millions of marks per year. The cable factory alone used 19,700 tons of copper. No fewer than 43,900 dynamos, motors and transformers were manufactured in the machine factory, with an aggregate capacity of 854,500 kw. The amount of sales has increased from 1,213,000 marks in 1884 to 216,081,000 marks in 1907.

Outside of Berlin, 700 cities and towns in Germany and abroad have had their power houses built by the A. E. G. Their total capacity is 745,000 hp. The A. E. G. has built 4300 km (counting single track) of electric street railways, with 10,100 motor-cars and 20,500 motors. The turbine factory, which manufactures horizontal Curtis turbines, and which was opened four years ago, built turbines with an aggregate capacity of 560,000 hp. The sales organization comprises 45 offices in Germany, 85 independent companies and offices abroad, and 40 agencies outside of Europe.

Sandycroft Induction Motors.

Fig. 1 illustrates an improved type of induction motor known as the Hunt cascade motor and manufactured by the Sandycroft Foundry Company, of Chester, England. The motor resembles the ordinary induction motor in general appearance and is built in three different types, all for variable-speed work. The striking feature, in addition to its efficiency, is that, in its simplest form, although of the variable-speed class, it requires no slip rings on the rotor shaft, the control being effected through resistances connected to the stationary windings. The motor is provided with a short circuited rotor winding without slip rings and has the same characteristics as an ordinary slip ring motor. The starting or regulating rheostats are connected to tappings in the stator winding and the speed can be varied from creeping to full speed by adjusting the resistances. The starting torque is controlled in the same way, the motor, it is said, developing full-load torque when taking only full-load current. The motor combines the simplicity of the squirrel-cage motor with the good starting and speed regulation characteristics of the slip-ring machine, and it can be wound for very slow speeds, even in small sizes.

A modified type has the same stator arrangement, but the rotor has a double winding and is provided with three slip rings. The control is said to be as simple as that of an ordinary slip-ring motor, no changes of connections being necessary when varying speed. Where machines are required to run at two fixed speeds a short-circuiting switch is mounted on the side of the motor, which is connected to tappings in the stator windings. The motor is started by means of a resistance connected to the slip rings in the ordinary manner, and when it is desired to run at the lower speed, the slip rings are open-circuited and the tapping short-circuited. The machine then slows down to the second speed, acting as a generator while doing so. For such work as driving cranes, or where intermediate speeds are required, a special form of railway controller is supplied which controls both the stator and rotor resistances, but only one controlling handle is necessary. The motor is suitable for driving machines which require to be run efficiently for long periods at either one of two speeds. The efficiency is claimed to be high at both speeds, and the power factor but little reduced when running at the lower speed. The motor, the maker claims will develop full-load torque when taking 0.7 times full-load current or will start against twice full-load torque taking 1.4 times full-load current. When taking a starting current equal to the full load it will develop about 1.45 times full-load torque.

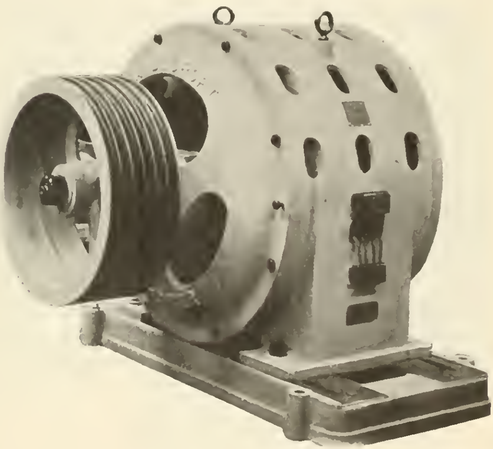


FIG. 1.—CASCADE MOTOR.

The losses at starting being small, the motor is well adapted for driving machinery which has to be frequently started and stopped, or where a large starting torque has to be exerted. In the third arrangement, a change-over switch is provided in the stator circuit. This, it is claimed, enables the motor to run at three efficient speeds without rheostatic losses. Intermediate speeds are obtained in the same way as with the other machines. An advantage in these motors is the low speeds for which they can be built: for instance, a three-speed motor for driving an induced-draft fan wound for 50 cycles gives 25 brake horse-power at 720 r.p.m., with proportionately reduced outputs at 480 and 290 r.p.m., these speeds corresponding respectively to 8, 12 and 20 poles. Similar motors with 20 poles are made to give as low as 10 brake horse-power, and 12-pole machines 5 brake horse-power. In the two-speed machines the ratio is usually 2 to 3. The designs have been standardized from five to 200 brake horse-power at various speeds and for 50 and 25 cycles.

The "X" type of motor, shown in Fig. 2, is adapted for constant speeds. While possessing the good features of the ordinary squirrel-cage motor it is said to be simpler to handle, as no auto-transformer or suchlike starting device is necessary The rotor is of the short-circuited type having high resistance squirrel-cage windings. The stator windings are of a patent type, giving alternative numbers of poles, and the motor is started by means of a simple automatic change-over switch which alters the connections of the stator windings from parallel star at starting to mesh for ordinary running. All that the operator has to do is to draw a spring bolt and move the switch into the starting position, where it is held by an electro-magnet energized by the stator current. As the motor speeds up the current in the stator falls until at normal speed the magnet releases the switch, which then drops by its own weight into the running position. The action of changing over can be regulated by springs and made to synchronize with normal speed so that no jump is caused in the circuit. For high-tension work the switches are of the oil-break type, and the hold on coil is wound for low tension and energized from the series transformer. The machines, the manufacturer claims, will develop twice full-load torque taking 3 to 3.6 times full-load current. With full-load current they will start against 55 to 60 per cent of full-load torque, and will develop full-load starting effort requiring 1.5 to 1.8 times full-load current, the actual value being dependent on the number of poles. The motors have high power factor when starting, so that difficulties with voltage regulation due to excessive lagging currents do not occur. The overlapping of the currents in the short-circuited rings and the fan action of the cross-connections with their consequent cooling effect allows the rings even of large motors to be of quite small cross-section. The inductance of the rotor is said to be less at starting than when running normally; this helps the power factor and increases the maximum-starting torque.

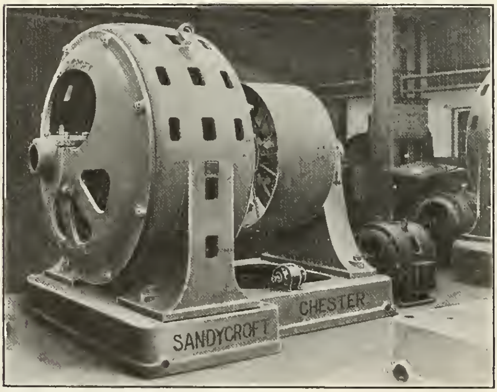


FIG. 2.—MOTOR.

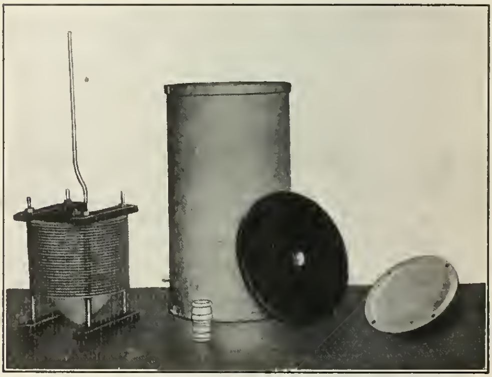
Aluminum Cell Lightning Arresters.

There has just been placed on the market by the General Electric Company a form of electrolytic lightning arrester known as the aluminum-cell arrester for operation on alternating-current circuits. The arrester, as shown in Fig. 1, consists essentially of a series of concentric inverted cones placed one above the other with a vertical spacing of about 3/16 in. The cones are insulated from each other except for the electrolyte, which partially fills them. Each cell then consists of two aluminum cones and the intervening electrolyte.

A sufficient number of cells placed in series form a complete arrester, the electrical characteristics of which are the same as a single cell. The cones complete with the electrolyte are immersed in a tank of oil which affords the necessary insulation and great heat absorbing capacity.

The efficacy of the cones as a lightning arrester depends upon a thin film which is formed upon the surface of the aluminum by a special process of manufacture. This film may be compared with the safety valve of a steam boiler which opens at a definite pressure and allows the steam to escape.

Each cell, two adjacent cones with intervening electrolyte, is designed to operate normally at 300 volts. If the potential rises to any value greater than 300 volts and less than 420 volts, the film allows the discharge to take place, but a thicker film is immediately formed and the current is again decreased to a small value. When the line potential becomes normal this extra thickness of film gradually dissolves, leaving the film in its normal condition.



ONE LEG OF 12,500-VOLT LIGHTNING ARRESTER.

At 420 volts (about 40 per cent above normal voltage) the film opens and allows a free and heavy discharge to take place. This voltage represents the maximum critical film value per cell. The plate area of the cells is sufficient to allow a discharge of more than 1000 amperes at double normal potential, or 600 volts per cell. This represents a quantity of electricity many times greater than that usually liberated by an ordinary induced lightning stroke. Consequently it is not possible to get an excessive potential across the terminals by such discharges.

The aluminum-cell arrester is designed to be connected to the line through the adjustable horn-gaps. These gaps may be set so that the voltage will break across at any desired rise above the normal operating voltage. When the conditions warrant, the gaps can be set so as to allow the arrester to discharge when the line voltage rises only about 25 per cent.

The horn-gaps perform three important functions: First, they act as spark-gaps as explained; second, they may be used as disconnecting switches, and, third, for subjecting the arrester to normal voltage. It is recommended that current be sent through the arrester every day or two, so as to assure proper formation of the film on the aluminum cones. The horn-gaps are so constructed that they can be easily short-circuited momentarily for accomplishing their purposes.

The steel containing tank prevents liability of breaking during transportation, installation or operation. Another important feature in the mechanical construction of these arresters is that the aluminum cones are supported by their rims at four points, thus making a sturdy construction and eliminating any liability of the adjacent cones short-circuiting against each other. The cone shape, or pointed construction of the aluminum, has a very decided advantage in preventing explosive or corrosive action of the arrester and prevents local heating and short life.

Some of the advantages are as follows:

1st. They are designed to discharge at a comparatively small rise of voltage.

2d. The arrester will discharge the heaviest induced stroke without allowing an abnormal rise of voltage in the system.

3d. The large amount of oil used for heat absorbing and radiating capacity enables the arrester to discharge continuously for one-half hour. This is particularly desirable in case of a grounded phase, since the cause of the ground can often be located in a half hour's time, or the necessary switching done to transfer to another set of buses.

4th. An inherent feature of the aluminum-cell arresters with a properly formed film is the fact that no dynamic current will flow as a result of the discharge.

An Emergency Telephone Installation at Antwerp.

An emergency installation recently completed at Antwerp, Belgium, is of peculiar interest, on account of the ingenious adaptation of certain types of central-battery apparatus to other uses than those for which they were originally designed and the great saving of time thus accomplished in completely restoring a telephone service which had been entirely destroyed by a disastrous fire on the night of Oct. 28, 1907.

The fire started in a room adjoining the telephone exchange and before it was subdued completely wiped out the local exchange as well as the long-distance switchboard located in the same building. The local switchboard, a multiple-magneto board employing series jacks and manual restoring line and clearing-out drops, was the oldest multiple exchange in Europe. The subscribers' lines were all operated on grounded circuits, except 200 which operated on metallic circuits for subscribers talking long distance.

The morning after the fire a conference was held between the officials of the government, which controls the telephone system in Belgium, and the engineers of the Bell Telephone Manufacturing Company, the Antwerp house of the Western Electric Company, to arrange details for restoring the service. The first problem, after arranging to take care of the long-distance business over a temporary board, which work was completed in a few hours, was to restore telephone service to the subscribers in the shortest possible time. As a second consideration it was desired to make the installation of such a nature and design as to permit of an easy and economical transformation to a permanent and modern system. Several plans for a provisional magneto board were discussed, but upon the advice of the manufacturing engineers it was decided to use central-battery switchboard frames and to arrange all the circuits so that they would operate satisfactorily with the magneto subscriber sets which had been in use with the old board. This plan accomplished the saving of a great deal of time which would have been required to install new central-battery telephones at all substations and presented the advantage of using switchboard apparatus which could be readily rewired and used in any central-battery exchange.

The frameworks for 12 sections were immediately taken from the factory and set up in the new telephone building located about one mile from the old exchange. The standard central-battery line and cut-off relays were rewired to operate on the magneto calling system and the cord circuits were provided with series drops for clearing-out purposes. Such radical departures from central-battery principles involved a complete rearrangement of the circuits, and some auxiliary circuits, which had to be worked out as the installation progressed which it was impossible to try out until it was practically completed.

The new switchboard, as it now stands, consists of 12 subscriber sections, one auxiliary line section and one switching section, each section equipped with 4800 multiple jacks and 130 to 140 answering jacks and line lamps per operator. The main frame and relay rack are located in an adjoining room, but the intermediate distributing frame was left out of the emergency equipment in order to save time and avoid all unnecessary installation work. Twelve long-distance switchboards are located in line with the subscriber switchboards and a number of temporary tables have been arranged for regular chief operator and information-desk service. They are connected in the regular way by local trunks to the various switchboards to permit supervision and are arranged for central-battery transmission.

The entire switchboard installation was completed just 28 days after the fire. During this interval the subscribers' lines had been carried into the new terminal room, and each station had been called up and tested out from that point, so that it was possible, at this time, to begin immediately the work of connecting up the individual subscribers to the new board at the main distributing frame. Complete and regular service was restored on Sunday, Dec. 1, just 33 days after the fire. The Belgian Telegraph Administration had anticipated a delay of several months in opening the new exchange for service.

The Time-Element Thermal Cut-Out.

The time-element thermal cut-out illustrated herewith is actuated entirely by the heat generated in the circuit of the apparatus it is designed to protect. The device is very simple and consists of a chamber containing a resistor above which is placed a corrugated capsule, the expansion of which causes a piston pressing directly on to it to raise and actuate the trigger of the switch. The capsule can exert a pressure of 20 lb. to 30 lb. without being damaged. The burning out of a motor or other apparatus is caused not only by an excessive current, but also by the time this excess is allowed. This device, once set, acts quicker or slower according to the magnitude of the current flowing, and with proper adjustment no apparatus thus protected should ever come to grief from this cause.

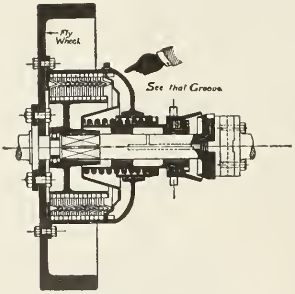
THERMAL CUT OUT.

With normal current, the device absorbs only about five watts, and the heat developed in the chamber is radiated; but any overload above 10 per cent will cause the device to act in a time inversely proportional to the overload. Any motor or arc lamp takes at starting an increased current and especially so the alternating-current motors, and, in fact, there always is a rush of current on closing a circuit. The thermal cut-out not only allows the rush of current of starting, but also prevents this or any smaller excess above the normal to flow for an undue time. Further, an alarm can be given as soon as the piston begins to rise, and before the cut-out opens, thus giving sufficient warning to the attendant. The device is manufactured by the Simplex Conduits, Limited, of London, England.

The "Hele-Shaw" Clutch.

The accompanying illustration shows the "Hele-Shaw" clutch, an English invention, of which the Merchant & Evans Company, of Philadelphia, are the manufacturers in this country. It is stated that the English manufacturers have, during the past four years, installed something like 25,000 horse-power in rating of this clutch in over 50 different applications ranging from one to 1000 horse-power.

The peculiarity of the clutch lies in the fact that the engagement of the plates is in a 35-deg. V-shaped circumferential groove which, it is claimed, makes each pair of plates do three times the work of any flat pair, or the same work with one-third the spring pressure. By the engagement in a V-shaped groove, the flat portions of the plates, or the fins as they are called, are always separated by about ⅛ in. This permits the circulation of an oil bath constantly right up to the point of work and radiates heat continuously, thus preventing excessive temperature rise of the clutch due to slippage. In the event of the accidental absence of oil, the same amount of heat that would distort a flat plate does no injury to the Hele-Shaw plate because of its transverse rigidity due to its peculiar groove. The absence of heating makes it peculiarly advantageous for constant-duty work, such as planer and machine tool reverse gears, automobile and motor-boat work, all automobile drives, where the clutch is constantly working in and out of engagement, pulley and coupling work at important points, cranes, gas-engine and electric-motor drives, rope-drive work for conveyors, hoists, etc.



CLUTCH.

Another peculiarity of the clutch is its uniform rate of pick-up. When thrown into an engagement it picks up its load on a straight diagrammatic line instead of a curved one. This peculiarly gratifying property of the Hele-Shaw clutch appeared in its experimental stage and was later proved in practice by its employment to couple up alternating (constant-speed) electric motors to Hoe printing presses. Unless the rate of pick-up in this engagement is absolutely uniform from a state of rest to full speed the damp paper in the press is torn. A number of large electrically-driven printing establishments in London are now equipped with Hele-Shaw clutches.

The inner disks of the clutch are of mild steel and the outer of phosphor-bronze except in certain peculiar cases, where all of the toothed plates are steel with intermediate slipper plates of bronze. The inner plates are toothed to the driven drum and the outer plates are toothed to the driving drum, and by proper mechanism the engagement is permanently or temporarily affected, as the design demands.

Equipment of English Mines and Factories.

Renewed activity appears to be manifested in the electrical equipment of English mines and factories. A number of new equipments are reported by the power and mining department of the British Thomson-Houston Company, as noted below:

Sheffield Coal Company, for its Birley Collieries, near Sheffield.—One 250-kw, 375 r.p.m., 3000-volt, 50-cycle, three-phase b.t.h. Belliss generating set; three-panel main switchboard; five sets of main and tail haulages (two 30 and three 50 horse-power); two motor-driven pumps (30 and 80 horse-power); one 100-kw and two 70-kw transformers, and high-tension and low-tension panels.

Pease & Partners, Darlington, for plant to be installed at Bowden Close Colliery.—One 120-hp, 480 r.p.m., 440-volt, 40-cycle, three-phase, slip-ring, protected type haulage motor, with tramway type reversing controller and panel; one 25-hp, 770 r.p.m. fan motor; one 130 kw, three-phase, 2750/440-volt, oil-cooled transformer, with the necessary switchgear.

Morris & Shaw, Ltd., Birch Coppice Colliery, Polesworth, near Tamworth.—Main switchboard, pit bottom and feeder panel; one 75-hp, three-phase motor for driving endless haulage gear; the requisite feeder cable.

Gwynnes, Ltd., Hammersmith.—Testing plant, consisting of a 120-kw motor generator set, made up of two 60-kw C. C. generators tandem coupled to one induction motor; one 110-k.v.a. three-phase motor generator, and a motor exciter of 10 kilowatts.

D. Selby Bigge & Company, for Earl Fitzwilliam's Colliery, Elsecar, near Sheffield.—One 350-kw exhaust steam turbo-alternator, with heat accumulator, condenser and the requisite switchgear.

Glenboig Union Fireclay Company, Glenboig, Scotland.—Two 45-hp, one 25-hp and one 15-hp, three-phase motors and panels and two transformers, for driving pumps at its works.

Finlayson, Bousfield & Co.'s linen-thread mills, Johnstone, Scotland.—One 200-kw, 428 r.p.m., 500/550-volt, 50 cycle, three-phase alternator, with three pedestal bearings, protection caps, rope pulley, base plate and direct-coupled exciter, together with the necessary switchgear.

Joshua Whiteley & Company, Ltd., Huddersfield, for their "Albert" textile mill.—Complete installation, consisting of 23 three-phase induction motors totaling upward of 800 horse-power, with the necessary steel work for mounting the ceiling motors and controlling gear and cables. This is the first textile mill to be electrically driven from the corporation three-phase mains in the Huddersfield district, which is one of the main centers of the textile industry. This contract should be as far-reaching in its influence on the development of textile driving in this district as the Acme Mill has been in Manchester.

D. Selby Bigge & Company, Newcastle-on-Tyne, for the Cannop Collieries, near Lydney, Glos.—Two 300-kw, 375 r.p.m., 2750/3000-volt, 50 cycle, three-phase alternators complete with exciters and rheostats, for direct coupling to high-speed engines.

Steel, Peech & Tozer, Ltd., Sheffield.—One 750-kw, 285 r.p.m. continuous-current generator for direct coupling to Belliss engine.

J. Booth & Bros., Rodley, near Leeds, equipments for four cranes.—Two 24, two 15, one 10, one 8, four 7½, one 5 and two 3-hp, three-phase, 400-volt induction motors, 710 r.p.m., in all 13 machines, complete with tramway-type controllers and brake magnets.

Admiralty.—Nine motor generators (eight 120 amp. and one 8 amp) for operating searchlights on H. M. S. *Defence.*

Robt. Addie & Sons Collieries, Ltd., for their Rosehall Colliery (No. 7 pit), Coatbridge.—One 250-kw (310 k.v.a.), three-phase generator, 550-volt, 50-cycle coupled direct to Belliss engine.

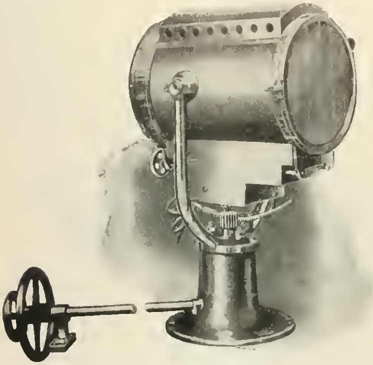
Messrs. Stevenson, McGuffie & Milne, of Glasgow, for Binley Colliery, belonging to Messrs. Merry & Cunninghame, Glasgow. —Two 62½-kw C. C. generators coupled on combined base to one Howden engine; one four-panel switchboard.

The Ansley Hall Coal & Iron Company, Atherstone, Warwickshire.—One 500-kw, 340 r.p.m., 500-volt, compound wound, open type C. C. generator, to be driven by ropes by a pair of Robey engines running at 85 r.p.m.; two switch panels for above.

The Dean & Chapter coke oven plant of Messrs. Bolckow, Vaughan & Company.—Eight 16-hp, two 10-hp and four 3½-hp, three-phase motors complete with the needful controllers and switches.

Marine Searchlight.

The accompanying illustration shows one of many different types of searchlights manufactured by the Carlisle & Finch Company, of Cincinnati, and which is said to embody all the latest improvements. This type of searchlight is intended to be placed on the upper deck or mast of the vessel and to be operated from the bridge or some other distant point. The horizontal controlling rods may be made any length desired and are supported in small brass bearings. All parts of the lamp are made of brass and copper and are not liable to corrosion. The mirrors used in this and in all of the searchlights made by the company are carefully ground and polished and silvered on the convex side. The company manufactures searchlights up to and including projectors of 38 in. in diameter and in a great many different styles to meet various requirements. A 9-in. yacht searchlight, arranged for pilot-house control, is fitted with a new form of carbon-feeding mechanism. This follows the same general construction of the mechanism of larger lamps with the exception that it is more compact. The lamp is arranged for both automatic and hand control and is suitable for launches and yachts. The company also builds a 14-in. marine-type projector which is fitted with a glass lens mirror, the metal parts being made of brass and copper so as to withstand the corroding action of the salt air.



SEARCHLIGHT.

The Cutting of Armature Disks and Segment Blanks.

The extensive introduction of electric motors and dynamos for power and lighting purposes has created a large and increasing demand for special tools and machinery for the accurate and economical production of the various parts entering into their construction. One of the most important of these parts is the armature disk. The needs of the trade demand many different sizes of armatures, which has consequently developed several distinct methods for making the blanks or punchings from which the armatures are built up.

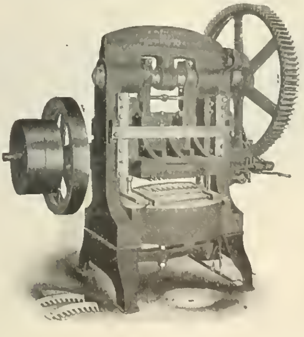


FIG. 1.—ARMATURE DISK AND SEGMENT CUTTING PRESS.

The usual form of armature is made up of annular disks with notches on the outside and inside edges. As it is essential to have the outside and inside concentric it has been found best to adopt dies which, by cutting them simultaneously, eliminate the inaccuracies which are almost unavoidable when the cutting is done in two or more operations. In many cases the notches and keyslots are also punched at the same time, all of which call for tools having "throw-out" pads in addition to the cutting parts, so as automatically to push the disks and scrap out of the dies and punches.

These "throw-out" pads have generally been operated by means of heavy springs, which are not always reliable and consume a great deal of the power of the press. To overcome the uncertainty of positively stripping the blank and the use of unnecessary power, the press shown in Fig. 1 has been so designed as to do away with springs and to operate these "throw-outs" in a positive manner, and in doing so to consume but little of the power of the press.

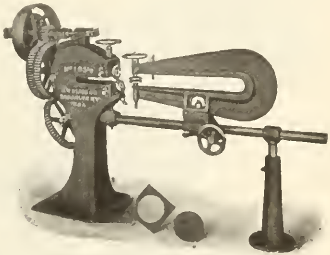
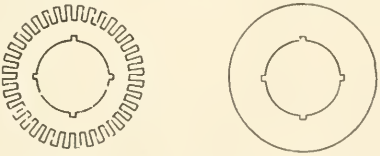


FIG. 2.—CIRCLE SHEAR.

The bottom plate, which operates the "die-pads" through radial slots or pin holes in the bolster, is actuated by two rods connecting it directly with the slide, as shown in press illustrated in Fig. 1. It is adapted for both disk and segment cutting.



FIGS 3 AND 4.—ARMATURE DISKS.

When presses are to be used exclusively on work requiring "die throw-out" pads some manufacturers prefer a solid bed with radial pin slots and "T" bolts, as shown in Fig. 1, but the presses are more generally built with bolster plates.

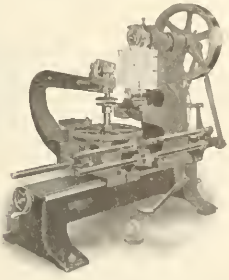


FIG. 5.—ARMATURE DISK NOTCHING PRESS.

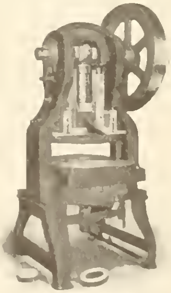


FIG. 6.—ARMATURE DISK CUTTING PRESS.

For disk cutting only, two cross-pieces adjustably attached to the frame of the press actuate the "throw-out" pads of the punches by striking against them on the return motion of the slide. For cutting armature segments, as well as disks, a plate knockout in the slide, as shown on press in Fig. 1, is required instead of the bar knockout, which permits of locating knockout pins at any point in the slide as may be required by the size and shape of segments to be cut.

According to the size and quantity of disks required they are usually cut in one of many ways. For very large diameters or relatively small quantities, the shearing of the outside and inside circles is done on a circle shear, such as shown in Fig. 2. These disks are then notched on a notching machine, such as illustrated in Fig. 5. The key notches on the inside are usually slotted by means of a vertical shaping machine after the disks have been put together. A deep-throat press fitted with a special attachment may also be used for this work.

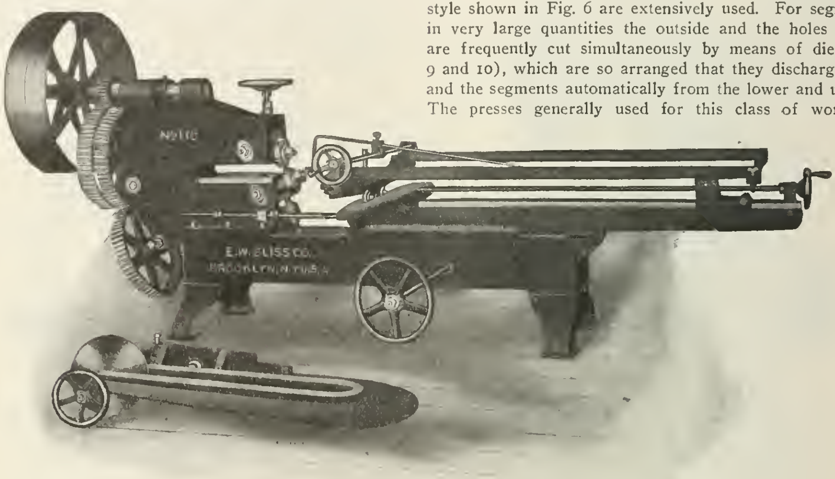
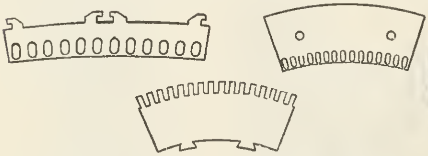


FIG. 7.—CIRCLE SHEAR, WITH SEGMENT-CUTTING ATTACHMENT.

For such disks as are made in large quantities and which are of moderate diameter (street-car motor disks, for instance), the best factories use power presses with tools so arranged that the inside with its key slots and the outside with its notches are cut simultaneously at one stroke (see Fig. 3). This constitutes the quickest, most accurate and most economical way of manufacturing armature disks in large quantities. The presses used for these dies are provided with knockout attachments which discharge the scrap and the disks so as to lie loosely on top of the dies whence they may be easily and quickly removed. When possible the presses are placed in an inclined position, allowing the blank to fall off by gravity, which method permits of increasing the daily production.



FIGS. 8, 9 AND 10.—ARMATURE SEGMENTS.

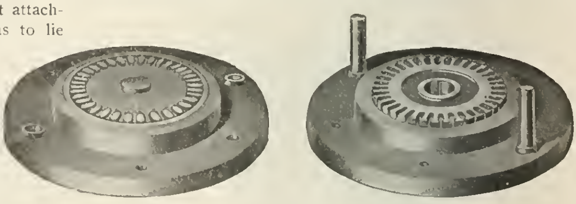


FIG. 11.—ARMATURE DISK-CUTTING DIE.

In many cases where the dies, mentioned in connection with the second method, would be too costly to be used economically, a successful method for good results is the cutting out simultaneously of the plain outside and the notched inside as indicated by Fig. 4. This method produces an absolutely concentric blank ready to be notched, and, as the outside notches are cut separately, the power of the press is equal to cutting much larger diameters than when the outside, inside and notches are cut simultaneously as specified in connection with the second method. The notching is then done on a notching press, such as illustrated in Fig. 5. From the inside scrap the projections corresponding to the key notches are usually removed by a die which at the same stroke cuts the inside with its key notches, thus working the scrap over into smaller disks without any loss of stock.

In some works it would not pay to use the dies named for the third method, which dies are still somewhat expensive on any but the most current sizes of disks. In that case dies which cut the outside and inside separately are used and operated in standard presses. For the smallest sizes of disks, presses of the style shown in Fig. 6 are extensively used. For segments used in very large quantities the outside and the holes or notches are frequently cut simultaneously by means of dies (Figs. 8, 9 and 10), which are so arranged that they discharge the scrap and the segments automatically from the lower and upper tools. The presses generally used for this class of work are the double-crank type, such a press being illustrated in Fig. 1, the size depending upon the length of segment. However, many segments have their plain outside cut first and are perforated or notched separately in a notching machine, such as illustrated in Fig. 5, to which is fitted a segment-notching device.

In some cases segments are of such a large size and the number required comparatively small; in these cases it has been found economical to adopt the following method: To cut the inside and outside diameters in a circle shear fitted with segment-cutting device, such a machine being illustrated in Fig. 7, after which the ends are sheared in a power squaring shear by means of a stop gage. The notches are then cut in an armature-notching machine, such as illustrated in Fig. 5, which for this purpose is fitted with a segment-notching attachment, not shown in the machine illustrated. In Fig. 11 is shown an armature-disk cutting die and punch, such as used for cutting the inside, outside, notches and keyways simultaneously. This construction of die has been found to give very good results. The machines illustrated are built by the F. W. Bliss Company, Brooklyn, N. Y.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Unseasonable weather conditions during the last week curtailed distributive trade, but sentiment was greatly improved in financial circles by the successful bond flotations. Fall orders are scarce and collections remain slow. In most industrial lines curtailment is still the feature. The number of idle freight cars has reached a record low point, but money continues abundant and easy, with little demand. Foreign trade, as a whole, was quiet with a promise of improvement in export demand for cereals after the smallest week's shipments in two years. Prices are irregular. Certain iron and steel lines show improvement, but as a whole that line of trade is quieter than a week ago, the pig-iron industry being exceptionally dull. Good crop conditions promise well for all lines of business, but at present reports indicate a small volume of trade. Business failures for the week ended April 30, as reported by *Bradstreet's*, were 282, against 254 last week, 163 in the corresponding week in 1907, 139 in 1906, 193 in 1905 and 176 in 1904. The electrical export trade during the last month on the whole has held up remarkably well considering financial conditions in this country, which were more or less reflected in all other countries. The falling off in this branch has been estimated at about 15 per cent from the same period a year ago. There are many indications that a number of large electrical development projects which were stopped at the time of the panic will shortly be taken up again and pushed to conclusion. The total gross earnings of 194 electric traction properties in 1907 was $235,718,432, an increase of $23,275,526, or 10.9 per cent over 1906, but the first quarter for 1908 will undoubtedly show a heavy falling off from the above figures. The circular issued by Mr. George Westinghouse to the Westinghouse stockholders urging them to subscribe to the new "assenting" stock, which will enable the company to emerge from the receivership, attracted much attention and the consensus of opinion was that the stockholders would advance the necessary funds, especially in view of the fact that the business of the Westinghouse Electric Company is in good shape and showing betterment from month to month.

STATUS OF EXPORT TRADE.—According to an officer of one of the largest electrical exporting houses which has offices in nearly all of the civilized countries, there is every indication that during the next decade China will take place as one of the largest, if not the most important, importer of American electrical machinery. "Japan for some time has been an important factor," he said, "and at present is the most active foreign country in electric development, but China is beginning to stir and seems to offer the most possibilities for the future. The opportunities in a country with 400,000,000 inhabitants, which has been practically at a standstill for centuries, is obvious and already there are indications that the rooted customs of the country which have been so long an obstacle against the introduction of modern methods, are beginning to change. In the past the Chinese would touch little in the line of cereals except rice, but now they are beginning to take up wheat and grain, and recently machinery for flour mills has been shipped up the Yang-tse-Kiang, where there is good hydraulic power. Although there is much coal in the kingdom, it is mined in a primitive fashion and a great deal is brought from the Pacific islands. With its immense population and its many opportunities for excellent hydro-electric installations, China should develop enormously. The trouble with the Chinese is that they have very little engineering ability. They have not sent their young men to the American universities to learn modern engineering methods as have the Japanese, and heretofore most of their importing has been done through English or Japanese concerns. The Chinese business man is a wonderfully close buyer, but is as honest in his dealings as one could wish. This is in accordance with the reverence which he feels for his ancestors which permits him to do no dishonest act. In contrast are the Japanese, who may be charitably described as 'shifty.' That the Japanese realize the superior ethical qualities of the Chinaman is shown by the fact that a large percentage of the clerks in the Japanese banks are Chinamen. The opening up of China has been largely done by the Japanese, but at present there exists a trade boycott between the two countries which grew from the seizure by the Chinese of a Japanese vessel laden with munitions of war, and was intensified by the failure of a large Japanese bank which had Chinese connections. Bank failures in China are almost unknown. Most of the Chinese importing has been done through the house of Mitsui & Company, headed by Prince Mitsui, who is called the 'J. Pierrepont Morgan of Japan.' As yet the trade boycott has not made itself felt in this country and whether or not it means that hereafter Chinese buying will be done directly, or simply placed through another house, remains to be seen. American machinery holds the field in China and Japan, although the English and Germans are by no means negligible quantities. The predominance of the Americans is due to the fact that the Japanese control the situation in both countries and the Japanese, educated along American lines and familiar with American products, stick to the methods and products with which they are acquainted. South Africa, Australia and India continue, as in the past, to purchase the major part of their electrical supplies in England. In the Philippines there is little activity in electrical lines excepting government supplies. In Panama there is an active government demand, but the manufacturer does not get his money for 12 months or longer and so vexatious is the system of inspection and there is so much bureaucracy and so many men 'higher up,' that practically all of the large concerns have ceased bidding on government material. The building of the canal by the army is a huge blunder. There are four clerks to every workman and more time is spent in estimating the height to which a laborer swings his shovel and seeing that he does not work five minutes over time, than to the actual amount of work he accomplishes. In many instances civilians are at the head of departments which should be run by engineers. If the building of the canal had been sub-let to hard-headed Irish contractors there would have been an immense saving in time and also of about $15,000,000 in cash. Cuba is purchasing little on account of bad sugar and tobacco crops and the same is the case with Porto Rico. Conditions in Cuba have improved vastly since we again took over the island and it is to be hoped that we remain in control. The country offers excellent opportunities and is at length getting down to a strong, stable business basis. In Brazil and Peru the Germans have practically run away with the market owing to close price-shaving and strong home co-operation and backing. The German Emperor is more of a Commercial Emperor than a War Emperor. He has made a strong bid for foreign business by awarding medals, subsidies and by backing exporters with all the other means in his power. Notwithstanding the fact that German freight rates to Valparaiso, Iquique and Lima are $2 per ton higher than American freight costs, the Germans have all but shouldered the English and Americans out of the market. The Deutsche Bank has branches in Mexico, Brazil, Argentina and Peru; the local branch looks into an account and if satisfactory, guarantees it to the manufacturer, often allowing a year's credit. Moreover, the Germans have a system of pooling business interests, a sort of 'close corporation' among themselves. If the steel salesman comes across anything of interest to the electrical representative, he transmits the information and vice versa. There are indications, however, that the tide is about to turn from the Germans toward the Americans and English. If a German agent sells a 100-hp motor the native purchaser gets exactly 100 horse-power and no more to allow for overload. The leeway in our machinery is giving it a better standing than the German output. Chili and Peru are virtually bankrupt and very few orders are being placed. Their condition might be called an echo of the crash here. Their currency has depreciated heavily, inflation and excessive and 'wild-cat' mining speculation having contributed to their financial prostration. Strangely enough Argentina, on the other side of the Andes, is in splendid financial and industrial condition. The country is rolling in wealth, the cattle herds were never larger and the country will produce more wheat this year, it is predicted, than the United States. Never in its history was the Argentine Republic in better shape. Nearly all of the large electrical houses have branches in Canada, as the duty prohibits much exporting. Mexico continues to furnish an active demand for American products. Summarizing the general export situation, it is evident that, under the financial conditions, the export business is holding up remarkably well, vastly better than home electrical markets. As compared with the same time a year ago the export trade has fallen off by between 15 and 20 per cent, which, all things considered, is an excellent showing."

WESTINGHOUSE COMPANIES.—The business of the Westinghouse companies for the month of April continues to show the evidences of improvement which have manifested themselves since the beginning of the year, when the first signs of a returning activity in the industrials became noticeable. As far as the affairs of the Westinghouse Electric & Mfg. Co. are concerned, the improvement was not marked by any spurts in the shape of very large orders. On the contrary, the increase has been slow and steady and was especially remarked in those departments where the smaller apparatus is constructed. "Our business in small motors," remarked one of the heads of the department, "has never been better than at present." Similar information was obtained from the industrial and power department. A particularly encouraging feature in the operations of that branch has been the business in electric mining machinery, especially mining locomotives, for which the company has received quite a large number of contracts this spring. The export business of the Electric Company has also been unusually active within the last three months. The fact that the Westinghouse Machine Company was taken out of the hands of the receivers on April 1 had undoubtedly a favorable effect upon the affairs of that company, inasmuch as the business during last month showed strong and encouraging signs of a distinctively active revival. Various orders for large steam turbines were obtained at the East Pittsburg works, and the producer, gas engine, steam engine, as well as the stoker departments show this increase in business. Among the turbine orders was one for a 5000-hp machine from the West Penn Railway Company, of Connellsville, Pa., making the fifth turbine of the Westinghouse type ordered by that company within the last three years. The City of Cleveland also furnished a repeat order for a 2000-hp steam turbine, to be installed in the municipal lighting plant. A 1000-hp turbine order was also received by the Machine Company from the Hawaiian Electric Company, of Honolulu, and an order for a 5000-hp turbine came from the New England district, the Hartford Electric Company sending the contract. The business at the works of the Air Brake Company in Wilmerding, and in the shops of the Union Switch & Signal Company in Swissvale has not made any records of exceptional improvement. The operation of these plants depends almost entirely upon the activity in the railroad business, and no great revival is looked for by these companies until the railroads are again in a position to take up new construction work, as well as new brake and signal equipments.

WESTINGHOUSE EXPORTS.—It is gratifying to note the continued demand from the Far East for American machinery. Japanese industries are particularly active in this direction and within a recent period the Westinghouse Machine Company has booked a large number of orders through its Japanese representatives, Messrs. Takata & Company, of New York and Tokio. Outside of turbines and gas engines, the demand for vertical compound steam engines, a characteristic of Westinghouse construction, is as active as ever. Three 500-kw Westinghouse turbines have been shipped to the Imperial Steel Works, Japan, and to the Hakkaido Tanko Steamship Company. The Noble School, Japan, has installed a gas engine producer plant. Four 105-hp compound engines go to the Tamagawa Electric Company, Japan, and to a private isolated plant in China. Other equipments have been ordered by the Acadia Sugar Refining Company and the Yamada Hospital.

MOTOR MACHINERY FOR VITICULTURE.—Considerable attention is being attracted in Europe, a consul writes, by the application of motors for agricultural purposes, and especially for viticulture. The international competition for motor machinery will be held at Palermo, Italy, in the fall and a royal decree states that the machine adjudged to be the best will be awarded a diploma and about $2,000, and that the Minister of Agriculture will purchase two of this class. The second prize consists of a medal and about $600. Application for admission must be sent to the Minister of Agriculture at Rome, not later than Aug. 15, and the machines or apparatus must reach Palermo by Oct. 16.

REPRESENTATION FOR AMERICAN FIRMS IN EUROPE.—A member of a New York firm of engineers who will leave this country shortly for an extended business trip in Europe, would like to hear from American firms who desire to obtain a market for their goods in any of the European countries. He says that he has business connections in Austria, France, Germany, Italy and Switzerland, all of which countries it is his intention to visit. He adds that he is familiar with European market conditions and possesses a knowledge of the languages required to do business. His name and address may be obtained from the Bureau of Manufactures, Washington, D. C.

NEW WIRELESS INSTALLATION.—A complete equipment for a 20-kw wireless station was shipped on April 25 to the Dominican Republic on the island of Hayti by the firm of Frame & Company, of 90 Wall Street. This new government station will have an effective range of 800 to 1000 miles and will communicate with Central America, North America and South America. A 2-kw service has been shipped to the new revenue cutter *Androscoggin*, which is stationed at Baltimore. The *Androscoggin*, with a displacement of 1276 tons, is the second largest vessel of her class in the service, and is the tenth of the U. S. revenue cutters to be equipped with the wireless service.

DEVELOPMENT OF WHITE RIVER.—The hydro-electric power development on the White River will be completed this year. Plans and specifications are being prepared by Mr. H. von Schon, consulting engineer, Wayne County Bank Building, Detroit, Mich. The works required will consist of a spillway 300 ft. long and 20 ft. high; reservoir banks 15 ft. high and 250 ft. long, and a system of waste gates. The power station was built some years ago. The power equipment will provide for an output of 600 kw. The electrical energy is to be transmitted to Noblesville, two miles distant from the power site.

BRITISH THOMSON-HOUSTON COMPANY, Rugby, England, has sold to the Vickers Sons & Maxim, Ltd., Barrow-in-Furness, on behalf of the Admiralty, 21 motor-generator sets, each giving 120 amp at 55 volts (6.6 kw), 1600 r.p.m., with the necessary control panels. These are to operate searchlights on board H. M. S. *Vanguard*, a battleship of the *St. Vincent* class which Vickers are building. The company has also sold to the Admiralty nine motor-generator sets, eight of 120 amp and one of 80 amp, for operating searchlights on H. M. S. *Defence*.

WINNING FOREIGN MARKETS.—Many letters having been received by the Bureau of Manufactures from American exporters making inquiry as to the best methods to pursue in seeking foreign trade, a monograph of 256 pages has been prepared covering various phases of this subject. It is entitled "Winning Foreign Markets," and contains chapters on Methods and Requirements, Obstacles to Trade, Shipping Facilities, Proper Packing, the Parcel Post, Foreign Advertising and Patents and Trade Marks. Copies of the book may be secured on application to the Bureau, Washington, D. C.

TRADE WITH GERMANY.—The statistics of the trade of the United States with Germany for the nine months ending with March, show that the exports of electrical instruments and appliances was $174,583, as compared with $275,198. The exports of heavy electrical machinery were $59,445 as compared with $74,335. Other instruments for scientific purposes were $226,646, as compared with $168,214, showing a gain instead of a decline as in the two other instances.

ELECTRIC AUTOMOBILES.—The Washington commercial representative of a foreign government advises the U. S. Bureau of Manufactures, Washington, that a firm in his country would like to obtain the agency of an American electrical automobile manufacturer for the sale of his goods.

OPENING FOR SALE OF ELECTRIC AUTOMOBILES. The commercial representative in Washington for a foreign government advises the Bureau of Manufactures that a firm in his country wishes to obtain the agency for the automobiles of an American electric automobile manufacturer.

STATUS OF THE COPPER MARKET.—Copper prices remained substantially unchanged throughout the week, but the continued lack of home consumption, the coming increased production, and the pressure to sell in London caused by the presence of Japanese and Chinese metal and heavy American imports, gave a decidedly weak tone to the market. The improvement in demand expected for this month has not materialized, and 12-cent copper in June seems the logical outcome of the situation as it exists at present. The good buying movement which started in March has almost entirely disappeared. Consumers realize that the metal is cheap at present prices, but notwithstanding easy money are not buying ahead, and probably will not buy for future until there are actual orders on hand covering such purchases. Continued heavy exports during April enabled the market to remain steady, and as there is a large amount of copper going into consumption abroad, it is likely that Europe's capacity for American metal at present prices is still a considerable way from being exhausted. For the month of April, shipments showed an increase of 10,133 tons, or nearly 50 per cent over March, and an increase over last year of 14,490 tons. Since Jan. 1 exports have been 110,957 tons, as compared with only 57,532 tons for the first four months of 1907, an increase of 53,425 tons. Following are the figures for exports during the last four years:

	1907-8. Tons.	1906-7. Tons.	1905-6. Tons.	1904-5. Tons.
April	31,753	17,263	16,330	24,121
March	21,620	13,006	16,433	21,073
February	24,650	9,174	15,801	17,508
January	32,944	17,089	15,307	21,245
December	37,034	13,992	18,158	19,847
November	33,787	18,451	13,195	22,294
October	28,786	17,528	17,784	26,585
September	17,157	14,119	19,755	20,569
August	13,208	20,682	22,692	24,906
July	14,646	18,309	18,478	19,490
June	16,193	18,634	22,096	16,279
May	9,010	19,260	23,758	14,772

Monday's market showed little change except with a more developed weaker tone, arising from continued pressure to sell abroad. Closing prices were as follows:

Lake	12⅝ @ 12⅞c.
Electrolytic	12½ @ 12¾c.
Castings	12¼ @ 12½c.

The London market was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	56	17	6	57	0	0
Standard copper, futures	57	10	0	57	12	6
Market	Steady.			Firm.		
Sales of spot				250 tons.		
Sales of futures				400 tons.		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Castings copper, spot	13½			12⅛		
London copper, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	15	0

BRAZILIAN NORTHWEST RAILWAY.—The importance of the Brazilian railroad, known as the "Noroeste" road, work on which was started two years ago by a French company, under the present plans promises to outrank any railway enterprise undertaken in South America in recent years. This railroad will cross the Parana River within a few miles of the junction of that river and the river Tiete. Each of these rivers at that point has a magnitude nearly equal to the Mississippi at any point above its confluence with the Missouri. Within a few miles from the point on the streams where the railway will cross each of the rivers is broken by waterfalls with a head of 45 ft. and having a volume of water, according to the chief of the Brazilian Zoölogical Service, rivaling that of Niagara Falls and capable of furnishing power to the extent of millions of kilowatts. This location offers opportunities for twin cities on the South American continent which may be destined to outrank the great industrial centers at the head of navigation on the Mississippi. The initial station of the railroad mentioned is at Baurn, the present terminus of the northwest branch of the Sorocabana Railway in the state of Sao Paulo. From these the line extends northwestward. There are now 110 miles in operation over a territory which two years ago was virgin and scarcely well explored. Surveys have been completed to the point to where the road is to cross the Parana River, which forms the boundary line between the state of Sao Paulo and the state of Matto Grasso. It was intended originally to extend the line from the Parana River to Cuyaba, a point nearer the geographical center of Matto Grosso, but this plan has been modified in view of the evidently superior position of a terminus on the Bolivian border and on the great stream forming the boundary line between the two countries. With the prevailing high prices for coal it is not likely that the splendid opportunities for water power will be neglected, both in reference to the railroad and to light and power for the adjacent districts, which the falls are more than ample to supply.

WIRELESS FOR VENEZUELA.—As a result of the disagreements between the French Cable Company in Venezuela and President Castro it is stated that President Castro has taken steps to install five wireless stations at different towns to supplant the cable company. E. C. Newton, a representative of the De Forest Wireless Company, left Porto Rico several days ago to arrange with the President for the installations. Concessions were given to the French company in 1887, but in recent years the operation of the concessions has been attended with many difficulties, which finally ended in open rupture between the government and the cable company. The latter placed its affairs in the hands of the French government, which gave assurance that it would protect the company against any arbitrary action. In 1900 the contract between the government and the cable company had been modified in accordance with the views of the cable company, and for which the company paid a large sum to President Castro and his ministers. In 1902 President Castro again made charges against the company, and friction has existed since that time.

THERMIT IN CANADA.—The Goldschmidt Thermit Company announces the establishment of an office and works at 103 Richmond Street, W., Toronto, Can. The new branch was opened for business on May 1, and is under the management of Mr. E. C. Rutherford, of Toronto. Mr. Rutherford is a Canadian by birth, and has a wide acquaintance among the business men of the Dominion, having been for several years the manager of the Magann Air Brake Company, and of the Canadian Brake & Supply Company. A complete stock of thermit and appliances will at all times be carried at Toronto, and the branch organization will be in a position to execute promptly the welding of heavy steel sections, such as sternposts of steamships, crank shafts, etc., as well as trolley rails in paved streets, motor cases, and other broken steel sections. A fully equipped repair shop will be in operation for the repair of steel castings up to 1000 lb. in weight.

Financial Intelligence.

THE WEEK IN WALL STREET.—Up to the beginning of last week, the steady advance in the securities market was a reflection of the gradual improvement in business conditions, and was based on the feeling that the business depression had reached its lowest level, and that the tide had set in slowly but strongly in the other direction. Two large Wall Street firms which

NEW YORK

	Apr. 27	May 4	Shares Sold.		Apr. 27	May 4	Shares Sold.
All-Ch.	8	8¼	2,400	Int-Met., com.	10½	9⅞	14,400
All-Ch., pfd.	20⅞	20⅝	4,237	Int.-Met., pfd.	28¼	27½	10,000
Amal. Cop.	60⅛	60⅜	203,875	Mackay Cos.	61½	61½	910
Am. D. T.	39*	39*	——	MackayCos.,pfd.	65½	65⅜*	657
Am. Loc.	47	47⅝	14,965	Met. St. Ry.	20	25*	300
Am. Loc., Pfd.	100	99½	1,410	N.Y. & N.J. Tel.	100*	108*	233
Am. Tel. & C'bl.	50*	50*	——	Steel, com.	35⅞	35⅜	365,189
Am. T. & T.	118¾	117½	2,210	Steel, pfd.	100⅜	100¾	39,372
B. R. T.	47½	46⅛	52,305	W. U. T.	51½	50¼	2,030
Gen. Elec.	134	133	1,600	West'h, com.	56	48	13,050
Hud. R. Tel.	—	—	——	West'h, pfd.	68*	64*	725

PHILADELPHIA

	Apr. 27	May 4	Shares Sold.		Apr. 27	May 4	Shares Sold.
Am. Rys.	44¼	44⅜	——	Phila. Elec.	7 15/16	[illegible]	——
Elec. Co. of Am.	9½	9⅛	——	Phila. R. T.	18⅛	18	——
Elec. Stor. B'ty.	30	29	——	Phila. Traction	[illegible]	80	——
E. S. B'ty, pfd.	—	—	——				

CHICAGO

	Apr. 27	May 4	Shares Sold.		Apr. 27	May 4	Shares Sold.
Chicago City Ry.	160	160	——	Met. Elec., com.	17	[illegible]	——
Com. Edison.	92	91½	——	Met. Elec., pfd.	47	[illegible]	—
Chicago Subw'y.	18⅛	—	—	National Carbon.	57¼	57½	——
Chicago Tel. Co.	118¼	118	——	Nat. Carbon pfd.	[illegible]	[illegible]	——

BOSTON

	Apr. 27	May 4	Shares Sold.		Apr. 27	May 4	Shares Sold.
Am. Tel. & Tel.	119	117¼	——	Mass E. R., pfd.	46½	44	——
Comb'ind Tel.	109	—	——	Mex. Tel., pfd.	—	5⅝	——
Edison El. Ill.	213		——	New Eng. Tel'p.	114	113½	——
Gen. Elec.	134½	134	——	W's. Tel. & T.	6	[illegible]	——
Mass. Elec. Ry.	9½	11	——	W. T. & T., pfd.	[illegible]	5	——

*Last price quoted

Shares sold are for week April 27 to May 2.

held other views were caught in the rising market and forced to cover, precipitating a "bear panic" which drove the market sharply upward. In addition, the market was influenced by a number of favorable factors, such as the phenomenal success of the Pennsylvania loan, the ease of money, and the indifference of the loan market to the Treasury's call for $45,000,000 and engagements for $4,000,000 of gold for shipment abroad. The poor Steel statement was discounted by the Street. As the week progressed the buying by shorts began to exhaust itself and there was a tendency on the part of operators to realize. Following the circular issued by the president of the Westinghouse Electric & Manufacturing Company urging the stockholders to subscribe to a new stock issue, the Westinghouse securities fell sharply, recovered somewhat, and fell again on Monday. The rumor that the reorganization plan was in danger of failing was emphatically denied by officers of the company. Upon heavy liquidation in London and profit taking here, stocks on Monday eased off, in some cases closing below Saturday's levels, but the general tone of the market was one of strength. Monday's closing prices are given in the table on page 997.

MERCHANDISE CREDITOR'S PLAN PROGRESSING.—The meeting of the stockholders of the Westinghouse Electric & Manufacturing Company, which was scheduled to take place at East Pittsburg on April 29 to consider the advisability of issuing bonds in accordance with the plans of the Readjustment Committee, was adjourned in view of the progress in the plan submitted by the Merchandise Creditors' Committee, which provides for an issue of $10,000,000 of assenting stock without an issue of bonds. Of this stock the Merchandise Creditors' Committee, representing the large creditors of the company, proposes to accept for their claims $4,000,000 of the new stock and of the remaining $6,000,000 the creditors of the Security Investment Company, who hold about 40 per cent of Westinghouse shares as collateral, are expected to take their pro rata shares according to the provisions of the Merchandise Creditors' plan, leaving $3,000,000 to be subscribed for by individual stockholders. The work of obtaining these subscriptions has been in charge of a stockholder's committee which began its operations on April 8 and has already obtained the signatures of more than 500 stockholders. Mr. George M. Verity, secretary of the Merchandise Creditors' Committee, speaking of the work of that committee, said: "Considering the length of time we have been at work, a little more than 20 days, we are highly satisfied with the progress of the plan. Already signatures for $3,500,000 out of a possible $4,250,000 have been received, representing most of the larger creditors. The committee alone represents $7,500,000 and returns are coming in rapidly. In fact, it is only necessary to explain the plan to those interested to gain their hearty co-operation. The good results to be obtained by the carrying out of the plan and the evils which will result if other means are made necessary are too evident to render its failure at all likely. The Westinghouse Electric Company is too large and too much of a factor in the industrial world to be held back by temporary financial difficulties and as soon as the creditors are made to realize this fully they stand ready to support the plan. We are really a subordinate committee of the Readjustment Committee and have until May 15 to carry out our end of the arrangements. With the adjustment of debt as proposed and the ample cash funds which will be provided by the stock subscriptions, the company will be in a better position than at any other period in its history. And it is of vital interest to the creditors that the company be placed in such a position that it will not be crippled in any way or its effectiveness diminished by lack of funds. About one-third of the debt ranges in amounts from $1,000 to $800,000 and the number of creditors is about 1500. The creditors are classed in the following districts: New York, Philadelphia, Cincinnati, Pittsburg, Boston and Chicago. One member of our committee has charge of each district, getting in touch with each creditor either personally or by writing."

MEETINGS AND DIVIDENDS.—The Electric Properties Company has declared an annual dividend of 6 per cent on the preferred stock and subscription receipts, payable May 11. The annual meeting of the Electric Company of America was held last week in Camden, N. J., merely routine business being transacted. During the year the following three changes took place: Mr. G. B. Roberts, Mr. H. S. Kerbaugh, and Mr. J. E. Hayes, directors, resigned, and were succeeded by Mr. C. R. Snowden, Mr. E. D. C. Catherwood and Mr. John B. Morton. The other old directors were re-elected. The directors of the United Electric Securities Company have declared the regular semi-annual dividend of 3½ per cent, payable May 1, to stock of record April 21. The guarantee dividend of the American Telegraph & Cable Company will be paid on June 1.

WESTINGHOUSE ELECTRIC.—George Westinghouse has issued a circular to the stockholders urging them to subscribe pro rata to the new "assenting" stock. The circular says in part: "Your affairs have been efficiently administered by the receivers and since their appointment the direct and contingent liabilities of the company with reference to its Canadian and European interests have been reduced by $1,750,000. They have also converted into cash a large amount of surplus materials, raw, in process, and finished, which were on hand on Oct. 23, 1907, this very materially strengthening and improving the general situation. Your interest in the company as a stockholder is nevertheless in serious jeopardy owing to the unfortunate financial events of last October, which necessitated the appointment of receivers on the 23d of that month to administer your affairs and to preserve your property until provision could be made by the united action of the creditors and stockholders of the company to adjust the debt and provide ample new working capital to carry on your business on a cash basis and to an extent commensurate with the facilities already provided to meet the increasing demands in normal times. Your creditors, through a committee appointed to represent them, have been very indulgent and have already given a total of seven months (until June 1) to permit the several interests involved to perfect some plan which would adjust the debts of the company and also conserve your interests as stockholders." After reviewing the mortage-bond plan and the merchandise creditor's plan, which was substituted in place of the mortgage-bond plan, the circular goes on to say: "The Readjustment committee are willing to accept this substitute provided the company promptly provides subscriptions at par to $10,000,000 of new 'assenting' stock, of which amount $4,000,000 is to be provided by creditors and $6,000,000 must be provided by stockholders. In the spring of 1907 the financial requirements of the company were so urgent that it was deemed advisable to issue additional stock and on April 25, 1907, you were invited by circular letter to subscribe for your pro rata amounts of $5,000,000 par value (100,000) shares of assenting stock, which subscriptions were to be payable in installments from July to December. There was no material response to this effort to raise capital. In order to meet the situation resulting from this lack of support on the part of the stockholders, the Security Investment Company, with the aid of my personal resources (the Investment company and myself owning together about 50 per cent of the outstanding assenting and preferred stock), made large contributions to the company in an effort to maintain its solvency. These efforts resulted in the exhaustion of my own resources as well as those of the Security Investment Company. It is, however, my expectation that through a plan and agreement recently submitted to the creditors of the Security Investment Company, which has already been accepted, signed or agreed to by many of its large creditors, the assenting stock required to be taken by that company will be provided for, as well as the stock required to be taken by me personally. Should the usual course of a sale to a new company be adopted, there undoubtedly would be some provision for a participation by those stockholders who will submit to an assessment in order to retain their interest in a greatly depreciated equity: but this assessment will certainly be larger in amount and upon more onerous terms than the subscription now solicited. Concerning the future management of the company, I may add that I consider essential the election of a board of directors, representative of the several interests, whose character and experience will insure a safe management of finances and who will devote enough time to your business to become so acquainted with its requirements that they can intelligently direct its affairs." The circular closes by stating that a failure to subscribe on the part of a stockholder is virtually a vote for the sale of the property to the creditors and thus the elimination of all stock interests. Coincident with the circular letter issued by Mr. Westinghouse and quoted above, the stockholders' committee, consisting of Messrs. Charles Francis Adams, Charles J. Canda, George W. Guthrie, Alvin W. Krech and George T. Oliver, issued a circular joining with Mr. Westinghouse in urging the stockholders to send in their subscriptions.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

BESSEMER, ALA.—The People's Home Telephone Company is planning to install an entirely new system in this city.

FOLEY, ALA.—The Consumers' Service Company has been organized and proposes to establish an electric light and power plant and water works system. Frank Fesler is interested in the project.

HEADLAND, ALA.—The city has awarded the contract for the construction of the municipal electric light plant and water works system, at an approximate cost of $23,500.

LINEVILLE, ALA.—Plans are being considered by the Clay County Telephone Company to extend its telephone lines.

MONTEVALLO, ALA.—Bids will be received by the President of the Alabama Girls' Industrial School for the construction of a brick power house and boiler room. William E. Spink, Title Guarantee Building, Birmingham, is the architect.

OPELIKA, ALA.—Preparations are being made for the construction of the proposed electric railway from Opelika to Eufala and thence to the coast by the Alabama Railway & Electric Company, work on which will commence at an early date. Judson C. Chapman, of Atlanta, Ga., is interested in the project.

GRIDLEY, CAL.—The citizens have voted in favor of establishing a municipal electric light plant and water works system.

HEALDSBURG, CAL.—The Petaluma-Santa Rosa Railway Company has recently established an automobile service between Sebastopol and Healdsburg pending the extension of its railway to this place.

MODESTO, CAL.—Plans are being considered for the construction of an interurban electric railway through Stanislaus County by John Hays Hammond, engineer of Guggenheim Exploration Company, and E. A. Willtsee. It is proposed to erect a power plant on the Toulumne River to furnish electricity and to build and operate electric railways in all of the cities of northern San Joaquin Valley, with Modesto as the center. Another line will be built from Turlock and Newman and across the Pacheco Pass to the coast.

OROVILLE, CAL.—It is announced that the Humbug Valley power plant is but one of a number of plants that the Oro Water, Light & Power Company propose to construct.

PASADENA, CAL.—The City Council has awarded contracts for equipment for the electric lighting contracts as follows: For 15,800 pounds of No. 6 triple braid weather-proof drawn copper wire to the California Electric Company, for $2,464; to J. B. F. Kierulff, Jr., & Company, for poles, crossarms and braces, for $5,843. Herman Dyer is city clerk.

PASADENA, CAL.—Bids will be received at the office of the city clerk until May 12 to furnish material and equipment for the municipal electric light plant as follows: Single-phase transformers rated at from 5 to 50 kilowatts, 60 cycles, 2200 volts primary; 110 or 220 secondary voltage. Transformers to be designed for a high all-day service. Separate proposals will be received on three-phase transformers of the same rating. Proposals will also be received for single-phase induction integrating wattmeters.

PLACERVILLE, CAL.—J. W. White, of San Francisco, has been engaged to prepare plans and estimates of the proposed municipal electric light plant.

PLACERVILLE, CAL.—The American River Electric Company is remodelling its power station on the American River near here. Four Doble water wheels have been installed at a cost of $10,000. The new wheels have a rating of 600 hp. and take the place of the Pelton wheels placed five years ago. A large switchboard has also been received and other improvements made. R. H. Sterling is manager.

PLACERVILLE, CAL.—James O'Brien and Robert Duncan have filed a notice of appropriation of 5000 cu. in. of water on the main fork of the Cosumnos River to be utilized for power, mining, irrigating and other purposes. A notice has also been filed by Norval Douglas appropriating 5000 cu. in. in Travis Creek, the point of diversion to be at the Lower or Big Falls in El Dorado County to be used to generate electrical power.

REDDING, CAL.—The Northern Light & Power Company has made application to the City Trustees for a franchise giving it permission to erect transmission lines for the distribution of electricity through the streets and alleys in the city. The company expects to have its plant in operation by the end of the year.

SAN FRANCISCO, CAL.—Bids will be received by the State Board of Prison Directors, San Francisco, until May 11 for an electric plant for Folsom State Prison at Represa. Plans and specifications can be obtained at the office of the board and at the office of the state engineer, Sacramento. E. Herriott is secretary of the board.

SAN FRANCISCO, CAL.—Agents of E. H. Harriman are said to have secured valuable water rights located in the mountains of Kern County, east of Bakersfield, in Fresno County, east of Fresno, in El-Dorado County, on the Rubicon River, and on the Klamath River, in Siskiyou County, near Chase's place. It is stated that fully $15,000,000 ultimately will be spent in developing power at these points.

SANTA CRUZ, CAL.—The City Council has decided to call an election to vote on the proposition to issue $200,000 in bonds for the electric light plant, sewers, etc.

STOCKTON, CAL.—The City Council has granted the Central California Traction Company a franchise for an electric railway.

WEAVERVILLE, CAL.—The North Mountain Power Company contemplates the construction of another power plant to supplement the one now operated on the Trinity River below Junction City, for which surveys have been made and plans adopted. The plant will be located at Big Flat.

CANON CITY, COL.—The Colorado Telephone Company is to build a telephone line to Royal Gorge, which is to be used in connection with the proposed city water works system.

CASCADE, COL.—Plans are being made by the Cascade Town Company for the construction of an electric light plant. C. E. Heyer is manager.

DENVER, COL.—The Town Council of Littleton has granted to the Denver & South Platte Railway Company a permit, pending the passage of a franchise ordinance, allowing the company to construct its railway through the town. Work will commence at once on the extension of the road up the Platte River to Roxbury Park and Colorado Springs. William J. Coursin, of Pittsburg, Pa., has charge of the work, and W. E. Hughes, of Denver, is president.

LAY, COL.—The Maybell Valley Telephone Company is in the market for equipment for a telephone line 65 miles long, with branch lines, which will include telephone instruments, 10,000 lb. hard-drawn copper wire, 9000 lb. galvanized iron wire, 2000 cedar poles, insulators, etc. W. T. Stillings is manager.

WILMINGTON, DEL.—The West Chester & Wilmington Electric Railway Company has awarded a contract for the construction of its proposed electric railway between this city and West Chester to the Eastern Railway Construction Company. The contract includes the construction of the railway, power house and entire equipment. The power house will be located at Brandywine Summit.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the superintendent of the United States capitol, building and grounds, until May 2 for electric fans for use in the office building, House of Representatives: 100 16-in. swivel and trunnion desk fans, 120 volts, direct current, three speeds, black japanned bodies, heavy brass guards and blades. Each bid to be accompanied by a sample fan. Elliott Woods is superintendent of U. S. capitol building and grounds.

WASHINGTON, D. C.—Bids will be received until May 12 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Puget Sound, Wash.: Schedule 1047—4 motor-generator sets and switchboards; 12 single-phase transformers; 2300 ft. rubber-covered braided cable. Charleston, S. C.: Schedule 1106—2 feeder panels. Brooklyn, N. Y.: Schedule 1107—82,000 ft. wire. Norfolk, Va.: Schedule 1107—1800 ft. conductor and 1450 ft. lighting wire. Boston, Mass.: Schedule 1155—switchboard. Bids will also be received until May 19 as follows Mare Island, Cal.: Schedule 1088—12 electric drills; schedule 1090—soft-rolled copper; 20,000 lb. rolled sheet-zinc plate; schedule 1091—seamless drawn copper tubing. Applications for proposals should designate the schedule desired by number. E. B. Rogers is paymaster-general U. S. N.

DE LAND, FLA.—The De Land Electric Light, Power & Ice Company has filed articles of incorporation with a capital stock of $100,000. J. Howell Cummings is president of the company.

LYONS, GA.—The citizens have voted in favor of the proposition to issue bonds for the construction of an electric light plant

SYLVESTER, GA.—The city has voted to issue $10,000 in bonds for the construction of an electric light plant.

BOISE, IDAHO.—It is stated that the Gooding-Milner Electric Railroad contemplates extending its railway southward to Wells, Nev., and to the north across Camas Prairie to Boise Surveys have already been made of both routes, and it is announced that work on construction of the roads will soon commence.

LEWISTON, IDAHO.—Plans are being made by the North Coast Power Company for the construction of a large power plant on the Clearwater River, near Lewiston. The plant will have an output of about 50,000 hp and will furnish energy to operate a system of interurban lines connecting Lewiston with Clarkston, Asotin, Anatone, Cloverland and Pomeroy. The proposed dam is to be located on the Clearwater River, near Porter's Island, about four miles above Lewiston Work has commenced on a temporary plant, which is to furnish power to use in the construction of the dam. Frank McKean has charge of the engineering work.

POCATELO, IDAHO.—The Bear Lake Electric Company has decided to make improvements to its system and will construct a new power house and develop the water power of Paris Creek.

SANDPOINT, IDAHO.—J. F. Reynaud, manager of the Pend D'Oreille Electric Company, writes that the company has placed an order with the Allis-Chalmers Company for a heavy duty Reynolds Corliss engine; one 225-kw Bullock, two-phase, 2300-volt generator; one four-panel switchboard fitted with General Electric instruments. Boilers, condensers and pumps have been ordered from the Platt Iron Works, of Dayton, Ohio. The plant will be equipped for an output of 425 kw. Plans are being prepared for the development of a water power, with a transmission line 44 miles in length and an output of 4000 kw, the cost of which is estimated at $250,000.

WATSON, ILL.—The East Watson & Gilmore Telephone Company has been reorganized and its name changed to the Watson Telephone Company. The capital stock has been increased from $1,600 to $4,800. Plans are being made by the new company for improvements and extension to the system.

WAUKEGAN, ILL.—The plant of the North Shore Electric Light Company was wrecked April 23, causing a loss of $30,000.

CHERUBUSCO, IND.—Arrangements are being made by the Geiger Telephone Company to improve and rebuild its system in this city. The company is also planning to build several additional farm lines.

EVANSVILLE, IND.—Plans are being considered to extend the Evansville & Eastern Electric Railway from Rockport to Louisville in the near future.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company has made arrangements with the Indiana Union Traction Company to supply electricity for operating the Bluffton branch. C. D. Emmons is general manager of the Fort Wayne & Wabash Valley Traction Company.

MICHIGAN, IND.—The Merchants' Mutual Telephone Company is in the market for telephone equipment, including 15,000 ft. paper cover and lead encased cable of all sizes from 25 to 200 pair, cedar poles, insulators, etc. George H. P. Barnum is manager.

NOBLESVILLE, IND.—We are informed that the hydro-electric power development on the White River will be completed this year. Plans and specifications are being prepared by H. von Schon, County Bank Building, Detroit, Mich., consulting engineer. The work consists of the construction of a reservoir and a system of waste gates. The power station was built some years ago. The equipment will have a rating of 600 kw. Electricity will be transmitted to Noblesville, two miles distant.

RICHMOND, IND.—The city is asking for bids for the furnishing of meters for the present year. There are about 1600 meters used in the city by the municipal system.

RICHMOND, IND.—E. E. Witherby, representing the syndicate which controls the plant of the Richmond Light, Heat & Power Company, has submitted an offer to the City Council for the municipal electric light plant. Mr. Witherby declares that the city has expended approximately $39,000 more than it should have paid out during the time it has operated the plant, and renews his offer, on behalf of the company, to purchase the plant and agrees to pay the city not only the cost of the construction of the plant, but to reimburse the city for the maintenance of plant during the period of municipal ownership. In addition the company offers to enter into a contract to maintain a schedule of rates that will conform with those the city now has in force and to provide a street lighting system that will cost less by $10 a lamp than it now costs the city to maintain its own lamps.

WILLIAMS, IND.—Senator Hemenway has secured the necessary authority from the Federal Congress for the construction of a dam in White River at this place. The purpose is to generate electricity for light and power purposes and especially to furnish power for the cement factories in the vicinity of Bedford. A company recently incorporated will carry out the enterprise.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company is in the market for a 750-kw motor-generator set to be used for railway purposes. G. Dows is president and general manager.

IOWA CITY, IA.—The Johnson County Telephone Company contemplates the construction of a long-distance telephone line between this city and Des Moines, the cost of which is estimated at about $6,000.

MASON CITY, IA.—The Western Electric Telephone Company is planning extensive improvements and extensions to its telephone line in this city and in northern Iowa, which will involve an expenditure of about $100,000.

MISSOURI VALLEY, IA.—The citizens on April 28 voted in favor of granting a franchise to L. D. Gascho for an electric light plant.

ARGENTINE, KAN.—The Metropolitan Street Railway Company is planning to improve its service in Argentine and will lay two miles of double track.

CONCORDIA, KAN.—The plant and holdings of the Concordia Electric Light Company have been sold to L. K. Green, of Osborne, who, it is said, will make improvements to the plant.

KIOWA, KAN.—The citizens have voted to issue $12,000 in bonds for the erection of an electric light plant and $40,000 for the construction of a water works system. Burns & McDonnell, of Kansas City, Mo., are the consulting engineers.

LEAVENWORTH, KAN.—Bids will be received at the office of the superintendent of prisons and prisoners, Department of Justice, Washington, D. C., until May 27, for furnishing and delivering at the United States Penitentiary, Leavenworth, Kan., distributing panel, cables, conduit and switches and other electrical supplies in accordance with specifications, copies of which may be obtained upon application at the office of the superintendent. R. V. La Dow is superintendent.

HOUMA, LA.—Preparations are being made to begin work on the construction of the proposed municipal electric light plant. J. Posey Campbell is mayor.

HOULTON, ME.—The Houlton Water Company has recently installed a 15-kw, three-phase generator in its station to be used in case of accident to the Aroostook Falls plant.

HAGERSTOWN, MD.—The report of the manager of the municipal electric light plant shows a net profit of $7,000 for the year, allowing $50 per lamp for street lamps, of which there are 144. Additional improvements to the plant are contemplated, including a new condenser. Another arc lamp circuit will be established.

NORTH ADAMS, MASS.—The citizens on April 16 voted to appropriate $1,200 to install an electric light plant at the town farm.

PITTSFIELD, MASS.—Application has been made to the State Board of Railroad Commissioners by the Berkshire Street Railway Company to increase its capital stock by $285,000.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has petitioned the Selectmen of Hancock for permission to extend its railway through that town. The proposed road will be extended from the present terminus of the West Pittsfield line. P. C. Dolan is superintendent.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has applied to the State Board of Railroad Commissioners for permission to issue $500,000 additional capital stock.

WINCHENDON, MASS.—The Winchendon Electric Light & Power Company is removing part of the machinery from its present power house on Elm Street to the station purchased last fall on River Street, which will be used as an auxiliary to the Elm Street plant.

FLINT, MICH.—The Oak Park Power Company is planning additions to its plant which will involve an expenditure of $60,000. A 1000-kw generator and a cross-compound Corliss engine will be added, together with three 300-hp boilers. An air compressor with a capacity of 960 cu. ft. per minute will be installed. The plant furnishes electricity for motors for the Buick Motor Company and the Weston-Mott Company.

WAYNE, MICH.—The People's Telephone Company has increased its capital stock from $6,000 to $12,000, the proceeds to be used for building new lines.

WYANDOTTE, MICH.—Plans are being considered by the Home Telephone Company, of Detroit, for the installation of a telephone system in this city. The company has applied to the City Counsel for permission to erect its lines on Twelfth Street for its long-distance line from Detroit to Toledo, and an application will soon be made to install a local system.

BRAINERD, MINN.—Plans have been prepared by O. Claussen, St. Paul, for an electric power plant and water works to cost about $150,000. H. J. Spencer is city clerk.

ST. PETER, MINN.—The contract for installing two generators in the municipal electric light plant has been awarded to the General Electric Company, of Schenectady, N. Y., for $1,274.

WINONA, MINN.—The Winona Telephone Company is planning extensive improvements and extensions to its system in this city.

NATCHEZ, MISS.—The city has extended the time for awarding the contract for public lighting to June 17. This action was taken on account of the Southern Light & Traction Company, which holds the present contract, having been declared a trust, and it will take six weeks to sell the property and reorganize the local company.

OXFORD, MISS.—Plans are contemplated for the construction of a new electric light plant and water works system to cost about $15,000. The present distributing system will be used.

POPULARVILLE, MISS.—The citizens have voted in favor of the proposition to issue bonds for extending the electric light and water works systems.

VICKSBURG, MISS.—It is reported that the electric light franchise granted by the city to Harry K. Johnson will be purchased by Edward M. Dean & Company, of Grand Rapids, Mich. The new company proposes to place its wires underground on Washington Street before the street is paved.

ST. JOSEPH, MO.—Plans are being made by the Interstate Telephone Company for extensive improvements and extensions to its local service and the surrounding towns.

ST. LOUIS, MO.—The Kimmswick & Northern Railway Company has applied for a franchise to lay tracks on certain streets in the southwestern part of the city, with a terminus at Ivory Avenue and Broadway. This is said to be part of the scheme to connect Crystal City, about 10 miles south of the city, by an electric railway with the United Railways Company's line in South St. Louis.

HELENA, MONT.—The Elling estate has commenced work on the construction of the Blaine Springs power plant, which will furnish electricity for the Easton Mine, and also for lighting Virginia City. The plant will be located on the Blaine Springs Creek, about 16 miles distant from the mine.

TOWNSEND, MONT.—N. S. Poole, president of the Deep Creek Improvement Company, writes that the company proposes to construct a 600-hp plant on Deep Creek at a cost of about $85,000 to furnish electricity for lighting Townsend and for the mines at Radersburg. The company also proposes to develop the falls of Crow Creek at a cost of $120,000, and will probably furnish electricity to Elkhorn, Basin and perhaps to Boulder.

WAHOO, NEB.—John Martz, superintendent of the municipal electric light plant at Seward, has been appointed consulting engineer of the proposed municipal electric light plant and water works system, for which the citizens recently voted to issue $65,000 in bonds.

HIGH BRIDGE, N. J.—The Borough Council has passed a resolution to call an election to vote on the proposition to issue $15,000 in bonds for the erection of a municipal electric light plant to furnish electricity for both public and domestic lighting.

BERGEN, N. Y.—The Genesee County Electric Light, Gas & Power Company has awarded the contract for the construction of its power house in Bergen to Sanford Wilcox. The company has purchased a dynamo, switchboard and the pole line from the estate of B. L. Lewellyn for $750.

HUDSON, N. Y.—Proposals will be received by the Common Council until May 5 for lighting the streets and the city hall for a term of three years, and also for a term of five years, beginning Sept. 15, 1908.

NEW YORK, N. Y.—Bids will be received until May 11 by C. B. J. Snyder, superintendent of school buildings, for installing electric equipment in Public School No. 24, Borough of Brooklyn.

ONEIDA, N. Y.—The company which has leased Sylvan Beach is contemplating the construction of an electric light plant. The company will use 1000 lamps in the park, and will also furnish electricity for lighting the entire village of Sylvan Beach.

PLATTSBURG, N. Y.—The Clinton Telephone Company has decided to make several extensions to its lines.

SCHENEVUS, N. Y.—Extensive improvements are contemplated by the Home Telephone Company including the installation of a new switchboard, the overhauling of its toll lines leading out of Oneonta and the completion of the toll lines running south to Kingston.

SLATER SPRINGS, N. Y.—To take care of its increasing business the Carolina Telephone Company contemplates the construction of another telephone line to Ithaca.

ASHEVILLE, N. C.—The plant and holdings of the North Carolina Power Company, which includes a power plant of 600 hp and water rights and properties on the French Broad River, have been purchased by W. T. Weaver and associates. Mr. Weaver has been appointed president of the reorganization and W. E. Reid, secretary and treasurer.

GOLDSBORO, N. C.—The commissioners of the municipal electric light plant are contemplating increasing the output of the plant, at a cost of about $10,000.

ROCKY MOUNT, N. C.—Plans are being prepared for the proposed improvements to the municipal electric light plant and water works system.

GRAFTON, N. D.—The municipal electric light plant was damaged by fire, entailing a loss of about $5,000.

CARTHAGE, OHIO.—Bids will be received at the office of John Kuderer, secretary of Trustees of Public Affairs, until June 1 for furnishing labor and material for a new arc lighting system for the municipal electric light plant, consisting of a generator, switchboard, wiring and arc lamp equipment, in accordance with plans and specifications on file at the above office.

CINCINNATI, OHIO.—The Interurban Railway & Terminal Company has recently placed orders for the construction of a new substation and the following equipment: Two 250-kw rotary converters with transformers and switchboard complete; one quadruple 75-hp car equipment and two Christensen air-brake equipments to the Allis-Chalmers Company, of Milwaukee, Wis. The Westinghouse Electric & Manufacturing Company was awarded a contract for two quadruple 50-hp car equipments. The company also purchased two freight cars.

CLEVELAND, OHIO.—An ordinance has been introduced in the City Council to authorize the Board of Public Service to expend $2,000 to furnish a lighting plant for the Fairmount pumping station.

COLUMBUS, OHIO.—The Ohio Senate has passed the bill introduced by Mr. Hillenkamp, which provides that unincorporated districts may contract for street lighting and levy a tax to pay for it if the owners of one-half the abutting property so petition.

LEWISBURG, OHIO.—Plans are now being prepared for the installation of a municipal electric light plant and water works system.

SANDUSKY, OHIO.—Bids will be received by the Board of Trustees of the Soldiers' and Sailors' Home, Sandusky, Ohio, until June 1 for furnishing three or four boilers of 200 hp to be installed in connection with the power plant of the Home. Bids will also be received for steam pumps. Daniel Dugan is quartermaster.

MARSHALL, OKLA.—The installation of a new switchboard and building of several rural lines is being considered by the Marshall Telephone Company.

WAURIKA, OKLA.—It is reported that the O'Neil Engineering Company, of Dallas, Tex., has been granted a franchise to construct a new lighting plant. The cost of the plant is estimated at $100,000.

GRESHAM, ORE.—The Portland Railway, Light & Power Company has installed an electric lighting system at this place and also has a contract for lighting the streets of the city. Electricity for operating the system is supplied from the Cazadero plant.

KLAMATH FALLS, ORE.—Plans are being made by the Klamath Falls Electric Railway Company for extensions to its street-car system during the summer. The company expects to complete the Belt Line, for which negotiations for rails are under way. E. R. Reames is local manager.

PORTLAND, ORE.—The United Railways Company, it is said, will soon begin preliminary work on the construction of an electric railway from Portland to Tillamook, Netart's Bay and Bay City, a distance of about 88 miles. A. C. Emmons is secretary of the company.

PORTLAND, ORE.—Plans for extensive improvements and extensions have been announced by the Oregon Electric Railway Company, which include the construction of a system of interurban railways aggregating about 250 miles. The capital stock of the company has been increased from $2,500,000 to $10,000,000. Work will commence at once on the Garden Home-Hillsboro road. The officers of the company are: George Barclay Moffatt, of New York, N. Y., president; Guy W. Talbot, of Portland, vice-president; George F. Nevins, of Portland, secretary, and H. W. Brower, of New York, N. Y., treasurer.

CLARKSVILLE, PA.—The erection of additional telephone line between this city and Zollarsville is being considered by the Clarksville Telephone Company.

FOREST CITY, PA.—The Forest City Electric Light, Heat & Power Company has awarded contracts for new equipment for its plant as follows: To the Westinghouse Machine Company, of Pittsburg, Pa., one 175-kw, two-phase alternator, 30 magnetite arc lamps, switchboards and exciter; to the American Ball Engine Company, of Bound Brook, N. J., one 350-h.p. engine, and the Keeler Boiler Company, of Williamsport, Pa., for two 150 h.p. boilers. Work will commence on improvements at once. A. D. Kehren is superintendent.

NEWTOWN, PA.—The Bucks County Electric Railway Company is reconstructing its entire system and installing modern equipment. This company is a consolidation of the Newtown Electric Street Railway Company and the Newtown, Langhorne & Bristol Trolley Street Railway. The railway extends from Bristol to Doylestown, a distance of about 27 miles. Frank Battles is president.

PITTSBURG, PA.—The Central District & Printing Telegraph Company will extend its lines in the Pittsburg district. The cost of the improvements is estimated at about $1,000,000.

STROUDSBURG, PA.—The Stroudsburg & Water Gap Street Railway Company contemplates increasing the equipment of its power house and will soon place contracts for a 250 or 300-hp slow speed engine and a 100-hp boiler. H. E. Sweeney is president of the company.

WILKES-BARRE, PA.—Bids will be received by James M. Norris, county controller, until June 5 for furnishing and installing complete the electric lighting fixtures for the new Luzerne County court house. An appropriation of $35,000 has been made for the work.

BATESBURG, S. C.—It is reported that the water power privileges near Batesburg have been purchased by E. F. Strother, who it is said will develop them.

SPARTANBURG, S. C.—It is reported the Electric Power & Manufacturing Company has purchased the plant and holdings of the Spartanburg Street Railway, Gas & Electric Company. It is understood that extensive improvements will be made to the railway system. R. C. Crawford, of Pittsburg, Pa., is president of the Electric Power & Manufacturing Company.

FORT MEADE, S. D.—Bids will be received at the office of the constructing quartermaster until May 25 for installing steam heating, electric wiring and electric lighting fixtures in the following buildings: One set of commanding officers' quarters; one double set of lieutenants' quarters; one set of bachelor officers' quarters; one band barrack and administration building. Plans and specifications may be seen at the offices of the chief quartermaster, Department of Missouri, Omaha, Neb., Department of Colorado, Denver, Col.; Department of the Lakes, Chicago, Ill.; Department of Dakota, St. Paul, Minn.; Depot Quartermaster, St. Louis, Mo., and at the Fort Meade office, at which place all information may be obtained upon application. Captain [illegible] C. [illegible] is constructing quartermaster.

VIENNA, S. D.—The establishment of an electric lighting system in this town is under consideration.

LEWISBURG, TENN.—A company has been organized here, of which E. L. Aschheim was elected president, Dr. S. T. Hardison, vice-president, and J. B. Hardison, secretary and treasurer. The company proposes to construct a power plant at Lillard's Mills, on Duck River, ten miles north of the city. The company will also install two steam engines to use in case of accident or low water. The company proposes to furnish electricity in Lewisburg for lamps and motors and to give a 24-hour service. The cost of the plant is estimated at $30,000.

McKINNEY, TEX.—The city has decided to issue $26,000 in bonds for extensions to the electric light plant and water works system.

OGDEN, UTAH.—Bids will be received by James Knox Taylor, supervising architect, Washington, D. C., for the installation of a conduit and electric wiring system in the extension to the United States post office and court house building at Ogden, Utah.

ASCUTNEYVILLE, VT.—Surveys are being made of the L. H. Bailey water privilege with a view to installing an electric light plant. Rush Chellis is engineer.

RUTLAND, VT.—The Board of Aldermen has accepted the proposition of the Rutland Railway, Light & Power Company, whereby the city will save about $3,000 on the five-year contract. Under the new arrangements the company is to furnish arc lamps to burn until 12:30 a. m., at $66.65 per lamp per year, and arc lamps on all-night schedule at $84.40 per lamp per year. Under the old rate the city paid $69.30 and $87.40 respectively. The rate for incandescent lamps and for the fire alarm system is to be 12 cents per kw-hour..

FREDERICKSBURG, VA.—It is reported that the Fredericksburg Power Company contemplates further development of its water power properties.

RADFORD, VA.—The Radford Water Power Company has just placed an order with the Westinghouse Electric & Manufacturing Company for a 1000-kw motor-generator set. J. A. Baird is secretary of the company.

RICHMOND, VA.—The receivers of the Virginia Passenger & Power Company have decided to offer special rates for electricity for electric signs, the price to be regulated by the number of lamps used, varying from five to 400 lamps, at from $5.18 to $36 per month, the lamps to burn from dusk until 9 o'clock in the evening.

CENTRALIA, WASH.—An election will soon be held to vote on the proposition to issue $45,000 in bonds to establish a municipal lighting plant.

NORTH YAKIMA, WASH.—The electric railway which the Yakima Inter-Valley Electric Railway Company proposes to build to Granger will be extended to Sunnyside. Work will commence as soon as the right of way is secured.

ORIENT, WASH.—Preparations are being made for the construction of a power plant for which the water power of Deer Creek will be utilized. Arthur Phillips and H. D. Merritt, who have been granted a franchise to furnish water and electricity for lamps and motors in this city, are interested in the enterprise. They propose to furnish a water supply and electricity for lamps and motors in Orient and the nearby mines.

PORT ANGELES, WASH.—The Independent Telephone Company and the Angeles Telephone & Telegraph Company have been consolidated, and plans are being perfected for extending the system throughout the county.

SNOHOMISH, WASH.—Announcement has been made that the Snohomish Valley Railroad Company has been financed and that work on the construction of the first 15 miles of the road will commence at once. The company proposes to build an electric railway from Snohomish to Issaquah, thence to Renton, and from there to Seattle and Tacoma. The company is capitalized at $2,500,000.

SPOKANE, WASH.—Plans are being prepared by George Nixon, of this city, to erect a power plant on the Little Spokane River about 10 miles from Chattaroy to furnish electricity in the towns of Chattaroy and Deer Park. Mr. Nixon has filed an application with the County Commissioners for a franchise to erect transmission lines over the county roads to furnish electricity in the above-named towns for light, heat and power purposes.

GRAFTON, W. VA.—The Consolidated Telephone Company has decided to take over the plant and holdings of the Terra Alta Telephone Company, and contemplates the construction of a new telephone line from Grafton to Newburg.

WELCH, W. VA.—The Welch Ice & Cold Storage Company has been granted a franchise to furnish electricity in this city. J. J. Rhodes is president of the company.

ALLENTOWN, WIS.—The Allentown-Kohlsville Telephone Company has been organized with a capital stock of $5,000. The company has purchased from the Theresa Telephone Company a telephone line, which it expects to extend to Huelsburg. The erection of a number of telephone lines east of Allentown is also contemplated by the company.

ATHENS, WIS.—The capital stock of the Athens Telephone Company has been increased from $6,000 to $15,000.

CAMERON, WIS.—The Cameron telephone exchange has been purchased by A. W. Larson, of Deerfield. The new owner proposes to improve the local service and build new lines to Deerfield and Fort Atkinson.

GRESHAM, WIS.—The citizens have voted to issue bonds to establish an electric lighting system.

KENOSHA, WIS.—It is said that the city has abandoned the fight for a municipal electric light plant as the new administration has declared itself in favor of making a new contract with the Kenosha Gas & Electric Company.

LOYAL, WIS.—The Village Board has awarded contracts for equipment for the municipal electric light plant as follows: For gas engine and producer to the National Meter Company, of New York, N. Y.; pumps to Goulds Manufacturing Company, of Seneca Falls, N. Y., and for generator and switchboard to the Western Electric Company, of Chicago, Ill.

MARTINTOWN, WIS.—Plans are being considered by E. B. Bucher, owner of the water power in this place, to install an electric plant to furnish electricity for lighting in the nearby towns.

EDMONTON, ALB., CAN.—The City Council has decided that it would be unwise to proceed with the construction of a municipal street railway system on account of the present financial conditions. It is expected a franchise will be given to some company to build a system. For further information address Mayor Macdougall.

FERNIE, B. C., CAN.—The Fernie Electric Light Company has made an offer to sell out its plant to the city. A special committee of the City Council is now considering the matter.

NEW WESTMINSTER, B. C., CAN.—The British Columbia Wood, Pulp & Paper Company, Vancouver, B. C., has applied for 20,000 cu. in. of water from the Cowholm River for power purposes to operate the plant now under construction.

WINNEPEG, MAN., CAN.—The Manitoba Government has provided about $300,000 for improvements and extension of the telephone system.

HALIFAX, N. S.—Extensive improvements and extensions will be made to the system of the Nova Scotia Telephone Company, which will involve an expenditure of about $200,000.

FOREST, ONT., CAN.—The People's Telephone Company has been incorporated with a capital stock of $20,000, by R. F. Scott, W. Lawrie and J. W. Bell.

FORT ERIE, ONT., CAN.—The Legislature of the Province of Ontario has passed a bill giving permission to the Fort Erie Ferry Railway Company to build extension to its present lines. The company proposes to build an electric railway extending along the Canadian frontier from Chippewa to Port Colborne. Frank J. Weber, president of the company, states that work will commence on the construction of the road this year.

HAMILTON, ONT.—The Cataract Power Company has notified the city clerk of its intention to appeal against the decision of Judge Snider in the street lighting arbitration matter. A reduction was granted to the city in the cost of street lamps from $85 to $70 per lamp per year.

TORONTO, ONT., CAN.—Pending the signing of the contracts by the municipalities, the Hydro-Electric Power Commission has had estimates prepared for the cost of the transmission lines to the various cities and towns which have passed by-laws to take electrical power from the commission. The cost of the lines is estimated at from $3,400,000 to $3,500,000. The estimates are based on the plan for the erection of a transmission line designed for 30,000 horse-power.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has made a reduction in its prices for gas and electricity. A discount of 10 per cent. will be allowed on one-year contracts for electricity, and on five-year contracts 50 per cent. will be allowed. The price of gas will be reduced from $1.20 to $1.15 per thousand cu. ft.

HERBERT, SASK., CAN.—Plans are being made to organize the Herbert Rural Telephone Company, which proposes to erect about 30 miles of lines. The officers of the company are W. H. Hallett, secretary; F. J. Dafchr, treasurer, and Franz Cornelson, manager.

MOOSEJAW, SASK., CAN.—The rate-payers will shortly vote on a by-law to raise $200,000 by the sale of debentures for improvements to the power plant, etc. For further information address John D. Simpson, city clerk.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until May 23, 1908, for furnishing the following supplies: Wiring material, chandeliers, lamp shades, incandescent globes, cross-arm pins, magneto testing sets, dry cells, turn-buckles, brake arms, cable clamps and thimbles, wire cable, soldering paste, friction tape, varnish cambric, wire solder, insulating paint and varnish, mica, wire cutters, pliers, rubber gloves, etc. Blanks and general information relating to this circular (No. 439) may be obtained from this office or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; also from the U. S. engineer offices in the following cities: Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala. Lt.-Col. H. F. Hodges is general purchasing officer.

New Industrial Companies.

THE TWENTIETH CENTURY ELECTRIC & REPAIR COMPANY, of Akron, Ohio, has been incorporated, with a capital stock of $10,000, by F. N. Harris, C. L. Bigler, J. M. Hassler, George J. Schaffer and N. K. Walters.

THE ELECTRIC VIBRATOR COMPANY, of Plainfield, N. J., has been incorporated, with a capital stock of $250,000, by Henry B. Suydam, George S. Jacob and Allen G. N. Vermilya. The company proposes to manufacture massage appliances.

THE CHAUTAUQUA ELECTRIC COMPANY, of Jamestown, N. Y., has been incorporated with a capital stock of $5,000 by Fred H. Baloon, of Jamestown; George B. Barrell and B. J. Shanahan, of Buffalo, N. Y. The company proposes to do general electrical work.

THE S. K. ELLIOTT ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $150,000, by S. K. Elliott, Logan Myers, Clifford P. Billings, C. W. Elliott and K. M. Elliott. This company handles a line of motors and other electrical equipment.

THE AUTOMATIC ELECTRIC SIGNAL COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $100,000, to manufacture automatic signals. The officers of the company are: S. A. Corbett, of Boston, Mass., president; F. L. Hall, of Winthrop, treasurer.

THE NUTTING-ROE ELECTRIC COMPANY, of Muncie, Ind., has incorporated to manufacture and sell all kinds of electrical equipment, generators, motors, switchboards, electric heating devices, lamps and electric light plant equipment, etc. J. R. Hummel, K. E. Nutting and W. L. Roe are the directors.

THE AUTOMATIC COIN-WRAPPING MACHINE COMPANY, of Plainfield, N. J., has filed articles of incorporation with a capital stock of $125,000. The company proposes to manufacture coin-wrapping machines and do a general electrical and mechanical engineering business. The incorporators are: R. D. Geswein, E. A. Sidman and H. L. Bell, of Plainfield, N. J.

New Incorporations.

NEWPORT, ARK.—The Newport Water, Light & Power Company has been incorporated, with a capital stock of $100,000, by N. V. and A. N. Walker, John A. Williams and L. Minor.

RECTOR, ARK.—The Rector Co-operative Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are J. W. Dollison, president; W. E. Lynch, J. B. Hafford, A. J. Sides, A. W. Gill, W. C. Cochran, R. A. Klope, T. A. Jones and others.

GRASS VALLEY, CAL.—The I.X.L. Telephone Company has been organized to build a telephone system between Grass Valley and Pet Hill.

DAYTONA, FLA.—The Daytona Telephone Company has been incorporated with a capital stock of $1,000. The officers of the company are: S. H. Gove, president; H. C. Thompson, secretary.

ADRIAN, GA.—Articles of incorporation have been filed for the Adrian Power Works, with a capital stock of $50,000, by J. E. Taylor, W. W. Strickland, of Adrian, and J. L. McKeaver, of Guthrie, Okla.

LEVERETT, ILL.—Articles of incorporation have been filed for the Somer Township Telephone Company with a capital stock of $8,000, by C. B. Fiatt, M. C. Busey and P. P. Dunn.

PIPER CITY, ILL.—The Piper City Telephone & Telegraph Company has been incorporated with a capital stock of $10,000. The incorporators are: James P. Glass, W. H. Roberts and J. A. Montelius, Jr.

WEST POINT, ILL.—The Tri-Mutual Telephone Company has been incorporated with a capital stock of $1,020, by W. H. Felger, J. I. Farnsworth and L. F. Miller.

ELK CITY, KAN.—The Farmers' Mutual Telephone Company has been chartered with a capital stock of $10,000.

GARDEN CITY, KAN.—Articles of incorporation have been filed for the Northwestern Mutual Telephone Company.

FRANKFORT, KY.—The Ballard County Home Telephone Company has been incorporated with a capital stock of $6,000 by J. F. Hahs, H. E. Morrow, L. S. Turner and others.

STEPHENSPORT, KY.—Articles of incorporation have been filed for the Stephensport Telephone Company with a capital stock of $500 by Andrew Crawford, R. A. Shellman, John S. Adair and others.

AUGUSTA, MAINE.—The North Fork Water Company has been incorporated with a capital stock of $500,000, for the purpose of conducting a mining business, selling water for irrigation purposes, also selling water and electrical power. J. Berry, of Augusta, is president and manager.

WATERVILLE, MAINE.—The Kennebec Farm & City Telephone Company has been incorporated with a capital stock of $10,000. The officers are F. E. Webster, of Skowhegan, president; F. L. Ames, of Norridgework, treasurer, and E. A. Webster, of Norridgework, clerk.

EAST SAUGATUCK, MICH.—The Farmers' Telephone Company has been incorporated to establish a telephone system in this city.

BATTLE LAKE, MINN.—The Battle Lake Mutual Telephone Company has been organized and the following named officers elected: Ludwig Jensen, president; William Bondy, vice-president; A. Bjorklund, secretary, and Knute Sandstrom, treasurer.

CHILLICOTHE, MO.—The Mutual Telephone Company has been organized in this city and the following officers elected: Z. B. Myers, president; H. P. Scruby, vice-president; C. F. Wykoff, secretary, and John McBride, treasurer.

SHERIDAN, MO.—Articles of incorporation have been filed for the Farmers' Mutual Telephone Company with a capital stock of $3,000.

FARMINGTON, N. H.—Articles of incorporation have been filed for the Cloutman Gas & Electric Company with a capital stock of $15,000.

ELLENBURG, N. Y.—The Ellenburg Telephone Company has been incorporated by F. H. Gardinier, N. W. McGaulley, J. H. Moore, F. L. Myers and others. The company is capitalized at $5,000.

HIGH POINT, N. C.—The Orinoco Telephone Company has been incorporated with a capital stock of $5,000 by C. E. Spurgeon, W. A. Motsinger, W. E. Swain and others.

DES LACS, N. D.—Articles of incorporation have been filed for the Ward County Farmers' Telephone Company. The company is capitalized at $19,950 and the incorporators are William G. Varnes, T. M. Williams, E. S. Waterman and others.

TIPPECANOE, OHIO.—The Laurel Valley Telephone Company has filed articles of incorporation with a capital stock of $7,500. The incorporators are: S. F. Groves, N. S. Bower, S. A. Gurnincy, W. F. Owens and others.

ASHLAND, OKLA.—Articles of incorporation have been filed for the Ashland Telephone & Telegraph Company by J. W. Rose, S. H. Rose and Henry Judgemire. The company is capitalized at $2,500.

BEULAH (P. O. DOXEY), OKLA.—An independent telephone company has been organized by J. A. Corbell and others. The company is on the market for a 25-drop switchboard, telephones, wire, and other equipment.

CATAWISSA, PA.—The Farmers' Union Telephone Company has been incorporated with a capital stock of $5,000, to operate a telephone system in Columbia, Mantour and Northumberland Counties with headquarters at Catawissa.

CENTER HALL, PA.—The Patrons Rural Telephone Company has been incorporated with a capital stock of $10,000 for the purpose of installing a telephone system in Center, Clinton, Huntingdon, and Clair Counties.

LANDISVILLE, PA.—The Landisville Telephone Company has been organized to install a telephone system in this town.

McKEANSBURG, PA.—The McKeansburg Rural Telephone Company has filed articles of incorporation. The incorporators are: John Shoener, Oscar P. Leidenspergcr and William H. Matten.

GRANVILLE, TENN.—The Granville Home Telephone Company has filed articles of incorporation with a capital stock of $1,500 by H. S. Holleman, H. B. Smith, A. B. Hayes, J. H. Hargis and others.

McKENZIE, TENN.—The Rural Home Telephone Company has been chartered with a capital stock of $1,500.

ISLAND POND, VT.—The Essex Telephone Company has been chartered with a capital stock of $25,000 by O. T. Davis, M. K. Davis, Porter H. Dale, M. G. Davis and E. M. Bartlett, of Island Pond. The company proposes to install exchanges in this city and Brighton.

HERTEL, WIS.—The Independent Telephone Company has been organized to construct a telephone line from Hertel to Doran.

STEVENS POINT, WIS.—The Porter Telephone Company has been formed for the purpose of constructing a telephone system between Stevens Point, Stockton and Plover. The following-named officers have been elected: John Porter, president; John Britz, vice-president; A. F. Else, secretary, and J. P. Leonard, treasurer.

KIRTLEY, WYO.—The Pleasant Ridge Telephone Company has been incorporated with a capital stock of $5,000, to install a telephone system between Kirtley and Luck, and eventually throughout Converse County. The directors are: William P. Sargeant, Thomas H. Thompson, Harry R. Rogers, and Harry C. Snyder.

Legal.

RECEIVERS FOR FOSTORIA LIGHT PLANT.—The Fostoria City Heat & Light Company, of Fostoria, Ohio, was placed in the hands of receivers April 23, on application of the Consolidated Railway & Light Company, of Philadelphia, Pa. E. W. Allen, of Fostoria, and A. R. Law, of Philadelphia, Pa., were appointed temporary receivers. The indebtedness of the defendant company is placed at $365,000 with no assets.

SUIT TO PREVENT SALE OF FRANCHISE.—The Kentucky Electric Company has filed a suit for injunction against the Board of Public Work, of Louisville, Ky., to enjoin the city from selling on May 12 what is known as the Fetter franchise. The company claims that the ordinance was not passed by the Board of Council as required by law, and also states that the ordinance is void. for the reason that it excludes the Louisville Lighting Company and the Kentucky Electric Company, or any one bidding in their interests on the franchise when it is put up for sale. The ordinance, it is shown, is so drawn as tn create a franchise solely for the George G. Fetter Lighting & Heating Company, and it is alleged that no other person could bid on the franchise in good faith or comply with its provisions.

EFFECT OF DELAY IN APPLYING FOR A PATENT.—The complainant in an action to restrain the infringement of a patent covering an improved telephone transmitter showed that the inventor of the device, who assigned it to the complainant company, conceived the invention in 1895. At that time he was working under a contract by which his employer was entitled to the benefit of any inventions which he might make during the course of his employment. For this reason he kept his invention a secret for six years and did not take steps to secure a patent on it until 1901. Meantime another inventor had conceived the same idea and applied for and was granted letters patent, the letters being issued subsequent to the patent of the first inventor. The patent issued to the second inventor was assigned to the defendant and in the present action the defendant claimed that the first inventor had abandoned the idea upon which the invention was based and was estopped to question the validity of the defendant's patent by reason of the long period of time which intervened between the conception of the invention by the first inventor and the time of his application for letters patent. It was held that as there was no evidence of actual abandonment and as the prior invention was the first to give the idea to the public, the plaintiff was entitled to restrain the defendant from interfering with its patent rights. In the language of the court an estoppel "could hardly be based upon what two men held locked up in their minds." Kellogg Switchboard Co. v. International Telephone Mfg. Co., United States Circuit Court, 158 Fed. 104.

Personal.

MR. BERNARD C. COBB has been appointed vice-president of the Saginaw-Bay City Railway & Light Company, of Saginaw, succeeding Mr. S. E. Wolff, recently resigned.

MR. B. W. MENDENHALL has resigned as manager of the Ely, Nev., Light & Power Company, to accept the position of commercial agent for the Utah Light & Railway Company, Salt Lake City. He has now taken up his new duties.

MR. HENRY B. IVERS, who for the past year has been assistant to the president and treasurer of the Bangor Railway & Electric Company, of Bangor, Maine, has been appointed general manager of the Lewiston, Augusta & Waterville Railway Company, of Lewiston, Maine.

MR. FREDERICK RALL has become the New York selling agent for O. C. White & Company, of Worcester, Mass., the manufacturers of the White adjustable incandescent lamp fixtures. He will have offices and headquarters at 16 Murray Street and 19 Park Place, and will carry a complete stock.

MR. JOSEPH E. WAYNE, formerly superintendent of the York Street Railway Company, of York, Pa., has been appointed general manager of the Waynesboro Electric Light & Power Company and the Chambersburg, Greencastle & Waynesboro Street Railway Company, of Waynesboro, Pa. Mr. Wayne assumed the management of the company May 1.

MR. IVAN OFVERHOLM, chief engineer of the electrification department of the Swedish Government Railways, arrived in New York April 30. The question of the electrification of the railways in the Southern part of Sweden is an important one owing to the high price of coal, and as is well known, the government engineers have been making a study of the possibilities of electrical energy. No detailed plans have yet been adopted. Mr. Ofverholm will visit a number of the most important heavy electric traction and single-phase railways while here, and expects to return to Sweden on May 27.

MR. H. R. FOTHERGILL, the engineer and manager of the Scholl Engineering Company, in resigning from the position of general superintendent of the Greenville Traction Company, superintendent of the Greenville Gas & Electric Light & Power Company and superintendent of the Paris Mountain Water Company, all plants of the American Pipe Manufacturing Company's syndicate, owned principally in Philadelphia, to again engage in the contracting business, was presented with a handsome gold watch by the employees as a token of their appreciation of his treatment to them and their desire to have him carry their good will wherever he might be. Mr. Fothergill has been identified with the electric railway and lighting trade for the past 15 years, particularly in power-plant construction, and enters his new field with two central station plants already turned over to him for construction.

Removals.

MR. JOHN BOGART, C. E., has removed his New York offices to 115 Broadway, New York City.

MR. A. A. KUNDSON, the electrolytic expert, has removed his offices in New York City to 50 Pine Street.

HARVEY & HILL have removed their general offices to suite 1880 Fulton Building, Hudson Terminal, 50 Church Street, New York City.

ELEVATOR SUPPLIES.—The Elevator Supply & Repair Company, New York City, has removed its offices to the sixth floor of 114 Liberty Street.

AMERICAN CIRCULAR LOOM.—The American Circular Loom Company has opened offices in the International Trust Building, 45 Milk Street, Boston.

THE ELECTRIC SERVICE SUPPLIES COMPANY has moved the offices of its New York sales department to the Hudson Terminal Building, 50 Church Street.

THE NEW YORK OFFICE of Messrs. McIntosh, Seymour & Company has been moved from 26 Cortlandt Street, to 50 Church Street, in the Hudson Terminal Building.

ALLIS-CHALMERS IN SAN FRANCISCO.—The district office maintained by Allis-Chalmers Company at San Francisco in charge of Mr. H. D. Scribner, manager, has been removed from the Atlas Building to the Phillips Building, 599 Mission Street. As it is only a step from one building to the other, callers will have no difficulty in finding the new location.

THE STANDARD GAUGE MANUFACTURING COMPANY, of Syracuse, N. Y., makers of indicating gages for all purposes, has moved its New York branch from 141 Broadway to Room 1770 Hudson Terminal Buildings. This change was made in order to obtain more spacious quarters for the display of a long line of engineering specialties, as well as to remain in the center of the downtown engineering community. The Western branch of the Standard Gauge Company is located in the Monadnock Building, Chicago, Ill.

Unclassified Items.

WATERLOO, IA.—The Waterloo, Cedar Falls & Northern Railway Company has filed a trust deed in Black Hawk County conveying the street railway and interurban property to Louis Boisot and the First Trust & Savings Bank, of Chicago, Ill., to secure a loan of $2,000,000, the proceeds of which will be used to extend its lines in this city and surrounding territory.

COUNCIL BLUFFS, IA.—The Omaha & Council Bluffs Street Railway Company has completed surveys for the extension of its line from this city to the School for the Deaf, for which contracts for construction of the road will soon be let. The road will be about two miles in length.

ROME, N. Y.—At the annual meeting of the Rome & Osceola Railroad Company the following named officers were elected: W. Pierrepont White, president; John D. McMahon, secretary and treasurer; executive committee: J. S. Haulton, David Swanscott, W. I. Taber and W. S. Jones.

MILLSBORO, DEL.—The Town Council is considering the question of establishing an electric lighting system in this town. Two propositions are under consideration: One to make an agreement with the Georgetown Light, Heat & Power Company to furnish electricity for lighting the town; the other is to form a stock company and utilize the water power of the Indian River to operate an electric light plant.

DAYTONA, FLA.—Adam Schantz has submitted a proposition to the City Council for the rebuilding of the electric light plant recently destroyed by fire. Mr. Schantz has asked the city for an extension of the present electric light franchise for 16 years, or 30 years from April 30, 1908, and an extension of the electric light contract for 10 years.

MONROE, LA.—Orders have recently been placed for new equipment for the municipal electric light plant, which include new boilers, engine, generators and other apparatus. The improvements to the plant will cost about $20,000.

BRIDGTON, ME.—At a special meeting of the Bridgeton Center Village Corporation it was voted to continue lighting the streets of the city by electricity. At its annual meeting the corporation refused to accept the proposition of the company, and the streets of the village have been in darkness since.

PITTSBURG, KAN.—The Joplin & Pittsburg Railway Company has placed a contract with the John A. Stewart Electric Company of Cincinnati, Ohio, for two 600-kw direct-connected units for railway service, and complete power house equipment, consisting of water-tube boilers, etc.

NEWBURGH, N.Y.—The Public Service Commission, second district, has authorized the Newburgh Light, Heat & Power Company to issue bonds to the amount of $330,000, the proceeds to be used for the discharge of its lawful obligations, and to pay for the cost of improvements to the electric light plant and extensions to line. The company applied for permission to isue $350,000.

BELLINGHAM, WASH.—A section of the transmission lines running from the main substation of the Noosack Falls Power Company was destroyed by fire April 23, entailing a loss of about $10,000.

PLATTSBURG, N. Y.—The Public Service Commission has authorized the Plattsburg Light, Heat & Power Company to issue $250,000 in bonds.

CHISHOLM, MINN.—The Northern Power Company has commenced work on the construction of a power plant six miles north of Chisholm. The plant will furnish electrical energy to the Northern Traction Company, and also for lamps in this city.

TAYLORVILLE, ILL.—The Taylorville Electric Railway Company has been incorporated to build a street railway line in Taylorville.

BILLINGS, MONT.—The Stillwater Power & Light Company has been incorporated to construct an electric railway from this city to Cooke City by the way of Columbus. Branches also will be built to Yellowstone, Sweet Grass, Carbon and Park Counties. The capital stock of the company is placed at $3,000,000, and the incorporators are: Willard Bennett, of Helena; George H. Savage, W. E. Durfresee and E. E. Congdon, of Butte

RED OAK, IA.—Articles of incorporation have been filed for the Red Oak & Northwestern Interurban Promotion Company with a capital stock of $10,000, for the purpose of constructing an electric railway from Red Oak to Des Moines. The officers of the company are: B. B. Clark, of Red Oak, president; G. W. Curtis, of Redfield, vice-president; M. N. Spencer, of Red Oak, secretary; L. D. Goodrich, of Red Oak, treasurer.

Business Notes.

MARCONI WIRELESS TELEGRAPH COMPANY, 27 William Street, New York, is making a registration of cable code addresses. This is a good idea, though it sounds novel. Every user of the cable ought to put his code name on file for the wireless as well.

THE AMERICAN DISTRICT STEAM COMPANY, of Lockport, N. Y., originator of underground steam heating, will have an exhibit at the convention of the National Electric Light Association in Chicago. This company, with more than 31 years of experience, has developed the underground steam-heating business to such a degree of perfection that its exhibit will be worth the time to investigate it thoroughly. Every detail of the operation of both live and exhaust underground steam-heating systems will gladly be explained by the company's engineers and representatives who will be in attendance.

WESTERN ELECTRIC COMPANY will hereafter conduct in its own name the business which it has hitherto carried on in San Francisco for Pacific Slope business, under the name of the California Electrical Works.

DOSSERT & COMPANY, 242 West 41st Street, New York, manufacturers of solderless connectors, cable taps, and terminal lugs for electric cables and solid wires, will be represented at the convention of the National Electric Light Association in Chicago by Mr. H. B. Logan, president, and Mr. Charles A. Flynn, M. E. Their exhibit, which will be in space No. 6, will include a number of new devices for central station work and connectors for heavy cables.

FAIRBANKS, MORSE & COMPANY.—The officials of the various branch houses and factories of Fairbanks, Morse & Company in the Middle West held a banquet at the Commercial Club, in Indianapolis, Ind., on the 28th ult. Mayor Bookwalter made a felicitous address, expressing the appreciation of the people of Indianapolis that the company had established an important and extensive electrical factory in the city without the blowing of trumpets or the asking for a subsidy. The officials held an interesting two days' session. Among those in attendance and who took a part in the deliberations were: W. E. Miller, first vice-president; H. C. McClary, second vice-president; F. F. Forbes, purchasing agent; L. J. Osburn, manager of electrical department, and F. E. Benedict, department manager of supplies, all of Chicago; W. B. Wood, Detroit; George B. Woodard and John Snarenberger, Louisville; J. M. D. Robb and H. W. Bonnell, Cincinnati; H. E. Cluckering, Cleveland; E. V. Abbott and S. L. Hadley, of Indianapolis. The officials expressed themselves as being well pleased with their visit and meeting in Indianapolis and will likely meet there again next year.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY is placing on exhibition at the Chicago N. E. L. A. Convention one of its total output station integrating wattmeters, also one of its latest graphic recording instruments, which it claims to be the most accurate and the most simple in use. These two instruments are so combined that the totalizing meter not only integrates and adds up the total output of the plant, but it also actuates the graphic recording instrument, which shows the output on a moving strip of paper. This is the first public exhibition of a system whereby the output of any number of dynamos, irrespective of whether they are direct current, or single or polyphase alternating current, can be conveniently combined so as to show their total output on a single instrument, and is well worthy of the attention of every central station manager who is interested in the latest and most approved methods of keeping an accurate cost of the production of his electrical energy. There will also be on exhibition a number of the latest Duncan house type and switchboard type meters, all of which embody the very latest features in the art. The exhibit will be in charge of Mr. Adrian Tobias, sales manager, and Mr. John A. Clark, laboratory expert.

GENERAL ELECTRIC CONVENTION EXHIBIT.—The exhibit of the General Electric Company at the N. E. L. A. convention in Chicago will occupy a space of some 16 ft. square near the center of the Auditorium Annex. A full line of heating devices, including the new mantel type luminous radiator, will be shown. Prominent among the apparatus exhibited will be tungsten lamps for both interior and outdoor lighting, and the luminous and flame arc lamps. There will also be exhibited the new aluminum cell lightning arrester, a line of meters, both portable and stationary, and a number of alternating and direct-current motors for small power purposes. An oscillograph will be in operation, and records will be taken to show the effect of different values of reactance on the wave form. A daily demonstration of electric cooking devices will be held, and a substantial welcome is assured those who desire to judge the excellence of electrically cooked edibles. Among the representatives of the company at the convention will be the following: E. W. Rice, Jr., J. R. Lovejoy, C. D. Haskins, P. D. Wagoner, F. G. Vaughen, D. R. Bullen, E. E. Gilbert, W. L. R. Emmet, C. W. Stone, N. R. Birge, C. B. Burleigh, C. P. Steinmetz, J. W. Kirkland, Theo. Beran, A. D. Babson, H. J. Buddy, A. D. Page, T. E. Bibbins, F. H. Gale, G. L. Thompson, D. B. Rushmore and F. W. Willcox.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 28, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

885,745. ELECTRIC FURNACE; Paul Girod, Ugine, France. App. filed Dec. 20, 1905. Construction of electric furnace having a chamber with a mass of resistance material arranged in layers in contact with the sides, ends and bottom of the receptacle.

885,754. SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn., App. filed Jan. 15, 1903. System of distribution having a plurality of prime movers and energy consumption devices driven thereby. Includes a plurality of dynamo electric machines having driving connection with the prime movers, and means for causing the transfer of energy from one dynamo electric machine to another.

885,755. SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Belleville, N. J. App. filed Aug. 24, 1905. Distribution system adapted to accommodate and regulate all parts of the system in accordance with changes in the average load occurring during a given period, such as the course of a day, during which the demand is at a light average, and later when the demand is at a heavy average.

885,761. PROCESS OF RECOVERING METALS FROM THEIR SULFID ORES; Edward Frank Kern, Knoxville, Tenn. App. filed Sept. 1, 1906. A process of recovering lead and associated metals from lead sulfid which contains ore, which consists in first fusing said ores with a suitable flux to form a matte and electrolyzing a suitable fused electrolyte with said matte as anode.

885,763. PHYSICAL LABORATORY APPARATUS; Louie E. Knott, Boston, Mass. App. filed Nov. 23, 1907. A laboratory dynamo or generator which can be taken apart and reassembled. Is of the original Gramme type.

885,769. ELEMENT FOR ELECTRIC HEATERS; Abbot A. Low, Horseshoe, and Harry Hertzberg, New York, N. Y. App. filed May 4, 1907. A resistance element for heaters making use of carbon blocks which are held together by an asbestos cord.

885,771. TRANSFORMER COIL INSULATION; Jesse E. Mateer, Wilkinsburg, Pa. App. filed Dec. 16, 1905. Has current carrying parts of unlike potential and means for insulating said parts from each other, comprising a wall of insulating fluid maintained between the parts in which barrier plates of hard insulating material are interposed at regular intervals.

885,776. TROLLEY POLE HEAD; Garret Mott, of New York, N. Y. App. filed April 25, 1907. The trolley wheel is mounted in a section of the trolley pole which is swiveled to the main portion on a vertical axis.

885,782. RHEOSTAT; Granville F. Packard, Pittsburg, Pa. App. filed April 28, 1906. Has a set of contact terminals and a switch arm to engage therewith, together with a doubled resistance strip and means for making continuous circuit connection to both portions thereof.

885,800. COIL SUPPORT FOR ELECTRIC TRANSFORMERS; Herbert C. Soule, Wilkinsburg, Pa. App. filed Aug. 3, 1907. A transformer having a core member and a winding having a plurality of coils which project beyond the ends of the core member, and means independent of the other transformer parts for supporting the projecting ends of the winding.

885,836. INSULATED CANOPY-COLLAR; Thomas H. Bullock, Jr., New York, N. Y. App. filed Aug. 24, 1906. A canopy-collar comprising a ring and a cap having screw threaded connections with each other and forming the two parts of a clamp, and a contractible insulating sleeve contained within said collar and cap, adapted to embrace the metallic tubing of the fixture and to be forced into frictional contact therewith by said clamp.

885,847. ELECTRICAL DISTRIBUTION; John Somerville Highfield, London, England. App. filed Jan. 20, 1908. High-tension, direct-current series system of electrical supply designed to improve the method of distribution whereby greater security in the supply is obtained and greater flexibility of the arrangement to allow of the growth of the system.

885,859. TELEPHONE-STAND; William B. Oliver, Collingswood, N. J. App. filed March 23, 1907. A telephone support, including in combination an adjustable counter-balancing supporting means, a stem comprising a switch box carried by said supporting means, and held from horizontal rotation thereon, a switch hook mounted upon said stem and a transmitter carried by said stem and mounted to rotate with relation thereto in a substantially horizontal plane.

885,864. ELECTRICAL CONNECTION; Henry R. Read, Brooklyn, N. Y. App. filed April 26, 1907. The strands of the conductor are double backed on the outside of the insulation, and a spring sleeve is pushed over this portion of the cable so as to establish electrical contact therewith.

885,882. STARTING DEVICE FOR MERCURY LAMPS, Charles P. Steinmetz, Schenectady, N. Y. App. filed Oct. 17, 1904. In an electric system, the combination of a mercury tube, means for supplying current thereto, a movable member within said tube, a solenoid for operating said movable member, an auxiliary conductive path for supplying current to said solenoid independent of that transmitted by said vapor tube, and means for automatically opening said auxiliary path when the current in said vapor tube has attained substantially its normal value.

885,890. LAMP SOCKET; William C. Tregoning, Cleveland, Ohio. App. filed Aug. 12, 1907. Lamp socket for electric light signs. Makes use of a cylindrical porcelain block having a socket shell and having integral lateral lugs through which the fastening screws are passed.

885,906. ELECTRIC-ARC LAMP; Heinrich Reck, Frankfort-on-the Main, Germany. In an electric-arc lamp, an apertured frame, an electrode adapted to be fed through the same, and a plurality of sliding frames having apertures of progressively decreasing diameters through which the electrode also passes, said plates free to be moved by the electrode and co-operating to seal the aperture in the frame.

885,915. BUSY-SIGNAL APPARATUS; Charles J. Erickson, Chicago, Ill. App. filed Nov. 12, 1906. An interrupter or buzzer for producing an interrupted current of a relative high rate vibration, and a second interrupter or buzzer for interrupting the said current at a relatively low rate of vibration.

885,922. TELEPHONE SYSTEM FOR FIRE-HOSE; Harry Grosswith, Philadelphia, Pa. App. filed March 8, 1905. Renewed March 24, 1908. The hose has wires longitudinally embedded therein which terminates in engaging abutments to establish telephone connection. Makes use of clasps to avoid a screw coupling.

885,934. METHOD OF MAKING ARTIFICIAL MICAS; Florentine L. Machalske, Niagara Falls, N. Y. App. filed Nov. 21, 1907. A method of making artificial micas which consists in melting in an electric furnace a charge proportioned to yield a mica.

885,935. RHEOSTAT; Edward L. Mahon, Bellaire, Ohio. App. filed June 6, 1907. Construction of rheostat having a stationary and an adjustable conductor plate and means for interposing a body of water under pressure between the conductor plates.

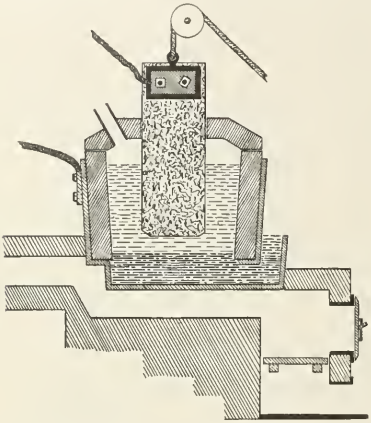
885,941. ELEVATOR INDICATING SYSTEM; Charles E. Moore, Los Angeles, Cal. App. filed Sept. 3, 1907. Has a visual indicator upon the grill work at each floor or landing, connected with the car and operated by the movement thereof, so as to show in which direction the car is moving.

885,942. SAFETY FLASHLIGHT APPARATUS FOR ELEVATORS; Charles E. Moore, Los Angeles, Cal. App. filed Sept. 3, 1907. A safety flashlight system for an elevator car, comprising a light adapted to flash across the floor of the car at the gateway thereto, electrical connections for said light, and means in combination with the operating lever of the car for automatically lighting said light when the lever is thrown to stop the car.

885,961. CONTROLLING SYSTEM FOR HOISTS; Barton R. Shover, Chicago, Ill., and Arthur C. Eastwood, Cleveland, Ohio. App. filed June 20, 1907. A controlling system analogous to that in use for elevators and adapted to control a hoist motor for blast furnace coal and oil carriers.

885,967. ELECTRIC CONTROLLER; Reuben I. Wright, Cleveland, Ohio. App. filed Oct. 11, 1906. Construction of the contact arm, the finger, and finger holders of a controller. The blow-out magnet is embodied directly in the contact arm and produces a magnetic field across the contacts.

885,978. PREPARATION OF THE INDIGO-VAT EMPLOYED IN DYEING; Henri Chaumat, Paris, France. App. filed Aug. 20, 1907. Consists in treating an alkaline solution by an electric current in a chamber having a diaphragm with an anode of non-oxidizable metal and a cathode of metallic powder.



885,761.—Process of Recovering Metals from their Sulfid Ores.

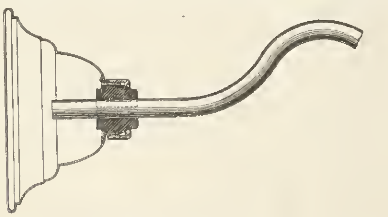
885,988. DUPLEX MOTOR CONTROL SYSTEM; Fred R. Fishback, Cleveland, Ohio. App. filed Sept. 13, 1907. A motor control system for operating a plurality of magnetically operated switch controllers by means of a single handle so that by said handle one or both of the magnetically operated controllers may be actuated.

885,998. DIAPHRAGM AND METHOD OF MAKING THE SAME; Heinrich Hirtz, West Hampstead, Eng. App. filed Oct. 3, 1905. A diaphragm for use in an electrolytic cell, consisting of a suitable textile fabric having deposited within it an insoluble double cyanid.

886,035. DIRECT-CURRENT TURBO-GENERATOR.; Bernard A. Behrend, Norwood, Ohio. App. filed Oct. 31, 1906. In a dynamo-electric machine, an armature core, coils carried thereby, a commutator, a clamping device for said commutator, and a protective end-ring surrounding the ends of the coils and extending inward to said clamping device.

886,049. MULTIPLE-VOLTAGE SYSTEM FOR DISTRIBUTION; Budd Frankfield, Norwood, Ohio. App filed Nov. 30, 1906. In a multiple-voltage system of distribution, main and compensating conductors, a balancer, and a controller for first connecting the balancer to the main conductors and then, after the balancer is up to speed, to a compensating conductor.

886,073. COOLING SYSTEM FOR ELECTRICAL APPARATUS; Karl C. Randall, Edgewood Park, and Charles B. Gibson, Wilkinsburg, Pa. App. filed Aug. 3, 1907. Cooling system for electrical apparatus, providing means for regulating the circulation of insulating fluid through a plurality of tanks or cases which are connected in multiple and in which transforming or other electrical devices are contained.



885,836.—Insulated Canopy Collar

886,093. CONTACT POST SYSTEM FOR TRANSMITTING ELECTRIC POWER; George E. Titcomb, Philadelphia, Pa. App. filed Feb. 29, 1908. Specially constructed contact rods depend from spring arms on the body of the car so as to engage stationary contacts at spaced intervals along the side of the track.

886,109. FIELD ADJUSTING DEVICE FOR ELECTRIC GENERATORS AND MOTORS; Frederick Ossian Ball, North Plainfield, N. J. App. filed Jan. 11, 1907. Field adjusting device for electric generators and motors. Includes specially constructed clamping and adjusting irons which are placed beneath the supporting legs of the generator frame.

886,135. WATTMETER TESTING APPARATUS; Otto A. Knopp, Oakland, Cal. App. filed June 10, 1907. Apparatus particularly designed and connected to provide a convenient means for testing recording wattmeters without the necessity of removing them from the various positions in which they may be installed.

886,138.—ELECTRIC IGNITER; John N. Lansinger, Kent, Ohio. App. filed April 24, 1907. Curling iron so arranged that a circuit is completed to heat the prongs thereof when the prongs are in their divergent relation, but not when they spring together in use.

886,141. INTERRUPTER; August R. Luschka, River Forest, Ill. App. filed Dec. 11, 1905. Relates to pole changers for transferring direct current into pulsating or alternating current. Has a magnet operated vibrator which engages the spring blades of a pole changing switch. The apparatus includes resistances and condensers to prevent sparking at the contacts.

886,148. SIGNALING DEVICE FOR INCUBATORS; Georg Mücke, Reisenberg, Austria-Hungary. App. filed Dec. 31, 1907. Has a thermostat connected with an alarm, and a separate thermostat operating a damper for the lamp which furnishes the heat.

886,154. OSCILLATION RECEIVER; Greenleaf Whittier Pickard, Amesbury, Mass. App. filed Sept. 30, 1907. An oscillation receiver or detector making use of a fused mass of oxid of zinc.

886,157. ELECTRICALLY OPERATED CLOCK; Dominic Sandretto, Ladd, Ill. App. filed Nov. 21, 1907. An attachment for ordinary clocks by means of which they may be transformed into electrically operated clocks after having removed the main spring and wheel.

886,169. MEANS FOR ESTABLISHING ELECTRICAL COMMUNICATION WITH MOVING TRAINS; Joel Ames, Montrose, Iowa. App. filed Sept. 16, 1907. The patentee has a specially constructed slider depending from the locomotive tender and which is adapted to engage spiral contact arms projecting upwardly from the ties of the track.

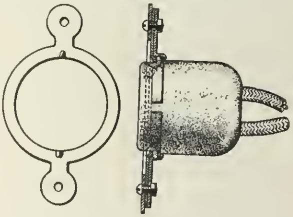
886,176. TROLLEY HARP; Percy C. Bliven, Danielson, Conn. App. filed May 23, 1907. The harp of the pole is made hinged in sections which separate to permit the ready removal of the trolley wheel.

886,220. REGISTERING TELEPHONE CALLS; Eugene Lamar Smith, Oak Cliff, Tex. App. filed June 26, 1907. Means to register a telephonic call, said means comprising a registering device with polarized electromagnet located at the outlying or subscriber's station, and comprising an auxiliary source of current and switching means located at the center, the switching means adjusted to connect said source to the circuit of said outlying station and disconnect said circuit from its normal source of current, said switching device adapted to be manipulated by the operator independent of the means to connect two subscribers' stations with each other.

886,230. RHEOSTAT; John William Mertz, Mount Clemens, Mich. App. filed Jan. 14, 1908. A rheostat having an upper bar and a lower bar with tubular posts connecting said bars together, and resistance windings interposed between said bars. Has electrical connections for said windings, some extending through said tubular posts.

886,239. TROLLEY WHEEL; William W. Neighbour, Denison, Tex. App. filed July 13, 1907. A form of ball bearing for a trolley wheel, having a pair of insulating plates constituting a supporting web for the tread portion and which have run-ways for the balls, so that the current does not pass through the latter. The contact is made by spring cones at the center of the wheel.

886,246. COOLING SYSTEM FOR TRANSFORMERS; Karl C. Randall, Edgewood Park, Pa. App. filed Aug. 3, 1907. Cooling system for electrical apparatus designed to regulate the circulation of insulating and cooling fluid through a plurality of cases which are connected in multiple and in which transformers or other electrical devices are contained.



886,267.—Means for Supporting Lamp Receptacles.

886,262. SWITCH-CORD PLUG; Eugene L. Smith, Oak Cliff, Tex. App. filed Sept. 1, 1906. A device of the class described, comprising a switch cord and a switch cord plug, the switch cord being provided with a hollow ball secured thereto by a hollow neck and the switch cord plug being provided with a socket adapted to receive said ball, said plug being formed of two semi-cylindrical members rigidly secured together to hold the ball within the socket, and a cylindrical casing surrounding said plug.

886,267. MEANS FOR SUPPORTING LAMP RECEPTACLES; James S. Stewart, New York, N. Y. App. filed April 12, 1907. A form of lamp receptacle or clamp adapted for use for outdoor and interior purposes where the lamps are designed to be fixed to and supported by a base or surface such as an electric sign. The patentee provides a special form of sheet metal clip or stamping, which engages the porcelain body so as to rigidly support the same.

886,269. RAILROAD DANGER SIGNALING AND TELEPHONING APPARATUS; Edward Sughroue, Bartley, Neb. App. filed May 18, 1907. In a signaling system, the combination of a plurality of pyrotechnic signaling devices, mechanical means for igniting each device, and electrical means for simultaneously actuating the mechanical means of the several devices.

886,302. COMBINED TUNING COIL AND CONDENSER; Walter W. Massie, Providence, R. I. App. filed April 3, 1907. Combined tuning coil and condenser. A plurality of segmental plates are fixed to a vertical shaft and swing between fixed segmental plates so as to vary the capacity of the device. Also includes a form of choke coil.

886,303. SPARK GAP APPARATUS; Walter W. Massie, Providence, R. I. App. filed May 2, 1907. Has a rotary spark gap wheel having an arc chamber and also having an inlet leading to and an outlet leading from said chamber, and spark gap rods co-operating with said wheel.

886,319. SUPPORT FOR ELECTRIC CONTACT SHOES; Ed. Wilson Farnham, Chicago, Ill. App. filed Aug. 2, 1905. A means for maintaining the contact shoe of a train in spring-pressed engagement with the under side of the conductor rail. Makes use of spring-impelled link arms depending from the truck frames.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, MAY 16, 1908. NO. 20.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE..............................1015 Schofield Building
PHILADELPHIA OFFICE.......................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico........................per year, $3.00
Dominion of Canada..4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 20,000 copies are printed.*

NEW YORK, SATURDAY, MAY 16, 1908.

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THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Started at a time when there were barely four or five hundred central station companies in the field—from 1881 to 1886 inclusive only 247 now existing went into operation—the National Electric Light Association to-day is even more authoritative and representative, when nearly 500 are organized in a single year. We have in the United States at the present time over 5000 central-station systems, and every one that amounts to anything and is conducted by progressive men is in the association and proud of its membership. This is certainly cause for congratulation upon the part of all interested in the prosperity of the central station industry, and if we may judge from the preparations for the Chicago meeting next week and the program, there is further cause for congratulation in the evidence given of abounding vitality and willingness to grapple with the problems which, as ever, beset this wonderful art of electric illumination. No field of mechanical industry has undergone more revolutionary changes than this typified by the National Electric Light Association, which has already held 30 conventions. But while such solidarity exists, combined with readiness to learn and change, and also with an aggressive commercialism ever seeking new fields of opportunity, the association may well expect to wield relatively greater influence and enjoy deeper esteem when its conventions number 60. Possibly the art may by that time have settled down to standards and fundamental bases of practice that still seem to be denied it after nearly 40 years of trial and experiment. That may or may not be, but the association will flourish under any such conditions so long as it enjoys the enthusiasm of men who, while they lead in the development, desire nothing better than to place themselves at the service of their fellows in the association ranks.

ECONOMIC ASPECTS OF VARIOUS ELECTRIC ILLUMINANTS.

Mr. Wohlauer's article, on page 1042 of this number, collates economic statistics for a number of electric lamps and presents the conclusions in a very comprehensive form. It is interesting to observe that no less than 20 different types of lamps, direct and alternating-current, are included in the tables and curves without including differences of type due to series or multiple operation. A few years ago illuminating engineers had only two of these types at their disposal, namely, the carbon incandescent lamp and the carbon open-arc lamp. The growth and development of new types of electric lamps have been very remarkable in recent years. In examining the curves and tables of the article, we should bear in mind that the various lamps considered are supposed to be already installed and only the expenses of operating and of renewal are considered. The cost of first installation appears to be omitted for all types, or taken as not materially affecting the question.

Fig. 1, which includes the multiple-circuit types, bears certain deductions that are of much practical interest. When a customer installs a lamp and buys power from a central station for operating it, the diagram indicates that, for dwelling-room lighting, the tungsten lamp is much cheaper than any other filament lamp. The arc lamps and mercury-vapor lamps are hardly to be considered as suitable candidates for such lighting. If, however, we consider shop, factory or exterior lighting, the arc lamps and mercury-vapor lamps become available. In such a case, according to Fig. 1, the tungsten lamp is ordinarily less expensive than the enclosed arc lamp, but is more expensive than the flaming arcs or mercury-vapor lamps. Curiously enough, the cheapest light of all is indicated as that of the quartz lamp, a type not yet introduced into industrial service in the United States. This is the type of mercury-vapor lamp that boasts of certain red rays in the spectrum, as distinguished from the ordinary glass mercury-vapor lamp whose spectrum is a bald and dreary waste at the place where the red ought to grow. According to the tables, this quartz lamp will produce 1000 spherical candles or 12,570 candle-lumens of light for 3.25 cents per hour, with power costing 10 cents per kw-hour. This is less than half the corresponding indicated cost of the vertical flaming arc light, less than one-fifth of the indicated cost of the tungsten light and less than one-twelfth the cost of light from the ordinary carbon-filament. If these figures can be substantiated in practice, we may expect to see the quartz lamps grow and multiply.

Natural Resources.

This week a convention of governors has been called in Washington by President Roosevelt to discuss the protection of the natural resources of America in water powers, minerals, forests, natural gas, oils, etc., and the invitation has been very generally accepted. We cannot imagine any subject of more vital importance to this country or its people, and it seems impossible that such a gathering of representative men of authority can take place without good resulting. With the things that cannot be renewed or replaced, we need the minimization of waste; with resources that are recreated by the seasons we need the maximum of preservation. This is in the best interests of all the people to-day and of our successors to-morrow. We shall know less of hard times when we eliminate the extravagance that makes for panic and cultivate the economy that underlies all wealth. The President has the cordial good wishes of all engineers and publicists in this effort to conserve all that makes physical America what it is.

Private and Municipal Plants.

For a number of years there has been considerable feeling of hostility between managers of central-station companies and those connected with municipally-owned plants. While the superintendents and engineers of municipal plants are looked upon by their corporation brothers as a fairly decent lot of fellows in the concrete, the municipal-ownership idea in the abstract has in the main aroused the ire of the company managers. The chief reason for this has been that absurd claims as to extreme cheapness of production have been made by the enthusiastic devotees of municipal ownership, and that these claims have, as a natural consequence, tended to throw suspicion on the fairness of the prices made by the various private companies, and to create a sentiment that the various private companies should be displaced by municipal plants. The average central-station company manager does not have any particular grudge against municipal ownership as an abstract theory, nor would he object to municipal ownership in any other city if the cost of conducting the business were truly represented by those engaged in operating municipal enterprises. Up to the present time this feeling of hostility between the municipal and private camps has prevented much intimacy or acquaintance between the members thereof, and perhaps in many cases has even helped the cause of municipal owenership by scattering abroad the general impression that if central-station companies were so hostile to municipal ownership, they must surely be making enormous profits which municipal ownership would destroy. The public have failed to recognize the fundamental difficulty, which is that cost of production in municipal plants has been so frequently misrepresented, and that in the majority of cases this misrepresentation is due far more to ignorance than to deliberate intention to deceive. The rabid municipal ownership advocates that wilfully twist what they know to be truth are a minority.

There are to be noted at present the beginnings of a movement to handle this matter in a much more rational way than in years past, although the movement is not to the liking either of the rabid municipal ownership advocate or to the central station man who is so bitterly opposed to everything connected with municipal ownership that he cannot bring himself to think calmly in regard to the matter. The movement is not a large one, it is true, but there are a few straws which seem to indicate the way the wind is blowing. We refer to the recent actions taken by the State electric light associations of Minnesota and Nebraska admitting municipal plants to membership and inviting them to send representatives to take active part in the association. In this connection it is also to be noted that the Michigan Association has always welcomed members from municipal plants. In the Minnesota and Nebraska Associations the matter has been recently discussed thoroughly, and all sides of the question brought out. There were only one or two dissenters from the proposition that the admission of municipal plants offered such possibilities for good that they would far counterbalance any slight chances for evil in such an arrangement. In the first place, the meeting together of municipal and company plant managers is certain to result in a better understanding of the correct principles of central-station operation and accounting, both on the part of the municipal and of company men. As a matter of fact, a great many of the smaller companies know but little more about true costs than do the smaller municipal plants. By meeting together in an association of this kind, uniformity of opinion on the importance of certain fundamental principles in operation and book-keeping is likely to result, and as a result of this education, much of the misrepresentation as to costs, which has very largely been the result of ignorance, will in time disappear As one member remarked, if uniformity of accounting can be secured for both municipal and private plants, it is worth any risk. In this respect, it is not well for private companies, as a class, to claim any too great superiority over municipal plants as it is well known that the book-keeping of many of the small companies is in deplorable condition. It is to be a case of both company and municipal men sitting down and learning together if the problem is to be worked out in any place where State commissions do not require uniform reports. The plan has the further advantage that in case legislation is needed for the help or protection of companies and municipalities engaging in the electric light and power business, the State Association can with much better grace go before the Legislature with requests if its membership is composed of both municipal and private plants, than if it is simply composed of private corporations.

Among the practical objections which have been urged against the feasibility of admitting municipal plants to State electric light associations, one is that many of the municipal plants are in very small towns and that the superintendent of the plant will frequently feel that he cannot afford to attend convention at his own expense, and the municipality would never make an appropriation to send him. Another is that in many cases there will be difficulty in getting anyone to attend from a municipal plant, the actual operation of the plant being in the charge of a man of too small caliber to make attendance at convention profitable; while the city officers in charge of the financial end of the plant will not feel sufficient indentification with the electrical business to be induced to attend. These practical obstacles will no doubt prevent many municipal plants from being represented, just as similar obstacles prevent numerous private plants from being represented at State conventions. Nevertheless, there are, as was demonstrated at the Minnesota convention in February, a number of managers of municipal plants in small towns whose presence is of value at any State convention. As to the danger which some central-station men have urged, that the admission of municipal plants to associations of this kind is likely to result in their taking entire possession of them and running the association in the interests of municipal plants, as against privately owned companies—that possibility is entirely too remote to be worth a moment's consideration. Those familiar with association work of this kind know that every State association depends for its existence upon the attendance and efforts of a comparatively limited number of the most progressive and able central-station men of the State, and that municipal plants, which practically have no permanent executive head, and which in general contribute so little to the progress of the art, should muster up a convention attendance sufficient to overpower the representation from private companies, is nothing short of ridiculous. The only difficulty will be in arousing sufficient interest among municipal plants to secure the attendance of their representatives at conventions.

Over-Shooting of Tungsten Incandescent Lamps.

As our readers may remember, we published in our issue of April 25 last, on page 859, an article by Mr. John B. Taylor on the new observation of over-shooting in tungsten-filament incandescent lamps. In our editorial columns of the same number comment was made on the newly reported phenomenon, with a recommendation that the experiment should be repeated to secure photographic evidence that the effect was an objective or real physical event, and not a subjective or apparent influence upon the sensory mechanism of the observer. In this number, at page 1046, Mr. Taylor reports further observations in support of his original statement, and presents a pair of photographic records which speak for themselves. Judging from these photographic reproductions, there seems to be no room for further doubt upon the question of reality versus visual sensation. The photographs indicate a distinct increase in the radiation intensity of the lamp, when first turned on, over the normal and final radiation intensity. The effect is clearly presented in the upper photogram for the direct-current experiment. Starting at *A*, with the lamp cold, there is no record of the moment of closing the circuit. If, however, we take the tip of the arrow near *A* to correspond with the instant of full radiation intensity, then the interval of time which elapsed between the first recorded appearance of light at *A*, and the attainment of full intensity, seems to be 0.012 second; or the time spent in coming up from first recorded brightness to full brightness was about the 80th part of one second. But after the lapse of approximately one-tenth of a second, the intensity of the record is shown at *B* to have fallen off to a subsequently steady value. When the lamp is turned off at *C*, the subsidence of radiation can be detected on the picture for one-thirtieth of a second. Again, when the lamp is relighted at *D*, the growth of radiation can be traced on the picture for one-thirtieth of a second, but there is no evidence of over-shooting at *D*. The interval of time between *C* and *D*, the turning-off and turning-on again, as stated in the article, is only about two thirds of a second.

The retarded growth in radiation intensity at *D* when the lamp is turned on for the second time may perhaps be explained by the fact that the filament had not time enough to cool off completely, so that its resistance would be much higher than when starting cold at *A*. This must be the reason for at least a part of the delayed relighting; but the over-shooting at *A B* would not be explained in such a manner. Moreover, on a direct-current circuit, any inductance present could not explain the action. Only two possible reasons suggest themselves. One is that when the filament starts cold, and admits a great initial rush of electric energy, it takes time for the resistance of the filament to increase with temperature, or that there is a lag of resistivity behind temperature that is rendered appreciable when the temperature is increasing at the rate of about 100,000 deg. C. per second. No such phenomenon has been reported hitherto, so far as we are aware. That is, there is supposed to be no appreciable time lag between the temperature of a conductor and the amount of resistivity which pertains to that temperature. When the temperature comes up, we are accustomed to think of the full corresponding development of resistivity coming up along with it. The second suggestion, offered in Mr. Taylor's articles, is to the effect that residual gases absorbed, either in the cold filament or in the walls of the lamp-chamber, may be driven out when the lamp is heated and affect the luminous intensity in some way, such as by a lowered degree of vacuum. According to the observations thus far recorded, the overshooting has been more marked with thicker tungsten filaments. The subject should certainly be investigated, and the determination of the active cause or causes of overshooting should be valuable as well as interesting information. It would, moreover, be desirable to secure, with the regular oscillograph, records of the rate at which electric energy enters these filaments when the lamps are turned on, cold and hot. The oscillographic curves of current rise in the different types of tungsten lamps, which reveal different degrees of the effect, might throw light upon the subject.

The Commonwealth Edison System.

In honor of the National Electric Light Association convention gathering at Chicago next week, we have prepared and present elsewhere in this issue a set of articles on the system and operating practice of the Commonwealth Edison Company at Chicago. While this probably constitutes one of the most comprehensive descriptions of a large central-station company's equipment and practice which has ever been presented in a single issue of a technical journal, the magnitude of the subject is such that our article can attempt to do little more than cover the most notable points. To the central-station man coming from the small town, such a system interests by virtue of size, if on no other account. Its equipment and methods of doing business are on such a large scale that he finds many things not applicable to his own problems, but also many details which he can with advantage take home and apply. To other large central-station companies, Commonwealth Edison practice has many points wherein its experience is of immediate and practical value in the larger engineering problems.

The interest of convention visitors this year will, of course, center around the great Fisk Street steam-turbine plant and its annex across the river at Quarry Street. We imagine many visitors will feel as if they had awakened from a Rip Van Winkle sleep when they note the size to which the Fisk Street station has grown in the five years since the last convention, and the tremendous strides in steam economy that have been made. Between the first and fifth turbines installed there is a reduction of consumption from nearly 24 to less than 13 lb. of steam per kw-hour; the steam economy represented by the latter figure being so high that present efforts are being devoted mainly to improving boiler efficiencies rather than to seeking improved turbine economies. In this connection the evolution going on in these stations has been in the direction of a much higher rate of working for boilers of a given rating, grate areas having been steadily increased in proportion to heating surfaces.

From a financial and business standpoint, one of the most notable things about the Commonwealth Edison system is the large amount of energy being generated for electric-railway purposes and sold to corporations which are entirely independent of the central-station company. This result practically shows that the Commonwealth Edison Company has been able to underbid railway companies at producing energy. By a wise selection of voltage and frequency it was made possible for railway companies to erect their own substations with 25-cycle rotary converters and purchase energy from the central-station company with the possibility of utilizing these same substations to receive energy from their own generating plants, should they ever desire to build such plants themselves. The price for electrical energy of ½ cent per kw-hour, plus $15 per year per kilowatt of maximum demand at the station busbars, has evidently been so near the cost of production plus interest on investment that the street- and elevated-railway companies of Chicago have not seen fit to invest in generating plants of their own where additional energy has been needed. In some cases the old plants owned by the railway companies are being used simply to reduce the peak load demanded from the Commonwealth Edison Company, and so to reduce the investment charges. For other than peak loads the low-operating charges of the Fisk Street station are taken advantage of.

While the railway business taken on in the last five years has been largely responsible for the tremendous rate of growth, the company's regular electric lamp and motor service also shows an increasing rate of growth during the past four years, which should be an encouraging sign not only to the Chicago company, but also to other central-station companies of the country. It indicates what has been apparent in a number of other cities, namely, that the central-station business is becoming a more important factor in turning the wheels of a community than formerly, and that in the future it will, with proper treatment, grow more rapidly than ever.

Methods of Grounding.

We are glad to note that at the recent Iowa Electric Light convention the discussion on the grounding of secondaries resulted in the appointment of a committee to investigate the best methods of grounding. The question of the advisability of grounding seems, as far as the National and Iowa conventions are concerned, to have got far beyond the point where anyone can be found to oppose it on the floor of a convention, and to have settled down entirely to a consideration of the best method and means. It is especially desirable that various State and local organizations of this kind should take steps to investigate the matter, for the reason that soil conditions differ greatly in various parts of the United States, and the central stations in each locality should make a topographical study for themselves. An imperfect ground is worse than none at all, because of the false security it offers. At the present time, four general methods have been pursued, each one of which has its peculiar local conditions to which it is best adapted. First, is the buried copper ground plate surrounded with charcoal or coke, as recommended by the National Electrical Code. The next is the plan of driving a ⅝-in. galvanized-iron pipe about 10 ft. into the ground. Both these methods of depending upon the ground for conductivity having failed in some localities, recourse has been had to waterpipe systems. Some companies ground each consumer's service connection to the service water pipes. There is also the possibility of grounding transformers to water mains where the mains are located close to the transformer. Another method used where ground plates have proved unreliable is to run a continuous grounded secondary over an entire system, and make secure grounds to water pipes at substations or other convenient points. The investigation of the subject of grounding by various local associations should greatly assist the framers of the National Electrical Code in making suggestions on grounding, to say nothing of the aid it would be to central-station companies, all of which are earnestly trying to render their systems more secure against accident.

A Proposed Synthetic Primary Standard of Light.

The march number of the *Proceedings* of the American Institute of Electrical Engineers contains a very suggestive paper by Dr. Steinmetz on the subject of a primary standard of light. Up to the present time, our so-called primary luminous standards have been flame-standards. That is, we supply a mixture of air and of a certain hydrocarbon to a burner in such a manner as to produce a flame of definitely reproducible physical characteristics. When we obtain the proper standard flame, we secure, with a certain degree of approximation, carbon particles at a certain temperature. The oscillations in these particles produce electromagnetic waves, in the surrounding ether, of certain amplitudes and average wave shapes, that affect our eyes in a certain corresponding manner, and produce a certain intensity and color quality of light. This is an empirical method, and it is the best we have been able to arrive at. It is true that at one time it was proposed to use the radiation emitted in the normal direction from a square surface of freezing platinum; i. e., molten platinum at the very high temperature of solidification; but this plan was not found to work well. At the present time, Germany uses a standard amyl-acetate flame, France a colza-oil flame and England a pentane flame.

These primary standards do not admit of being accurately compared, because their colors are different. Our eyes are able to compare quantitatively luminous intensities of the same color, but no satisfactory means have yet been found for comparing luminous intensities of different colors. These different-color sensations are distinct physiological impressions, just as the taste of sugar is distinct from the taste of almonds, and we have no means of comparing accurately the intensity of sugar taste with the intensity of almond taste. Physiological responses to stimuli are, moreover, different in different individuals, or in the same individuals at different times and periods of life. We have no knowledge as to the precise relative response of the average human eye to different colors, at the present time, and at the time, say, of the zenith of the Roman empire. Nevertheless, light as a physiological stimulus is a matter of production and sale at the present day. We know very little about the matter, but enough to work with provisionally. Dr. Steinmetz proposes to build up white light by taking certain intensities of definite blue, green and red colors; a composite beam of, say, so many watts per steradian of each of these three components, the proportions to be determined by convention based upon experimental results. So far, the proposition is purely academic, a scientific suggestion that appears to be sound. There can be little doubt that if we take three such defined colors and vary their relative intensities, we can arrive at a beam which produces a sensation of white, and we can express the total energy in the beam volumetrically, as watts per cubic centimeter at a given point, or total watts per steradian, when emerging from a virtual point. The energy of each component beam could be measured by the thermopile or bolometer, although the precision of such measurements, as they exist to-day, would have to be improved before the specifications of the proposed synthetic standard could be made satisfactorily precise.

The practical merit of the suggestion, however, lies in the indication of the means, which promise to be practicable, for deriving the three component beams. It is proposed that two mercury-vapor lamps should be used, one in glass walls at a conveniently low temperature, for blue and green rays, and the other in quartz walls, at an enforced higher temperature, for the red rays. It is comforting to know that red rays are to be obtained from a *hot* mercury-vapor lamp, because it has been generally believed that though our sins were as scarlet, they would be invisible by the mercury-vapor light. By means of glass prisms, the green, blue and red beams could be separated out, and adjusted bolometrically to the required standard ratio of intensities. The beams could then have their directions deflected, without other change, so as to mingle on the photometer screen and give us standard whitish light of known volume energy. In order to measure the luminous intensity of some particular lamp, with a different color to that of the standard, translucent wedges would have to be used in the path of one or more of the three component beams, the energy diminutions being subsequently measured. Having arrived at the proper color balance on the photometer screen, and having compared the relative intensities of the two lamps, the absolute light-giving power of the lamp tested could be computed from the relative intensities of the three colors present.

Incidentally, Dr. Steinmetz's paper, above referred to, points out that the ordinary methods of presenting light spectra or curves of luminous properties with respect to wave length are defective and unsatisfactory. Such presentations take as abscissas, either the frequency of the light waves, or their wave-lengths. If the frequencies are plotted as abscissas, we have a relatively great length for all the infra red rays, then the length for the visible rays, and beyond these all the length to infinity left for the ultra-violet. The visible rays, moreover, occupy only a very small interval on this uniform scale. If, on the contrary, the wave lengths are plotted as abscissas, we crowd all the wave lengths in the ultra-violet into a very small compass near the origin, then take the visible spectrum and leave the length beyond to infinity for the infra-red. Both of these methods are unsuitable. If, however, we imitate the keyboard of a piano in our scale of abscissas, each octave, or doubling of vibration frequencies, or halving of wave lengths, occupies the same distance. In other words, the geometrical scale of abscissas, adopted unconsciously by the pianoforte maker, but scientifically introduced into acoustic literature by Helmholtz, devotes the same length to the octave of visible rays, along the axis of abscissas, that it does to all other octaves, above or below. On the geometric musical scale, all semitones are equally spaced, although the absolute differences between the frequencies of semitones in the bass and in the treble are very different.

On the geometric optical scale, the most sensitive part of the spectrum, i. e., the color to which the retina most powerfully responds, except in very feeble light, is brought near to the center, in the green, near the yellow. There are two big regions, the green and the red, occupying jointly nearly half of the spectrum. There is one region of intermediate length, the violet, half the length of the red, and four short regions, each less than half the length of the red—namely, indigo and blue, yellow and orange. Consequently, we may regard the succession of colors in the geometric scale to be one long region, followed by two short ones—violet, indigo, blue and green, yellow, orange; or we may describe the spectrum on this scale as being composed of three roughly equal long patches, violet at one end, red at the other with green in the middle; while a pair of short intermediate colors intervene between the green and each terminal color. The color octave is thus composed of three tones and four semitones, or 10 semitones in all, whereas, the acoustic octave is composed of five tones and two semitones or 12 semitones in all. A semitone in music represents on the scale of even temperament used by the pianoforte a frequency ratio of the twelfth root of 2; whereas the corresponding even semitone on the color scale would be represented by a frequency ratio of the tenth root of 2.

Program of the National Electric Light Convention.

The annual convention of the National Electric Light Association will be held at the Auditorium Hotel, Chicago, on May 19, 20, 21 and 22. The special train from the East will leave New York on Sunday morning, May 17. The program as now arranged is as follows:

Tuesday, May 19, Opening Session, 10 o'Clock.—President's address; announcements by the secretary; report of committee on progress, Mr. T. Commerford Martin, New York; "Distribution in Suburban Districts," Mr. George H. Lukes, Chicago, Ill.; "Tape," Mr. Paul Lüpke, Trenton, N. J.; report of committee on grounding secondaries, Mr. W. H. Blood, Jr., chairman, Boston, Mass.; "Series Incandescent Lighting with Tungsten Lamps," Mr. P. D. Wagoner, Schenectady, N. Y. Afternoon Session, 2:30 o'Clock.—"Observations on the Precision of Different Types of Photometer," Prof. A. E. Kennelly and Mr. S. E. Whiting, Harvard University; "Power-Load Development for Central Stations of Moderate Size; Some Unappreciated Possibilities," Mr. Charles Robbins and Mr. J. R. Bibbins, Pittsburg, Pa.; "The Small Station and Its Economical Operation," Mr. J. T. Whittlesey, Newark, N. J., and Mr. Paul Spencer, Philadelphia, Pa. Question Box.—Mr. Alex. J. Campbell, editor, New London, Conn.; report of committee on uniform accounting, Mr. H. M. Edwards, chairman, New York City; "Candle-Power Standard"—The presentation of resolutions toward the adoption of an international standard.

Wednesday, May 20, Morning Session, 10 o'Clock.—General meeting; report of committee on gas engines, Mr. W. C. L. Eglin, chairman, Philadelphia, Pa.; "Low-Pressure Steam Turbines," Mr. John W. Kirkland, Schenectady, N. Y.; report of committee on meters, Mr. L. A. Ferguson, chairman, Chicago, Ill.; "Receiving Stations Operated from High-Tension Lines," Mr. S. Q. Hayes, Pittsburg, Pa.; report of committee on organization possibilities, Mr. Henry L. Doherty, New York City; special meeting, Banquet Hall, sixth floor. Parallel Session, 10:15 o'Clock.—"Uniform Accounting and Its Details," open to all accountants and others interested; Mr. H. M. Edwards, chairman committee on uniform accounting, will preside. Evening Session, 8 o'Clock.—Executive session; report of secretary and treasurer and executive committee; report of insurance expert, Mr. W. H. Blood, Jr., Boston, Mass.; report of committee on public policy, Mr. Arthur Williams, chairman, New York City; "The Status and Commercial Possibilities of High-Efficiency Lamps" and Discussion, Mr. W. W. Freeman, Brooklyn, N. Y.; report of committee on rates and costs, Mr. R. S. Hale, chairman, Boston, Mass.; election of nominating committee.

Thursday, May 21, Morning Session, 10 o'Clock; Afternoon Session, 2:30 o'Clock.—Commercial Day.—Mr. C. W. Lee, chairman, program committee, New York City· Mr. Henry L. Doherty, past president, will preside during Commercial Day sessions. 1. Address—"Relationship Between the Engineering and Commercial Departments," Mr. Louis A. Ferguson, past president, Chicago, Ill. 2. Preparation for a Campaign. (a) Field Work and Other Essentials; (b) Analysis of Customers' Accounts; (c) Proportion of Lamp Equivalent Lost to Lamps Connected—Showing Percentage in Cities of Varied Population; (d) Policy of Handling Complaints; (e) Policy of Handling Collections. Editor, Mr. H. J. Gille, Minneapolis, Minn. 3. The Contract Agent and the Representative. (a) The Contract Agent—His Possibilities; (b) The District Representative—His Possibilities; (c) The Special Representative: 1 The Sign Expert; 2 The Power Expert; 3 The Woman Representative; (d) Solicitors' Meetings—Their Objects. Editor, Mr. V. A. Henderson, Memphis, Tenn. 4. The Display Room. (a) Appointments and Methods; (b) Value of Special Demonstrations; (c) Value of Electrical and Food-Show Exhibits. Editor, Mr. L. G. Mathes, Dubuque, Iowa. 5. Advertising. (a) What is Being Done; (b) Why? (c) Results. Editor, Mr. Charles A. Parker, Detroit, Mich. 6. Publicity. (a) Methods to Create Proper Public Sentiment; (b) Dormant Publicity Opportunities of Lighting Companies. Editor, Mr. Percy Ingalls, Newark, N. J. 7. Creating Demand for Electricity. (a) The Creative Principle; (b) Notable Examples; (c) Stereopticon Talk upon Outline and Sign Lighting, Showing Progress in Large and Small Cities. Editor, Mr. Frank B. Rae, Jr., New York City. 8. Evolution of New-Business Building. (a) Examples of Central Stations that Have Continued Methods During Depression; (b) Strong Plea for Up-keep of Commercial Departments and Advertising; (c) Opportunities for Creating Business Along Existing Lines. Editor, Mr. George N. Tidd, Scranton, Pa. 9. The Electrical Contractor. Symposium; (a) What He is Doing to Assist in Creating Greater Demands for Electricity; (b) Specific examples. Editor, Mr. Joseph F. Becker, Jr., Brooklyn, N. Y. 10. "Co-Operative Commercialism," Mr. J. Robert Crouse, Cleveland, Ohio. 11. "Illuminating Engineering as a Commercial Factor," illustrated, Mr. V. R. Lansingh, New York City. 12. Report of committee on solicitors' handbook prize award, Mr. John F. Gilchrist, chairman, Chicago, Ill. 13. Report of committee on co-operative electrical development, Mr. W. W. Freeman, chairman, Brooklyn, N. Y.

Friday, May 22, Morning Session, 10 O'clock.—General meeting; "Illuminating Engineering," Mr. W. D'A. Ryan, West Lynn, Mass.; Report of committee on protection from lightning and other static disturbances, Mr. R. S. Stewart, chairman, Detroit, Mich.; "The Value of Care and Maintenance of Meters," Mr. H. D. King, Hoboken, N. J.; "Some Experiments in Combustion," Mr. S. J. Lenher, New York; "Specifications for Construction on Joint Poles," Mr. Paul Spencer, Philadelphia, Pa.; final report of 1907 committee to consider specifications for street lighting, Mr. W. D'A. Ryan, West Lynn, Mass.; memorials, Mr. T. C. Martin, New York; executive session; report of nominating committee; election of officers for the ensuing year; adjournment. Special meeting, Banquet Hall—sixth floor. Parallel Session, 10:15 o'Clock, Commercial Day.—Unfinished business (if any) from the Thursday session.

Ways to Meet Gas and Gasoline Competition.

In a discussion on the best ways of meeting gas and gasoline competition which was held at the Iowa Electrical Association convention, April 23, Mr. M. A. Harris, of Nevada, Iowa, said that the gasoline-plant salesman will be sure to compare a new gasoline installation with an electric installation of old, blackened incandescent lamps. It, therefore, behooves the central-station manager to see that installations of old lamps are weeded out. In order to meet competition, his company started a day service last July which has not been paying, but he fully expects it to do so. In competing with gasoline for motor business he would install electric motors on trial. They are so much more convenient than the gasoline engine that not a single motor which has been thus installed has been taken out.

Mr. Gus Lundgren, talking on the same subject, emphasized first the importance of good and reliable service to meet such competition. He has been careful to be promptly on hand with emergency break-down service when customers of the gas plants get into trouble. To convince prospective customers that their electric bills would likely not be excessive, he would show them the books giving the bills of various other customers in town. When consumers understand meters they rarely complain about meter readings. It seems well, therefore, to teach consumers to read their own meters.

Mr. Austin Burt stated his belief that a number of satisfied electric-motor customers in town would in time drive out any gas or gasoline engine, so superior is the service rendered. He gave some examples from Waterloo experience to show how badly gasoline engine users at times wish to change to electric service. One customer too far from polyphase feeders to get regular three-phase service finally agreed not to use his motor during lighting hours in order to be permitted to operate a single-phase motor from a lighting circuit which was near the plant.

New Deed of Gift for Edison Medal.

Mr. C. L. Clark, chairman of the Edison medal committee of the American Institute of Electrical Engineers, issues in the current *Proceedings* of the institute an interesting statement as to the terms of the new deed of gift governing the award of the medal. It is as follows:

An important change has been made in the conditions under which the Edison medal is hereafter to be awarded.

The Edison medal was founded upon the initiative of an organization, known as the Edison Medal Association, composed of old associates and friends of Mr. Edison, who subscribed a trust fund for that purpose, under an indenture dated Feb. 11, 1904, and entitled "Deed of Gift Creating the Edison Medal," whereby the institute engaged annually to award the medal "to such qualified student as shall have submitted to the institute . . . the best thesis on record of research on theoretical or applied electricity or magnetism."

No student whatsoever having entered in competition for the medal, although wide publicity had been given to the provisions of the deed by means of appropriate notices, repeatedly sent broadcast to institutions of learning where electrical engineering is taught, the institute became convinced that: (1) the foundation had practically been demonstrated to be a dead letter; (2) the conditions of award under the deed did not properly meet existing circumstances; (3) or insure a general competition by students representing any substantial number of the qualified institutions of learning; (4) criticism of the Edison medal foundation had become general on the ground that it was unusual to award gold medals in the manner provided to young students at the beginning of their careers; (5) the terms of the deed ought to be changed so as to place the award of a medal in the name of Edison on a plane comparable to the award of the John Fritz medal, the Bessemer medal, the Rumford medal, and others of equal renown, whose recipients have been the foremost scientists, philosophers and engineers of their time, and (6) the award ought to be made to bear a distinct relation to achievement in the electrical field.

Thereupon, the Edison medal committee of the institute was directed, in the spring of 1907, if possible to obtain such change in the deed as to make the award dependent upon "meritorious achievement" in the electrical field.

Owing, however, to the legal requirement of obtaining the assent of the 24 surviving and widely scattered members of the executive committee of the Edison Medal Association to the change, and their signatures and seals to a deed embodying the same, it was not until March 26 of the present year that the change was finally consummated in a new deed entitled "Amended and Substitute Deed of Gift Creating the Edison Medal."

By the terms of the new deed, the Edison medal is no longer open for competition, but it is to be awarded "for 'Meritorious Achievement' in Electrical Science or Electrical Engineering or the Electrical Arts," thus placing the award on the high plane where the institute and the Edison Medal Association deem it properly belongs. The award is limited to a resident of the United States and its dependencies or of the Dominion of Canada.

The New York Edison Company and the Tungsten Lamp.

The plan of the Edison Illuminating Company of Brooklyn to supply its customers with tungsten lamps at cost, as reported in these columns last week, will be participated in by the New York Edison Company, which arranged the details with the cooperation of the Brooklyn Edison Company. The plan contemplates furnishing these special lamps at cost, allowing for the present cost of carbon lamps which are supplied free of charge, as noted on page 962 of our issue for May 9.

The company does not incline to the belief that the popularizing of the high-efficiency lamp will mean a loss in energy consumed and a decrease in revenue to the company. At a recent meeting of the New York section of the Illuminating Engineering Society, Mr. Arthur Williams, of the New York Edison Company, stated that a person regulated the use of his light according to his financial condition, and that when improvements are introduced into the lighting field that enabled the consumer to decrease his lighting bill by one-half, instead of taking advantage of this opportunity, the consumer will use two lamps where he had used only one before. Any improvement which decreases the cost of lighting, Mr. Williams concluded, increases the field of lighting and should be encouraged.

Ithaca Section A. I. E. E. Meeting.

Dr. Charles P. Steinmetz visited the Ithaca Section of the Institute last month and delivered an address on "The Alternating-Current Commutator Motor." Dr. Steinmetz's presence and the interest in the topic which he had chosen resulted in an attendance of over 350 persons, and the lecture was stimulating and instructive. He described the various types of alternating current commutator motor, and explained the difficulties of commutation in such motors. He pointed out that compensation for the reactance and transformer voltages involved is a complicated problem, and showed the latest inventions and devices for insuring satisfactory commutation at various loads and various speeds. The lecturer stated that the alternating-current commutator motor is not by any means new. One of the first tasks upon his arrival in this country in 1889 after joining Mr. Rudolph Eickemeyer at Yonkers, N. Y., was the designing of an alternating-current commutator motor. Prof. Elihu Thomson had two years before invented and patented the repulsion motor.

Dr. Steinmetz, while at Ithaca, delivered a most interesting reminiscent address before the annual dinner of Sibley College, at which about 350 students and members of the faculty were present. The speaker described his early experiences in Germany and Switzerland, as well as his later work with Mr. Eickemeyer, at Yonkers, N. Y. He compared the different fields of electrical engineering, in regard to their relative attractiveness and promise. To say that the students appreciated his remarks is stating the matter very mildly. They were delighted with them, and all present felt that their effect would be lasting as well as stimulating. As a large proportion of the 275 seniors in mechanical and electrical engineering were present, Dr. Steinmetz had an unusually receptive audience. While in Ithaca Dr. Steinmetz on several occasions met the members of the local branch, and everywhere his presence was greatly enjoyed.

Attempt to Defraud Supply Houses.

We are informed that a man giving his name as George Williams and stating that he is connected with the Brenham Compress Oil & Manufacturing Company, Brenham, Tex., has approached several electrical companies, including some dealers in Buffalo, with the evident intention of defrauding them. One of his methods has been to place a substantial order for electrical material, with which he seems to be thoroughly familiar, and after offering checks and referring to his credit with Texas banks, he attempts to borrow money.

Subsequently, it has turned out, that his checks offered in payment are not covered by the local banks in which he claimed he had deposited, or would deposit, money to cover his purchases. The man did not deposit the funds as promised, and used the receipt for the checks in an attempt to secure more material from another dealer

This man is described as about 5 ft. 9 in., stocky build, weighing about 170 lb., with light hair, blue eyes, smooth face, large, rough weather-beaten features, upper front tooth broken or missing. He wore a soft hat and dressed in general western style.

Proposed Financing of New York Lighting Competition.

The first hearing on the application of the Long Acre Power Company to the Public Service Commission of the First District of New York for permission to issue $10,000,000 par value in preferred stock, non-cumulative and non-voting, with interest at 7 per cent, and $50,000,000 in 6 per cent bonds, took place before Commissioner Maltbie on April 30. The petition asked that $12,000,000 of the bonds might be issued at the present time, secured by a mortgage on the company's property. Mr. J. S. L'Amoreux, of the law firm of Graham & L'Amoreux, appeared for the Long Acre Company. In opposition Mr. Henry J. Hemmens, of the law firm of Beardsley & Hemmens, appeared for the New York Edison Company; Mr. Frank P. Allen for Mr. George E. Corey, a property owner, and Mr. Sterling Pierson for Mr. J. J. Moore. The petition as entered on the records discussed the financial condition of the company, its present plant and the uses intended for the money to be raised, all of which appeared in the discussion of the affairs of the company at previous hearings in the matter of the investigation of the New York electric companies, which have been recorded in these columns. The company presented its case by offering in evidence the record of these previous hearings. In contradiction to the statement made at one of the previous hearings by the Long Acre Company, to the effect that the city was "inadequately" supplied with electric lighting, a letter was offered in evidence signed by Mr. John W. Lieb for the Edison Company, stating that a careful survey of the 393.29 miles of streets in the Borough of Manhattan showed that electric service is now available in 321.46 miles. A survey of the districts to which special reference was made by the Long Acre Company as inadequately supplied, shows that while the total mileage in those districts is 57.62, electric service is available in 46 miles, not including unoccupied subways. The following table was presented:

YEARLY EXTENSION OF STREET MAINS.

1903	56.2 miles
1904	44.5 miles
1905	49.8 miles
1906	54.7 miles
*1907	28.0 miles

* Business depression.

The sale of energy for the year 1907 represents a use to the amount of $7.59 per year for each inhabitant. Comparing the Borough of Manhattan with a population of 2,203,000 for 1907 with the whole metropolitan district of London, with a population more than three times as great, shows that Manhattan used 223,000,000 kw-hours while London used only 213,000,000 kw-hours. The letter stated that the Edison Company had followed a most aggressive policy in extending its activities; by personal solicitation, illuminated signs, monthly bulletins, newspaper advertising, the distribution of circulars and a well-organized "follow-up" system. The increase of new customers' installations from year to year shows an average new gain in candle-power of more than 30 per cent each year for the last five years. The total generating rating in December, 1907, was, including batteries, 186,400 kilowatts, or a reserve rating of nearly 50 per cent above actual demands. More than 95 per cent of the large buildings constructed in recent years are equipped for electric service exclusively from the mains of the company. The company has pursued the most liberal policy, the letter said, in respect to lamp renewals, and is now planning to supply tungsten lamps at actual cost. The letter concluded with the statement that general experience in all large cities and in New York has shown that it is unwise to install and operate duplicate electric-lighting plants, and that under present conditions there is no valid reason for the duplication of investment resulting from the introduction of parallel systems in New York City.

At the hearing on May 5 Mr. Alfred J. Talley appeared in opposition to the Long Acre application on behalf of the Anti-Monopoly Light & Power Company, a corporation organized under New York laws. Mr. Talley alleged that the franchise of the Long Acre Company is invalid, and that the Anti-Monopoly Company is owner of one-half interest in that franchise. He said that last February the Long Acre Company was served with a notice made to the Supreme Court in New York County for the examination of Mr. William H. Kelly before trial, the intention being to commence a suit in equity to establish the title of the Anti-Monopoly Company to the one-half interest in the Long Acre franchise. William H. Kelly was the custodian for several years of a bill of sale or an assignment made by Martin Minturn, who was at one time the owner of the franchise. Mr. Kelly, who, according to Mr. Talley, is a lawyer and former judge, had disappeared from his accustomed haunts coincident with the granting of the order for his examination. Mr. Talley pointed out that Mr. Kelly for some time past had had his office with Messrs. Dittenhoefer, Gerber and James, but no information as to his whereabouts could be obtained at that office. Mr. Talley said that an essential part of the hearing was to establish the validity of the Long Acre franchise, and that if the Long Acre Company officers were acting in good faith they would produce Mr. Kelly, or at least should be in communication with him as an associate in their own office.

Mr. L'Amoreux objected to the filing of the petition on the ground that the subject to which the notice relates is not within the jurisdiction of the commission, but was over-ruled and the petition admitted to the record. The petition was signed by Mr. John L. Walsh, secretary and treasurer of the Anti-Monopoly Light & Power Company, and stated that the company derives its title to one-half interest in the franchise through one of the beneficial owners for whom Martin F. Minturn was an agent and trustee. The hearing was adjourned until May 8.

Grounded Secondaries at Iowa Convention.

Mr. Thomas Sloss, of Cedar Rapids, presented a short paper at the Iowa Electrical Association convention, April 22 and 23, on "Grounded Secondaries." He is strongly in favor of grounding secondary circuits, and said that it will probably be required in the not distant future. He quoted from various authorities, including Dr. C. P. Steinmetz and Dr. Louis Bell, to the effect that the grounding of secondaries is the best method known of protecting consumers from dangerous shocks, and that it should be required. He also quoted from a letter from W. H. Blood, Jr., who represents the National Electric Light Association in matters pertaining to insurance, interests and the National Electrical Code. Mr. Blood in this letter explained that it was agreed by the various interests that it is desirable to ground alternating-current circuits when the maximum voltage between any conductor and ground is not over 200 volts. This question hinges on the maximum voltage from which shocks can be obtained by ordinary persons without injury, and this limit seems to be about 200 volts. For this reason, the committee did not feel like recommending the grounding of circuits having more than 200 volts between a conductor and ground, and recommended further investigation of the desirability of grounding such circuits.

Mr. Sloss said that in Cedar Rapids, the lighting company had grounded all its secondaries for six years past, using copper plates buried in coke. In testing these grounds for conductivity recently, a bank of 12 50-watt lamps in multiple was connected between the non-grounded side of the circuit and ground. In some of the outlying districts these copper plate grounds were found to be so defective that this lamp bank would not be brought up to full incandescence. In such cases the ground plates or wires were found to be nearly destroyed by chemical or electrolytic action. As to transformer breakdowns with grounded secondaries, this company had experienced only two transformer breakdowns in the six years since grounding was the practice—a much better showing than had been obtained before. The question of securing good grounds is an important one. In one stretch of five miles on the interurban line between Cedar Rapids and Iowa City, it had been found impossible to keep ground plates for lightning arresters intact long enough to warrant their installation. A ground, such as his company installs, costs about $10. He pointed to the fact that in case of damages caused by electric shock to consumers, courts have held that the company is responsible if it does not take the well-known precaution of grounding its secondary circuits.

There was considerable informal discussion of this paper, the consensus of opinion seeming to be that there is no question as to the desirability of grounding secondaries if they are securely grounded, the main question being how to secure a good ground, and what is the best kind of ground. As a result of this discussion it was voted to appoint a committee to investigate and report upon the best methods of grounding. The committee appointed for this purpose was Mr. Thomas Sloss, of Cedar Rapids; Prof. T. A. Fish, of Ames, and J. A. Innes, of Eagle Grove.

Mr. J. P. Walters, of Toledo, expressed the opinion that wiring should not be done at or below cost by a company. The difference between wiring at a profit and at cost could not greatly influence the customer, and the profit on wiring would help cover the expense of running service wires to the customer. He thought, however, the plan of allowing consumers to pay for wiring at the rate of $2 to $4 per month was feasible if not gone into so heavily as to cause an undue financial burden on the company.

Mr. Thomas Ferris called attention to the dissatisfaction arising from the poor voltage regulation which prevails among small plants. For example, frequently during the peak load the voltage at consumers' lamps might be somewhere near normal. A little while after the peak, the voltage would be possibly 10 per cent high at some of the lamps, which would make the lamps burn far above normal candle-power. With such conditions, the customer immediately argues that the lamps should be at this high candle-power all the time, and if the company has not equipment enough for carrying the peak load, the result is dissatisfaction. As to introducing tungsten lamps among dissatisfied customers, he thought that the placing of samples for a few nights' trial was the best method of disposing of all arguments.

Mr. Austin Burt said that in electrical, as well as other matters, it was possible to set styles and get people talking about new things. Once a thing came into style, it was easy to get it introduced. Mr. O. E. Brownell, of Lake City, spoke of the feasibility of getting vacuum-cleaning apparatus introduced in a community, both as a source of direct revenue to the company and as a popularizer of electric service. His idea was for a company to purchase a portable electric vacuum-cleaning outfit and rent it to some man who was making a business of cleaning carpets around the town. Mr. Gus Lundgren, of Cherokee, reported that Mr. Grover, of Ames, recently purchased a vacuum-cleaning apparatus to be operated in this way.

Toronto Institute Meeting on Oscillograph.

The regular meeting of the Toronto section of the American Institute of Electrical Engineers was held on the evening of Friday, April 24, in the lecture room of the Engineering Building of the University of Toronto. The chair was taken by Vice-Chairman W. A. Bucke, and the subject of the evening was introduced by Mr. H. W. Price, lecturer in electrical engineering at the university. Mr. Price discussed the oscillograph, showing by means of the lantern the essential characteristics of manufacture and operation. Slides were also shown of oscillograph records of current and voltage taken on the occasion of sundry operations with direct and alternating-current motors. Quite a number of oscillograph records taken on the lines of the Ontario Power Company, at Niagara Falls, were then shown and explained by Mr. Johnson, assistant engineer to that company. Among these records were those of the current in a neutral ground lead of a transformer bank; the phenomena resulting from the use of open fuses as lightning arresters; the operation of an expulsion fuse; charging current of 165 miles of line. One record showed the use of the oscillograph for comparing the speed of two machines.

A short discussion on the uses of the instrument then followed, which discussion was partaken in by Messrs. R. G. Black, P. W. Sothman, H. W. Price, Johnson and W. A. Bucke. The efforts of Mr. Price to make this demonstration an interesting one were very much appreciated by those present.

New Business Methods.

A number of short talks on new-business methods were given at the Iowa Electrical Association convention at Des Moines, April 22 and 23. Mr. L. D. Mathes, of Dubuque, first emphasized the necessity of giving reliable service as a foundation for getting new business. Further than this, prices must be such as to invite the use of electricity by the public. The exhibition of appliances in the company's offices in window displays is a help. He believes in a liberal policy in putting out electrical conveniences on trial, and guaranteeing their satisfactory performance, letting customers try them for a month, or if not satisfied with that, a longer period. Out of a lot of toasters recently put out in this way by his company, only one had been returned, and that by a person who could not use it. The tungsten lamp will appeal to that class of people who have not heretofore been persuaded to recognize quality rather than quantity when they purchased lighting service; in other words, those who are now using gas or gasoline. The tungsten lamp puts the price of electric light down to where it appeals to such users. The introduction of the tungsten lamp among customers already using electricity should result in the use of about the same amount of electrical energy as before, the customer getting increased illumination.

Mr. J. F. Porter, Davenport, in a general review of new-business methods for central-station companies, places newspaper advertising as one of the first essentials in creating a general popular interest in electric service, although yielding but few direct returns in the way of inquiries. The next essentials are solicitation and display or exhibition of devices. He said that it has been demonstrated that an electric company can secure as much business among consumers who already have gas installed as if electricity alone were used. The presence of both illuminants tends to increase the total consumption of energy. This company in Davenport is now maintaining only one outside solicitor and is advertising in the daily papers. He thought that a company in a city the size of Davenport (population about 40,000) could secure power customers up to a size of about 300 kilowatts. Most customers having installations smaller than this could be supplied cheaper from the central station than by themselves.

Mr. A. L. Dodd, of Charles City, also emphasized the necessity for good service if a company is to make progress in getting business. He spoke especially from his own experience at Charles City. When he took hold of the plant, the policy seemed to have been to delay making repairs as long as possible. While he was not an electrician when he took hold of the plant rather against his will, he claimed to be a good enough business man to know that bad service could never make any plant succeed. As an amusing example of some of the troubles under which the plant was laboring, he said it was nothing uncommon for the grates to become so clogged up with clinkers in the middle of an evening's run that a shut-down was necessary to give the fireman a chance to clean the fires. The steam pipes were uncovered so that heat was lost, and there were many leaky joints in the piping. Conditions had been improved so that in the past two and a half years the total interruptions to service added together would amount to less than 30 minutes. An office was established in the business part of town and show-window advertising started. He has now in Charles City (population, 6450) 83 flatirons and 25 fans in service, besides 25 to 30 small motors. He believes in placing complete electric cooking outfits among some families, as this will satisfy a demand that might otherwise spring up for a gas plant.

Discussions on High-Efficiency Incandescent Lamps at the Iowa and Missouri Conventions.

The discussions on tungsten and other high-efficiency incandescent lamps at the electric light conventions of the Iowa and Missouri associations, held during the week beginning April 20, at Des Moines and St. Louis, respectively, resulted in bringing out many points of practical value and interest as to the progress that is being made in the field with these illuminants. At the Iowa convenion a paper by Mr. F. W. Willcox, of the General Electric Company, was read by Mr. George C. Osborne. Mr. Willcox took up the gem, tantalum and tungsten lamps.

The 100-watt gem lamp has largely replaced the 32-cp common carbon-filament lamp. The 125-watt gem has replaced the 50-cp carbon filament, and the 250-watt gem lamp has replaced the 100-cp common carbon filament.

The 50-watt gem lamp has made a good start in replacing the 16-cp common carbon-filament lamp during the past year. This lamp when burning at the highest voltage shown on the label, gives 20 horizontal candle-power, with a useful life of 500 hours or more. At the third or lower voltage the lamp burns at about 16.5 cp, taking 47 watts, with a life of 1000 hours or more. The performance of the gem 50-watt lamps as shown by actual test on large numbers of lamps during the past year. shows that the useful life approximates an average of 500 hours, with a specific consumption of 2.55 watts per candle. As to individual performance, the gem lamps have a slightly higher per cent of early breakages than the carbon lamps, but this is more than made up on the average performance.

The tantalum lamp for direct current shows a saving of over 40 per cent with the same illumination as secured with the 3.5-watt-per-candle carbon lamp. This material gain in economy has given the tantalum lamp a good start in commercial lighting, and over 1,200,000 of the lamps have been sold in this country. This lamp would have had a wider use but for the fact that it was developed about the time of the introduction of the gem filament lamp, which was considerably cheaper and also because its life on alternating current was so short as to restrict it to direct-current circuits. Out of 4000 central stations in this country, less than 300 by number have direct-current service (about 40 per cent in quantity of lamps). Central-station patrons hesitate to adopt a lamp which they have to pay for, when they get free renewals of common lamps, even though a saving or increased illumination can be shown. Most of the tantalum lamps introduced have been of the 50-watt 25-cp, and 40-watt 20-cp sizes. The average life of these on direct-current service runs well beyond the guaranteed figures of 700 hours, many lamps lasting for 1200 hours or more. The 40-watt tantalum lamp is naturally the most popular, since it saves 10 hours over the ordinary 50-watt carbon lamp.

A large part of the tantalum-lamp installations have been on isolated plants, giving relief to overloaded apparatus and giving additional illumination without any increase of equipment. A successful example of its use in central-station work is to be found at Muncie, Ind., a city of 30,000 inhabitants. Over 10,000 50-watt 25-cp tantalum lamps have been put into service out of a total of 32,000 50-watt lamp equivalents connected. A tantalum lamp is sold at 60 cents, as compared to 15 cents for a carbon lamp. About one-half of the tantalum lamps installed are used on a flat-rate basis under a two-year contract.

Tungsten is too brittle to be drawn into a wire. In order to make a filament of tungsten, the fine particles of the metal fiber are made into a paste with some binding material, and this paste is squirted through a diamond die. The filament so obtained is dried, the binding material removed by suitable processes and the particles of tungsten welded together into a continuous wire. To obtain the necessary resistance, tungsten lamp filaments must be long and very thin, which requires special methods of support. The General Electric Company supports its tungsten filaments with a special form of anchor which permits burning the lamp in any position. Although the filament is fragile, this difficulty is being overcome by special methods of packing. The early carbon filaments were as delicate and fragile as filaments of tungsten are to-day. The General Electric Company in the first few months has shipped over 75,000 tungsten lamps to all parts of the country with positive and direct information on most of the packages as to breakage. The results show an average of 1.5 per cent breakage, which compares favorably with ordinary lamps.

It is found that tungsten filaments while burning cannot be readily broken, so that if customers will keep lamps lighted while cleaning lamp, globe or fixture, lamp breakage will be minimized. So far, over 200,000 tungsten lamps of 40-, 60- and 100-watt sizes have been made and sold. The probable supply of such lamps for the ensuing 12 months will be from 3,000,000 to 5,000,000 lamps. This will be enough to enable the central stations of the country to displace some high candle-power gas lamps and take on additional business.

The tungsten lamp is used to the best advantage with the bowl-form of prismatic reflector, particularly with the frosted-tip bulb, which gives a very soft, agreeable lighting effect. From such a unit it is possible to obtain an illumination of 4 foot-candles per watt per square foot upon a plane of 10 ft. to 12 ft. below the lamps, which is four-fold better than the average results from ordinary lamps and shades. It must be realized that the tungsten lamp is not a lamp to replace ordinary lamps everywhere, as it has too large a candle-power and is too brilliant. It must be used in a special way above the line of vision, or, in any event, suitably enclosed in frosted or opal globes or shaded so as to avoid glare. The tungsten lamp has brought about a wholly new condition, as by reason of its very high efficiency it is no longer necessary to depend upon the nearness of the illuminant. A room can be flooded with an almost daylight brilliancy at a reasonable cost with lamps placed well above the view.

Improvements in lamps heretofore have indicated progress, but the tungsten lamp means a revolution in the lighting industry. Its effect will be more far-reaching than even that of the Welsbach mantle. The tungsten lamp can and should be employed primarily to secure new business. Every central-station company should use the tungsten lamp to wean away users of gas or oil. It is not necessary to do anything more than put the lamps in. They will talk for themselves far more eloquently than anything else can for them. In other words, if one will try the "pay-after-you-have-tried-them" plan he will find that he can introduce as many lamps as can be obtained from the manufacturers and hold business permanently with them. Experience has shown that it is desirable for central stations to have as complete control over the lamps used on their circuits as it is possible to obtain. This has heretofore been obtained by the free-renewal policy.

The relatively higher price of the new lamps makes it impossible to supply them on a free-renewal basis. It might be desirable to supply the lamps at a lower price than they could be purchased by the customer in the open market. Several companies have adopted the plan of furnishing the lamps by making a monthly maintenance charge per lamp, after the plan followed for years with high candle-power gas lamps and Nernst lamps. A fair monthly charge for the 100-watt tungsten lamp for an average use of two to four hours per day would be 25 cents per lamp per month. It might be desirable to have this done by a separate maintenance company controlled by the lighting company. The author discussed the feasibility of burning the tungsten lamp at a lower efficiency so as to increase its life to a point where free renewals would be possible. He concludes that it is impractical to do this, as it will necessitate a lamp life of from 3000 to 7500 hours, within which period mechanical lamp breakage would be too large a factor. The diagram herewith shows the cost per 1000 candle-hours to a customer using different types of lamps with rates from 1 to 10 cents per kw-hour.

The tungsten street-series lamp is of equal, if not greater, value than the tungsten multiple lamp in providing profitable business for central-station companies. These are made in 32-, 40- and 60-cp sizes for several current values from 4 to 75 amp, at a consumption of 1.25 watts per candle. A recent installation of these lamps at Adel, Iowa, shows the following saving secured: The electric-light company installed a constant-current transformer rated at 8.8 kw, 5.5 amp, complete with switchboard panel, with a circuit of 82 tungsten lamps of 40 cp. These replaced a lighting installation of 82 multiple carbon lamps of 32 cp. The saving in energy consumption made the first year paid for the installation of the new apparatus and, in addition, showed a net saving of over $115. The second year the saving, as estimated, will be over $413. This saving is obtained on the basis of 3-cent per kw-hour energy cost and three renewals of lamps per year, as shown by the following statement:

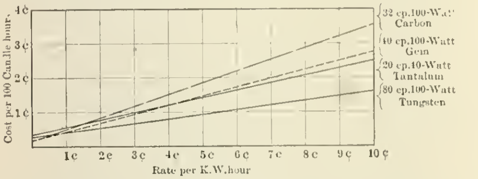
COST OF NEW SYSTEM.

8.8-kw 5.5 ampere transformer and panel	$298.00
246 40-cp tungsten lamps	313.65
Total	$611.65

ANNUAL SAVING OVER OLD SYSTEM.

In energy at 3 cents per kw-hour	$556.50
Cost of 656 32-cp carbon lamps	170.56
Total	$727.06
Cost of new system	611.65
Net saving	$115.41

Comparing the cost of tungsten street lighting with gas, the 40-cp tungsten lamp with its candle-power constantly maintained during life, will match the regular Welsbach street gas lamp, which, while an initial candle-power of 60 is claimed, declines so rapidly in candle-power that its average candle-power is no greater than that of the 40-cp tungsten lamp. The gas mantle using 3½ cu. ft. of gas per hour will burn 14,000 cu. ft. during a year's service of 4000 hours, amounting to $14 with gas at $1 per 1000 cu. ft., or $10.50 with gas at 75 cents per 1000 cu. ft. Assuming the renewals of mantles in use, repair and attention to lamps as fixed at 3 cents per lamp per night (the figures used in the recent Buffalo contract), the total cost per lamp will be $24.95 with $1 gas, or $21.45 with 75-cent gas. Assuming four renewals per year as a conservative figure for the tungsten lamp at a price of $1.275 each, the renewal cost for the tungsten lamp is about $5. The 40-cp lamp consumes 50 watts, or on the basis of 4000 hours' service, 200 kw-hours per year. Now, the cost of gas and gas-lamp maintenance is $19.50 per lamp above the cost of tungsten maintenance, which amount ($19.50) is available to pay for energy. This $19.50 divided by 200 kw-hours gives a rate of nearly 10 cents per kw-hour to make the cost equal. Central stations could afford to make a materially lower rate than this, and thus be able to effectually compete with Welsbach gas-lamps for street lighting. Central-station companies have great cause for rejoicing over the new developments which will enable them effectually to compete on the basis of cost against cost of other illuminants. Electric lighting has held its own in spite of a serious handicap in cost, and now that it is able to compete on equal terms, the limit of its use is only measured by the capacity of the central-station company to supply the energy.



COST OF LAMPS AND ENERGY PER 100 CANDLE-HOURS.

Mr. George Loring, of the National Lamp Association, Cleveland, discussing this subject, showed that with proper efforts by the central-station company, the introduction of tungsten lamps would tend to cut down the peak load and to increase the load at other than peak periods. For example, in stores, if a merchant cut down his bill for the regular lighting of his store by the use of tungsten lamps he would be likely to listen to a proposition to spend the money saved in this way in lighting after closing time either by electric signs or show-window lighting or by keeping the interior of his store lighted as an advertisement. In this way the company's income per kilowatt would be increased. In residences, he cited an example to show that a similar change could be made. A householder who had heretofore been switching out all lamps and leaving rooms in complete darkness which were not in use, would feel that since electric illumination did not cost so much with the new lamps, he could afford to keep 2-cp or 4-cp lamps lighted in several of the rooms of the house which had heretofore been in darkness when not in use. In fact, the whole tendency would be for the consumer to spend as much or more money for electrical energy used in a different way and spread his demand over more hours per day than formerly.

Mr. George C. Osborne favored the use of the large 100-watt tungsten lamp in store lighting rather than the smaller sizes in most cases because of the lower first cost. As a practical example of what could be done with the tungsten lamp in lowering a consumer's maximum demand without greatly increasing his total consumption, he cited a drug store in Newark, N. J., formerly lighted with 110 16-cp lamps, taking 5.5 kw maximum demand. This was reduced to 1.6 kw by installing 16 100-watt tungsten lamps. This consumer's bills, however, are only about 25 per cent less than formerly because he is so much better satisfied that he is getting his money's worth that he uses a part of the lamps more hours per day than formerly. The tungsten lamp, giving a whiter light, does not appear to such disadvantage in a store partially lighted by daylight as did the common incandescent; hence the consumer has more inclination to use that during the day.

At the Missouri convention at St. Louis, Mr. E. H. Haughton reviewed incandescent lamp development. He described one process of making tungsten filaments as boiling down tungsten oxide with some binder to a kind of plastic mass, which is squirted through a die at heavy pressure. This gives a filament of tungsten oxide, which is treated with certain gases at high temperature and reduced to a metallic state, thus eliminating the binder.

In the practical use of the tungsten lamp he recommended the cleaning of the lamps while burning to avoid breakage. He explained that it is always possible to tell whether a lamp was broken by handling or by being burned out in service. A lamp broken by handling or transportation does not have the filament curled or bent. A lamp burning out in service always has the broken end curled back because of its plastic condition when broken. He said that several schemes to secure careful handling in shipment have been worked out, one of which is to place a bottle with colored liquid exposed in the upper part of the box. The tungsten lamp gives a steadier light with poor voltage regulation than the common carbon lamp. Tungsten lamps burned at less than their normal rated voltage would give a remarkable life.

As to the practical competition of the tungsten lamp with high candle-power gas lamps, he read an extract from a letter from the Citizens' Light & Power Company, of Adrian, Mich. A drug store was lighted with three three-burner gas lamps and also by 24 8-cp incandescent lamps. The cost of operation was $67.69 per 1000 hours. Twelve 40-watt tungsten lamps were installed and gave more light than the gas installation at a cost for 1000 hours with 8-cent energy of $34.96 plus $18 for lamps, making $52.96 for 1000 hours. The National Lamp Association tungsten factories are four months behind orders on tungsten lamps. He commented on the fact that the orders for tungsten lamps from jobbers had been out of proportion to the consumption of ordinary lamps by the same jobbers, showing that many of these lamps are being rapidly sold through small dealers direct to consumers rather than through central stations. He spoke of a 20-watt 16-cp tungsten lamp as one of the future possibilities, in which event small central stations with flat-rate customers would be able to supply these customers at a greatly reduced expense. Mr. George Loring, at the Missouri convention, gave estimates showing that three 100-watt tungsten lamps could safely be counted on to equal in performance a four-burner gas lamp, and at a 7½-cent per kw-hour rate would cost no more than gas at ordinary figures.

Mr. C. L. Clary, of Sikeston, Mo., believes that the tungsten lamp can be used to decrease a customer's maximum demand without decreasing his bill. He cited one of his store customers who took the money he had saved in store illumination and purchased an electric sign.

Mr. W. B. Hays, of Poplar Bluff, reported that he is displacing gas lamps with tungsten lamps. He sells the tungsten lamps at cost. At the Iowa convention Mr. George C. Osborne said that two 100-watt tungsten lamps would ordinarily replace one high candle-power gas lamp. He mentioned a plan used by F. M. Tait, general manager of the Dayton (Ohio) Lighting Company, who had a pair of booths constructed, one of which contained a high candle-power gas lamp, and the other tungsten lamps properly equipped.

Influence of Load Factor on Cost of Production.

Mr. Austin Burt, of the Citizens' Gas & Electric Company, of Waterloo, Iowa, at the convention of the Iowa Electrical Association, Des Moines, April 22 and 23, gave some interesting information on the operation of the central station of this company, which supplies energy to Waterloo and Cedar Falls. Waterloo has a population of about 20,000 and Cedar Falls has a population of 5319. Mr. Burt showed charts from curve-drawing wattmeters indicating the total load in the generating plant at Waterloo, which showed a remarkably good load factor, due to the large amount of electricity sold to small factories. Mr. Burt presented these and other charts for a period of several years to show what an important influence load factor of a station has on the cost of production per kilowatt-hour. He explained the term "load factor" as commonly used, as the ratio of the average to the maximum load during any given period of time, this factor being usually expressed in the percentage which the average load is of the maximum. The author showed a typical daily load curve for December, in 1907, and also one for December, 1902. The load factor for the month of December, 1902, was about 21 per cent, while that for the month of December, 1907, was about 37 per cent. The curve-drawing wattmeter charts for April, which he showed, indicated that the evening lighting peak is very little higher than the regular day load, a most unusual condition of affairs in ordinary central-station operation. To illustrate, the practical bearing which load factor may have on operating cost aside from any factors of interest and depreciation, he presented a number of curves. One of these curves shows the load factor for December of each year from 1902 to 1907, and also the load factor of February and March, 1908, which is given for reasons to be explained later. Besides the load-factor curve, there is a curve of average load taking the average load of December, 1907, as 100 per cent. There is also a curve showing the cost of coal per kw-hour in percentage of the cost for December, 1902. The load factor for February and March, 1908, is, of course, better than for December, as would be expected, because the February lighting and power peaks do not overlap to such an extent as those in December. There is a further reason for this, however. The average load curve showed the output for February and March, 1908, to be greater than that for December, 1907, due to taking on power customers. This increase in output for February and March and the increase in load factor acted to bring down the whole cost per kw-hour nearly one-third from what it was in December. Mr. Burt called attention to the importance of maintaining good engine loads in small stations; that is, having engines for operating during the long light-load period of the day of a small enough capacity so that they would not run greatly underloaded.

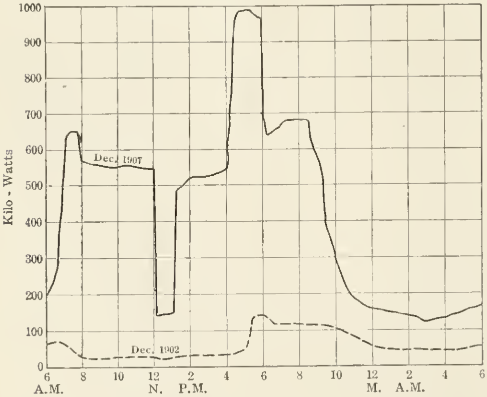


FIG. 1.—DECEMBER DAILY LOAD 1902 AND 1907.

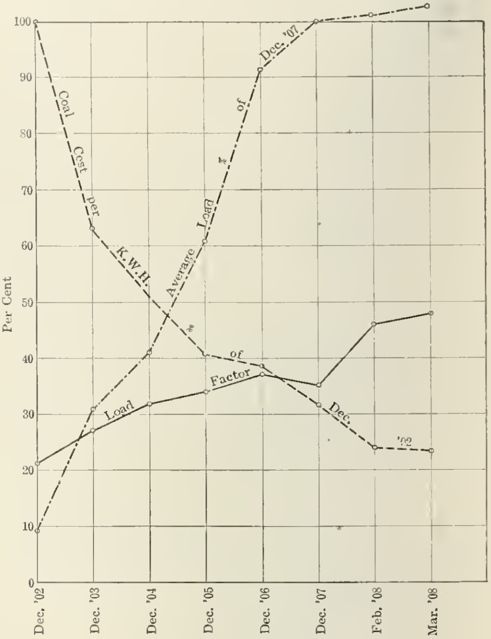


FIG. 2.—LOAD FACTOR CURVE.

Popularizing the Use of Electricity.

A paper on the above subject was given before the Iowa convention, April 22, by Mr. E. L. Callahan, heating appliance specialist, of the General Electric Company's Chicago office. The author discussed electric-heating devices and the sale of energy during daylight hours. He said that all of the business that a company takes may be profitable in the long run, but some of the load connected is more profitable than the rest. The motor business is usually profitable and the sign business is also profitable, but the latter comes heavily on the lighting peak and does not draw on the plant at all during the daylight hours. The residence lighting business is gleaned from an immense territory covered by a network of expensive copper and line material. In small cities approximately 95 per cent of the residences are not wired, and in large cities about 98 per cent are not wired. He called particular attention to the electric heating appliances with which a day load could be built up quickly. The flatiron is the best-known electric device and the easiest to introduce. He then gave the following list of tested recipes for increasing dividends by means of electric irons:

First—Select the best young lady or young man salesman in your employ or to be found in town (you may need four or five of them), either to give all or a portion of his or her time to your residence customers, following up inquiries on heating and making a thorough house to house canvass of all residences wired and taking time to demonstrate the use of the iron thoroughly.

Second—See that an electric iron is included in contractors' bids for wiring of each residence so that when a meter is set an iron is installed.

Third—Arrange with one of your newspapers to have an iron offered as a premium or at a reduced price with each new subscription. (The Chicago *Examiner* is doing this and expects to place 25,000 within a year.)

Fourth—Obtain from your nearest college, university or high school a young woman or young man recommended as a hustler to solicit, install and perhaps collect for irons at a commission of 50 cents to $1 per iron.

Fifth—Secure from the manufacturer of the irons an expert solicitor to call and demonstrate the iron at each residence, leaving the iron on trial; then follow up the work by telephone, letter or by call of your solicitor when necessary.

Sixth—On each Saturday, if the day be warm, take out a load of irons and distribute them on trial—probably very few will be returned.

Seventh—Rent the iron for 25 cents per month or loan it for a period of one year, customer paying a deposit of practically cost which is returnable with interest.

Electric cooking has appealed to people who have longed for some means of cooking with absolute cleanliness. It is safe to say that because of widespread advertising and the progressiveness of the times, you can quite easily persuade many of your customers to use electricity for all their cooking.

The amount of profitable cooking load that you can take on your lines depends upon local conditions entirely.

The size of the city or town has much to do with whether a portion or none of this load comes upon the lighting peak. In summer time and in small cities and towns I do not believe an appreciable amount of the load will come on the peak, for the days are long and dinner is eaten at noon. In large cities perhaps 25 or 30 per cent of this cooking load would be noticeable on the peak, but, even so, it is encouraging to see that these lighting companies are planning to take care of it.

There is a very substantial revenue to be obtained from use of the various so-called "lamp-socket devices." The coffee percolator and the toaster should be used in the home every morning. The revenue will amount to more than that from the use of a flatiron for the week's ironing. Then there is the shaving cup, water heater and baby milk warmer, all of which help.

In the discussion of this paper, Mr. L. D. Mathes, of Dubuque, said that he thought the central station should co-operate with the local supply dealers and protect them as to prices. At one time the supply men in Dubuque did not carry a stock of irons and similar electrical conveniences, and the central station began the sale of these devices at nearly cost. He later became convinced that this was not best, and that the supply men should be given a chance, so the price on these devices was put up so that the supply houses could carry them. On flatirons the profit was restricted to 50 cents per iron.

Mr. Austin Burt, of Waterloo, raised the question whether it would be feasible for a very small station which was not giving day service to arrange to operate during the day on Tuesday to supply energy for electric irons. Mr. Thomas Ferris raised the question whether it would pay to operate such a plant until 8 o'clock every morning to supply toasters and breakfast cooking utensils. Mr. Thomas Crawford, of Clinton, said that finances stood in the way of the operation of day circuits by many small companies, not so much because of the operating expense as because the operation of such circuits would immediately require extension of lines and increased investment for which the capital could not be obtained. He thought a day circuit would usually pay in a town of 1500 inhabitants and over.

Mr. Austin Burt thought that the existence of numerous flat-rate customers had prevented the operation of day circuits in small towns. His company, when it began to operate day circuits in Cedar Falls, placed all flat-rate customers on a meter basis. This change brought in enough more gross income to pay for maintaining the day service.

Mr. H. A. Zinn, of Anamosa, reported 30 per cent of his customers on flat-rate schedule before day service was given. When day service was begun, most of these were placed on a meter basis because of the improved service to be given, so that now only about 8 per cent were supplied with energy on a flat rate. This change was satisfactory to customers because of the fact that they were getting day service. Mr. G. Deiderich, of Avoca, asked as to the policy of installing meters for customers having only two or three lamps where the cost of a meter was hardly justified. Mr. Burt reported that his company took nothing less than a four-lamp consumer; that is, charged no rates less than those based on four lamps.

Reporting the Briarcliff Races by Wireless.

The entire progress of the 240-mile automobile race, April 24, at Briarcliff, Westchester County, New York, was reported to the Times Building, in Long Acre Square, by wireless telegraphy, using the Marconi system. One minute after Strang shot across the finishing line a winner, the crowds who blocked Broadway saw the announcement posted on the *Times* bulletin board, from five to 10 minutes ahead of the telephone and telegraph. The credit for this latest application of the wireless belongs to the Lozier Automobile Company, which backed the project and made the arrangements with the *Times* for reporting the race. The main wireless station, put in place during the week before the race, was at Briarcliff Lodge, a hotel situated on an elevation about half a mile from the grandstand and finish line. Transmission and receiving wires were strung from a corner basement room in the hotel to the top of a steel water tower, 106 ft. high, which stood near at hand. The operator sat in the basement room and received the dispatches for transmission over a temporary telephone line connecting with the grandstand. This station was equipped with a ½-kw outfit. Eight miles distant, directly across and half-way round the course, near Mt. Kensico Cemetery, was a second station or substation, with a slightly smaller equipment, which reported the progress of the race to the main station at Briarcliff. The main station obtained energy from the alternating-current lines of the private plant at the hotel, and the substation was operated by 16 storage cells. In place of a wireless mast, an old windmill tower, 50 ft. high, was pressed into service at the substation. As there was no building available at hand it seemed that the operator would be obliged to sit on the ground until the proprietor of a small livery stable near the cemetery, after having refused to loan the hearse in his charge,

TEMPORARY WIRELESS STATION NEAR MT. KENSICO CEMETERY.

offered the use of an old, broken-down stage coach which had been used for years at negro funerals. The coach was hauled near the windmill directly by the side of the course. The accompanying illustration shows the operator sitting in the coach with the sounder before him and the storage batteries under the coach with the wires running up through its rickety bottom. Transmission and receiving wires were strung from the flag pole on the top of the Times Building, and the operator, sitting in a small room in the tower, telephoned the results to the bulletin-board man stationed on the ground floor.

Nebraska Electrical Association Convention.

The Nebraska Electrical Association, which was organized about a year ago, held its first annual convention at Omaha May 6 and 7, 1908. The active membership of this association consists of electric lighting companies, of which over 20 out of the 60 companies in the State were represented, some companies sending several men. This remarkable showing at the first annual convention verifies the truth of a statment frequently made, that the farther West one goes, the larger the percentage of companies which are enterprising and progressive enough to be represented at State conventions of this kind.

The first session of the convention was opened Wednesday morning at the Omaha Auditorium, where the Omaha Electrical Show was in progress. The following three sessions were held at the Millard Hotel, which was association headquarters. President T. H. Fritts, of Grand Island, presided over most of the sessions; Vice-president R. D. Russell, of Fairbury, occasionally acting in his place.

In the president's address at the first session, Mr. Fritts called attention to the fact that the association met with 25 members on its roll at its first annual convention. Among the principal things of general interest which he called attention to were municipal lighting, accounting, depreciation in private plants, wiring inspection in the State, and the radical changes about to be caused by the tungsten lamp. He brought out the well-known fact that statements made as to costs of production in municipal plants were seldom correct, because all costs were not included. This was especially true when the plant was run in connection with the waterworks, and the waterworks was saddled with expenses really belonging to the lighting plant On the question of depreciation, he said that this item was not being sufficiently considered in connection with either private or municipal plants. Probably sooner or later, to judge from the general sentiment of the public, State regulation of electric light companies would be put in force. In preparation for the time when strict accounting must be made to a commission, companies should begin to write off proper depreciation reserves. He thought that the inspection of electrical wiring by competent men is to be encouraged, and recommended the appointment of a committee on inspection. He favored State inspection of electric wiring.

A nominating committee of five was appointed as follows: Messrs. L. J. Schwengel, of Holdredge; S. E. Schweitzer, of Omaha; L. E. Watson, of Beatrice; E. J. Sullivan, of Omaha, and J. M. Roberts, of York. The president's address was referred to a committee of three, consisting of Messrs. W. P. Byron, of Gothenburg; W. B. Stark, of Fremont, and J. M. Roberts, of York. Mr. E. J. Sullivan, of Omaha, secretary of the Beatrice Electric Company and of the Electric Service Company, of Wymore, introduced a resolution which, if passed, would admit municipal plants to membership in the association.

This resolution was discussed at length at this and other sessions, and was finally passed without a dissenting vote. Both sides of the question were thoroughly brought out in the discussion. It was pointed out that against this action was the indifference and incompetency of many men responsible for the conduct of municipal plants, and that the misrepresentations of true costs, both wittingly and unwittingly, made by those connected with municipal plants, had aroused a feeling of hostility against municipal undertakings among those connected with private electric lighting companies. It was therefore urged that it would be difficult to conduct an association in which both private and municipal plants were represented. On the other hand, in favor of admitting municipal plants, it was pointed out that in a great many cases those connected with municipal plants, if brought into the association, would come into closer touch with the men and mehods of private plants, and vice versa, to the benefit of all concerned; and that the ideas and education thus received would tend to make municipal plant managers figure true costs of service and to check the circulation of the absurd figures on costs of production which had aroused bad feeling between municipal and private plant managers in the past. It was pointed out that the Minnesota and Michigan associations admit municipal plant superintendents. It was also pointed out that as long as the hostile spirit exists of fighting blindly everything connected with municipal ownership by private companies, little progress can be made in bringing to light the true state of affairs as regards municipal and private undertakings.

Wednesday afternoon Mr. Waldemar Michaelsen, city electrician of Omaha, read a paper on "The Duties of the Electrical Inspector," which brought out a very complete discussion. Further consideration of the matter, however, was left until the following morning, when the insurance committee announced that Mr. W. S. Boyd, of Chicago, representing the National Fire Underwriters, would be at the convention the next day to take up the subject of "Electrical Inspection in the Smaller Cities." Following this discussion, Mr. V. W. Bergenthal, of the Wagner Electric Manufacturing Company, St. Louis, read a paper on "The Motor Problem from the Standpoint of Small Central Stations." In this he outlined the legitimate fields for various types of single-phase and polyphase motors. This paper was discussed the next day, as the association had accepted an invitation for 4:30 p. m., tendered by Mr. H. A. Holdrege, general manager of the Omaha Electric Light & Power Company, to take a special car and visit the modern plant of the company. The convention, therefore, adjourned promptly at 4:30 to do this and were taken to the power house, which is an excellent example of modern steam engineering practice. The latest units installed are two 2500-kw Curtis turbo-alternators.

In the evening the Omaha Electric Club tendered the convention a banquet at the Henshaw Hotel. The arrangements were made in excellent taste. Mr. E. J. Sullivan, in the dual capacity of an Omaha supply man and member of the Electric Club and as a Nebraska central-station man, acted as toastmaster. The following toasts were responded to, interspersed with music from an excellent quartette; "How It Feels to Be the Pioneer," George W. Johnston; "The Points of Similarity in a Threshing Machine and an Electric Light Plant," E. A. Bullock; "Contractors and Their Relation to Central Stations," E. F. Schurig; "The Branch of the Business I Have Not Yet Covered," F. H. Brooks; "The Association and Its Benefit," I. A. Campbell; "What I Don't Know About Inspections," W. Michaelsen.

Thursday morning the executive committee's report and secretary's report were read. The secretary's report showed 23 central stations as having joined since the organization up to May 1, 1908; and a number had applied during the convention. Mr. W. S. Boyd, representing the National Underwriters, then addressed the meeting at length on insurance inspection, especially with reference to small cities. Mr. E. J. Sullivan, of the insurance committee, announced before this address that the committee had been meeting with Mr. Boyd and that on some points they agreed, while on others they disagreed. He asked that the insurance committee be continued, which was done. Following Mr. Boyd's address, there was an extended and at times a very warm discussion over some of the points raised, but no satisfactory solution was offered of the question as to how wiring inspection and good wiring could be secured in small cities, unless the central-station company takes the matter in hand for its own protection.

Thursday afternoon the discussion of Mr. Boyd's address was taken up again. This was followed by a talk on "Meeting Gas and Gasoline Competition," by Mr. J. R. Cravath, Western editor of the Electrical World. This took up principally the use of the tungsten lamp; the illuminating engineering connected therewith; a table showing for comparison the tungsten lamp illumination together with gas mantle burners and gas arcs; and the business policy to be followed both as to rates and as to installation and maintenance of tungsten lamps.

Mr. I. B. Zimman, contract agent of the Omaha Electric Light & Power Company, gave a short paper on rates, in which he took up principally the two-rate system which automatically takes care of readiness-to-serve charges and gives the long-hour user a low rate. This brought out considerable discussion. The rest of the session was taken up with the question box.

The officers elected were: President, Mr. E. A. Bullock, of Norfolk; vice-president, Mr. S. J. Duncan, of Kearney; secretary, Mr. Wm. Bradford, of Lincoln; treasurer, Mr. L. J. Swengel, of Holdredge.

Zoelly Steam Turbine.

In a report to the Department of Commerce and Labor, special agent Capt. Godfrey L. Carden gives full details concerning the Zoelly steam turbine, manufactured by Escher, Wyss & Company, of Zürich, Switzerland. The turbine is of the parallel-flow "simple action" type with pressure stages and with a minimum number of stages of 9 or 10. It differs from the reaction turbine in several essential points. The steam enters the turbine wheel with its pressure preserved and is not lowered in passing. As there is neither axial thrust nor leakage, a large radial clearance can be allowed between the turbine wheels and stationary parts. In this new Zoelly steam turbine, which may also be described as a simple-action turbine, the steam jet from each guide apparatus acts on one wheel only. The steam on being admitted to the turbine passes on to the first guide apparatus, in which it is partially expanded, and so acquires kinetic energy, and is further directed at the proper angle to the running wheel, which absorbs the energy corresponding to the first expansion. The steam then passes to the second guide apparatus, where the second expansion takes place, and in like fashion the steam works through all the wheels and passes out to the exhaust pipe. Each guide apparatus consists of a disk divided along its horizontal diameter, and is made of cast steel or cast iron in one piece with a distributing ring. The blades are of nickel steel, and the whole apparatus is very solid in construction. The construction of the runners appears perfected to a high degree of reliability. Each turbine wheel disk is made of high-grade steel forged in one piece at the boss, and is carefully turned and polished all over. The blades are thickened toward the center in order to make the stress of the metal the same at every radius.

The Zoelly turbine has only about one-third to one-fifth the number of blades of a multi-stage reaction steam turbine of the same output, and the average velocity of the steam being low the wear on the blades is not appreciable. Captain Carden says that this turbine seems to be regarded in high favor in Germany, and is especially commended by reason of the little care and attention that are necessitated. He has seen one of these turbines working under very low pressure, utilizing, in fact, exhaust steam, at one of the colliery pits, and as the engine requires no extensive warming up before starting, it is valuable as a reserve machine.

Escher, Wyss & Company are building turbines of this type for a 20,000-hp German scout cruiser, two of 6000 hp for outboard screws and two of 4000 hp for inboard screws. Turbines have also been designed for two torpedo-boat destroyers, one of 9000 hp and another of 14,000 hp, the machinery to be built by the German and French governments respectively. Krupp has obtained the Zoelly turbine rights for Germany, Schneider, of Creusot, for France; Orlando & Company, of Leghorn, for Italy. The Russian government is also about to take up this type of turbine. The American rights have not yet been disposed of.

Escher, Wyss & Company are also bringing out a liquid-fuel heating system for marine boilers. This involves a steam turbine-driven turbo-compressor of the Zoelly type. The use of liquid fuel, it is pointed out, calls for compressed air at about 14 to 15 lb. per square inch, to be forced through suitably dimensioned nozzles placed over the grates. It is not practicable to use reciprocating engines for this purpose, owing to the reduced floor space of stoke holes, and to overcome this difficulty Escher, Wyss & Company have bought out the Zoelly type of turbo-compresson driven by a Zoelly steam turbine. The system can be operated in any position that may be required by ship conditions.

Electric Light Association for Pennsylvania.

A movement toward forming an association of electric light companies in the State of Pennsylvania was started last fall by Mr. L. H. Conklin, general superintendent of the West Penn Electric Company, headquarters at Connellsville, Pa., who sent a circular letter to all the companies in the State asking them if such an organization would be desirable. The number of replies received was encouraging, and a "follow up" system was inaugurated to interest corporations in the organization of such an association. A meeting was called at Harrisburg Jan. 15, but only those companies were asked to attend that had responded favorably to the circulars sent out. This resulted in 10 companies sending representatives, and as this was so small a percentage of the companies in the State, it was not deemed wise to organize a permanent organization with such a small representation. Hence, a temporary organization was effected, whose officers were elected until such time as the executive committee thought it wise to call another meeting for the purpose of a permanent organization. At that meeting, the temporary officers were to vacate and the permanent officers be elected in their stead for a period of one year. Since that time, a systematic effort has been made to interest the companies in this association, and the results have been remarkably good.

Realizing the fact that the matter of associations has been rather overdone, it was deemed advisable to follow this up with explanations of the reasons why a State association was often of more particular benefit than a general association, due to the fact that they deal with local conditions, all having to figure on the same laws and legislative body, together with many other reasons, not the least of which is the social enjoyment of knowing one's neighbors. The results of this campaign, which has been carried on somewhat intermittently, have been that there are at present 23 member companies regularly enrolled and at least a dozen others which have signified their intention of joining. Among the companies enrolled are the very largest in the State and also some of the smaller ones. The idea seems to be well received and the chances for continued success are very bright.

The meeting for the permanent organization will probably be called some time during the coming summer, at which time, it is fully expected, at least 50 companies will have enrolled. The officers of the temporary organization are as follows: President, L. H. Conklin; vice-president, F. F. McCabe; secretary and treasurer, E. L. Smith; members of executive committee, E. H. Davis and A. R. Granger.

International Telegraph and Cable Conference.

Advices from Washington state that the Department of Commerce and Labor has been advised by cablegram from Special Agent Dennis, who is in attendance as representative of the United States government upon the international telegraph conference, now in session at Lisbon, containing important information that business interests are not to be disturbed by a serious curtailment of the right to use codes in international cabling. The cablegram reads as follows:

"Tone of the conference is not strongly antagonistic to the large majority of existing code regulations. There is a feeling to prevent the use of unpronounceable combinations of letters now being supplied by codemakers. The British postoffice circular issued to Chambers of Commerce reads in part:

"'The Postmaster General thinks it desirable that the condition as to pronounceability be somewhat more clearly defined in order to put some limit for the future to a growing tendency which, if unchecked, cannot fail to produce results highly injurious to the telegraph service generally, and therefore to the public and to commerce.'"

There is, however, no intention of adopting other than a wide and even generous interpretation which would cover the bulk of the codes at present in use.

A press dispatch states that Belgium has proposed a modification of the present system of counting words whereby the existing distinctions regarding plain, conventional and code language is to be abolished and a uniform word of five letters or five figures substituted. This proposition met with strenuous opposition from the commercial interests of Great Britain and America.

CURRENT NEWS AND NOTES.

NATIONAL FIRE PROTECTION.—The twelfth annual convention of the National Fire Protection Association is to be held at Chicago on May 26, 27 and 28 in the assembly room of the Chicago Board of Underwriters, National Life Building. A number of interesting reports will be presented as usual.

N. E. L. A. RECEPTION.—The regular program for the Chicago convention of the National Electric Light Association is given elsewhere in this issue. The meeting will be preceded by the formal opening on Monday evening, May 18, of the manufacturers' exhibition, and this in turn will be followed by a reception given by the local reception committee in the beautiful new gold banquet room on the second floor of the Auditorium Hotel Annex. Immediately after the reception there will be dancing and supper will be served.

PUBLIC UTILITIES OF INDIANA.—Mr. B. V. Hubbard, of Mooresville, Ind., who was elected president of the Public Utilities Association of Indiana at the time it was organized in December, 1906, has recently recovered from an illness of over a year. We are informed by Mr. Hubbard that a meeting of the Public Utilities Association of Indiana is called for Tuesday, May 12, at the Palm Room of the Claypool Hotel, Indianapolis. Every gas, electric, water and telephone company in the State is invited to send representatives to this meeting and to join the association.

WARNING OF FRAUD.—We have had to call attention during the past five or six years, upon various occasions, to the fraudulent practices of a young man about 30 years old, 5 ft. 8 in. high, slender build, light complexion, crooked teeth. He speaks with an English accent, claims to be connected with various important men engaged in the electrical or mechanical field in England, generally has a hard-luck story, and borrows money which is never returned. He is using a number of aliases and has operated all over the country. We are informed that he is at present in New York, has been recently heard from in Philadelphia, Rochester and other Eastern cities; and our readers are hereby warned against him.

INSTITUTE OF CHEMICAL ENGINEERS.—We are informed by Mr. W. M. Booth, of Syracuse, N. Y., that after nearly a year of deliberation the committee on a proposed engineering society for practical chemists has decided to request the principal technical journals to state that the committee appointed at Atlantic City last June to consider the formation of an American Institute of Chemical Engineers has found, after obtaining the views of the chemists of this country, that there is a strong sentiment for bringing together into closer relationship those men who more particularly specialize in chemical engineering. A very decisive vote has been received in favor of the formation of the society. It has been decided to call a meeting for the purpose of organization. This will be held in Philadelphia some time during the middle of June. Several men eminent in the profession have consented to address the meeting.

TIME ON TELEGRAMS.—At Washington, on May 5, Mr. George H. Fearons, general attorney for the Western Union Telegraph Company, addressed the House Committee on Interstate and Foreign Commerce in opposition to the bill introduced by Mr. Carey, of Wisconsin, to require telegraph companies to transmit with telegrams the time of filing messages and the time of putting them on the wire. Mr. Fearons said that 60 per cent of the telegraph business of the country was the transmission of information for exchanges, boards of trade and similar commercial bodies; 20 per cent was newspaper matter; 15 per cent railroad intelligence, and less than 3 per cent "private and social telegrams." He said that on the basis of 74,805,000 telegrams transmitted annually, the additional number of words imposed by the bill upon the Western Union Company for transmission would be equal to 17,454,000 10-word messages. This means 174,540,000 words unnecessarily transmitted, clogging the wires and delaying service.

ELECTRIC RAILWAY JOURNALISM.—The McGraw Publishing Company announces that it has purchased from The Wilson Company the *Electric Railway Review*, and that this periodical will be combined with the *Street Railway Journal*. The first issue of the consolidated publication will be dated June 6. It will be known as the *Electric Railway Journal* and will be published from the main office of the McGraw Publishing Company, at 239 West Thirty-ninth Street, New York. In addition, the publishers maintain editorial and business offices at Chicago, Cleveland, Philadelphia and London. The McGraw Publishing Company will carry out by means of the *Electric Railway Journal* all unfilled subscriptions to the *Street Railway Journal* and the *Electric Railway Review*. The subscription price for the *Electric Railway Journal* will be $3.00 per year. The consolidated paper, with its broadened field and range of vision, will combine all that is best in each of its former constituent elements, and will certainly be of greater usefulness and benefit to the art and industry than was possible under the old conditions. The great electric railway development will have a weekly publication worthy of it and able adequately to record its every aspect.

OMAHA ELECTRICAL SHOW.—The electrical show which was held in the Omaha Auditorium, May 4 to 9, resulted in a local interest far beyond anything anticipated. The attendance, which ran over 2000 per evening, taxed the capacity of the exhibit space and aisles, and dispelled any doubts as to the desire of the Omaha public to investigate electrical matters. The central feature of the show was a cottage full of things electrical, erected by the Omaha Electric Light & Power Company, in charge of Mr. I. B. Zimman, contract agent of the company. The show was carried out by the Nebraska Electrical Trades Association, of which Mr. E. J. Sullivan, of the Nebraska Electrical Company, Omaha, is president, and William L. Burgess secretary. The Omaha Auditorium, where the show was held, is under the management of Mr. J. M. Gillan, who arranged many of the details. The leading local supply houses were represented. The cottage of the Omaha Electric Light & Power Company was lighted in good taste at a very moderate expenditure in fixtures to illustrate a typical simple lighting scheme for a small building of this kind, rather than to make an elaborate fixture display. The general lighting of several rooms was accomplished with a frosted-tip tungsten lamp placed at the ceiling in the center of the room, equipped with an enameled bowl reflector, so that nothing but softened and diffused light could reach the eye. In the bedroom, brackets on each side of the dressers were provided with frosted diffusing globes over carbon lamps. All of the common heating appliances and electrical conveniences were shown in each room in their proper places.

NIGHT VIEW OF CHICAGO FROM LAKE FRONT.

The System and Operating Practice of the Commonwealth Edison Company, Chicago.

PRACTICALLY all of the central-station electric lighting and industrial service in Chicago, except that for street lighting, is furnished by the Commonwealth Edison Company. This company, which is the result of various consolidations, has a franchise covering the entire city. Besides furnishing electricity for lamp and motor service, the company also sells a large amount of energy at wholesale to street and elevated railway companies and to interurban railways. There have been no important extensions or enlargements of electric railway generating plants in the city of Chicago in the past five years, with the exception of one elevated road. The increase of business on the railways and the change from cable to electric traction on the principal street railway lines has been entirely taken care of by the purchase of energy from the Commonwealth Edison Company.

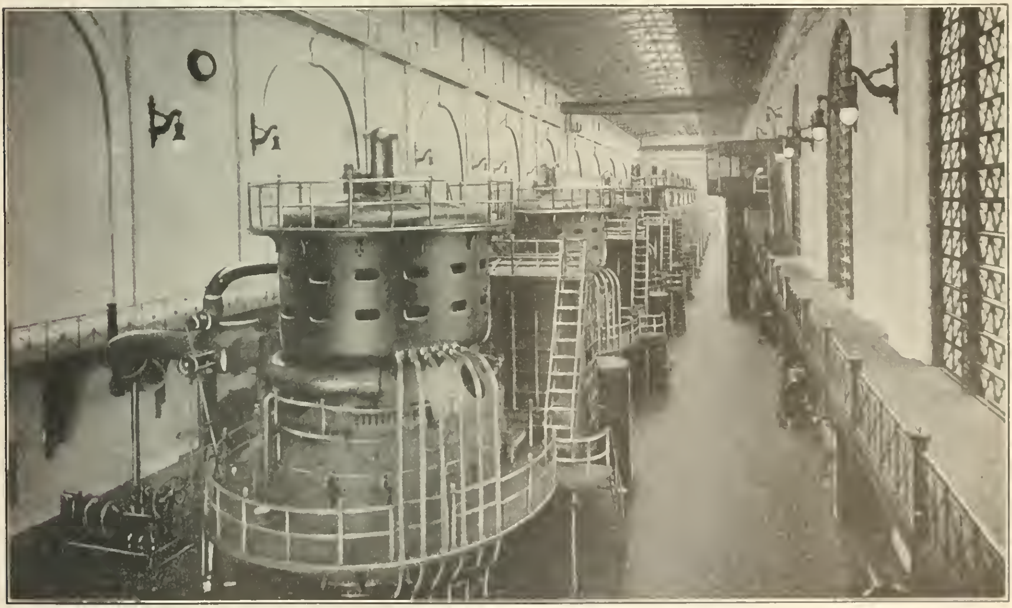


FIG. 1.—TURBINE ROOM OF FISK STREET STATION.

Although isolated plants are still numerous in Chicago, they were never so hard-pressed by central-station service as now, and the Commonwealth Edison Company has among its customers establishments formerly run by some of the largest isolated plants in the city. In the past five years there has been a material advance in the supply of energy to such large consumers. The manufacturing districts also have been invaded and all-day motor load secured. The residence districts are being much more thoroughly covered than a few years ago. These railway, manufacturing and residence lighting loads are having an important influence on the company's load factor.

EQUIPMENT OF STATIONS.

The peak-load generating output of the company aggregates 119,250 kilowatts in three stations. Of this total 98,250 kilowatts is in the Fisk Street station, 18,000 kilowatts in the Harrison Street station and 3000 kilowatts in the Fifty-sixth Street station. These generating plants transmit energy to 33 substations belonging to the Commonwealth Edison Company and 11 substations belonging to various railway companies. The rotary-converter rating connected to the 115-volt and 230-volt direct-current network in the central part of the city aggregates 50,700 kilowatts. The alternating-current motor-generator frequency-changer sets, through which 60-cycle energy is supplied to the outlying alternating-current districts, aggregate 21,340 kilowatts in rating. The rating of the rotary converters in the substations of the railway companies aggregates 50,400 kilowatts, and there is one railway motor-generator of 500 kilowatts. The total equipment of rotary converters and motor-generators connected to the system has a rating of 122,940 kilowatts. The Commonwealth Edison Company at various substations has storage batteries for discharging into its direct-current network which aggregate 18,030 kilowatts in output at a one-hour discharge rate. The railway companies also have batteries aggregating 4856 kilowatts at a one-hour rate.

GENERAL CHARACTER OF THE SYSTEM.

The Commonwealth Edison Company furnishes direct-current energy at 115 and 230 volts in the central part of the city, and 60-cycle, 115- and 230-volt single-phase, alternating-current energy for lamps and for motors rated up to 5 horse-power, and three-phase alternating-current energy for motors rated above 5 horse-power.

The greater part of the output is generated at 9000 volts, 25 cycles, three-phase and transmitted to substations. Substations for direct-current energy distribution contain step-down transformers and rotary converters. The substations for alternating-current energy distribution contain motor-generator frequency-changers, which receive three-phase, 25-cycle, 9000-volt current and deliver 60-cycle current for four-wire, three-phase energy distribution with 2200 volts between each phase wire and neutral, and 3800 between phase wires.

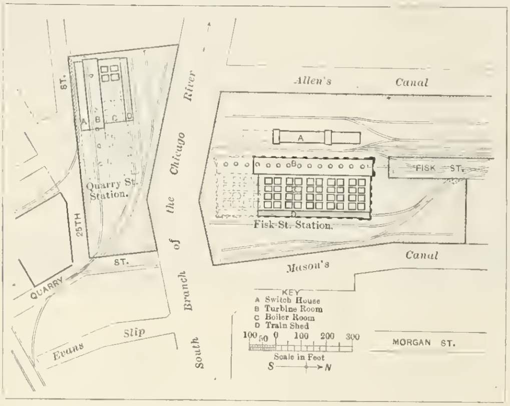


FIG. 3.—COMMONWEALTH EDISON GENERATING STATION PROPERTIES.

Fig. 2 is a map of Chicago, showing the location of the Commonwealth Edison Company's stations and substations and the location of the railway substations with the 9000-volt transmission lines connecting them. The distributing circuits which spread out from each substation are not shown on the map. These extend many miles beyond the outlying alternating-current substations.

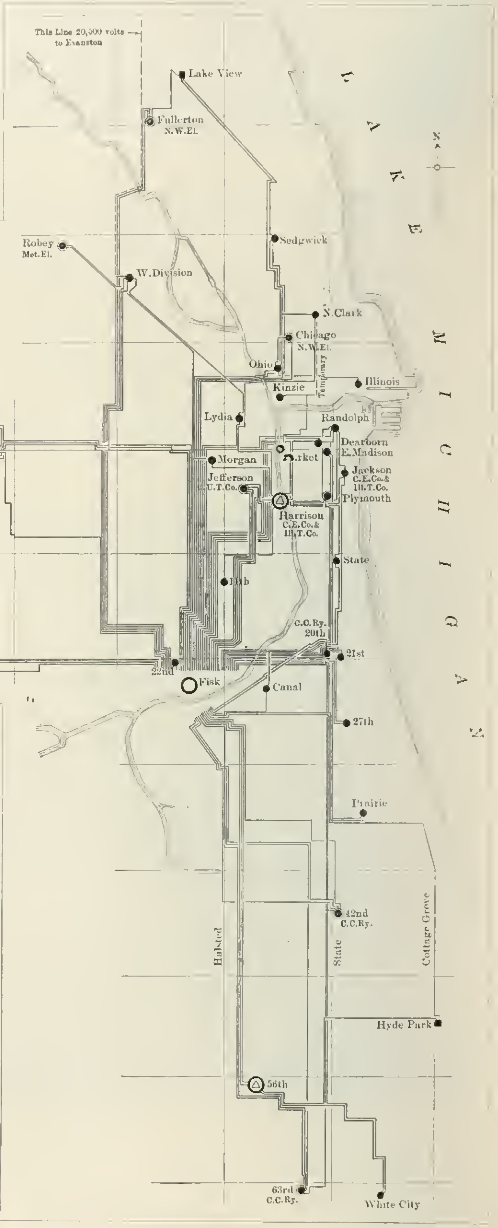
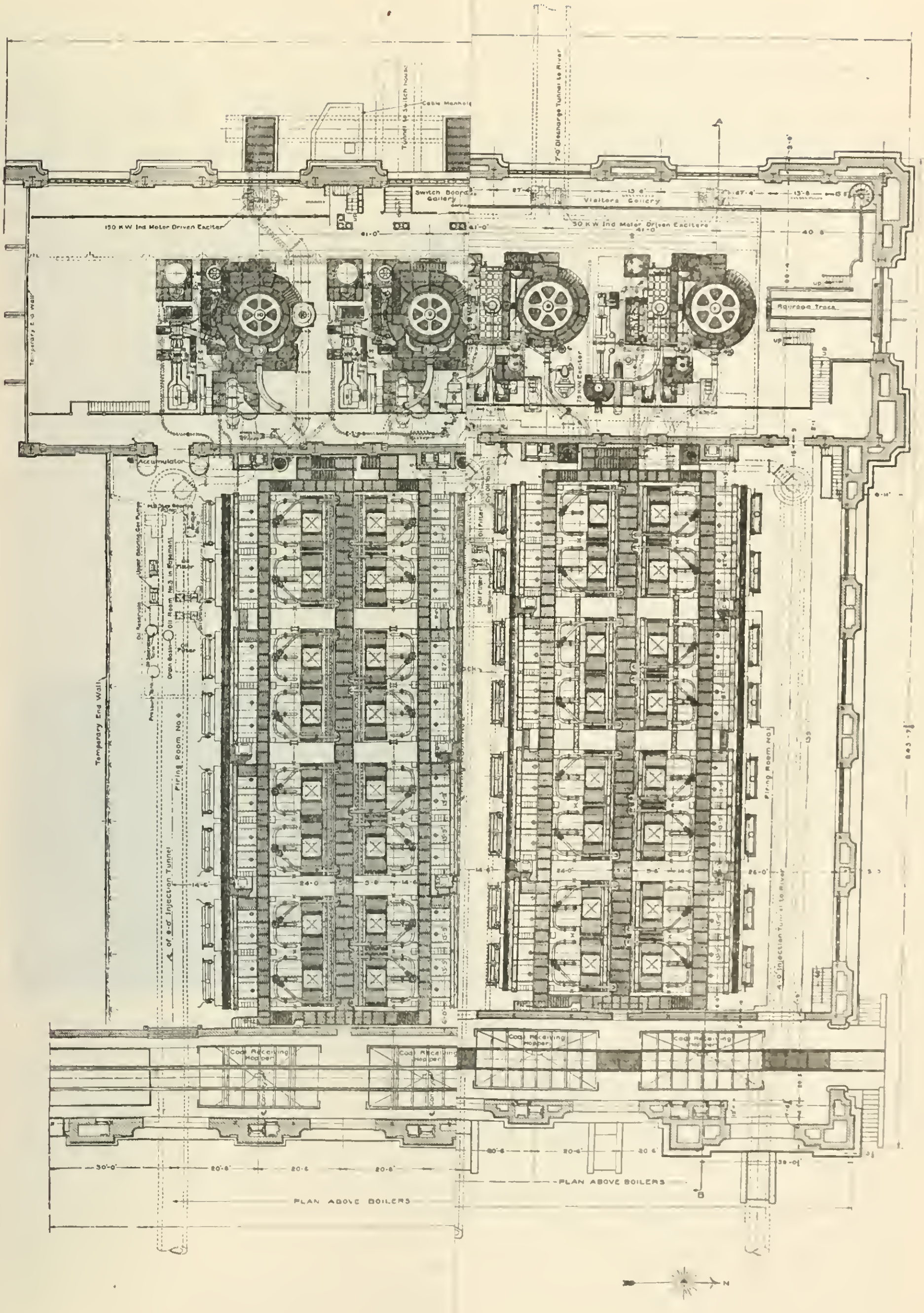


FIG. 2.—MAP OF 9000-VOLT, 25-CYCLE TRANSMISSION SYSTEM.

The direct-current district extends approximately 6.5 miles north and south along the lake and two miles back from the lake. The direct-current network, which was started in the down-town district many years ago, was originally supplied


Cable Manhole
Tunnel to Switch house
7'-0" Discharge Tunnel to River
A
Switch Board Gallery
Visitors Gallery
27'-4"
13'-6"
150 K W Ind Motor Driven Exciter
30 K W Ind Motor Driven Exciters
41'-0"
40'-6"
Temporary End Wall
Squirrel Track
UP
75 K W Exciter
Accumulator
Upper Bearing Gas Pump
Oil Reservoir
Oil Room No 3 in Basement
Drain Basin
Oil Filter
Pressure Tank
Temporary End Wall
Firing Room No 6
of 8'-0" Injection Tunnel
Oil Filter
Cyl Oil Tank
Firing Room No 1
4'-0" Injection Tunnel to River
24'-0"
14'-6"
26'-0"
Coal Receiving Hopper
Coal Receiving Hopper
Coal Receiving Hopper
Coal Receiving Hopper
30'-0"
20'-6"
20'-6"
20'-6"
20'-6"
20'-6"
20'-6"
30'-0"
PLAN ABOVE BOILERS
PLAN ABOVE BOILERS
B
N

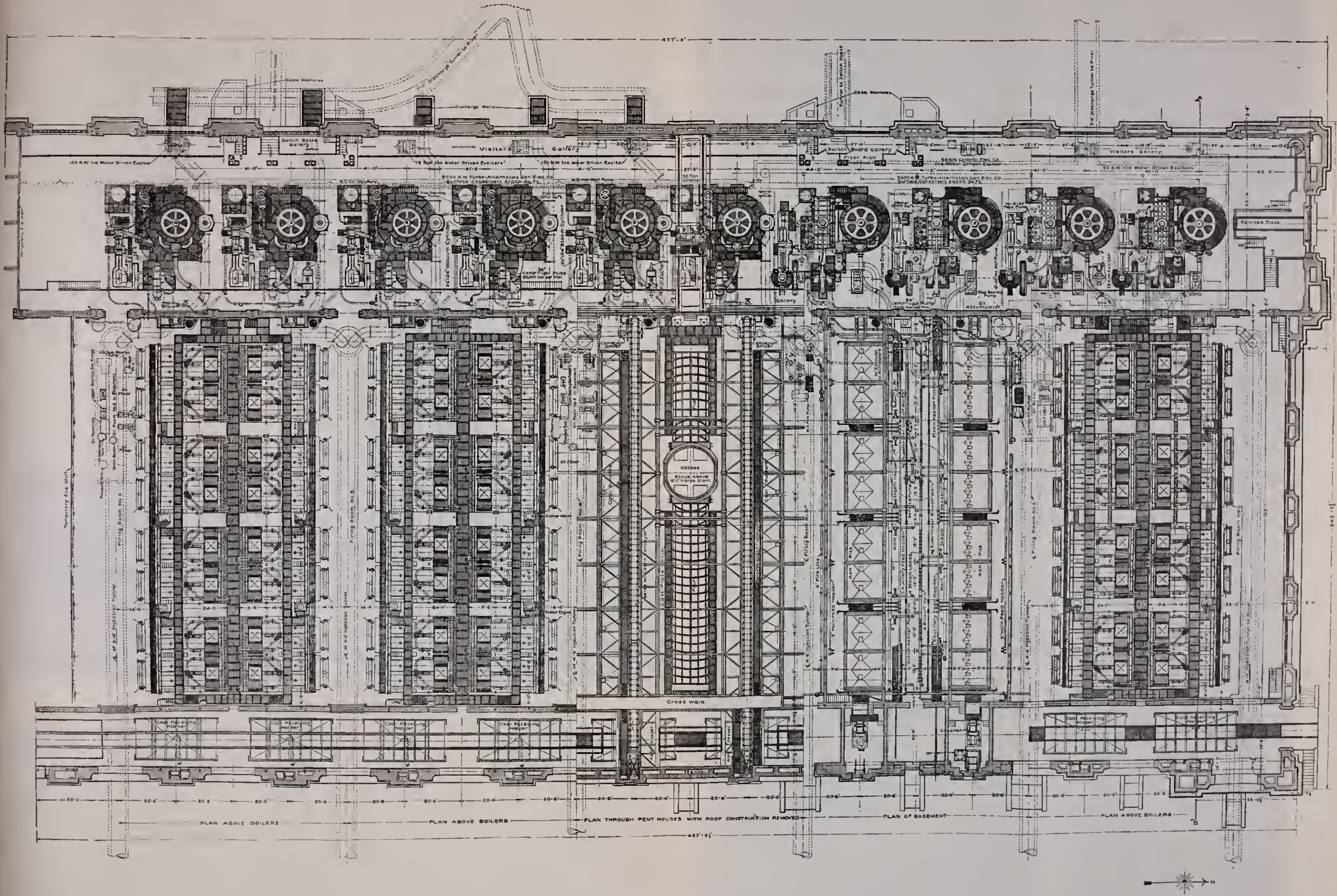


FIG. 4.—GENERAL ARRANGEMENT PLAN OF FISK STREET STATION, SHOWING TURBO-GENERATORS, BOILERS AND COAL-HANDLING EQUIPMENT.

with energy from a small direct-current station in the heart of the business district at 139 Adams Street, where the company's general offices are now located. In 1892 a large generating plant was built on the Chicago River at Harrison Street about .5 mile from the company's direct-current load center. In the meantime small direct-current generating plants had also been established beyond the congested down-town district. Later various alternating-current plants which had been established in the residence districts were acquired. The Harrison Street station, originally started as a direct-current plant, became a combination direct- and alternating-current plant. It now has half its 18,000-kw rating in alternating-current generators and the other half in generators for feeding energy directly into the down-town direct-current network. Some of the latter, however, are provided with alternating-current collector rings so as to give either alternating or direct current. The transmission of energy to substations was first accomplished by double-current generators. The e.m.f. was increased to 4500 volts, three-phase, the energy being transmitted to substations. Later the e.m.f. was doubled, making it 9000 volts, three-phase, which is today the standard transmission e.m.f. of the system. When the great Fisk Street station was planned, in 1901, an e.m.f. of 9000 volts and a frequency of 60 cycles were adopted for all of the turbine generators.

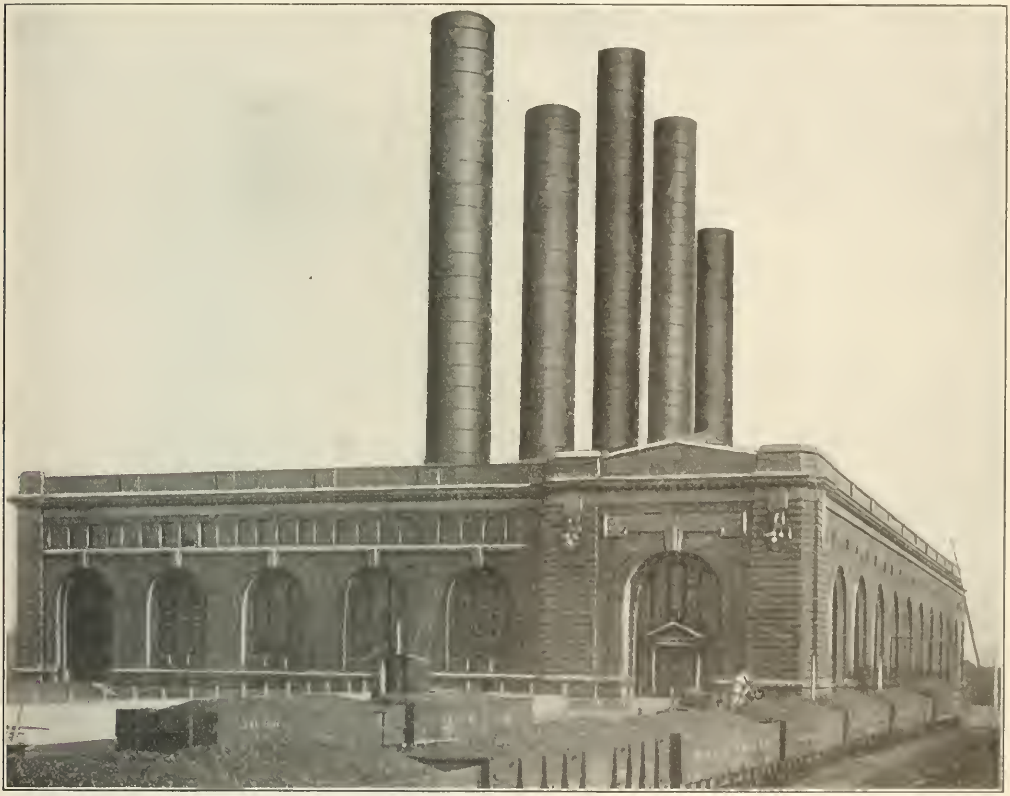


FIG. 5.—EXTERIOR OF FISK STREET STATION.

The use of 25-cycle, three-phase current for transmission from a generating station to a substation in Chicago dates back to 1897, when the first rotary converter, one of 250 kilowatts, was put in operation at the Twenty-seventh Street substation with energy supplied from a double-current generator at Harrison Street. A frequency of 25 cycles was selected at that early date because at that time 60-cycle rotary converters were not considered reliable machines because of the difficulties in hunting, getting out of step and commutator troubles. In 1901, when the Fisk Street station plans were drawn, the company had to make an important decision as regards frequency and voltage. A change would have been possible, but it was decided after full consideration to continue the existing standard. It was then generating energy at 9000 volts, three-phase, 25-cycle current at Harrison Street for transmission to substations. The e.m.f. of 9000 volts had been reached by a kind of doubling process. The common e.m.f. of 2250 volts was first doubled to get 4500. Then it became evident that 4500 was not high enough and that a change would have to be made. After that decision transformers were purchased that could be operated at either 4500 or 9000 volts. Thus the e.m.f. of 9000 volts came to be fixed upon, and this, in accordance with common practice, is about right for the distances of transmission in Chicago. As to frequency, the selection of 25 cycles made it possible for the central-station company to offer to sell electrical energy to the electric-railway companies at such a voltage and frequency that it could be used in standard rotary-converter substations erected by the railway companies. If at any time the railway companies wished to generate their own energy, no substation investment would be lost and the generating apparatus used to supply energy to them could be applied to increasing the electric lamp and motor load. In this way neither company would take any risks.

In the down-town district where the load density is very high, the map indicates that rotary-converter substations re-

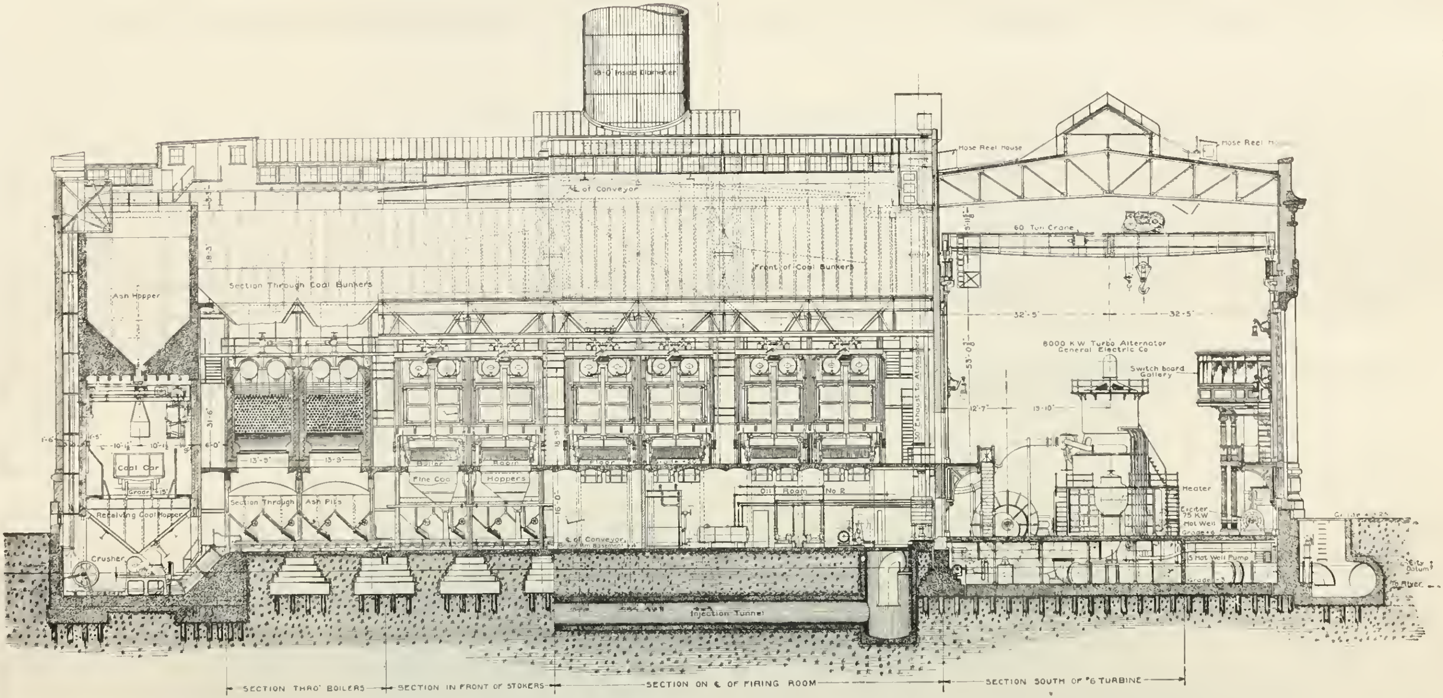
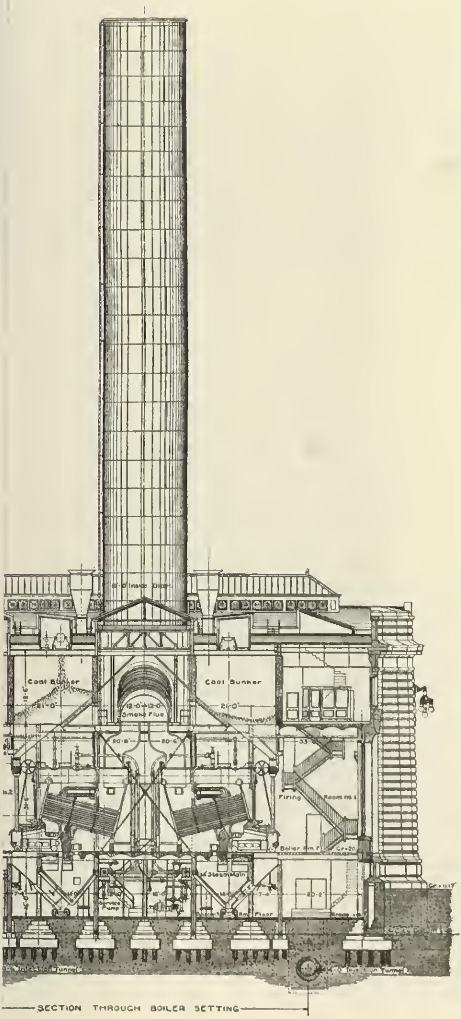


FIG. 6.—CROSS-SECTIONAL ELEVATION OF FISK STREET STATION, CHICAGO COMMONWEALTH EDISON SYSTEM, AT FRONT OF BOILERS.


Coal Bunker
Coal Bunker
21-0"
21-0"
12-0"
12-0"
Smoke Flue
20-6"
20-6"
Firing
Room No. 1
Boiler Rm. F
Gr.+20
Steam Main
Service Pump
Floor
7-4"
20-2"
Tunnel
Tunnel
SECTION THROUGH BOILER SETTING

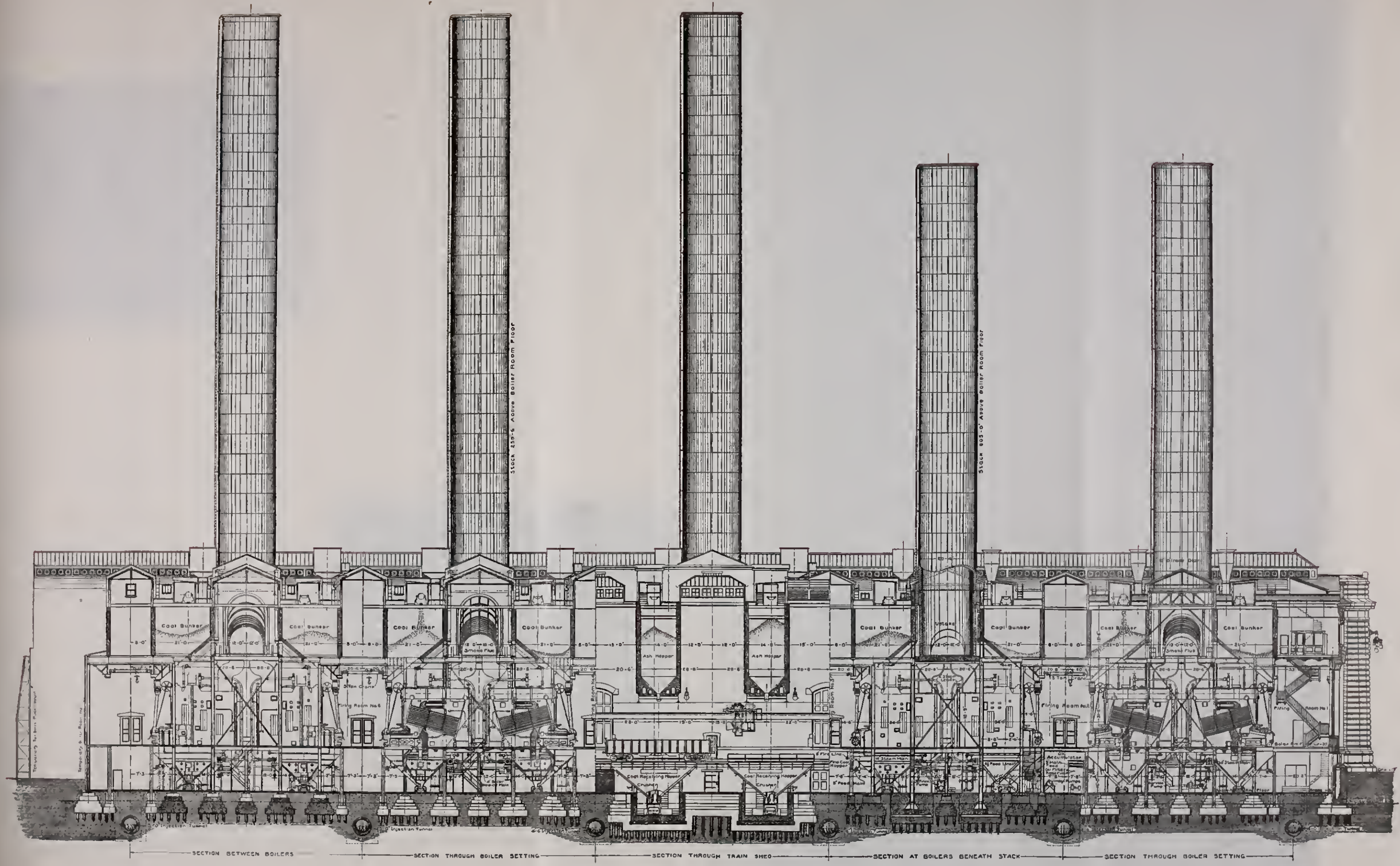

Stack 259-6 Above Boiler Room Floor
Stack 203-0' Above Boiler Room Floor
Coal Bunker
Smoke Flue
Ash Hopper
Uptake
Firing Room No. 5
Firing Room No. 1
Coal Receiving Hopper
Crusher
Injection Tunnel
SECTION BETWEEN BOILERS
SECTION THROUGH BOILER SETTING
SECTION THROUGH TRAIN SHED
SECTION AT BOILERS BENEATH STACK
SECTION THROUGH BOILER SETTING

FIG. 7.—LONGITUDINAL SECTIONAL ELEVATION THROUGH BOILER ROOM OF FISK STREET STATION, LOOKING WEST.

ceiving 25-cycle, 9000-volt, three-phase energy have been established at very frequent intervals. These substations for the most part have been established in high-class fireproof buildings, the upper stories of which can be utilized for office and commercial purposes. In some cases the basements of large office buildings already erected have been leased and in other cases buildings have been started by the company which can later be extended to the height of ordinary tall office buildings.

Another feature of the direct-current network is the existence of 15 storage batteries which are kept floating on the line purely for emergencies. These are in some cases located in converter substations and in other cases in separate buildings.

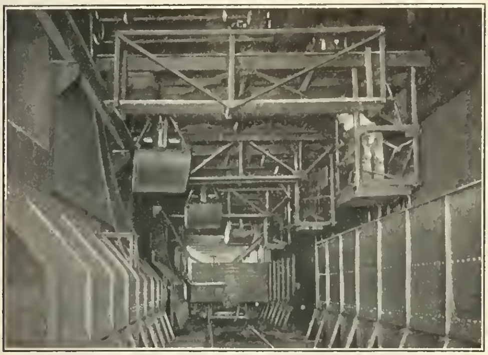


FIG. 8.—UNLOADING BUCKETS IN TRAIN SHED.

FISK AND QUARRY STREET STATIONS.

Five years ago, in 1903, when the National Electric Light Association last met in Chicago, the great Fisk Street station was under construction. The first of the 5000-kw Curtis steam turbine units had not been started. This station as originally planned for 14 5000-kw turbine units, making a total rating of 70,000 kilowatts, was doubtless considered by the majority of engineers, both inside and outside of the Commonwealth Edison Company, as providing for a future growth of many years.

Probably few who attended the convention at that time would have predicted what has actually taken place. The Fisk Street station has been enlarged to carry a peak load of 100,000 kilowatts, although by virtue of increase in size and economy of units it does not occupy all of the ground provided for the enlargement of the station. Across the river from the Fisk Street station, at Quarry Street, a building is being erected to house another station of 84,000 kilowatts ultimate rating. The development is certainly a most remarkable one and brings to mind again the oft-demonstrated fact that the average central-station man is apt to far under-estimate the future possibilities of the business. The Fisk Street station five years ago was an object of much interest as being planned to contain the first 5000-kw Curtis steam turbines, the contract for these turbines having been let at a time when turbine development was in its beginnings in this country and when the building of a vertical-shaft turbine for as large a rating as 5000 kilowatts was a matter involving many unknown factors. Over one-half of the equipment of the Fisk Street station was put in service within the year ending Sept. 22, 1907. Although to the casual observer the station (Fig. 1) appears remarkably uniform in apparatus from one end to the other, as a matter of fact it illustrates an important advance in steam turbine economy. The first units rated at 5000 kilowatts required under test 23.94 lb. of steam per kw-hour, while the last six units of 8000-rated output required only 13.07 lb. of steam per kw-hour.

The Fisk Street station as it stands to-day, and as illustrated in the drawings and photographs which accompany this article, contains 10 turbine units. Of these the first three installed were rated at 5000 kilowatts. For carrying peak load their output may be considered 6250 kilowatts. The third unit installed, rated at 5000 kilowatts, is able to carry 7500 kilowatts during the peak-load period; while each of the last six, rated at 8000 kilowatts, is able to carry 12,000 kilowatts. The total output of the station at peak loads may, therefore, be considered as 98,250 kilowatts.

In connection with the rapid growth of the Fisk Street station the following chronology may be of interest: The contract for the first two turbines was let Dec. 28, 1901. Ground for the first section of the building was broken June 25, 1902. Unit No. 1 was started on commercial load Oct. 2, 1903; unit No. 2, Dec. 11, 1903; unit No. 3, April 21, 1904; unit No. 4, Oct. 27, 1905; unit No. 5, Sept. 19, 1906; unit No. 6, Oct. 10, 1906; unit No. 7, Nov. 13, 1906; No. 8, Jan. 22, 1907; No. 9, July 19, 1907; No. 10, Sept. 22, 1907.

The reason for this remarkable growth is the increase in electric lamp and motor business, combined with the large railway business, which latter now amounts to over half of the 1,000,000 kw-hours generated daily in this station. The company has been able, by virtue of the economy obtained in this station, to offer electrical energy to various railway companies at figures which made it seem to the companies unnecessary to go to the expense of building their own generating plants.

The general arrangement of the power-plant properties at Fisk and Quarry Streets is shown in Fig. 3. Both properties are located on the south branch of the Chicago River. This location, with reference to the distributing system as a whole, has already been shown in Fig. 2. There is a canal or slip on each side of the Fisk Street property. There are also excellent railroad facilities. Coal is brought in by railroad, although in case of emergency it might be brought in over the river. Condensing water is taken from the slip on the upstream side of the station through tunnels which pass under the station to the condensers, and discharge into the downstream slip. As is evident from the plan of the property (Fig. 3) there is abundant yard room around this station. This is utilized for the storage of coal. A switch engine is kept constantly in use shifting cars. The present daily coal consumption of the plant is about 40 carloads. For coal-storage purposes a good grade of washed coal is used in order that there may be a minimum loss in storage. As can be seen from the dotted lines in Fig. 3, there is still room for enlargement of the Fisk Street station.

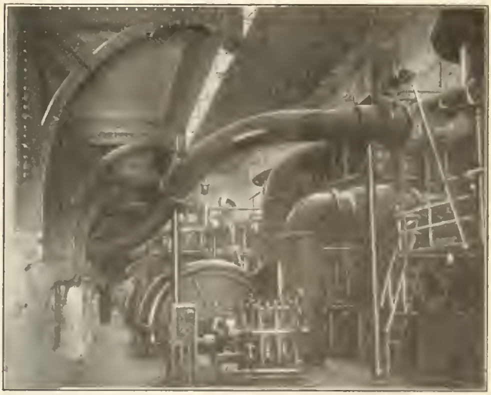


FIG. 9.—CIRCULATING WATER PUMPS, FISK STREET STATION

Instead of completing the Fisk Street station at present to its final size, it was decided best to start another station across the river at Quarry Street, as shown on Fig. 3. The reason for starting the separate station was mainly to avoid having the entire generating equipment in one station, which might by some remote possibility become partially disabled.

The general arrangement plan of the Fisk Street station is shown both on the map of the property (Fig. 3) and in the detailed plan of the station (Fig. 4). Longitudinal and cross-sectional elevations are shown in Figs. 6 and 7. The row of turbines in the turbine room extends north and south and opposite each turbine unit at right-angles to it, extending east and west, is a battery of boilers of sufficient size to supply steam to that unit. The "comb" arrangement of apparatus, made possible by the fact that there were no real estate limitations, is a very desirable one in many respects, and makes a simple arrangement with all the boilers supplying steam to a single turbine unit on one floor in two straight lines. This plan simplifies the conveying and storage arrangements, and the piping is also not complicated.

Coal is received in the train shed at one side of the boiler room. If it is in dump cars it is simply delivered into hoppers, from which it is taken by conveyors to coal bunkers over the boilers, as shown in Fig. 7.

When dump cars are not obtainable (which is true with most of the coal delivered to the station) electrically-operated grab buckets, as shown in Fig. 8, are used to do most of the unloading. In this case it is, of course, necessary for laborers to clean out the corners of the cars. Each row of boilers has its conveyors, the same set of conveyors serving for both coal and ashes.

The bunkers in this station can hold a total of 10,800 long tons. Each conveyor can handle 75 tons per hour, the conveyor serving only one turbine unit. The station uses about 1500 long tons per day.

For each turbine unit there are eight B. & W. water-tube boilers, with B. & W. chain-grate stokers, each boiler having a heating surface of 5087 sq. ft. The usual rating of such boilers, 10 sq. ft. per horse-power, gives a nominal rating of about 4100 horse-power for each bank of boilers. This rating, however, is largely of academic interest in connection with this station, where the rates of working the boilers and the economy of the turbines make it possible for a bank of these boilers to supply steam to turbines of 8000-kw rated output working sometimes at 12,000 kilowatts. The grate areas on boilers supplying steam to units 1 to 3 is 76.5 sq. ft. for a heating surface of 5087 sq. ft. On unit No. 4 the boilers have a grate area of 8325 sq. ft. On units 5 to 10, which have a rated output of 8000 kilowatts, the boilers have 90 sq. ft. of grate surface. These boilers are, therefore, worked at a very high rate of steaming. The steam pressure is 200 lb. per square inch. The boilers have superheaters of 900 sq. ft. surface and the super-temperature used is 150 deg.

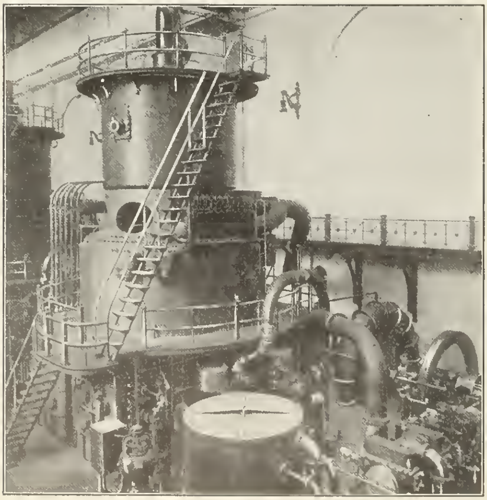


FIG. 10.—8000-KW TURBINE AND AUXILIARIES.

Turbine performance having been brought to a high state of efficiency, boiler-room economies are being strictly looked after. Boilers have been tested under very high rates of combustion with boilers giving from 150 to 200 per cent of their rated output. The best economies seem to be obtained under these conditions, the flue gas temperature being only a little higher than at lower rates of working.

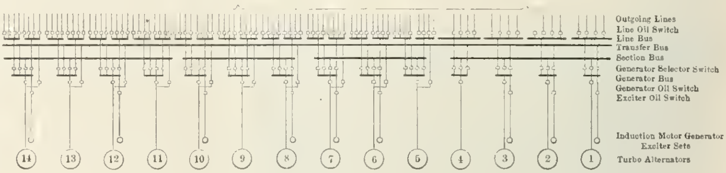


FIG. 11.—GENERAL SCHEME OF HIGH-TENSION CONNECTIONS AT FISK STREET STATION.

The coal used in this station is obtained from central Illinois; it averages from 15 to 20 per cent in ash, and from 13 to 29 per cent in volatile matter. The average b.t.u. per pound of coal is 10,430.

In the regular operation of the Fisk Street station, the aim is to vary the number of turbine units in operation from time to time so as to have each machine run as nearly as possible to its rated load. Boilers not in use, but to be called for at some hour of the day, are kept under pressure with fires banked.

The latest and most efficient units are, of course, operated as much of the time as possible, the first units installed being used only for peak load. The coal actually used by the station during 24 hours averages about 3.33 lb. of Illinois screenings per kw-hour.

The steam-pipe line from each row of boilers connects to one turbine. Cross-connections are provided so that these boiler-unit rows can be connected in pairs, but pairs cannot be connected together. In this way the station is completely sectionalized so that trouble on the pipe lines of one unit cannot spread to others.

There is one stack for each two boiler and turbine units. Three of the stacks are 256 ft. high and 18 ft. 10 in. inside diameter. The other two stacks are 200 ft. high.

As regards the oil pumping for step bearings, each pair of units has a pair of duplicate pumps, an accumulator and a storage tank. When the accumulator falls below a certain point a motor-driven step-bearing oil pump is automatically started. One of these step-bearing pumps is shown in Fig. 9.

The last five turbines installed, of 8000-kw rated output, with ability to work at 12,000 kilowatts during peak load, are Curtis five-stage machines running at 750 r.p.m. One is shown in Fig. 10, together with its auxiliaries. These turbines stand 34 ft. 8 in. above the floor. The governors are of the hydraulic type. The Worthington surface condensers, which are located in the base of each unit, have 25,000 sq. ft. of tube surface and can handle 216,000 lb. of water per hour. Each unit has its own condensing apparatus, feed-water heater, hot wells and feed pumps. A centrifugal hot-well pump, seen in Figs. 9 and 10, takes the condensed steam from the condenser and delivers it to the feed-water heater. This centrifugal pump is a 4-in. vertical-shaft, two-stage machine driven by a 20-hp direct-current motor, seen in Fig. 10. The dry-vacuum pump and the centrifugal pump for circulating the condensing water are driven by a Corliss engine running at 75 r.p.m. The circulating pump is of Worthington make for handling 22,500 gal. per minute. Each unit has two vertical uniplex feed pumps 20-in x 14-in. x 24-in. made by Deane Brothers, with a rating of 581 gal. per minute. The closed feed-water heater has 3000 sq. ft. of surface, with ability to raise the temperature of 160,000 lb. of water per hour by 55 deg.

The floor area per turbine in this turbine room, including all the auxiliaries, is 273 sq. ft. The turbine room has two traveling cranes of 70-ft. span, one being a 50-ton Whiting and the other a 60-ton Niles.

The general scheme of high-tension connections in the Fisk Street station is shown in Fig. 11, as designed for the completed station with 14 units. Only 10 units have so far been installed. The sectionalizing busbars and the possible isolation of different parts of the station electrically to prevent spread of trouble is always a matter of considerable interest and concern in connection with a large plant of this kind. It will be seen from Fig. 11 that the first four units installed, which are of smaller rating than the last six, have a different scheme of connections. The first four units are connected through an oil switch to a short bus called a "generator bus." To this "generator bus" three oil switches are connected, one of which joins it with a section bus; the second with a "transfer bus" which extends through the whole station, and the third to a "line bus" which is really a kind of sectionalized feeder bus to which the oil switches of the outgoing feeders are connected. Each of these line buses supplies energy to four feeders. It is evident that these feeders can receive energy either directly from a generator, or from a section bus, or from some other section through the transfer bus.

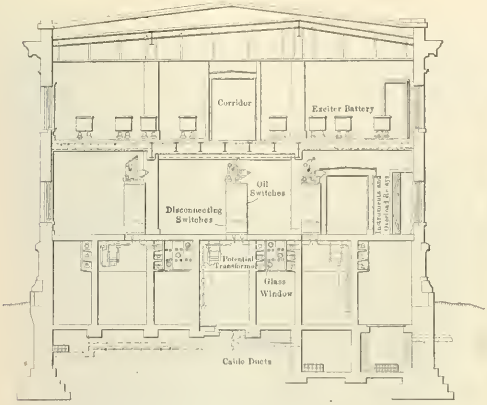


FIG. 12.—SECTIONAL ELEVATION OF OIL-SWITCH HOUSE.

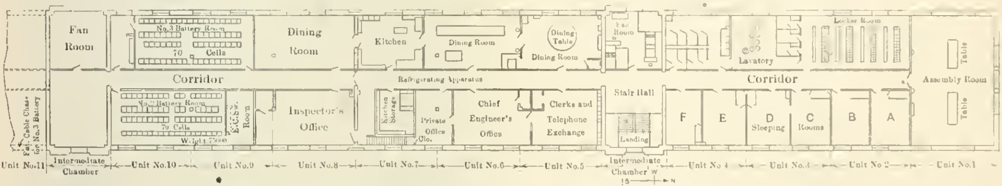


FIG. 13.—WELFARE ROOMS AT THE FISK STREET STATION.

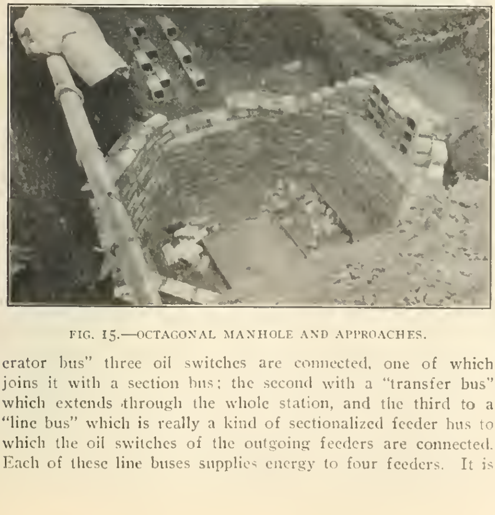


FIG. 15.—OCTAGONAL MANHOLE AND APPROACHES.

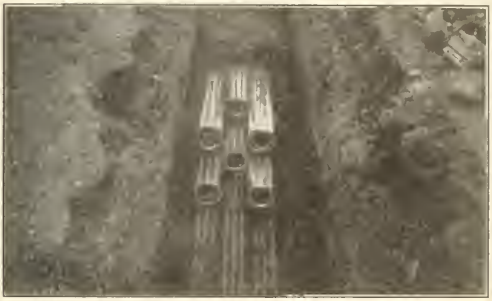


FIG. 14.—TYPICAL CONDUIT CONSTRUCTION.

For generators 5 to 10 there is a different arrangement. Each generator is provided with two oil switches, one of which may connect it directly to the transfer bus. The other switch connects it to its generator bus. To the generator bus four outgoing oil switches are joined. From the generator bus two of these oil switches unite it to two sectional line buses, a third connects it to the section bus, and a fourth to the transfer bus.

The motor-driven oil generator switches are operated from a remote-control board on a gallery of the turbine room. Feeder switching and metering are done in the switch house adjoining the station. A cross-sectional elevation of this switch house is shown in Fig. 12. All the busbars, oil switches and meters, as well as the principal operating switchboard, are placed in this switch house. On the first floor are busbar compartments and instrument transformers. On the second floor are the oil switches and the overload relays, instruments and switchboard. To aid in avoiding mistakes the mosaic floor of the switch room has in white lines a diagram indicating the busbar relations of the circuit leading to each oil switch. It is, therefore, unnecessary for employees to enter the busbar compartment rooms in order to trace the circuits.

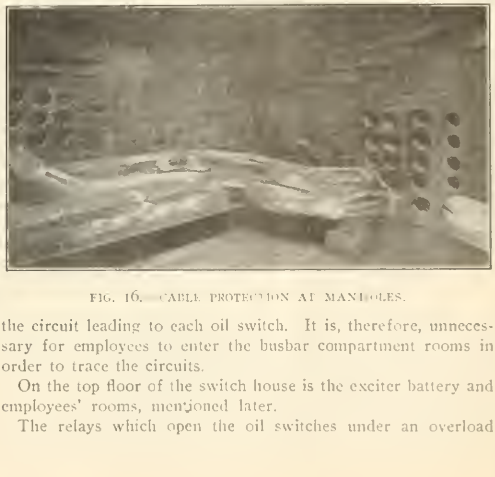


FIG. 16.—CABLE PROTECTION AT MANHOLES.

On the top floor of the switch house is the exciter battery and employees' rooms, mentioned later.

The relays which open the oil switches under an overload are of the bellows type in which the rate of opening is dependent on the expulsion of air from a little bellows due to the magnetic pull of the relay, and hence is more rapid the severer the short-circuit current.

The switchboards are arranged with busbar diagrams on their faces, and handles are so placed as to indicate just what the connections are when the switches are thrown.

About half the output of the Fisk Street station is sold wholesale by watt-hour meter measurement at the generating station busbars to various street and elevated railway companies. The rate made to the railway companies on this class of business is an indication of the economies attained in generation at Fisk Street, as the Commonwealth Edison Company must, of course, estimate on the highest economy and a very small margin of profit to be able to hold this railway business in competition with possible generating plants to be built by the railway companies themselves. This rate consists of a kind of readiness-to-serve charge based on the maximum demand made by a railway company during any one hour of the year, plus ½ cent per kw-hour. This ½ cent per kw-hour, of course, covers only the operating costs. The fixed and investment charges are supposed to be taken care of by the readiness-to-serve charge, which is $15 per year per kilowatt of maximum demand. The maximum demand in kilowatts is taken as equal to the largest number of kw-hours delivered to a railway company during any one-hour period of the year.

As the measuring of this wholesale energy involves such large amounts of money, considerable study has been given to the methods of measuring and the accuracy of instruments. At first it was the practice to have the switchboard attendant read each railway watt-hour meter on the Fisk Street switchboard once each hour. This method was objectionable because of the possible errors involved by not reading the meter exactly at the specified time. If such an error occurred during one of the heaviest-load periods of the year, a great difference would be made in the fixed or readiness-to-serve charge paid by the railway company. An instrument was then applied to the watt-hour meter whereby the position of the dial pointers was punched in a sheet of paper once each hour. Then by putting this sheet of paper over a dummy dial the position of the pointers at the time the punching occurred could be instantly determined. A further refinement has been evolved from this, however, and now the hourly readings of the watt-hour meter are recorded in numerals on a sheet of paper.

Transmission lines of 9000-volt, three-phase cable leave the Fisk Street station by six different routes north and two south; the two south going under the river in a tunnel. The separation of these conduit lines is a matter of great importance when dealing with such enormous outputs. A heavy short-circuit current on any one line of ducts has been demonstrated to be capable of fusing ducts, cable, sheaths and conductors into one conglomerate mass for 100 or more feet of duct without causing enough disturbance to be noticed or to trip the overload relays.

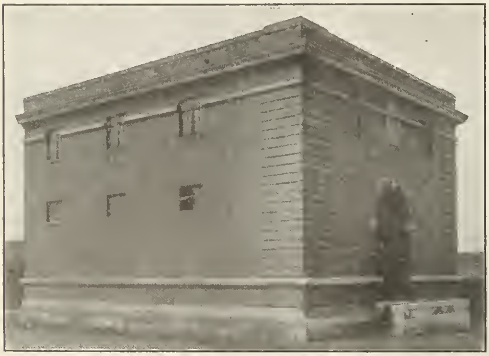


FIG. 17.—EXTERIOR OF SUBSTATION.

The amount of labor required in the operation of a mammoth generating station of this kind is a matter of interest. The number of men actually in attendance on the machinery in operation is surprisingly small. The number of men employed on general work, however, increases the total number to over 300, including all working "shifts." The work is divided in eight-hour shifts. A proper conception of the labor factor can best be obtained by considering the number of men required per unit, a unit representing from 8000 to 12,000 kilowatts in the latest units installed. The list of operating men per unit is shown in the table.

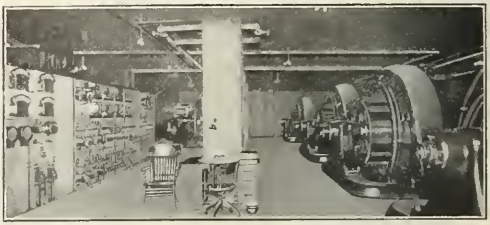


FIG. 18.—SUBSTATION IN BASEMENT OF OFFICE BUILDING.

Moreover, there is a general force for the station consisting of the following men: Chief engineer, first assistant engineer, second assistant engineer, chief electrician, assistant electrician, second assistant electrician, boiler-room foreman, fuel engineer. Besides these there are steamfitters, machinists, machinists' helpers, watchmen and janitors, all under their respective foremen, their number being varied from time to time.

The provisions for the comfort and welfare of employees around the Fisk Street station are even more notable than the engineering features of the station. In providing these comforts the management has realized that to get and keep the highest grade of faithful employees provisions for the comfort and welfare of these employees are important. This is even more necessary at the Fisk Street station than it would be in some other locations, because the station is in a district surrounded by railroad yards, factories, lumber yards and a poor class of dwellings, so that restaurant and other facilities for the men are not to be found in the neighborhood. In providing these comforts the station employees are divided according to occupation. Beginning at the bottom, the coal heavers employed in unloading cars have washing and toilet facilities in the basement of the boiler room which are far superior to those usually provided for this class of labor. The boiler-room men are provided with toilet and bath facilities in the north end of the boiler room. Here both shower and tub baths are installed. The turbine-room and electrical men have quarters on the top floor of the switch house. The plan of this floor is shown in Fig. 13. This floor contains offices for the chief engineer and clerks, the kitchen and several dining rooms, where meals are served somewhat below cost. All working "shifts" are served here. Sleeping rooms are provided for use in case of emergency work. Across one end of this floor is a large assembly room and library. The Fisk Street station, therefore, offers almost the facilities of a club for its occupants, and in emergencies men can live there in comfort for days at a time.

OPERATING MEN PER UNIT.

In turbine room, including janitor work	2
In oil room	1
Attending water	.5
Fireman	1
Fireman's helper	1
Conveyor men	2
Turbine switchboard gallery	.3
Exciter tenders	.2
Switch-house attendants	.17

The new Quarry Street station, as will be seen from Fig. 3, is to be entirely different in its general plan from the Fisk Street station. This is because of the real estate limitations at Quarry Street. In the Quarry Street station the boilers are in two rows parallel with the turbine room, and the firing space is also parallel with the turbine room instead of being at right-angles to the turbine room as at Fisk Street. The turbine space for each unit is, therefore, longer and narrower than at Fisk Street.

The Quarry Street station building will contain three turbine units having a total of half the ultimate rating of the station. These turbine units are to be 14,000-kw machines. The steam-turbine part of these units will be the same in size as on the largest Fisk Street units. The generator part of the unit will be larger, however. The experience at Fisk Street has demonstrated that the rise in temperature in a turbo-alternator under load takes place much more rapidly than in large slow-speed engine-driven units. Consequently, there is not so much difference between the temporary overload that a turbo-alternator can safely carry and the load which it can carry continuously, as there is in the temporary overload and continuous permissible load of large slow-speed units. The reason for this, of course, is that the body of copper and iron is larger in proportion to the heat losses to be dissipated in the slow-speed unit than in the high-speed turbine. The temporary overload rating of the turbo-alternator is, therefore, not far from its rating for steady load.

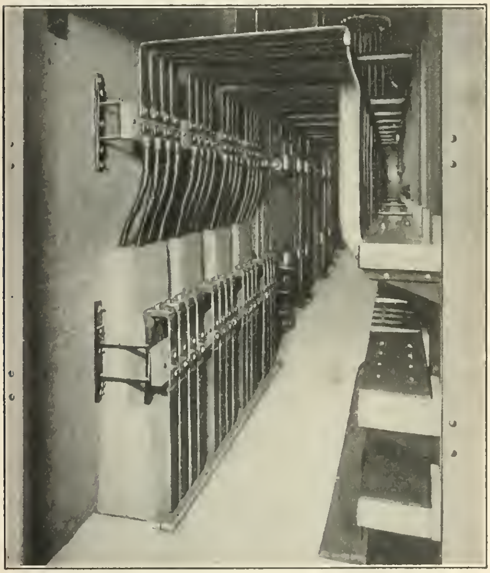


FIG. 19.—HORIZONTAL BUSBARS OF DIRECT-CURRENT FEEDER BOARD.

In the Quarry Street generators a novel provision for ventilation is to be made. Air ducts under the turbine room are to be connected to an outside air intake. From these ducts a large pipe will take air up to the top of the generator. The rotor or field cores of the generator will be provided with a fan, which will draw air from the duct down through the generator windings and discharge it into the turbine room below the generator in the space between the generator and the steam turbine.

There are to be eight boilers, each having 5087 sq. ft. of heating surface, for each 14,000-kw unit, this being the same boiler heating surface that is provided for each unit in the Fisk Street station. It is thus interesting to note that although the kilowatt rating of the turbine units has been raised to almost double those of the first units in the Fisk Street station, the boiler heating surface has not been altered. However, the grate surface and the draft have been increased. The Quarry Street station boilers are to have 110 sq. ft. of grate surface per boiler, as against 90 sq. ft. in the latest boilers at Fisk Street and 76.5 sq. ft. in the first boilers at Fisk Street.

The arrangement of boilers with reference to the furnaces at Quarry Street is radically different from that at Fisk Street At Quarry Street the position of the B. & W. boilers with reference to the chain-grate stokers will be practically reversed from common practice; that is, the water tubes will slant toward the furnace. The furnace gases will pass a considerable distance from the grate before striking directly any water-tube surface. The furnace proper for some distance is, therefore, entirely surrounded with firebrick so as to maintain the high temperature conducive to good and smokeless combustion. After leaving this combustion chamber proper, the gases pass up through the rear ends of the water tubes to the level of the superheaters and lower part of the steam drums. They then make one downward passage to a point over the rear of the furnace and then an upward passage to the stack.

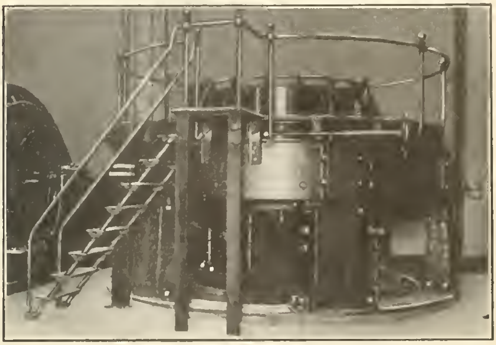


FIG. 20.—VERTICAL-SHAFT ROTARY CONVERTER.

The condensers will be placed in the base of the turbines, although one-third of the condenser will extend outside of the turbine base on account of the amount of condensing surface necessary. Condensed steam will be taken out of the condensers by a centrifugal hot-well pump driven by a Kerr steam turbine. A dry-vacuum pump and a centrifugal pump for circulating water will be driven by a Corliss engine. Each pair of turbines will have three horizontal boiler feed pumps. The oil step-bearing pumps and accumulators are independent for each turbine. Each turbine has two steam-driven oil step-bearing pumps and one hydraulic accumulator.

Three provisions will be made for supplying exciting current to the generators. For each pair of units there will be one 50-kw steam turbine. A storage battery located in the switch house can also furnish exciting current. There will be a substation with a 250-volt rotary converter for supplying direct-current locally in the station and vicinity. The wiring will be such that this also might be used for supplying excitation current. The rotary converter to be used in this substation will be a 500-kw machine and will be the first of the Woodbridge split-pole design to be used in Chicago. With this converter

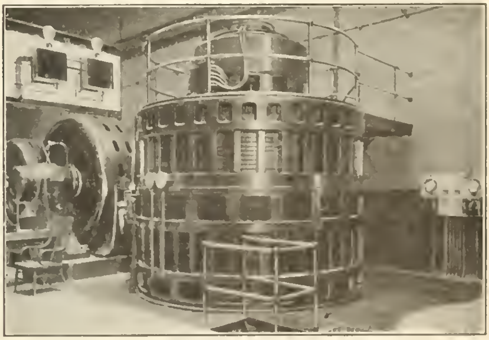


FIG. 21.—VERTICAL-SHAFT MOTOR-GENERATOR.

voltage regulation is accomplished in the machine itself without recourse to induction regulators in the alternating-current supply lines.

CABLES AND DUCTS.

The standard high-tension, 9000-volt, three-phase underground feeder cable used for transmitting energy from generating plants to substations is one having three No. 4-0 conductors each with 6/32-in. paper insulation and 4/32-in. paper insulation over all three. The lead covering is ⅛ in. For the 20,000-volt underground transmission system, of which there is one 11-mile line at present, a three-conductor cable having three No. 2-0 conductors is used, the insulation over each being 9/32 in. paper, with 6/32-in. paper over all.

For the 60-cycle feeders, which operate at 4000 volts, three-phase, four-wire, a four-conductor No. 0 cable is used. Single-conductor No. 0 cables are also used on the 60-cycle distributing system. The insulation of these cables is 5/32-in. paper over each conductor and 3/32-in. over all conductors. For the single-conductor cable the paper is 10/32-in. thick.

The standard construction for high-tension cable ducts is shown in Fig. 14, illustrating a conduit line under construction. Single-duct tile is used with a 3½-in. hole and with ⅞-in. wall. The joints are staggered, both for mechanical strength and to prevent the spreading from one duct to another of trouble due to the escape of hot gases created by an arc through joints from one duct to another. When the ducts approach a manhole they are gradually spread out so as not to enter the manhole in a bunch. This arrangement is illustrated in Fig. 15. The manholes are made octagonal in shape. The object in keeping ducts as far apart as possible where they enter the manhole is to facilitate the work of running cables neatly through the manhole. At manholes the cables are not left exposed as in the old practice, but they are carefully and completely covered with split-tile duct, as indicated in Fig. 16, so as to isolate each cable as much as possible. The idea of this is, of course, to prevent the spread of short-circuiting trouble in manholes.

The art of cable-joint making has become so perfect in this company that joint failures are almost unknown. Minerallac compound and tape are used in these joints, these products having originated with engineers of this company.

SUBSTATIONS.

The substation buildings are of the highest class of construction. Fig. 17 shows the exterior of the West Twenty-second Street substation, which is in a locality near the Fisk Street station, where real estate is relatively cheap. In districts where land is more valuable the company employs as a substation the basement and first floor of a building, the upper floors of which can be used for office or other purposes. In the most congested down-town districts the practice has been to obtain a long lease of basement space in high-class fireproof office buildings. The interior of such an office building substation located in the basement of the Railway Exchange Building is shown in Fig. 18.

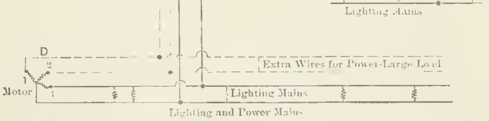


FIG. 22.—ALTERNATING-CURRENT DISTRIBUTING CIRCUITS FOR LAMPS AND MOTORS.

In a typical substation the 9000-volt transmission lines from the generating plants enter through either motor-operated or solenoid-operated oil switches which connect them to the substation busbars. From the busbars the various rotary converter or motor-generator units are operated. In case of a direct-current substation, a rotary-converter unit and its equipment, there is a motor-operated or solenoid-operated oil switch with overload relays which controls the supply of high-tension alternating-current energy to the unit. From this oil switch the 9000-volt energy is taken to a three-phase step-down transformer, which reduces the e.m.f to 186 volts. Three-phase transformers rather than three single-phase transformers have been regularly used with this company since 1902, when the first transformer of this kind was ordered. Each unit occupies less floor area than three separate transformers. The transformer secondaries are connected six-phase and pass directly to the collector rings of the rotary converter through a motor-operated induction regulator. This regulator can be moved to raise or lower the direct-current voltage by a motor-controlled circuit terminating at the switchboard. The direct-current leads from the rotary converter, according to the latest practice with large machines, are not joined to the generator switchboard, but are connected and disconnected by a solenoid-operated switch, and only the control circuits are taken to the board. The neutral point of the converter is connected to the neutral of the direct-current three-wire system so that balancer sets are not ordinarily required. In each substation where there is a storage battery, the latest practice is to provide the transformers for one rotary converter with extra high-voltage taps so that an e.m.f. high enough to charge storage batteries can be obtained from that converter, so that a booster set for battery charging is not needed. The generator leads pass directly by the shortest possible route to busbars, from which feeder switches connect to the various feeders. In substations feeding energy over long distances three separate feeder busbars are installed to make it possible to deliver three different voltages. In certain of the substations feeding energy over short distances only two sets of busbars, however, are provided.

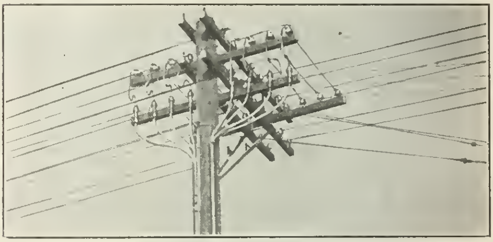


FIG. 23.—CABLE POTHEADS.

Fig. 19 illustrates typical busbar practice of this company, the special feature of which is that busbars are placed horizontal, which makes work about the switchboard easier. It will be noticed that the feeder fuses are located on the wall back of the switchboard, beyond which feeders immediately pass into tile ducts. These feeders are confined in ducts, not being again exposed until they reach the consumer's premises. Rotary converters are started from the direct-current end, sufficient storage-battery reserve being maintained to keep the direct-current network alive in emergencies.

The latest rotary converters purchased are of the vertical-shaft type. One of these 2000-kw machines in the Market Street substation is illustrated in Fig. 20. This machine was described in the Electrical World of Dec. 28, 1907. The weight of the armature is carried by a roller bearing. An oil step-bearing can be substituted quickly for this should the roller bearing fail. The advantage of the vertical-shaft converter is a reduction in headroom and floor area, more accessible commutator and brushes, and less journal friction. There is also a saving of about 17 per cent in the weight of the vertical-shaft machines, as compared with the horizontal shaft machines this company has in service.

The alternating-current territory is supplied with energy from motor-generator substations which receive 25-cycle, 9000-volt, three-phase current and deliver 60-cycle, three-phase current for distribution over a three-phase, four-wire system, the neutral of which is grounded. The e.m.f. between neutral and any one of the outer legs at full load is about 2200 volts, while that between the outer legs is 3800. Single-phase lighting feeders are connected between the neutral and the outer leg of the circuit.

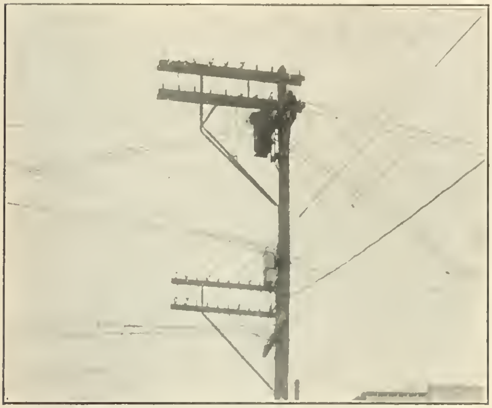


FIG. 24.—TYPICAL JOINT-POLE CONSTRUCTION.

Three-phase motor circuits are operated Y-connected between the neutral and the three outer legs, thus obtaining the benefit of 3800-volt, three-phase transmission. This system combines the advantage of a standard 2200-volt, single-phase independently regulated lighting distribution with 3800-volt transmission for heavy loads.

In the motor-generator substations from which 60-cycle alternating energy is supplied, the high tension switches and bus bars are similar to those used in the direct-current substations described above. Of course, no step-down transformers are necessary, as the synchronous are joined directly to the 25-cycle 9000 volt substation busbars. To maintain the 60-cycle generators at constant voltage, Tirrill regulators are employed in the field circuits of the exciters. The 60-cycle bus e.m.f. is kept at a fixed point by these regulators, and the necessary raising and lowering of the e.m.f. on the feeders is accomplished by motor-operated induction regulators. One of these is connected in each lead of every outgoing feeder, so that the phases can be regulated separately.

Vertical-shaft motor-generators were employed in these substations before vertical-shaft rotary converters were perfected. The 2000-kw motor-generator with vertical shaft in the West Madison Street substation is illustrated in Fig. 21. This machine has a step bearing, the weight of the revolving shaft being carried by a film of oil under pressure as in a Curtis turbine. The motor-generators are started through auto-transformers with alternating current. One advantage of the vertical-shaft machine with oil step-bearing is a reduction of the initial starting current because the standing friction of the step bearing is less than that of common horizontal bearings. For more detailed descriptions of substation practice and construction of this company the reader is referred to articles in the ELECTRICAL WORLD of Dec. 1, 1906, July 27, 1907, and Dec. 28, 1907.

DIRECT-CURRENT DISTRIBUTING SYSTEM.

The three-wire direct-current distributing system from substations is arranged on the feeder-and-main plan as regards the positive and negative wires. The neutral feeders are connected according to a kind of "tree" method. From the substations positive and negative feeders extend to various points where they tap into the mains. The mains, which extend along the streets, are tapped for consumers' service connections as often as necessary. The mains form a complete interconnected network in normal operation, but each block of mains can be separated from the network by the blowing of fuses in junction boxes, through which each section of the main is connected to the network. Many of the mains are constructed of the old Edison tubing. The newer circuits are of lead-covered cable in vitrified clay conduits. In the conduit construction, Tailleur junction boxes are used for the fuses which interconnect the mains. Short strip copper fuses are employed, the copper being much narrower at the middle of the fuse than at the terminals. These fuses are made so large that they will not blow at less than a heavy short circuit current. In a 1,000,000 cir. mil cable a 2000-ampere fuse is used. In addition to the service mains there are also some tie mains, so that feeders supplying energy to mains in one vicinity can assist the feeders supplying neighboring mains in case of an extra heavy load at one point. The feeder-and-main plan is not used on the neutral because it does not utilize the neutral copper to best advantage. For example, if an unbalanced load requires a flow of electricity through the neutral from one part of the distribution system to another over the neutral feeders, such current as would exist in the neutral feeders would flow to the substation. With the neutral feeders connected on the "tree" plan, with plenty of taps between the substation and the end of the feeder, there is more opportunity for the unbalance current to be utilized to correct unbalance on the other side of the system before reaching the substation.

Neutral feeders and mains, when installed in conduit ducts are of bare copper cable. Positive and negative feeders in the latest standard practice of the company consist of 1,000,000 circ. mil concentric cables. The concentric feeder cable has stranded inner and outer conductors. Woven in with the stranded outer conductors is a No. 14 insulated wire, the diameter of which over insulation is the same as the diameter of the bare wires forming the outer conductor of the cable. These are used as pressure wires, to which the substation voltmeters are connected for indicating the e.m.f. at feeder ends.

In most of the substations three sets of busbars are used to provide for three voltages: a high e.m.f. for the very long feeders, a low e.m.f. for the very short feeders, and a medium e.m.f. for the medium-length feeders. In some substations only two buses are used. As substations are being established at short distances apart in the down town district, the tendency is to reduce the e.m.f. drop in feeders so as to require a smaller number of busbar voltages. The lamp e.m.f. is 115 volts. During the peak load on some of the short feeders, the e.m.f. is from 118 to 122 volts at the substation. On the longest feeders connected to the highest voltage busbars, the e.m.f. sometimes reaches 135 volts during peak.

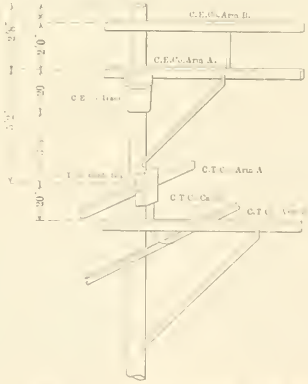


FIG. 25.—STANDARD JOINT POLE ARRANGEMENT.

Some portions of the down-town district of Chicago probably show the highest central-station load density to be found anywhere in the world. A half mile on State Street, which is the principal retail shopping street, has a load of 5000 kilowatts. Some portions of this distance show much greater density than this. In this half mile are many department stores. Not all of them, however, are purchasing energy from the company.

Some of the large customers have feeders from two or three neighboring substations, as well as connection directly with the street service mains. As an interesting example of the security to service made possible by this arrangement, cases are on record where a severe short-circuit current occurred in the street mains near a customer's building. This current resulted in blowing the junction-box fuses at each end of this street main and also, by virtue of the energy fed back from the busbars of the large consumer's switchboard, the fuses connecting the consumer's busbar with the street mains were blown. The service was uninterrupted, however, as the fuses did not blow in the two feeders which connected the customer directly with two neighboring substations. The customer was unaware that anything unusual had happened.

A number of storage batteries are located at various points in the direct-current distribution system. These batteries, however, are kept almost entirely as emergency reserve, and are not ordinarily discharged even during peak load. They are discharged about once a month for test to keep them in good working commission.

The 1,000,000 cir. mil concentric feeder cables are worked at about 1100 amperes for an hour during peak loads if necessity requires. This is not likely to be continued long, however, because when the maximum load reaches that point additional feeders are put in service. The concentric feeder cables have paper insulation 5/32 in. between conductors and the same outside.

In a typical example of service main construction in some recent work, manholes are placed at street intersections and at the alley intersections. At street intersections service wires can be run off diagonally to any one of the four corners and at the alley, and branches are run each way, so that the chances are good for reaching most of the customers without requiring any extra hand-holes. Should there be a customer between the alley and the corner inaccessible from these manholes, the street is opened, a service main exposed, a hand-hole made and a branch line tapped into the main at the point where needed.

ALTERNATING-CURRENT DISTRIBUTING SYSTEM.

In the alternating-current distribution from substations to consumers the Commonwealth Edison Company meets all kinds of conditions, from those of a large city to those of the smallest town, there being outlying suburban districts where conditions are almost identical with those in a small town. The general practice is to use one lighting transformer for each 660-ft. block. In most of the territory an interconnected secondary network fed by a number of transformers is impracticable because of local conditions. To interconnect the secondaries from one block to another would require about 25 per cent increase in copper, and it is not considered that the advantages in the majority of cases would justify this expense. There are, however, a few places where secondaries are interconnected and fed by several transformers. In such cases there are placed in the secondaries midway between transforms fuses which will blow and isolate any transformer in case of trouble. These fuses are common open-link fuses mounted on a slate block placed in a wooden box. The fuses are rated at about one-half the output of the neighboring transformers.

The great majority of the pole lines are run in alleys, and, in some cases where there are no alleys, along rear property lines by permission of the owners. The usual lot width in Chicago is 25 ft. Poles are generally placed 125 ft. apart. Secondaries are arranged three-wire, the lamp e.m.f. being from 113 to 115 volts. Estimates for wire are on a basis of 2 per cent maximum drop in voltage between the transformer and the farthest customer. The transformer ratio is such that 115 and 230 volts are delivered on the secondary with 2080 volts primary. The neutral wire of all secondary lighting circuits is grounded, and one point of each three-phase motor circuit is grounded, as will be explained later.

The grounding of transformers and lightning arresters is accomplished by driving a ⅝-in. galvanized-iron pipe 10 ft. into the ground. A G. & W. pipe-cap is placed over the end of the pipe before it is driven, this cap performing the double function of protecting the end of the pipe during driving and making the electrical connection between the end of the pipe and the ground wire. The ground wires are of No. 6 or No. 4 copper, and they are protected in molding partly for mechanical reasons and partly to avoid shocks to persons who may come in contact with them, should the ground connection be accidentally broken.

Where the arc-lamp load on the secondary becomes larger than the incandescent load, a separate arc-lamp transformer and secondary service main are installed, unless there are less than five arc lamps. This method is used because of the voltage drop in secondaries and transformers caused by arc-lamp load.

Motors are also placed on separate transformers from lighting load, except where the motor load is a very small fraction of the lamp load on a transformer. Motors rated at 5 horse-power or less are required to be single-phase, as the company will not go to the expense of installing three-phase service with two transformers for such small motors. The company will supply energy to any single-phase motor in which the starting current is not over three times the full-load running current. The same restriction is made on three-phase motors.

In residence districts transformer rating equal to 15 to 20 per cent of the connected load is installed. The higher ratio applies to secondaries supplying energy to a large number of small consumers. The transformer rating used in determining these transformer ratios is based on an eight-hour full load, according to customary transformer rating. It is considered that transformers can operate with entire safety at from 25 to 33 per cent overload for one or two hours per night. In manufacturing and mercantile districts the transformers installed are rated at 75 per cent of the connected load. The transformer rating on motor installations of over 25 horse-power is usually 50 per cent of the connected load. On installations of from 100 to 300 horse-power it is 70 to 80 per cent of the connected load.

Transformers having a total rating of 38,000 kilowatts are connected to the 60-cycle distributing system. There are 5600 transformers. The connected alternating-current load totals 71,000 kilowatts, of which 50,000 kilowatts is for incandescent lamps, 2500 kilowatts for arc lamps, and 18,500 kilowatts for motors. The average transformer rating is, therefore, 53.5 per cent of the connected load for all classes of business.

The same kind of transformers are used for lamps and motors, the only difference being in the method of connecting the secondaries. The smallest transformer used is rated at one kilowatt. No transformers larger than 50 kilowatts are used. If more output is needed than this, additional transformers are installed. The reason for this limit is partly the unwieldiness of large transformers, but mainly the fact that there are so few places where transformers of over 50 kilowatts are needed that it is not thought wise to keep the larger sizes in stock. The oil is replenished in transformer cases yearly.

Transformers for three-phase motors are joined with their primaries in Y-connection between the neutral and outside wires of the circuit. This connection impresses the regular 2080-volt primary e.m.f. upon them and gives a secondary e.m.f. of 230 volts. The 230-volt secondaries are connected in "delta" for the motors. The middle point of one of these delta-connected secondaries is grounded. For miscellaneous small three-phase motors only two transformers are installed. If a motor rated at from 15 to 20 horse-power is put in, three transformers are ordinarily used; this rule is not rigid, local conditions modifying it. Fig. 22 illustrates the method by which new territory having both motor and lamp loads is built up. From a substation located, for example, at *A*, four wires are run to a distributing center at *B*. From this center single-phase lighting feeders branch off in three directions. These feeders use the common neutral from the substation at *A* to *B*. Aside from this, each of these feeders is independent of the others, voltage regulation being inserted in each feeder at the substation to maintain the proper voltage at feeder ends. If there is a demand for motor service along any one of these single-phase feeders, as, for example, at *C*, an additional wire is connected to the other phases at the distributing center *B*, as indicated by the dotted line. These wires are of smaller diameter than the single-phase lighting feeder. If larger loads develop two more phase wires are put in for motors, as at *D*. The neutral and single-phase lighting feeders already up are used for one phase of the motor circuit and the two additional smaller wires furnish the other two phase leads. This arrangement utilizes one of the great advantages of the three-phase four-wire system for this miscellaneous class of work. Each single-phase lighting feeder can be regulated independently as to voltage for lighting purposes, and at the same time used to supply energy to one leg of the three-phase motor circuit.

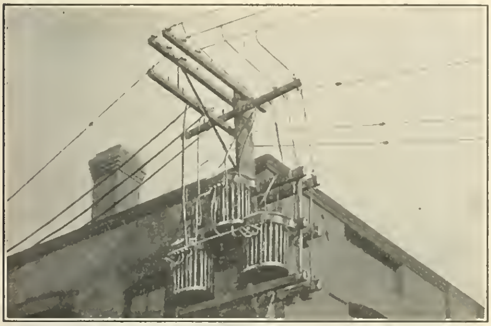


FIG. 26.—TRANSFORMERS IN INDUSTRIAL SERVICE MOUNTED ON POLE.

All of the 2080-volt distribution system is laid out on the feeder-and-main principle, as indicated in Fig. 22. From the substation, feeders lead out to distributing centers where they join the mains from which transformers are supplied with energy. The mains may extend in any direction from the feeder end. Some of them, of course, extend back parallel with the feeder. An attempt is made to limit the maximum voltage drop to 2 per cent at full load between the end of a feeder and the most distant transformer on a set of mains. The drop at full load between the substation and the end of a feeder averages about 5 per cent. The conditions never require mains larger than No. 6 wire, so this size is made the standard. The standard size of feeders is No. 0, and the maximum load on a feeder is 100 amperes or 200 kilowatts. When the load on a feeder would exceed this value, additional wires are installed.

About one-half of the main feeders are laid underground. Most of the mains are erected overhead in alleys. In fact, about 90 per cent of the overhead work is located in alleys. The feeders average about 1½ miles in length, the short length being due to the frequent location of substations, local conditions, rather than reasons of electrical distribution having required the placing of substations at such intervals.

In a few cases where alleys have not been available, and underground work was necessary, transformers have been used in manholes. This construction is avoided as much as possible, however.

All primary mains are connected according to the "tree" method, and there are no closed loops, because in most cases there is little advantage to be gained by such loops; moreover, they are likely to cause accidents to linemen who think that a line is dead when it has been opened at one place, but is being fed with energy from the other end. No fuses are placed at branches except in a few places where there is a current of only 10 to 15 ampéres. Large fuses on poles have been found unreliable. Disconnecting boxes, however, are provided at branches so that a branch circuit can be disconnected for repairs.

When passing from overhead to underground circuits, the lead-covered underground cables are brought up the pole in iron pipe and terminate in G. & W. porcelain potheads, as in Fig. 23; these pot heads also serving as disconnecting switches. The shell of the pothead, which is of porcelain, is placed over the end of the cable and poured full of "Minerallac" compound. The overhead line terminates in a brass plug with a porcelain cap which slips over the pothead.

A typical piece of overhead distribution construction is shown in Fig. 24. Poles are located on one side of an alley, side arms with braces being used. When the poles are set they are given about 1 ft. "rake" toward the property line, so that the weight of the wires will tend to straighten them. Nearly all of the lines are held on poles owned jointly by the Commonwealth Edison Company and the Chicago Telephone Company, there being some 25,000 such joint poles in use. The standard joint pole is of Michigan cedar, 35 ft. long with a 7-in. top. Larger tops are used on corner poles. There are two cross-arms for each company and one service buckarm. The dimensions of the cross-arm spacings are shown in Fig. 25. The standard distribution line cross-arm has six electric lighting wire pins on the alley side and one on the property side. On poles carrying through lines there are nine pins, eight of which are on the alley side. The secondary wires are placed next to the pole, the primary wires on the outer end. The distance between pin centers is 15½ in. on six-pin arms and 14 in. on eight-pin arms. The electric lighting wires are placed on the top of the pole so that the smaller and more breakable telephone lines cannot fall among the high-tension wires and also so that the telephone linemen will be safer when working on the poles. The insulators for the primary wires are of common double-petticoated glass.

Lightning arresters are placed about 1500 ft. apart. Three kinds are in use—old and new style General Electric and Garton-Daniels. All are placed in wooden boxes.

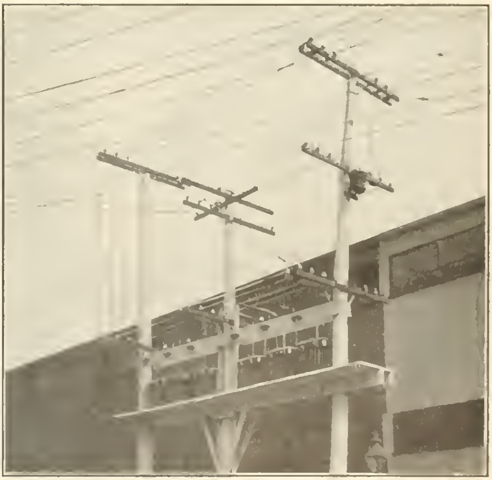


FIG. 27.—TRANSFORMERS MOUNTED ON PLATFORM.

Figs. 26 and 27 show typical transformer installations at large motor customers' in manufacturing districts.

ROUTINE AND EMERGENCY OPERATION.

The routine and emergency operation of a large electrical distributing system with enormous rotory-converter and motor-generator substations connected to generating stations of enormous output, presents operating problems entirely unknown in smaller systems. When the 9000-volt, 25-cycle transmission system began to assume large proportions, the necessity of having all switching operations pertaining to that system under supervision from a central office became apparent. The generating plants supply energy to the substations through 9000-volt transmission lines running directly from the generating plant to the substation. To supplement these lines there are also some tie lines connecting the substations for emergency use. The necessity for central supervision is further emphasized by the fact that in normal operation two separate electrical systems are maintained, part of the generators used feeding energy into "A" system and part into "B" system. These systems are, of course, not operated in parallel, but their separate frequencies are maintained so nearly the same that they can easily be joined in parallel at any time on short notice. However, with busbars in the same substation receiving energy from separate sources the chances for throwing these two systems together when not desired would be great if the substation operators were allowed to perform the high-tension switching without central supervision. All companies having such large systems maintain a central supervision of this kind, called by various names. The term "load dispatcher" was selected by this company as indicating the responsibility of the man who has charge of the electrical operation of the system, this responsibility corresponding to that of the train dispatcher on a railroad, without whose authority no trains can move.

In a quiet room, Fig. 28, at the company's headquarters, 139 Adams Street, there will always be found on duty one, two or three load dispatchers, the number being varied according to the time of day. From this room direct telephone communication can be had with all of the generating and substations. Occupying the sidewall is a large diagram of the 25-cycle, 9000-volt transmission system. This diagram shows all the transmission lines, high-tension oil switches and station busbars connected with the system, and is placed there for the use of the dispatchers in keeping a record of switching operations. On this diagram switches are indicated by holes for pegs. When a switch is closed, a peg is inserted in the hole. Copper-colored plugs are used on the "A" system and green plugs on the "B" system. In most cases the absence of a peg from a hole indicates that the switch is open, but in order to remind the load dispatcher of danger points red pegs are used where the closing of a switch would connect the A and B systems together. The red pegs serve as warnings to the dispatcher not to order any of those switches closed. White pegs are also used as warnings in connection with certain busbars in the Fisk Street station which operate motor-driven exciter units, in order that the supply of current may not accidentally be cut off from these exciter motors without previous provision for exciting current.

In general, the load dispatcher gives orders for the opening and closing of all switches in the 9000-volt, 25-cycle system, but there are some important exceptions to this rule. For example, in case a substation which is supplied with energy over two transmisison lines has the circuits suddenly opened. The substation operator will immediately synchronize and connect the converters to the other line if he is able to obtain energy over it. To provide for such emergencies, all lines to a substation are normally kept "alive" up to the switch connecting the transmission line to the substation busbars.

In case of a short-circuit on the system causing the rotary converters supplying energy to the down-town direct-current network to be thrown out of step and consequently disconnected from the 25-cycle system through the opening of overload switches, the emergency storage batteries immediately discharge into the system, as they are kept floating on the line. Battery attendants have orders immediately to connect in enough end cells to hold the e.m.f. on the system as near normal as possible. The batteries may be discharged up to as high as three times the regular one-hour rate. The rotary converters are run up to synchronizing speed from the direct-current end and again connected to the system. In the alternating-current substations, of course, no such reserve exists.

The substation operator is instructed to get the machinery into operation from any remaining good line as quickly as possible without calling the load dispatcher and notify the dispatcher afterward. An operator noting some disturbance not serious enough to throw the machines out of step must not call the dispatcher until five minutes have elapsed, because if all substation operators were to call the dispatcher at each time of slight disturbance confusion would result. The Fisk Street station in the ordinary routine of connecting and disconnecting units to conform to the load, is allowed to connect units to the busbars and notify the dispatcher subsequently. In case of a disturbance on either the "A" or "B" systems, one of the first procedures of the operator at the Fisk Street station is to parallel the two systems, so that the undisturbed system may help out the one in trouble.

The large diagram on the wall in the dispatchers' office indicates merely the 25-cycle busbars, switches and lines. There are between 500 and 600 oil switches on this system. The elementary busbar diagrams of the various substations are kept in the form of drawings under a glass plate on the dispatcher's desk, where it is in plain sight as he answers the telephone. The telephone switchboard which gives the dispatcher communication with the entire system is divided so that two dispatchers can work at once. The e.m.f. af two substations is indicated by voltmeters in front of the dispatchers, one of these substations being on the "A" system and the other on the "B" system. Two voltmeters also show the feeder e.m.f. at two points in the down-town direct-current network. The dispatchers also have in convenient reach complete necessary data on routes of feeders, feeder tunnels, etc.

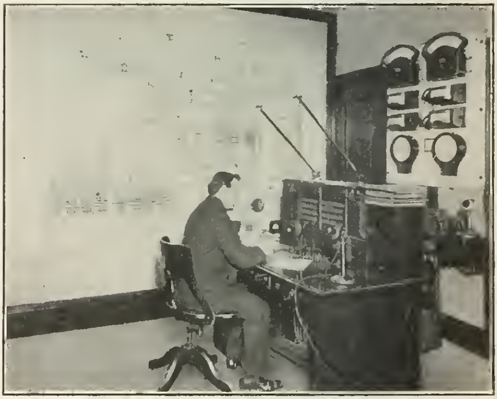


FIG. 28.—LOAD DISPATCHER'S ROOM.

Although the street and elevated railway substations are not owned by the Commonwealth Edison Company, their operators are subject to orders of the load dispatcher as far as high-tension switching is concerned. There are in all 41 substations under the dispatcher's orders. To prevent misunderstandings, all orders are repeated back to the dispatcher after being received. An order from the dispatcher is required before any alteration or construction work is done around stations.

During the peak load, three dispatchers are on duty. At all other hours two are on duty, except after midnight until morning, when one of these two is allowed to sleep in the building where he is within immediate call of the one on duty. The dispatchers work in three shifts, a total of five dispatchers being required. Each dispatcher is off regular duty two days out of every eight. One of these days is for rest and recreation: the other day is for visiting stations and substations, getting acquainted with conditions in each substation and becoming familiar with the men and methods of operation. Load dispatchers are promoted from the ranks of chief substation operators, and so have had a very complete operating experience.

TRAINING OF OPERATORS.

Substation operators are very carefully picked and trained, the training and discipline of these men having reached a

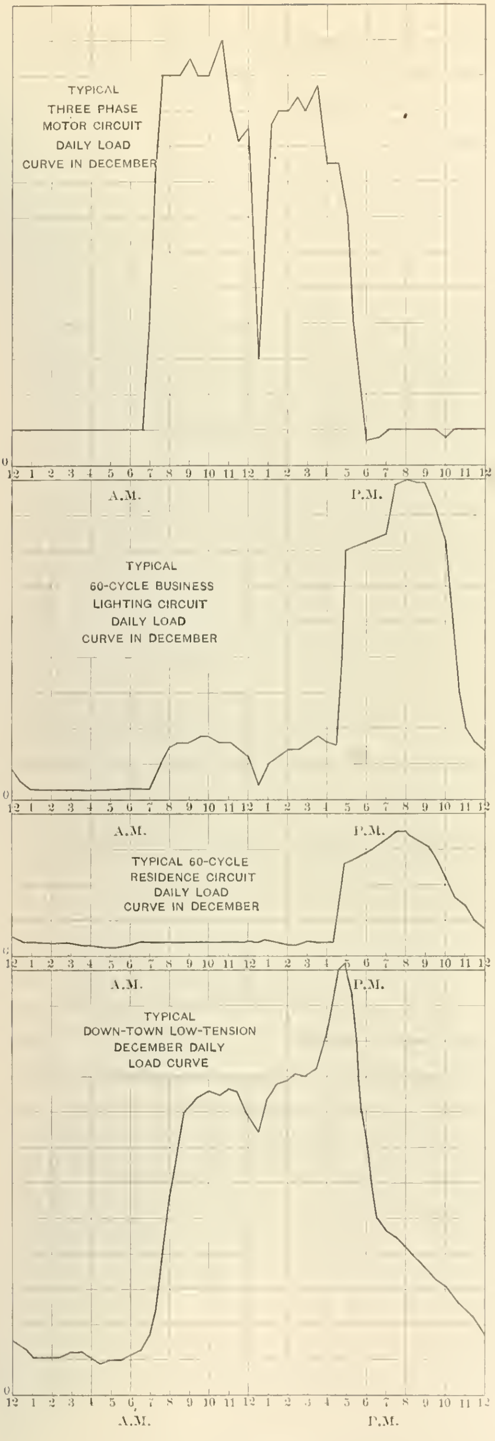


Fig. 29.—Typical Load on the System.

high state of perfection. Of the applicants for the position of operator, only about 5 per cent have qualifications which cause them to be considered. An applicant, to be considered, must have at least a high-school education, and in addition must have completed either correspondence school work or taken evening courses in electricity. To be in line for promotion, the applicant must have at least completed and graduated from a correspondence school course or something better. Voltmeter readers and battery boys not eligible to promotion are sometimes taken without the educational requirements mentioned, but these are not eligible for promotion until they have qualified by graduation from a correspondence school course or by night school work. From 10 to 15 per cent of the men have attended college, most of them in electrical courses of technical schools. Over 50 per cent of the men are correspondence school graduates. Many have also taken evening courses at Lewis or Armour Institutes in Chicago, both of which institutions have been doing excellent work in this line during the past few years.

Very few experienced substation operators apply for positions. The company has to train most of its operators from the beginning. A few who have operated in interurban railway substations apply, but the knowledge required is so much less in the latter substations than it is in Commonwealth Edison substations that interurban railway experience is considered only a beginning. Nothing short of graduation from a correspondence school course is considered in connection with correspondence school work, because of the observed fact that only about 10 per cent of those starting correspondence school work persevere to complete it. Applicants are discouraged rather than encouraged when making application, in order that the men who lack determination and persistence and who are looking for easy jobs may be weeded out. Applicants, when first put to work, are rated as apprentices during a preliminary period of training, extending over from one to six months. During this time they work 10 hours a day and receive 17½ cents an hour. They are then assigned to their first responsible operating shift in the grade of third operator, at the rate of 22¼ cents an hour for nine hours a day. From the grade of third operator they are promoted to second operator and then to chief operator in charge of a substation. All men in responsible charge (that is, from third operator up) are over 21 years of age. To pass from one grade to another, an examination is required before a board which consists of the general inspector, the general operator, the district operator and the chief operator of the station in which the man works.

In the 33 substations belonging to the company, about 150 men are employed, of which 80 are certified operators who are in responsible charge and have passed out of the grade of apprentice by examination given by the board and have the certificate of the superintendent of substations. The requirements for acceptance of a man as apprentice to begin with are in general as follows: He must be acquainted with the fundamental principles of electricity and magnetism. He must be free from physical defects, especially those of sight or hearing, and must be able to hear well and make himself understood well over the telephone. His character is carefully looked into, references being followed up. References to a banker or a minister are preferred. The ability to stay awake is another qualification looked into as far as possible by testimony of previous employers, because men are frequently alone on duty in substations during part of the night. Preference is given to men having had practical mechanical or electrical experience. The training of an apprentice before promotion averages about five months.

The examination for promotion from apprentice to third operator includes familiarity with operating rules and general orders of the company. He must be able to draw without hesitation a complete wiring diagram of a substation, including both the main and the control circuits. He is examined as to maintenance of equipment and as to his appreciation of the value of seconds in getting service restored after an interruption. He is also examined as to his appreciation of precautions and care necessary to preserve life and property which may be jeopardized by his actions. He is also put through regular operating work by the chief operator. To pass to the grade of second operator, he is again examined to be sure that he has not allowed himself to become "rusty," and his operating record is also considered. To test operators' performance under the fire of actual emergencies, sham interruptions of transmission lines are frequently sprung on the substation operators at times when someone is around with a stop watch to see how much time is consumed by him. Of course, nothing which in any way interferes with the service can be tolerated in this respect, but it is frequently possible to interrupt a transmission line to a substation when the load on the substation is light, without interfering with the service supplied by the substation. It is, of course, impossible to reproduce the worst emergency conditions in order to test the operators, and the best that can be done is to explain continually, and educate, as to the procedure in extreme emergencies and then to rely on the discipline of the men to carry out the instruction when the emergency arises.

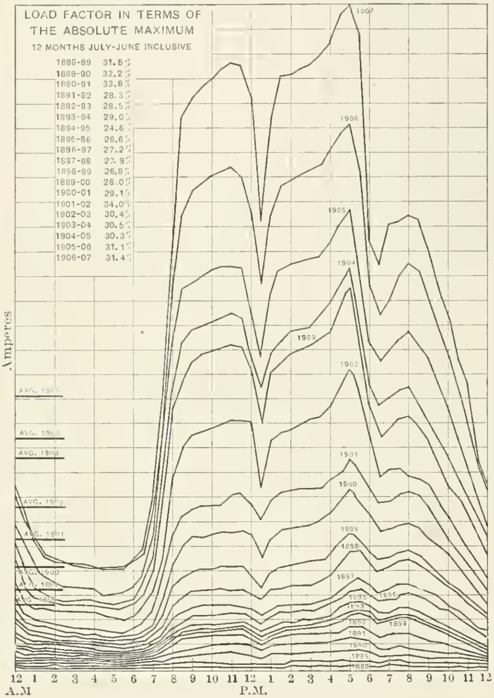


FIG. 30.—COMPOSITE AMPERE CURVE.

METER DEPARTMENT.

The company maintains under separate management three departments for testing. The meter department sets, removes and tests consumers' meters. For the regular testing and calibrating of the hundreds of switchboard instruments and watt-hour meters a separate department is maintained in connection with the company's laboratories. The laboratories constitute a department of engineering testing for the purpose of carrying on electrical and photometric tests of various kinds on matters upon which the company needs information. Space does not permit describing the work of all these testing departments, but that of consumers' meter testing will be taken up briefly, as being of much practical interest to both large and small central-station companies.

The company has in use commutator-type watt-hour meters on the down-town direct-current system and single and polyphase 60-cycle induction meters in the outlying districts. After considerable investigation, this company several years ago adopted a schedule for the testing of meters whereby the frequency of test of the consumers' meter is somewhat in proportion to the size of the meter and the amount of money involved in the monthly bill. The classification adopted for commutator meters was as follows:

Annual tests for meters of from 5 to 10 amp rating.
Semi-annual tests for meters of from 15 to 50 amp rating.
Quarterly tests for meters of 75 amp rating and above.

Meters making over 1,000,000 revolutions of the disk between tests under the foregoing classification are changed to a more frequent class so as not to exceed 1,000,000 revolutions between tests. It is not, however, considered necessary to test any meter oftener than once in three months. Where a meter has not retained its calibration for this length of time, an investigation has been made, and the rapid loss of accuracy is usually found to be the result of commutator trouble caused by excessive vibration or heavy momentary overloads. All commutator meters are being equipped with cupped diamond bearings to replace the sapphire bearings formerly used.

Induction meters on alternating circuits, it is found, can safely be allowed to run much longer without test. Single-phase meters rated at 50 amp or less are allowed to run from one to two years between tests. Those rated at over 50 amp and polyphase meters are tested every six months. Meters are inspected and cleaned and adjusted to run freely on a light load after installation on a consumer's premises, but are not tested. This plan is the result of investigations which show that the initial inspection results in greatly improving the average accuracy of meters. Meters are tested in place on the consumer's premises. For giving a testing load, a lamp bank is used for loads not exceeding 50 amp. For larger loads the consumer's lamps are used in addition to the portable lamp bank. In testing meters on motors the consumer's motor load is used in order to test the accuracy of the meter under actual working conditions of power factor. The present practice is in the direction of testing meters with a portable master watt-hour meter. About one-third of the force now checking meters carry the portable watt-hour meter with several field coils for testing different ratings of meter, and all new equipments consist of the watt-hour meter rather than the indicating instruments formerly used. Meters are usually tested at one-tenth load and at one-half load; one-half load being considered as representing nearer the running condition of the meter than full load.

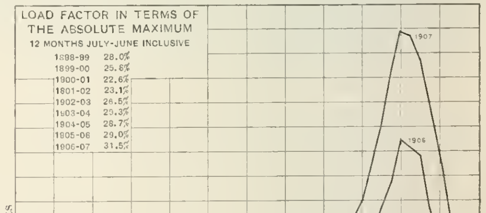


FIG. 31.—COMPOSITE CURVE, 60-CYCLE ALTERNATING SYSTEM.

A study of the character of the load in a large system of this kind is a matter of considerable interest to both large and small companies. It is also of value to observe what changes in the character of the company's load have taken place from year to year. In order to show the different characteristics of the electric lamp and motor load carried by this company Fig. 29 has been prepared. This illustration shows a typical load curve for a December day of the following: The down-town low-tension network which supplies energy to electric lamps and motors in the down-town district; a typical 60-cycle, alternating-current residence lighting feeder; a typical 60-cycle feeder devoted mainly to business lighting in an outlying district; and a typical three-phase motor circuit running to a manufacturing district. As December is the peak-load month of the year, these curves serve to indicate the extent to which the maximum yearly demands of these four classes of business overlap. On the down-town low-tension network, which is, of course, the heaviest portion of the company's load circuit, it is seen that the peak occurs a little before 5 p. m. and that it falls rapidly after that time until after 6, after which the falling off is more gradual until midnight. The 60-cycle residence and business lighting circuits are very similar in general form, each reaching its peak at 8 p. m. However, both reach about 75 per cent of their maximum at the time that the down-town peak occurs. The three-phase motor circuit reaches its peak in the morning and it decreases to half its maximum demand by the time of the down-town peak. The aggregate peak load from all classes of business, or, in other words, the station peak, occurs at about 5 o'clock.

Figs. 30, 31 and 32 show load curves obtained by averaging the load at each hour of the day for an entire year. While these load curves, therefore, represent the average load at every hour of the day for a year, they do not represent the form of curve which would be obtained during the peak load period of the year in November and December. The load factors which accompany the curves (Figs. 30 to 32) are not calculated from the curves, but are calculated from the actual maximum load of the year and the actual kw-hours output. Beginning with Fig. 30, which shows the load on the down-town low-tension system, it will be seen that the yearly load factor for last year was 31.4 per cent, or almost the same as for the year ending June 30, 1889. In the 19 years covered by these curves, the load factor has at times been better and worse than this, due probably to circumstances which affected the peak. The failure of the load-factor to improve with the increasing use of electric motors is probably to be explained by the increasing number of tall office buildings, the lighting load of which has a notoriously bad load-factor.

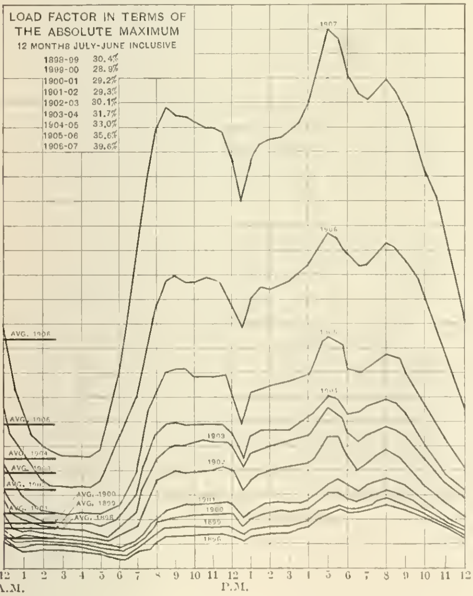


FIG. 32.—COMPOSITE KILOWATT CURVES, TOTAL OUTPUT.

The load-factors indicated on Fig. 31 for the 60-cycle alternating-current system for a period of nine years, show a decline for the first part of that period and an increase for the latter part. Any increase in the load-factor for the 60-cycle system is to be ascribed to the increasing use of motors in the outlying manufacturing districts. But for the fact that the residence lighting has greatly increased in the nine-year period, the effect of the motor business in improving the load-factor would be much more noticeable.

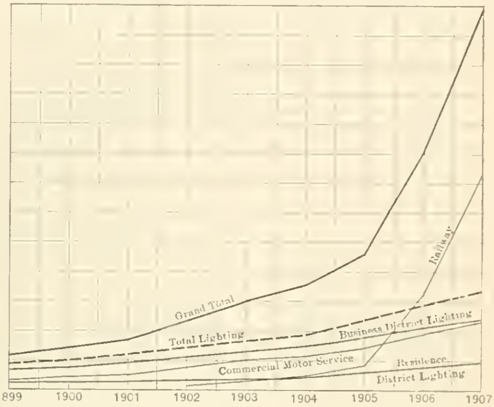


FIG. 33.—ANNUAL OUTPUT KILOWATT-HOURS SOLD.

The load-factors for the entire system, both direct and alternating current (including also the railway load, which has recently risen to a point where it represents half the output) are shown in Fig. 32. From this it is seen that since 1903 the load-factor has been rapidly rising, due, of course, to the railway business. Fig. 33 shows curves indicating the relative number of kw-hours sold each year for various purposes from 1899 to 1907, and also the grand total. From these it will be noted that the rapid increase of the railway business since 1905 is responsible for the sudden increase in the energy sold for the past two years. In the electric lamp and motor service the increase has been very uniform, although all classes of lighting and industrial service show an increased rate of growth beginning with 1904. Among the causes which contribute to this increasing rate of growth are the lowering of the rates and the completion of the Fisk Street station so that the company was prepared to handle the rapid growth. There is certainly nothing about the curves, Fig. 33, to indicate that the saturation point has been reached, but rather to indicate that an increasing rather than a decreasing rate of growth is to be expected.

Spinning Machines.

A paper was read recently by Mr. Schnetzler before the Dresden Electrical Society on the electric driving of spinning machines, especially on the methods used by Brown-Boveri & Company. Direct connection with the motor is thought to be essential. The ordinary induction motor with squirrel-cage armature is excellent when change of speed is thought to be unnecessary and when an increased number of breaks of the thread during starting is considered to be a matter of small importance. If variations of speed are desired the direct-current shunt motor should be used if direct current is available. For alternating-current systems the Deri repulsion motor is recommended.

Electrically-Propelled Fire Boats for Chicago.

THERE are now being built at Manitowoc, Wis., two fire boats for the fire department of the city of Chicago which will be ready for service by the middle of this summer. The boats are fitted with twin screws driven by electric motors, and altogether show one of the most interesting applications of electricity yet made in craft of such importance and size.

HULLS.

The boats are 120 ft. over all, 109 ft. 6 in. between perpendiculars, 28 ft. molded beam, 15 ft. molded depth and will have a draught of about 9 ft. 6 in. They are constructed of steel throughout, practically no wood being used anywhere except for the inside finish of the deck house and pilot house. The forefoot is cut away considerably, both for convenience in handling and for breaking ice, and the bows at the water line are heavily strengthened also for the latter purpose. There are five bulkheads, of which four are watertight, and lower decks forward and aft, dividing the hull into six watertight compartments.

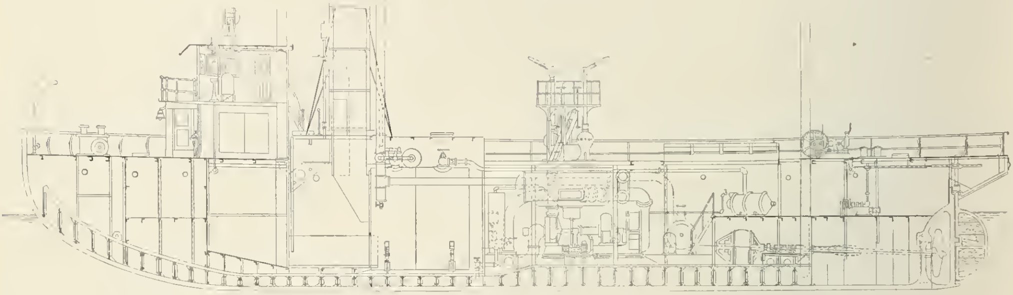


FIG. 1.—ELEVATION OF ELECTRICALLY-PROPELLED FIRE BOAT.

With the exception of the engine-room skylight, the low boiler trunk and a deck house immediately forward of it containing a toilet room and a large hose room, with pilot house on top, the deck is flush. A plate bulwark forward continues back to the deck house, from which an open iron rail extends aft supported by cast-steel stanchions. Two lines of heavy iron trough-shaped fenders run all fore and aft on the outside of the hull.

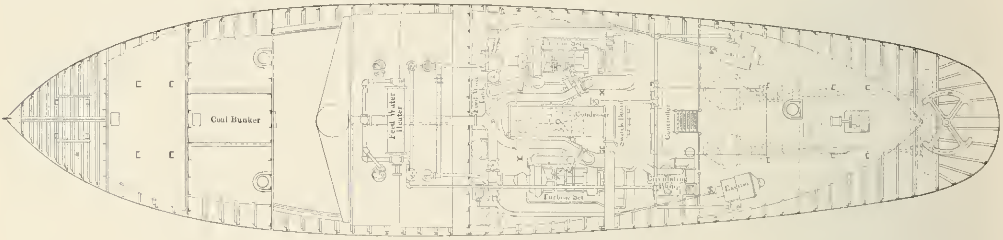


FIG. 2.—PLAN OF ELECTRICALLY-PROPELLED FIRE BOAT.

SPUDS.

The Chicago River, where these boats will be used, is in many places 200 ft. or more wide and the buildings extend right to the water's edge. The depth of the river is about 20 ft. Since the opening of the Drainage Canal to the Mississippi there is at all times a considerable current in portions of the river. In order, therefore, to hold the boats in a position where they can do effective work on a fire at the river bank, where lines cannot be made fast to moor them, they are fitted with spuds like a dredge, two forward and one aft, working through wells in the bottom of the boat, and raised and lowered by steam power. These spuds are made of double thick steel pipe, 18-in. diameter, stiffened internally by heavy plates and angles, shod with cast-steel points to take hold of the river bottom, and made watertight to reduce the apparent weight to be handled.

For facility in manœuvring in the narrow and crooked river and in the slips, where the boats have to work, they are fitted with twin screws and also with steam steering gear. By working one screw ahead and the other astern, the boats can be swung completely around as on a pivot in either direction.

MACHINERY.

The arrangement of the machinery on these boats is novel in that the same engines are used for operating the fire pumps and propelling the vessel, thus entirely doing away with separate propelling engines. Each boat is fitted with two centrifugal fire pumps, built by the I. P. Morris Company, of Philadelphia. These are of the two-stage type with 14-in. suction and discharge and capable of delivering together 9000 gal. of water per minute at a pressure of 150 lb. per square inch when running at a speed of 1700 r.p.m. By branch pipes properly fitted, the discharge of one pump can be turned into the suction of the other, thereby running the pumps in tandem as one four-stage pump, then delivering 4500 gal. per minute at 300 lb. pressure. This, going through a 3½-in. nozzle, will make a tremendously powerful and effective stream.

At 125 lb. pressure these pumps will each deliver 5500 gal. per minute. One of the great advantages of the centrifugal pump for this service is that the volume and capacity can be varied at will. Combined with this is a smoothness of operation and lack of necessity for attention not found in any other pump, while if inadvertently all discharge openings are closed at once, the pressure would rise but slightly and there would be no danger of bursting hose or anything else. Another great advantage of centrifugal pumps operated by steam turbines is in the fact that the boat can throw her rated capacity of water at all times and also in the great saving of fuel over the ordinary reciprocating pumps, operated with single, non-condensing steam cylinders. The water consumption of the turbine per horse-power per hour is only about 17 lb., whereas with the reciprocating pump it is doubtless at least three times that amount. It is practically impossible to put boilers enough in the boat to supply this amount of steam. Even with the exhaust turned into the stack to force the draft, which means a low efficiency for the boilers, there is probably no fireboat in service to-day with reciprocating pumps that can run those pumps to anywhere near their full capacity.

The pumps are set one on each side of the ship, drawing from a 14-in. header, extending across the engine room immediately forward of them and delivering to turrets on deck directly above. All connections are short and direct and all curves of easy sweep. The deck turrets are set diagonally on deck and each has nine 3½-in. openings for hose with quick-moving lever valves at a convenient height. In the winter these turrets will be enclosed in iron casings to which steam pipes are led to prevent freezing. At a height of about 7 ft. above the turrets is an oval platform carrying the two 3 1/3 in. universal monitors, which are vertically over the turrets and supplied by 5-in. pipes from them. The supports for the platform and the ladder to it come between the turrets so as not to interfere with the hose lines.

Each fire pump is driven by a horizontal Curtis turbine of 660 horse-power, built by the General Electric Company, of Schenectady, N. Y., and directly connected to it on the same shaft and bed plate. This shaft also carries a 200-kw generator of the direct-current type, shunt-wound for 275 volts, for operating the propelling motors. On each of the propeller shafts of the vessel is placed a direct-current, variable-speed reversing motor, shunt wound and designed for operating on the variable-voltage system, developing 250 horse-power at 200 r.p.m. Two turbo-generator exciter and lighting sets, of 25-kw rating, are provided, either of which alone is sufficient. All generators and motors are to be tested by a stream of water from a hose and moisture in the engine room will have no effect on them.

The generators and motors are supplied with independent controllers, two in the engine room and two in the pilot house, with suitable switching devices so that only one set can be in use at a time. A switchboard is installed in the engine room. Between the two turbine sets, high up under the deck beams to save floor space, is a surface condenser built by the Allberger Condenser Company, of New York, with wet- and dry-vacuum pumps directly beneath it. The 10-in. centrifugal circulating pump is on the port side abaft the turbine set. The rating of this pump is 3000 gal. per minute, and it is fitted with a bilge suction so that it can be used for pumping out the engine room in case of necessity. Feed and pony pumps, sanitary pump, etc., are placed on the bulkhead next the boiler room.

BOILERS.

There are two Scotch boilers, built by Johnston Brothers, of Ferrysburg, Mich., in a compartment next forward of the engine room, placed side by side facing forward. These boilers are 12 ft. 6 in. in diameter and 11 ft. 6 in. long between heads, built for a working pressure of 170 lb. In each boiler are two Morrison furnaces, 44 in. diameter, with separate combustion chambers. The boilers have one stack in common and are operated on the closed-stokehold system, the blower being in the engine room.

OPERATION.

In the operation of these boats great speed is not required and therefore the generators and propelling motors are only of moderate power, less than one-half the capacity of the two turbines. The Chicago River is crossed by bridges every block or two, which must be opened for the passage of the boats, so that high speed is out of the question. It was further considered that a combination of circumstances requiring full power on the fire pumps and full power on the propelling motors at the same time for any protracted period is practically impossible, and that if, while the boat is pumping water to her full capacity, the motors are called into service to change her position slightly, the turbines will easily stand the temporary overload. It was for this reason that the electric propulsion was decided upon. The turbines were there anyway for the fire pumps. If ordinary steam engines were used for propelling the boat it meant two more engines with four cylinders, valves, shafts, rods and all the complication and workings parts to take care of and keep in repair. Adding the generators and motors, which practically require no attention at all, added nothing to the work of the engineer, while by the system of control adopted he is even relieved of the necessity of answering bells and operating engines as usual. All this is done from the pilot house, where the captain has a lever under each hand and can control the twin screws, going ahead or back on either or both at any speed instantaneously and entirely independent of the engineer, to whom it makes no difference whether the motors are turning or not. When the boat is lying at her station, under banked fires, waiting for an alarm, the seacocks are closed and the pumps drained of water. When an alarm comes in the engineer has only to start the turbines, circulating and air pumps. The captain starts the propelling motors and on the run to the fire, the power of the turbines is used for running the boat only, the impellers of the fire pumps turning freely in the casings and doing no work. Special arrangements are fitted for oiling the bearings under this condition. On arrival at the fire all the engineer has to do is to open the seacocks and turn water into the pumps without stopping the turbines. As soon as the propelling motors stop, the generators cease to develop power and the armatures turn freely, the power of the turbines then being used for pumping only. If the motors are called upon temporarily to shift the position of the boat the action of the pumps is not interfered with.

When the fire is over and the boat relieved, the engineer simply shuts the seacocks, opens the drains on the pumps and the boat returns to her station.

There are important incidental advantages in driving the screws by motors instead of steam engines. One is that if the boat ever has to go into rough water there is no racing of the screws, the speed of revolution being constant for whatever voltage is being used, which is governed by the controller. It is also possible for short periods to increase considerably the revolutions and power developed by the motors, though this cannot be done for any length of time on account of undue heating. Another advantage is that if a sudden strain is put upon the shaft by the propeller striking heavy ice or against dock piles or other obstructions which are frequently encountered in the confined spaces in which the boats must work, the circuit-breaker opens, instantly opening the motor circuits and there is much less danger of breaking wheels or shafts than if a steam engine were used. Of the machinery installed, the turbines and fire pumps are entirely enclosed and require no attention at all, while the generators and motors entail very little care. As an additional precaution, extra controllers are fitted in the engine room and the engineer can operate the motors on signals from the pilot house as usual, if desired

A full installation of electric lamps is installed, operated by either one of the turbine-driven exciter sets, and a powerful searchlight is fitted on top of the pilot house.

BREAKDOWNS.

These boats are exceptionally guarded against total disablement by breakdowns of any single part of the equipment, as nearly everything is in duplicate. There are two boilers, two fire pumps, two turbines, two generators, two screws, two propelling motors, two exciter and lighting sets, two feed pumps and two injectors. While there is naturally only one condenser, circulating and air pump, the turbines are fitted with disabling pipes through which they can be exhausted to the atmosphere if necessary, so that any accident which puts the condenser temporarily out of service can only reduce somewhat the efficiency of the boats without causing them to be laid up.

The boats are being built by the Manitowoc Dry Dock Company, of Manitowoc, Wis., from designs of Mr W. I. Babcock, engineer and naval architect, of New York City, to whom we are indebted for the information presented herewith

Economical Aspects of the Various Electric Illuminants.

By Alfred A. Wohlauer.

The cost of light production is a decisive criterion for the selection and final adoption of a certain illuminant. Of course, it cannot be denied that other qualities and features of a lamp, as size or candle-power, light distribution or polar-curve, also the color of the light, have to be taken into first consideration, and that, very often, a certain lamp drops out of the discussion before the question of economy arises. Nobody, for instance, would consider a flaming arc lamp instead of an incandescent lamp when the illumination of a small living room is concerned, or an incandescent lamp for the illumination of a large thoroughfare, or a mercury-vapor lamp for a ball room. As soon, however, as a certain set of lamps is found suitable for a particular purpose at hand the relative cost will determine which lamp should be given the preference.

Furthermore, attention must be called to the fact that the latest developments in the art of lamp making have markedly disarranged and shifted the relative territories of the various lamps. The enclosed arc lamp has found a strong competitor in the tungsten lamp, the flaming arc lamp in the mercury-vapor quartz lamp, etc., so that a readjustment of the boundaries is timely and desirable. A general and up-to-date survey of the whole field of lighting will therefore convey a clear and comprehensive idea of the present situation and considerably assist the estimating illuminating engineer.

The actual or total cost of light production per mean spherical kilocandle-hour is made the basis for the following discussion. It involves not only the cost of electrical energy consumed by a thousand mean spherical candles per hour, but also takes into account the cost for maintenance and renewals. Depreciation and interest of the invested capital will not be considered separately, as they do not materially influence the cost of the kilocandle-hour; moreover, it is impossible to subject the investment cost to the general rules, as the cost of the general outfit of an arc lamp would come in the same category as the cost of fixtures, or at least of shades or reflectors of incandescent lamps, and this would lead too far. The ballast resistance of an arc, vapor and Nernst lamp must certainly be included in the calculations not only as far as the energy consumption of the lamp is concerned, but also, as in the case of the Nernst lamp, in connection with the renewal cost.

The cost of energy consumption per kilocandle-hour

$$C_c = R \times S \qquad (1)$$

R = rate for electric energy per kw-hour, and
S = specific watt consumption per mean spherical candle.

The present article takes into account the mean spherical candle-power as a basis for all lamps. The writer does not consider it feasible to compare mean spherical candles of incandescent lamps with mean hemispherical candles of arc lamps. It would be possible and perhaps also correct to make the mean hemispherical candle the basis for both types of lamps employing reflectors in the case of incandescent lamps and assuming that for both classes of lamps all light is utilized in one hemisphere. The light absorption due to the reflectors, however, has not the same value for the different types of reflectors, and in the case of arc lamps a certain amount of light is thrown uselessly into the other hemisphere, so that the adoption of the mean spherical candle-power is preferable as the most correct basis, while the mean hemispherical candle-power is stated in every individual case, allowing a loss of 20 per cent of light with incandescent lamps for absorption in the reflectors.

The cost for renewal and maintenance is

$$C_r = \frac{P \times 1000}{l \times L_s} \qquad (2)$$

wherein

L_s means spherical candle power
l = life of lamp for incandescent lamps
life of glower for Nernst lamps
life of electrode for arc lamps
life of vapor tube for vapor lamps.
P = price of bulb for incandescent lamps
price for renewal of glower, ballast and for Nernst lamps
price for renewal of electrodes and trimming for arc lamps
price for tube for vapor lamps.

As the average life of the glower of Nernst lamps is 500 hours and the ballast and heater last about 2000 burning hours of the lamp, the price for renewals on Nernst lamps during the period of the life of the glower consists of the price for glower plus a quarter of the cost for ballast and heater.

The cost for trimming of arc lamps varies between 2 and 5 cents per trim on multiple circuits, as was ascertained by the writer from a number of reliable sources, and the corresponding value is added to the price of electrodes.

The total or actual cost of the kilocandle-hour will be thus

$$C_t = C_c + C_r \qquad (3)$$

These three formulas have been used to calculate the data given in the various tables and diagrams.

The abbreviations used in the tables mean:

A = current in amperes
V = voltage of the line
V_a = voltage across arc
W_t = total watts
W_a = watts consumed by arc
L_h = mean hemispherical candle-power
L_s = mean spherical candle-power
S_h = watts per mean hemispherical candle
S_s = watts per mean spherical candle
P = renewal cost per trim or life
l = life of lamp or electrode
C_r = renewal cost per kilocandle-hour
C_t = total cost per kilocandle-hour
R = rate per kw-hour.

The lamps represented in the tables may be considered as typical or normal for the special kind of lamp in question, the data regarding quality and performance of the lamps are taken from trade and other publications and it has been endeavored to give proper values for each lamp without palliation or misrepresentation; the prices are standard or average trade prices

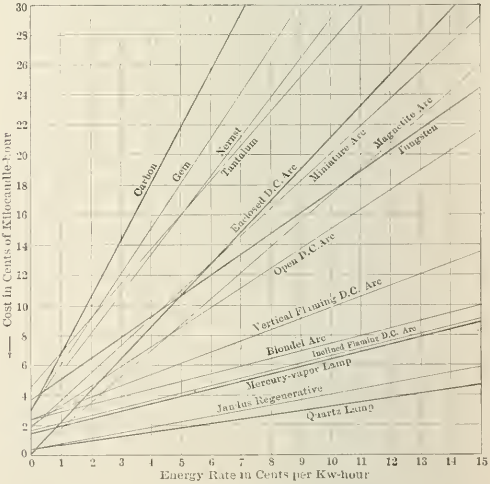


FIG. 1.—COSTS OF OPERATING VARIOUS MULTIPLE LAMPS.

Some of the lamps are comparatively new to the general public, especially the mercury-vapor quartz lamp, which is a new type of lamp not yet manufactured in this country. The chamber containing the mercury is made of quartz, which has a very high melting point and considerable heat-resisting ability. For this reason, it is possible to use a much higher current temperature and vapor pressure in quartz lamps than have been customary in mercury-vapor lamps and consequently an increase of the efficiency of the lamp is obtained.

The Carbone lamp is also comparatively unknown in this country; it may be called an arc lamp with inclined normal carbon electrodes yielding a rather long arc of a sun-like color and possessing somewhat longer life than the vertical open arc carbon lamps.

Another lamp has become of interest of late which might be classified as an "enclosed flaming arc lamp." The commercial name of it is "Jandus regenerative arc lamp." It has been described recently in the English technical press. As stated there, the lamp is intended mainly for street, open space and work-shop lighting, indicating that the annoyance from fumes and gases has not yet been overcome, although its efficiency is greater and its life is considerably longer than that of the ordinary flaming arc lamp.

TABLE I.—CHARACTERISTICS OF VARIOUS MULTIPLE ILLUMINANTS.

Illuminant.	A	V	W_t	L_h	L_s	S_h	S_s	P	l	C_r
INCANDESCENT LAMPS.										
Carbon	.31	110	50	20	13.2	2.8	3.8	16	450	2.7
Gem	.45	110	50	26.5	16.5	1.9	3.05	20	450	2.7
Meridian	2.3	110	250	130	82	1.9	3.05	70	450	1.9
Nernst	1.0	110	110	79.4	42.5	1.37	2.6	65	500	3.0
Tantalum	.36	110	40	25.5	17	1.57	2.3	50	700	4.5
Tungsten	.91	110	100	115.0	72	.87	1.4	200	800	3.6
DIRECT-CURRENT APC LAMPS.										
Open arc	10	55	550	725	400	.76	1.3	8	10	2.0
Enclosed	5.0	110	550	435	260	1.16	2.1	9	150	.2
Carbone	10	110	1100	950	550	1.16	2.0	8	16	1.0
Miniature	2.5	110	275	220	150	1.25	1.8	6	20	2.0
Magnetite	3.5	110	385	400	225	.96	1.7	10	150	.31
Flaming	10	55	550	1200	600	.4	.75	17	10	2.4
Blondel	5	55	275	1080	550	.255	.5	25	18	2.5
Inclined flaming	10	55	550	2150	1100	.255	.5	18	10	1.6
Inclined enclosed flaming	5.5	100	550	2200	1500	.25	.365	30	70	.31
ALTERNATING-CURRENT ARC LAMPS.										
Open arc	15	—	530	470	300	1.10	1.75	10	13	2.2
Enclosed	7.5	—	600	350	230	1.7	2.6	9	100	.4
Flaming	10	—	330	750	425	.4	.8	17	7	5.6
Inclined flaming	10	—	550	1950	1000	.3	.55	18	10	1.3
Blondel	10	—	350	1400	715	.265	.5	25	15	2.3
MERCURY-VAPOR LAMPS.										
Cooper Hewitt	3.5	110	385	—	770	—	.5	1200	4000	0.4
Quartz	4.2	220	924	—	2740	—	.33	700	1000	.25

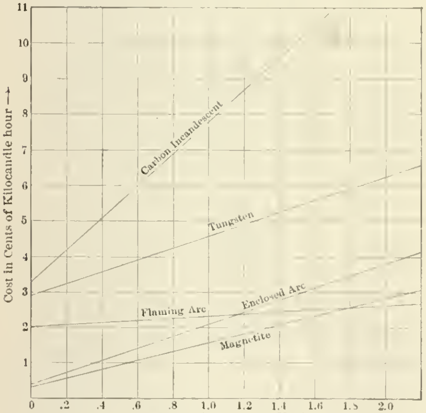


FIG. 2.—COSTS OF OPERATING VARIOUS SERIES LAMPS.

All the other lamps have been freely described in standard periodicals and do not require any special mention.

Table II gives the total cost of light production for different rates for energy varying from 2 to 12 cents per kw-hour, and Fig. 1 is the graphical illustration thereof.

Tables III and IV and Fig. 2 refer to series incandescent as well as arc lighting, and it will be noticed that several lamps which appear in Tables I and II are left out, as they have not been developed for series lighting. Other lamps, however, possess remarkable advantages for series operation. For instance, the tungsten lamp, when adapted to a lower voltage on series circuits, gives a stronger and more stable lamp; series operation is favorable for arc lamps, because the resistor, which consumes quite a portion of the energy, can be omitted, whereby the actual or total energy consumption of the lamp is considerably reduced.

TABLE II.—ECONOMICAL ASPECT OF VARIOUS ILLUMINANTS AT DIFFERENT RATES FOR ENERGY.

Illuminants.	Rating.	S_s	C_r	$C_t = S_s \times R + C_r$. Rate per kw-hour. 2	4	6	8	10	12
INCANDESCENT LAMPS.									
Carbon	16 c.p.	3.8	2.7	10.3	17.9	25.5	33.1	40.7	48.3
Gem	20 c.p.	3.05	2.7	8.8	14.9	21.0	27.1	33.2	39.3
Meridian	100 c.p.	3.05	1.9	8.0	14.1	20.2	26.3	32.4	38.5
Nernst	110 watt	2.6	3.0	8.2	13.4	18.6	23.8	29.0	43.2
Tantalum	20 c.p.	2.3	4.5	9.1	13.7	18.3	22.9	27.5	32.0
Tungsten	80 c.p.	1.4	3.6	6.4	9.2	12.0	14.8	17.6	20.4
DIRECT-CURRENT ARC LAMPS.									
Open arc	10a. 2 i. ser.	1.3	2.0	4.6	7.2	9.8	12.4	15	17.6
Enclosed	5 a. 110 v.	2.1	.2	4.4	8.6	12.8	17.0	21.2	25.4
Miniature	2.5 a. 110 v.	1.8	2.0	5.6	9.2	12.8	16.4	20.0	23.6
Carbone	10 a. 110 v.	2.0	1.0	5.0	9.0	13.0	17.0	21.0	25.0
Flaming	10 a. 2 i. ser.	.75	2.4	3.9	5.4	6.9	8.4	9.9	11.4
Blondel	5 a. 2 i. ser.	.54	2.5	3.5	4.5	5.5	6.5	7.5	8.5
Inclined Flam.	10 a. 2 i. ser.	.5	1.6	2.6	3.6	4.6	5.6	6.6	7.6
Encl. Flam.	5.5 a. 110 v.	.365	.3	1.03	1.76	2.49	3.22	3.95	4.68
Magnetite	3.5 a. 110 v.	1.7	.31	3.71	7.11	10.51	13.91	17.31	20.71
ALTERNATING-CURRENT ARC LAMPS.									
Open	15 a.	1.75	2.2	5.7	9.2	12.7	16.2	19.7	23.2
Enclosed	7.5 a.	2.6	.4	5.6	10.8	16.0	21.2	26.4	31.6
Flaming	10 a.	.8	5.6	7.2	8.8	10.4	12.0	13.6	15.2
Inclined flaming	10 a.	.55	1.8	2.9	4.0	5.1	6.2	7.3	8.4
Blondel	10 a.	.5	2.3	3.3	4.3	5.3	6.3	7.3	8.3
MERCURY-VAPOR LAMPS.									
Cooper Hewitt	3.5 a.	.5	.4	1.4	2.4	3.4	4.4	5.4	6.4
Quartz	4.2 a.	.3	.25	.85	1.45	2.05	2.65	3.25	3.85

The cost for trimming of arc lamps is of course higher for series street lighting, as the distances from lamp to lamp are greater. For instance, with 20 lamps per mile, 3 cents per lamp must be added to the cost for trimming, which will therefore amount to from 5 to 8 cents per lamp.

TABLE III.—CHARACTERISTICS OF SERIES LAMPS.

Illuminant.	A	V_a	W_a	L_h	L_s	S_h	S_s	P	L	C_r
Carbon incandescent	5.5	32.0	176	50	40	3.5	4.4	.55	410	3.35
Tungsten	5.5	14.7	81	60	48	1.35	1.7	1.40	1,000	2.0
Enclosed arc	5.0	80.0	415	350	232	1.18	1.8	12.00	150	.35
Magnetite	4.0	78.0	310	420	244	.72	1.27	13.00	150	.35
Flaming arc	8.0	45.0	360	2,100	1,020	.17	.35	21.00	10	2.0

In general the tables are self-explanatory and do not require any further comment. The influence of the renewal cost is obvious, being comparatively small for higher energy rates, but of intrinsic significance if efficient illuminants are used at a low rate for energy.

The advantage of the mercury-vapor lamp over the flaming arc lamp is due to the low renewal cost of the former; the superiority of the tungsten lamp over the enclosed miniature arc lamp is also remarkable.

If one compares the cost of the kilocandle-hour of the old carbon incandescent lamp at a rate of 10 cents per kw-hour, namely, 40.7 cents, with the latest mercury-vapor quartz lamp, at 3.25 cents, he is in position to appreciate the progress which has been made in increasing the efficiency and decreasing the cost of light production.

TABLE IV.—ECONOMICAL ASPECT OF VARIOUS SERIES LAMPS

Illuminant.	A	S_s	C_r	.2	.4	.6	.8	1	1.2	1.4	1.6	1.8	2
Carbon incandescent	5.5	4.4	3.35	4.2	5.1	6.0	6.9	7.8	8.7	9.6	10.5	11.4	12.3
Tungsten	5.5	1.7	2.9	3.24	3.58	3.92	.426	4.70	5.04	5.38	5.72	6.06	6.4
Enclosed arc	5	1.8	.35	.71	1.07	1.43	1.79	2.05	2.41	2.77	3.03	3.69	3.85
Magnetite	4	1.27	.25	.6	.85	1.1	1.25	1.62	1.85	2.1	2.35	2.72	2.89
Flaming arc	8	.35	2.0	2.01	2.14	2.21	2.28	2.35	2.42	2.49	2.56	2.63	2.7

The Series Transformer.

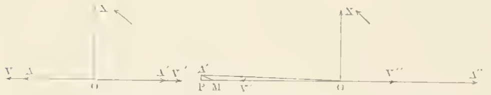
By E. S. Harrar.

The chief function of the alternating-current series transformer is to furnish to the measuring or indicating instrument a current proportional to the line current in a certain ratio. In this respect it is analogous to the shunted resistor used to accomplish the same result in direct-current service. The actions of the two devices, however, are altogether different.

The shunted resistor merely provides a sufficient voltage to cause a small current to flow through connecting leads to the instrument, and since this voltage will increase with increase of line current, the instrument current will be proportional to the line current. If the shunt has no temperature coefficient the ratio of instrument current to line current is constant for all values of line current. It is to be noted that the connecting leads and live parts of the instrument are at the same potential as the busbar to which the shunt is connected.

The current supplied to the measuring instrument by the series transformer is also proportional to the line current, but the ratio may not be strictly constant for all values of line current. It is also a separate current from the line current, is at a different potential, and has a different phase.

In general these transformers consist of only two small coils built up with an iron core. One coil, the primary, is connected in series with one of the line wires, and the other coil, the secondary, is connected to the terminals of the instrument, thus being closed through the coils of the instrument. The coil connected in the line is necessarily at line potential, which may be thousands of volts above ground potential, hence, if this coil has sufficient insulation to prevent a break-down between coils or between primary coil and iron which is at ground potential, the secondary coil and iron and, consequently, the instrument are effectually insulated from the line potential. This feature is of great importance, as it provides a means of indicating the line current on extremely high-voltage circuits and still have the switchboard instrument at low potential. A series-switchboard instrument capable of measuring the total current at line potential would be impracticable on high-voltage circuits, for the amount of insulation required and the spacing between live parts would make such an instrument out of proportion to other equipment and be extremely expensive as well as a source of danger.



FIGS. 1 AND 2.—VECTOR DIAGRAM OF IDEAL SERIES TRANSFORMER AND TRANSFORMER UNDER NON-INDUCTIVE LOAD.

The fundamental expression for the current of a series transformer is the same as for the shunt transformer. This expression is as follows:

$$\frac{A'}{A''} = \frac{T''}{T'} = R \text{ or } T'' = RT' \qquad (1)$$

where A' = primary amperes.
A'' = desired secondary amperes.
T' = primary turns.
T'' = secondary turns.
R = desired ratio of transformation.

That is to say, with desired ratio known and primary turns fixed, the secondary turns are equal to primary turns multiplied by the desired ratio. It must be understood that the relations expressed by the above equations are ideal and are not strictly true, but are assumed to be true for the present merely as a basis of development.

A vector representation of these ideal conditions is shown in Fig. 1 for a 1 to 1 ratio of transformation and a non-inductive secondary load.

In the above figure OX is the direction of magnetic flux.
OA' is primary current
OA'' is secondary current.
OV' is primary e.m.f.
OV'' is secondary e.m.f.

In this case the primary voltage and current are equal to and opposite in phase to the secondary voltage and current, respectively, and since the load is assumed non-inductive the secondary current is in phase with secondary voltage, and primary current is in time-phase with the primary voltage. If the ratio is other than 1-to-1, OA' and OA'' must be expressed in ampere turns and they will still be equal and opposite, the voltages in this case being no longer equal. As we are to deal with the ampere or ampere-turns relations voltage ratios will be ignored in further discussion, and OA' and OA'' will be expressed in ampere-turns, whence the vector representation will apply to all ratios.

In the actual transformer the ampere-turns necessary to supply the core loss and to overcome the reluctance of the core causes a change in the current relations, as is shown by Fig. 2, which is a vector representation of the actual conditions met with in practice, the core loss and reluctance being taken into consideration. A non-inductive load is again assumed.

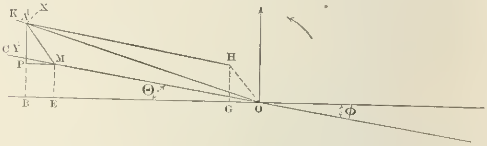


FIG. 3.—VECTOR DIAGRAM OF SERIES TRANSFORMER UNDER INDUCTIVE LOAD.

In this case the secondary current is still in time-phase with the secondary voltage since the secondary load is non-inductive, but the primary current lags behind the primary voltage, as represented by the angle $A' O V'$. Using ampere-turns in plotting Fig. 2, OA'' is the secondary ampere-turns, and OA' is the total primary ampere-turns, being equal to the line current multiplied by the primary turns, and is made up of two components, namely, $A'M$, that part which supplies the core loss and overcomes core reluctance, and OM, that part which is equal and opposite to the secondary ampere-turns. $A'M$ may be further resolved into its two components, MP and $A'P$, the iron loss and wattless components, respectively.

Fig. 2 shows that in order to approach the ideal case, $A'M$ must be kept small, since the smaller $A'M$ is the nearer will OM, which is equal to the secondary ampere-turns, be to OA'. Since the component OM of the primary ampere-turns is always equal to the secondary ampere-turns, it is convenient to call OM the secondary ampere-turns, OA' total primary ampere-turns, and $A'M$ the magnetizing ampere-turns.

In order to keep $A'M$ small the induction at which the iron is worked must be kept low. This may be accomplished either by allowing sufficient turns of wire, or a large cross-section of iron for the particular transformer conditions. $A'M$ may be further maintained small by keeping the magnetic path as short as possible. Inspection of Fig. 2 shows that for this case (non-inductive load) the effect of the component MP is to decrease the secondary ampere-turns directly, while the effect of $A'P$ is to cause a phase difference between the primary and the secondary currents. A small increase in the value of $A'P$ will not affect the value of OM appreciably, but an increase in the value of MP affects OM directly.. In fact, if a series transformer is correctly designed for the particular service required of it, the secondary ampere-turns for non-inductive secondary load may be taken as equal to $OA' - PM$, the difference between OA' and OP being so small as to be negligible. Dividing $OA' - PM$ by the secondary turns will give the secondary amperes without appreciable error. The procedure in finding the secondary current in this case is then very simple. It is necessary merely to determine the ampere-turns, supplying the iron loss, subtract this value from the total primary ampere-turns and divide by the secondary turns. To determine the iron-loss ampere-turns it is necessary to know the loss in watts per unit weight of iron at given frequency and various inductions. From this the iron loss ampere-turns are found as follows:

Let W = watts iron loss at given frequency and induction.
V = volts corresponding to given induction.
A = iron loss amperes.
T'' = secondary turns across which V is measured.

Then $A = \frac{W}{V}$ and ampere-turns iron loss $= AT'' = \frac{WT''}{V}$ and on the basis above-mentioned it follows that

$$\text{Secondary ampere-turns} = A'T' - \frac{WT''}{V} \qquad (2)$$

dividing equation (2) by secondary turns

$$\text{secondary amperes} = A'\frac{T'}{T''} - \frac{W}{V} \qquad (3)$$

Equation (3) shows that if the ratio of primary to secondary turns is made equal to $\frac{I}{R}$ or $\frac{A''}{A'}$ (equation 1), the secondary current will be less than the desired value by the amount $\frac{W}{V}$ amperes. The per cent error in transformation is $\frac{100\,W}{A''\,V}$

This error can be compensated for, however, by designing the transformer as if the secondary current was to be increased by the amount $\frac{W}{V}$ amperes, and equation 1 takes the form

$$\frac{A'}{A'' + \frac{W}{V}} = \frac{T''}{T'} \text{ or } T'' = \frac{A'}{A'' + \frac{V}{W}}\,T' \qquad (4)$$

That is, the secondary turns must be slightly diminished from the ratio $\frac{A}{A''}$, T' in order that the secondary current shall equal A'', the desired value. If the solution of equation 4 for a particular case shows T'' to be a whole number of turns, the compensation will be exact. If, however, the value of T'' is found to contain a fraction of a turn, the nearest whole number must be used and a slight error will result.

A specific example of a particular transformer may be of interest as an illustration of the above conditions. In a certain given transformer the primary current was 200 amperes and the desired secondary current 5 amperes, whence $R = \frac{200}{5} = 40$. The number of primary turns was fixed at 8. If the secondary turns had been determined from equation (1) the value would have been 40×8 or 320. W was found to be .12 when $V =$ 3 volts. Then, according to equation (3) secondary current $= 200 \times \frac{8}{320} - \frac{.12}{3}$ or secondary current $= 5 - .04 = 4.96$ amperes and per cent error $= \frac{.04}{5} \times 100 = .8$ per cent.

Instead of making the turns equal to 320, the number was determined from equation 4 thus: $T'' = \frac{200}{5 + .04} \times 8 = \frac{1600}{5.04} =$ 317.46, and as 317 is the nearest number of whole turns T'' was made 317, whence actual secondary current $= 200 \times \frac{8}{317} - \frac{.12}{3} = 5.0073$ and per cent error $= \left(1 - \frac{40 \times 8}{317} + \frac{.12}{3 \cdot 5}\right) 100$

$$= (1 - .100946 + .008)\ 100.$$
$$= -.146 \text{ per cent.}$$

That is, the error of .8 per cent has been overcompensated for, and the secondary current will be slightly high (less than 15/100 of 1 per cent) at full load. This is not a bad feature, however, for the per cent error increases with decrease of load, hence the average loss below full load will be less than if the compensation had been exact. This is readily seen to be true, for as the load decreases the voltage decreases and the induction decreases in the same proportion, but as the iron loss varies as some power of the induction greater than unity, the per cent decrease in watts loss is less than the per cent decrease in induction or in load.

It should be noted again at this point that the above development of formulas is based on the assumption that when the secondary load is non-inductive the secondary ampere-turns are equal to total primary ampere-turns minus the ampere-turns supplying the iron loss, and that this is allowable is proved by numerous tests on well-designed transformers in which the difference between the actual value and assumed value is too small to have any effect on the result. In fact, the quality of iron in any case may vary from the quality taken as standard and from which the iron losses was determined to such an extent that the loss may be greater or less than the calculated value and the error due to this may be greater than that due to the above assumption.

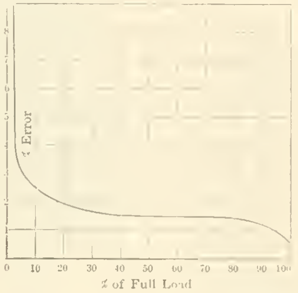


FIG. 4.—VARIATION OF ERROR WITH LOAD ON A SERIES TRANSFORMER.

When the secondary load is inductive the conditions are altogether different. Fig. 3 is a vector representation of this case which shows the secondary current lagging behind the secondary voltage by the angle θ. This causes the component OM of the primary ampere-turns to lag θ time-degrees behind the primary voltage, and the total primary ampere-turns to lag still further behind.

In this case OM may be determined either graphically or analytically, and great care must be exercised in either method for the values of $A'P$, PM and $A'M$ are so small in proportion to OA' and OM that a serious error will result if the scale is not made large or if the calculations are not carried far enough.

The graphic solution is as follows:

The known values are θ, $A'M$, PM, $A'P$ and OA'. Lay off $BOC = \theta$, $OG = PM$, $GH = A'P$ and $OH = A'M$. Draw HK parallel to OC, and with O as the center and a radius equal to the primary ampere-turns describe arc $X - Y$ cutting HK at A'. Construct the triangle $A'PM$ at A' with sides parallel to HGO and join OM, whence OA' = total primary ampere-turns, $A'M$ = magnetizing ampere-turns and OM = secondary ampere-turns, whence by dividing by secondary turns the secondary amperes will be obtained.

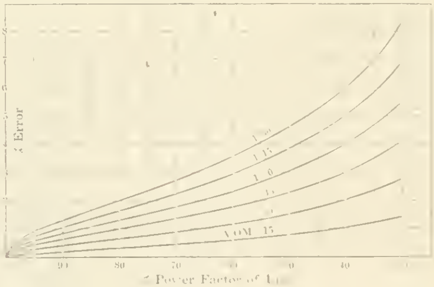


FIG. 5.—VARIATION OF ERROR WITH LOAD POWER FACTOR FOR DIFFERENT TRANSFORMER PROPORTIONS.

The analytical solution is as follows. Project $A'P$ to B and draw ME perpendicular to OB.

Then $(A'P+PB)^2+(OE+BE)^2=OA'^2$ or $(A'P+OM \sin\Theta)^2+(MP+OM\cos\Theta)^2=OA'^2$ which reduces to $OM^2+2\,SOM=OA'^2-A'M^2$ where $S=(A'P\sin\Theta+MP\cos\Theta)$, all the terms of which are known;

finally $OM=\pm\sqrt{OA^2-A'M^2+S^2-S}.$

Figs. 4 and 5 are characteristic curves of these transformers, showing losses typical to this class of transformers.

Fig. 4 shows the total error introduced into the wattmeter reading by a reasonably well-designed transformer. This curve was obtained by taking readings on a standard wattmeter when connected directly to the line and again when connected through the transformer, which has a 1 to 1 ratio. In this manner the errors due both to phase displacement and to iron loss were determined.

Fig. 5 shows the errors that will be introduced into wattmeter readings due to phase displacement and has been plotted for various values of the angle $A'OM$. This figure shows that if the power factor of the line is 100 per cent, the error due to phase displacement is negligible, even for $A'OM=1°-30'$, and that as the power factor decreases the error increases, and at a more rapid rate for higher values of $A'OM$.

$A'OM$ should never be more than 45 seconds, even if ammeters alone are to be operated from the transformer, in order that the difference between OA' and OP, Fig. 2, may not be too large and the ratio error increased accordingly.

"Over-Shooting" of Tungsten Incandescent Lamps.

By John B. Taylor.

A short article in the issue of the Electrical World for April 25 described what has been termed an "over-shooting effect" in the light from the tungsten incandescent lamp for a brief fraction of a second after the circuit is closed. The accompanying illustrations, Figs. 1 and 2, present the photographic evidence to show that this "over-shooting effect" is a real physical action as distinguished from a physiological effect or mental impression. These records were made on a photographic film 4 in. wide and a little over 12 in. long, placed in the G. E. oscillograph film holder shown in Fig. 1.

For making these records, the film drum was placed in a screw cutting lathe and driven at a uniform speed of approximately 266 r.p.m. The screw cutting gears were arranged for six threads per inch, while the tool post carried a piece of cardboard covering the slit seen in the oscillograph film holder. An opening ⅛ in. wide in the cardboard exposed a small portion of the film (about ⅛ in. x 1/16 in.) to the light of an incandescent lamp under test. For these records a 20-watt, 22-volt tungsten lamp was placed about 24 in. from the photographic film. It will be readily seen that the arrangement permitted of obtaining a photographic trace more than 20 ft. long.

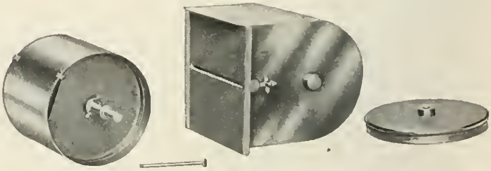


FIG. 1.—FILM HOLDER FOR PHOTOGRAPHIC ATTACHMENT OF OSCILLOGRAPH.

In Fig. 2, with the drum rotating continuously, the lamp circuit was closed at A, opened at C, closed again at D, etc. It is plainly evident that the trace between A and B is appreciably lighter than the remainder of the record, and the known velocity of the film gives the time between A and B as very nearly one-tenth second. Particular attention is called to the fact that this "over-shooting effect" is not seen at D, the lamp being still warm, as the interval between C and D is only about two-thirds second. In making this record the source of supply was a 25-volt storage battery from 15 to 20 ft. from the lamp with no inductive apparatus in the circuit.

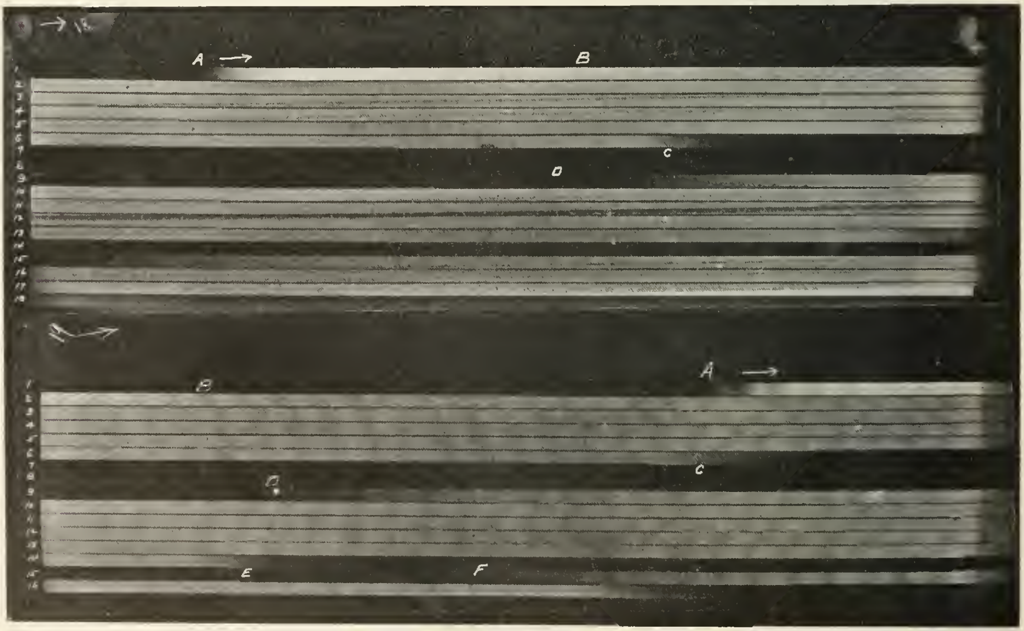


FIG. 2.—OSCILLOGRAPH RECORDS OF "OVER-SHOOTING EFFECT."

The source of energy supply for the record of Fig. 2 was the commercial 60-cycle lighting circuit with a small auto-transformer to reduce the e.m.f. from 110 to 22 volts. The same lamp was used as for the record of Fig. 1. This record is lettered similarly to Fig. 1, the greater initial brilliancy being shown by the trace between *A* and *B*. In this record the alternate heating and cooling of the filament, corresponding to the peaks and zero values of the current wave, is readily seen.

The photographs have not been retouched. It is not claimed that the photographic trace as presented shows the proper relative values of light at the different times, as exposure and chemical development have been chosen with a view to bringing out the contrast for illustrating the phenomenon.

From the records which the writer has made, these two have been selected as best presenting the effect for reproduction. As the cause of this effect has not yet been definitely demonstrated, it seems only fair to add that a higher voltage tungsten lamp of different manufacture showed this same effect, but not in so great a degree, which might indicate that the thicker filament is in some way responsible for the effect. On the other hand, the relative exhaustion of the two lamps is not known and the relative proportions of lamp volume, surface of glass, and watts dissipated may be factors of more importance than the size and structure of the filament.

Lighting Equipment of the Union Station at Washington.

One of the most important matters that had to be dealt with in connection with the new Union Station at Washington was that of its lighting, and a number of the country's foremost illuminating and electrical engineers were engaged to give this subject close attention and study. This magnificent station has been in use since the latter part of last October, when the Baltimore & Ohio Railroad first moved into it. The electricity used in furnishing the light for the station and other buildings of the Washington Terminal Company is generated in a power house that is located some distance from the station building. The wires are carried to the various terminal buildings through a system of terra-cotta conduits located in tunnels built in the bases of the retaining walls forming the north approach to the station. To care for the wires leading to the station, 48 lines of 2-in. glazed terra-cotta ducts were laid along the wall of the 12-ft. tunnel in the west retaining wall for the wires leading to the express building; six lines of the same size ducts were laid in a 5-ft. tunnel under the north walk of H Street.

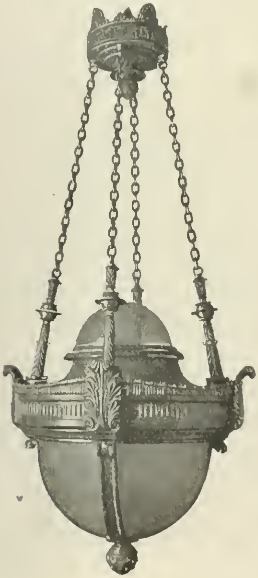
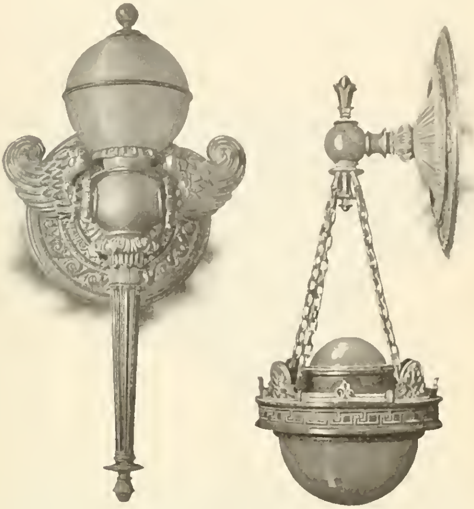


FIG. 1.—CHANDELIER USED IN DINING, LUNCH, SMOKING AND WOMEN'S ROOMS.

In the lighting of the station about 480 500-watt arc lamps, 500 high-efficiency lamps and about 3600 16-cp incandescent lamps are in service. To light the pipe and wire tunnels between the power plant and the station and the express building required 190 incandescent lamps. To care for the wires used in this great lighting system required the installation of about 83,000 ft. of conduit of various sizes, about 68,000 ft. for the express building, power plant and K Street signal tower, and about 12,000 ft. on the train sheds. In addition, about 20,000 ft. of conduits was used for the telegraph and telephone wires at the station and about 12,000 ft. at the express building, power house and K Street signal tower.



FIGS. 2 AND 3.—INTERIOR AND EXTERIOR SIDE-BRACKET FIXTURES.

Special lighting plans were necessary on account of the unusual size and height of the ceilings in the general waiting room and other rooms of the station. Natural light is provided in the general waiting room by the use of semi-circular windows located at about the elevation or spring line of the ceiling arch. In the east end of the room there is one window, on the north side five windows and in the south three windows. The west end receives light through the roof over the ticket lobby, which is equivalent to a window 50 ft. in diameter. Artificial light is furnished by 180 inverted arc lamps located in the alcoves of the balcony over the vestibules in the north and south sides of the wall.

The ticket lobby receives natural light through the roof, which is of barrel-vault design, the roof covering and ceiling being of glass construction. It was originally intended to light this space artificially and provision was made for placing 160 high-efficiency lamps in a groove or pocket in the walls of the room, located about 33 ft. above the floor. The objection to this was the inaccessibility and the fear of losing much light through the glass roof construction.

In lighting the dining room no effort was made to conceal the lamps. This room is provided with eight chandeliers (Fig. 1), each containing 12 100-watt gem lamps, and 12 side brackets, each equipped with three 100-watt gem lamps. Owing to its central location, very little natural light could be secured from the sides. To overcome this difficulty a saw-tooth roof construction was adopted, the north slope being filled with glass and the south with tile and composition roofing. To provide for additional light, should it be desired, 39 floor outlets have been installed, permitting of the placing of electric lamps on all tables.

As the lunch room faces on a well-lighted concourse, and the women's waiting rooms and the men's smoking rooms front on the open portico extending across the entire front of the station, no special expedients for natural illumination were resorted to. These rooms are lighted artificially by suspended chandeliers and wall brackets. The lunch room is lighted by six chandeliers (Fig. 1) and 10 wall brackets (Fig. 2), each of the latter containing four 50-watt gem lamps. The ladies' waiting room has three similar chandeliers and nine wall brackets (Fig. 2) and the smoking room has three chandeliers and 10 wall brackets.

The baggage room is lighted by a saw-tooth roof construction, similar to that of the dining room.

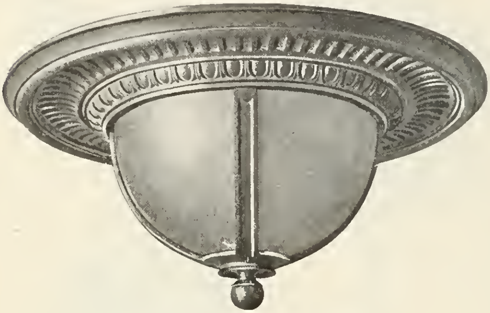
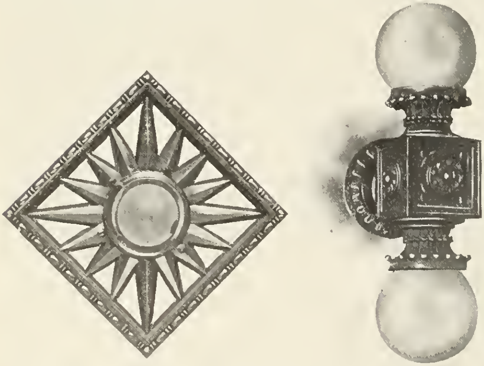


FIG. 4.—DOME CEILING FIXTURE.

In the State apartments at the east end of the building there are both concealed and exposed lighting. In the reception room three handsome chandeliers are suspended from the ceiling and eight ornamental brackets are placed over the sidewalks (Fig. 2).

In lighting the open portico extending across the front of the building a distance of 620 ft., good results have been obtained by placing brackets on the faces of piers forming the north and south sides of the portico or colonnade. The same method is used in the east portico. Twenty side-bracket units are used in lighting the central pavilion or main entrance, 12 in the State entrance or east pavilion, and 36 in the west pavilion or carriage porch, making a total of 68. A view of one of these units is given in Fig. 3. Eight of the units at the main entrance are provided with six 125-watt and one 187-watt gem lamp, the other 60 are equipped with three 100-watt gem lamps. To light the remainder of the portico, 55 side brackets are used. Twenty-five of these have three 100-watt gem lamps, 30 have one 100-watt gem lamp.



FIGS. 5 AND 6.—CEILING FIXTURE AND SIGNAL LAMPS.

In addition to the bracket lighting described, the main domes are equipped with ceiling fixtures, particularly those over the central pavilion and west carriage entrances (Fig. 4). There are three ceiling fixtures in the dome of the main portico and one in the State entrance dome, each of which is provided with six 100-watt gem lamps. Similar fixtures are used in the east and south porticos and at the carriage porch. A ceiling fixture of the same general appearance, but containing six 50-watt gem lamps, is used over the vestibule between the waiting room and the lunch room. Fig. 5 shows a form of ceiling fixture that is used over all other vestibules, about 200 being employed, each containing one 16-cp lamp.

The concourse is lighted by skylights in the roof, about one-half of the area being of glass construction, while the entire north end is open to a height of 17 ft. Artificial light is supplied by 72 arc lamps suspended from the ceiling, while 20 additional arc lamps are used in lighting the 15-ft. extension of the concourse. About 600 incandescent lamps are used in lighting the train signs, gates and train starting signals. A type of signal lamp used on gate posts at the train fence is shown in Fig. 6. It contains two 16-cp lamps. These lamps are only used when the gates are open for passengers.

The basement, where baggage and mail are handled, require the constant use of artificial light. This is supplied by 138 arc and 260 incandescent lamps. The sub-basement, used in handling of baggage to the low level, or tunnel, tracks, is lighted with 11 arc lamps.

The office space is lighted wholly by incandescent lamps distributed as follows: Mezzanine floor, 80; second floor, 690; third floor, 66, and attic, 290; on the balustrade along the east and west courts 14 arc lamps are provided.

The fixtures were manufactured by the Sterling Bronze Company, New York, the lamps being supplied by the General Electric Company. In a subsequent issue we hope to discuss the many illuminating engineering features of the building, which have been merely touched upon in the present sketch.

New Generating Station for the Delaware & Hudson Company.

An electrical generating station embodying a number of interesting features has just been completed at Mechanicsville, N. Y., for the Delaware & Hudson Company. J. G. White & Company, of New York, designed the plant and carried out the construction under the general direction of Axel Ekstrom, consulting electrical engineer of the Delaware & Hudson Company. The station is located on the west bank of the Hudson River, about one mile south of Mechanicsville and 12 miles north of Troy. The energy developed will be used for electric railway purposes by the Delaware & Hudson Company, supplementing the present sources of supply to the Hudson Valley Railway Company, United Traction Company, of Albany and Troy, and Schenectady Railway Company.

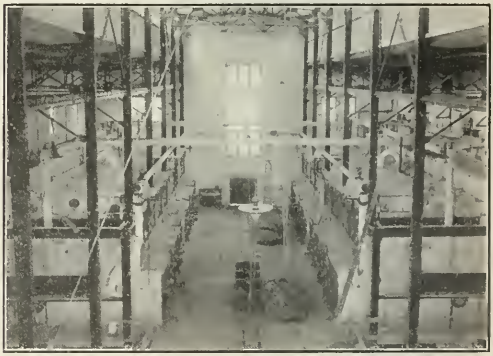


FIG. 1.—BOILER ROOM.

The present installation of machinery is rated at 4000 kw. but the building has sufficient space for equipment rated at 10,000 kw and the condensing water tunnels, portions of the foundation and steel work, coal-handling apparatus and coal storage are ample for generating equipment having a 20,000-kw output.

The general arrangement of the interior of the building is novel in several respects, the principal object being to place all of the auxiliaries under the view and supervision of the engineer in the turbine room, the only auxiliaries in the boiler room being the draft blowers and engines. Economy of space, as well as suitable elevation for heaters, was secured by placing them on a platform in the turbine room parallel with the division wall.

The boiler room is 165 ft. long by 82 ft. 6 in. wide. The firing aisle parallels the turbine room and the boilers are arranged in two rows, as shown above. The dimensions of the boiler room allow for an installation of 16 435-hp boilers, eight of which are installed at the present time. Below the boiler room is a basement 15 ft. 6 in. in height, the floor of which is about the level of the main turbine room floor. Besides the forced draft apparatus, the basement contains a storeroom, machine shop, oil room, locker and toilet rooms. This basement was made unusually high in order that gondola cars of the Delaware & Hudson Company could be run directly under the ash hoppers, and the ashes removed and used for ballast without making use of the station ash-handling apparatus.

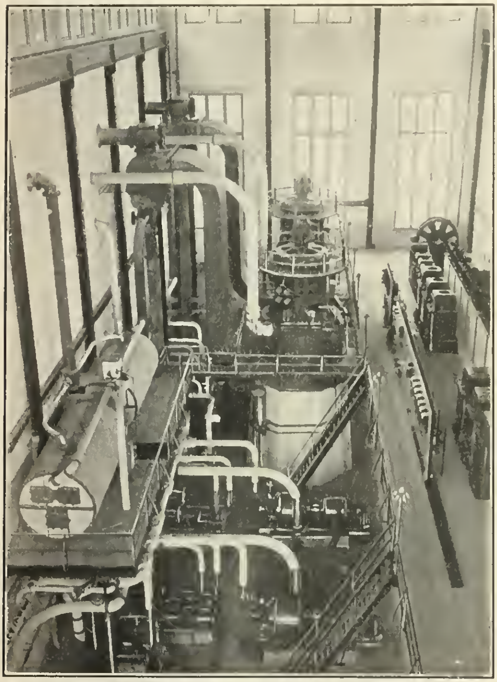


FIG. 2.—ENGINE ROOM.

The main generating room is 165 ft. long by 54 ft. wide, and is designed to accommodate two Curtis turbo-generators rated at 2000 kw and two rated at 3000 kw each. At present two 2000-kw units are installed.

The foundations for all the columns, turbines and the intake and discharge tunnels are placed on rock; all foundations and column footings are of concrete. The superstructure consists of a self-supporting steel skeleton frame, the walls of which are of brick, laid in lime and cement mortar. The two stacks are of the Custodis type, 100 ft. in height above their foundations by 9 ft. internal diameter.

The coal handling and storage arrangements for the plant are unusually comprehensive and interesting. It is the intention of the Delaware & Hudson Company, during the early spring and summer months, when there is less demand for its coal-hauling equipment than at other seasons, to accumulate coal in the storage yard adjacent to the plant. The coal-handling apparatus therefore has been designed with the idea of storing coal during these months in sufficient quantity to run the plant through the winter. The coal-storage yard is 319 ft. long by 117 ft. 6 in. wide, enclosed by retaining walls entirely spanned by a Mead-Morrison gantry crane, with a two-ton bucket capable of handling over 50 tons per hour. The approximate coal storage is 30,000 long tons.

The railroad company's coal cars are run in on a siding and directly over reinforced concrete coal pockets, under which is an industrial railroad track on the same level as the boiler room floor. On this industrial track run charging cars, into which the coal from the concrete hoppers may be dumped and brought directly in front of the boilers. When the coal supply exceeds the requirements of the station the surplus will be permitted to flow from the pockets through gates provided on the side of each hopper into the storage yard and will be distributed by the gantry crane.

The boilers at present installed are of the Stirling type and built for a working pressure of 180 lb. per square inch. They are provided with superheaters designed to give 100 deg. superheat, and are provided with flat grates, the front and rear section of which are dumping, the remaining portions being stationary. As it is the intention of the Delaware & Hudson Company to use a low grade of anthracite bird's-eye coal, the ratio of grate surface to heating surface in the boilers is unusually large, approximately 1 to 30.

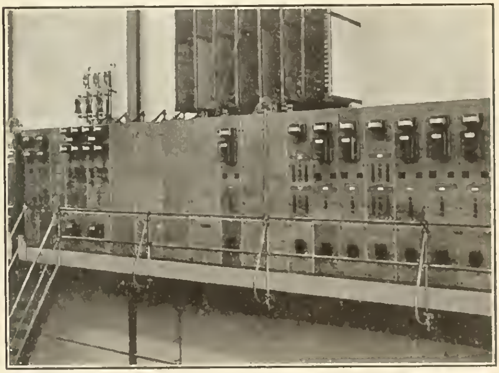


FIG. 3.—SWITCHBOARD.

The boiler feed water is supplied by two horizontal duplex pumps, 14 in. x 9 in. x 12 in., so piped that either pump may supply water to any of the boilers after first passing it through the feed-water heaters. The feed water is taken from the river through the tunnel supplying water for the condensers by two 8-in. x 10¼-in. x 10-in. duplex horizontal house pumps, either of which is of sufficient size to supply the ultimate needs of the station. The two heaters are of the Cochrane horizontal type, rated at 5000 hp each.

The steam leads from the boiler are 6 in. in diameter, and connect to the main header by a system of flexible connections. The main header is 10 in. nominal diameter and from it 8-in. branch leads are run to the turbines. The auxiliary steam piping is taken from the bottom of the main 10-in. steam header and this auxiliary steam main in turn is drained directly to the boiler feed pumps, this method of draining obviating the use of traps. All the steam piping is covered with two layers of 85 per cent magnesia covering, while the exhaust and feed-water piping is covered with a single thickness of similar material.

The turbine units, manufactured by the General Electric Company, are of the four-stage Curtis type, with six-pole generators, operating at 800 revolutions, and deliver current at 2300 volts and 40 cycles.

The condensers are of the Worthington barometric type; the circulating water is furnished by 14-in. steam-driven centrifugal pumps; the dry-vacuum pumps are of the rotative, single-stage type, also steam driven. The vacuum exhaust, taken from the turbine base, is carried in a rectangular steel duct, 2 ft. x 7 ft. 9 in., to the top of the condensing cone. By placing the relief valve on top of the condensing cone, the usual separate free exhaust line is eliminated. Duplicate exciter turbines rated at 75 kw each are of the Curtis horizontal, two-stage, non-condensing type, driving 125-volt direct-current generators.

The main oil switches for controlling the electrical operation of the station are the General Electric Company's type H-3. Current at 2300 volts is delivered by the turbo-generators to the busbars and thence to step-up transformers, which raise the voltage to 11,500 or 23,000 volts. The current capacity of all high-tension conductors is such as to allow full rated station output to be delivered at 11,500 volts, while the insulation and spacing are arranged for 23,000 volts. It is, therefore, possible, by means of the duplicate sets of busbars and sectionalizing switches provided, to supply electrical energy at the above voltages to outgoing feeders.

In addition to the foregoing alternating-current apparatus, there has been installed one 600-kw rotary converter for supplying direct-current to the trolley lines adjacent to Mechanicsville. Sufficient space has been provided for an additional rotary of similar size.

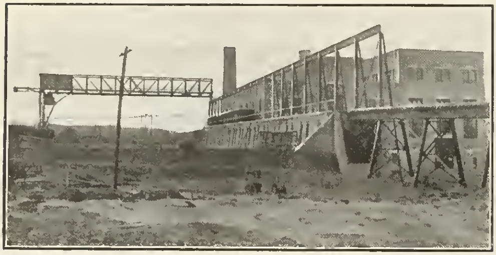


FIG. 4.—COAL YARD AND GANTRY CRANE.

Directly behind and over the switchboard gallery are located high-tension lightning arresters, of the multiplex type, designed for 23,000 volts, with means of reducing the number of air-gap units for use on 11,500-volt service. The main busbars of the station are in the basement directly underneath the oil switches. Paralleling the busbar compartments is the duct for supplying air to the various transformers which are located in a row, about the middle of the switchboard gallery, where they may be readily handled by the overhead traveling crane.

Roentgen Rays.

The *Philosophical Magazine* for April publishes an account of an experimental investigation by Mr. H. A. Brumstead of the heating effects produced by Roentgen rays in lead and zinc. The result previously obtained by the writer that the heat generated in lead by Roentgen rays is twice that in zinc is not confirmed by further experiments, which show that the quantities of heat are equal, with an uncertainty of from 5 to 10 per cent. No rays capable of producing scintillations on a zinc blende screen are present among the secondary radiations from lead when exposed to Roentgen rays. The disintegration of the active deposit from thorium emanation is not hastened by exposure to Roentgen rays.

Technical Welfare Work.

By Sydney Whitmore Ashe.

Much has been published concerning the proper training of the technical student while in college; and also his subsequent training in the apprenticeship courses offered by several of the large manufacturing companies. It is the purpose of this article to consider the more general problem of raising the technical status of the employee who has not been so fortunate as to obtain a college training. The ages of the latter men vary between wide limits, from 16 years to fully 60 years. Their knowledge of theory and of practical things is varied. Some have accumulated an extensive knowledge of facts and operating details, and have taken advantage of evening courses in technical institutions, while others have not been theoretically inclined, and have simply become familiar with their daily routine work. For several years past it has been the privilege of the writer to make a close study of this problem. Certain recommendations in this connection have been made to some of the large companies in New York City. These recommendations have been put into effect during the past two years by the New York Edison Company and the Edison Illuminating Company of Brooklyn. The results obtained have been very gratifying. With a hope that other companies may undertake similar work and so benefit some of their ambitious employees, the general details of this work are given.

In certain respects most practical men are similar; their knowledge of mathematics is limited to that obtained in the elementary school, their knowledge of physics and chemistry is vague, their knowledge, in fact, of all technical subjects is not very extensive. On the other hand, they possess valuable knowledge of commercial methods, and they have personal characteristics which are highly commendable. They are anxious to learn, are attentive, are not wrapped up with a sense of their own importance, can be appealed to by experimental demonstrations during a lecture, or by practical experimental work in which they take part. In laying out an educational course for practical men these factors must be borne constantly in mind.

The general scheme followed by the writer has been to prepare a course of 20 experimental lectures on electrical engineering, extending from the elements of magnetism to the subject of alternating current measurements. The topics of these lectures were as follows: 1, Magnetism; 2, electromagnetism: 3, batteries, primary and secondary; 4, electromagnetic induction. Theory of the dynamo; 5, electrolysis and electrolytic corrosion; 6, practical management of shunt motors; 7, practical management of series motors; 8, Ohm's law applied to distribution problems. The three-wire system; 9, Ohm's law applied to electrical measurements. Ammeter and voltmeter methods; 10, Ohm's law applied to electrical measurements. Galvanometer methods; 11, physics of light; 12, the carbon arc and arc lamp mechanisms; 13, incandescent lamps; 14, principles of recording wattmeters; 15, elementary principles of alternating currents; 16, alternating currents continued; 17, transformers; 18, alternating-current motors; 19, rotary converters; 20, alternating-current measurements.

The lectures were given at weekly intervals, and were about 1½ hours in length. With the New York Edison Company it was felt desirable to give an afternoon lecture as well as an evening lecture, so as to afford all employees an equal opportunity to attend. Privilege of attendance at the afternoon lectures was also extended by the New York Edison Company to the employees of other companies in the vicinity. The attendance at the evening lectures was so great at first that the seating capacity of the lecture room was taxed to its utmost, and consequently the attendance of other than employees was allowed at only the afternoon lectures.

In giving experimental lectures it is especially desirable to perform all of the experiments on a large scale so that all may see. Images of ammeters, voltmeters, galvanometers, electrolytic tanks containing liquids, small parts of instruments, magnetic fields and diagrams should be projected on the screen so that all present will have no difficulty in following the theory as presented. This method of presentation tends to stimulate interest, and is followed to-day in many of our technical institutions. The more the spectator takes part in the lecture, such as noting instrument readings on the screen, and following calculations on the board, the greater his interest will be.

The experimental lantern should be not more than 15 ft. from the screen and the lecture table, so that no time will be lost in passing to and from the table. The lecture table should be provided with direct and alternating-current outlets, and it should also have a gas outlet. Running water should be within easy access.

In order that the greatest benefit may be obtained from such a lecture course, it is recommended that a syllabus be prepared giving dates, topics, detailed notes on experiments to be performed, and also directions for study. One of these syllabuses should be sent to every employee in the company at the beginning of the lecture course. In order to call attention to the lecture course from week to week, it is recommended that typewritten notices be posted on the bulletin boards in the offices, stations and shops throughout the company. The details in connection with these bulletins should be looked after by a special lecture committee appointed from the company's staff. These bulletins should give detailed directions for study, and should in addition show the application of the lecturers to the company's business.

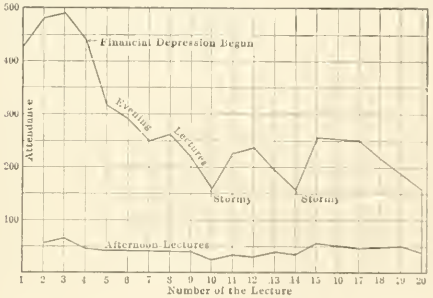
The lecturer should be primarily a teacher, who realizes the limitations of his audience, and who is familiar with practical operating methods. He should be in sympathy with his audience or he will not be successful. Much depends upon the personality of the lecturer. The men should be encouraged to come forward after the lecture, examine the apparatus and ask questions. If it is possible to supplment the original lecture course by a course of talks given by the various department heads, still better results could be obtained. For instance, a lecture given on the watt-hour meter should be followed by an operating lecture by the head of the meter department. In a similar manner, other talks could be given on storage batteries, transformers, rotary converters, etc., by the heads of the respective departments. These lectures would not only be valuable to the men, but the experience of lecturing would be excellent for the departmental heads. A better method than this, however, would be to combine the talk and the lecture, in which case the departmental head could discuss the operating features in the last 15 minutes of the lecture.

Several standard books should be selected by the lecturer and referred to from time to time during the lecture course, so as to cause individual study and self-development on the part of the men. An excellent plan was followed by the New York Edison Company of purchasing several sets of the books recommended for its lecture course, and placing these books in the library where they could be consulted by those who could not afford to purchase them, and by those who found it convenient to come early to study before the lecture. These books were referred to many times when discussions were under way, and the statements of authors were used as arguments by the discussers.

The question naturally arises as to how far this educational scheme could be carried and what would be the final result. The writer is not in a position as yet to lay out the whole of this educational scheme. Each step must be taken slowly. When a certain lecture course has been given for one year, the question naturally arises as to whether it should be repeated during a second year, or whether an advanced course should be given. If the same course be given the attendance will fall for obvious reasons, and if the course be advanced the attendance will fall because it will be necessary to use more mathematics and many men unable to follow the treatment will lose interest. The following extract from the report of the writer to the New York Edison Company with regard to another season's work will show what plans have been suggested to meet this condition:

"*Suggestions for Another Season.*—In continuing this educational work during another season the writer would recommend under no consideration to repeat the same lecture course given this year. Modifications of experiments and lectures might be used, but there must be no semblance to last year's course. The idea must be conveyed in another course that there is the element of progress present, otherwise a course, no matter how good, would lose its main purpose and the attendance would not be satisfactory. If possible, it would be wise to shift the scene of interest, in which case we should retain the interest we now have and attract other men. This would be possible in putting into effect a suggestion which has been made by the writer that a laboratory course be given to the men during another year. I cannot too highly recommend this idea, providing a way can be found for carrying on the work in an economical manner.

"There is nothing in my mind which will do so much for a man as giving to him experimental work in which he performs the part of the experimenter. The instruction in this event becomes more individual, but the initial expense per man rises. The men become immediately more productive, and their sphere of usefulness increases. They are able to do more things. They are better able to locate trouble. Their interest in their work increases and the value of the instruction to them is much increased. I see no reason why a course could not be arranged, using the company's apparatus, employing some of the company's men as assistants, which would be equal to that given in any technical institution. As it would be impossible to accommodate everyone who might apply for a laboratory course, it would seem fitting that such a course should be supplemented by an experimental lecture course. Therefore, a combination of the two would be advantageous, as well as profitable and desirable.



ATTENDANCE CURVE OF LECTURES.

"Bearing in mind the previous remarks in reference to lectures for another year, it would seem that the proper method of procedure would be to select for lectures either different pieces of apparatus of the company and to discuss their operating features in an experimental way, or to consider certain operating phases, such as voltage regulation, locating trouble, protection, what it is possible to do with a certain piece of apparatus, factors of safety, etc., and devote the lectures to them.

"There are other minor improvements which could be made during another year. For instance, wherever possible, direct application of theory to the company's apparatus or system should be made, by slides showing the apparatus or detail of the apparatus as installed. Standard wiring diagrams in elementary form, linking together the different pieces of apparatus could be manifolded and distributed to the men. Also standard formulas and data pertaining to the company's apparatus could be arranged in a similar manner and distributed to the men. Such diagrams as would ordinarily be drawn on a blackboard during a lecture could be drawn with india ink on glass and their images projected on the screen so that they could be seen by all. It would be an easy matter to exhibit with each lecture from 15 to 20 slides of different types of company's installations and methods of construction which would be of great interest to the men.

"In laying out plans for future educational work, it would seem wise to develop the men in their weakest point, namely, the subject of mathematics. During the past winter this seemed to be the only phase of the subject which the men had difficulty in following. A simple course in practical mathematics could be given to the men at small expense. This course, however, would have to be laid out with a view to treating of only those parts of the subject of mathematics which the men would have occasion to use. For instance, in algebra through simple equations; in trigonometry, the properties of the right triangle; in analytical geometry, plotting of curves and their analysis, etc. This class need not necessarily be large, but I feel that it would fill a long-felt want."

Attendance.—The attendance at experimental lectures will be large at first, as many attend through curiosity. It will increase for the first few lectures and will then decrease slowly till a point is reached where the attendance will fluctuate until the end of the course. Curve sheet Fig. 2 shows the attendance during afternoon and evening at the New York Edison lectures. The effects of the financial condition of the country and also the effects of stormy weather are clearly shown in the curves. The following details, taken from the report on this attendance, made by the writer to the New York Edison Company, may be interesting:

"The attendance at the lectures was exceptionally large at first, due to the fact that the manner of presentation was novel and that from the experimental demonstrations it was possible to follow easily the theory as presented. This attendance, about 420 men, at evening lectures, was maintained for four weeks until the financial crisis came with its disorganizing influence, the attendance falling to 275 men. From this point the attendance followed the natural decline of all educational courses, until the alternating-current lectures were given. Here it seemed as if a process of selection had been going on, for the attendance gradually rose for a few lectures, and then declined until the 20th lecture, when the attendance was 119. At the five lectures, which were repeated for those who wished to review the subject, the average attendance was not very great, being for the evening lectures 74. The attendance at the afternoon lectures was more nearly constant, as may be noted from the attendance curve. For instance, at the 15th lecture the attendance was greater than at the first lecture, and for the first nine lectures the attendance was quite constant.

"The writer wishes to call attention to the total attendance of the course, namely, 5956 men. This result, considering the restless winter through which the course has passed, is very gratifying, and shows that great interest has been manifested in the work, an interest, judging by the number who attended regularly, which was sustained." The maximum attendance at the evening lectures was 425 men, the minimum for the original course of 20 lectures, 156; and the average, 274 men.

Interest Manifested.—The interest manifested by the men in the lecture course may perhaps best be given by extracting again from the report presented by the writer to the New York Edison Company:

"During the entire lecture course the interest manifested by the men in the individual lectures was excellent. The experiments, the slides, the tabulated information on the company's apparatus, the diagrams, the explanations, seemed to appeal to the men. After each lecture the men would come together in groups around the room, or near the lecture table, discussing the various points of interest. This discussion I understand was not alone confined to the lecture room, but was continued in the offices and stations throughout the company until the next lecture. The lectures in this way seemed to stimulate the men, creating a very healthy interest. A social spirit also prevailed at the lectures, the men looking forward to them as a time when they would meet their fellow employees. This spirit manifested itself primarily before the lectures when the men would meet in the library and smoke.

"From time to time the writer received inquiries from the men regarding other evening studies at Cooper Union, Columbia University and the Brooklyn Polytechnic Institute. During the winter, four of the Edison employees took up laboratory work at the Brooklyn Polytechnic as a result of the lectures, and several others have expressed an intention of doing likewise next year. Quite a few others intend to join the American Institute of Electrical Engineers. Several regulator attendants have come together at stated intervals to discuss questions which have arisen, and they are endeavoring to form a society. The writer has encouraged this interest, as it is realized that it is good to accustom the men to coming out during evenings or afternoons for self-study.

"There is no natural inclination on the part of men to educate themselves, so that all educational courses represent up-hill work. Self-development of the men was the keynote of the New York Edison course, and therefore anything which it was within the power of the writer to do to stimulate the enthusiasm of the men in this direction, was done."

It will be readily seen from the foregoing remarks that much can be done to raise the educational status of the employee.

If this system of education be continued for a few years it would be possible by a process of concentration on fundamental principles, of using practical mathematics, of dwelling upon a company's methods to develop valuable, practical, operating engineers from among the employees of the company.

In closing it might be well to mention the plans which have just been consummated by the Brooklyn Edison Company for next year, its third year of educational work. A course of 20 experimental lectures will be given dealing with the Edison System from "The Coal Pile to the Consumer." From the two years' previous experience at the lectures, the men are now in a position to discuss operating features and understand the relation of the fundamental principles to them. In the last 15 minutes of each lecture a department head will take charge and discuss such operating features as had not been previously mentioned in the lecture. Excellent results are expected from this method. The writer will have charge of this course.

Remote Controlled Valves in Power Stations.

A reliable device for closing steam valves from a remote point will in many cases be found of considerable value. Such a device, however, should be positive in operation, and the closing should be effected gradually, as a sudden closing would throw considerable strain on the steam piping. A number of constructions are on the market, more or less fulfilling these requirements. The device described below, which is applicable for quite a number of other conditions, has been developed for the special purpose of closing from remote points high-pressure gate valves in the steam mains of the two turbo-generator power stations of the New York Central Railroad Company, New York. The arrangement consists of a 14-in. gate valve, actuated by a hydraulic cylinder of standard construction available on the market. The gate valve is operated by a four-way pilot valve, admitting water supplied either from the city water mains or from the boiler feed pumps, above or below the hydraulic piston.

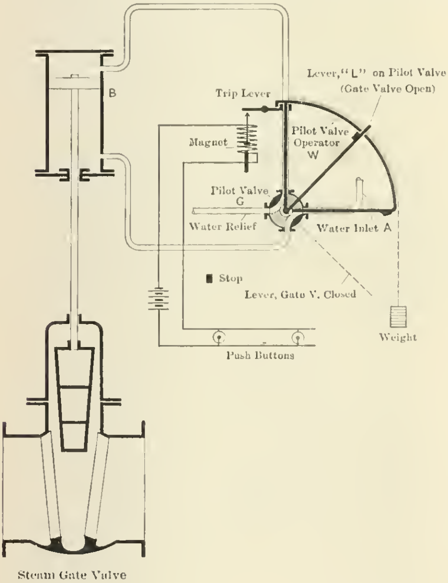
As shown in the illustration, water enters at *A*, moving the piston in the hydraulic cylinder *B* up or down, according to the position of the four-way pilot valve. To the pilot valve is connected a lever *L*, which is turned 90 deg. by the pilot valve operator *W*, when the latter is released by the tripping magnet in case contact is made by a push button. Energy can be obtained from a storage battery, or from any lighting circuit.

It will be noted from the sketch that lost motion is allowed between moving parts in order to safely overcome friction that might otherwise cause sticking of the tripping device or pilot valve. The entire construction is enclosed in a tight cast-iron case, and an indicator shows whether the valve is open or closed. The valve, after it has been tripped, can be reset by a removable handle.

The advantages of the above construction are the following:

The valve can be closed from any point in the power station; for instance, from the switchboard gallery. It can either be used to shut off the steam supply from the engines or turbines in case of emergency, or regularly as soon as the electric load is taken off and the machine is to be shut down. The valve cannot be opened accidentally, because the counterweight has to be reset, making it necessary for a man to go to the valve for opening it. The valve can, however, be opened as readily as any ordinary valve, hydraulically operated, not equipped with the special electrical tripping device. The time of closing the valve can be adjusted by properly limiting the water supply, making its performance independent from the operator, and permitting the valve to be closed sufficiently slow to avoid excessive strain on the piping. The mechanism is simple and positive, and it is not apt to get out of order, an advantage over most motor-operated valves. Long and cumbersome water connections are not required as in case of exclusively hydraulic operation.

It should be mentioned that all wiring must be installed most carefully, in order to preclude a possibility of accidentally tripping a valve, or failure to operate in case of emergency. With such a device in the hands of a switchboard operator, giving him control of the steam supply to the engine, it is believed that the safety of operating large power stations can be increased. There should be no hesitancy in giving the switchboard operator control over the valves in the steam mains to steam-driven generators, for the reason that the steam supply can be shut off as soon as the generator is taken off the system. In case of emergency, for instance, burnout of a generator, the main circuit breaker will trip automatically, and under these conditions, the possibility of shutting off the steam supply from the switchboard gallery will tend to decrease the accident and danger to the operating force; also, avoid confusion in the engine room.



TRIPPING ARRANGEMENT FOR HYDRAULICALLY OPERATED VALVE.

Wireless Telephony.

A note on a patent of A. Steinacker and A. Plisnier describing some improvements in wireless telephony is published in London *Electrical Engineering*. It is stated that good results have been obtained by substituting a mercury-vapor lamp for the copper-carbon arc in the oscillating circuit.

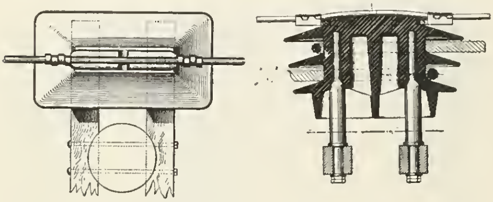
Large Hotel Sign on Broadway, New York.

There has just been erected on the roof of the Hotel Knickerbocker, at the corner of Broadway and Forty-second Street, New York, one of the largest electric signs on the Rialto. The sign is 105 ft. long and 27 ft. high and faces toward the Grand Central Depot. On it are the words "Hotel Knickerbocker" forming two lines. The letters in the word "hotel" are 6 ft high, while those in the word "Knickerbocker" are 8 ft. high. The framework is constructed of angle iron throughout and is riveted and bolted. Before being assembled and fastened to the roof all the iron work was painted with red lead. The framework is thoroughly braced and fastened to the roof of the hotel with lead expanders, which seal the holts and thus prevent rust and deterioration. About five tons of iron were used in the skeleton framework and the factor of safety is very high. The wind pressure of the average storm at Times Square was determined and the framework designed to withstand a storm five times as great, so that it is doubtful if even a cyclone would cause it to show the slightest sign of weakening. The letters in the sign are an improvement over the old-style skeleton letter heretofore used on signs of this type. The receptacles which heretofore were exposed are in the sign under discussion enclosed at the back by a gutter, so that whereas the wires in the older type of construction would break close to the terminal owing to constant vibration, in the improved type of construction these troubles are eliminated. Moreover, by this means the letter is stiffened considerably, the gutter acting as a reinforcement. There are over 400 4-cp lamps used on the sign; what is termed a 9-lamp letter being used in the upper row and a 12-lamp in the lower row; that is, there are nine and 12 lamps used in the letter "I" which is the standard used in spacing the lamps. The sign, which was built by the George H Rice Company, of Brooklyn, is supplied with electricity from the magnificent Sprague plant installed in the basement of the hotel. Owing to its great height above the sidewalk and the absence of tall buildings between the hotel and the Grand Central Depot, the sign is distinctly visible from that distance, being silhouetted against a black sky.

ELECTRIC SIGN ON HOTEL KNICKERBOCKER.

Insulator for Heavy Conductors.

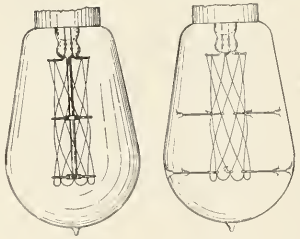
The accompanying illustrations show an insulator for heavy conductors, for which a patent was granted to Mr Louis Steinberger, on April 21. The insulator body is provided with several hoods of different sizes, the largest being at the top and the smallest at the bottom, as shown in Fig. 2. The insulator body is hollow and is provided with a web crossed by other webs integral therewith. These webs serve as braces and prevent crushing of the insulator in case it is subjected to excessive strains. The inventor claims for the insulator the following advantageous features: A firm and substantial support for sustaining the insulator so as to distribute the mechanical strains upon it; a maximum of insulating effect with a minimum of weight and a minimum of material employed in construction; the insulator may be readily removed from its support; it provides an improved means for holding the wire upon the insulator; it provides specially arranged spaces for receiving cables or other flexible members which may pull sidewise upon the insulator; it enables lighter supporting members to be used by multiplying the number thereof; it facilitates the ease with which a wire or cable may be applied to or removed from the insulator; it possesses improved means for preventing undue movement of the wire or cable relatively to the insulator; it gives each wire or cable a comparatively long stretch of surface upon which to rest, and provides internal braces for the insulator so as to reduce the weight without proportionately reducing the strength thereof, and it affords greater security and better facilities for the lineman when placing the insulators and cables into operative positions, repairing them, or removing them from the poles.


FIGS. 1 AND 2.—STEINBERGER INSULATOR.

Recent Lamp Patents.

METALLIC-FILAMENT LAMPS.

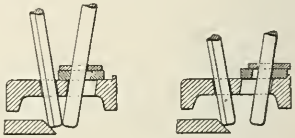
A disadvantage encountered in electric lamps of the metallic-filament type resides in the extreme fineness of the filament, which renders them liable to breakage. Mr. Hans Kuzel, of Baden, Austria-Hungary, on May 5 obtained a United States patent for a method of supporting the filaments so as to eliminate the liability to breakage, and to prevent such deformation of the loops of the filaments when hot as to cause short-circuits. The filaments are supported from a central stem or from the walls of the bulb by eyelets which are so arranged that the filaments are wound helically. The constructions are illustrated in Figs. 1 and 2.


FIGS. 1 AND 2.—KUZEL INCANDESCENT LAMP.

ARC LAMPS.

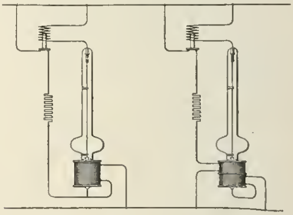
In the practical operation of arc lamps with inclined electrodes fed forward by gravity, it has been found that when the aperture in the framework through which the free electrode is adapted to pass is not well sealed, the products of combustion arising from the burning electrodes and the dust will pass upward through this aperture and will injuriously affect the mechanism above it. If a single seal plate is employed as has been attempted, and this plate is large enough in its lateral movement to seal the aperture necessary to accommodate the electrode, it is apt to touch the other electrode with disastrous results. Figs. 3 and 4 illustrate a device patented by Mr. Heinrich Beck, of Frankfort-on-the-Main, Germany, on April 28, which is claimed to overcome the above difficulties. The inventor employs several superimposed apertured plates arranged to slide one above the other, each plate encircling the electrode, the lowermost one having a large opening and the plates above having progressively diminishing openings, so that each plate is adapted to seal a portion of the aperture in the surface beneath it, and the lowermost plate is adapted to seal the outer portion of the aperture in the framework and at the same time is not wide enough when the electrode is nearest to the supported electrode to contact with the supported electrode.

Mr. W. S. Weedon, of Schenectady, N. Y., obtained a patent on April 7 for a method of overcoming the injurious oxidation of impregnated-carbon electrodes in arc lamps. An electrode composed principally of titanium carbide possesses excellent light-giving qualities, but the high temperature at which the arc operates causes a considerable portion of the carbid to be converted into titanium oxide without vaporization. In order to prevent the oxidation, the inventor incases the titanium carbid in a sheathing of copper applied by electro-deposition. The copper and copper oxide, into which more or less of the copper adjacent the arc end of the electrode is converted, vaporize only near the arc, and until vaporized they act to protect the core so that the only consumption of the titanium carbid which takes place is at the surface from which the arcing occurs.


FIGS. 3 AND 4.—BECK ARC LAMP.

VAPOR LAMPS.

Figs. 5 and 6 show forms of an improved starting device for mercury-vapor lamps patented April 28 by Dr. C. P. Steinmetz. Under starting conditions a carbon filament extends from the upper electrode to an iron cup filled with mercury floating upon the lower mercury electrode. When the main switch is closed current passes along the filament between the two electrodes. The solenoid acting magnetically upon the iron cup draws it downward and starts an arc between the lower end of the filament and the mercury. Current will now pass through the ionized mercury-vapor directly from one electrode to the other, and almost none will exist in the high-resistance filament. The present invention relates to the circuit shown in parallel with the lamp, which is arranged to allow sufficient current to pass to the solenoid to cause the iron cup to be attracted, the current through the high-resistance filament being too weak for this purpose. When the mercury-vapor becomes ionized and the current through the lamp increases, a switch in the auxiliary shunt circuit is opened and waste of energy is prevented thereby.


FIGS. 5 AND 6.—STEINMETZ MERCURY-VAPOR LAMP.

In order to overcome the color defects of the light from a mercury-vapor lamp, Mr. Richard Kneck, of Hanaw, Germany, according to a United States patent issued May 5, would mix other substances with the mercury. For instance, a mixture of 98 parts of cadmium with 2 parts of mercury has been found to give excellent results. When this mixture is used only a very insignificant quantity of mercury appears at every moment on the surface of the melted alloy and vaporizes, while at the same time a larger quantity of cadmium vaporizes.' It is stated that even better results can be obtained by diluting the two metals to be vaporized in a metal which cannot vaporize at the operating temperature of the lamp. A suitable lamp can be made by using tin to which 5 per cent of cadmium and 2 per cent of mercury have been added. This lamp can be started by means of sparks produced by induction and it produces a light, of which the spectra of the cadmium and of the mercury show an approximately equal intensity. The tin does not boil at a temperature of 1200 deg. C. in vacuum, while the cadmium boils at 450 deg., and the mercury at 150 deg. In consequence of this no spectrum of the tin will appear, since the mean temperature of the lamp space is far below the boiling point of the tin in vacuum. In such a lamp the tin merely serves as a diluter of the two metals to be vaporized, namely, cadmium and mercury, and the effect of this diluter is that the two metals vaporize in a constant proportion on the surface of the electrode. The lamp tube should be made of quartz, so that full advantage may be taken of operation at high temperature.

LETTERS TO THE EDITORS.

The Inventor's Problem.

To the Editors of Electrical World:

Sirs:—The United States patent system purports to be a method of rewarding inventors, and thereby stimulating the production of inventions of value to the public.

In reality the principal beneficiaries of the United States patent system are the patent lawyers and the large manufacturing corporations.

There is no class of brain workers in the world so dependent upon another class as are the United States inventors upon the United States patent lawyers.

There is probably not an experienced inventor in the United States who would not prefer some one of the foreign patent systems to our patent system, unless he is really a representative of one of the large corporate interests. On the contrary, practically all patent lawyers will tell you that the United States patent system is the best in the world. And so it is for the patent lawyers. But it is probably the worst in the world for the inventor.

Our present patent system has been gradually evolved into its present form, not in the interests of the inventors nor of the public, but in the interests of the patent lawyers and of the large corporate interests. This is a natural consequence of the fact that they are the only parties who have given serious attention to changes in the patent system. The inventors seem to have foolishly hoped that someone else would guard their interests for them and they can blame no one but themselves for their present weak position.

If all the inventors of the country should elect representatives and all the patent lawyers should do likewise, and these representatives should convene to consider reforms in the patent system, it would probably be found that many radical changes advocated by the inventors would be opposed by the patent lawyers, and vice versa.

As a class the American inventors are a most helpless class, and are growing more so every day. They do not come in contact with each other and have no representative organization. The quality of American patented inventions is depreciating steadily. This is the natural result of the fact that the inventor cannot get the reward which, as a patentee, he is entitled to. Most of the money he can earn has to be spent in lawyers' services and the enormous expenses of patent interferences and litigations, and meantime the large corporations continue to appropriate his new inventions as fast as he patents them. The non-technical and inexperienced judges usually fail to see the invention which the Patent Office saw, and hence decline to grant preliminary injunctions.

The chief sufferer from all this is the American public, which in late years is surprised to find that to buy the latest and best inventions, it must indirectly pay tribute to foreign inventors, because the American inventors are being left so far behind.

Where did the inventions found in the modern automobile come from? Europe.

Where did the designs of our best battleships come from? Europe.

Where did the inventions as to recent electric-railway development come from? Europe.

Where did the revolutionary inventions in high-efficiency incandescent and arc lamps come from? Europe.

It is unnecessary to extend the list. Every observer knows that while 20 years ago we heard almost daily of important inventions of American inventors, nowadays we are obliged to talk of the inventors of the past generation in this country.

What will be the outcome of this suppression of the constitutional rights of American inventors? Probably the outcome will be still further combinations of capital and new boards of patent control and further increase in the price to the public of every manufactured article.

What is the relief for the public and for the inventor? The abolition of the so-called patent rights or else an intelligent revision of the laws by Congress in the interests of the public and of the inventors.

The interests of the public and those of the inventor are in common. The interests of the large corporations and of the patent lawyers are certainly not usually in common with those of the public and the inventors.

It is to the interest of the public and of the inventor that the inventor should have for the life of his patent the maximum protection at the minimum cost to him, because this enables the inventor to make new inventions, to the ultimate benefit of the public and of the inventor. The corporate monopolies rely upon capital and organization more than upon inventions, and it is to their interest that the unaided inventor should have the minimum protection and should have the maximum expense in trying to establish his rights. As to the patent lawyer, he is the chief beneficiary of the minimum protection and maximum expense system.

Every real inventor would gladly pay to the government 10 times the present patent fees if the government would stop granting improper patents upon unpatentable devices, and, on the other hand, would carry out its agreement with him in good faith whenever he is really entitled to a patent.

If the government cannot afford to guarantee at its present small fee the exclusive right it purports to grant, and gets paid for, why does it not charge the inventor enough to do its work properly and guarantee its grants in good faith?

It is to be expected that the majority of the patent lawyers and the large corporations would oppose the idea of increasing the government fee to an amount such as would enable the government to really guarantee to the inventor the exclusive right contemplated by the United States Constitution until the courts decide that he is not the first inventor.

Under such an arrangement, if proof of infringement carried with it as a matter of course a preliminary injunction, probably the majority of the patent lawyers would go out of business, but the best of them would continue. Probably the majority of the large corporations would be enjoined until the inventors got their rights, and probably the majority of the ablest inventors in this country would resign their present jobs and again begin to produce and patent valuable inventions.

As there are probably more infringed patents, fewer independent inventors, more successful patent lawyers, and fewer competent judges met with in connection with inventions in the electrical field than in any other field, the Electrical World is an especially appropriate forum for the discussion of these questions, and it is, therefore, to be hoped that many inventors who have recently expressed their views privately will do so publicly as to the difficult questions involved in a consideration of reforms in our patent system.

The practical question for American inventors is: How can the American inventors secure the support of the representative American patent lawyers in advocating patent reforms which will give to the real inventor the maximum protection at the minimum expense instead of the present system of minimum protection and maximum expense?

Bronxville, N. Y. H. Ward Leonard.

A Severe Case of Electric Shock.

To the Editors of Electrical World:

Sirs:—We recently had a very remarkable case of electric shock, which, in view of the high voltage on the line and the subsequent recovery of the patient, I believe is unique in the annals of electrical accidents and will therefore be of interest to the readers of the Electrical World.

In the lower story of our transformer house are located the 50,000-volt step-up transformers, which are star-connected with the neutral grounded, the high-tension leads passing upward through the concrete ceiling, which is the floor of the switch room above. On the occasion in question some employees were at work in the far end of the upper room, when they noticed a man, who was not an employee, standing near the oil switches. On being requested to come away from the dangerous locality he started to leave, but instead of following the safe passageway near the wall of the building, he walked between the 50,000-volt leads (coming through the floor) and the 50,000-volt series transformers to which they connected, when his head came very close to or in contact with one of the leads, receiving the Y-voltage of 30,000 between the lead and the concrete floor, which rendered him rigid; he then fell forward, striking his shoulder against the middle high-tension lead and suffered a second shock, but finally falling clear of the wires.

His head and shoulder and one heel were very severely burned, the nails in the heel of his shoe being partially fused where they were in contact with the concrete floor, and the overload circuit-breakers on the switchboard were opened by the short-circuit through his body. He was finally resuscitated after an hour's hard work and to-day, three months after the accident, is regularly at work.

Gainesville, Ga. F. P. Catchings.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Turbo-Generators.—An account of the discussion which followed the paper of Stoney and Law, recently abstracted in the Digest. S. P. Thompson referred to the progress made in the utilization of materials in dynamo construction, taking as the basis of comparison the coefficient obtained by multiplying together the diameter and length of the armature core and dividing by the kilowatt output. For direct-current machines this coefficient was 2.4 in 1884 and has now been reduced to from 0.98 to 0.83. In the case of alternators the same coefficient has been reduced from 3 in 1889 to 0.64 at present. Most of the speakers did not like the use of smooth-core armatures and metal brushes employed by the Parsons Company and preferred slotted-core machines with carbon brushes. W. Parker said that in the design of direct-current turbo-dynamos the real difficulty is not vibration, but excessive heating, and that it has been found absolutely necessary to use carbon brushes. M. Walker thinks the cylindrical type of field magnet to be better than the salient pole type.—Lond. *Elec.*, April 10.

Lamps and Lighting.

Mechanical Equivalent of Light.—C. V. Drysdale.—A paper giving comparisons between the ideal and the actual efficiency of electric lamps. The efficiency of a lamp is the ratio of the light it gives to the power supplied. This definition suffers from the well-known imperfection due to the color of the light emitted. Strictly speaking, lights of different colors cannot be quantitatively compared. In comparing two lights of different tints, the only scientific method is to integrate the light over the different wave-lengths, comparing photometrically only the lights of the same wave-lengths, and adding up the amounts so found. This has to be done over the visible spectrum. The author isolated the latter by a prismatic contrivance which is more effective than screens. He then measured the radient energy by means of a bolometer, and the light in the various parts of the spectrum by means of a spectrum photometer. The results obtained with a standard incandescent lamp show than an ideal lamp giving white light would furnish 10 cp per watt. This would mean that all the radiant energy would appear in the form of light evenly distributed over the spectrum. For the brightest mono-chromatic light (540 $\mu\mu$) the amount so furnished would be 17 cp per watt.—*Bull.* 274 of *French Physical Soc.*; abstracted in Lond. *Elec. Eng'ing*, April 9.

Metallic-Filament Lamps and Central Stations.—H. W. Handcock and A. H. Dykes.—A paper read before the (Brit.) Inst. Elec. Eng. on electric supply prospects and charges as affected by metallic-filament lamps and electric heating. The authors draw attention to what would happen if high-efficiency electric lamps became universally adopted, and show that the effect would be disastrous for the energy supply authorities. They are convinced that it is essential that present systems of charging should be modified so that electric heating would be encouraged and short-hour consumers made to pay their fair share of the capital costs. The system proposed is a fixed price per kilowatt of estimated demand, determined by the capital costs of the supply system, and a low charge per kw-hour fixed by the production costs, no distinction being made between energy used for lamps and for motors, thus simplifying the wiring. A limit indicator should be fixed to indicate to the consumer by dimmed lamps when he is exceeding his rated consumption.—Lond. *Elec.*, April 10.—In the discussion which followed A. Wright deprecated such advertisements as "70 per cent discount on your bills," instead of "three times the light for the same bill." He pointed to the enormous increase in business which would accrue through cheaper light and to the necessity of reducing the cost of service connections. At present it cost nearly as much per kilowatt to connect to a house as to build a station. H. Hirst stated that new osram lamps can now be paired with old ones. He thought there was no need to resort to the panic measures suggested by the authors. B. Smith did not approve of the proposed "contract demand" system of charging. W. R. Rawlings, as an electrical contractor, objected strongly to the Wright system of charging, and favored the authors' system. F. M. Long described a system in use at Norwich in which the consumer is charged an annual sum of 12 per cent of the net assessment of his house plus 2 cents per kw-hour.—Lond. *Elec. Eng'ing*, April 16.—In a long editorial on the subject it is said that English direct-current central stations are practically all supplying energy at 200 volts and more. If 8-cp lamps are displaced in favor of metallic-filament lamps the consumption is increased, and the cost of lamps become more expensive; if 16-cp lamps are similarly displaced there is not very much difference in the consumption, assuming, of course, that a single metallic-filament lamp does not take the place of two or more carbon lamps. In general, therefore, the direct-current stations are not likely to suffer much from a reduction of load while the consumers will principally gain in light. It is different with alternating-current systems, and on account of the easy transformation of voltage the position is more difficult from the supply point of view and better from the consumers' standpoint. It is thought to be not unlikely that an e.m.f. of, say, 50 volts may come into favor with further developments, so as to permit of greater elasticity in the lighting.—Lond. *Elec.*, April 17.

Metallic-Filament Lamps.—The free supply of low-voltage metallic-filament lamps in England has caused a rush of manufacturers to produce inexpensive fittings, so-called "series adapters," to use two or more lamps in series on circuits of 100 volts or more. Under such conditions the metallic-filament lamp does not show to best advantage in direct-current circuits. On alternating-current circuits, cheap autotransformers are being installed in large quantities. Although their magnetizing losses may be small (three or four watts), the fact that they will rarely be registered by the meter will result in a considerable loss of energy if a large number of such transformers is installed. Central stations should therefore insist upon a certain standard of efficiency in such transformers before permitting them to be connected. The influence of many small transformers on the power factor of the system, although injurious in tendency, is unlikely to become important, since the light-load current will be small in amount and mostly out of time-phase with the e.m.f. in daylight hours. Comparative tables of cost are given for the lighting of a small house with 18 lamps of which 15 are rated at 16 cp and the others at less. It is shown that the use of both metallic and carbon-filament lamps at 100 volts (both kinds mixed, with mostly metallic filament lamps), compared with the use of all carbon lamps at 200 volts, results not only in a better lighted house, but in reduction of cost by more than one-third. The initial outlay in this instance is only the cost of the transformer, and experience extending over 18 months appears to show that, given good care in handling, the useful life of the metallic-filament lamps is three to four times that of carbon lamps, thus rendering the cost of renewals practically equal in each case at present prices. —Lond. *Elec. Rev.*, April 10.

Metallic-Filament Lamp.—An illustrated description of a new metallic-filament lamp of British make, invented by F. Harrison and called the "British Metalite." The filament is an alloy of tungsten and some other metals, and consumes from 0.8 to 1.5 watts per candle, according to life and candle-power. Thus the 115-volt, 20-cp lamp runs at 0.9 watt per (Hefner) candle, and has a life of over 1000 hours. This same lamp, run on a 100-volt circuit, would, according to the pamphlet issued by the manufacturers, give 10 cp at a consumption of 1.5 watts per candle. A 34-cp, 200-volt lamp can also be obtained. The 200-volt, 34-cp lamp consists of six filaments (six loops) arranged in series. An alternative design for this lamp has nine filaments, the length of each double filament being 2 2/8 in. The 100-volt lamp has four or five filaments in series. The filaments are cemented to the supporting wires at the top, and are also supported at the bottom by means of a zigzag spring. The filament itself is particularly smooth, and has the appearance of a very fine steel wire. The finest filament has a diameter of 0.0264 mm. Blackening of the globe does not take place unless the lamps are run at a consumption of 0.5 watt or less per candle, when the temperature is so high that the filament commences to volatilize and the metal condenses on the surface of the glass. On account of the symmetrical arrangement of the filaments, the horizontal distribution of light is perfectly uniform. The distribution in a vertical plane is shown in Fig. 1, which is the polar illumination curve for a lamp without any shade. For the 90-cp, 120-volt lamp the candle-power rises within the first 60 hours to 95 and then falls to 90 again after a life of 1000 hours. The amperes fall steadily from 0.9 to 0.85 and the watts per candle fall to about 0.8 after about 60 hours and rise again to slightly over one after a life of 1000 hours. The lamps are said to run better with alternating current than with direct current and better with high than with low frequency. Lamps are made for all e.m.fs. from 1.2 to 250 volts. The 250-volt lamps have candle-powers from 42.5 to 188.—Lond. *Elec. Eng'ing*, April 16.

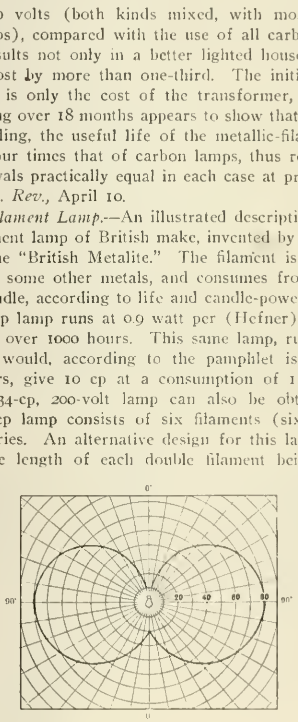


FIG. 1.—POLAR ILLUMINATION CURVE.

Generation, Transmission and Distribution.

Combination of Stations in France.—G. Dary.—An illustrated article on the distribution of electrical energy on the Mediterranean Coast in France. The huge organization of the Société d'Energie Electrique du Littoral Méditerranéen is an example of the distribution of electricity over an extended area where the available waterfalls, while numerous, are extremely irregular in their individual output, and can consequently be arranged to give a regular supply of energy only by a system of general concentration. The company now actually controls a total of 56,000 hp of which 34,000 hp is obtained from waterfalls. The company controls 16 interconnected different stations. The interest in this undertaking consists mainly in the reliability of operation resulting from the combination of different hydro-electric stations. Some of them are established on streams of glacier origin, and others on rivers fed by rainfall. It is possible, therefore, by careful combinations of the different plants to eliminate the influence of periods of low water which arise at different seasons in connection with both sources of hydraulic supply. Furthermore, by having a certain number of steam-driven plants available, it is possible to reduce to a minimum any interruptions to the service which might arise from abnormal atmospheric conditions. The reliability thus obtained is comparable with that of a steam operated plant equipped with reserve engines and generators, and the flexibility is generally much greater by reason of the considerable reserve power available.—Lond. *Elec. Rev.*, April 24.

Hydro-Electric Stations in Switzerland.—Continuation and conclusion of the long serial giving a description of the typical arrangements of hydro-electric generating stations in Switzerland. In the last two instalments the usual equipment of alternating-current stations of the line and of the substations is described.—*L'Ind. Elec.*, March 25 and April 10.

Electric Cranes.—H. H. Broughton.—Continuations of his long illustrated serial. In the present instalments the author deals with collectors, switchgear and wiring. Two typical diagrams of connections are given, and from these have been deduced simple rules for determining the number of cross wires required to supply energy to the various motors. Types of line insulators, supports and current collectors are then described, with examples covering the best practice. Installation material for revolving jib cranes is dealt with at some length, and collector rings and cable-drums of English make are described. In order to protect crane equipments against overloads and short circuits, and to facilitate testing, it is usual to provide a switchboard with a double-pole main switch and a double-pole fuse, and single-pole circuit fuses. For high-voltage and continuous-current equipments, circuit breakers and magnetic blow-out fuses are recommended. "Association" cables, 600 megohms grade, should be used for wiring, and the insulation resistance of each motor-circuit should be observed regularly. Ground and wall connecting boxes suitable for connecting to outdoor cranes, more particularly dock cranes, are also described.—Lond. *Elec.*, April 10 and 17.

Electric Installation of Rolling Mill.—O. Allen.—An illustrated description of the electric installation of a rolling mill at Sandviken in Sweden. It is a three-phase plant, and in order to equalize the rapidly-varying load, use is made of a motor-generator connected with a booster and a storage battery, the booster being excited by a special converter connected to the supply mains.—*La Lumière Elec.*, March 21.

Traction.

High-Tension Roads in Europe.—An illustrated article on the present status of high-tension direct-current and alternating-current railways in Continental Europe. Compared with the United States, in Europe the three-phase system has been a more active competitor to the direct-current and single-phase systems. Several 900 and 1000-volt direct-current lines are noted. Of three-phase railways the Valtellina road and the Simplon Tunnel are dealt with. Of single-phase railways the Valle-Maggia 5000-volt, single-phase system, equipped by the Oerlikon Company, and the generating station for the Blankenese Hamburg single-phase line are noted. The generating station contains four 1250-kw, 6300-volt, 25-cycle alternators. The transmission e.m.f. is 30,000 volts, the trolley e.m.f. 6300 volts. Sixty motor cars are used. A test line has recently been built by the Prussian State Railways at Oranienburg, the purpose being to study ballast, rail joints, ties, etc., in a shorter period than would be possible under ordinary operating conditions. It is also intended to use this section for testing motors, electric control systems, etc., as to their availability for trunk line service. The track, which is built in a forest, is circular, 1.75 km (1.08 miles) long and without grades. Cars can be operated on it at speeds up to 50 km (31 miles) an hour. Up to the present time experiments have been conducted with two 52-ton motor cars, each equipped with two Winter-Eichberg single-phase motors having an "hourly" rating of 110 hp, a "continuous" rating of 45 hp and a "maximum" rating of 125 hp. The trolley e.m.f. is 6000 volts, 25 cycles, collected through pneumatically-operated sliding bows. The trolley wire is suspended as a catenary. An unusual feature about the tests is the control of the car from a small building along the route and the automatic numbering of round trips.—*St. R'y Jour.*, May 2.

Single-Phase Road.—An illustrated description of the York and Hanover 6600-volt, 25-cycle, single-phase, high-speed railway in Pennsylvania which has a length of 18½ miles. The cars are equipped with four 75 hp Westinghouse motors connected for multiple operation with unit-switch control system. —*St. R'y Jour.*, April 25.

Switzerland.—S. Herzog.—A summary of electric railways built in Switzerland in 1907. Some notes are also given on lines projected or in course of erection.—*La Lumière Elec.*, March 28.

Installations, Systems and Appliances.

Direct-Current High-Tension Electric Supply.—An editorial of the slow progress which has been made by the direct-current, high-tension electricity supply system, called in England the "Oxford" system from its first installation at Oxford. The largest installation of this system is that in Hull, which is very satisfactory, the problems of commutation and insulation having been practically solved. With this system motor-generators are installed in substations in different parts of the supply area; these stations are unattended, being controlled entirely from the central station. As soon as the high-tension motor, to which is coupled the low-tension generator, has run up to speed, the low-tension end is automatically paralleled with the network. Even though the number of substations may considerably exceed that of an alternating-current direct-current system, yet since the substations can be controlled entirely from the generating center, the cost of attendance is reduced and the supervision of the supply is concentrated. In the same issue the detailed illustrated description of the switch gear used in the Hull station is concluded.—Lond. *Elec.*, April 10.

Charging for Electrical Energy.—T. Gruber.—The author discusses several methods of charging for electrical energy in which the number of hours for which the installed lamps, etc., are used is taken into consideration. In the oldest method the charge was based on the number of kw-hours divided by the number of kilowatts at which the installed apparatus and lamps were rated. A better system is that first introduced by Wright, in which the charge is based, not on the rating, but on the maximum load really obtained in the installation. To reduce the hardships of this system, Agthe uses maximum-demand indicators, which register only a maximum demand lasting for at least a quarter of an hour. The present author recommends the basing of the charge on what he calls the "normal" number of hours of using the lamps. From statistical data it may be shown that a certain average figure of lamp-hours consumed per year per number of lamps installed belongs to every class of offices, shops, public places, etc., which close at a certain hour. This figure will be higher for stores closing at 8 or 9 o'clock than for offices closing at 5 or 6, while the highest figure will be obtained for restaurants and amusement places kept open all night. A much higher percentage of the installed lamps are used simultaneously in commercial places than in residences. The author divides all the customers up into classes according to their occupation. In residences, statistics show that the maximum load corresponds to the simultaneous use of about 75 per cent of all the installed lamps. The size of the meter is to be chosen accordingly. But what is called the "normal" lighting load in residences starts at about 12 per cent of the rating of the lamps installed. It is recommended to register the time during which the installation is used at or above its normal load (at or about 12 per cent of the lamp ratings in the house installation). The method of charging recommended combines a fundamental fixed rate per kilowatt with a rate per kw-hour on the basis of the above considerations. The object of the method is to reduce the charge for residence lighting to a fair figure, since with the relatively long hours of normal load they represent satisfactory customers, and it is necessary to do so in order to enable electric lighting to compete with gas lighting.—*Elek. Zeit.*, March 26.

Electricity on Shipboard.—A long and fully illustrated description of the electric equipment of the steamship *Mauretania*. —Lond. *Elec. Rev.*, April 3, 10 and 17.

Wires, Wiring and Conduits.

High-Tension Insulators.—C. J. Greene.—The first part of a long article on high-tension insulators for overhead transmission lines. The author thinks that on nearly all overhead lines the size and cost of insulators have been needlessly great in consequence of a lack of exact knowledge. The author has carried out a number of tests at e.m.fs. up to 100,000 volts of three types of insulators of English make shown in Fig. 2, all of best quality vitrified porcelain, specially made for high-tension lines. In every case the pin was earthed, and the pressure was applied to a soft copper binding wire bound round the side groove of the insulator. The end of the wire, after being fastened to the insulator, was carried vertically upward so as not to reduce the arcing distance to the pin The arcing distance during the test was, therefore, in every case *K B C D* for the dry insulators. The over-all diameter varied between 5¾ in. and 7¾ in. and the over-all height between 6 1/5 and 8 1/5. These insulators were tested dry and wet, and in general it seems that the average puncturing e.m.f. of the porcelain tested is approximately 100,000 volts per inch. Some special observations made during the tests are interesting. When an insulator of type No. 2 was wet all over with clean, fresh water and a rising pressure was applied, the first spark jumped across at 45,000 volts and an arc almost established

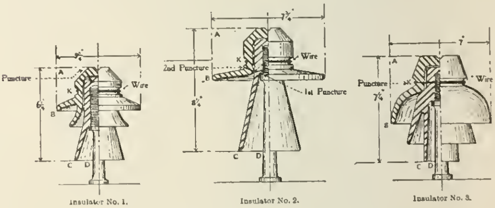


FIG. 2.—HIGH-TENSION INSULATORS.

itself, but the heat thus generated caused the insulator to dry and the arcing ceased. The pressure was then gradually increased, and with each slight increment of pressure, an arc attempted to establish itself, but was extinguished by the further drying of the insulator. At about 90,000 volts, when the insulator was probably quite dry, a permanent arc was coated with a mixture of coal dust and water. The process of the insulator drying and cleaning itself is interesting, but it is probable that it takes place with sufficient rapidity to be of service only at high voltages. An insulator does not by any means necessarily puncture in its thinnest place nor does its puncture necessarily form the shortest path of breakdown between line and pin. The insulator punctures at some point of local weakness which the electric pressure finds. It is probably quite a mistake to make any single part of an insulator with a thickness greater than 1 in. Masses of porcelain vitrified under great heat suffer from the same toughness as large masses of iron which cool unequally. By unequal cooling local internal stresses are set up which later result in a breakdown.—Lond. *Elec. Rev.*, April 24.

Electrophysics and Magnetism.

Electric Discharges Through Gases.—J. J. Thomson.—An account of his fifth Royal Inst. lecture on electric discharges through gases. The speaker summed up the relations between sparking distances, gas pressure and potential. According to the law of F. Paschen the potential difference required to spark through a gas depends merely on the quantity of gas through which the spark has to pass. If the electrodes are formed by the fixed base and the movable piston of a cylinder, then the product of gas pressure and spark length will be a constant, provided there be no leakage of gas. For the same quantity of gas twice the volume (and therefore twice the spark length) will give half the gas pressure, and the sparks would pass at the same potential difference. This law of Paschen fails, however, when applied to very small gaps of wave-length dimensions. The nature of the gas does not matter for very small gaps, but the nature of the electrodes does. The force required to strike a very short spark is very much greater than that for ordinary spark lengths. It is about 1,000,000 volts per centimeter and about the same order as that required to send a spark through a solid or liquid dielectric such as glass or petroleum. The speaker suggested that in this case the spark is no longer carried by the ions produced by collisions with the molecules. It may be carried by the electrons dragged out of the electrode by the intense electric field.—Lond. *Elec.*, April 10.

Electronic Theory.—T. A. Schott.—A highly theoretical paper on the frequencies of the free vibrations of quasi-permanent systems of electrons and on the explanation of spectrum lines. It is shown that no system which includes electric charges in orbital motion can be absolutely permanent, for orbital motions always imply a radiation of energy. A degree of permanence sufficient to allow of the production of fine spectrum lines can be expected only from systems built up of coaxial circular rings of equi-distant electrons.—*Phil. Mag.*, April.

Units, Measurements and Instruments.

Water Rheostat.—An account of the discussion which followed a paper recently abstracted in the Digest on artificial loads for testing generators. O. T. Davis said that as a general rule the circulating water discharge from a surface condensing plant is suitable for use as an artificial load. For a permanent resistor, he is in favor of a brick-built, cement-lined tank. For a low-voltage resistor, the plates (which may be of ½-in. sheet iron for lightness) should be fixed in frames, and the load controlled by raising or dropping the whole frame into the water. This arrangement reduces the necessary size of the containing tank. It is good practice to have a light fuse in series with each individual positive plate, and the plates may be grouped, the groups being controlled by switches. The load may then be prepared by lowering the resistor frame into the water, switching on a certain number of groups of plates and finally securing fine adjustment of resistance by further raising or lowering, or preferably by manipulating a weir on the outlet. Using water with a resistance temperature curve given in Fig. 3, the writer has found the following to be convenient distances from positive to negative plates: 100 volts, 2 in.; 200 to 300 volts, 3 in.; 400 to 600 volts, 5 in.; 1000 volts, 7 in. Iron-wire resistors are best arranged in a box, and should be well swept with water. If run at a density of about 10,000 amp per square inch their life is fairly long. R. K. Keer gave details of a liquid resistor in use in an electrical laboratory in Manchester. The electrolyte used is a 2 per cent solution of aluminum sulphate, the electrodes being lead plates. This arrangement is very clean, as there is practically no sediment or fumes formed.—Lond. *Elec. Rev.*, April 3.

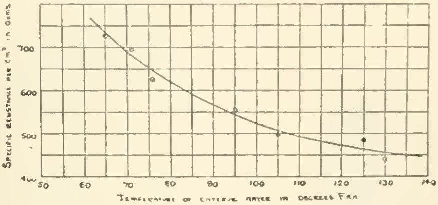


FIG. 3.—RESISTANCE TEMPERATURE CURVE.

Flaming Arc Lamps.

By A. S. Pearl.

Among the more prominent recent developments in electric illumination is the so-called flaming arc lamps, as it is in this type of lamp that the highest efficiencies in electrical illumination have been secured. The fundamental basis of this improved efficiency is that the electrodes have been impregnated with a combination of metallic salts, such as compounds of calcium, barium, strontium, etc., this change first being brought to notice by European engineers.

The principal phenomenon exhibited in the arc produced with metallized carbon electrodes is the increase in the length of the arc. For equal voltage, the length of the arc which then becomes a "flaming arc" is approximately five times as great as the arc between the usual type of solid carbon electrodes. Then again the aspect of the arc becomes quite abnormal, as there is no longer a great and brilliant crater in the positive electrode; in other words, it is no longer the incandescence of the carbon which supplies the chief source of light, but the arc or flame itself becomes luminous.

In the pure carbon arc, the largest percentage of light comes from the incandescent carbon points, while in the arc produced with impregnated carbon electrodes, the arc as well as the electrode points becomes luminous and the carbon being impregnated with metallic salts produces "a metallized carbon arc."

Various designs of lamps have been made to use such impregnated carbon electrodes. In the earlier lamps of Bremer, electrodes were operated in a vertical position similar to those in the pure carbon arc. The vertical axis arrangement of the electrodes did not prove entirely satisfactory when carbon electrodes mixed with mineral substances were used, owing to the production of slag, which, when melted, fell upon the lower electrode, thus preventing the free passage of the current and causing the arc to become very unstable.

To overcome this difficulty, it was necessary to design a new type of lamp which instead of employing electrodes placed in a vertical position and in alignment, are arranged so that they converge with their free ends downward, which has proved much more satisfactory owing to the fact that the slag drops away from the electrodes

Ordinarily when the electrodes are thus arranged the arc would form above the points, but by locating an electromagnet above the arc, the latter is projected by the repelling influence of the magnetism which maintains the arc between the points

This lamp was shown at the Paris Exposition in 1900, creating much favorable comment. Many different lamps have since been placed on the market to use impregnated carbon electrodes.

On account of the large volume of light given off by these lamps, they have been conspicuous during the past few years as an advertising feature, being used extensively for lighting fronts of stores, theaters, large signs and amusement parks.

The flaming arc lamps thus far used have produced a golden-yellow or vivid-white light, according to the composition employed in the electrodes. The composition giving the golden-yellow light are the most efficient and effective, as the color is hardly distinguishable from the color of the light from oil and candle flames and incandescent electric lamps. This color has particular points of advantage for exterior illumination, as it is least absorbed by smoke and fog.

The flaming arc is therefore well adapted for lighting foundries, iron mills, railway stations, railway yards or other large enclosures where smoke abounds, or for lighting large enclosures such as machine shops where it is necessary to hang the lamps a considerable distance from the floor in order to clear traveling cranes and moving machinery.

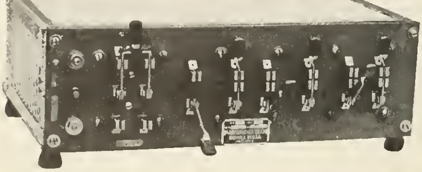
Heretofore, most flaming arc lamps used in this country have been imported. These lamps were usually more or less complicated, but owing to the increased demand for flaming arc lamps, it has been found desirable to develop more simply constructed lamps which would more nearly meet the conditions in this country. Such lamps are being marketed by the Central Electric Company, Chicago, Ill. The accompanying illustration shows a G. I. lamp which represents the very latest development in American flame arc lamps.

FLAMING ARC LAMP.

The chief points of the lamp are as follows: These lamps are manufactured for both alternating and direct current and as they are usually operated in series on standard lighting circuits, the well-known differential winding is used. They have a clutch device, feeding both electrodes by a single clutch, making them of very simple and reliable construction. Clock mechanism and chains have been eliminated, and they are designed to use standard makes of flame lamp electrodes. All insulation is of non-inflammable material. Every part is accessible when the shell is lowered into trimming position.

Load-Rheostat for Two Voltages.

The accompanying illustration shows a meter testing load-rheostat for use at either 110 or 220 volts. The rheostat is provided with a double-throw switch which when in one position allows 5-amp steps from 0.5 to 23.5 amp to be obtained when the e.m.f. is 110 volts; when the switch is in the other position 0.5 amp steps from 0.5 to 11.5 amp may be obtained when the supply e.m.f. is 220 volts.


LOAD RHEOSTAT FOR TWO VOLTAGES.

The rheostat is designed to replace lamp-bank for non-inductive resistance load. The elements are built up of enameled resistor units. There are several switches in parallel, each switch controlling its respective resistor. Each switch is marked with the approximate number of amperes that will exist in the resistor when it is closed.

The complete rheostat weighs only 14 lb. It has been placed upon the market by the Ward Leonard Electric Company, Bronxville, N. Y.

Hillside Works of the Wagner Electric Manufacturing Company.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., has recently built a new plant at Hillside Station, about 800 ft. west of the city limits. The site comprises about 15 acres and is admirably located as regards light and air and has excellent shipping facilities. The layout of the buildings is such as to give opportunity for expansion and also to reduce to a minimum the cost of manufacture. The materials are received at the north end of the plant and are stored in the rough stores building. All castings from the foundry will either be stored in this building or will pass through it en route to the workshops. The individual factory buildings are located at right angles to the rough stores building, the material being placed in the stores building at such a place as will insure its being loaded directly onto trucks running into the individual factory buildings. The latter have been laid out as units in themselves, no partially completed product being transferred from one building to another for completion.

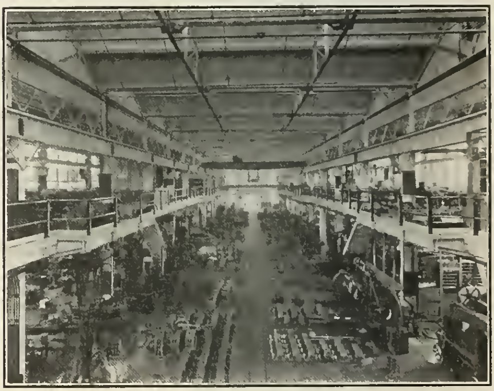


FIG. 1.—MAIN MACHINE SHOP.

All the buildings are served with traveling cranes operated with Wagner three-phase motors and are also fitted with hand cranes and air hoists to further the expeditious handling of material and finished product. A feature of the layout is the system of subways which connects the various buildings and departments. The subways run through the buildings and are served by elevators located at various points throughout the plant. The material is dropped from the factory floor to the subway, there transferred to the necessary department, and raised by an elevator to the particular spot where it is wanted. This prevents trucking through the aisles and keeps the latter practically free from accumulations of material.

The plant comprises a transformer building, a punch shop, main machine shop, service building, administration building, power house, water tank and reservoir, and is connected with the main line of the Wabash Railroad by a spur track. The buildings are excellently designed as regards light and ventilation and are fitted with all modern conveniences, such as metal lockers, lunch rooms, etc. The main machine shop is shown in

Fig. 1. This building is 100 ft. wide by 312 ft. long and has galleries on either side. The building has a saw-tooth roof, the vertical panels facing north. A 10-ton crane, operated by three-phase motors, runs the length of the building, and the shop is equipped with the most up-to-date machinery known to the trade.

A corner of the transformer shop is shown in Fig. 2. The heavy and large transformers are built on the floor of this building, while the coil winding and insulation processes are conducted in the gallery. A loading platform is provided, as shown, so that the overhead crane may serve the gallery. The double-track subway has turntables serving the elevators, and frequent switching points are provided so that trucks may be sent from one track to the other as occasion demands. The subways also carry the various power and lighting feeders together with the refrigerator and water supply.

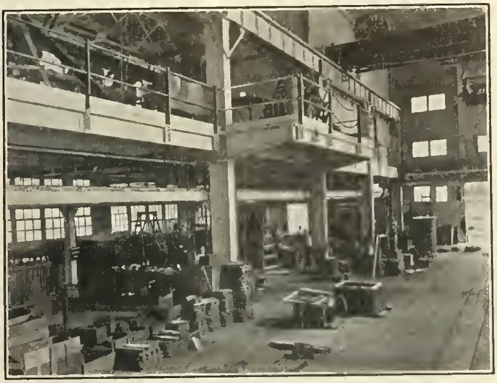


FIG. 2.—TRANSFORMER SHOP, SHOWING OVERHEAD GALLERY CONSTRUCTION.

The power house contains a 250-kw, three phase, 440-volt, 60-cycle alternator direct-connected to a tandem compound engine; a 100-kw, 133-cycle, 110-volt, single-phase alternator for testing purposes and a 50-kw, 500-volt, direct-current generator also for testing purposes. The output is controlled by Wagner switchboard indicating instruments and measured by Sangamo watt-hour meters. The boiler plant comprises two Heine boilers fitted with American chain-grate stokers driven by Wagner single-phase motors.

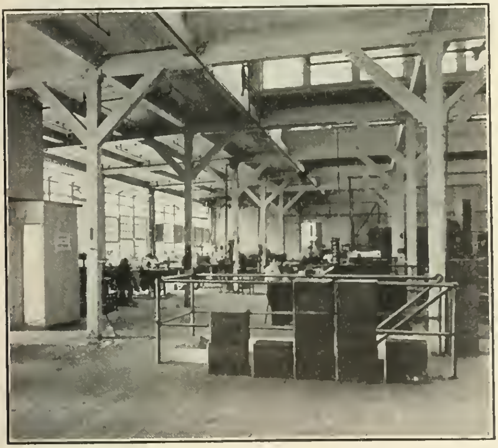
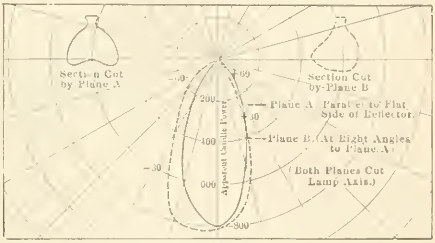


FIG. 3.—SECOND FLOOR OF PUNCH SHOP.

Helmet Reflector with Tungsten Lamps.

The accompanying curves show the light distribution in two planes about a Helmet reflector equipped with a tungsten lamp giving 80 mean horizontal candle-power. This Helmet reflector has already been illustrated in these columns, and is made by the National X-Ray Reflector Company, 245 East Jackson Boulevard, Chicago. It is especially designed for the lighting of high, shallow show windows, and for this reason is made a large size, 12 in. diameter by 11½ in. high, in order to reflect as large a percentage of the light as possible down where it is needed in the show window. The concentration obtained is something remarkable, reaching over 800 cp in the direction of the bottom of the window, and being in excess of 600 cp over an angle of over 35 deg. The reflector is intended to be used so that the plane *B* indicated on the photometric curve is at right-angles to the window pane, while the plane *A* is parallel with the pane.



LIGHT ABOUT HELMET WITH 80-CP TUNGSTEN LAMP.

Flaming-Arc Lamp.

The Grant flaming-arc lamp, manufactured by the German-American Electric Company, New York, recently placed on the market, is extremely simple in construction. It possesses no clockwork, gears, clutches, shunt-coils, resistors or dash pots, the electrodes being fed forward by gravity alone. The solenoid is provided with a floating plunger so adjusted that when the lamp operates under the proper voltage, it will separate the electrodes to a given distance, and use the amount of current for which they are designed. On account of this arrangement, no extra resistor is needed and no resistance heat loss takes place, and the lamp is highly efficient. Variations in the line

FLAMING ARC LAMP.

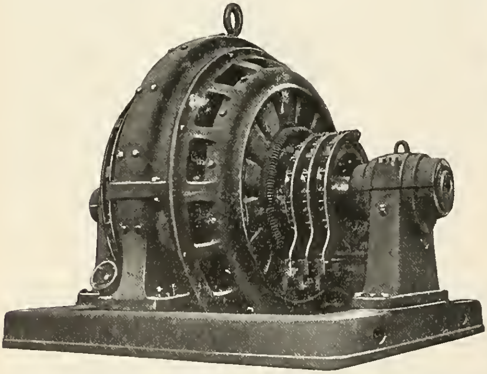
voltage which occur from time to time cause the solenoid to attract the plunger more or less strongly and thereby hold the arc length at the proper value.

The feed mechanism of the lamp is controlled by a lateral support, so arranged that as the electrodes are consumed underneath the support, the negative electrode deteriorates sufficiently to allow the electrodes to move forward properly. The frame of the lamp consists of top and bottom pieces held by four substantial rods and one additional rod in the middle to guide the electrode holder properly. The lamp is only 26 in. in height and uses 24-in. electrodes; it weighs 20 lb.

Rotary Converter with Synchronous Voltage Regulator.

The voltage delivered at the commutator of a rotary converter usually bears a fixed ratio to that at the collector rings. In lighting and industrial work it is essential that the potential on the direct-current feeders be maintained constant without regard to the variations in the supply voltage, and several methods have been devised for regulating the potential. Rotary converters are often provided with a series winding, and, when accompanied by a suitable reactance on the alternating-current side, this arrangement has been the only one for maintaining the voltage which did not entail considerable auxiliary wiring. Potential and induction regulators are used in many installations. Although these devices can be fitted up to control the voltage automatically, they not only occupy considerable space, but at the same time add a large amount to the auxiliary wiring required.

The rotary converter with synchronous voltage regulator illustrated herewith is designed to supply, in one compact, simple and efficient machine, an entirely self-contained piece of apparatus which will accomplish all that has heretofore been done by the use of the potential or induction regulator. These machines can be designed for either automatic or non-automatic control of the voltage at the commutator. Several of these converters are now being used by the New York Edison Company, where it is stated that they have proved very successful. In designing these machines it was necessary to proportion them so that they could be installed in existing substations in the same space that had been occupied by rotary converters of an earlier design.



ALTERNATING CURRENT SIDE OF SIX-PHASE ROTARY CONVERTER.

The machine illustrated herewith is of 1000-kw nominal rating and is designed to deliver direct current at from 225 to 300 volts when receiving alternating current at 166 volts, six-phase, 25 cycles. These machines have 16 poles and, therefore, operate at 187.5 r.p.m.

The rotary converter with synchronous regulator consists of a rotary converter of ordinary construction combined with a small alternating-current generator, the field and poles of the latter being supported by a bracket from the frame of the converter-field structure. The alternating-current regulating armature is carried on the same shaft with and between the armature of the rotary converter and the slip rings and, therefore, requires no separate collector or brushholder mechanism. The field coils are supplied with current from the substation busbars. The commutator voltage can be either raised or lowered by altering or reversing the field excitation of the alternating-current generator portion of the machine in a manner similar to that adopted in controlling the voltage of an alternator. The sole difference lies in the fact that the synchronous regulator is designed so that the normal commutator voltage is delivered with normal voltage on the alternating-current side with zero excitation of the regulator field. The commutator voltage is increased or decreased by altering the strength or the polarity of the regulator-field exciting current.

The advantage of this method of controlling the commutator voltage lies in the wide range of accurate control which can be secured without affecting the power factor of the circuit and the compactness of the arrangement.

The rotary converter with synchronous voltage regulation has been placed on the market by the Westinghouse Electric & Manufacturing Company. It is claimed that the new arrangement makes the rotary converter, within limits, as flexible and as easily controlled as a motor-generator set, retaining at the same time all of the advantages of the rotary converter.

Vertical Shaft and Back-Geared Motors.

Fig. 1 illustrates a new direct-current, Roth vertical-shaft motor for use with centrifugal pumps, the pumps being placed at water level. This motor can be furnished either with or without the tripod base, as shown. Some pump manufacturers prefer to make their own motor bases and brackets, in which case the tripod base is left off and a finished surface is left on the bearing bracket to which it is easy to make connection with any style of bracket base. Fig. 2 shows one of the new direct-current back-geared motors of the same manufacture, and from the view the heavy proportions can be understood. These machines are substantially made, and run very quietly. Both these motors have been recently brought out by Roth Brothers & Company, 29 South Clinton Street, Chicago, which concern reports operating its works practically with full force, and even running overtime during the recent financial flurry. The company now has a New York office at 136 Liberty Street.

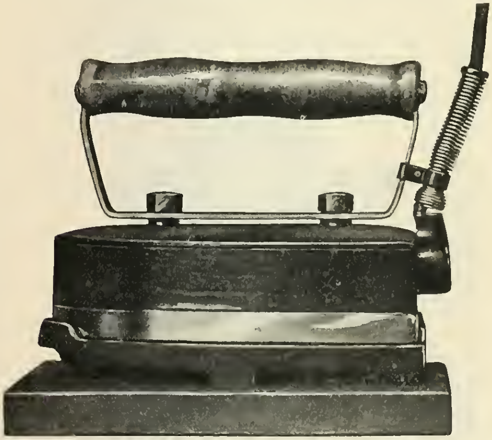
FIGS. 1 AND 2.—VERTICAL SHAFT AND BACK-GEARED MOTORS.

Electric Irons for Tailors.

To meet the demand upon the part of manufacturing and custom tailors for an iron embodying the same principles as the Westinghouse electrically heated sad iron, the Westinghouse Electric & Manufacturing Company has developed the goose shown in the illustration. This goose is designed to endure the same rough usage as the plain cast-iron goose and to fulfil all the requirements of the tailor with the elimination of the heat, dirt and inconvenience incident to other methods. It is made in two shapes—wide and narrow. The wide goose is 5½ in. by 8½ in., and comes in four different weights—12, 15, 18 and 22 lb. The narrow goose is 3 in. by 10 in. and is furnished in three different weights—12, 15 and 18 lb. Both types are made for three different voltage ranges—100-107, 108-115 and 116-125.

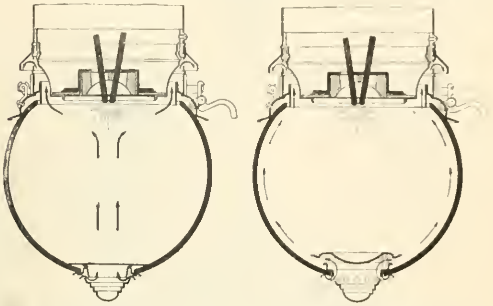
In order to avoid complication, a single heating element is provided which is sufficient to bring the iron to a working temperature and to maintain it uniformly during the heaviest service. On intermittent or light work the circuit can be turned off a considerable portion of the time, and the irons are constructed so that their working surface will remain hot a long time after the iron has been thoroughly heated.

The heating element is a thin steel grid, arranged to distribute the heat evenly over the entire working surface of the iron. This grid is hermetically sealed within a fireproof dielectric of good thermal conductivity, and is held between two solid iron blocks, one of which forms the working surface of the iron, the other, immediately above it, serving as a heat reservoir or thermal equalizer by which the constant input of heat from the heating element is stored up and given out to suit the irregular demands of the work. These two portions of the iron are secured together and in effect form a solid mass which is separated from the top of the iron by means of an air space which forms an effective heat insulator.


TAILOR'S ELECTRIC IRON.

Improvements in Flaming Arc Lamps.

Every flaming arc lamp when in operation gives off fumes and other products of combustion. The gases usually escape, but the ashes form an incrustation on the globe and absorb a great deal of the light. For this reason the globes must be regularly cleaned at short intervals and this adds to the maintenance cost of the lamp. In properly constructed lamps, a strong current of air enters through holes in the ash tray and drives before it the gases formed by the combustion of the carbons. Fig. 1 shows the usual scheme of ventilation, from which it is evident that the incoming current of air passing directly from the bottom to the top of the lamp, as indicated by the arrows, does not force out the gases next the globe and the ash contained in them. In order that the air shall be constrained to pass along the inside of the globe and thus sweep its surface, the Allgemeine Elektricitäts Gesellschaft, of Berlin, Germany, has devised the ash plate shown in Fig. 2. The air enters the holes as indicated and passes around the inside of the globe, escaping finally at the top. To show the efficacy of the device, tests were made on lamps with the old form of ash plate and with the newer form. At starting, the light in both cases was 3450 hefner candles in the lower hemisphere. After burning for 16 hours and 20 minutes, the intensity of light in the lower hemisphere was respectively 2240 hefner candles and 3390 hefner candles. The amount of light absorbed by the incrustation on the globe in the first case was 35 per cent and in the latter case 1.75 per cent at the end of the burning period.


FIGS. 1 AND 2.—GERMAN FLAMING ARC LAMP

Tungsten Diffusing Cluster.

To fill the demand for a large lighting unit of approximately the same power as the enclosed arc lamp, the General Electric Company has perfected the tungsten economy diffusing cluster. This unit provides, in addition, a light of variable intensity with a wide range of wattage adjustment without mechanical change.

The diffuser is designed primarily to carry six tungsten lamps suspended in a vertical position. Very good results, however, can be obtained by the use of either tantalum or carbon filament lamps. When the latter are used the platform carrying the lamps can be readily lowered without taking the fixture apart. This adjustable feature makes the fixture universal for all types of incandescent lamps.

The illustration shows the standard 26-in. cluster. The diffuser is made of steel, coated with white porcelain enamel on the under side and black on the top. The supporting reflector is made of brass with a nickel finish and carries springs to compensate for expansion or variation in the size of the globes. The casing is finished in streaked oxidized copper.

The 39-in. or mill type diffuser is identically the same as the 26-in., except that the diffuser is larger, and instead of being finished in porcelain enamel is coated with white zinc enamel. For store lighting, the 26-in. diffuser is recommended, and for mill and factory work the 39-in. gives more satisfactory results as regards distribution and diffusion.

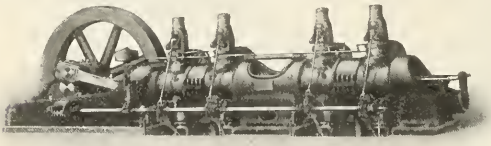
It has been found from experience that the 39-in. tungsten economy diffusing cluster gives excellent results for mill lighting when equipped with three 100-watt tungsten lamps. This permits, for the same energy, somewhat closer spacing than arc lamps.

The shade is made of clear glass frosted on the inside, and as may be seen from the illustration, is curved to take the same general shape of the lamps. Placing the frosting on the inside of the shade gives a lower intrinsic brilliancy than is obtained by the same grade of frosting placed on the lamps, and does not reduce the life of the lamps. The six-lobe shade is standard for all lamp combinations, and the curvature of the shade minimizes the spotted effect so apparent when part of the lamps are extinguished in a fixture having a spherical globe. By using various combinations of 40, 60 and 100 watt lamps, the cluster can be made to operate at 120, 180, 240, 300, 360 and 420 and 480 watts.

TUNGSTEN DIFFUSING CLUSTER.

Mesta Gas Engine.

The important position in the power field now occupied by the modern heavy duty gas engine has received careful consideration by the Mesta Machine Company, and after several years of close observation of the various types developed, both here and abroad, this company has actively taken up gas engine design and construction along with its regular established heavy duty Corliss and piston valve reversing steam engines.



HORIZONTAL GAS ENGINE.

The accompanying illustration shows the general arrangement of the 600-hp, 400-kw, direct-connected unit now in process of construction in the works at West Homestead, and typifies the series of sizes called for in the designs as at present laid down.

The engines, which are designed for operation on the four-cycle principle, are built either tandem or twin tandem. This method of placing the two double-acting cylinders in tandem results in two power strokes per revolution, giving very close regulation and making it feasible to operate 60-cycle generators in parallel without the use of any form of flexible coupling. Where the twin tandem type is employed, the power strokes are doubled, and result in the same effective torque as in a cross-compound steam engine.

The design throughout is characterized by massive construction, well suited to the demands of the most severe operating conditions; but in obtaining this necessary strength, the matter of accessibility and simplicity has not been lost sight of.

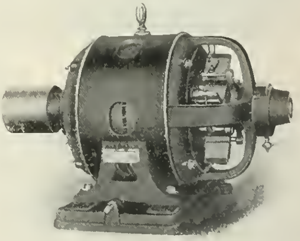
Following the American custom, the overhung crank construction is used, and owing to the tandem arrangement, attention has been given to longitudinal expansion, the cylinders being permitted to expand or contract with the varying temperature, while in no way affecting the engine alignment.

Simplicity and reliability are attained in the valve gear by first doing away with the spiral gear drive for the lay shaft, and secondly, by operating both inlet and exhaust valves from a single eccentric. All parts subject to wear are fitted with adjustable devices, the aim being to produce an engine well suited to the demands of 24-hour service.

For the development of this line of engines, ranging in capacity from 500 brake-hp to 4000 brake-hp, the Mesta Machine Company has secured the services of Mr. Frederick Ottesen, who has had wide European and American experience in gas engine design, and has spent over a year in the development of the design illustrated, which is particularly adapted to the American requirements.

Single-Phase Commutator Motor.

The motor illustrated herewith has been developed along the lines of single-phase railway motors, with the addition of some extra windings which prevent the speed from becoming excessive when the load is suddenly withdrawn. It is stated that the motor is very satisfactory for ordinary belt drive, but is particularly applicable where variable speed is required; by the use of either an auto-transformer or an ordinary resistor inserted in the secondary circuit excellent speed control can be obtained. It is claimed that there is absolutely no sparking at the brushes.

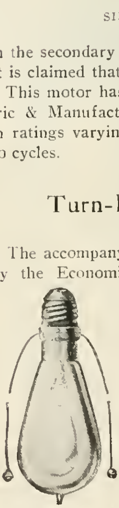


SINGLE-PHASE COMMUTATOR MOTOR.

This motor has been placed on the market by the Ideal Electric & Manufacturing Company, Mansfield, Ohio. It is built in ratings varying from 0.25 hp to 10 hp, and for 25, 30, 40 or 60 cycles.

Turn-Down Incandescent Lamp.

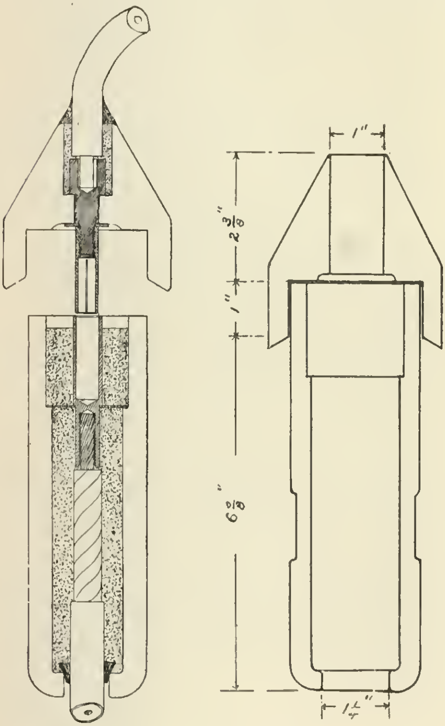
The accompanying illustration shows a turn-down lamp made by the Economical Electric Lamp Company, of New York City. The lamp is provided with the regular 16-cp filament and with a 1-cp filament, with connectors in the base such that by simply pulling a string the lamp may be caused to give a bright or dim light, or may be switched out of circuit altogether. Lamps of this type have found a very wide use, especially in residences where frequently a dim light is required during the night. The company manufactures turn-down lamps in three styles—pull string, turn bulb and long cord. The latter type is fitted with a triple-strand lamp cord, at the end of which is a pull-chain switch to control the lamp.



TURN-DOWN LAMP.

Recent Types of Porcelain Potheads.

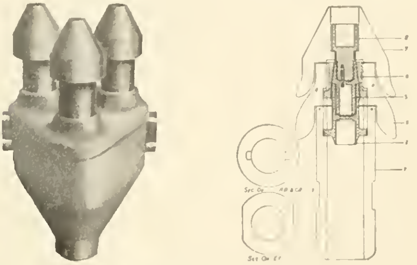
Some time ago there was illustrated in these columns a new combined porcelain pothead and disconnector for use outdoors in connecting overhead and underground lines, which was put on the market by the G. & W. Electric Specialty Company, 128 West Jackson Boulevard, Chicago. Since that time a number of additional types have been perfected. There are now three distinct types, each type being manufactured in several forms for single and multiple conductor cables. The type shown in cross-section in Fig. 1 was the first type developed, and was intended for terminating cables up to No. 0 size on voltages from 2000 to 20,000. For voltages above 6600 volts exposed to the weather, a larger petticoat than shown in Fig. 1 is used. In Fig. 1 the cable conductor terminates in a thimble, which is held in a central position in a porcelain sleeve. The porcelain sleeve extends down well over the lead covering of the cable, the space between the cable and the porcelain sleeve being filled with compound. The overhead line terminates in a split plug which is held in a central position in a porcelain cap. When the porcelain cap is slipped over the porcelain sleeve on the cable, the split plug enters the thimble or receptacle on the end of the cable conductor and forms an electrical connection. The porcelain cap protects the top of the sleeve from the weather.



FIGS. 1 AND 2.—POTHEADS.

It has been found in actual work that this type of pothead can be submerged in water, although, of course, its operation under water is not to be recommended as a regular thing. In manholes in Chicago, which have been accidentally flooded, these potheads have come through without accident, although completely submerged. Water is prevented from getting into the plug and receptacle by the air which is imprisoned under the cap.

Another form of pothead is shown in Fig. 4. This is intended for heavy conductors up to 500,000 cir. mil where heavier contact is needed than in the type illustrated in Fig. 1. The lead-covered cable terminates in part *2* and the overhead line in part *8*. The porcelain petticoat *3* turns the brass connector *6* so that screwing down on this petticoat draws the parts *5* and *2* together to make a strong electrical connection of large contact area. Fig. 3 shows how three cable conductors can be terminated in potheads of the general type shown in Fig. 1 and all three placed in an iron pot covered with a cast-iron lid, thus forming a multiple conductor detachable pothead. For some cases, around power plants and substations, where is it desired to get the advantages of the porcelain pothead feature without utilizing the disconnecting feature for the purpose, the type of pothead shown in Fig. 2 was devised. This is a porcelain pothead with an ordinary soldered joint inside. The advantages of utilizing such a good insulating material as porcelain for surrounding such usually weak places in the line as potheads will be readily appreciated by all handling high-tension currents. The disconnecting feature is another strong point of these potheads; in fact, some of them are installed on branch overhead lines in Chicago purely for disconnecting purposes.



FIGS. 3 AND 4.—POTHEADS.

Electrically Operated Wall Plaster Plant at Syracuse, N. Y.

The Syracuse Wall Plaster Company, Syracuse, N. Y., has recently erected a two-story plant equipped with motor driven machinery for the mixing and preparation of wall plaster, a product which up to the present time has been the result of each individual plasterer's formula or experience and dependent upon his judgment to obtain the right mixtures. The hydrating machinery, comprising a three-screw motor-driven conveyor, 16 in. in diameter, with a total length of approximately 72 ft., is installed in the basement of the plant. This conveyor operates at about one revolution per minute, making the time required for passage of the lime through its entire length one hour. Upon entering the conveyor, the lime is thoroughly mixed with water and comes out in a dried condition, after which it is pulverized.

The main floor is occupied by the mixing machinery, back of which is the dryer, conveying and lifting mechanism. A No. 2 Broughton mixer is used to receive a charge of 1350 lb. and requires eight minutes for mixing. This machine is operated by a 10-hp standard Allis-Chalmers induction motor, 1130 r.p.m., belted from a countershaft. A 7½-hp motor of the same make is used to drive an elevator of 3600 lb. capacity at a speed of 45 ft. per minute. Three sand elevators, a screen, 20-ft. screw conveyor and the knockers on the dryer are all operated from another 7½-hp Allis-Chalmers motor. These elevators are equipped with 7-in. x 4½-in. buckets spaced a foot apart and having an average lift of approximately 30 ft.

The hydrating machinery in the basement, a revolving screen on the top floor, a spindle grinder for grinding clay, and three elevators are operated from a third Allis-Chalmers 7½-hp motor. After the lime has been hydrated in the basement it is lifted to the top floor where it is mixed with sand, hair and the other ingredients used to make up the mixer charge. The average capacity of the plant for 10 hours is 710 bags of plaster each weighing 125 lb.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Owing to excessive rain slightly less favorable crop reports were received for the last week, but indications point that crops will be much better than last year. Distributive trade remained little changed from the preceding week, quietness prevailing in practically all markets. The metal trades are still far behind and pig iron is weaker. The output in April was 6 per cent under the output for March and 49 per cent under the output for April, 1907. Collections remain backward with extensions prevalent, but money is easy, the supply far exceeding the demand, and a large amount being invested in bond issues. There was an increase in orders for structural material and two leading railroads have placed orders for nearly 100 locomotives. Failures for the week ending May 7, according to *Bradstreet's*, were 288 against 282 in the preceding week, 154 in the coresponding week in 1907. Commercial failures for April numbered 1309 and totaled, in defaulted liabilities, $20,316,408. This is the best monthly statement since last November and is still more favorable if the brokerage and other more or less speculative concerns are omitted. Compared with April a year ago there was an increase of more than $9,000,000 in defaulted liabilities, but as compared with March this year there was a decrease of $7,000,000. For the month as a whole it cannot be said that there was any appreciable improvement in the electrical trades over the preceding month, except in inquiry and sentiment. Export trade, which on an average, since the beginning of 1908, has been but about 10 or 15 per cent below last year, is commencing to show signs of a revival from the dulness which has characterized that branch during the last few weeks. The electrical department of the Allis-Chalmers Company is operating at more than 65 per cent of its capacity, turning out a great deal of small equipment and filling old orders and is employing about 7000 men of its normal number of 12,000. This condition of affairs is representative of the larger electric companies. An improved sentiment is about all that can be said for the first week in May in reference to the electrical business.

BRISTOL COMPANY MERGER.—Final details of the consolidation of the William H. Bristol Company and The Bristol Company have been carried out, and the new firm, bearing the name of The Bristol Company, is now, it is said, the manufacturer of the most complete line of recording instruments for pressure, temperature and electricity in the world. In 1889, when Prof. William H. Bristol was an instructor in the Massachusetts Institute of Technology, he started the Bristol Company for the manufacture of two patented inventions. These met with such success that other recording instruments for temperature and electrical measurements were soon after designed and adapted to a large number of different ranges and applications. In the course of the last two years the William H. Bristol electric pyrometers and smoked-chart recorders have been brought out by Prof. Bristol, and have come into wide use. Among other patents on new instruments which have been taken out is one on an electric thermometer, which has been designed for the measurement of atmospheric and refrigerating temperatures. This thermometer can be used to measure the temperature at several different points, a single instrument being arranged with switches to provide for this. An officer of the company said: "The new plans are working out very nicely and the consolidation is being brought about harmoniously, without interrupting the activities of either business. We have some splendid new lines ready to bring out, and though we feel already safe in saying that we have the most complete line of recording instruments in the world, we are going to add lines which have already in preliminary experiments proved their efficacy in actual service."

QUICK WORK ON A BIG WIRE ORDER.—A large contract was recently placed by the Indian Government with Mr. Walter G. Clark, of 135 Broadway, New York, for cables and wire for electric transmission lines in India. The placing of the contract had been withheld for a considerable period awaiting a decline in the price of copper, so that when the order was finally given it was necessary that the cable and wire should be shipped with the least possible delay. The contract was closed by telegraph, and although the wire and cable ordered was all special and required special dies, it was being turned out within 12 hours from the time the contract was closed. Moreover, on account of the distance that the material had to be transported, and the rough country, it was necessary to develop special reels and containers for shipping it, all of which had to be done after the order had been received. All this was accomplished, and Mr. Clark got out a first shipment of 300,000 lb. in time to be sent forward by the next steamer, which sailed only 10 days after the work was started. In order to be sure that all material going forward should be of the best possible grade, the entire amount of wire and cable, aggregating considerably over a million pounds, was given continuous tests for tensile strength and conductivity and each length of wire and cable shipped was drawn in a continuous length from one bar, so that the entire shipment did not contain a splice or joint of any kind. Mr. Clark is giving special attention to high tensile strength copper conductors, and a number of the most important transmission systems are being operated over cables manufactured from his design and under his supervision.

THE STANDARD VITRIFIED CONDUIT COMPANY is running its factories to the fullest capacity, turning out over 1,000,000 ft. of conduit per month. It is supplying the Pennsylvania tunnels, the McAdoo tunnels, the New York subway loop connecting the Brooklyn and Williamsburg bridges and the Brooklyn subway, with all the electrical conduit, as well as with the clay blocks used for lining the sides of the tunnels to render them moisture-proof. Its orders for this latter material alone have run over 1,000,000 sq. ft. This company has also supplied all the sewer pipes for the Pennsylvania tunnels. The securing of these large contracts is a tribute to the enterprise of this company as well as to the merits of its product.

STOKERS FOR BROOKLYN PLANT.—Just at the close of 1907, one of the largest orders ever placed for mechanical stoking equipment was received by the Westinghouse Machine Company, aggregating 14,400 boiler hp. This was for one of the large Brooklyn power stations operated by the Transit Development Company, New York. This order comprises 24 stokers suited to 600-hp boilers of the Babcock & Wilcox water tube type. Moreover, this is the second large order placed by this company for Roney stokers, and may be regarded as the direct result of a year's successful operation of the original 7200-hp installation at the Kent Avenue station. This station was originally equipped with flat grates for hand firing.

RUBBER IMPORTS.—Crude rubber imports for the nine months ended March, 1908, amounted to only $26,000,000, against $45,500,000 in the corresponding months of the preceding year and $33,750,000 in the corresponding months in 1906, and yet the quantity imported was more than 42,000,000 lb., against 58,000,000 lb. in the corresponding months of the previous year and 43,500,000 lb. in the corresponding months of 1906.

DOSSERT & COMPANY, 242 West Forty-first Street, New York, have received orders from Walter Kidde for 2-way connectors, cable taps and terminal lugs for use in the wiring of the plant of the American Hard Rubber Company, College Point, L. I. Mr. Kidde states that he will hereafter discard all soldered connectors and use only Dossert connectors and terminals on all panel boards, generators and wiring of every description installed by him.

LARGEST AIR-BRAKE CONTRACT ON RECORD.—It is reported from Milwaukee, Wis., that the National Brake & Electric Company of that city has closed a contract to manufacture 12,000 air-brakes for the Chicago Railways Company. The outlay involved is more than $100,000, and the contract is said to be the largest of its kind as yet recorded.

POWER PLANT IN SHENANDOAH VALLEY.—Due to a constantly increasing business ever since the power plant of the Winchester & Washington City Railway Company, of Winchester, Va., was put in operation some two years ago, it has been found necessary to double the output by the installation of two more hydro-electric units. The executive offices of the company are located in Winchester, Va., while the power plant is in the famous Shenandoah Valley at Millville, 28 miles northeast of Winchester. The power house is substantially constructed of concrete and brick, with provision made for four waterwheel and four generating units. The initial equipment consisted of two units of 45-in. Sampson wheels complete, with rope-drive to Westinghouse generators located on the floor above the wheel pits. The two new units for which contracts have just been placed, and which are expected to be ready for operation during the coming summer, will consist of "Improved New American" turbines built by the Dayton Globe Iron Works Company, Dayton, Ohio. Each unit will consist of a pair of 49-in. turbines mounted horizontally and enclosed in a steel flume 12 ft. 6 in. in diameter which will connect to the thimble now built in the bulkhead wall. The turbine shaft will extend through the flume head cover on the down-stream end of the unit, and be supported by heavy ring oiling bearings upon cast-iron bridge-trees spanning the foundation I-beams. Each pair of wheels will develop 1000 hp and 150 r.p.m. under 22 x 6 in. working head, and the power will be transmitted to the generators above through a rope drive, built by the Dodge Manufacturing Company, Mishawaka, Ind. The driving sheaves will be 132 in. diameter, and the driven sheave 55 in. diameter, with grooves for 30 1½-in. ropes. The generators will be 500-kw capacity, each running 360 r.p.m., and will be Westinghouse alternators. The shafts and bedplates are to be extended for rope drive. Mr. S. H. Hansbrough, of Winchester, Va., is president of the Winchester & Washington City Railway Company, and the power plant, with its hydraulic and electric equipment, is under the supervision of Mr. S. M. Swink.

LARGE GAS ENGINES.—Allis-Chalmers Company is shipping out and installing large blast-furnace gas engines, weighing 1,500,000 lb. each, at the rate of three per month. These are principally for the United States Steel Corporation for its several plants at Pittsburg, Pa.; Chicago, Ill.; Cleveland, Ohio, and Gary, Ind. A number of these engines have already been in commercial service and are giving highly satisfactory results, fulfiling the most sanguine expectations of the builders and purchasers. The Allis-Chalmers Company has been more fortunate than almost any other large industrial company in that it was last year favored with a large volume of work for 12 to 18 months' delivery, including mining and crushing machinery for domestic and foreign purposes, also pumping machinery for various municipalities throughout the country, as well as the immense gas-engine orders from the steel corporation. It is stated by an official of that company that at this date it has nearly a year's work ahead of its West Allis and Chicago plants. The company also announces a gradual but steady improvement in its bookings of new orders for steam turbines and its smaller lines of electrical apparatus. It is also receiving at the present time a very satisfactory volume of business for their standard products in mining, rock-crushing and flour-mill machinery. It reports marked activity in the way of new inquiries. These are well distributed from all parts of the country and indicate that a great many of the industrial and electric lighting and power companies' plans made for extensions previous to the recent financial depression have again been taken up actively for completion.

NANKAI RAILROAD EQUIPMENT.—A second order of cars has been placed for the Nankai Railroad in Japan, on which the motive power was changed from steam to electricity about two years ago. This order is for 12 electric car equipments, capable of operating at a speed of about 55 miles per hour. All the parts, except the car bodies, which are to be built in Japan, will be imported from this country. The outfit consists of 12 Westinghouse quadruple, No. 101 H, 500-volt direct-current, railway motor equipments with unit-switch control, and 12 Westinghouse schedule S. M. E. straight air-brakes, including the emergency feature, and arranged to be operated from both ends of each car. The order includes 12 pairs of Brill 27 E. I. trucks, complete with standard equipments, with wrought-iron center and steel-tired wheels. The entire contract was placed by Takata & Company, of Tokio, London and New York. The original installation, which was put in place by Takata & Company in 1906, consisted of two Westinghouse 500-kw, 600-volt, engine-type generators, driven by two McIntosh & Seymour compound, side-crank engines. A complete switchboard outfit was also erected. The original equipment consisted of 25 motor cars with 25 pairs of Brill 27 G. E. I. type, substantially the same as the new order mentioned above. A complete system of automatic signals made by the General Railroad Signal Company was installed at that time, to be used in connection with both the electric and the steam service.

THE YOUNGSTOWN SHEET & TUBE COMPANY, Youngstown, Ohio, has lately placed a contract with Allis-Chalmers Company, Milwaukee, for three large motor generator sets intended for operation in connection with two 1500-kw Allis-Chalmers steam turbines and generators ordered some time ago. The equipment will also include two induction motor exciter sets, a balancer and transformers of the oil filled self-cooled type. The main motor generator sets each comprise 500-kw 250-volt direct-current generators and 750-hp, 6000-volt, 25-cycle motors. This addition will give the plant electric current for lights, crane operation, furnace skip, etc. The added power, to provide which practically a new power house was required, was rendered necessary by the erection of two new blast furnaces. One of the turbines is designed to operate condensing and one non-condensing, with steam pressure of 150 lb. per square inch. The exhaust from the non-condensing turbine is to be utilized for heating boiler feed water in an open-type heater. Mr. Julian Kennedy, of Pittsburg, Pa., acted as consulting engineer.

CONTRACT BETWEEN WESTERN ELECTRIC COMPANY AND NEW ENGLAND TELEPHONE COMPANY.—Out of 32 operating companies of the American Telephone Company, 26 are now working under the system of having the Western Electric Company act as its purchasing agent, a contract making such an arrangement having been signed recently between the Western Electric Company and the New England Telephone Company. The Western Electric Company, under the terms of the contract, receives 2 per cent for handling general supplies furnished the telephone companies, but only on the condition that the total price to the telephone company, with the 2 per cent commission added, does not exceed the price the telephone company would pay if it purchased these same goods at the most favorable terms in the open market. This arrangement is said to be made solely in the interests of and is expected to save the Bell companies hundreds of thousands of dollars annually.

SALES OF INSULATORS.—Mr. Louis Steinberger, of the Electrose Manufacturing Company, informs us that he has had some very large orders lately. Five thousand standard insulated bolts, 7500 standard insulated spools and 50 bronze Brooklyn strain insulators have been sold through the Western Electric Company to the Chicago City Railway Company. This is the largest insulator order of its kind ever given out in Chicago, and was secured in the face of sharp competition and after severe tests and experiments lasting a year. This order was accompanied by one from the city of Chicago itself for 500 Electro insulators with malleable-iron pins and 300 Electrose insulators for high-tension arc-lighting work. Many thousands of these will be required and used during the year.

WESTINGHOUSE ELECTRIC COMPANY BUSY.—The Westinghouse Electric & Manufacturing Company obtained an order last week for 150 electric motors for the Washington Railway & Electric Company, of Washington, D. C., which will be used to equip cars on the lines of that company now in operation. Work on this order has been begun. Officers of the company state that a large number of small contracts are coming in, and these, added to the amount of work pending, will, in all probability, keep the plant at East Pittsburg in fairly active operation throughout the summer.

J. G. WHITE & COMPANY, Inc., of New York, have been awarded the contract for engineering and constructing a complete hydro-electric plant, with transmission lines, substations, etc., for the Central Georgia Power Company. This plant will be built on the Oemulgee River, about 36 miles above Macon, Ga., supplying power to that point and to other points in the vicinity. The normal capacity of the plant will probably be 12,500 kw, generated by water wheels under 100-ft. head. The crest of the dam will probably be 750 ft.

Financial Intelligence.

THE WEEK IN WALL STREET.—Although with less vigor, and at times weakening somewhat on profit taking, the market continued bullish last week, with little apparently in sight to justify its advances. The present rise is conceded to be the result of manipulation, and is thought by many to have been engineered in order to create a favorable sentiment in the bond market, an end which has certainly been attained, but it is pointed out by those optimistically inclined, that no matter how manipulative a market may be for the moment, it indicates in the long run the trend of events in the business world. The uncertainty of the $100,000,000 bond issue of the Union Pacific Railroad tended to keep matters quiet until Mr. Harriman announced that it was planned to place only $50,000,000 of bonds at this time, and then there was a moderate reassertion of strength. The announcement that the control of the smelting interests still rests with the Guggenheims, and that affairs are harmonious among the copper interests, gave firmness to those securities. The sale of the Interborough 6 per cent notes so as to yield a bid of 2¾ per cent to members of the underwriting syndicate is calculated to draw money from out of the hidden places more quickly than any other inducement. On Friday the government published its customary monthly report on the conditions of crops, which announced that the prospective yield of the winter wheat is 467,000,000 bushels, a gain of 56,000,000 bushels over the prospective yield at this time a year ago. The New York City banks returned to the United States Treasury during the week $15,000,000 of the $20,000,000 of government deposits recalled at this time. In spite of this withdrawal and the heavy financing done during the week, the money market remained easy and showed signs of continuing to do so. There is a great accumulation of money in all the financial centers of the world, with the exception of Germany and Japan, which keeps rates down, and will, in the end, make it comparatively easy for merchants to obtain funds to carry on their business. The transactions in the market on Monday were the largest for more than a fortnight, totaling more than 1,000,000 shares. Closing prices were as follows:

NEW YORK.

	May 4	May 11	Shares Sold.		May 4	May 11	Shares Sold.
All-Ch.	8¼	8	500	Int-Met., com..	9⅞	11⅜	6,920
All-Ch., pfd....	20⅝	21½	2,900	Int-Met., pfd...	27½	31⅜	5,200
Amal. Cop.....	60⅜	63⅞	203,700	Mackay Cos....	61½	63	1,000
Am. D. T......	39*	39*	———	MackayCos.,pfd.	65⅜*	64	1,600
Am. Loc.......	47⅝	50½	43,405	Met. St. Ry....	25*	29	50
Am. Loc., Pfd..	99½	102*	1,015	N.Y. & N.J. Tel.	108*	105*	14
Am. Tel. & C'bl.	50*	50*	———	Steel, com.....	35⅜	37⅛	189,452
Am. T. & T....	117½	117½	1,550	Steel, pfd......	100¾	102⅛	28,632
B. R. T........	46⅛	50¾	41,245	W. U. T.......	50¾	51¼	615
Gen. Elec......	133	137	2,500	West'h, com...	48	47	5,365
Hud. R. Tel....	—	—	———	West'h, pfd.....	64*	60	1,000

PHILADELPHIA.

	May 4	May 11	Shares Sold.		May 4	May 11	Shares Sold.
Am. Rys.......	44⅜	44⅝	———	Phila. Elec....	8½	8¾	———
Elec. Co. of Am.	9⅞	10	———	Phila. R. T.....	18	18¼	———
Elec. Stor. B'ty.	30	32¼	———	Phila. Traction.	89	91	———
E. S. B'ty, pfd.	—	—	———				

CHICAGO.

	May 4	May 11	Shares Sold.		May 4	May 11	Shares Sold.
Chicago City Ry.	160	160	———	Met. Elec., com.	17	19	———
Com. Edison....	91½	91¾	———	Met. Elec., pfd.	46	49	———
Chicago Subw'y.	—	—	———	National Carbon.	57½	61¼	———
Chicago Tel. Co.	118	118¾	———	Nat. Carhon pfd.	110	107½	———

BOSTON.

	May 4	May 11	Shares Sold.		May 4	May 11	Shares Sold.
Am. Tel. & Tel.	117¼	117½	———	Mass E. R., pfd.	44	44	———
Comb'ind Tel...	—	109¾	———	Mex. Tel., pfd..	5⅝	—	———
Edison El. Ill...	—	214	———	New Eng. Tel'p.	113½	113¾	———
Gen. Elec......	134	137½	———	W'st Tel. & Tel.	—	6¼	———
Mass. Elec. Ry.	10	9¾	———	W. T. & T., pfd.	65	65½	———

*Last price quoted.
Shares sold are for week May 3-9.

THE WEEK IN COPPER.—A sagging copper market in London, coupled with no appreciable improvement in home demand during the last week, intensified the dulness which has existed for some time in the copper trade and caused the outlook to be viewed with increasing gloom. Vigorous efforts were made by some of the larger interests to bolster up the market, but met with little success. Those who hold optimistic views declare that while the buying at present is 50 per cent or less than normal, there are many indications that at least 90 per cent of the consumers have used up their available supplies and are ready to enter the market at a moment's notice. They back their views by pointing to the slight increase in demand which was noticeable at the beginning of this week. Other authorities on the metal trades refer to the over-stocks of metal abroad, the belief that there is little chance for a marked improvement in home consumption for some months to come, the increased production which will be dumped on the market in June, and predict 12-cent copper. The statement that the coming output of the Butte mines has already been contracted for is not taken literally. Whatever the outcome may be it is certain that the market is being held only with the greatest effort under existing conditions. Closing prices on the Metal Exchange, Monday, were as follows:

Lake	12½ @ 12¾
Electrolytic	12⅜ @ 12⅝
Castings	12⅛ @ 12⅜

STOCKHOLDERS RATIFY $50,000,000 BOND ISSUE.—The proposed $50,000,000 bond issue by the Public Service Corporation of New Jersey, which was noted in these columns, was authorized at a meeting of the stockholders on May 5. Of the issue, $3,725,000 are to be delivered by the trustee, the Fidelity Trust Company of Newark, to the corporation to recoup the company for improvements made recently and $7,250,000 are to be reserved for retiring at par, a like amount of collateral gold notes, dated Nov. 1, 1904, and $6,250,000 reserved to retire that amount of convertible notes issued by the company under date of April 16, 1906. After the delivery of the first instalment of $25,000,000 it is provided that no further bonds can be certified and delivered by the trustee until the officers of the company certify that the earnings of all the property mortgaged and the income from the securities pledged for 12 months preceding exceed by 33 1/3 per cent the interest on all bonds issued under mortgage. Of the remaining $25,000,000, the certified earnings must exceed the interest by 50 per cent.

PACIFIC CORPORATION SHARES LISTED.—The preferred and common stocks of the Pacific Lighting Corporation have been listed on the San Francisco stock and bond Exchange. There are 41,620 shares of preferred, par $100, and 48,000 common shares, $20 par, issued. The Pacific Lighting Corporation was organized last year to succeed the Pacific Lighting Company, with a capital of $20,000,000 in 200,000 shares of a par value of $100 each. There were issued 100,000 shares of preferred stock and 100,000 of common stock, of which 40,000 common shares were exchanged for 40,000 common shares of the old corporation and 40,000 shares of preferred stock in exchange for 40,000 preferred stock of the old company. The new company owns the entire capital stock of the Los Angeles Gas & Electric Company, 98 per cent of the stock of the Pasadena Consolidated Gas Company, $997,000 par-value bonds of the Los Angeles Gas & Electric Company, Pasadena Consolidated Gas Company and Eureka Lighting Company, and owes $480,000 in time loans.

WASHINGTON RAILWAY & ELECTRIC.—The annual report of the Washington Railway & Electric Company, of Washington, D. C., for the year ended Dec. 31, 1907, shows a gross income of $3,385,748, as compared with $3,133,240 for 1906. Expenses were $1,748,752, as compared with $1,613,096 for 1906, leaving a net of $1,636,996, against a net of $1,520,144 for the previous year. The total income was given as $1,679,349, as against $1,564,739 for the previous year and a total surplus of $572,121, against a total surplus of $523,621 for 1906. Deducting preferred dividends of $425,000 and fixed charges of $52,700 from the total, left a profit-and-loss surplus for 1907 of $832,382. The surplus for the year of $572,121, as given above, is equal to 5 per cent earned on the $8,500,000 preferred stock and 2.26 per cent on the $6,500,000 common stock.

BROCKTON EDISON COMPANY BONDS.—The banking firm of Perry, Coffin & Burr, of Boston, are offering $100,000 first mortgage, 5 per cent gold bonds of the Edison Electric Illuminating Company, of Brockton, Mass. The issue is dated Dec. 1, 1900, and is due Dec. 1, 1930, redeemable all or in part on any interest date at 110 and interest. The company has a capital stock of $800,000 and a funded debt of $265,000. Net earnings for the year ended Feb. 29, 1908, were $85,626, equaling eight and one-half times the annual interest on the entire first mortgage bond issue, including the $100,000 bonds just issued and now offered.

HUDSON RIVER CO.—The Hudson River Power Company report for the quarter ended March 1 shows gross earnings of $324,555, as compared with $256,959 for the same period last year, and expenses of $159,918, as compared with $155,246 for the corresponding quarter in 1907. The net for the three months was $164,637, against a net of $101,713 for 1907, and the net for the twelve months was $549,125, as compared with a net of $369,213 for the previous twelve months.

WORK OF THE WESTINGHOUSE COMMITTEES.—The following letter explaining the relations between the Merchandise Creditors' Committee and the Westinghouse interests has been issued by Mr. George M. Verity, secretary of the Merchandise Creditors' Committee: "Many creditors do not understand the exact relation of the Merchandise Creditors' Committee to the Westinghouse Electric & Manufacturing Company and some of them seem to be under the impression that the members of the committee are persons connected either directly or indirectly with the company. No member of the committee is connected either directly with any of the Westinghouse companies or interested in any of them in any way save as a creditor. Each member of the committee represents one of the largest merchandise creditors and their claims aggregate $1,700,000. Mr. Joseph Marsh, chairman of the committee, is vice-president of the Standard Underground Cable Company, of Pittsburg, Pa.; Mr. F. W. Roebling is treasurer of the John A. Roebling's Sons Company, of Trenton, N. J.; Mr. C. R. Remington is secretary of the American Electrical Works, of Phillipsdale, R. I.; Mr. A. Bournonville is a member of the firm of Alfred F. Moore, of Philadelphia, Pa., and Mr. Geo. M. Verity, secretary of the committee, is president of the American Rolling Mill Company, of Middletown, Ohio. These gentlemen being interested in the Westinghouse Electric & Manufacturing Company as large creditors are naturally well informed on the general character and scope of the Electric Company's business. They are working in the interests of the merchandise creditors of which they represent so large a part, and entirely independent of the company. They desire to preserve both the integrity of their claims and that of the Westinghouse Electric & Manufacturing Company as an industrial factor, and believe that this much-desired result can be accomplished through the consummation of the plan proposed by them for a readjustment of its financial interests without either a sale or a drastic reorganization. "Claims of the merchandise creditors to the extent of $3,750,000 have been signed or promised," said Mr. Verity, "out of $4,000,000 guaranteed and a possible total of $4,250,000. We are doing our part, and it is up to the stockholders to do theirs. Certainly it would seem that they have more at stake than the creditors, as we would have a prior claim on the assets in case the plan was not carried out. It does not seem likely, however, that any one would be so shortsighted as not to subscribe his pro rata share to save his holdings in a company whose minimum net earnings are more than enough to pay the fixed charges on all the capital stock, including the new issue, and whose maximum earnings may and will without question, in prosperous times, exceed the fixed charges by from 15 to 20 millions. One feature that has not been touched upon to any extent but which will be a distinct advantage to the company, is the fact that the issue of the 'assenting' stock will mean at least 1500 new stockholders, one might almost say an additional sales force of 1500 working in the interests of the company." The Stockholders' Committee will have until June 1 to carry out its share of the programme. "Out of 3700 stockholders 900 have subscribed for their pro rata amount of the new stock at the rate of one share of the new stock for every four shares held," said the secretary of that committee, "and the returns continue to come in satisfactorily. The circular issued by Mr. Westinghouse evidently stirred them up to a realization of the necessity of their co-operation. In a few cases where it was impossible to raise the necessary money, stockholders sent regrets and of course there is the usual number of persons holding stock who are abroad and cannot be reached immediately, and also stocks tied up in estates and trusteeships, all of which requires time to bring into line. The committee has evolved a new plan to reach large stockholders, and it is confidently expected that by June 1 the requisite amount of subscribers will have been obtained." The National Shawmut Bank, of Boston, has been appointed by the Stockholders' Committee as an additional depositary to receive payments for the new stock on which subscriptions are payable as follows: 25 per cent May 25, 20 per cent Aug. 1, 20 per cent Nov. 1, 20 per cent Jan. 1, 1909, and 15 per cent April 1, 1909. A committee has taken charge of the Security Investment Company, of Pittsburg, with a view to safeguarding the interests of the creditors of the Security Investment Company. The committee proposes to extend all notes and raise $3,000,000 through the sale of more obligations to protect the Westinghouse Electric stock, now held as collateral in loans. This committee strongly indorses the merchandise creditors' plan. By order of United States Judge Cross sitting in Trenton, N. J., the receivers of the Atha Steel Casting Company, Benjamin Atha, Ernest F. Harder and George W. Hebard, will accept $61,000 of the stock of the Westinghouse Electric & Manufacturing Company in discharge of the merchandise liability of the Westinghouse Company to the Atha Company. The claim against the Westinghouse Company was for work done and represented 45 per cent of the entire business of the Atha Company. Under an agreement between the two companies the Atha Company is to get the Westinghouse Company's business when the reorganization is completed, which will rehabilitate the Atha Company.

MASSACHUSETTS ELECTRIC COMPANIES.—The report of the Massachusetts Electric Companies for quarter ended March 31, 1908, shows gross earnings of $1,552,171, as compared with $1,526,523 for the same month in the previous year. Operating expenses were $1,127,120, against $1,207,781 for the first quarter of 1907. Net earnings were $425,051, against $318,741 for the period in comparison in 1907. Deducting taxes and charges of $464,316, left a deficit of $39,265, a marked decrease from the deficit for the same time in 1907, which was $117,411. The gross earnings for the six months were $3,332,246, against $3,241,142 for the same six months in the preceding year and net earnings were $884,463, against $804,553, for the corresponding six months of the previous year. The deficit for the six months is given as $16,289, as compared with a deficit of $41,890 for the same six months in 1907. In 1906, for the six months there was a surplus of $34,262.

STOCK AND BOND ISSUES AUTHORIZED.—The Gas Commission has authorized the Lowell (Mass.) Electric Light Corporation to issue $93,000 in additional stock at $1.50 per share, the proceeds to be used to cancel outstanding notes. The Gas Commission has authorized the Edison Electric Illuminating Company, of Brockton, to issue $100,000 5 per cent 30-year, first mortgage bonds, the proceeds to be used to cancel outstanding promissory notes. Subscriptions to the 1950 shares of new stock of the Lynn Gas & Electric Light Company, recently authorized by the Board of Gas & Electric Light Commissioners, will close on May 6. Of the $3,962,200 additional stock issue of the New England Telephone Company, rights to which expired April 16, it is reported that more than 95 per cent has been taken.

PLATTSBURG LIGHT, HEAT & POWER.—A $250,000, thirty-year, 5 per cent bond issue by the Plattsburg Light, Heat & Power Company has been authorized by the Public Service Commission of the Second District, New York State. The company is permitted to put out $230,000 of the bonds at the present time, and the issue is secured by a mortgage to the Standard Trust Company of New York upon all of the company's property. Of the issue, $65,000 must be sold at not less than 90, to take up the company's floating indebtedness, while $25,000 must be sold at not less than 90, to be used in making extensions and improvements to the gas-distributing system.

ROCHESTER RAILWAY & LIGHT.—The Rochester Railway & Light Company has been authorized by the Public Service Commission of the Second District, New York State, to issue 5 per cent consolidated mortgage bonds at par to an amount not exceeding $1,637,000, which must be sold at not less than 90. The bonds are redeemable at 103 under mortgage dated June 15, 1904, securing a total issue of $16,000,000. The proceeds of this additional issue are to refund outstanding obligations to the amount of $1,474,000.

CENTRAL & SOUTH AMERICAN TELEGRAPH.—The Central & South American Telegraph Company, in its annual report for the year ended Dec. 31, 1907, gives a gross income of $1,749,045. Expenses were $556,666 and the net of $1,192,379 is equal to 11.9 per cent of the $10,000,000 of capital stock. Dividends of $551,031 were declared, leaving a balance of $641,348. Adding the surplus of $607,936 to the previous surplus gives a total surplus of $2,478,386, as compared with $1,870,450 for 1906.

MEXICAN TELEGRAPH COMPANY.—The Mexican Telegraph Company, in its annual report for the year ended Dec. 31, 1907, gives total receipts of $1,047,531, with total deductions of $182,163, leaving net earnings of $865,368, equal to 30 per cent on the $2,879,100 of capital stock outstanding. Dividends of $287,010 were declared, leaving a surplus of $578,358 which, added to the previous surplus, gives a net surplus for the year of $2,381,895.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

SHEFFIELD, ALA.—The power project of the Muscle Shoals Power & Development Company has been approved by the Inland Waterways Commission at Washington, D. C. It is proposed to make another survey of the bed of the Tennessee River before the exact location of the dam is determined. Representative Richardson states that Congress, at the next session, will appropriate the necessary money which, with the co-operation of the Muscle Shoals company, will complete the project.

DANVILLE, ARK.—The electric light plant owned by A. Pace has been put in operation and is now furnishing electricity for lighting the town.

BERKELEY, CAL.—J. V. Mendenhall, town clerk, writes that the citizens voted against the proposition to issue bonds to establish an electric light plant in connection with an incinerating plant, for which the proposition to issue bonds was also defeated.

NEVADA CITY, CAL.—The machinery at the new power plant on Deer Creek of the Pacific Gas & Electric Company has been started, the station being placed in regular service on the company's long transmission system to San Francisco and Oakland. About 8000-hp can be developed.

REDDING, CAL.—It is reported from Heroult-on-the-Pitt that the electric iron smelter of the Noble Steel Company is to be considerably enlarged. The present furnace is to be replaced immediately by one several times as large. Construction work has already been commenced. The furnace will be about eight feet high, and the experiment will be carried on with three-phase current. Prof. Lyon, of Stanford, has the experiment in charge.

SAN BERNARDINO, CAL.—An independent telephone company has been organized in this city. The incorporators are: P. S. Hamer, M. E. Foulke, A. L. Streeter and others.

SAN BERNARDINO, CAL.—The Board of Supervisors has granted A. G. Hubbard, of Redlands, a franchise for an electric railway in this place. It is proposed to extend the Redlands Central Railway toward Redlands Junction.

SAN FRANCISCO, CAL.—The City Electric Company is now selling nearly all of its output to the United Railroads. The company is planning to install a 6000-kw Westinghouse generator in its plant.

SAN FRANCISCO, CAL.—The United Railroads has placed a contract with the General Electric Company for a Curtis steam turbine direct connected to a 5000-kw General Electric, three-phase, 13,200-volt generator to be installed in the North Beach power house. It is stated that an increase in the boiler plant will be necessary.

DANIELSON, CONN.—The Danielson Cotton Company has purchased a tract of land in Pomfret Landing, where it will build a large dam to secure water power to operate its manufacturing plant. The company also contemplates the construction of another large mill in Danielson, which will be operated by electrical power generated at the Pomfret Landing plant.

HARTFORD, CONN.—The Railroad Commissioners have approved the proposed route and construction of the electric railway which the Connecticut Company is to build between Hartford and Middletown.

WILLIMANTIC, CONN.—The Willimantic Gas & Electric Company is installing an electric pump at the engine house of the New York, New Haven & New York Railroad Company to operate the water supply for the engines by electricity, instead of steam power.

SMYRNA, DEL.—The Diamond State Rapid Transit Company is contemplating the construction of a power plant to be located at St. Georges, plans for which, it is said, are being prepared by John D. Thompson, of Wilmington.

WASHINGTON BARRACKS, D. C.—Bids will be received until May 27, by Lieut. W. H. Rose, Quartermaster, U. S. A., for furnishing and laying primary and secondary electric cable at this post.

ADRIAN, GA.—The Adrian Power Works, recently incorporated, contemplates the construction of an electric light plant, water supply and ice plant. W. W. Strickland, of Adrian, is president and manager.

JACKSON, GA.—The Central Georgia Power Company has awarded the contract for the construction of its hydro-electric plant on the Ocmulgee River, near Jackson, 35 miles from Macon, to J. G. White & Company, of New York, N. Y. The contract includes the construction of hydro-electric plant, transmission lines and substation. The plant will have an output of about 12,000 kw and will furnish electricity in Macon and other points in that vicinity. Charles F. Howe, Grand Building, Macon, Ga., is chief engineer of the Central Georgia Power Company.

ROME, GA.—The town of Rome is reported to have about reached an agreement with the Rome Railway & Light Company to furnish lamps for another year at $65 per lamp, against $84 formerly paid by the town. The company proposes to maintain about 200 lamps and to sell electricity for lamps for private use at 10 cents per kw-hour and for motors at half that rate.

STATESBORO, GA.—The Statesboro Telephone Company is planning to erect about 7500 ft. of aerial cable, and would like to receive estimates for the cost of the material and also the cost of erecting the same.

CLINTON, ILL.—The Wasson Telephone Company is planning to rebuild its old lines and the erection of a number of new lines.

LA SALLE, ILL.—Plans are being considered by seven of the largest independent telephone companies in northern Illinois to incorporate a local company to install a system at La Salle and Peru, at a cost of $100,000, which would have toll connections with the Illinois companies included in the International Independent Telephone Association.

PRINCETON, ILL.—Extensive improvements and extensions are contemplated by the Independent Telephone Company, including the construction of a new copper toll line to Spring Valley and Ladd.

BURKET, IND.—Plans are being considered for the organization of a telephone company here. Gilbert Alexander, E. S. Vandemark and T. L. Blue are interested in the project.

MT. VERNON, IND.—The City Council has granted a franchise for the construction and operation of a lighting plant in this city to S. C. Goodrich and J. G. Heesler, of Flint, Mich.

RED KEY, IND.—An election will be held to vote on the proposition of issuing $12,000 electric light bonds.

TIPTON, IND.—Ex-Senator Osborn, of New Castle, has petitioned the City Council of Tipton for a franchise to construct, equip and operate a lighting plant.

CLINTON, IA.—Plans are being made by the Iowa Telephone Company for extensive improvements and extensions to its local plant, which will involve an expenditure of about $150,000.

MASON CITY, IA.—The Western Telephone Company contemplates extensive improvements to its system, among which is the construction of a telephone line between Rock Rapids and Estherville. The cost of the work is estimated at $100,000.

OSKALOOSA, IA.—The Home Telephone Company contemplates extensive improvements to its plant in this city, the cost of which is estimated at $50,000.

COFFEYVILLE, KAN.—Surveys are now being made of the route of the proposed railway of the Kansas Traction Company. The road will extend from Coffeyville to Lawrence, branching at that place to Kansas City and Topeka, and will be about 200 miles in length. The main power plant will be located in the natural gas field. The third-rail system will be used.

PRATT, KAN.—S. S. Smith, proprietor of the Pratt electric light and ice plant, which has been purchased by a syndicate of local capitalists, it is reported, has awarded a contract for the construction of a new plant at a cost of $25,000.

CLINTON, LA.—The city is contemplating the purchase of the local electric light and ice plant to be operated by the municipality. A committee, consisting of John Levy, W. J. Sebastian and I. L. Heyman, has been appointed to investigate the matter.

NEW ROADS, LA.—The Town Council is contemplating the establishment of an electric light plant in conjunction with the water works plant.

BRIDGTON, MAINE.—The Bridgton Center Village Corporation has entered into a contract with the Bridgton Water & Electric Light Company for lighting the streets of the village one year. Under the terms of the contract the village is to pay $10.75 for incandescent lamps of 32 cp, which is an advance of 75 cents over the former contract.

BALTIMORE, MD.—The United Amusement Company, lessees of Electric Park, has entered into a contract with the Consolidated Gas, Electric Light & Power Company for electricity for lighting the park. The contract calls for electricity for 40,000 incandescent lamps. Electrical energy for the system will be supplied from the Westport power house. A substation will be erected in the park. Max Rosen is manager of the park.

BERLIN, MD.—The City Council will receive propositions until May 20 for furnishing the city with electric light and water, the city to have the option of purchasing the plants at the end of 5, 10 and 15 years at a price a committee may fix. Orlando Harrison is mayor.

SWALLOWS FALLS, MD.—Plans are being considered by the Swallows Falls Electric Light & Power Company for the construction of an electric power plant at Swallows Falls, and also contemplates the construction of an electric railway between Oakdale and Swallows Falls, a distance of about eight miles. H. P. Tasker, of Oakland, is interested in the project.

CLINTON, MASS.—A substation will be built by the Connecticut River Power Company near the Lancaster Mills, from which the electrical energy received from the company's plant at Vernon, Vt., will be distributed in Clinton.

FITCHBURG, MASS.—Thirty grants of perpetual rights of way have been recorded at Worcester North, registry of deeds, for the Connecticut River Power Company, which is seeking to enter Fitchburg to furnish electricity for motors. The grants include right to erect and maintain a double transmission line across land in Westminster, Leominster and Fitchburg, connecting at Westminster with lines direct to power stations near Brattleboro, Vt.

HAVERHILL, MASS.—The State Board of Gas and Electric Light Commissioners has authorized the Haverhill Electric Light Company to issue 1,145 additional shares of capital stock to be offered to the stockholders at not less than $130 a share.

SOUTHBRIDGE, MASS.—The Southbridge and Webster Gas & Electric Company is making arrangements to operate the Southbridge electric system from the Webster plant, and as soon as the transmission line is completed the company will furnish a 24-hour service in Southbridge. For the present the local plant will be kept in operation.

WESTFORD, MASS.—The citizens are considering the question of lighting the streets of the town.

WILLIAMSBURG, MASS.—The Massachusetts Lighting Companies has resumed negotiations for the purchase of the property of the Mill River Electric Light Company, which furnishes electricity in Williamsburg and Haydenville. If the Massachusetts company takes over the plant, electrical energy for operating the system will be furnished from the station of the Northampton Electric Lighting Company, at Northampton, which is owned by the company, and a 24-hour service will be given.

WILLIAMSTOWN, MASS.—The Williamstown Gas Company is making arrangements to extend its transmission lines from the Henderson Road to the Sand Springs.

ESCANABA, MICH.—The hydro-electric power plant of the Escanaba Pulp & Electric Company at Flatrock will be put into commission in July. The plant will have an output of 1200 hp and will supply electrical energy to the city of Escanaba and also to the Escanaba Electric Street Railway Company, for which contracts have already been placed. The plant cost approximately $80,000.

GOODWELL, MICH.—An independent telephone company has been organized in this city and the following named officers elected: C. H. Kensbol, president; John Fairchild, secretary, and Gabe Burket, treasurer.

MENOMINEE, MICH.—The Menominee & Marinette Traction Company is contemplating the purchase of the Holmes interest in the Grand Rapids water power, two miles east of Ingalls. The capital stock of the company has been increased to $1,000,000. It is said that work will commence in June on the construction of the power house and dam.

PLAINWELL, MICH.—The Commonwealth Power Company contemplates the construction of a dam about one mile below Plainwell, at a cost of about $50,000.

ELLSWORTH, MINN.—A franchise has been granted to Fred M. Sadler to construct and operate an electric light plant in this town.

MONTICELLO, MINN.—The Mississippi River & Electric Power Company has been granted permission by the War Department, Washington, D. C., to construct two dams on the Mississippi River, one at Monticello and the other near Clearwater. Under its charter the company is authorized to transmit electricity to nearby cities and towns, and to construct and operate electric railways. The company owns right of way from Monticello to the southern limits of the city of St. Cloud, on both sides of the river.

FARMINGTON, MO.—The Commercial Electric Supply Company, of St. Louis, has been awarded the contract for the construction of the municipal electric light plant, for $23,120. Thomas B. Carter is engineer.

NEVADA, MO.—We are informed that the Freeborn Engineering & Construction Company, of Kansas City, Mo., has been awarded the contract for all improvements to be made to the property of the Missouri Light & Traction Company.

WEST PLAINS, MO.—The Martin Power Company is reported to have secured a franchise to erect transmission lines for the distribution of electricity and also to erect telephone lines from West Plains to Ozark County, and will later apply for a franchise to construct a system from the Howell County line to the river, where it proposes to erect a power plant.

GENOA, NEB.—John W. Early, of Columbus, Neb., has been employed by this village as consulting engineer in connection with the construction of the new municipal electric lighting plant. The cost of the plant is estimated at $10,000.

MILFORD, N. H.—The Milford Light & Power Company has absorbed the plant and holdings of the Milford Electric Light Company, and will make extensive improvements, including the installation of another 500-hp engine, dynamos, and additional transmission lines.

LITTLE FALLS, N. J.—A special election will be held June 2 to vote on the proposition to establish a lighting district.

PARK RIDGE, N. J.—The Borough Council has voted to appropriate $30,000 for the municipal electric light plant.

BABYLON, N. Y.—The South Shore Traction Company has applied to the Village Trustees for permission to construct and operate an electric railway on Main Street in this village.

EAST SPRINGFIELD, N. Y.—The East Springfield Telephone Company has decided to increase its bond issue from $15,000 to $75,000 and construct 25 miles of toll lines, connecting Cherry Valley, Fort Plains and Canajoharie.

FORT WOOD, N. Y.—Bids will be received until June 9 by C. C. Burnell, Constructing Quartermaster, Fort Wood, for furnishing and installing, complete, an electric elevator in Signal Corps storehouse at this post.

NEWBURGH, N. Y.—The Orange & Cronomer Lakes Power & Electric Company has petitioned the City Council for a franchise to erect transmission lines and to construct underground conduits for the transmission of electricity on the principal streets of the city. In return for the franchise the company offers to furnish the city with arc lamps at the rate of $60 per lamp per year. The city now has a contract with the Newburgh Light, Heat & Power Company for lighting the streets at a cost of $82.50 per lamp per year. M. C. Krug is president of the Orange & Cronomer Lakes & Electric Power Company.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, until May 18, for installing electric equipment in additions to and alterations in Public School No. 75, and new Public Schools Nos. 156 and 158, Borough of Brooklyn.

NEW YORK, N. Y.—The Hudson & Long Island Traction Company proposes to build an electric railway from Long Island City across the Blackwell's Island Bridge to the West Forty-second Street Ferry, Manhattan, a distance of 4½ miles. The company is capitalized at $50,000, and the officers are: F. K. Morris, president; C. M. Wicker, vice-president; Anthony Stumph, treasurer, and W. B. Spencer, chief engineer.

NEW YORK, N. Y.—Bids will be received until June 4 by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the installation of an interior conduit and wiring system for vacuum tube lighting in the basement of the United States Court House and Post Office Building, New York, N. Y., specifications for which may be obtained at the office of the supervising architect, Washington, D. C., or at the office of the superintendent, U. S. Custom House, New York, N. Y.

WATERTOWN, N. Y.—The Citizens' Telephone Company contemplates extensive improvements to its plant and equipment in this city, the cost of which is estimated at $100,000.

CHARLOTTE, N. C.—The contract for electrical equipment for the Chadwick, Hoskins and Louise mills has been awarded to the Westinghouse Electric & Manufacturing Company, for about $40,000. These mills are to be operated by electricity instead of steam power, energy for which will be supplied by the Southern Power Company. A substation will be erected at the mills.

HICKORY, N. C.—Plans are being prepared by Temple & Sommer, Land Title Building, Philadelphia, Pa., for the proposed electric plant of the Water Power Electric Company, which, it is said, will have an output of 3000 hp. M. E. Thornton is president.

LEAKSVILLE, N. C.—It is reported that the Leaksville Light, Power & Milling Company, recently incorporated, will install an electric light and power plant. A. B. and J. C. King are interested in the project.

SALISBURY, N. C.—The Southern Power Company has gained entrance into Salisbury, N. C., and will furnish electricity in the town. A substation is to be built jointly by the power company and the Salisbury & Spencer Railway Company at a cost of $20,000. A combination plan for distributing electricity for lamps seems to have been reached whereby the peak load will be met and the price of arc lamps greatly reduced. Numerous cotton mills will also make use of the electrical power furnished by the Southern Power Company.

THOMASVILLE, N. C.—The Thomasville Light & Power Company has established a 24-hour service in the town for both lamps and motors.

KENSAL, N. D.—Plans are being considered for the organization of an independent telephone company, which include the purchase of the local system, the extension of existing rural lines and the construction of a toll line to Carrington. L. C. Lane is interested in the project.

ASHTABULA, OHIO.—The Ashtabula Electric Street Railway Company is contemplating the construction of its proposed railway from Ashtabula to Ashtabula Junction, a distance of about 5½ miles, this year. As yet no contracts have been placed. J. V. Paulson is secretary of the company.

BUCYRUS, OHIO.—The citizens on May 5 voted to issue $90,000 in bonds for the construction of an electric light plant.

CLEVELAND, OHIO.—A franchise giving the Cleveland Electric Illuminating Company rights in a number of streets in the business section has been approved by the Board of Public Service.

CROOKSVILLE, OHIO.—It is said that the plant of the Acme Electric Light & Power Company, which was placed in the hands of a receiver, and will be ultimately sold, may be acquired by the village. The company recently built a new power house and installed a 175-hp engine. Thomas O. Crossman is the receiver.

NEW LEXINGTON, OHIO.—The capital stock of the Rushcreek Telephone Company has been increased from $10,000 to $20,000.

PIQUA, OHIO.—C. C. Custer, secretary and general manager of the Miami Light, Heat & Power Company, states that a new magnetite arc lighting system has just been installed in this city, consisting of 200 arc lamps and 125 series tungsten incandescent lamps. Two new General Electric 2300-volt three-phase alternators have also been installed. In addition, the company also operates an Edison three-wire network for lamps and motors in the commercial district. The Evans Almirall hot water heating system is operated in connection with the electric plant.

PORTSMOUTH, OHIO.—It is reported that the City Council has decided not to install a municipal electric light plant and will advertise for bids for lighting the city.

CHICKASHA, OKLA.—The Chickasha Water Power Company is installing a pair of turbine wheels with a rating of 800 hp in its hydroelectric power plant, and is also planning to install another pair of water wheels of the same rating, which will give the plant when completed an output of about 1400 hp. Lawrence Martin is treasurer.

McALESTER, OKLA.—The City Council is considering a proposition to establish a municipal electric lighting plant.

WAURIKA, OKLA.—Plans are being prepared for the construction of an electric plant, at a cost of $15,000, for which bids will be asked in about 30 days. The system will consist of 50 arc lamps of 2000 cp and 4000 incandescent lamps of 16 cp. The plant will be operated by steam power. The O'Neil Engineering Company, of Dallas, Tex., will have charge of the engineering work.

ASHLAND, ORE.—Surveys have been completed and plans made for the power plant to be erected in the Brewster Valley, at a cost of about $150,000, for which, it is said, bids for construction will be received in about 30 days. The work will include the construction of a power house, flume, reservoir and 35 miles of pipe line. E. N. Kelley, of Portland, is the designing engineer, and J. R. Benson is owner.

GRESHAM, ORE.—The Multnomah & Clackamas County Telephone Company has increased its capital stock from $5,000 to $11,000, the proceeds to be used for extending its lines to Sandy, Corbett, Eagle Creek, Damascus and other points.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 2, for furnishing the following supplies: Turbine pump and motor, pump governors, burners for marine boilers, power hammers, copper chain, etc. Blanks and general information relating to this circular (No. 441) may be obtained at this office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and 410 Chamber of Commerce Building, Tacoma, Wash., and also from the U. S. Engineer Offices in the following cities: Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala. Lieut.-Col. H. F. Hodges is general purchasing officer.

CONNELLSVILLE, PA.—The West Penn Railways Company is building an extension to its system from New Salem Junction to Brownsville, to be opened by July 1. The company is constructing a new substation at New Salem Junction, which will be equipped with two 300-kw, 60-cycle, motor-generator sets, where electricity will be transformed from 22,000 volts, three-phase to 650 volts, direct current. It is also rebuilding its storage battery plant at Uniontown, and has placed an order for a 3250-kw Westinghouse turbo-generator set to be installed at the main power station at Connellsville, and is also building extensive coal bunkers and enlarging the coal-handling machinery. L. H. Conklin is general superintendent.

DANVILLE, PA.—Local capitalists are interested in a project to furnish electricity in this city for lamps and motors. An option has been secured on the Muncy dam in the west branch of Susquehanna River, where a power plant will be erected, from which transmission lines will be erected to distribute electricity in the towns between Williamsport and Sunbury.

HALLSTEAD, PA.—The Montrose Telephone Company has secured the right of way on the Hallstead side of the river to Susquehanna to erect a telephone line.

HANOVER, PA.—The capital stock of the Hanover & McCherrystown Street Railway Company has been increased from $30,000 to $200,000.

NEW WILMINGTON, PA.—The Blacktown and New Wilmington Telephone Companies are contemplating the erection of a telephone line to connect their exchanges at Balm and New Wilmington.

PHOENIXVILLE, PA.—The American Union Telephone Company contemplates issuing $30,000 in bonds, the proceeds to be used for the construction of a new telephone system in Phoenixville.

PITTSBURG, PA.—Plans are being prepared by John P. Brennan, architect, for a one and two story power house for the Department of Charities and Correction, the cost of which is estimated at $50,000.

ROYER, PA.—Plans are being considered by the Morrison's Cove Electric & Power Company for the construction of a power plant on the branch of the Juniata River near Royer. The company proposes to furnish electricity to Williamsburg, Martinsburg and surrounding towns.

WEST CHESTER, PA.—The West Chester & Wilmington Street Railway Company has increased its capital stock from $254,000 to $500,000, and will issue bonds to the amount of $500,000.

CHESTER, S. C.—The citizens on May 5 voted in favor of the proposition to issue $26,000 in bonds for extending the municipal electric light plant and water works system.

KNOXVILLE, TENN.—Plans have been prepared by Ladshaw & Ladshaw, of Spartansburg, S. C., for the French Broad River Power Company on the proposed development to be located at Pickell's Island, five miles from Knoxville. The cost of the proposed plant is estimated at $1,273,100, as follows: For dam, $299,500; power house and boat lock, $173,600; hydraulic machinery, $220,000; electrical machinery, $185,000; five-mile pole line, $105,000; substation and equipment, $165.000, and for engineering and incidentals, $125.000. The hydraulic and electrical equipment includes nine water wheels, units with a rating of 4400 hp. each; nine alternating-current generators rated at 2000 kw each; oil-cooled transformers with a rating of 35,000 kw. The output of the plant is estimated at 38,925 hp. The estimate was prepared for W. A. Boyce, of Asheville, N. C., who is interested in the project.

GEORGETOWN, TEX.—The Gravis & Corn Hill Telephone Company contemplates the construction of a new line to Georgetown.

SAN ANGELO, TEX.—A company has been organized in the city to build an electric street railway system. Among those interested in the enterprise are: E. E. Bailey, Wilbur Brown and W. T. Bartholomew.

UVALDE, TEX.—The Uvalde Telegraph & Telephone Company is considering the construction of a number of additional branch lines.

BELLOWS FALLS, VT.—The Bellows Falls Canal Company contemplates the construction of a large cement dam below the present dam during the coming summer, and is also considering the construction of another dam on the Lawrence mills property, about seven miles below Bellows Falls, which will furnish power to operate an electric plant.

EUREKA MILLS, VA.—Wood Bouldin, Jr., and J. S. Easley, of South Boston, civil engineers, have been making investigations recently with a view of establishing an electric railway from Drake's Branch to some point on the Virginian Railway. If the railway is built the towns of Drake's Branch and Charlotte Courthouse will be lighted by electricity.

WINCHESTER, VA.—Plans are being made by the Winchester & Washington Railway Company to double the output of its power plant located on the Shenandoah River at Millville, which supplies Winchester, Berryville and Charlestown with electricity for lamps and motors. Contracts for machinery have been placed with the Westinghouse Electric & Manufacturing Company and the Dayton Globe Iron Works at a cost of about $50,000.

DEER PARK, WASH.—The County Commissioners have granted a franchise to George Nixon, of Spokane, for the installation of a power plant on the Spokane River near Deer Park, which will furnish electricity for lamps and motors in Deer Park, Chattaroy and Milan. The proposed transmission line will be about 25 miles in length.

EDMONDS, WASH.—It is reported that the Stone & Webster syndicate has acquired the controlling interest in the Sander electric railway, and contemplates extending the road from Halls Lake into Everett.

EVERETT, WASH.—The Sandstone & Brick Company, of Clinton, is contemplating the construction of an electric railway between Everett and Granite Falls.

EVERETT, WASH.—The Seattle-Tacoma Power Company is planning to equip its transmission line from Everett to the power plant at Snoqualmie Falls with new insulators for a change of voltage from 15,000 to 60,000 during the coming summer. The cost of the work is estimated at about $20,000. Morton Ramsdell is manager.

RITZVILLE, WASH.—The Washington Water Power Company, of Spokane, has been granted a franchise by the County Commissioners to erect transmission lines along the public highways of the county outside of the incorporated cities and towns to distribute electricity for lamps and motors.

SEATTLE, WASH.—Bids will be received until May 23 for the construction of the power plant for the State University. The cost of the plant is estimated at $80,000. A. H. Markwort is engineer and architect.

SEATTLE, WASH.—The Seattle-Tacoma Power Company has been granted permission to erect a power station on Western Avenue, adjoining the present transformer house of the company. Machinery having a rating of 1500 hp will be installed. Provision will be made to double the output of the plant when needed. N. H. Lattimer is president.

SEATTLE, WASH.—The Seattle, Snohomish & Everett Railway Company, recently incorporated, is planning to build an electric railway from Seattle to Everett, by the way of Bothell and Snohomish. The road from Seattle to Bothell, a distance of 12 miles, will be completed during the coming summer. The company is capitalized at $500,000, and the incorporators are C. W. Kimball, Joseph H. McLaughlin and Clyde C. Chittenden.

SPOKANE, WASH.—Jay P. Graves, president of the Spokane & Inland Empire Electric Railway Company, has applied to the City Council for a franchise to construct an electric railway in Mindenhall Avenue, which will give direct service to the Spokane Interstate Fair Association's Grounds.

WENATCHEE, WASH.—The City Council has granted a franchise to the Entait Power Company to erect and operate an electric plant to furnish electricity for lamps and motors in the city. The company has commenced work on the construction of its plant, the cost of which is estimated at $100,000.

NEW MARTINSVILLE, W. VA.—The plant and holdings of the Wetzel & Tyler Electric Railway Company, including the franchise and railway in Sistersville, have been sold to H. W. McCoy, of Sistersville. E. L. Robinson is special receiver for the road in Martinsville.

BERLIN, WIS.—It is reported that the Oshkosh Traction Company has purchased the Winneconne branch from Rush Lake Junction of the Chicago, Milwaukee & St. Paul Railway Company. The Oshkosh Traction Company, it is said, will equip the road to be operated by electricity in connection with the present interurban railway running between Oshkosh and Omro.

MILWAUKEE, WIS.—The Plankinton Light & Heat Company is making arrangements to make extensions to its plants and to increase the area of its service.

MILWAUKEE, WIS.—An order signed by Judge Grosscup, of Chicago, permitting the sale of receiver's certificates of the Chicago-Milwaukee Electric Railway Company to the amount of $1,000,000 has been filed in the local Federal Court. As soon as a working force can be organized work will commence on the construction of the road in this city.

MONROE, WIS.—The Jefferson Telephone Company is making arrangements to erect new lines in this city and also into the surrounding country.

ROSENDALE, WIS.—Plans are being considered by the Rosendale Telephone Company to extend its lines to Eldorado.

SHEBOYGAN, WIS.—A deal has been closed whereby the Elkhart-Plymouth Interurban line will be completed by the Milwaukee & Fox Valley Railroad Company. The road will be completed by July 1, and the Sheboygan Light, Power & Railway Company has secured a lease of the tracks for 25 years for a service to Elkhart Lake.

BEULAH, WYO.—Plans are being considered by the Black Hills Traction Company, of Deadwood, S. D., for the construction of a new power plant near Beulah, the cost of which is estimated at $250,000.

BEULAH, WYO.—The Redwater Power Company, of Spearfish, S. D., has secured water rights and the right of way on Sand Creek, above Beulah, and proposes to erect a hydro-electric plant with an output of 1200 hp.

THERMOPOLIS, WYO.—The plant and holdings of the Thermopolis Electric Light & Power Company have been purchased by H. J. Thompson, of Billings, Mont., for $30,000. It is said that the new owner contemplates extensive improvements to the system.

CALGARY, ALB., CAN.—P. A. G. Rodrique has applied to the City Council for permission to construct a street railway. He proposes to secure electrical energy for operating the road from the municipal electric light plant.

CALGARY, ALB., CAN.—Bids will be received until May 15 for installing the following machinery in the municipal electric-lighting plant: One 100-hp reciprocating engine; one 750-kw, three-phase, 60-cycle, alternating-current generator; one 30-kw, direct-current, 120-volt, direct connected, steam-driven exciter set; one "Tirrill" automatic voltage regulator; switchboard of two panels; one station watt meter, and one 750-kw turbo-generator set complete. V. Hill, of Calgary, is engineer.

FORT STEELE, B. C., CAN.—It is reported that the Bull River Power & Light Company will erect a power plant on the Bull River, near Fort Steele, and develop 10,000 hp. The power house will be equipped with percussion water wheels operating under a vertical head of 275 ft. George E. Henderson, of Merrillan, Wis., is manager.

NEW WESTMINSTER, B. C., CAN.—It is stated that the Canadian Pacific Railroad Company is arranging to equip its line between here and Westminster Junction, to be operated by electricity, early next year. F. E. Busteed, Vancouver, B. C., is general superintendent.

PORTAGE LA PRAIRIE, MAN., CAN.—The Central Electric Company, of this city, has submitted a proposition to light the city on a 25-year franchise and proposes to supply 25 arc lamps of 2000 cp each at $125 each per annum, or 30 lamps for $120 each. The price of electricity for lamps under this franchise would be 20 cents per kw-hour. John O'Brien is manager for the company.

RUSSELL, MAN., CAN.—The United Telephone Company has been granted a franchise to erect a rural telephone system throughout Silver Creek municipality. The company expects to commence work on its system this summer.

MALLORYTOWN, ONT., CAN.—The Mallorytown Rural Telephone Company has decided to extend its lines to Lynn, Junctown, Caintown and McIntosh Mills.

MERRITTON, ONT., CAN.—K. L. Aitken, of Toronto, consulting engineer, has submitted a report to the Town Council in connection with an electric lighting system for the town. He places the value of the present street lighting system, which includes poles and wires, which might be used as part of a municipal system, at $4,207, and states that an expenditure of $2,500 more would be sufficient to give a 24-hour service with 180 incandescent street lamps. The street lighting contract expires this year, and the Council is considering the installation of a municipal electric light plant.

TORONTO, ONT., CAN.—The City Council has authorized the signing of the agreement with the Hydro-Electric Power Commission to supply electrical power at $18.10 per hp per year. The city's share of the cost of the transmission line from Niagara Falls will be $828,000. Toronto is the first city to take definite action in this matter.

EASTVIEW, SASK., CAN.—The Eastview Telephone Company is contemplating the erection of a number of rural telephone lines. R. E. Allcock is manager.

ESTEVAN, SASK., CAN.—The ratepayers will shortly vote on a by-law to provide $83,000 for improvements and extensions to the electric light and water plants. For further information address Councilor Davies.

BATOPILAS, MEX.—Ira Bowles, of Batopilas, state of Chihuahua, is preparing to install a hydro-electric plant on the San Miguel River near the town of Batopilas.

CHIHUAHUA, MEX.—The Compañia Electrica y de Irrigacion has obtained from the Government of the State of Chihuahua an extension of time of three years in which to establish its hydro-electric power enterprise on the Conchos River. This company has had plans prepared for a plant which will have an output of 30,000 hp. It will be erected about 25 miles from the town of Santa Rosalia, and electricity will be transmitted to the cities of Chihuahua, Parral, Santa Eulalia, Jiminez and other places in the state, where it will be used for mines and industrial enterprises.

GUADALAJARA, MEX.—The Compañia de Tranvias, Luz y Fuerza de Guadalajara, which operates the lighting and street railway systems of the city of Guadalajara, is preparing to enlarge its generating stations at La Junta and Juanacatlan, state of Jalisco, to meet the increasing demand for electrical energy. The system is to be changed from single phase to the three-phase system.

GUANAJUATO, MEX.—Owing to the increasing demand for electrical power for the operation of the machinery of mines, mills and other industries of the states of Guanajuato, Michoacan and Jalisco, the Guanajuato Power & Electric Company has decided to increase the output of its hydro-electric plant to 28,000 hp. It is stated that practically all of this power is already contracted for. When the enlargement now being made is finished the expenditures will have aggregated not less than $8,000,000. The initial hydro-electric plant of the company was erected at Elduro, state of Michoacan, a few years ago and now has an output of 10,000 hp, all of which is being utilized by the mines of the Guanajuato district and industrial concerns and for lamps in the cities of Guanajuato, Zamora and Irapuato. The company is now installing a second hydro-electric plant, located at El Sabino, state of Michoacan, and will generate 6000 hp. It is constructing a loop transmission line to supply electricity for lamps and motors to La Luz and Leon and other smaller towns.

LA JOYA, MEX.—It is stated that the company which was promoted by James D. Schuyler, of Los Angeles, Cal., to install a large hydro-electric plant at La Joya, on the Conchos River, state of Chihuahua, will soon begin construction work. It is estimated that from 15,000 to 20,000 hp can be developed.

MEXICO CITY, MEX.—The Michoacan Power Company has been granted a concession by the Federal Government to install a hydro-electric plant on the Zacapu River, state of Michoacan.

MEXICO CITY, MEX.—The Mexico City Motor Car & Omnibus Company has established a regular service of electric omnibuses and cabs in this city. The omnibus lines reach points not reached by the electric railway lines, and the electric cabs do a general passenger business. L. C. Browne is general manager.

ORIZABA, MEX.—The Compañia de Luz y Fuerza Motriz Electrica de Orizaba is erecting an addition to its plant, situated on the Rio Blanco, near Orizaba, which will increase the output by 750 hp. The company supplies the city of Orizaba with electricity for lamps and motors. The original plant has an output of 2000 hp.

ORIZABA, MEX.—The Compañia Industrial de Orizaba is installing a new power plant on the Rio Blanco River at Orizaba. The electrical apparatus consists of two 750-kw, alternating-current generators; two 70-kw, direct-current, exciter generators, and four 375-kw, oil-cooled transformers for changing the voltage from 440 volts to 10,000 volts for transmission purposes.

TAMPICO, MEX.—The Secretary of Public Works of Mexico has let the contract for the equipment of the Government wharves at the port of Tampico with electric cranes. Electrical energy for operating the cranes will be supplied by the Compañia de Fuerza Electrica de Tampico. It is reported that the Government has in contemplation the providing of similar equipment for the other ports of the country.

TORREON, MEX.—Fedrico Ritter is arranging to install a hydro-electric plant on the Nazas River near Torreon, in the state of Coahuila.

TEMASCALTEPEC, MEX.—The capital stock of the Sultepec Light & Power Company has been increased from $300,000 to $1,000,000. Hagen, Goodrich & Coughlan, 49 Wall Street, New York, N. Y., are attorneys for the company.

New Industrial Companies.

THE FOLEY-GREGORY ENGINE COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $25,000, by Daniel F. Flannery, William McKinley and S. Longwell.

THE NATIONAL ELECTRIC DEVICE COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $50,000 by B. L. York, E. P. Norwood and C. M. Boyd.

THE S. HEALEY COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $20,000. The incorporators are Herbert T. Jennings, James W. McCabe and Sumner Healey, of New York, N. Y.

THE GUARANTY ELECTRIC HEATER COMPANY, of Cleveland, Ohio, has been incorporated, with a capital stock of $10,000, by George Ross, Edward J. Cole, W. J. Barr, J. W. Burrell and William E. Patterson.

THE CONSUMERS' GAS & ELECTRIC FIXTURE SUPPLY COMPANY, of Brooklyn, N. Y., has been incorporated, with a capital stock of $10,000, by Samuel Tepfer, Harry Tepfer and George M. Tepfer, all of Brooklyn, N. Y.

THE BANKERS' ENGINEERING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $5,000, by M. L. Rodman and Willard G. Searles. The company proposes to do a general building and contracting business.

THE MORAN VAN FOSSEN & TUCKER COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $20,000, to manufacture gas and electric fixtures. The incorporators are Lavern W. Thompson, J. T. Tyrell and Percival Steele.

THE WILLEX MANUFACTURING COMPANY, of Rome, N. Y., has been incorporated, with a capital stock of $10,000, to manufacture gasoline engines, etc. The incorporators are F. W. Mills, H. M. Browne and E. J. Forhan, of New York, N. Y.

THE RELIABLE GASOLINE ENGINE COMPANY, of Boston, Mass., has been incorporated, with a capital stock of $20,000. The incorporators are George E. Chase, president; August Adolph, clerk, and Edson J. Smith, all of South Boston, Mass.

THE WATSON MOTOR COMPANY, of Lynbrook, N. Y., has been incorporated, with a capital stock of $10,000, and the following-named directors have been elected: Julian N. Walton, Lynbrook, N. Y.; Eldridge N. Smith, of Brooklyn, N. Y., and George F. Hickey, of New York, N. Y.

F. A. BURDETT & COMPANY, of New York, N. Y. (consulting engineers), have filed articles of incorporation, with a capital stock of $100,000. The incorporators are: S. B. Howard, of Millbrook, N. Y.; A. W. Britton, of East Orange, N. J., and J. D. Baker, of New York, N. Y.

THE SEABOARD ENGINEERING & CONSTRUCTION COMPANY, of Asbury Park, N. J., has been incorporated, with a capital stock of $125,000, by W. W. Kurtz, A. J. Flynn and F. F. Haberstick, all of Asbury Park, N. J. The company proposes to do a general electrical and mechanical engineering business.

New Incorporations.

MODESTO, CAL.—The Tuolumne Water & Power Company, capitalized at $1,000,000, has been incorporated by Warren Gregory and H. H. Rolfe, of San Francisco; Geo. Whipple, of Alameda; Winfield Dorn, of Oakland, and J. L. Lamson, of Berkeley.

BARRY, ILL.—The Hot Air Telephone Company has been organized, with a capital stock of $2,500, by Albert W. Triplett, W. D. Gamble and Orland Havrid.

CHICAGO, ILL.—Articles of incorporation have been filed for the Public Telephone & Messenger Company, with a capital stock of $1,000, by F. M. White, George M. Newhart and Philip Strauss.

CHICAGO, ILL.—Articles of incorporation have been filed with the Secretary of State for the Portland Electric Light & Power Company. The company is capitalized at $15,000. The incorporators are: Fred Frost, John R. Rooney and John P. O'Shaughnessey.

HIGHLAND, ILL.—The Grantfork Mutual Telephone Company has been incorporated, with a capital stock of $2,400, by John Schwartz, J. S. Leef, Nicklaus Trautner, A. L. Hitz, Jacob Raeber and others.

PEKIN, ILL.—The Farmers' Mutual Telephone Company has been organized for the purpose of erecting a telephone system in Groveland, Elm Grove, Tremont, Dillon and Hopedale, with exchanges at Morton, Groveland and Tremont. The company will be capitalized at $25,000, and the following-named officers have been elected: John Sommers, president, and Frank J. Wilkins, secretary.

ROBINSON, ILL.—The Terre Haute, Robinson & Illinois Railroad Company has been organized to build an electric railway from the banks of the Wabash River to Mt. Vernon, Ill., about 100 miles in length. Another company will be organized under the laws of Indiana to build the road from the river to Terre Haute, a distance of about 25 miles. The officers of the company are: H. C. Pugh, of Terre Haute, president; S. C. Wilson, vice-president; F. W. Lewis, secretary; Norman Moss, treasurer, and Baxter L. Brown, of St. Louis, Mo., chief engineer. The contract for the construction of 100 miles from the Wabash River to Mt. Vernon has been let for $2,500,000, to be completed in 18 months.

SCOTT MILL, ILL.—Articles of incorporation have been filed for the Scott Mill Telephone Company. The capital stock of the company is placed at $1,500, and the incorporators are E. A. Meyers, E. F. Byrns and W. J. McClelland.

WINCHESTER, ILL.—Articles of incorporation have been filed for the Winchester Electric Company with a capital stock of $10,000 by William Milhous, C. H. Condit and S. Hainsfurther. The company proposes to operate a heat, light and power plant.

BROOKLYN, IND.—The Brooklyn Mutual Telephone Company has filed articles of incorporation. The directors of the company are J. F. Dobson, Louis Hays, W. A. Morgan, J. M. Lang and E. M. Kramer.

DUPONT, IND.—The New Marion & Dupont Telephone Company has been incorporated, with a capital stock of $10,000, by Jacob Deek, B. J. Johnson, W. E. Fall and John Eckston.

BULAH, KY.—The Bulah Telephone Company has been incorporated, with a capital stock of $500, by R. T. Courtney, G. T. Wooley, W. D. Hagdon and others.

FLEMINGSBURG, KY.—Articles of incorporation have been filed for the Fleming Ice & Light Company with a capital stock of $8,000 by J. L. O'Bannan, Charles E. Rodes, J. H. Powers and others.

GOSHEN, KY.—The Goshen Telephone Company has been incorporated, with a capital stock of $400, by S. J. Bell, Liborn Gooch and others.

LOUISVILLE, KY.—The Kentucky Telephone Company, of Powell, has been incorporated, with a capital stock of $12,000, by J. H. Sherley, Laura Sherley, Henry Watson and others, of Mt. Sterling.

CASS CITY, MICH.—The East Line Telephone Company has been organized by the farmers of Evergreen Township. The company has already constructed five miles of telephone lines east of Cass City and contemplates enlarging its system.

MINNEAPOLIS, MINN.—Articles of incorporation have been filed for the Arizona Southern Power Company, I. A. England, of Alexandria, and A. A. Van Dyke, of St. Paul. The company is capitalized at $50,000, and proposes to construct an electric railway and telephone and telegraph lines.

MINNEAPOLIS, MINN.—The Twin Cities & Lake Superior Electric Railway Company has been incorporated by Edward Henry, of Minneapolis, and F. R. Duxbury, of St. Paul. The company is capitalized at $7,000,000.

MOOSE LAKE, MINN.—The Rural Telephone Company has been organized at this place, and contemplates the erection of a telephone line east from Moose Lake. Charles Gunderson is secretary.

RED LAKE, MINN.—Articles of incorporation have been filed for the Clearwater Telephone Company, with a capital stock of $2,500. The officers of the company are: Charles Sall, president; John Lynch, vice-president; James Walker, secretary, and H. J. Enderle, treasurer.

YAZOO CITY, MISS.—The Rapid Transit Company has been organized, with a capital stock of $10,000, by J. W. Bailey, G. A. Pullen and others.

WILLOW SPRINGS, MO.—The Water, Light & Land Company has been chartered, with a capital stock of $25,000, by G. W. Stough, M. T. January, Levi Cook and others.

CROFTON, NEB.—The Farmers' Mutual Telephone Company has been organized for the purpose of building and operating telephone lines in Cedar and Knox Counties. J. O. Mormann is interested in the enterprise.

BROCKET, N. D.—An independent telephone company has been organized in this city, with a capital stock of $1,500, to erect about 20 miles of telephone lines. P. A. Lee has been elected secretary and treasurer.

Company Elections.

CINCINNATI, OHIO.—At the annual meeting of the Tuscarawas County Electric Light & Power Company the present directors and officials were re-elected.

CINCINNATI, OHIO.—At the annual meeting of the Cincinnati Gas & Electric Company the following officers were elected: Charles P. Taft, president; Louis Hauck, vice-president, and Theodore Clauss, secretary.

CONWAY, MASS.—At the annual meeting of the Conway Electric Street Railway Company the following named officers were elected: Moses Williams, of Brookline, president; J. B. Laidley, of Conway, vice-president; H. E. Fisher, of Somerville, treasurer, and J. B. Laidley, clerk.

DOYLESTOWN, PA.—At the annual meeting of the Philadelphia & Easton Railway Company the following named officers were elected: William P. Ayres, of Wilkes-Barre, president; A. Sickler, of Philadelphia, vice-president; W. S. Chambers, of Doylestown, secretary, and J. C. Lugar, of Philadelphia, treasurer.

CLEVELAND, OHIO.—At the annual meeting of the Cleveland, Brooklyn & Elyria Railway Company the following named officers were elected: J. J. Breitinger, president; W. E. Brooks, vice-president; J. Harry Knisely, Jr., secretary, and B. E. Oppman, treasurer. It is stated that work will commence on the construction of the road soon.

Legal.

INJUNCTION NOT SUSTAINED.—The Economic Power & Construction Company, of Geneva, N. Y., has succeeded in having vacated, with costs, the injunction secured by the Geneva-Seneca Electric Company, of Geneva, temporarily restraining the Economic Company from laying pipes in the streets of Geneva. The court was also of the opinion that the consent of the Public Service Commission was not required, under its direct charter from the state.

PLANKINTON TUNNEL PROJECT.—The Plankinton Light & Power Company, of Milwaukee, Wis., has filed a petition asking the right to begin condemnation proceedings against property north of the Davidson theatre and from that point eastward to the Milwaukee River in order that it may improve and further install tunnels to transmit electricity for light and power to downtown business houses. In connection with this petition an injunction signed by Judge Tarrant, restrains Gimbel Brothers from interfering in any way with the wires, tunnels and piping of the company.

RECEIVER FOR OWOSSO & CORUNNA ELECTRIC COMPANY.—Judge Swan of the United States circuit court has appointed Edward E. Mandeville, of Philadelphia, Pa., and Gilbert L. Taylor, of Owosso, as joint receivers of the Owosso & Corunna Electric Company, of Owosso, Mich. The Fidelity Trust Company, of Philadelphia, Pa., has begun suit in the United States district court at Bay City to foreclose the bonds of the company which are held by the Fidelity Trust Company, default having been made in the payment of the interest on the bonds. The company operates a street car system in Owosso and Corunna and a lighting plant in Owosso.

ELECTRIC LIGHT COMPANY NOT LIABLE FOR INJURIES TO APPRENTICE WHILE ENGAGED IN WORK NOT ASSIGNED TO HIM.—The foreman of a force of men in the employ of an electric light company assigned two designated and experienced men to the duty of attaching a guy wire to a particular telegraph pole. These two men, without being authorized to do so, delegated the duty to an inexperienced apprentice who, in climbing the pole, came in contact with a wire used in raising and lowering the electric lamp attached to the pole, which wire had, owing to faulty construction and improper insulation, become charged with a current of sufficient voltage to cause death. It was held that the company was not liable for the death of the apprentice, thus occurring while he was engaged in work which had not been regularly assigned to him. An apprentice lineman occupies relations of a special charancter in respect to the company which employs him, jost as the company occupies a special position touching its rights and obligations to the apprentice. The company recognizes that the apprentice is under its tutelage and entitled to its special protection, and is not justified and warrarted in placing him by its orders in places of danger. On the other hand, the apprentice is not at liberty to select for himself the particular work he is to do, nor the time, place and manner of executing it. He can only do this under the orders and direction of the employer. If he does otherwise, he does so on his own responsibility and at his own risk. It is not for him to determine whether work of a particular kind is dangerous or subject to possible risks and to act on his own judgment. While the climbing of poles and the handling of wires may be within the scope of an apprentice lineman's employment, he is not in the discharge of his doties as an employee when he undertakes to do work of that kind which he has not been directed to do. Maitrejean v. New Orleans Ry. & Light Co., Supreme Court of Louisiana, 46 So. Rep. 21.

DUTY TO WARN EMPLOYEES OF DAMAGES INCIDENT TO WORK.—The duty of an electric light company to warn an employee as to abnormal dangers is not violated, where from either the character of the work or other sources, the employee is possessed of all the information which the master could have furnished regarding such perils; and it has recently been held in Massachusetts that an electric light company was not liable for the death of an employee through coming in contact with a tap wire while stringing wires where the wire was clearly visible, and decedent, an experienced workman, had been informed of all the elements of danger attendant on his employment, and was permitted to perform the work in his own way, with an opportunity of unrestricted observation which the dangerous environment demanded. It appeared from the facts that the electric wires of the defendant's system being in a dangerous condition for want of proper insulation, new wires were to be substituted, and a gang of men, including the decedent, who was an experienced lineman, was sent out to perform the work, under the direction of a general foreman of the company. On changing his position from one crossarm to the next one above, he was obliged to step over the tap wire, which had become charged with an alternating current, the end of which penetrated his body and caused him to fall across other wires which were uninsulated and heavily charged. On these facts the conclusion was reached that, if generally the employer, or one who stands in his place, owes a duty to an employee to warn or instruct him as to abnormal dangers, this duty is not violated, where from either the character of the work, or other sources, the employee is possessed of all the information which the employer could have furnished regarding such perils. Pembroke v. Cambridge Electric Light Company, Supreme Judicial Court of Massachusetts, 84 N. E. Rep. 231.

Obituary.

MR. FREDERIC H. MAY, formerly vice-president and general manager of the American Rapid Telegraph Company, died May 10 at his home in Newark, N. J. He was prominent in railroad building in the West and Middle West in the 70's and won fame during the Civil War by keeping the Illinois Central open for troop and supply trains for General Grant. Mr. May was born on the Isle of Man.

MR. JOHN A. ERNER, president of the Erner Electric Company, of Cleveland, Ohio, died at his home in that city May 7 from the results of an attack of the grip. Mr. Erner was 43 years of age and was formerly with the Bissell, Dodge & Erner Company, of Toledo, and a stockholder of the Erner-Hopkins Company, of Columbus, Ohio. He was a member of the Chamber of Commerce, the Builders' Exchange, the Cleveland Athletic Club, the Catholic Federation and the Knights of Columbus.

Personal.

MR. ALEXANDER SIEMENS has been elected a vice-president of the Institutions of Civil Engineers of England.

MR. NIKOLA TESLA and his new nitrates company have taken offices in the new City Investing Company's building, at Broadway and Cortlandt Street, New York City.

DR. LOUIS BELL has sailed this week for Europe in the interest of several American central stations, to look over the field and make a study of recent developments there.

MR. C. L. KINGSLEY has become a director in the New York Telephone Company in place of Mr. C. Steele, of J. P. Morgan & Co.

THOMAS & NEALL, consulting electrical engineers, have moved their New York offices from 52 William Street to the United States Express Building, 2 Rector Street.

MR. L. S. MONTGOMERY, who has been traveling in the Southern States for the Western Electric Company, is now in the employ of the Federal Electric Company, of Chicago, and has Ohio, Illinois and Indiana as territory.

MR. WILLIAM PLATTNER, superintendent of the municipal electric light plant at Bluffton, Ohio, has been appointed superintendent of the municipal electric light plant at North Attleboro, Mass., to succeed Mr. W. P. Whittemore, recently resigned.

MR. W. BARCLAY PARSONS, of New York City, has been awarded a Telford gold medal by the Institution of Civil Engineers of England in recognition of the merit of his paper read and discussed before that body on underground electric railway development in New York.

MR. PERCY R. FROST, formerly president of the Union Electric Company, of Pittsburg, has accepted the position of sales manager for the large electrical supply house of Stuart-Howland Company, of Boston. The company is to be congratulated on securing a competent official, Mr. Frost standing high in the estimation of the electrical industry.

MR. WILLIAM E. PRICE, who has had charge of the electrical department of the Pueblo & Suburban Traction & Lighting Company, of Pueblo, Col., will hereafter act as consulting engineer of the company with headquarters at Pueblo. Mr. T. C. Roberts, master mechanic of the Pueblo plant of the American Smelting & Refining Company, has been appointed superintendent of power and shops for the Pueblo & Suburban Traction & Lighting Company, with headquarters at Pueblo.

MR. J. T. CORNISH, chief engineer of the La Capital Traction & Electric Company, Metropolitana Tramway, Grand National Tramway Company, Buenos Aires Electric Tramway Company, Belga Argentina Tramway Company, and consulting engineer of the Cordoba Light & Power Company, has been appointed resident engineer of the City of Santos Improvements Company, of Santos, Brazil, controlling the gas, water, electric lighting and tramways in that city. Mr. Cornish left Buenos Aires May 1 to take up his duties at Santos.

MR. HENRY FLOY.—According to the Syracuse, N. Y., newspapers, Mr. Henry Floy, the well-known electrical engineer, has been approached on the subject of succeeding Dean Kent at Syracuse University. Mr. Floy has declined to say anything on the subject, but there is no doubt as to the authenticity of the report. Mr. Floy is a graduate of Wesleyan and Cornell Universities and has been engaged in practice for some years past as a hydraulic and electrical engineer, with a consulting practice all over the country. He is a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society and other bodies.

MR. H. L. WELLS, formerly advertising writer for the Allis-Chalmers Company, Milwaukee, more recently publicity manager of the Power & Mining Machinery Company, Milwaukee, has opened an office in Chicago at No. 1205 Monadnock Block, for the general practice of technical or trade journal advertising, and is now ready to undertake work of any kind in the broad field of publicity for manufacturers of machinery and allied products, the regular service to be rendered on a monthly or yearly salary basis. Mr. Wells' long experience in the preparation of attractive copy and complete catalogs for firms of world-wide reputation fits him eminently for serving his clients in this broader field of work.

DR. SCHUYLER SKAATS WHEELER, past president of the American Institute of Electrical Engineers and president of Crocker-Wheeler Company, recently addressed the Engineering Society of Columbia University on the subject of "Engineering Honor." As an undergraduate at Columbia, in the class of '83, he, with Prof. F. B. Crocker, had addressed the same society on technical subjects. After declaring that he felt the audience before him to be more sympathetic than any of the audiences he had addressed on engineering ethics, he alluded to the ethical codes of the various so-called learned professions. He spoke also of the code which he proposed in his presidential address brfore the American Institute of Electrical Engineers. Dr. Wheeler mentioned three great duties of the engineer in the order of their importance—first, the engineer's duty to his client; second, to the public, and, third, to his engineering society. He condemned strongly the publication of false scientific and false engineering statements in the newspapers, and insisted that discoveries and inventions should be announced not in the daily papers, but through the technical societies or the technical press.

Removals.

THE AMERICAN STEEL FOUNDRIES have changed their New York office from 42 Broadway to the Hudson Terminal Building.

FORT WAYNE ELECTRIC WORKS.—The New York office of the Fort Wayne Electric Works, formerly located at 40 New Street, has been moved to the Cortlandt Building, Hudson Terminal, 30 Church Street. The new office is on the 15th floor.

AMERICAN BRIDGE COMPANY.—The Boston offices of the American Bridge Company have been moved to the Oliver Building, 141 Milk Street. The American Bridge Company has moved its office to the Hudson Terminal Building, Church Street, New York City. Watson-Stillman Company has moved to the same building.

Trade Publications.

OIL-BREAK SWITCHES.—The General Electric Company, Schenectady, N. Y., in bulletin No. 4576, describes the Type F, Form K-3 line of 4500-volt oil switches for panel installation and remote control. This switch has been especially designed with a view to combining satisfactory operation with low price and is claimed to meet the most severe requirements of service on systems at e.m.fs. of 4500 volts or less.

CENTRAL DISCOUNT SHEET.—The Central Electric Company, of Chicago, has issued a new trade discount and price list, applying to its 1906-1907 general catalogue. This price-list has been revised. It cancels all previous quotations, and now contains the most up-to-date prices of electrical appliances sold by them. It is dated May, 1908, and is now being distributed. Holders of catalogs who do not receive a copy of this price-list should write for one.

MOTOR-DRIVEN VACUUM CLEANER.—The Electric Renovator Mfg. Co., Farmers' Bank Bldg., Pittsburg, Pa., has issued an extremely attractive catalog, dealing with its motor-driven centrifugal air pump for vacuum cleaning processes. The apparatus is entirely self-contained and is quite compact. The catalog contains a large list of users of "Invincible' cleaners, which includes many public buildings, churches, theatres, hotels, stores, residences and house-cleaning firms.

ADVERTISING.—"What Makes the Best Advertising Medium" is the name of a neat, well-printed pamphlet consisting of a series of articles reprinted from *Selling Magazine*, written by Mr. Emerson P. Harris. The question is discussed in this pamphlet in a clear, concise and unbiased manner. The articles are full of interesting reading which will be of great value to every man who is called upon to decide the question of what advertising medium he will use to promote the welfare of his business. The price of the book is 50 cents, but it will be sent free to any reader of ELECTRICAL WORLD who will write for it to *Selling Magazine*, Postal Telegraph Building, New York.

"TRUMBULL CHEER," issued by the Trumbull Electric Manufacturing Company for May, is an anniversary number. It gives a most interesting story of the growth of the business in seven years, from the occupancy of a little old chuck factory to the present handsome buildings at Plainville, Conn. At first and for some time knife switches were made, but successive new lines were taken up, and last August the panel and switchboard factory was erected. Views are given of the factory, with work in progress, and a lot of chatty data and points are given as to features of the industry. At first as now the company consisted of Frank T. Wheeler, president; John H. Trumbull, treasurer, and Henry Trumbull, secretary. There has been no change of personnel or position.

ENGINEERING INDEX ANNUAL.—The *Engineering Magazine*, 140 Nassau Street, New York, has just issued its "Engineering Index Annual" for 1907. In this volume, as in that for 1906, issued about a year ago, the classified system has been adhered to, which is followed in the monthly parts. The reason given is that it makes the maintenance of the publication commercially practicable. The five-year volume was a burden of expense, "which even great devotion to the profession could not bear with any equanimity." Apart from that, the annual form has the advantage, both to consultants and to publishers, that it indexes current literature while it is still fresh, timely in point of practice and more readily obtainable. The publishers have improved the arrangement of the items, clarified the classification, standardized catch words and brought all references to a subject together with abundant correspondences.

Unclassified Items.

HINCKLEY, MINN.—A franchise has been granted to J. J. Coburn, of Cloquet, to construct an electric light plant in this town. It is expected that the water power of Grindstone will be utilized to generate electricity.

EDGELEY, N. D.—The Aberdeen Electric Company has been awarded the contract for the construction of the pole line for the municipal electric light plant, and Fairbanks, Morse & Company was awarded the contract for the dynamo, engine and other equipment.

COQUILLE, ORE.—The Coos County Electric Light & Power Company has been organized by W. C. Rose, George A. Robinson, C. R. Barrows, E. C. Barker and C. C. Evland. The company has filed water rights on the North Fork River from the mouth of Big Creek to the Fox Bridge at Fairview. It is estimated that 6000 horse-power can be developed. The company will furnish electricity to Coquille and other towns in Coos County.

LEHIGH, IOWA.—Plans are being considered by H. V. and J. M. Williams for the installation of an electric light plant.

GENEVA, N. Y.—Plans are being prepared by the Geneva-Seneca Electric Company for the construction of a new power plant to cost about $150,000. The equipment of the plant will include four 500-kw, three-phase, 60-cycle generators direct connected to turbine engines.

CASHTON, WIS.—Plans are being considered for the construction of an electric light and water works station, the cost of which is estimated at $15,000.

CARLETON, MICH.—The Washtenaw Light & Power Company has been granted a franchise by the Huron Township to erect its transmission lines through the town. The company proposes to furnish electricity for lighting between Geddes and Trenton, and will supply several of the towns through which its line extend with electricity for the same purpose.

FARIBAULT, MINN.—The City Council has passed upon the first reading of an ordinance granting a franchise to the Minneapolis, St. Paul & Dubuque Electric Traction Company to enter the city. The company will be required to build an extension from here to Shieldsville, passing Roberts, French and Shieldsville Lakes.

POPLARVILLE, MISS.—The Board of Mayor and Aldermen has adopted a resolution ordering an issue of $10,000 in bonds, the proceeds to be used for paying a balance due on the electric light plant and water works system and also to improve and extend the service.

ELLSWORTH, MINN.—The Village Council has granted F. M. Sadler a 25-year franchise to furnish electricity for lighting the town. The franchise carries with it a provision that the city can purchase the plant at the end of any period of five years.

MARQUETTE, MICH.—Plans and specifications have been authorized by the Board of Light and Water Commissioners for the construction of a new substation in connection with the present electric system.

BRISTOL, R. I.—Extensive additions are contemplated for the power plant of the National India Rubber Company, which includes the installation of a 1000-hp engine and three additional engines aggregating about 1000 hp, manufactured by the Hewes & Phillips Iron Works, of Newark, N. J., together with three Crocker-Wheeler generators to furnish electricity for lamps and for motors.

DETROIT, MICH.—The Stecker Electric & Machine Company is making arrangements to erect a new factory building near Woodbridge and Bates Streets, which will be equipped with motor drive throughout.

WASHINGTON, D. C.—Bids will be received until May 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Puget Sound, Wash., Schedule 1130—15,000 ft. galvanized iron wire; 300 dry batteries; 300 lb. micanite plate. Schedule 1133—12,000 lb. ingot copper. Schedule 1151—electrical supplies; connecting boxes; electric fixtures; 8000 attachment plugs; water tight communicators; transmitters and indicators. Schedule 1153—hard brass wire; galvanized steel wire. Mare Island, Cal., Schedule 1132—6700 lb. sheet; 3800 lb. galvanized hook steel; rolled bronze; phosphor bronze. Schedule 1153—steel plates. San Francisco, Cal., Schedule 1131—about 4500 ft. rubber-covered copper wire; 700 ft. copper stranded dynamo flexible cable. Applications for proposals should designate the schedules desired by number. F. B. Rogers, paymaster-general, U. S. N.

SPRINGFIELD, MASS.—The Enfield Power Company has been organized for the purpose of building a power plant on the Connecticut River at Warehouse Point and in aiding the United States Government in opening the Connecticut River to navigation between this city and Hartford. In return for permission from the Government to use the water power to generate electricity, the company will dredge a canal from Windsor Locks to Hartford, which can be used for all boats passing up and down the river. The officers of the company are: Charles H. Tenney, of Springfield, president; Ralph P. Allen, vice-president, and Ambrose Clogher, of Pittsfield, Mass., clerk.

CLARKSDALE, MISS.—Walter G. Kirkpatrick, of Jackson, consulting engineer, has been engaged by the city to take charge of the installation of a direct connected unit in the municipal electric light plant, and extension of water mains, sewers, and other improvements, the cost of which will aggregate about $55,000.

OKLAHOMA CITY, OKLA.—The Somerville Light & Ice Company has been incorporated with a capital stock of $25,000 by J. D. Giddings, R. E. B. Bledsoe, of Somerville, Tex., and others.

SUMPTER, ORE.—The Columbia Mine is making extensive improvements in its plant and is making arrangements to operate its machinery by electricity.

Business Notes.

THE NUTTING-ROE ELECTRIC COMPANY, of Muncie, Ind., recently incorporated, will establish and equip a plant to manufacture and sell electrical equipment of all kinds. K. E. Nutting and M. L. Roe, directors

CENTRAL ELECTRIC COMPANY AT THE N. E. L. A.—The Central Electric Company is planning to have a large exhibit of high tension insulators, and other specialties of this nature. The exhibit will be shown in booths 23, 24, 47 and 48.

THE BASELER, LAWRENCE & HEINEKEN COMPANY, of Philadelphia, Pa., is planning to establish a plant in Havre de Grace, Md., for manufacturing electrical switchboards, fixtures and supplies. William H. Brown, Isaac Hecht and P. L. Hopper have been appointed to take charge of the project.

"POPULAR ELECTRICITY" is the name of a new magazine published in Chicago by the Popular Electricity Publishing Co., of which Mr. Samuel Insull is president and Mr. E. B. Overshiner, vice-president, with offices at 1116 Fisher Building. The new magazine, although devoted exclusively to the subject of electricity, is of a non-technical nature and will appeal to the general reader. It is aimed to meet the wants of the average person who desires to become conversant with electrical things in general but who finds the specialized technical journal too deep. "Popular Electricity" is written in "Plain English," is interesting and should go a long way toward creating a desire on the part of its readers to avail themselves of the advantages which may be derived in a thousand and one ways by the use of electricity. As such, it should enjoy the approval and co-operation of the entire electrical fraternity.

THE CROCKER-WHEELER COMPANY will exhibit at the N. E. L. A. convention a lighting transformer, small induction motor and a Form L direct-current motor. Heretofore the company has made its chief offering to central stations in the line of direct-current generators, alternating-current generators and its Form L direct-current motors. It now takes its place as a supplier of alternating-current and direct-current motors and transformers of the high C-W standard.

H. W. JOHNS-MANVILLE COMPANY IN DETROIT.—The business interests of the H. W. Johns-Manville Company in Detroit and the territory adjacent thereto have increased to such an extent that a new branch is about to be opened by that company. This branch will be located at 72 Jefferson Avenue, Detroit, under the management of Mr. Willard K. Bush, who is well known throughout that section of the country, having been connected with the Milwaukee branch of the company for a number of years. The company will carry a complete stock of goods at the Detroit branch, so that shipments can ordinarily be made direct from local stock.

WHEELER CONDENSERS.—Mr. D. D. Pendleton has been appointed the Pittsburg representative of the Wheeler Condenser & Engineering Company, of Carteret, N. J., and will hereafter handle the sale of Wheeler surface, jet and barometric condensers, Wheeler-Volz combined condenser and feed heater, Wheeler-Barnard water cooling towers, Edwards wet vacuum pumps, and other Wheeler specialties, such as dry vacuum pumps, centrifugal pumps, vertical engines, vacuum pans, multiple effect distilling apparatus, etc., in that territory. Mr. Pendleton has, during the past 15 years, occupied various positions in the manufacturing, engineering and sales departments of the Westinghouse Companies and is well acquainted with the industries of Western Pennsylvania, particularly with the designing and installation of mine power plants. His offices will be located in the Frick Annex.

REYNOLDS FLASHERS.—An important announcement to the trade with regard to some recent litigation and its effect has been made by the Reynolds Electric Flasher Manufacturing Company, of Chicago, from which we abstract the following: "On April 22 a judgment was rendered in the Circuit Court of this city restraining us from the further manufacture of the Reco and Improved Reynolds Flashers. This decision was reached in consideration of the fact that our type of flashers had embodied certain parts protected by a patent granted in 1896. Although we have always felt that our devices were no infringements, but the result of many years of careful and costly experimenting, we are neither surprised nor handicapped at this decision of the court. On the contrary, we have well provided ourselves for this event, and we have a flashing device that is superior to our previous flashers, and to those of any competitor. This flasher we have named the New Reco. The New Reco is now on the market, and cuts and explanations of its superior features will be mailed as soon as the photo-lithographer and printer have done their work. In the decision of Judge Kohlsaat, of the United States Circuit Court, he gives us full credit of reinventing the Sinclair device, without having seen or heard of the Sinclair patent. He also gives us our due credit for having made the electric flasher a commercial machine, and for resurrecting the patent from its burial in the tomes of the Patent Office. There is, therefore, not the slightest reason for our friends to be alarmed. Nothing has been changed in the course of our business, and we shall continue to make every effort to justify the confidence our friends have always been kind enough to place in us."

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 5, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

886,338. PRINTING TELEGRAPH; John C. Barclay, New York, N. Y. App. filed Aug. 15, 1905. Printing telegraph system of the stock-ticker type, having means for operating a two-wire ticker or printer circuit from a distant transmitter by means of a single line circuit. Has repeating means whereby signals may be repeated into a further line circuit for operating tickers or printers.

886,339. AUTOMATIC TELEGRAPH TRANSMITTER; John C. Barclay, New York, N. Y. App. filed July 22, 1907. Automatic telegraph transmitters of the type in which the transmitting mechanism is controlled by a suitably marked or perforated message strip. Provides means whereby it is impossible to throw the hand transmitter into circuit without simultaneously stopping the feed of the message tape.

886,355. INVISIBLE ELECTRIC BURGLAR AND FIRE ALARM; James W. Dawson, Kansas City, Mo. App. filed Sept. 12, 1907. Relates to electric alarms and more particularly to invisible burglar and fire alarm systems, which will be operated through the opening of the door or by a person walking against a thread stretched in such a position that it cannot be avoided.

886,371. SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Belleville, N. J. App. filed Aug. 10, 1905. Relates to systems of electrical distribution in which an auxiliary storage battery is connected in parallel to a compound wound main generator in order that the battery may maintain a substantially constant load on the main generator.

886,372. ELECTRICAL SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed Apr. 15, 1905. Provides an arrangement of regulating apparatus which will act to maintain the load on the main generator much more constant than it has hitherto been possible to maintain it; varies the primary regulation by means of fluctuations in the generator branch of the circuit.

886,374. HEAT-COIL AND PROTECTOR UNIT; William Kaisling, Chicago, Ill. App. filed May 29, 1905. In a protector unit, a mounting base having a bifurcated end adapted to be clamped by a bolt or screw, and protective devices mounted upon said mounting base adapted to furnish complete equipment of heat coil and carbon arrester protection for one telephone line independently of other similar units.

886,395. SYSTEM OF ELECTRICAL REGULATION; Morris Moskowitz, New York, N. Y. App. filed June 28, 1907. Provides means to vary the output of a generator in accordance with the load on the work circuit. Includes a carbon resistance having a variable pressure device actuated by a differentially wound solenoid.

886,443. VIBRATOR; Egmont Max Tornin, Newton, Mass. App. filed Jan. 23, 1908. A form of vibrator for an induction coil designed to avoid sparking at the terminals. Has high resistance coils in series with the primary windings and having a condenser in parallel therewith, the circuit being continually closed. The vibration is closed by short circuiting the magnetic coils by the action of the vibrator.

886,445. CAR LIGHTING SYSTEM; William A. Turbayne, Lancaster, N. Y. App. filed June 20, 1906. Car lighting system in which a main dynamo is provided and driven in a suitable manner from the car, while a storage battery is connected across its terminals. Employs a "crusher" between the battery and the lamp circuit, and regulated by a variable speed apparatus.

886,475. CUT-OUT BLOCK; Fred Brunberg, Windber, Pa. App. filed Apr. 25, 1907. A trolley switch having a depending arm which is moved to and fro by the engagement of the usual trolley wheel. Is particularly for use in mine tunnels where electric cars are used for the purpose of transporting material into and from the mine.

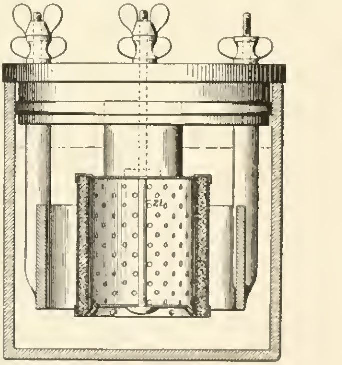
886,498. SYSTEM FOR MEASURED TELEPHONE SERVICE; James Harrison, St. Louis, Mo. App. filed May 10, 1905. Details of cord circuits for party line system.

886,517. TROLLEY HARP; Hugh W. Kimes, Dayton, Ohio. App. filed Jan. 13, 1908. A form of trolley harp having an axle clamped rigidly in the harp to insure good electrical contact. Makes use of a pin passing through the axle and which is received in a clamping device to prevent displacement.

886,559. BRUSH HOLDER; William L. Waters, Milwaukee, Wis. App. filed June 3, 1905. A brush rocker is pivoted to the holder by a swinging connection spring-impelled toward the commutator by an adjustable spiral spring received between the bifurcated arms of the rocker.

886,561. COIL SUPPORT; William L. Waters, Milwaukee, Wis. App. filed Sept. 4, 1906. A means for supporting the armature coils of dynamo-electric machines. Provides a coil support in the form of a bracket which is clamped at one end to the machine frame and is provided at its other end with an engaging surface to which the coils may be secured by means of rope or similar material passing about the coils and through an opening in the support proximate to the engaging surface.

886,562. DYNAMO-ELECTRIC MACHINE; William L. Waters, Milwaukee, Wis. App. filed Dec. 13, 1906. Brush holder mechanism for dynamo electric machines designed to prevent sparking between the commutator and the machine frame. In street railway work there is a tendency for the commutator to flash over to the frame of the machine at the time of quick voltage changes. The patentee provides an insulating shield to intercept this discharge.



886,652.—Electric Battery.

886,566. ELECTRIC CABLE; Charles E. Wilson, Philadelphia, Pa. App. filed July 13, 1905. An electric cable having a plurality of wires composed of successive lengths of electrically conductive materials differing in their magnetic permeability. Is intended to answer the purposes of the present telephone lines having loading coils.

886,620. ELECTRIC SIGNALING APPARATUS FOR RAILROADS; Paul Julius Matter, Coswig, Germany. App. filed Dec. 19, 1907. Relates to improvements in electric signaling apparatus for railroads designed to provide an alarm indication within the engine cab in case two trains run on the same block section. Makes use of a trolley conductor the circuit of which extends through signal lamps along the roadway and which receives its power from a generator on the wheel axle of the train.

886,624. AUTOMATIC FIRE ALARM; William Tom Munro, East Blairlinn, Cumberland, Scotland. App. filed Jan. 28, 1907. Has two vessels filled with gas, one at a higher pressure than the other One of the vessels is more easily affected by heat than the other, whereby a gradual change of temperature has no effect, but a sudden change of temperature causes an alarm circuit to be closed.

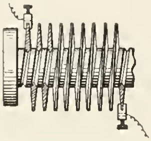
886,634. CABLE HANGER; Henry W. Pleister, Newark, N. J. App. filed Jan. 24, 1907. A wire frame having hooked extremities for the purpose of suspending a cable from a messenger wire. Makes use of a strap of fabric material to directly engage the cable.

886,645. TROLLEY GUARD; Jean E. Saucier, Montreal, Quebec, Canada. App. filed June 30, 1906. In addition to the usual trolley wheel, the patentee has a barrel-shaped roller on a frame pivoted to the harp and extending rearwardly therefrom. The purpose is to make a double contact with the wire and prevent flashing.

886,649. BATTERY COVER AND ELEMENT SUPPORT; Charles B. Schoenmehl, Waterbury, Conn. App. filed May 29, 1905. A battery cover having an integral extension to enclose the supporting rod and the end of a battery element, and a shouldered pocket in said extension to hold the element and rod from turning.

886,650. BATTERY COVER AND ELEMENT SUPPORT; Charles B. Schoenmehl, Waterbury, Conn. App. filed May 29, 1905. Relates to modifications of the above.

886,651. NEGATIVE ELEMENT FOR PRIMARY BATTERIES; Charles B. Schoenmehl, Waterbury, Conn. App. filed June 2, 1905. A battery element comprising a mass of black oxide of copper having its surface metalized and oxidized and coated with finely divided particles of metallic copper.


886,682.—Electric Heater and Rheostat.

886,652. ELECTRIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed March 29, 1906. A negative element for batteries comprising a thin pressed cylinder of metal oxide, having a perforated sheet of metal upon the outer side and a bolt-supported perforated flanged sheet of metal upon the under side.

886,676. AUTOMATIC ELECTRIC SIGNAL SYSTEM FOR RAILWAYS; John P. Buchanan, Cleveland, Ohio. App. filed Aug. 3, 1906. Has means for controlling or elminating the "sneak" currents by means of relays which are energized to establish discharge circuits.

886,678. ELECTRIC DRIVEN TOOL; Allen F. Carver, New York, N. Y. App. filed Feb. 5, 1907. A means for preventing the magnetization of the hard metal parts which has hitherto given rise to inefficiency in electric hammers on account of the magnetic action set up by their relative movement.

886,682. ELECTRIC HEATER AND RHEOSTAT; James H. Delany, Berwyn, Ill. App. filed Aug. 23, 1906. The patentee has a specially rolled bar for his resistance element, which takes the form of a helix by virtue of the rolling process.

886,706. VAPOR ELECTRIC LAMP; Richard Kuch, Hanau, Germany. App. filed Sept. 6, 1905. A gas or vapor electric lamp having the electrode material formed of a mixture of metals vaporizable at different temperatures, the metal constituting the greater part of said mixture being vaporizable at a higher temperature than the remainder of the mixture.

886,733. CONTROLLER; George B. Schley, Norwood, Ohio. App. filed Dec. 31, 1906. A controller device for electric motors designed to be fool proof in all particulars, among them to prevent the controller being moved backward from a running to a starting position.

886,740. RELAY FOR SIGNALING APPARATUS; Louis H. Thullen, Edgewood Park, Pa. App. filed March 25, 1907. An alternating-current relay for use in signaling systems where an alternating current of one frequency is used for propulsion purposes, and an alternating current of a different frequency is used in the track or signaling circuit.

886,755. TELEGRAPH INSTRUMENT; Benjamin F. Bellows and Ambrose Behner, Cleveland, Ohio. App. filed Sept. 27, 1904. Has a key by which one movement will make dashes and another movement will release automatic mechanism to make dots until the return of the key to normal position cuts off the dots. Makes use of vibrating pendulums having a different periodicity of movement.

886,757. ART OF REDUCING ALUMINUM AND OTHER METALS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed Nov. 14, 1905. The process of reducing metal from substances containing the same, which consists in liberating the metal by the combined action of metal-yielding and non-metal-yielding electric currents, disposed through the metal-containing substances in a parallel path.

886,774. WIRE TIE; Harry A. Drew, New York, N. Y. App. filed April 18, 1907. A fastener for engaging a conductor to a porcelain insulator, making use of a stiff curved wire hook which embraces the insulator and resiliently engages the conductor.

886,811. ELECTRICAL CONNECTION; George H. Jacob and John L. Hagadorn, Detroit, Mich. App. filed July 14, 1906. A flush plug for providing electrical connection with a fixed socket and constructed to carry the conductors of the extension and insure proper electrical contact of said conductors with the conductors of the socket to form a continuous circuit by the introduction of the plug into the socket.

886,821. ELECTRIC INCANDESCENT LAMP; Hans Kuzel, Baden, near Vienna, Austria-Hungary. App. filed July 16, 1907. In an electric incandescent lamp, the combination horseshoe shaped metal filament having the free ends of its legs fastened to leading-in wires, and a plurality of holding devices within the bulb of the lamp adapted to loosely guide each of said legs longitudinally at a plurality of points, the line connecting the centers of successive holding devices of each leg being a helical line.

886,824. CHOKE-COIL; Louis O. Langworthy, Bradford, Pa. App. filed Oct. 4, 1907. A choke-coil comprising two cores with coils wound thereabout and means for holding the same in a predetermined direction, and adjusting one core and coil to the other core and coil to produce a variable air gap.

886,827. ELECTRIC DOOR OPENER; Joseph Lock, Brooklyn, N. Y. App. filed April 16, 1907. A door lock mechanism designed to operate with a minimum amount of force on the operating magnet, regardless of how much pressure may tend to bind the lock of the door. Makes use of a compound tripping movement.

886,847. AUTOMATIC RAILWAY SIGNAL; James P. Norwood, Chicago, Ill. App. filed Oct. 5, 1906. A signal system adapted for use at a railroad crossing, designed to display signals and make a time indication as to the position of the trains in approaching or receding from the crossing.

886,856. ELECTRIC FURNACE; Edgar F. Price, Niagara Falls, N. Y. App. filed Nov. 14, 1905. Construction of electric furnace having an open bottom beneath which is a movable receptacle which receives the molten product and is shifted to withdraw its contents from the product remaining in the furnace.

886,857. ELECTROLYTIC PROCESS OF PRODUCING METALS; Edgar F. Price and William Smith Horry, Niagara Falls, N. Y. App. filed Dec. 29, 1906. The process of producing calcium, which consists in electrolyzing a molten compound of calcium with an anode comprising calcium carbid.

886,858. PROCESS OF PRODUCING LOW-CARBON FERRO-ALLOYS; Edgar F. Price, Niagara Falls, N. Y. App. filed Sept. 24, 1907. A process comprising two stages in which the ore is first reduced in an electric furnace by an excess of carbon and the carbon thereafter removed by electrically heating the molten alloy to a temperature such that the carbon is burned off.

886,869. ELECTROMAGNET; Harold Rowntree, Chicago, Ill. App. filed June 23, 1905. A magnet in which the pull exerted on the core will not be weakened by induced currents and in which quietness of action without the generation of heat is insured. Has a plunger composed of laminations united solidly together at one end and disconnected at all other points.

886,870. ELECTROMAGNET; Harold Rowntree, Chicago, Ill. App. filed April 6, 1907. Relates to modifications of the above.

886,874. APPARATUS FOR PRODUCING ELECTRIC DISCHARGES THROUGH GASES; August Schneller, Ginneken, near Breda, Netherlands. App. filed April 25, 1904. An apparatus for subjecting gases to invisible electric discharges, comprising discharge terminals and means for circulating therebetween a flowing medium for the purpose of cooling said terminals.

886,879. SIGNALING SYSTEM; John Shepherd, Chicago, Ill. App. filed Sept. 17, 1906. A combined fire-alarm and watch-service signal system. Provides a transmitter adapted for use as a combined watch box and fire-alarm box, whereby the watch signal is characteristically different from the fire signal.

886,880. TROLLEY; John Shepherd, Chicago, Ill. App. filed Dec. 20, 1907. An anti-friction bearing for a trolley wheel designed to permit movement of the axle whereby the latter may partake of movements to maintain the wheel in properly contacting relation with the wire at all times.

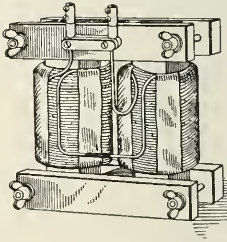
886,833. COMBINED GAGE AND SIGNAL DEVICE; Mark G. Melvin, Scranton, Pa. App. filed March 16, 1907. Gage for indicating the pressure of steam or water, or the height of water in a tank. Has an audible electric signal connected in circuit at either high or low predetermined limits of pressure or height of water.

886,909. PARTY-LINE TELEPHONE SELECTOR AND LOCK-OUT; Herbert D. Williams, Vermillion, Kan. App. filed June 19, 1906. In a telephone system the combination with a central office and a plurality of subscribers' stations comprising local signal and talking circuits, a switch for controlling each talking circuit, means for locking said switch in inoperative position, means for impressing currents of different intensities upon the line, means responsive to current of certain intensity for releasing the locking means, and means controlling said responsive means and the signal circuit.

886,942. TROLLEY LINE CLAMP; Auguste Caron, Indian Orchard, Mass. App. filed July 25, 1906. A trolley line clamp in which the trolley conductor is bent on a fixed radius of curvature and engaged between the members of a clamp, which has a lower surface adapted to guide the trolley wheel at the portion where its continuity is interrupted by said bend.

886,947. RAILWAY BLOCK SIGNAL; David H. Cocker, Piedmont, and Whitfield A. Scarbrough, Choccolocco, Ala. App. filed April 3, 1907. Mechanical construction of semaphore device and circuit-closing apparatus therefor, making use of tappets which are displaced by the wheel flanges of a passing train and which close circuits to energize electric magnets for the semaphores.

886,978. CONNECTION BOX; Russel Dorr Holabird, Los Angeles, Cal. App. filed May 21, 1907. A connection box for electric wiring, comprising a body section and interchangeable end sections, said sections having co-operating connecting means and additional means for connecting a plurality of body sections to form a larger sectional box.


886,824.—Choke Coil.

886,983. COHERER AND DECOHERER; Joseph L. Jones, Kizer, Tenn. App. filed Dec. 26, 1906. A form of vibrator for a coherer making use of a magnet having a depending armature which carries the coherer so that the latter is vibrated back and forth.

886,993. ELECTRIC SIGNAL FOR RAILWAYS; Anton Kuzel, Cleveland, Ohio. App. filed Dec. 30, 1907. The track is equipped with special mechanical tappets at the locations to be protected, and these engage devices on the locomotive, so as to establish alarm signals in the engine cabs in case two locomotives are simultaneously located on the protected track section.

887,038. DUPLEX TELEGRAPH; John L. Ghegan, Newark, N. Y. App. filed May 20, 1907. A duplex telegraph system having differential or double wound relays and designed to have one or more intermediate stations in the circuit, and to duplex an ordinary way circuit for all or only some of the offices on the line.

887,052. ELECTRICAL SYSTEM OF DISTRIBUTION; Walter E. Winship, New York, N. Y. App. filed Sept. 25, 1906. A system of distribution in which there is a motor generator connecting two sides of the system. Is directed to the regulation of the motor generator so that it may efficiently transfer energy from one side of the system to the other as the needs of the system require.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, MAY 23, 1908. No. 21.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office.............................590 Old Colony Building
Cleveland Office.............................1015 Schofield Building
Philadelphia Office.............................Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.............................per year, $3.00
Dominion of Canada.............................4.50
Other Foreign Countries within the Postal Union.............................6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,250 copies are printed.*

NEW YORK, SATURDAY, MAY 23, 1908.

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The Natural Resources Conference.

For the first time in the history of our country the governors of the States have been invited into conference by the President. and the meeting took place at the White House last week, when over 40 governors participated in the discussion of the best means to conserve and preserve the natural resources of America. The occasion was obviously one of first-class historic importance, and while the body thus composed of governors and of experts, publicists, engineers and journalists invited to assist, had no executive or legislative powers, the mere fact that such a gathering has taken place, and has given its approval to the President's "counsel of warning" on this momentous topic, will be productive of lasting good. The governors, now that the example has been set, will probably get together again, either in the White House or outside; but whether they do or do not, the duty of scientific, engineering treatment of our great stores of natural wealth has been brought to the attention of the whole people in a manner that can only promote the national welfare. Several of the governors have gone home to investigate reform and regulation; and every instance of that kind will relieve the central, Federal authorities of some burdens and ensure for the public benefits whose value can hardly be calculated through the long future of national existence.

Grounding of Secondaries.

The Committee of the National Electric Light Association on the Grounding of Secondaries does not, in its report submitted at the Chicago convention, confine its recommendations to the grounding of alternating-current circuits, but proposes also a rule for direct-current circuits. In each case grounding is made mandatory up to a voltage of 150, but coupled with the astonishing prohibition that a circuit must *not* be grounded when the difference of potential between the ground and any part of the circuit would exceed 150 volts. No reason is given for this limitation of voltage; and as the principal object in grounding the secondary or alternating-current circuits is the protection of life, under such a rule protection will be withheld at voltages introducing the higher life hazard. It is true that the number of installations coming under the prohibition against grounding is likely to be very small, but in a matter affecting life it would be better to prohibit entirely such classes of installations than withhold protection from those endangered by them. The report admits that at a conference on the subject with representatives of other bodies, this limitation of protection to 150 volts did not meet with the approval of a committee of the American Institute of Electrical Engineers, which committee, by majority of one, voted in favor of a limited voltage of 250. The latter figure would probably cover every case of secondary circuit installed where protection is most needed, and it would be interesting to know why the recommendation of the A. I. E. E. committee was rejected. In fact, the report is anomalous in presenting no reasons or arguments supporting its recommendations, if we except statements that over 99 per cent of lighting circuits are ordinarily run at 150 volts or less. Until satisfactory reasons for limitation of protection to 150 volts are presented, the report of the committee will lack weight with the underwriters who are asked to act upon the recommendations. The insurance interests look upon the matter of grounding the secondary as one relating to humanitarianism rather than to fire hazard, and they will not be apt to be impressed with an appeal for action on their part which ignores in part the humanitarian consideration.

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Use of the Term "Light-Flux" in Illuminating Engineering.

As problems in artificial illumination become treated more and more along engineering and scientific lines rather than by cut-and-try methods, greater need is felt for accurate and convenient units for expressing light quantities and their physical relations. Perhaps the most familiar unit employed is that of light—that is, the candle, or its equivalent. Equal to it in importance in illuminating engineering, and next to it in familiarity, is the unit of illumination produced by a unit of light at unit distance from the source. The terms frequently employed interchangeably for this unit are "foot-candle" and "candle-foot." Of these two terms it would seem that the former is preferable, because the plural should be "foot-candles" and not "candle-feet." Doubtless the foot-candle as a unit of illumination will remain in use for many years, although, as pointed out by Dr. C. H. Sharp in his presidential address before the Illuminating Engineering Society, it is desirable to abandon this unit for the more appropriate and less confusing unit relating to light flux, namely, the "lumen." Quite independent of the value that may be assigned to the unit of light flux, and the name by which it may be designated, it is extremely instructive to keep constantly in mind the conception of the "light-flux" from a lamp, rather than its "candle-power," or "foot-candles" which it may produce at a certain distance. The lamp should be looked upon as the source of a certain number of light-rays which travel indefinitely in straight lines unless absorbed or reflected. A perfect reflector changes the direction of the rays, but neither increases nor decreases their number.

The above-described physical relations are so well known that it might seem unnecessary to call attention to their existence. However, the reports that are frequently received from photometric investigations, and the solutions that are offered for various problems in lighting with lamps equipped with reflectors, show that these well-known relations are often ignored. For example, when the so-called "polar candle-power curve" of a lamp equipped with a reflector is given, the fact that it is absolutely essential to state at what distance from the lighting unit the measurements were made, is rarely recognized. If a lamp with a reflector giving a true parallel beam of light is photometered at, say, a distance of 10 ft., and subsequently at 20 ft., its maximum "candle-power" on the polar curve in the latter case will be four times that in the former; the "light-flux density," however, is, of course, equal in the two cases. The conception of the total light flux from a lamp as its real output leads one at once to the conclusion that if a certain floor area is illuminated by a certain number of lamps equipped with the reflectors whereby all of the light rays strike upon the floor, the total light flux over the floor and the average light-flux density will be constant, independent of the height of the lighting units. Moreover, if the walls and ceiling of a room are of such nature that no light is absorbed, the average light-flux density over the floor area equals the total light flux from the lamps divided by the area of the floor, quite independent of the position of the lamps. The exact conditions here assumed are ideal and cannot be obtained in practice, but the relations illustrated by them are real and should not be ignored.

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Longitude by Wireless.

One of the most interesting propositions for the practical utilization of wireless telegraphy is its use for determining longitude at sea. A French commission, headed by M. Poincaré, is now investigating the project which, on its face, looks practicable and valuable. As our readers well know, the finding of longitude is and always has been a very troublesome matter. Practically it amounts to finding at any point the local time and comparing it with standard meridian time carried by the ships' chronometers. In clear weather on land this is a very easy matter indeed, but at sea with no fixed instruments it is troublesome, and there are often long periods of thick weather during which no observations can be taken and one must depend upon dead reckoning. Even when good observations can be had, there is more or less uncertainty regarding the rates of the chronometers which cannot be checked during the sea voyage save by comparison with each other. The wireless project is directed to the distribution of standard time signals so that the chronometers can be checked during the whole of a trans-Atlantic voyage as readily as they would be by telegraphic signals or the dropping of a time ball while in port. The plan is to distribute time signals over the whole ocean by wireless from a central station located at some convenient point—the peak of Teneriffe, for example.

Carried out in this way, the chronometer error in the determination of longitude would be practically eliminated, thus considerably simplifying the situation. There still remains the difficulty of finding local time in thick weather. In clear weather, with the chronometer error out of the way, positions can be ascertained with very satisfactory precision. There is, however, another possibility of a somewhat startling character which may yet be realized. If it becomes possible to send out a wireless impulse that shall travel clear around the globe, finding longitude will be a very simple matter. For at the speed of electrical waves an impulse would girdle the globe equatorially in about a seventh of a second. A ship 180 deg. of longitude from the sending station would receive two impulses, one from each direction, simultaneously, and one-fourteenth of a second late. At any other place she would get the two impulses received on the same instrument at an interval which depends directly upon her position in longitude. It should be possible to measure this interval, say, by a revolving mirror method with sufficient precision to give a very good position in any weather. Assuming the wave path to be a great circle, a second sending station would enable a ship to get two angular co-ordinates from a known base which would fix her position both in longitude and latitude. Evidently the success of such a process depends on some factors as yet unknown. It is by no means certain that the wave path would necessarily be a great circle or that the speed of propagation would be exactly uniform. If, however, variations from the uniform law were systematic they could be soon ascertained and allowed for. Of course, the interval of time to be measured is very small, but it is nevertheless capable of surprisingly exact measurement, good enough certainly to give a great improvement over dead reckoning. Such possibilities are a strong argument for international control of wireless since the success of such a revolution in navigation as is here outlined would depend upon an international agreement for silence in the ether while the world-wide signals were being distributed.

THE INDUCTANCE OF ELECTRIC TRANSMISSION LINES WITH UNSYMMETRICALLY DISPOSED CONDUCTORS.

The flux surrounding and linked with alternating-current transmission lines is rapidly becoming a vexed question, in view of the rapid growth of such lines and their increasing disturbing influences upon neighboring wires. But the troubles are not confined to neighboring wires and extraneous circuits. They also extend to the conductors of the same circuit. If the three conductors of a three-phase transmission system, for example, are symmetrically disposed, so that a vertical section of the line presents the wires at the vertices of an equilateral triangle, we know that the self-induced e.m.f. of reactance on these lines will not tend to unbalance the system; but that if the lines are dissymmetrically disposed, the self-induced voltages will, in general, tend to throw the voltages of the system out of balance. The analysis of the e.m.f's. induced in a multiphase transmission line is presented by Mr. Alfred Still in the article on page 1098. The total flux linked with each conductor may, as is pointed out, be considered as the sum, with reversed sign, of all the individual fluxes surrounding the return currents with respect thereto. From this proposition the various e.m.f's. of self-induction may be readily deducted, no matter what the relative geometrical arrangement of the conductors may be.

It is curious to observe that, according to the vector diagrams presented, a two-phase system with three wires, at equal distances apart, will develop a set of induced e.m.f's. which is obtained by rotating the balanced vector current system through a negative angle of 90 deg. On the other hand, when the wires are not equally spaced, the star of induced e.m.f's. is not obtained by a mere quadrature twist of the vector current diagram. There are also individual displacements of the e.m.f's. to be added. In either case, however, whether the three wires of a two-phase system are equally spaced or not, it would seem that the e.m.f's. of self-induction superposed upon a balanced two-phase voltage system will tend to unbalance it, so that it is not of great importance to keep the wires of such a system at equal distances apart. If, however, a four-wire two-phase system were adopted, this discrepancy would disappear. The effect of transpositions among the wires at intervals along the line is omitted, but may be easily taken into account.

PARALLEL OPERATION OF ALTERNATORS.

Following upon an editorial article on the subject of the parallel operation of alternators, in our issue of the 28th December last, we have published in our correspondence columns of Jan. 25 and Feb. 15 two communications elicited by that article, and bearing upon the interesting experimental fact that an alternator may be driven in parallel with others, even when its field excitation has been removed. It is hardly necessary to point out that with direct-current generators this could not occur. If, for example, a number of direct-current units are operating in parallel between central-station busbars and the field-excitation of one unit is removed by the opening of its field circuit, that unit will be deprived of its e.m.f., and it will virtually constitute a short circuit on the system unless automatically removed by its circuit-breaker. With alternators, however, operating in parallel between busbars, if the excitation of one unit is suddenly removed, there will be a relatively large wattless component of current supplied to the machine from the busbars, but the unit may not fall out of synchronism and may even supply a considerable amount of power to the system. The communications referred to supplied experimental evidence of this fact, under particular conditions of operation. Indeed, the phenomenon may be carried yet further in the case of a synchronous motor running on light load. As pointed out by Dr. Steinmetz at Niagara Falls last year, if such a motor be running in synchronism, not only may it run without excitation, but if the excitation be reversed, the machine may still run in synchronism, taking a powerful wattless current, until at a certain value of the reversed excitation, the machine will slip a pole and run in normal synchronism with normal armature current and with the excitation no longer in opposition.

The article of Mr. Henry Herman, on page 1100 of this week's issue, takes up the analysis of the action in a synchronous unexcited machine, and throws light upon the development of torque in these cases. According to the simple theory of alternator operation, assuming constant synchronous impedance, it is easily shown that on light load a relatively small proportion of the normal e.m.f. generated in the armature may serve to keep a motor in synchronous operation. This elementary theory, although satisfactorily explaining ordinary conditions of load, breaks down completely when the e.m.f. is practically reduced to zero by withdrawing the field excitation. Some modification in the theory is necessary to explain the maintenance of torque in the unexcited motor. Mr. Herman's article points out that the effect may be explained by taking into account the cyclic variation of the armature reactance at different successive positions with respect to the field-poles. The article shows that the inductance of the armature not only consists of the flux per ampere linked with the armature conductors and confined to the armature grooves, but also includes the flux, per ampere, linked with the field pole-pieces and also with the field coils. These extraneous linkages vary as the coils occupy successively varying positions with respect to the field-poles. Expressing the reasoning of the article in a condensed alternative form, the average electromagnetic energy owing to inductance during one current cycle is markedly greater, for a given armature current strength, if the armature is running in synchronism than if it breaks out of synchronism. Consequently, the machine will exert a torque of self-induction tending to maintain synchronism, and this condition will apply whether the machine be operating as a generator or as a motor. If the inductance of the armature were exactly the same in all positions with respect to the poles, this increase of magnetic energy in synchronous relation would disappear, and the corresponding torque tending to maintain synchronous relation would disappear likewise. Apart from the questions of theoretical explanation discussed in the article, the property of tending to maintain synchronism in the absence of excitation indicates the remarkable flexibility of the synchronous alternator.

National Electric Light Convention.

(*By Telegraph.*)

The thirty-first convention of the National Electric Light Association began on Tuesday at the Auditorium Hotel, Chicago, the city that witnessed the birth of the association more than a score of years ago. From the outset a large attendance was indicated, the anticipatory registration being over 1100, so that a final attendance of at least 1500 is expected. Owing to the transportation plans made, the attendance prior to the opening of the convention was very much larger than usual. The special train over the Pennsylvania Railroad, conducted by Mr. George F. Porter, master of transportation, carried no fewer than 108 people, and made a smooth run on Sunday, arriving in Chicago before 9 o'clock Monday morning. Other large parties came in from the East and West. Among those present are several past presidents, including Messrs. Insull, Doherty, Blood, Ferguson, Davis, Ayer, Huntley, Edgar and Williams.

The opening of the convention is associated with cool but stormy weather, but better conditions are promised for the excursions and entertainments that are laid out for practically every day of the week. Great interest is taken in the visit to the Fisk Street plant of the Commonwealth Edison Company, and the full description in last week's issue of the Electrical World is highly praised. The plan put in effect this year of having the erection of exhibit booths and the delivery of goods in the hands of an exhibition committee, which contracted for the work and handled it in a systematic way, worked with remarkable smoothness and saved exhibitors much worry. As a result exhibits were in place in due time for the formal opening of the exhibit hall on the ninth floor of the Auditorium Annex at 8 o'clock Monday evening. At that hour President Farrand threw in the main switch controlling the general lighting of the hall, and the first exhibit of the association to be lighted entirely by tungsten lamps was formally opened, thus marking an important milepost in the American central-station industry. After an hour spent in the exhibit room as guests of the exhibitors, the delegates adjourned to a formal reception in the Annex, to be followed by dancing.

The first session opened Tuesday morning at 11:40. President Farrand's address referred to the increasing importance of the association for good or ill. Active members now number 664 in class A, 394 in Class B and 151 in Class D. The increase in the year is 10 per cent. The old question box, he stated, was inefficient and slow. The monthly bulletin of the association was started last August with eight pages to answer questions and for other matter. It has since grown to 16 or more pages and costs less than the old yearly question box, and is more satisfactory. The officers and committees have held weekly meetings during the past year at the association's headquarters. Questions of public policy are now attracting more attention than ever before. The recent agitation for a multiplicity of commissions, national, State and municipal, for regulation purposes, is likely to interfere seriously with the conduct of central-station business. He pointed out the injustice of the low-maximum rate. The New York commission had prevented several companies from making improvements, but accomplished no real good during the past year. As to municipal ownership the pendulum has already swung to its farthest extreme and now sentiment is waning. He said that the program had been drawn up with few subjects to permit much discussion. One parallel or branch session was arranged for, although he does not believe in subdivision of association work. He acknowledged the efficient work of Secretary Freeman, Miss Billings and the office staff during the past year.

The address was followed by Mr. Martin's report on progress and Luke's paper, the latter being dicussed at length by Osgood, Steinmetz, Junkersfeld, Gear and others. (Abstracts of convention papers will be found elsewhere in this issue.)

Conservation of Natural Resources.

Creating a new precedent, taking a step that for some unexplained reason has never been taken before, President Roosevelt last week called a conference of governors of the several States of the Union to discuss the conservation of the national resources of the country and to take such action as might appear proper to prevent further waste and extravagance. In inviting the governors, Mr. Roosevelt suggested that each be accompanied by three officials and citizens of the respective commonwealths interested directly in the subject. In response to this novel summons, the first of the kind in the history of the country, no fewer than 41 governors attended the conference. To meet them and assist in the deliberations, the President invited also the heads of all the great national bodies representative of trade, agriculture, engineering and finance. The American Institute of Electrical Engineers was represented by President Stott, accompanied by Secretary Pope. The National Electric Light Association was represented by President Farrand. There were four representatives of the American technical press, Messrs. Kirchhoff, of the *Iron Age;* Baker, of the *Engineering News;* Ingalls of the *Mining and Engineering Journal,* and Martin, of the Electrical World.

The conference was held at the White House, in the famous East Room, where no such meeting had ever gathered before, and each session, from Wednesday until Friday, was opened by President Roosevelt, who then called a governor to the chair for each session except the last on Friday, of which he remained the chairman throughout. Every session was attended by members of the cabinet, all of whom spoke, and members of the U. S. Supreme Court, the Senate and House of Representatives were also in attendance from time to time, as well as heads of the various bureaus of the government. Mr. T. R. Shipp was secretary of the conference, and Dr. W. J. McGee, of the Inland Waterways Commission, organized the arrangements and the conduct of the convention as a whole.

On Wednesday, May 13, President Roosevelt opened the conference with a striking address on "Conservation as a National Duty," in which he took occasion to emphasize his policy as to the control of water powers, the limitation of franchises for their use, and the exaction of a charge based on the extent of their development. After this address the conference adjourned and the sessions for the three days were then divided into the treatment of mineral resources, land resources and water resources. At the session on Wednesday afternoon Mr. Andrew Carnegie read a most interesting paper on ores and related minerals, and showed how rapidly the supply of ore and coal was being exhausted. This was followed by a paper on fuel exhaustion by Dr. I. C. White, State Geologist of West Virginia. One of the speakers in the discussion was Mr. John Mitchell, the well-known leader of union coal miners, who made an admirable speech in advocacy of the conservation of human life.

In the evening a dinner was given to the governors by the Washington Board of Trade, at the New Willard Hotel, this affair being presided over by Gen. George H. Harries, who is a member of the executive committee of the National Electric Light Association. Among the speakers were Vice-President Fairbanks, Speaker Cannon and the Hon. John Sharp Williams, leader of the Democratic minority in the House.

The morning session of May 14 was opened by a weighty address from Mr. James J. Hill, the great railroad manager, on the "Natural Wealth of the Land," in which he adduced statistics that showed how under prevalent methods, the fertility of the American soil was slowly but surely declining. It made a profound impression. Other papers followed on soil wastage and forest conservation. Secretary of State Root took part in the discussion, laying great stress on the duty of the States. The afternoon session resumed the treatment of this topic, with a paper from ex-Governor Pardee, of California, on land resources as related to irrigation. In the course of this paper he expressed fear as to a "monopolization" of the water powers of California, and said: "The action of the United States government, however, in regulating the use of these streams ought to prevent an absolute and oppressive monopolization of them." This remark was heartily approved by the conference.

The closing session on Friday morning, May 15, was conducted throughout by President Roosevelt in person, and constituted in many ways a dramatic finale of a most significant conference, setting in motion forces and agencies that will operate through long ages. The governors, to a committee of whom a great variety of resolutions had been referred, adopted at the opening of the session a "declaration of principles," dealing with the topics raised and in one paragraph expressing a "strong conviction" as to the duty laid upon the States "to conserve the navigation and other uses of our streams, and the minerals which form the basis of our industrial life and supply us with heat, light and power." These declarations, looking with favor upon further conferences of the same kind, were adopted unanimously after a little brisk discussion as to the commitment involved by each State.

Mr. W. J. Bryan, the leading Democratic candidate for the presidency, was then introduced by Mr. Roosevelt, and made an excellent address summarizing the results of the conference and insisting that there must be "no twilight zone between the Nation and the States, where predatory exploiting interests could take shelter from both." A little later President Roosevelt referred to the "twilight land" and said that the one aim in developing his policy had been to find and provide some sovereignty, whether in the Nation or the State was indifferent, that could control and hold accountable the great corporations and the big individuals, too. With regard to water power rights, he believed strongly that no perpetual franchises, but renewable ones, should be granted, and that for these compensation should be paid. This would guarantee to future generations the right to control natural resources upon which they must depend, and to terminate such franchises if proper. "Where this policy can be carried out best by the State it ought to be by the State. Where it can be best carried out by the Nation, then the Nation should enforce it. My concern is not in the academic discussion of either the principle of State rights or the principle of National sovereignty, but what will best conserve the needs of the people as a whole." Aside from this he was willing and desirous that any corporation developing natural power resources should derive a handsome return for its initiative and enterprise. This outspoken declaration elicited applause that lasted several minutes.

During the morning, addresses were made by a number of governors on the subjects under discussion, and at the close steps were taken, by the governors in executive session, to provide for a repetition of this meeting, although not necessarily at the White House. It had been found by all the governors a most useful and desirable thing to consult together, and the wonder was generally expressed that in the 120 years of national life such a conference had not been held before.

Among the three papers presented at the final session on Friday was one by Mr. H. S. Clair Putnam, member of the American Institute of Electrical Engineers, on the "Conservation of Power Resources." This admirable paper brought out very clearly the enormous growth in recent years of electrical development, particularly as typified in manufactures, and said: "Prior to 1870 the use of water power in manufactures exceeded that of steam power. Water power expressed in percentage of the total power employed has since steadily declined, falling from 48.3 per cent in 1870 to 11.2 per cent in 1905. During the corresponding period steam power increased from 51.8 per cent in 1870 to 78.2 per cent in 1900 The census of 1900 showed a marked falling off in the rate of increase in the percentage of steam power used as compared with the rate prior to 1890, and this was accentuated in the census of 1905, when the percentage of steam power fell to 73.6 per cent of the total. This check to the ascendency of directly applied steam power was due to the introduction of electric power. In 1890 electric power was negligible. In 1900 it constituted 4.8 per cent of the total. In 1905 this had increased to 11.8 per cent—a marvelously rapid growth when the aggregate increase of over 1,000,000 hp in five years is considered. If the present rate of increase prevails until 1910 electric power will have reached 18 per cent of the total and steam power will have dropped to 68 per cent. If the same rate of increase is maintained until 1930, electric power as applied to the manufacturing industries will exceed the amount of steam power applied direct."

Mr. Putnam insisted very strongly on the necessity of governmental regulation of the water powers upon which such extraordinary results were predicated, and he urged the great necessity of a trustworthy census of the water powers of the country.

New York Companies to Supply Tungsten Lamps.

The hearing before the Public Service Commission on May 14 in the matter of the investigation of the New York electric companies was largely devoted to a discussion of the latest step of the companies in putting the tungsten lamp within reach of the consumers. Mr. J. W. Lieb, of the Edison Company, told of his company's plans to reduce the price of tantalum lamps, as reported in these columns in the issue of May 16. The price for the tantalum lamp is reduced from 35 to 25 cents each with a few renewal privileges. Tungsten lamps of 40-watt, 32 cp will be supplied at a cost of $1, the 60-watt, 48-cp lamp for $1.25 and the 110-watt, 80-cp for $1.50. The company will put the lamp in the customer's sockets and will demonstrate that each lamp is in condition before the customer is required to pay for the lamps. Mr. Lieb handed the following schedule to the commission:

PRICE OF INCANDESCENT LAMPS.

Cp.	Type.	Watts.	Prevailing retail price. Plain.	Prevailing retail price. Frosted.	Extra price charged to renewal customers.
16..........	Carbon	50	$0.20	..	Free renewal
32..........	Carbon	100	.30	..	Free renewal
20..........	Gem	50	.25	..	Free renewal
20..........	Tantalum	40	.60	$0.62½	25c. or 27c.
25..........	Tantalum	50	.60	.62½	25c. or 27c.
32..........	Tungsten	40	1.50	1.55	$1.00
48..........	Tungsten	60	1.75	1.82	1.25
80..........	Tungsten	100	2.00	2.10	1.50

Mr. Lieb stated that the above list covers the best tungsten lamp as yet put on the market. Probably before long a tungsten lamp of lower power than the 32 cp will be procurable in this country, he said, and the company will follow the development of the lamp and give its customers the benefit of decreases in prices which will probably ensue with increased manufacture of the lamp. In order to make the situation clear with reference to the relative status of the various types of lamps, Mr. Lieh had prepared the following table, which he submitted to the commission:

COST TO CUSTOMER OF 10,000 CANDLE-HOURS OF ILLUMINATION.

Cp. of lamp.	Type of lamp.	Watts.	Cost of lamp.	Kw-hours of current consumed.	Current cost.	Lamp cost.	Total cost.
16....	Carbon	50	Free renewal	31.25	$3.12	$0.000	$3.12
20....	Gem	50	Free renewal	25.00	2.50	0.000	2.50
25....	Tantalum	50	Extra 25c.	20.00	2.00	0.125	2.125
32....	Carbon	100	Free renewal	31.25	3.12	0.000	3.12
32....	Tungsten	40	Extra $1.00	12.50	1.25	0.312	1.562

Mr. Frank W. Smith, of the United Electric Company, stated that his company was prepared to make the same arrangement with its customers as the Edison Company. Mr. Smith said that it might be possible for a consumer using the tungsten lamp to be compelled to pay a higher price for current than formerly owing to the fact that the decrease in current consumption might remove him from the wholesale to the retail class. Mr. C. G. M. Thomas, of the New York & Queens County Company, stated that his company was prepared to furnish the tungsten lamp on practically the same basis as the other companies.

Before the hearing on May 20 the companies will prepare schedules which will show how many wholesale consumers might be forced to come into the class of retail consumers, owing to decreased consumption of current, brought about by the use of the new lamps.

Edison Leading-in Wire Lamp Patent Declared Invalid.

On May 14, Judge Buffington, in the United States Circuit Court, sitting in Pittsburg, handed down an opinion declaring invalid the Edison patent on leading-in wires for incandescent lamps, which, several years ago, figured so largely in litigation against incandescent lamp manufacturers. The patent (No. 444,530) was issued originally Jan. 13, 1891, and reissued (No. 12,393) Oct. 10, 1905. It relates to the use of a small length of platinum wire entirely sealed in the glass, to which are soldered outer and inner leading-in copper wires. Formerly the entire wire between the filament and the socket was of platinum, whereas by the means described in the patent the length of platinum is reduced to about a quarter inch for each side of the leading-in circuit.

The court held that the location of the Edison joint, while ingenious, useful and practical, was but a mechanical improvement. "He did not discover a copper-platinum joint could be made in a seal without destroying its integrity, but by correcting a false notion as to the effect of such a seal at its other end, he broadened the sphere of use of such seal. It was one of those mechanical advances which the increased cost of platinum and closer study of manufacturing problems naturally brought about." The decision was that the patent is void.

The litigants in the case were the Edison Electric Light Company and the Novelty Incandescent Lamp Company. As the patent expired in January of this year, the only effect of the decision is to preclude the recovery of damages in this suit and in other suits pending. The point on which the decision was based is only one of a number that have been advanced during the litigation of the patent, another being that the same joint was used by Heisler before the period which the patent was claimed to cover.

Long Acre Franchise Assailed.

The attack on the franchise of the Long Acre Company was continued by the Anti-Monopoly Company, represented by Alfred J. Talley, at the hearing held May 8 by Commissioner Maltbie in the matter of the application of the Long Acre Company for authority to issue $10,000,000 of preferred stock and $50,000,000 of bonds. An affidavit of Mr. John S. Walsh, secretary of the Anti-Monopoly Company, in which permission was asked from the courts for the power to examine Mr. William H. Kelly, was placed in evidence. According to the affidavit, the Anti-Monopoly Company was incorporated in New York on May 24, 1905, with power to manufacture and sell gas and electricity. The affidavit recites that Martin F. Minturn, as agent and trustee for John J. Moore and William H. Kelly, came into possession of the franchise, now held by the Long Acre Company, on or about Oct. 1, 1898, and that Martin F. Minturn had bought the franchise at a receiver's sale at the instance and request of John J. Moore and William H. Kelly. Mr. Minturn delivered a blank assignment of the franchise to Mr. Kelly, and the latter, inserting the name of the Long Acre Company in the blank space, delivered the franchise to the company. The affidavit alleged that this was a fraudulent act on the part of Messrs. Minturn and Kelly and in violation of the rights of Mr. Moore, and that the Long Acre Company was a party to the fraud. In July, 1902, John J. Moore transferred his alleged half interest in the franchise to John D. Moore, who transferred it, in June, 1905, to the Anti-Monopoly Light & Power Company. Mr. Minturn died in the spring of 1907, and Kelly could not be found when he was needed for examination.

Mr. Talley delivered a long speech to the commissioner in which he said that in the previous testimony before the commission there had been the most palpable kind of evasion of the efforts of the commission to find out who the real persons at interest were in the transfer of the franchise to the Long Acre Company, in which transaction "the Manhattan Transit Company acted as broker. The Manhattan Transit Company could not come before this commission," Mr. Talley said, "asking for leave either to operate this franchise or for an issue of $60,000,000 worth of securities, because it did not have the power under its charter. So it comes in the guise of the Long Acre Company. It is not the Long Acre Company with certain powers allowing it to create and sell electricity in this city; it is the Manhattan Transit Company, without the right to do what you are now asked to give permission to do, through the agency of the Long Acre Company." Mr. Talley paid his respects to the Edison Company by saying that he had looked in vain in the letter submitted to the commission by the Edison Company for any protest against the granting of the application, that bore the stamp of sincerity, and he added that the Consolidated Gas Company would welcome the granting of the application because it could acquire, by going to one person, George E. Bouchie, trustee for the Manhattan Transit Company, control of 490 shares of stock of the Long Acre Company's 500 shares, and then float $60,000,000 of securities.

In reply the counsel for the Long Acre Company presented a deposition from William H. Kelly, in which Mr. Kelly said that he did not know John L. Walsh, and that the statement in the affidavit made by Mr. Walsh that the franchise granted to the American Electric & Manufacturing Company was vested in Martin F. Minturn as agent for himself and John J. Moore was absolutely untrue, and that Mr. Moore had no direct or indirect interest in a franchise. The allegation that any act was done in fraud or violation of the rights of John J. Moore was absolutely untrue, Mr. Kelly deposed. Commissioner Maltbie stated that the question of the validity of the franchise was one for the courts to decide.

At the hearing on May 12, Mr. A. J. Dittenhoefer, of the law firm of Dittenhoefer, Gerber & James, testified that John J. Moore had said he had an arrangement with Judge Kelly whereby he (Moore) was to receive a share in the profits from the sale of the franchise, but he did not say that he owned any interest in the franchise. David Gerber, of the same law firm, said that the franchise had been in possession of his firm from six to eight years before it was sold. He said he had negotiated the sale of the franchise to Mr. Sheehan. He testified that he had talked with John J. Moore and that Moore said he was trying to sell the franchise for Judge Kelly on a commission basis, but he never asserted a title or claim to the franchise. The original assignment of the franchise in question from Martin F. Minturn to the Long Acre Light & Power Company was shown, and Mr. Gerber testified that it has the document which had been signed by Mr. Minturn and that there was no blank in the body of the assignment; but that he (Mr. Gerber) had dictated the whole document. He said that his firm received about $60,000 in bonds as payment for legal services. Various attempts had been made to sell the franchise, including a conversation with a representative of the Edison Company. Mr. Gerber said he considered the franchise worth much more than $500,000, but more could not be obtained for it when it was sold.

An affidavit signed by John J. Moore stated that when Mr. Minturn bought the franchise he was acting as agent and trustee for Mr. Moore and Mr. Kelly, and that the statement made that he, John J. Moore, had no interest directly or indirectly in the franchise was unqualifiedly false.

At the hearing on May 15, Mr. Talley stated that the Anti-Monopoly Company intended to bring a suit in equity to prove its claim to a half interest in the Long Acre franchise, since the question of the validity of the franchise or the ownership of it was not within the jurisdiction of the commission.

Another opportunity will be given on May 23 to those who wish to appear before the commission in opposition to the application of the Long Acre Company.

Detroit Meeting of the American Society of Mechanical Engineers.

The semi-annual meeting of the American Society of Mechanical Engineers will be held in Detroit, Mich., June 23 to 26. An entire session will be devoted to papers on the conveying of materials, and hoisting and conveying machinery, including belt conveyors, the use of conveying machinery in cement plants, etc., will be discussed.

Among other subjects which will be taken up by professional papers are "Clutches," with special reference to automobile clutches, by Henry Souther; "Some Pitot Tube Studies," Prof. W. B. Gregory, of Tulane University, New Orleans, La., and Prof. E. W. Schroder, of Cornell University; "Thermal Properties of Superheated Steam," by Prof. R. C. H. Heck, of Lehigh University; "Horse-Power, Friction Losses and Efficiencies of Gas and Oil Engines," by Prof. Lionel S. Marks, of Harvard University; "A Journal Friction Measuring Machine," by Henry Hess, of Philadelphia; "A Simple Method of Cleaning Gas Conduits," by W. D. Mount; "A Rational Method of Checking Conical Pistons for Stress," by Prof. G. H. Shepard, of Syracuse University; "The By-Product Coke Oven," by W. H. Blauvelt.

A lecture on "Contributions of Photography to Our Knowledge of Stellar Evolutions" will be delivered by Prof. John A. Brashear, of Alleghany, Pa. The usual receptions will be held and excursions will be made to manufacturing plants, shipbuilding yards and various points of interest in and around Detroit. Among the excursions planned is one to the University of Michigan, at Ann Arbor. The Gas Power Section of the society will hold a session, and the Society for the Promotion of Engineering Education and the Society of Automobile Engineers will hold a meeting in Detroit at the same time. As far as possible, sessions will be arranged so that members interested in subjects treated by the other societies may attend their sessions without missing papers on related subjects read before their own society.

Machinery Club of New York City.

Situated on the two topmost floors of the Fulton Building of the Hudson Terminal Buildings, 22 stories above the downtown section, the Machinery Club of the City of New York promises to become the largest business men's club in the city. The formal opening of the clubrooms will occur May 21, but already the membership is in excess of 1100. The constitution provides for 800 resident members, 250 suburban members and 2000 non-resident members. Although the club was ostensibly founded in the interests of the machinery and metal trades, its constitution admits to membership "any male person of the age of 21 years or over, and of good character." A large number of members connected with the various electrical interests have been enrolled.

No expense has been spared in fitting up the rooms of the club, a total of $125,000 already having been expended in furnishings and equipment. On the first floor is the main dining room, 50 ft. x 150 ft., finished in a light tone and with mahogany furniture, seating 500; also a Flemish grill room with its great round table of Mexican mahogany, bearing the name of the "talk table," because each diner who sits there is expected to converse with his neighbor. On this floor is also a large hall, offices and a smoking and lounging room. The second floor is given up to a ladies' dining room, with roof garden, and the main kitchen and servants' dining rooms with a roof garden. Still another roof garden is situated at the end of the hall, making five on the second floor, all of which command a superb panorama of New York City and the surrounding country. The club has its butcher's shop, bakery, storeroom, ladies' reception room, shower baths and lockers for out-of-town members who wish to dress for the evening, barber shop; in fact, every convenience of the best modern clubs. The furniture was specially constructed, as well as the glass and silverware; the Haviland china was imported from abroad and the linen made specially in Ireland. The lighting throughout is by tantalum lamps. Nine motors operate an automatic dish-washer, the dumb waiters, buffing and knife-cleaning machines and the ice-cream freezers. The club telephone system has five trunk lines and all the clocks are electrically regulated by Western Union time.

"The work of organization began about a year ago," said Mr. F. H. Stillman, founder and president of the club, "at the time when the tearing down of the buildings which stood on the site of this building, scattered the machinery interests which had centered in this neighborhood. The fact that the drug, dry goods and other business interests had clubs of their own, and the necessity for some recognized center for the metal and machinery trades, made the plan for a machinery club seem practicable, and that 60 per cent of the tenants of these two buildings are identified with machinery interests made it logical that the club should be situated here. The club will be especially appreciated by out-of-town members, who will now have a place to go where they will feel at home and will have an opportunity to meet, other than in a business way, the men interested in their lines of business. There are 20 charter members. Army and navy members are admitted without initiation fees and at nominal dues." The officers of the club are: Mr. F. H. Stillman, president; Mr. R. C. McKinney, vice-president; Mr. Walter L. Pierce, treasurer, and Mr. W. Seton Henry, acting secretary. The governors are: Messrs. O. C. Gayley, George A. Post, Walter L. Pierce, F. H. Stillman, C. A. Moore, H. L. Shippy, T. N. Motley, Henry Prentiss, H. B. Kirkland, W. P. Pressinger, A. B. See, W. H. Marshall, R. C. McKinney, E. H. Wells, W. L. Saunders, Otis H. Cutler, J. R. Vandyck, Kenyon B. Conger, William B. Albright and Chas. A. Schieren.

Training Naval Electricians.

For the purpose of training men to operate and care for the many types of electrical machines and apparatus used for various purposes on board of a modern warship, and for wireless telegraph and telephone service, the United States Navy maintains two electrical schools, one located at the Navy Yard in Brooklyn and the other at the Mare Island Navy Yard, near San Francisco, Cal. The students at these schools are men who have been regularly enlisted for a term of four years for the electrical department. Men are enlisted with the rating of electrician, or any specially skilled mechanic with some knowledge of electricity, or a student of electricity who shows aptitude for the naval service may be enlisted as landsman and later, upon qualification, will be advanced to the rating of electrician.

There are four classes of electricians in the naval service, namely, electrician third class, second class and first class, and chief electrician, the corresponding monthly pay for the several grades being $30, $40, $50 and $60. After having served one year on a sea going ship the pay of chief electricians is increased to $70 per month, and upon re-enlistment all grades are given four months pay as a bonus and receive, in addition to the pay of their grade, $6.36 a month for the first re-enlistment, and an additional $4.36 a month for each enlistment thereafter. Every person, when enlisting, is provided by the government with an outfit of clothing amounting to $60, and there are no expenses for board, lodging and medical attendance while in the service, the only necessary expenses being for renewal of articles of clothing.

After enlisting, electricians are sent to one of the two electrical training schools above mentioned, where they are instructed in the use of electrical apparatus and appliances and also in wireless telegraphy and wireless telephony, all books and material used in this instruction being furnished gratis. The course of instruction is both thoroughly practical and up-to-date with respect to all electrical applications on board ship. At the New York Navy Yard there is for purposes of instruction a complete equipment of modern dynamos, motors and electrical apparatus, together with wireless telegraph and wireless telephone installations.

The qualifications for enlistment of an electrician of the third class is that he shall have had a practical experience of two years as a wireman and six months as a dynamo and engine tender; or two years as a dynamo and engine tender, together with switchboard operating experience; or two years of technical training in electricity. If, however, the candidate for electrician enlists as a landsman, the practical experience required is reduced to at least one year's work as a wireman in house, telephone, lighting or traction work; or a training as a telegraph operator, with one year electrical experience; or that he shall be a high-school graduate who is a student of electricity; or a graduate from a two years' engineering course on the nautical training ship. The entrance examination for electrician, third class, relates more particularly to practical subjects, the only exceptions being questions as to the definition of the four electrical units and the solution of simple problems in fractions and decimals. The instruction is carried on in five sections, namely, theory section, mechanical section, practical electricity section, ship's watch section, wireless telegraph section. The entire course extends over 21 weeks and is followed by a final examination covering the work of the entire course. A series of illustrated lectures is given covering the school work, but practical instruction is, so far as possible, individual. The home of the students is on board the receiving ship, where there is an excellent technical and general library. After completing the course, the electricians are sent either to cruising ships or to wireless telegraph stations on shore, their term of enlistment being frequently divided between these two classes of service. Lieutenant-Commander R. H. Leigh, U. S. N., is in charge of the electrical instruction at the New York Navy Yard.

Lightning Arrester Performance.

Two papers dealing with lightning arresters were presented at the meeting of the American Institute of Electrical Engineers, held on May 19. Mr. J. F. Vaughan related the results of comparative tests of lightning protective devices on the 50,000-volt Taylors Falls transmission system. Mr. N. J. Neall discussed the data gained from the above tests and from tests made on the system of the Presumpscot Electric Company, which supplies energy at 11,000 volts to the Cumberland Mills, near Portland, Maine.

The results of the Taylors Falls experiments indicate that the principal trouble is from temporary or permanent breakdown of line insulation by static charges induced in the line by passing storms. The induced charges are highly concentrated, and often of immense volume and intensity, discharging to ground over insulators with a disruptive effect that tends to shatter, but rarely to puncture, them. The disturbances may occur anywhere on the line, but the preference is for exposed heights and to a less degree for wet low lands.

There was no evidence of surges other than the direct effects of grounds or short-circuits nor of stress at any definite points on the line, such as from reflected or standing waves. Overhead grounded wires are of decided value in shielding the line from induced static charges and in preventing insulator breakdowns. A grounded conductor running down the pole is of decided value in preventing splintering of the pole.

The shunted-resistance multigap type of arrester is effective in disposing of ordinary disturbances. The aluminum-cell type of arrester is, in general, more sensitive and freer in discharge: it gives great promise for station protection. Horn-arresters of the series-gap and selective-resistance type are of special value as emergency devices to relieve the station arresters in case of abnormal discharge. They may be adjusted to be fairly sensitive without causing interruption to the service.

Mr. N. J. Neall, after reviewing the experiences on the Taylors Falls and Presumpscot systems, expressed the opinion that a grounded wire suspended along a line will tend to absorb an electric charge. It is desirable to place one, two or more wires above the line wires, the former wires being grounded at each pole near stations and important places. When an overhead grounded wire is used exclusively for station protection, it should be not less than two miles in length and be grounded at each pole. Lightning rods added to the overhead grounded system probably add to the protection.

The shattering of insulators is liable to occur in every severe lightning storm, but not in mild ones.

Insulators should be so designed as to withstand at least twice normal voltage between line and pin; the equivalent spark-gap of the insulator should be higher than that of any arrester path to ground on the line. Horn-type arresters should be employed for extraordinary service only. A wood pole may be effectively protected against splintering from lightning discharge by providing it with a small metallic conductor connected to ground.

For station protection electrolytic lightning arresters have operated creditably, but they have not shown complete superiority over other types. When the external lines are fully protected, as by the use of overhead grounded wires, the station apparatus is also protected thereby.

Convention of the Southwestern Electrical & Gas Association.

The fourth annual convention of the Southwestern Electrical & Gas Association was called to order on Thursday morning, May 7, by President H. T. Edgar, in the St. Regis Hotel at El Paso, Tex. The address of welcome was delivered by Mayor Joseph V. Sweeney, of El Paso, and responded to by Mr. H. S. Cooper, of Galveston.

In his annual address President Edgar gave a résumé of the work of the association, and made the following recommendations:

1. That meetings of the executive committee be held at least twice a year. 2. That the expense of the secretary in collecting and classifying data regarding taxes, donations, etc., be paid by the member companies, and also that the secretary arrange in the future to collect and classify other information of general interest to the members of the association. 3. That the past records of the association be printed and sent out to the members. 4. That future conventions always arrange suitable exhibit space to be furnished free for the use of associate members. 5. That an assistant secretary be appointed to be paid by the secretary, and to maintain an office in Dallas, Tex. 6. That certificates of membership be furnished to the members of the association, with the request that they be framed and put up in their respective offices. 7. That a committee of four be appointed for the purpose of fostering closer relations with the national and other societies. 8. That a committee on municipal ownership be appointed.

These recommendations met with the hearty approval of a committee appointed to take action on the president's address.

A paper by Mr. Marsh Lowd, of the Stone & Webster Engineering Corporation, entitled "Track Construction," was read by Mr. C. H. Ladd. This paper outlined the advantages of the T-rail. After discussion by Messrs. Ladd, of Fort Worth; Kellogg, of El Paso; Edgar, of Fort Worth, and Brown, of San Antonio, and upon suggestion of Mr. Cooper, a committee was appointed, with Mr. Fred. M. Lege, of Galveston, as chairman, to frame a communication to be presented to the national organization at its meeting in October in regard to the desirability of standardizing a high T-rail.

A paper on the testing of gas meters was presented by Mr. J. A. Myler, Jr. The paper contained many hints relating to the operation and adjusting of meters.

The discussion, which was participated in by Messrs. A. E. Judge, J. A. Myler, H. S. Cooper, J. B. Conant, Frank Duffy and R. B. Stichter and Prof. A. C. Scott, covered the care and attention of meters, and the best ways of numbering and recording them.

The subject "What Policy Should be Pursued by Public Service Corporations in Making Extensions?" was discussed by Messrs. H. M. Moore, H. S. Cooper, E. L. Wells, C. W. Kellogg, W. B. Head, R. B. Stichter, H. T. Edgar and F. M. Lege.

The Question Box, a 188-page book bound in green cloth, which was edited by Mr. Samuel Kahn, of San Antonio, brought out the experiences of the members present in regard to the calorific value of oil and the method of handling fuel. Other questions regarding the use and advantages of steam turbines were freely participated in by the delegates. The subject of automotineers was discussed thoroughly, the various members relating their experience with them. This discussion was participated in by Mr. Duffy, Mr. Cooper, Mr. Kahn, Mr. Peel, Mr. Ing, Mr. Scott and Mr. Turner. The subject of arc head lamps was then taken up and discussed by Messrs. Peel, Kellogg, Cooper, Kahn, Edgar and Turner. The next question related to meters. This was participated in by Messrs. Cooper, Kellogg, Moore, Conant, Scott and Kelley.

A paper by Mr. W. B. Tuttle was devoted to gas producers and gas engines. The author gave data to show that Texas lignite can be used to advantage in gas producers. He described a process by which the exhaust gases are returned and introduced under the fuel bed in order to limit the temperature of the fuel. He claimed that by using this process the combustible consumed per brake hp-hour would be only 0.97 lb., as compared with 1.51 lb. required with the usual process. This paper was not discussed.

"Wood Preserving" was the title of a valuable paper read by Prof. Eugene P. Schoch. He reported the results of an investigation which showed that crude oil does not effectively preserve wood, except when used in sufficiently large quantities to exclude moisture from the wood. Of the other preservatives, namely, wood-tar distillates, poisonous salts of metals and coal-tar distillates, the last-named holds the highest rank. The mixture of tar oils known as creosote, which has long been in use, is undoubtedly effective. The value of creosote as a wood preserver is attributable to the oils of high-boiling temperature which, in addition to being germicidal, are quite permanent. This paper elicited an interesting discussion participated in by Messrs. Lee. Logan, Cooper, Gerhard, Kellogg, Ladd, Edgar, Carpenter, Stichter, Brown and Prof. Scatt. At a later session, on recommendation of the executive committee, Prof. Schoch was elected an honorary member of the association.

"Electric Illuminants and Their Efficiency" was the subject of a paper presented by Mr. C. W. Kellogg, Jr. The author showed that the renewal cost of a 32-cp, 3.1-watt carbon-filament lamp is .45 cent, and that of a 32-cp, 12.5-watt tungsten lamp is 2 cents per kw-hour of energy sold by the central station, and claimed that the latter cost is so high as to be prohibitive. He expressed the opinion that the method of charging for each high-efficiency lamp the difference in cost between it and the older carbon-filament lamp should be adopted. This plan will appeal to the customer because he will save $7.50 per 1000 lamp-hours by using the lamp of higher efficiency, and can well afford to pay $1 additional for the lamp. This paper was discussed by Messrs. Cooper, Kellogg, Rice, Moore, White and Gumm.

Prof. B. V. Swenson, secretary of the American Street & Interurban Railway Association, upon being invited by President Edgar, urged the members of the Southwestern Association to affiliate more closely with the former association. He commended the Southwestern Association for its ability to handle local matters in a way impossible in the general organization.

Upon recommendation of the committee appointed to select officers for the ensuing year, the following men were unanimously elected to the offices indicated: R. B. Stichter, president; W. B. Tuttle, first vice-president; W. B. Head, second vice-president; Joe E. Carroll, third vice-president; J. A. Myler, secretary, and A. E. Judge, treasurer.

From the standpoint of attendance, the convention was the most successful that has been held by the association. The total number in attendance was 140, of whom 27 were ladies. Thirty-six companies were admitted to membership during the convention. Handsome souvenir programs containing a history of the association and photographs of the officers were distributed to the members. From the proceeds of the advertising in the program, the minutes of the convention are to be printed in book form without expense to the association.

Electrical Engineering at Purdue University.

Two important changes are to be made in the curriculum of the School of Electrical Engineering at Purdue University during the coming year, which may be briefly outlined as follows:

Practice in the electrical laboratory covering the more elementary engineering tests on electrical machinery is to be given to the junior electrical engineers for the purpose of more closely connecting the theoretical work taken by this class with a practical knowledge of the fundamental laws of electrical engineering as applied to modern electrical equipment. This will, in addition, permit the introduction of more advanced tests during the senior laboratory course.

The subject of railway electrical engineering is to be introduced throughout the senior year. It is the intention of Prof. Harding, who has recently been appointed to the head of the School of Electrical Engineering, that this subject, together with additional railway work in the laboratory, act as a nucleus for marked development in railway electrical engineering at Purdue.

The records of the above university show that approximately 78 men will this year receive the degree of B. S. in electrical engineering, eight of whom are specializing in the telephone course. The graduate degree of E. E. will be conferred upon five in addition to the above.

Bleaching Flour by Electricity.

Mr. F. J. Postel, consulting engineer, addressed the noonday meeting of the Electrical Club, of Chicago, May 13, at the Grand Pacific Hotel breakfast room. The subject was "Bleaching Flour by Electricity," in which he reviewed briefly the history of this process and its objects. The art of bleaching flour in this way began with the discovery that flour when passed through air containing considerable ozone became bleached or whitened. Before this process came into common use among millers, flour was graded very much assording to its color, the whitest flour bringing the best price. With the bleaching process it is possible to sell naturally darker grades of flour at the best prices. Chemical analysis reveals no change in the flour due to the bleaching, although it is claimed that the bleached flour will keep and bake somewhat better than the unbleached.

According to Mr. Postel's history of the development of apparatus for manufacturing ozone and bleaching flour, considerable effort was wasted in the early days of process by lack of electrical knowledge on the part of the inventors. Much secrecy was maintained about the apparatus used in the process at first. Several rival companies came into the field with different apparatus for producing ozone, or nitrous acid. One of these is a chemical process. The companies exploiting electrical processes have all been absorbed by one company, the Alsop Process Company, of St. Louis. This company makes a simple outfit consisting of a small dynamo which is connected in series with an inductance coil. The circuit is made and broken by a reciprocating make-and-break device which also works an air pump for forcing air through the chamber in which the make-and-break occurs. This results in a series of flashes which generate ozone in the air being pumped through the chamber. The air is then piped to places where the flour is falling in streams for exposure to the gas. Another advantage which, from the consumer's standpoint, bleached flour has, is that the miller can use certain nutritive parts of the wheat in ordinary white flour which heretofore he was accustomed to eliminate from the best white flour because they made the flour dark and unsalable. Nearly all the best flour mills now employ bleaching processes and the introduction of electricity for this purpose has also served to get the millers better acquainted with electrical apparatus. This has in many cases resulted in the extensive application of electricity through a mill which formerly had no wires.

Break in the Hauser Lake Dam of the United Missouri River Power Company.

We published in our issue of April 25, among the general news items, a note to the effect that the Hauser Lake dam of the Helena Power Transmission Company failed on April 14. This dam is on the Missouri River, about 16 miles from the city of Helena, Mont., and additional information on the failure has just come to hand. The dam is 70 ft. high, 490 ft. long and was built of steel bents supporting curved steel plates forming the water face of the dam. Both ends of the latter were founded on the solid bedrock, but the greater part of it at the middle section was on a gravel foundation. The dam was anchored at the up-stream toe to Freistedt sheet piling, driven in the hard river ground. There was also a rubble-masonry fill at the up-stream toe located under the plates and down-stream from the sheet piling.

The initial break in the dam occurred about 400 ft. from the east, or power-house, end of the dam. The anchorage at this point apparently gave way, breaking the seal and allowing the water to pass under the rubble-masonry fill. The water rapidly cut away the gravel, permitting the settlement of this up-stream masonry and carrying down with it the lower end of the girder forming the upper member of the steel bent. The expansion joint in this girder and in the plates of the dam just above the top of the masonry gave way, leaving the bents and plates unsupported in such a manner that the water pressure pushed over this section. About six minutes elapsed from the time the water first came through under the rubble masonry until the expansion joint failed and the first bent toppled over, carrying out a section about 30 ft. in width. The tremendous rush of water rapidly widened this breach, the foundations on each side were undermined, and the posts and steel work buckled at right angles to the direction of the flow of the river. The bents continued to give way and fall until the breach widened to nearly 300 ft. The photographs show the break looking down-stream after the water subsided.

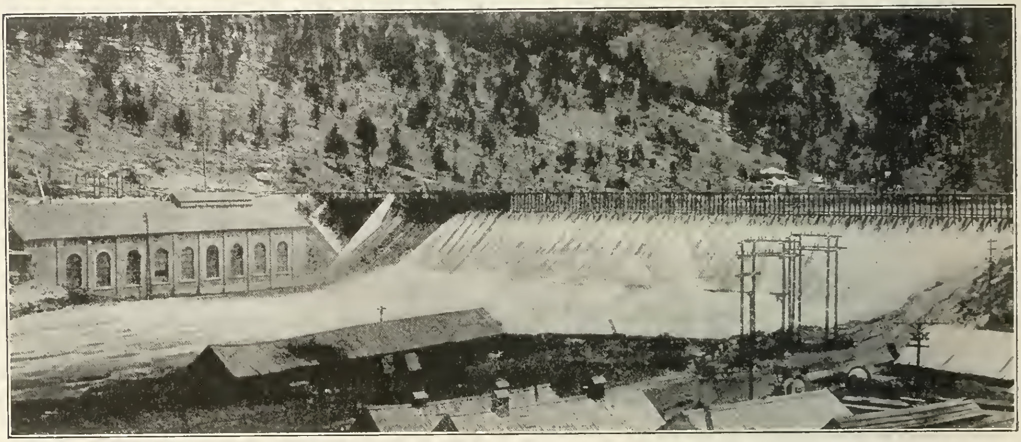

FIG. 1.—HAUSER LAKE DAM BEFORE THE ACCIDENT.

The acceptance of the dam had been refused by the engineers of the Helena Power Transmission Company. The matter was accordingly submitted to arbitration, and the builders have until very recently been making repairs and strengthening certain parts of the structure. At the time of the accident the matter of acceptance and final settlement was in the hands of the attorneys of the power company.

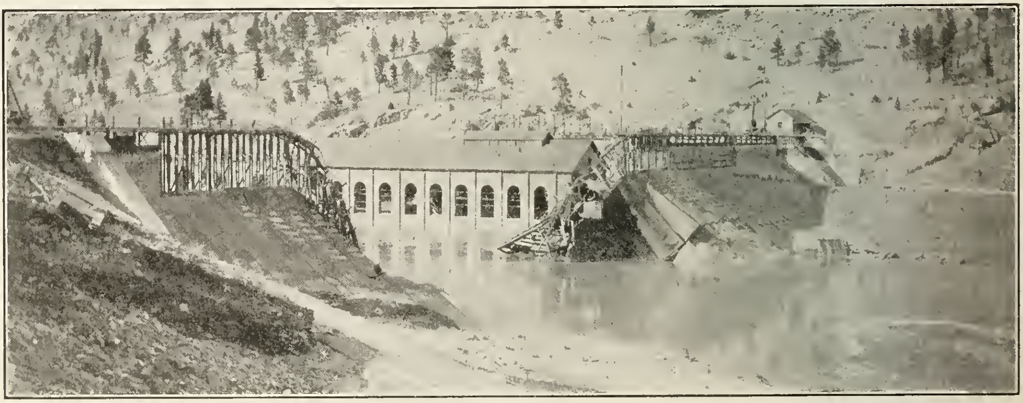

FIG. 2.—HAUSER LAKE DAM AFTER THE ACCIDENT.

Fig. 1 shows a view of the dam and generating station before the accident. Back of the dam is a lake 10 square miles in area. Structural steel trusses riveted to the crest of the dam serves the double purpose of supporting a foot bridge and holding the flash boards. The system of raising the height of the dam by use of flash boards is similar to the one in use at the Canyon Ferry station and in addition steel gates 10 ft. wide and 10 in number were placed at the east end in a vertical position on the crest of the dam. These gates took the place of the flash boards for 100 ft. of the crest and were used for the purpose of regulating the flow of the river when the flash boards were in place. On the east side of the river is a forebay 227 ft. long and 45 ft. wide at the intake. Openings are made in the west wall of the forebay for five gates and penstocks through which water is conducted to the turbines. There are also three openings in the north wall to penstocks conducting water to three exciter turbines. The power house, which is constructed of masonry and steel, is 212 ft. long by 52 ft. wide. The installation consists of five pairs of turbines operating on horizontal shafts direct connected to five, three-phase, 2400-volt, 2800-kw Westinghouse generators. On the north end of the generator room is a gallery for the switchboard and beyond is a room for the transformers which contains three banks of step-up transformers having an aggregate rating of 18,000 kw. Energy at a potential of 60,500 volts connects with the high-tension lines of the Missouri River Power Company, about 16 miles distant, for transmission to Butte and Helena, the equipment being operated in parallel with the plant of the Missouri River Power Company, located at Canyon Ferry, Mont., also on the Missouri River. The power house and machinery at the Hauser Lake dam sustained but very little damage. The electrical machinery has been dried out and it is estimated that the total loss to the power plant will not exceed $5,000.

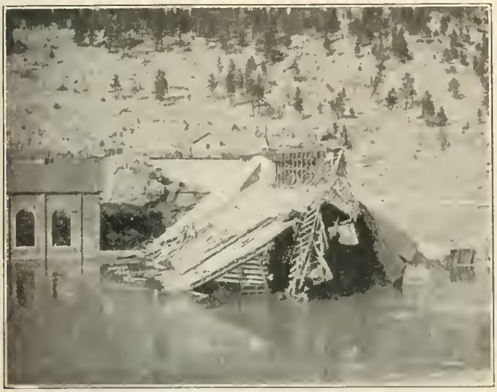

FIG. 3.—SIDE VIEW OF WRECKED DAM.

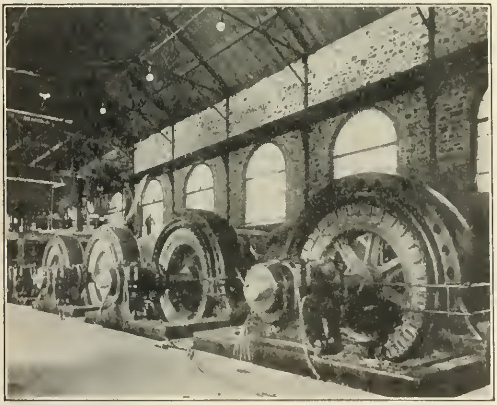

FIG. 4.—INTERIOR OF POWER HOUSE.

At the time of the failure the energy delivered from the station was being used in the Butte mines and smelters, but the auxiliary steam plant located at Butte was immediately started, and this plant, together with the hydro-electric development at Canyon Ferry, is carrying practically all of the load, so there has been no serious interference with operations at Butte, nor at Anaconda.

The electrical energy for the city of Helena is supplied entirely from the Canyon Ferry plant, so there was no interruption of service in that city. The total damage has been variously estimated from $250,000 to $300,000, and the time to make the necessary repairs at about six months. The dam, it is reported, will be immediately repaired.

American Electrochemical Society.

In our issue for May 9 was published an account of the recent meeting of the American Electrochemical Society at Albany, together with abstracts of several of the papers presented. Abstracts of other papers follow.

In a paper by Richard H. Gaines, the specific case of the corrosion of the Rochester steel conduit was discussed. There was absolutely no evidence that external currents, like the stray currents from tramways, entered the steel conduit, and it appeared to be a case of corrosion due to irregularity in composition and structure of the steel surface, aided by the nature of the surrounding soil and excessive moisture and to an inadequate protection of the steel surface from corrosion.

Both the address of Prof. Burgess and the paper of Mr. Gaines elicited a very extended discussion, in which Messrs. Acheson, Bancroft, Carhart, Grower, Hering, Lidbury, McElroy, Potter, Sharp and Wolff participated. Mr. Acheson referred to the fact that deflocculated graphite protects iron surfaces, at least to some degree, against corrosion. Dr. Bancroft urged that the e.m.f. existing between different points of a steel surface indicates only the tendency to corrosion or the beginning of corrosion. For its progress the formation of a surface film may become highly important. The question how far liability for damage done to water and gas pipes may be settled upon tramway companies was brought up by Dr. Carhart and Dr. Sharp. Dr. Sharp emphasized that there are two causes of corrosion: first, electrolysis due to stray currents, and, second, local voltaic action. There is great liability to self-deception in the use of the voltmeter as it is often employed.

The situation, serious as it is, has become even more serious by tests (called "electrolytic surveys") carried out by some so-called experts in a ridiculous manner. Dr. Potter thought that the only way of overcoming the difficulty would be to eliminate the electrolyte by using an impervious non-conducting coating on all steel pipes and structures embedded in earth.

ALUMINUM.

A paper on the commercial applications of aluminum was presented by Mr. E. Blough. Aluminum is used either alloyed or pure. Practically all castings are made from alloys. Among the applications in the electrical industry, the author mentioned electric meter frames, meter covers, etc. Large quantities of aluminum are used for deoxidizing steel to produce sound castings.

Sheet aluminum is made hard and soft and rolled in all gages from very thick to very thin. Sheet aluminum and aluminum tubes are used for many purposes in the chemical industries, in paper and pulp mills, etc. The use of aluminum for high-tension feeders and busbars is also increasing. As to the combination of aluminum with other metals, the author mentioned copper lined with aluminum for use in surface steam condensers and bi-metallic wire, which is a steel wire coated with aluminum. He also exhibited the different steps in the manufacture of aluminum cooking utensils from an aluminum sheet by drawing and spinning into the finished article.

COPPER ANODES IN CHLORIDE SOLUTION.

A paper by Mr. Saul Dushman on this subject was of a theoretical and experimental nature, the object being to investigate in detail the conditions under which the copper passes into solution as cuprous or cupric salt. There are two different equilibria at the anode, and the constants of equilibrium were determined. By a special arrangement of the electrolytic apparatus, the concentration phenomena at the electrodes were determined.

ELECTROCHEMISTRY OF LIGHT.

On the evening of Thursday, Prof. Wilder D. Bancroft presented an experimental lecture on the chemistry of light. The gist of his extended discussion was the proof that Grotthuss' theory of photochemistry explains all phenomena he knows. Grotthuss has developed two fundamental laws of photochemistry. The first is that only those rays which are absorbed can produce photochemical action. The second is that the action of a ray of light is analogous to that of a voltaic cell. Many examples were given by Dr. Bancroft to explain this second law. One conclusion is that the presence of a depolarizer increases or makes possible the action of light. Whether any given substance is reduced or oxidized by light depends on the depolarizer. In many cases of oxidation by oxygen gas, the oxygen acts as a depolarizer. When chlorine acts with silver or bromine with toluene, it is the halogen that is made active by light. The paper was discussed by Dr. Baekeland, Dr. Baskerville, and Prof. Burgess.

WATER POWER IN THE ADIRONDACKS AND FOREST RESERVATION.

The last paper of the Thursday evening session was presented by Mr. Edward R. Taylor on "Forestry, Water Storage, Power and Navigation." The author discussed the damage done by disastrous floods. While something may be done by reforesting our mountains, this will not solve the whole problem. To prevent the floods it is necessary to impound the water in lakes in the headwaters. This will cost money, but will place at our disposal vast water powers. The author called attention to the immense water-power possibilities of New York State, which he considered worth more than all the coal mines of Pennsylvania.

KINETIC MOLECULAR ENERGY.

The first paper of the Friday session was presented by Dr. Charles Proteus Steinmetz on kinetic molecular energy. The speaker showed in an exceedingly suggestive way how it is possible to develop the thermodynamical gas laws as the consequence of the elementary principles of mechanics of irregular molecular and intramolecular motion, taken together with the rules of probability. Comparisons were made with astronomical phenomena, and the laws of cosmic motion were applied to molecular motion. In this way it is unnecessary to assume perfectly elastic bodies or collisions between them. The molecules or atoms describe paths around each other just as the suns, planets, etc.

From simple definitions of temperature and pressure on the basis of these views, Dr. Steinmetz derived the Boyle-Mariotte-Gay Lussac laws, Avogadro's rule, the laws of adiabatic change, etc., and explained on the basis of these views, together with the principles of probability, why heat always moves from higher temperature to lower temperature.

HEAT OF VAPORIZATION.

Dr. Joseph W. Richards presented a paper on "The Heat of Vaporization of Metals and Other Substances." He proposed the following generalization: The latent heat of vaporization of atomic weight is proportional to the absolute temperatures of the boiling point at atmospheric pressure, and is numerically equal to about 23 times that temperature (21 times, if the outer work of overcoming the atmospheric pressure be not included). From this rule it is possible to estimate the amount of heat necessary to vaporize any metal whose boiling point under atmospheric pressure is known.

ELECTROCHEMICAL PATENTS.

A paper on this subject was presented by Mr. A. B. Marvin, Jr., who gave a history of the Patent Office, and showed curves illustrating the increase in the number of electrochemical patents since 1860. The present conditions in the Patent Office are deplorable, due to an insufficient, underpaid and overworked force. The situation will not be improved until the Patent Office is reorganized. The paper was discussed by Messrs. Baekeland, Potter, Raegener and Steinmetz. Mr. Louis C. Raegener declared with great emphasis that what is really needed is a reform in our patent laws. Our present laws afford no protection whatever to the inventor. They are only good for the patent attorney.

IRON TESTS DURING ANNEALING.

Mr. E. E. F. Creighton described a method for the magnetic testing of iron during annealing. The iron is simultaneously heated and tested for its magnetic properties. The decrease and disappearance of magnetism with rising temperature was observed, and the corresponding tests were then made with the temperature being decreased again. It seems that gases occluded in iron may greatly affect the electric and magnetic qualities of iron. Nitrogen seems specially obnoxious. This may explain the different behavior of steels of apparently the same composition made in the open-hearth and in the Bessemer converter. The paper was briefly discussed by Messrs. Burgess, Richards and Steinmetz.

HARE'S ELECTRIC FURNACE.

A paper by Dr. Charles A. Doremus described an early electric furnace of Robert Hare, formerly professor of chemistry at the University of Pennsylvania. At the age of 20, Hare invented, in 1801, the oxy-hydrogen blowpipe. In 1840 he described his first electric furnace and experiments made with it. It is a vacuum furnace, and it seems that he produced in it, with current from a primary battery, calcium carbide, phosphorus, graphite and metallic calcium. These products were, of course, obtained on a very small experimental scale, but the furnace was, nevertheless, larger than Moissan's first electric furnace (1892).

HYDROCYANIC ACID.

A paper by Mr. E. W. Smith and Dr. R. S. Hutton describes the direct synthesis of hydrocyanic acid and cyanides from carbon and gaseous mixtures, such as producer-gas containing nitrogen and hydrogen. No such high temperatures are necessary as has been thought before, so that it is possible to employ a resistor furnace, the gases being brought in contact with highly heated carbon. At temperatures above 1800 deg. C. the reaction proceeds readily, but it is necessary to withdraw the gases quickly from the high-temperature zone so that they can be cooled with sufficient rapidity to preclude their decomposition.

ELECTROCHEMISTRY AND THE CENTRAL STATIONS.

A paper by Mr. John Meyer on energy for electrochemical industries was briefly presented at the end of the Friday session. The author is collecting data which represent the conditions in the more important central stations so as to give exact information to electrochemists as to the hours at which energy could be supplied for electrochemical work at a very low cost. To be economically used, the electrochemical load must be a central-station equalizer and only such electrochemical processes are suitable in connection with central stations as do not require continuous operation. It is important for the central stations and electrochemical industries to get together.

CALCIUM.

Two papers dealing with metallic calcium were the first ones on the program of the Saturday session. A paper by Messrs. A. Hirsch and J. Ashton gives the conclusive proof that calcium can be alloyed with iron. However, it is necessary to carry out the alloying operation in a vessel under pressure so as to prevent the calcium from vaporizing at the required high temperature.

Dr. O. P. Watts and Mr. J. M. Breckenridge discussed the preparation of calcium alloys for use as a substitute for aluminum in the alumino-thermic reaction. The attempt to find substitutes for aluminum seems promising. The chief results are that alloys of calcium with aluminum and magnesium can be easily prepared up to a calcium content of 70 per cent. Alloys containing 25 per cent of calcium or magnesium can be readily pulverized. In the absence of any considerable amount of silicon, alloys containing much calcium or magnesium react with explosive violence, but the addition of silicon renders the reactions quiet.

CONDUCTION IN ELECTROLYTES.

A paper by Dr. Louis Kahlenberg discussed the question as to the nature of electrolytic conductors. The author showed the limitations of the dissociation theory and emphasized that in the light of present evidence the vapor-tension of solutions does not afford any basis whatsoever of a correct view as to the nature of electrolytes as contrasted to non-electrolytes. When a metal is combined with elements of non-metallic character, the resulting combination may be an electrolyte or an insulator. However, far more experimental work is necessary on the subject of electric conduction in general and electrolytic phenomena in particular before we can hope for a real improvement of our theories of the inter-relation of electricity and matter, and our views of the process of electrolysis and the nature of electrolytic conductors.

ELECTRODELESS CONDUCTION IN ELECTROLYTES.

A paper by Mr. Carl Hering on the passage of direct current through electrolytes without the use of electrodes suggested some experiments which might decide certain questions as to the difference between electrolytic and metallic conduction, the ionic theory, etc. Several methods were described by which a direct current may be produced in a complete circuit of electrolytes without electrodes. This may be accomplished, for instance, by repeated induction with the same flux, making use of the result of the experiment recently described by the author in this journal, in connection with his criticism of the usual statement of the fundamental load of electromagnetic induction. Other arrangements by which a direct current in an electrolyte may be produced are also described, but these methods have not yet been employed experimentally. The paper was discussed by Messrs. Bancroft, Breed, Burgess, Lidbury and Richards.

REVERSED ELECTROLYSIS.

A paper by Mr. J. W. Turrentine discussed some apparently abnormal results obtained in electrolysis, for instance, the evolution of oxygen at the cathode, the deposition of gold on the anode, etc. The reasons of this abnormal behavior were discussed and explained. The paper was discussed briefly by Messrs. Betts and Lidbury.

DRY CELLS IN IGNITION SERVICE.

A paper by Dr. J. W. Brown discussed the use of dry cells in ignition service, and was illustrated by some interesting experiments. A great disadvantage with which the manufacturer of dry cells for ignition service has to contend is that he must not only produce an efficient and reliable battery, but also secure their use in batteries of proper size and in connection with efficient and economical ignition apparatus. As a matter of fact, over 90 per cent of the trouble experienced with battery ignition is due to the use of poorly-designed ignition apparatus or the use of well-designed apparatus badly adjusted. From the standpoint of efficient use of the dry-battery energy the usual types of timers are faulty in having excessively long contacts variable with the speed at which the engine is running, and the usual types of spark coils are faulty in requiring too high an amperage per spark and in producing too many sparks per explosion.

As to the battery itself, it must also be able to furnish a given quantity of electrical energy, and it must also be able to furnish it in the form of impulses of 2 amp. or more in rapid succession through a resistance of about 0.5 ohm. Dry cells of the well-known 6-in. type should not, except in case of emergency, be used in the form of a single series battery, but in the form of a series-multiple battery with as many as four sets in multiple whenever possible.

CORROSION OF BRASS.

A paper by Mr. W. S. Rowland discussed the electrolytic corrosion of aluminum-bronze by the more common sodium salts and sodium hydroxide. Unless caused by some additional chemical action, the changes in the rate of corrosion occur only upon the appearance or disappearance of a phase as shown in the equilibrium diagram.

A paper by Dr. A. T. Lincoln presented an account of researches on the electrolytic corrosion of the bronzes, made in continuation of his former extended work on this subject. He studied the corrosion of bronzes of different composition in sea water. The results are about the same as with sodium chloride.

REFINING OF IRON.

The last paper presented dealt with the electrolytic refining of iron, the author being Dr. E. F. Kern. The author has employed quite a number of different electrolytes and finds, for instance, that suitable deposits are obtained with chloride solutions.

The paper was discussed by Prof. Burgess and Prof. Richards. The latter emphasized that the time has come to start an electrolytic iron-refining industry, the product to serve as the starting material for carbon free ferro alloys.

With a vote of thanks to all who had made the meeting so successful and enjoyable, the convention adjourned. The next meeting will be held in October in New York City.

Steinmetz on Natural Resources.

Dr. C. P. Steinmetz delivered a lecture in the Engineering Societies' Building, New York, Sunday, May 17, before the students and friends of the New York Electrical trade schools, the subject of the discourse being "The Future of Electricity." He laid stress upon the rapid rate at which our natural resources are being depleted, and pointed out what a great future was thus being opened for electricity. The present generation will see the time when the hard coal deposits will be exhausted, and some now alive may even see the day when the remaining deposits of soft coal are so far underground that they will not be worth the expense of bringing them to the surface. He also referred to the impoverishment of the soil through exhaustion of the elements of fertility. In the future, electricity will be called on to meet these untoward conditions, which are menacing the inhabitants of the earth. As to fertilization, the processes for extracting nitrogen from the air are being perfected, and with cheap power they will afford an abundance of this element so necessary for plant life. Electricity will serve to solve the problem of utilizing fully the energy residing in the water powers of the earth. It was pointed out that in a single State —Massachusetts—there is more water power now going to waste than is available at Niagara Falls.

Dr. Steinmetz predicted that in the future there will be no more creeks and rivers, as these will be dammed at frequent intervals in order to utilize every drop of water, including that otherwise going to waste at flood time, and the courses of streams will be entirely dry at some seasons of the year. The power generated by this means will be used not only to replace that of heat prime movers, but will also serve for heating purposes. Dr. Steinmetz also spoke of the manner in which the more extensive application of electricity to traction will affect the social life of the coming generations, through enormously increasing the means of transportation. The over population of cities, he said, will be relieved by the country becoming practically part of the cities. The latter are fast becoming merely places of business and sites for factories, office buildings and boarding houses for bachelors, while families are moving to suburban homes. The electric railway will also make it possible for farmers to draw upon the labor market of cities during the period of the year when they require extra help, men leaving their factory or other employment temporarily to go into the country. Dr. Steinmetz, in conclusion, expressed the opinion that the time may come when the government will have to take charge of all energy, human and otherwise, and direct it in order that the best conditions in life may be secured and maintained for the great populations of the future, deprived of many of the present gifts of nature

CURRENT NEWS AND NOTES.

CONSOLIDATED GAS CASE ADVANCED.—The U. S. Supreme Court has advanced the hearing to Oct. 13 of the appeal of the city of New York and the Public Service Commission from Judge Hough's recent decision holding the New York State 80-cent gas law to be unconstitutional.

CONTINUITY OF EDUCATION.—On Tuesday, May 26, Mr. Frederick P. Fish will deliver an address on "Continuity of Education" before the graduating class and alumni of the School of Mines, Engineering and Chemistry of Columbia University. The meeting will be held in Havemeyer Building at 3 p. m.

STREET RAILWAY PASSENGER TAX.—The U. S. Supreme Court has affirmed the validity of a tax of one mill per passenger imposed by the city of St. Louis on the street railways of that city, the decision reversing the judgment of a lower court. The court holds that the ordinances under which the franchise taxes were assessed contained no expressed relinquishment of the city of the right to levy license taxes; and as the city and its charater has the power to impose a license tax, such a tax is therefore valid.

MORE WIRELESS STATIONS ON THE PACIFIC COAST.—Plans have been completed by the United Wireless Telegraph Company to install 11 new wireless stations on the Pacific Coast. The largest, a 5-kw station, will be at Ketchkan, Alaska. Seven will be installed on the transpacific steamships and three will be land stations, the location of which will be decided later. All except the 5-kw station will be 1-kw or 2-kw installations. At present trans-continental communication is only possible when the conditions are most favorable.

WESTERN MARYLAND HYDRO-ELECTRIC PLANT.—The Youghiogheny Light & Power Company proposed to erect a water-power plant of from 10,000 to 13,000 hp at Swallow Falls, Deep Creek and Muddy Creek Falls, near Oakland, western Maryland. The plant will be located in a district where 90,000 acres of coal land have been bought up by large operators, and it is expected that the plant will furnish power for networks of electric railways for the transportation of the coal mines, and for mining work.

COLUMBIA UNIVERSITY SUMMER COURSES IN ENGINEERING.—Columbia University will conduct, during the present summer, a number of engineering courses, work in which will count toward the degrees of the School of Mines, Engineering and Chemistry, and the degree of M.A. in the School of Pure Science. The courses, which will extend from July 7 to August 14, will be of a character to be of special interest to instructors in technical schools, to gradute students and to practicing engineers. In electrical engineering there will be six hours of lectures per week by Prof. C. O. Mailloux on "Electric Train Movement."

TIME-PIECES VS. ELECTRIC RAILWAY TIME-TABLES.—According to the *Spokesman-Review*, of Spokane, Wash., since the commencement of service on the Spokane & Inland Electric Railway between Spokane and Halifax, not a watch or clock has been sold along the right of way and jewelers have quit handling them, people depending upon the regularity of the electric railway service for determining the time. According to the report, those along the line who wish to know the time note the number of a car passing, and refer to the time-table to see when the car gets to the neighboring station.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION.—The third annual meeting of the Indiana Independent Telephone Association was held in Indianapolis, May 13 and 14. There was a large attendance and Mayor Bookwalter welcomed the delegates to the city. In his address President Lindemuth stated that there are 250,000 telephones in Indiana, of which over 200,000 are operated by 455 Independent companies, an increase of 16,000 telephones during the year. Several papers bearing on the telephone business were read. Mr. C. S. Norton, of Indianapolis, was elected president; and Mr. A. J. Payton, of Rockport, secretary-treasurer. Many manufacturers and supply houses made exhibits of apparatus.

ENGINEERS VISIT CEMENT WORKS.—A party of about 150, comprising members of the Brooklyn Engineers' Club, paid a visit to the works of the Edison Portland Cement Company, at Stewartsville, N. J., last Saturday. A special train left over the Lackawanna Railroad, stopping at Orange for Mr. Edison, who accompanied the party through the works. The output from the works is 8000 barrels daily and all the apparatus except the steam shovels at the quarries and the grinding rolls is operated by electric motors of the direct-current type. The power house contains three 800-kw, 250-volt generators, and there are, exclusive of fan motors, 235 motors in use in the plant, varying in size from 1 hp to 200 hp, the average size being about 25 hp. Arc and incandescent lamps are used throughout the buildings and yards and these are fed from a three-wire system. Although subjected to very severe usage, the direct-current machinery has given no serious trouble.

PRESERVATION OF FORESTS.—A bill has been introduced in the House of Representatives including an appropriation of $100,000 to enable the Secretary of Agriculture to supply to forest owners expert advice on the subject of reforestization. The Secretary is also authorized to enter into an agreement with the owners of forests on the head waters of any navigable stream whereby the government shall, for a period of years, care for such forests instead of the owner. The bill permits the States to enter into agreements with each other not in conflict with the Federal laws, and establishes a commission of five senators and five representatives to investigate the relation, if there be any, between the navigability of streams rising in the White Mountains, the Southern Appalachians and the preservation of the forests. If the commission should find that such relation exists it shall then determine if the United States should acquire land within the waters heads or whether the government shall exercise supervision over the waters heads without purchase.

WORK OF CARNEGIE INSTITUTION.—At an address on Monday evening before a meeting of the Phi Beta Kappa Alumni of New York, Dr. Robert Woodward gave an account of the work of the Carnegie Institution, of which he is the Director. At present, he said, 80 or 90 per cent of the income of the institution is devoted to promoting the physical sciences. Dr. Woodward referred to 10 large projects upon which the institution is already embarked. These lines of work are botanical research, with a laboratory in Arizona, where cacti and reforestation are the chief objects of study; economics and sociology, with the collection of materials for a social and economic history of the United States; experimental evolution, the laboratory for which is at Cold Spring Harbor, L. I; geophysics, a study of the conditions of rock formation; historical research, chiefly interested in getting together materials for an American history; marine biology, with a laboratory at the Dry Tortugas; meridian astrometry, a department which is compiling a catalogue of all fixed stars, from the brightest to those of seventh magnitude; nutrition, with a laboratory at Boston; the solar observatory at Pasadena, in charge of George E. Hale, and terrestrial magnetism, in which department is employed a ship which is cruising about the Pacific. For the Pasadena observatory, Dr. Woodward said, a telescope, the largest of its kind, with 60-in. lens, was being constructed, and that one with a 100-in. lens is being planned, by the generosity of a citizen of Pasadena, who gave $50,000. Dr. Woodward said that 1000 persons had been engaged in research work under the auspices of the institution since its establishment in 1902, and over 300 were thus engaged at present.

MUNICIPAL ELECTRICIANS CONVENTION.—The annual convention of the International Association of Municipal Electricians will be held at Detroit, Mich., Aug. 19, 20 and 21. Mr. Frank P. Foster, Corning, N. Y., is secretary.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.—The date previously set for the annual convention of the Canadian Electrical Association has been changed, and the convention will take place Wednesday, Thursday and Friday, June 17-19.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—The next convention of the Society for the Promotion of Engineering Education will be held in Detroit, Mich., June 22 to June 27, in conjunction with the meeting of the American Society of Mechanical Engineers. Mr. Arthur L. Williston, Pratt Institute, Brooklyn, N. Y., is the secretary.

MUNICIPAL PLANT SOLD.—The C. H. Geist Company, a gas and electric syndicate of Chicago, Ill., has purchased the electric light plant at East Chicago and Indiana Harbor, Ind., formerly owned and operated by the City of East Chicago. The company in the future will be known as the Indiana Harbor & East Chicago Electric Company, with the following officers: C. H. Geist, president; C. H. Weak, vice-president; C. W. Fox, secretary and treasurer.

WIRELESS FROM A BALLOON.—The U. S. Signal Corps conducted last week some experiments with wireless telegraphy from a balloon. A receiving wire was hung from the basket, which latter was covered with wire netting. With the balloon over Washington, wireless messages from Annapolis were clearly received. Major Edgar Russell, who had charge of the experiment, said that wireless telegraphy from balloons will prove most useful in warfare, as a balloon could float over a battleground and give the commanding officer exact details of every move made by the enemy.

NEW ENGLISH ELECTRICAL JOURNAL.—The first issue has appeared of the *Post Office Electrical Engineers' Journal,* which will be issued quarterly. A feeling among British telegraph engineers that their interests were no longer adequately served by the Institution of Electrical Engineers led recently to the foundation of the Institution of Post Office Electrical Engineers, and the new journal will be the official mouthpiece of this organization. The greater part of the contents of the first issue, which is dated April, relates to the telephone and wireless telegraphy.

RAILWAY TELEGRAPH SUPERINTENDENTS.—The Association of Railway Telegraph Superintendents will hold its next annual convention in Montreal, June 24, 25 and 26. Several papers pertaining to railroad telegraph service and others of general interest are scheduled. Among the latter are the following: "Dry Batteries on Telegraph Circuits," by U. J Fry; "Wiring of Station Buildings From the Contractor's Standpoint," by J. H. Jacoby; "Adverse Railroad Legislation," by E. A. Chenery; "Moving Trains by Visible Signals," by L. B. Foley; "Use of Telephones in Connection with Train Movements," by W. W. Ryder; "The Interstate Commerce Commission," by C. Selden; "The Telephone," by F. F. Fowle.

CHINESE TELEGRAPH LINES.—According to a report recently submitted by Consul-General James W. Ragsdale, of Tientsin, 22,419 miles of telegraph lines were operated by the Imperial Chinese Telegraph Company in 1906. The system has 34,473 miles of wire, a submarine cable of 946 miles and 379 offices, of which 62 were open day and night, and 317 for day service only. The number of instruments was 768. At the head office in Shanghai the staff numbered 67 and the general staff 3175, while inspectors, linemen, etc., brought the total up to 2400. Besides the regular system there are in operation a number of provincial lines, usually constructed by the government, but operated and maintained by the provincial authorities.

TELEGRAPH COMPANIES TO BE INVESTIGATED.—Representative Cary, of Wisconsin, has introduced a bill into the United States House of Representatives directing the Secretary of Commerce and Labor to institute an investigation into the Western Union Telegraph Company and the Postal Telegraph Company to find out the methods used in handling the business, the wages paid operators and the working conditions of the employees. The results of the investigation are to be reported to the House as soon as possible. Mr. Cary started his career as a messenger boy in a telegraph office. His bill prohibits, under heavy penalties, telegraph companies from making discriminating rates in the same line of business. It permits leased wire contracts and newspaper rates at less than commercial rates, but requires that all business coming under a class, be charged according to the rates of the class under which it is listed.

GROUNDING OF THE SECONDARY.—In the annual report of the Wire Department of Boston, Mass., for the year 1907, Mr. James E. Cole, acting commissioner of wires, states that during the year there were no electrical fires due to wiring approved by the department, and with the exception of four fires in stations of the public service corporations, the total reported insurance loss for the electrical fires in the city during the year was but $166. Mr. Cole also reports that the grounding of secondaries has given good results in the city. Before the secondaries were grounded there were many cases of breakdowns in transformer insulations causing serious results. During the past year no damage has been caused by high-potential current entering buildings over secondary low-potential circuits, due to the proper grounding of the secondaries. He also states that there have been many cases where fires have been reported as caused by electric wires where there has been absolutely no justification for such report, there being no wires or electrical apparatus anywhere in the vicinity of where the fire occurred.

BOSTON Y. M. C. A. ELECTRICAL COURSE.—The School of Practical Electricity of the Boston Young Men's Christian Association is now in its fourth year of existence. There are two courses, one of 15 weeks and another extending over three years. The former requires an attendance of two and a quarter hours, three evenings in the week, and is intended to give as much theory as is necessary to the intelligent understanding of the principles which underlie the more common electrician's duties, together with as much practical experience in the handling of the various parts of all sorts of electrical equipment as can be crowded into this period. This course is intended for men who wish to obtain as much of a working knowledge as they can in a brief period, without attempting the far more complete study of theoretical principles and advanced matters which are given in the longer course. It appeals to men employed as steam engineers, janitors and others who are frequently called upon to perform certain lines of electrical work, as well as to those engaged in electrical work who know something along certain lines, but wish to obtain experience along other lines as well. The three years course is intended for men who wish to acquire as complete a knowledge of electricity as is possible but cannot attend a regular technical day school. It is intended to make the program sufficiently complete, both in theory and practice, to give the student an intelligent conception of electrical laws, electrical apparatus and electrical practice. The first year is devoted to mathematics, including algebra, geometry and trigonometry; physics, including lectures and laboratory work; mechanical drawing and theoretical electricity. A course in steam engineering, theory and practice, occupying one night per week, is also offered as an option to men attending the first year of the three-year course, but is not a part of the course. The fee for the short course is $35, and for the longer course $135 in all.

POWER IN PERU.—With regard to the recent statement that the first electrical energy transmission in South America was started in Peru in 1904, Mr. C. W. O'Farrell, of Cordoba, Argentine Republic, informs us that as early as 1897 or 1898 energy was supplied to the city by the Compania de Luz Electrica y Fuerza Motriz de Cordoba, at 10,000 volts over a transmission line 28 km long.

SPONGE-FISHING SUBMARINES.—Illustrations and description are given in a Parisian journal of a submarine intended for sponge fishing on the coast of Tunis. The vessel is built wholly of iron and is 16.4 ft. in length by 5.24 ft. in diameter, the general form being cylindrical with hemispherical ends. It is intended to carry two men, and is fixed so as to enable the vessel to move along the sea bottom. An electric lamp with reflectors fixed in front serves to illuminate the bed of the sea, and a glazed spy hole in the bow of the vessel enables the crew to seek out and to gather the sponges.

GRAPHITIC THERMO-ELECTRIC COUPLE.—In order to obtain an inexpensive thermo-electric couple for measuring temperatures of molten metals, Mr. W. H. Bristol employs for the two elements different forms, kinds or grades of carbon or graphite. These elements are capable of withstanding extreme temperatures and they do not appreciably alloy with most molten metals. In a patent issued April 21, it is stated that a particularly satisfactory couple can be made by using as one element pure carbon or graphite and combining from 15 to 20 per cent of Bavarian clay with carbon or graphite to form the other element.

STUDENTS GIVE AN ELECTRICAL AND MECHANICAL SHOW.—An electrical and mechanical show was given by the students of the mechanical and electrical department of the Washington State College, at Pullman, Wash., April 8 and 9. The show was very entertaining and instructive. There were many exhibits of scientific interest, such as a speaking arc, revolving field, a motor that would reverse its direction of rotavolving field and a motor that would reverse its direction of rotation every few seconds. X-ray and high-frequency apparatus were exhibited, and a 200,000-lb. testing machine was shown in operation. This is one of the largest machines west of the Mississippi. The attendance at the show was 2500.

ELECTRIC POSTAL TUBES.—According to advices from Berlin the German postoffice department has a scheme to connect the general postoffice in that city with the various branch offices by the construction of an underground railway, by which the distribution of the mail bags to and from the trains will be effected at a speed of about 25 miles an hour. The railway will be worked without a guard or driver, and the tunnel, placed close beneath the road surface, is to be only 29 in. in height by 71 in. in width. Each truck or car is intended for the conveyance of a large-sized mail bag. The complete train will be composed of a dwarf electric locomotive and not more than four trucks. The locomotive will have a pair of axles, each furnished with a motor. The line will be double track throughout, constructed on a 16.13-in. gage. Over each track will be conductor rails. A trench will be provided between the two lines of rails, so that a man will be able to pass through the tunnel. The construction of these tunnels for distribution of mails, the dispatch says, is regarded as a matter of certainty, as the negotiations between the postal authorities and city of Berlin have already been concluded. It will be interesting to see this "telpherage" method carried out, as it has already been seriously proposed more than once for New York City.

AWAKENED AFRICA.—Note is made of a remarkable feat of communication, in the current *Harper's Weekly*. Thirty-seven years ago, it is recalled by the writer, it took Stanley nine months of travel through the vast equatorial forest of Africa to reach Ujiji and find Livingstone. During almost his entire journey he was lost to communication with the outside world. At 12:30 p. m. on Wednesday, March 29, a cable despatch was sent through the Western Union Telegraph Company from New York to Nairobi, in British East Africa, a station 30 days' march from Livingstone's headquarters; and a reply was received through the Postal Telegraph Cable Company shortly after noon on the following Friday, an interval of less than 50 hours. The cable despatch was transmitted first to the Azore Islands, and thence to Lisbon, Gibraltar, Malta, Alexandria, Port Said, Suez, Aden, Zanzibar and Mombasa, on the East-African coast. Thence it was sent inland to Nairobi by telegraph, and from that point was conveyed 30 miles to the house of the recipient, the total approximate distance being slightly more than 10,000 miles. Owing to the difference in time between New York and Nairobi, the message lost eight hours in transit.

TUNGSTEN LAMP POLICY AT DUBUQUE, IA.—The Union Electric Company, of Dubuque, Ia., under the management of Mr. L. D. Mathes, has begun to introduce tungsten lamps, especially among former users of gas and dissatisfied electric customers. As to maintenance of tungsten lamps, the consumer is given the choice of two plans. By either plan the consumer purchases the initial installation and the company sells the lamp at cost. For maintenance, the company will either renew lamps for 3 cents per kw-hour or the consumer can purchase his lamps as required at the rate of $1.75 each for 100-watt lamps. In the first instance, the company takes the risk and virtually insures the consumer; in the second case the consumer takes the risk. The consumer may change from one plan to the other at any time he may elect. Thus, if a number of lamps burn out at about the same time and the consumer thinks the cost of lamps is running into too much money, the company will figure his meter reading from the time he put in the tungsten lamps, charge him 3 cents per kw-hour, and give him back any amount he has paid for the purchase of lamps in excess of this. On the other hand, if the consumer thinks he can maintain lamps for less than 3 cents per kw-hour, he can change to the plan of renewing them himself. The company expects within a reasonable time, as the tungsten lamp improves in quality, to reduce the flat rate renewal cost. Mr. Mathes reports no difficulty in placing the lamp.

TUNGSTEN LAMP INTRODUCTION AT WABASH, IND.—Mr. T. W. McNamee, manager of the Wabash Water & Light Company, of Wabash, Ind., early in the year began an active campaign with tungsten lamps to improve conditions for dissatisfied customers and to secure customers formerly using gas or gasoline. One of the most notable installations is in the Tremont Hotel, where formerly an installation of common carbon lamps, placed high on old-fashioned chandeliers without suitable reflectors, took 15,400 watts for the lobby and dining room. These were replaced with clusters of tungsten lamps in bowl reflectors hung near the ceiling with lamps pendent, and also a few single tungsten lamps placed at the ceiling, similarly equipped. The tungsten lamp installation takes only 6000 watts, as compared with 15,400, and gives much more satisfactory illumination, making a well-satisfied customer. There are a number of stores in the town which have passed through a number of changes in lighting. To begin with, there were enclosed arc lamps placed in a row down the middle of the store, the store being about 20 ft. wide. These were later replaced by Nernst lamps, but owing to the width of the store and the great distance apart of the Nernst lamps as installed, the illumination between lamps was not satisfactory and a number of such customers yielded to the arguments of the gas company and installed gas arcs. In such stores the plan is to install a two-light chandelier with a very short stem so as to bring the lamps near the ceiling and place on this chandelier two 100-watt tungsten lamps in bowl reflectors for each gas arc. The bowl reflector giving a wide distribution is able to cover satisfactorily a larger area than the Nernst lamps formerly employed. The plan is to put these in on trial, and let the consumer pay for them after he is satisfied that they are what he wants.

The Post Falls Development of the Washington Water Power Company.—I.

By C. S. MacCalla.

Ten miles from the outlet of Lake Cœur d'Alene, on the Spokane River, is the town of Post Falls, Idaho, where is located one of the hydro-electric plants of the Washington Water Power Company. Lake Cœur d'Alene is a body of water some 45 sq. miles in area, situated among the foothills of the Bitter Root Mountains in the western part of Idaho. The lake is 2120 ft. above sea level, and receives the drainage of a large part of the Bitter Root Mountains, being fed principally by the Cœur d'Alene and St. Joe Rivers, and is in turn the source of the Spokane River. In the low-water season there is a fall of about 9 in. between the outlet of the lake and the headwaters at Post Falls, while in flood seasons the difference has been over 8¼ ft., the lake itself having risen over 18 ft. above low-water mark.

Twenty-four miles down the river from Post Falls, in the State of Washington, is the city of Spokane, with 90,000 inhabitants, where is located the head office of the Washington Water Power Company. In the center of the city the Washington Water Power Company owns a series of falls within a distance of 1500 ft., having a total head of 134 ft., 71 of which are at present developed. The company, in addition, owns a modern steam turbine station in Spokane, which is used as an emergency relay and during periods of low water, the plan of the company being to develop its hydraulic plants beyond the limit of extreme low water.

In the design of the Post Falls development two principal objects were sought: (1) The erection of a hydro-electric plant to be operated in parallel with the Spokane hydraulic and steam plants, and (2) the building of a controlling works for the storage of water for use in the low-water seasons, while at the same time permitting a free passage of water during the season of flood water.

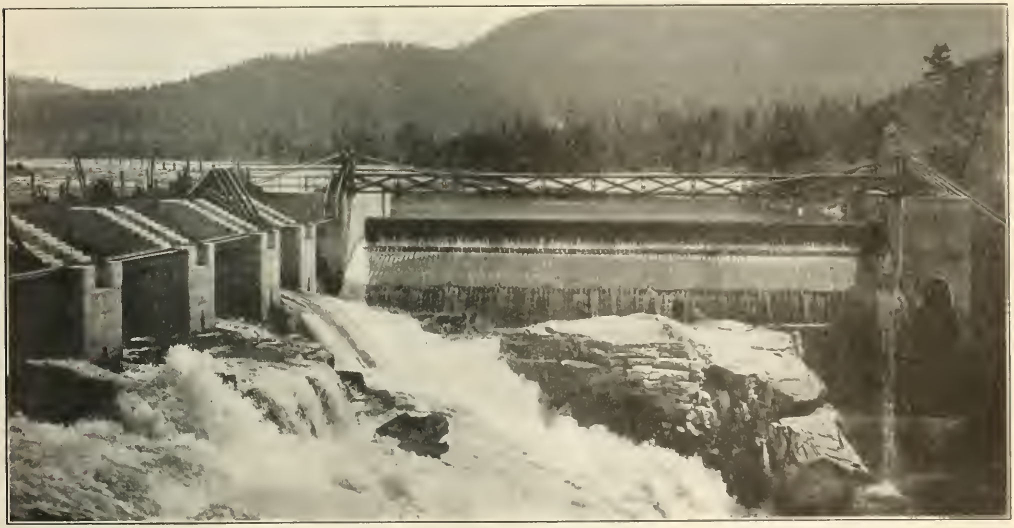

FIG. 1.—GENERAL VIEW OF THE DAM WITH THE BEAR-TRAP GATE CLOSED.

The Spokane River at Post Falls has cut through a granite ledge in three separate channels (Fig. 2) affording a head of 50 ft. The North and South Channels were utilized in the construction of controlling works, while the power station was placed directly across the Middle Channel.

Before the commencement of actual development, work was started on the construction of one of the permanent 60,000-volt transmission lines, which was later to be used as a tie line between the Post Falls and Spokane plants. A temporary step-down substation was erected and electric energy furnished from the Spokane station for operating rock crushers, concrete mixers, cableways, cofferdam pumps, as well as for lighting, proving of great value in the elimination of troubles incidental to the operation of numerous small engines and boilers and long lines of steam piping during freezing weather. A telephone circuit erected on the transmission-line poles afforded communication with headquarters in Spokane.

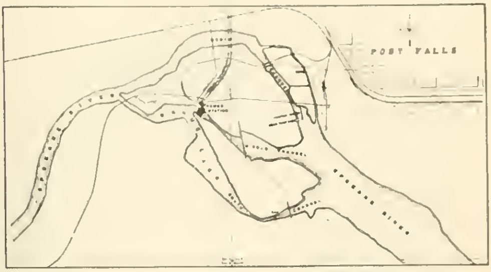

FIG. 2.—MAP OF THE POST FALLS PROPERTY.

CONTROLLING WORKS.

The controlling works permit of a maximum storage of water to a depth of 6½ ft. on Lake Cœur d'Alene, they are also designed to afford a more free discharge of the flood waters than existed in the three channels prior to the construction of the present works. This condition is of value to all ownerships upon Lake Cœur d'Alene and its tributaries, reducing as it does the area of land inundated by the yearly spring freshets, and, on the other hand, holding up the water level in the low-water season, thus aiding the shipping and lumber interests and assuring to Post Falls a navigable channel to the lake.

In the South Channel a concrete dam 78 ft. long was placed, having six gates each 6 ft. wide and 13 ft. high, together with a spillway 42 ft. long. The gates, which are of the ordinary sliding pattern, built of Puget Sound fir, may be raised or lowered by a hand-operated mechanism mounted on a car running on tracks placed on the top of the dam. As these gates would usually be operated only once a year, it was not considered necessary to provide other than a hand-operated device.

In the North Channel are placed the principal controlling works, consisting of seven sluiceways 21 ft. wide, one log sluice 12 ft. wide, each sluiceway controlled by a Tainter gate, together with the main sluiceway, 110 ft. long, controlled by a bear-trap gate of the reversed Parker type.

The Tainter gates are constructed of Puget Sound fir, with cast-iron hinges fitted to steel hinge beams of I-beam construction embedded in concrete piers. The hinge beams are anchored with long steel rods and anchor castings distributing the pressure to the base of the piers near the up-stream faces. Each gate is counter-weighted by a concrete cylinder weighing 4.8 tons, and is easily operated by one man by means of a worm-gear mechanism carried on I-beams placed across the sluiceway on the top of the piers.

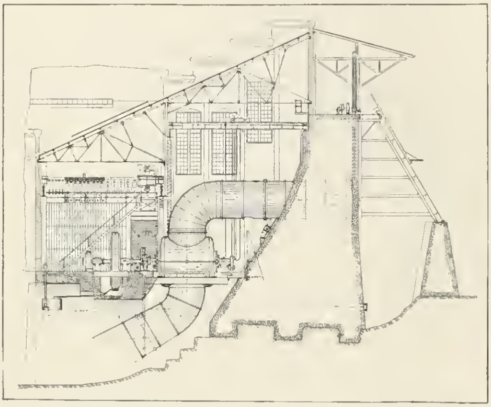

FIG. 3.—TRANSVERSE SECTION OF POST FALLS STATION.

The bear-trap gate consists of four leaves, having two fixed and two movable hinges, the X or resisting leaf, the Y or lifting leaf, the Z or connecting leaf, and the idler leaf, the function of the latter being to protect the connecting leaf and hinges.

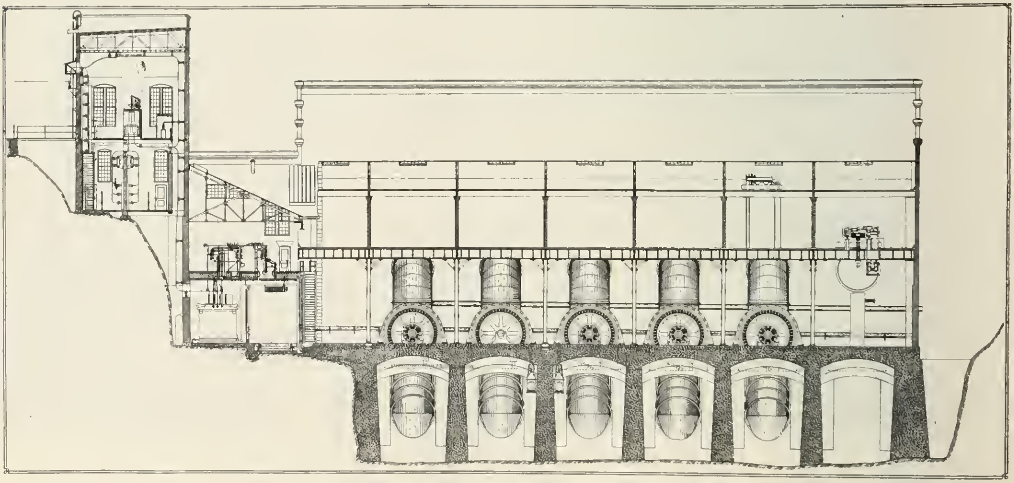

FIG. 4.—LONGITUDINAL SECTIONAL ELEVATION OF THE POST FALLS STATION.

The gate is placed partly on natural rock; where the latter was at too low an elevation a foundation was built up with a cyclopean rubble concrete substructure. The base timbers were securely bolted to the natural rock or substructure, the space between the base timbers and the natural rock or substructure being filled with concrete and a water-tight connection thereby made. Extreme care was exercised in accurately locating the piers with their faces perpendicular and at right-angles to the line of the dam, the faces of the piers adjoining the gate being absolutely parallel.

The material used in the gate was Puget Sound fir for the base timbers and leaves, cast-iron in the hinges, with steel hinge pins.

The gate is operated hydraulically from the adjoining concrete piers. For this purpose, tunnels are built in each pier, connecting the space under the gate with both head and tail water. A rack is placed at each opening to the headwater to prevent bark, rubbish, etc., getting under the gate. Two valves of the Tainter type control the tunnels in each pier. A crab placed on top of the pier operates both valves. To raise the gate the down-stream valve in each pier is closed and the up-stream valve in either or both piers opened. This exerts a lifting pressure under the gate, which is the resultant pressure due to the difference between the static head at the up-stream inlet of the piers and the head acting directly over the gate. To lower the gate, both up-stream valves are closed, and one or both down-stream valves opened.

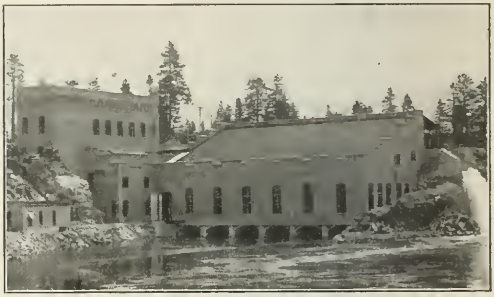

FIG. 5.—VIEW OF THE POWER STATION FROM THE DOWN STREAM SIDE.

POWER HOUSE AND DAM.

In the Middle Channel a solid concrete dam was erected across the channel, forming the up-stream wall of the power house. (Fig. 3.)

The work of concreting was prosecuted vigorously night and day during the entire winter. To this end a steam boiler was used, and hot water was furnished for mixing the concrete. The crushed rock was heated by a pipe furnishing steam in the bottom of the rock bin.

The concrete was taken from the mixing plant in buckets placed on flat cars operating on a short track extending under three cableways stretched across the work. The amount of water used in mixing was so regulated that the men in tamping would sink almost to their ankles in the wet mixture.

After concreting was completed in any part of the work, that part was covered loosely with canvas under which steam from a hose was kept playing until the concrete had sufficiently set.

In excavating for the power house the larger uncracked granite boulders which could not be used directly in the rock crusher were piled conveniently on one side under the cableways and later, after being thoroughly cleaned and wetted, replaced in the concrete, the latter being carefully tamped around them. The boulders were placed not less than 6 in. from each other or from the faces of the dam.

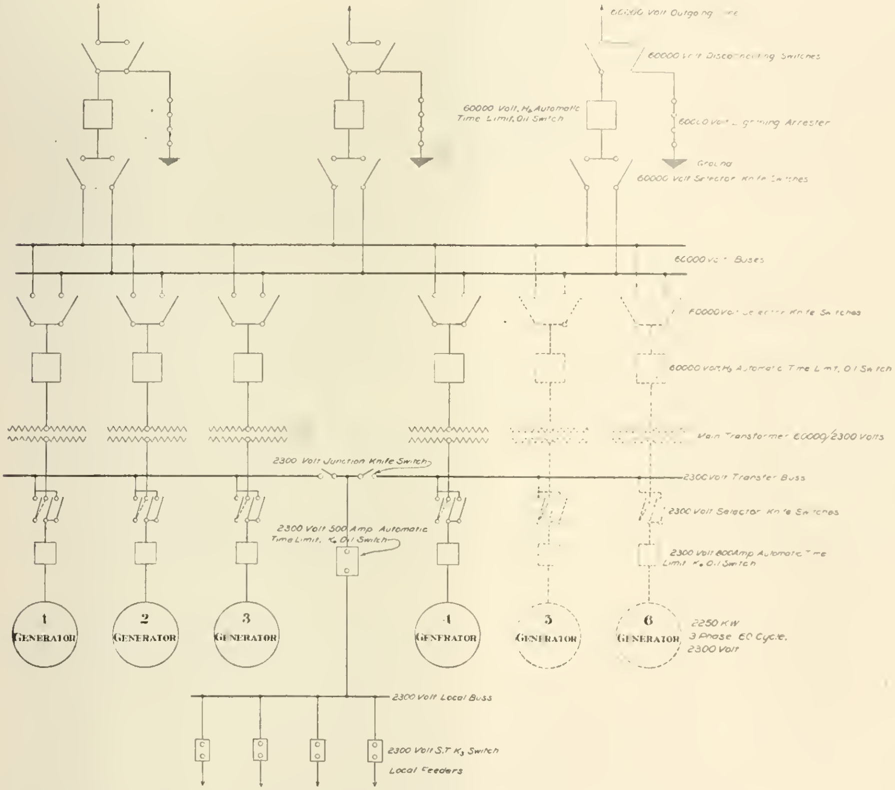
60000 Volt Outgoing Line
60000 Volt Disconnecting Switches
60000 Volt, H6 Automatic Time Limit, Oil Switch
60000 Volt Lightning Arrester
Ground
60000 Volt Selector Knife Switches
60000 Volt Buses
60000 Volt Selector Knife Switches
60000 Volt H6 Automatic Time Limit, Oil Switch
Main Transformer 60000/2300 Volts
2300 Volt Junction Knife Switch
2300 Volt Transfer Buss
2300 Volt Selector Knife Switches
2300 Volt 500 Amp Automatic Time Limit, K6 Oil Switch
2300 Volt 800 Amp Automatic Time Limit K6 Oil Switch
1 Generator
2 Generator
3 Generator
4 Generator
5 Generator
6 Generator
2250 KW 3 Phase 60 Cycle. 2300 Volt
2300 Volt Local Buss
2300 Volt S.T K3 Switch
Local Feeders

FIG. 6.—WIRING DIAGRAM WITH EQUIPMENT IN THE POST FALLS STATION.

Before commencing the concreting, the foundation of granite bedrock was carefully cleaned and covered with a grouting of neat cement. In freezing weather steam was used to thoroughly free the bedrock of frost and ice.

The concrete was carried across in layers. The large boulders were left projecting above the surface of each layer to form a dowel for the layer next above.

No special provision was made for expansion and contraction, the resulting strain being taken up in the mass of concrete. No cracks have become visible in the more than a year's time since the full hydraulic pressure has been against the dam.

The concrete was in the proportion of one part Portland cement, three parts clean sharp sand and six parts of crushed rock, run of crusher up to and including 2-in. size.

A complete cement testing laboratory was maintained on the work and full tensile (seven days and 28 days, hot and cold water) and pat (air, cold and hot water) tests carried out. Six samples were taken from every carload (averaging 150 bbl. each), and additional samples when the first test appeared unsatisfactory.

The up-stream face of the dam was waterproofed by applying alternately two coats of solutions of soft soap and alum, respectively. Great care was exercised in grouting crevices and placing the concrete at either end of the dam against the rock walls or abutments. The result has shown an exceptionally water-tight job, an essential condition as the dam forms a wall for the generator and turbine room.

The three cableways which were used for rock excavation and concreting were also used in placing the sections of the intake pipe in the dam, as well as erecting the structural steel for the crane columns, girders and roof trusses.

Figs. 4 and 3 show, respectively, the longitudinal and transverse sectional elevation of the plant, giving clearly the relative arrangement of the machinery, switchboard, etc.

The headgates are of the sliding pattern, of steel and timber construction, and are operated by a motor-driven mechanism placed on the top of the dam. This consists of a 15-hp motor direct-connected to the operating shaft extending across the dam. Opposite each gate a hand-operated clutch connects the shaft to a quill and this moves, through a worm-gear and pinions, the racks placed on the gate stems. At the side of each gate is a filler gate 36 in. in diameter, with a pipe connection to the main feeder pipe. The filler gates are operated from the main shaft on the dam in a similar manner to the main gates. The entire mechanism is so designed that the gates may be operated, one at a time, at any stage of water. The purpose of the filler gate is to facilitate the raising of the main headgate by filling the feeder pipe or penstock with water from the forebay, thus tending to equalize the hydraulic pressure on both sides of the headgate.

Racks extend the entire length of the dam, at one end of which is a small spillway used in sluicing rubbish, bark, etc. The racks consist of iron bars 3/8 in. x 2 in. placed on edge, 1 3/8 in. in the clear between bars, and supported by a steel I-beam construction extending from the face of the dam and resting on a concrete footing placed on the solid rock. The velocity of the water flowing through the racks will not exceed 2 1/4 ft. per second when the plant is carrying full load, or 18,000 hp, and with the water level in the forebay at the low-water stage.

In order to install the quarter-turn leading to the turbine it was necessary to place the intake pipes rather closer to the extreme low-water level than ordinary practice would deem desirable. In order to prevent the formation of whirlpools and the introduction of air into the feeder pipes, a raft of baffle boards was placed in front of each headgate. Each raft is 17 ft. long by 12 ft. wide, and consists of 1 in. by 12 in. boards placed on edge and spaced 3 in. in the clear between boards. These proved their efficacy during the first summer the plant was in operation, when, on account of the unfinished condition of the North Channel controlling works, the water in the forebay reached a level of only 2 ft. 5 in. above the entrance to the feeder pipes, and the vacuum gages on the draft tubes continued to show normal vacuum.

The power station, other than the wall made by the dam, is built of brick, on concrete foundations over the tail-race and on original rock in the rest of the building. The plant may be considered as being divided into three parts, namely: (1) the turbine and generator room; (2) the transformer and low-tension switchboard-rooms, and (3) the high-tension switch and bus rooms. The station is designed for six 2250-kw generating units, six 2200-kw step-up transformers, three 60,000-volt outgoing lines, one 22,500-volt and four 2300-volt feeders, each outgoing line and feeder being equipped with lightning arresters. The first three generator and transformer units have been in operation since the summer of 1906. The fourth unit is now in service, and fifth will be in operation early in the summer of 1908.

The turbine and generator room is 175 ft. long by 61 ft. wide. The units, which are direct-connected, are spaced 25 ft. on centers (Fig. 4). A track connecting with the Northern Pacific Railroad enters the building at one end so that cars may be unloaded by either or both cranes.

A line of steel lattice columns extends across the room between the generators and water-wheels. These columns, besides supporting the roof trusses, carry one rail of each of the two Niles cranes—a 10-ton hand crane over the turbines and a 30-ton electric crane over the generators. The other rail of these cranes is carried, respectively, the one on a notch built in the dam, and the other on plate girders supported on brick pilasters along the down-stream wall of the building.

Large windows are placed in the down-stream and end walls, as well as in the brick wall built on the top of the dam, giving a well-lighted room and providing excellent ventilation.

The roof consists of steel trusses securely anchored to the brick wall on top of the dam and supported in addition by the steel columns and down-stream brick wall. The columns are placed on lead plates 1/8 in. thick and securely anchored to the concrete foundations. The roof trusses are covered with 2-in. x 12-in. sheathing, which is waterproofed by Carey's magnesia roofing.

The transformer room forms an L at the end of the turbine and generator room, and is laid out for six 2200-kw, three-phase transformers. Under normal conditions each generator and its transformer together are operated as a unit. A switching arrangement and transfer bus permits any generator being operated with any transformer.

On the floor above the transformers and forming a gallery at one end of the generator room, is placed the controlling switchboard (Fig. 4). This is arranged in the form of a combined bench and panel board of blue Vermont marble. The diagram of the main wiring connections is shown in Fig. 6. In Fig. 4 is shown in section the electrical connections between generators, switchboard, transformers and the 60,000-volt switches and buses. Dummy buses with indicating lamps and switches are mounted on the panels and bench board so that the operator has before him at all times a clear diagram of the connections.

Inductance of Electric Transmission Lines with Unsymmetrically Disposed Conductors.

By Alfred Still.

The object of this article is to indicate a simple method of calculating the total induced e.m.f. in any conductor of an electric-energy transmission system, whatever may be the actual arrangement or relative positions of the conductors. It is assumed in all cases that the conductors are of circular section and that they remain parallel with each other throughout the whole distance of transmission.

FLUX SURROUNDING A STRAIGHT CONDUCTOR.

The magnetic lines of induction surrounding a long straight wire carrying an electric current, of which the return path is at a considerable distance, will be in the form of circles concentric with the conductor. The path of the magnetic lines will, therefore, increase in length in direct proportion to the distance from the conductor; and the intensity of the magnetic field—usually denoted by the letter **H**—will vary inversely as the distance (from the center of the conductor) of the point considered. This relation was first experimentally proved by Biot and Savart, the formula being:

$$\mathbf{H} = \frac{2I}{l} \tag{1}$$

where l is the distance of the point considered from the center of the conductor, all quantities being in c.g.s units. In order to calculate the total flux of self-induction surrounding unit length (1 cm) of straight conductor, carrying a current I, up to a limiting distance of D cms, when the diameter of the conductor is $2R$ (see Fig. 1) we have

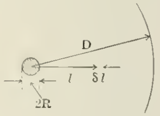

FIG. 1.—FORCES AROUND A STRAIGHT CONDUCTOR.

$$\mathbf{N} = \int_R^D \frac{2I}{l}\,dl$$

$$= 2\,I\,(\log_e D - \log_e R)$$

$$= 2\,I \log_e \frac{D}{R} \tag{2}$$

EFFECT OF TAKING INTO ACCOUNT THE RETURN CONDUCTOR.

There would be no limit to the self-induction of a long straight conductor if the effect of the return current could be entirely neglected, and the actual effective flux surrounding any single conductor of a transmission system will depend upon the distance of the parallel return conductor or conductors.

Consider, first, the loop formed by two parallel conductors of circular cross-section, one carrying the outgoing current I and the other carrying the return current $-I$ (see Fig. 2). The flux due to the current I in the conductor A may be considered as extending indefinitely throughout space, with ever-weakening intensity as the distance from the conductor increases, and the same argument applies to the flux surrounding the return conductor B, the only difference being that, if the direction of the flux round *A* be considered positive, that which surrounds *B* will be in a negative direction. It follows that the whole of the magnetic flux due to the current *I* in *A*, which is situated at a distance greater than the distance *D* between centers of the outgoing and return conductors, is exactly neutralized by the flux due to the current — *I* in *B*. Thus, in Fig. 2, it will be seen that the flux of induction surrounding *A* up to a distance *D*, is not neutralized by the current — *I* in the conductor *B;* but any magnetic line, such as *M*, situated at a greater distance, *P*, from the center of the conductor *A*, is exactly neutralized by the magnetic line *N*, due to the return current in conductor *B*, since it also surrounds the conductor *A*, but in an opposite direction to the line *M*. It follows that the total *effective flux* surrounding *A*—that is, the resultant flux which will give rise to an induced e.m.f. in the conductor when carrying an alternating current—is merely that portion of the total self-produced flux included between the surface of the conductor[1] and the surface of an imaginary cylinder, concentric with the conductor, and of radius *D*, equal to the distance between the centers of the outgoing and return conductors. The formula (2) can, therefore, be used for calculating the flux which is effective in producing an e.m.f. of self-induction in a straight conductor when the whole of the return current is situated at a distance *D* from the center of the conductor.[2]

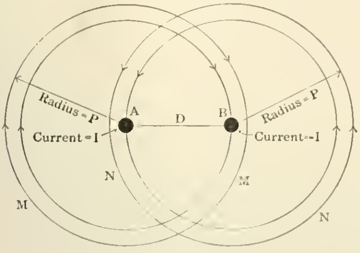

FIG. 2.—FORCES AROUND TWO PARALLEL CONDUCTORS.

CALCULATION OF THE TOTAL FLUX WHEN THERE ARE SEVERAL RETURN CONDUCTORS.

In Fig. 3 the total outgoing current *I* is supposed to flow along one conductor, while the total return current is divided up between a number of conductors, the condition being that

$$I = -(I_1 + I_2 + I_3 \;.\;.\;.\;.\;. + I_n)$$

Let D_1, D_2, D_3, etc., represent the distances between centers of the corresponding conductors carrying the return currents and the conductor carrying the outgoing current, and note that the total flux surrounding the latter conductor may be considered as the algebraic sum of several separate fluxes, namely: the flux due to a current I_1 returning at a distance D_1, the flux due to a current I_2 returning at a distance D_2, and so on, for any number of components of the total current *I*. All these separate components of the total flux can readily be calculated by means of formula (2), and the expression for the total flux due to the current *I* returning along a number of separate conductors, as indicated in Fig. 3, becomes:

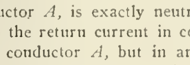

FIG. 3.—COMMON OUTGOING CURRENT PATH AND DIVIDED RETURN PATH.

$$\mathbf{N} = 2 \times \left[-I_1 \log_e \frac{D_1}{R} - I_2 \log_e \frac{D_2}{R} - \ldots\ I_n \log_e \frac{D_n}{R} \right] \qquad (3)$$

PRACTICAL APPLICATION—POLYPHASE TRANSMISSION.

In the case of energy transmission by polyphase currents, with any number of conductors, the algebraic sum of the currents in the conductors must, at any given instant, be equal to zero. Any one conductor can be looked upon as carrying the outgoing current, while the remaining conductors together carry the return current. Formula (3) can, therefore, be used for calculating the effective flux of induction surrounding any one conductor in a polyphase transmission, whatever may be the arrangement of the conductors. The phase relations of the various component fluxes must, however, be taken into account, and for this reason the graphical addition of vector quantities with the help of a diagram will be found most convenient. Instead of drawing the vectors representing magnetic flux components—in phase with the current vectors—the component vectors of the resultant e.m.f. of self-induction may be drawn—in this case 90 time-degrees behind the corresponding current vectors.

In order to calculate the induced e.m.f. it will be advisable first to put equation (3) in a more practical form. The symbols I_1, I_2, etc., in equation (3), when the latter is to be used for calculating the maximum value of the induction due to an alternating current, must be considered as representing the maximum value of the current wave expressed in absolute c.g.s. units. But since

$$\text{C.g.s. unit of current} = \frac{\text{amperes}}{10}$$

$$\left.\begin{array}{l}\text{maximum value of current on}\\ \text{the assumption of sine curve}\\ \text{wave form}\end{array}\right\} = \sqrt{2} \times \sqrt{\text{mean square value.}}$$

Hyperbolic logs = common logs × 2.3026, the multiplier in front of the brackets in formula (3) becomes.

$$\frac{2 \times \sqrt{2} \times 2.3026}{10}$$

$$= .6512$$

and if **N** is to represent the total flux per mile of conductor instead of per centimeter:

$$\mathbf{N} = 10480 \times \left[-I_1 \log_{10} \frac{D_1}{R} - I_2 \log_{10} \frac{D_2}{R} \ldots - I_n \log_{10} \frac{D_n}{R} \right] \qquad (4)$$

where the currents I_1, I_2, etc., in the various conductors are the amperes as indicated by an ammeter. In calculating the induced e.m.f. it must be remembered that the total effective number of magnetic lines surrounding the conductor are twice created and twice destroyed during one complete period. It follows that if **N** is the maximum value of the flux and *f* the frequency, the mean value of the induced volts will be

$$e_m = \frac{4\mathbf{N}f}{10^8}$$

and if we assume the sine wave form giving

$$\sqrt{\textit{mean square value}} = \frac{\pi}{2\sqrt{2}}\ \textit{mean value},$$ we have:

$$\text{Induced volts} = e = \frac{2\pi \mathbf{N} f}{\sqrt{2} \times 10^8} \qquad (5)$$

Inserting for **N** the value as given by formula (4) there is obtained for the induced volts per mile of conductor:

$$e = .004655 \times f \times \left[-I_1 \log \frac{D_1}{R} - I_2 \log \frac{D_2}{R} \ldots - I_n \log \frac{D_n}{R} \right] \qquad (6)$$

NUMERICAL EXAMPLE.

Consider a three-wire, two-phase overhead transmission system with the conductors occupying the vertices of an equilateral triangle (see Fig. 4). If the load is balanced, the current I_1 in No. 1 conductor will be equal to I_2 in No. 2 conductor, but the current in the common return conductor, No. 3, will be $\sqrt{2}$ times I_1 or I_2.

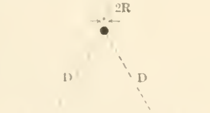

FIG. 4.—SYMMETRICAL ARRANGEMENT OF THREE CONDUCTORS.

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[1] The induction *within* the material of the conductor has been disregarded throughout the whole of this article.

[2] The intensity of the magnetic field at any point outside a long, straight cylindrical conductor can always be calculated on the assumption that the whole of the current is concentrated along the axis of the conductor.

Let I_1 and $I_2 = 50$ amperes.

$I_3 = 70.7$ amperes.

Distance between conductors D = 18 in.

Diameter of No. 1 and No. 2 conductors $= 2r = 3/8$ in.

Diameter of No. 3 conductor $= 2R = 1/2$ in.

Considering, now, the quantity between brackets in formula (6); it will be noted that, on account of the symmetrical arrangement of the conductors, the whole of the return current is at a distance D ($= 18$ in.) from any one of the conductors considered as carrying the outgoing current. The quantity between brackets will, therefore, be

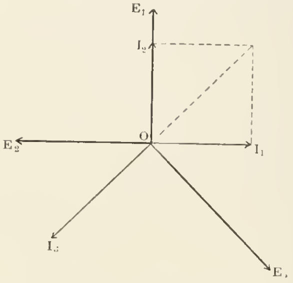


FIG. 5.—CURRENTS AND E.M.F'S. WITH SYMMETRICAL ARRANGEMENT.

$I_1 \log \frac{D}{r}$ for calculating the flux round conductor No. 1.

$I_2 \log \frac{D}{r}$ for calculating the flux round conductor No. 2.

$I_3 \log \frac{D}{R}$ for calculating the flux round conductor No. 3.

The induced volts per mile, at full load, in the conductors, respectively, as calculated by formula (6) will be

In No. 1 and No. 2 conductors, 9.8 volts.

In No. 3 conductor, 12.80 volts.

The vectors representing these quantitites have been drawn in Fig. 5; each pressure vector being drawn to scale exactly 90 time-degrees behind the corresponding current veotor.

The conditions are not so simple when the conductors are arranged as in Fig. 6, this arrangement being such that the distance between conductors 1 and 2 is greater than the distance separating either of these from the common return, in exact proportion to the difference of potential as measured between the conductors.

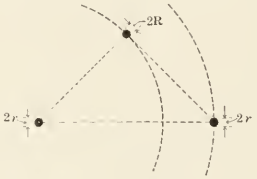


FIG. 6.—UNSYMMETRICAL ARRANGEMENT OF THREE CONDUCTORS.

The quantity between brackets in formula (6), as applied to conductor No. 1, now becomes:

$$\left[-I_2 \log \frac{D\sqrt{2}}{r} - I_3 \log \frac{D}{r}\right]$$

$$=\left[-I_2 \log \frac{D}{r} - I_2 \log \sqrt{2} - I_3 \log \frac{D}{r}\right]$$

$$=\left[I_1 \log \frac{D}{r} - I_2 \log \sqrt{2}\right] \tag{7}$$

this last simplification being obtained by inserting for — $(I_2 + I_3)$ its equivalent value I_1.

In a similar way, it will be found that the quantity in brackets in formula (6), as applied to conductor No. 2, becomes

$$\left[I_2 \log \frac{D}{r} - I_1 \log \sqrt{2}\right] \tag{8}$$

while for conductor No. 3 (the common return) the condition is as before, seeing that the whole of the return current $(I_1 + I_2)$ is at the same distance ($D = 18$ in.) as assumed in working out the previous example.

The vector diagram has been drawn in Fig. 7, and the numerical values of the component induced e.m.fs. work out as follows:

For conductor No. 3, $OE_3 = 12.8$ volts, as before.

For conductor No. 1 $OF = .004655 \times f \times I_1 \log \frac{D}{r}$ $= 9.8$ volts, and,

$OG = .004655 \times f \times I_2 \log \sqrt{2} = .87$ volts.

For conductor No. 2.

$OK = 9.8$ volts and $OH = .87$ volts,

the resultant vectors representing the total induced volts in conductors 1 and 2, being OE_1 and OE_2, respectively.

It will be seen that, although the components OF and OK are drawn 90 time-degrees behind the corresponding current vectors, the smaller components, OG and OH—which owe their existence to the unsymmetrical arrangement of the conductors —have been drawn in time-advance of the current vectors OI_2 and OI_1. This is because of the negative sign before the last item in the expressions (7) and (8).

It is interesting to note that the particular component of the total induced e.m.f., represented by the vectors OG and OH, is exactly in time-phase with the current I_1, and exactly opposite in time-phase to the current I_2. This results in the total induced e.m.f. lagging less than a quarter period behind the leading current (in this example, I_1) and more than a quarter period behind the lagging current (I_2). This is clearly shown in the vector diagram.

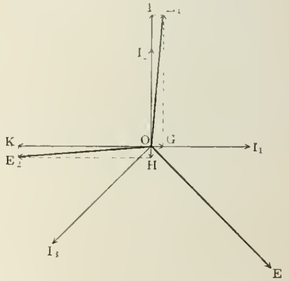


FIG. 7.—CURRENTS AND E.M.F'S. WITH UNSYMMETRICAL ARRANGEMENT.

Parallel Operation of Alternators.

By Henry Herman.

In view of the letters from Mr. Waldo V. Lyon and Mr. Milan V. Ayres in your issues for Jan. 25 and Feb. 15, respectively, relating to the parallel operation of alternators, it is believed that the following explanation of the facts mentioned by you in the former issue and verified by Mr. Ayres in the letter, may prove of interest to your readers.

It has frequently been observed that a synchronous machine with normal impressed e.m.f. and zero field current may keep in step and consume considerable power, either electrical or mechanical. This result is attributable solely to the influence of the periodical variation of the coefficient of self-induction, or, what is the same, to the effect brought about by the periodical variation of the reactance of the armature circuit.

As an approximation, one may assume that the coefficient of self-induction in an alternator varies, as shown in Fig. 1; that is, it may be represented by a sine wave of twice the frequency of that of the main current.

In Fig. 1 let L be that portion of the coefficient of self-induction which is constant in value, λL, be the amplitude of the variation. The instantaneous values are then:

$$l = L\,(1 + \lambda \cos 2\beta)$$

β being a time-angle having the value indicated. Thus, the coefficient of self-induction consists of two components. The component L is constant in value, and corresponding to the constant part of the reactance X_1, and $\lambda \cos 2\beta$ is variable in magnitude and equivalent to the variable portion of the reactance, which latter again consists of two components, X_2 and X_3, as will be shown below.

If now an alternator is deprived of its field current, its counter e.m.f (or e.m.f. due to the mechanical rotation of the field flux) is reduced to zero, or nearly so. The only e.m.f. induced in the armature winding is that of self-induction; that is, the e.m.f. due to the flux set up by the armature currents. This flux is of a pulsating character in a single-phase alternator and revolves synchronously in a polyphase machine. As a rule, the e.m.f. of self-induction is not wattless, but contains a power component, the latter representing either consumption or production of electrical power according to the phase relation between the current wave and the reactance wave.

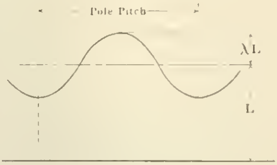


FIG. 1.—FLUCTUATING SPACE VALUE OF SELF-INDUCTION COEFFICIENT.

To illustrate the above more clearly one may proceed as follows: The total flux set up by the armature currents may be resolved into three components. First, ϕ_1 a component which does not cross the air-gap and which is interlinked with the armature conductors. This flux, in time-phase with the total current, may be called the flux of self-induction proper; it produces an e.m.f. E_{s1}, lagging 90 time-degrees behind I. Second, ϕ a component which crosses the gap twice and which may be considered as being in time-phase with the watt component I_e of the current. This flux under normal operating conditions distorts the main field but does not contribute to the magnetization or demagnetization of the main field: E_{s2} the e.m.f. due to ϕ_2 lags 90 time-degrees behind I_e. Third, ϕ_3 the flux which crosses the gap twice and which is interlinked with the field winding. Flux ϕ_3 magnetizes the field poles, the direction and magnitude of the magnetization depending upon the time-phase relation between the current wave and the reactance wave. Being in time-phase with I_m, the wattless component of the current, ϕ_3, produces an e.m.f. E_{s3} lagging 90 time-degrees behind I_m.

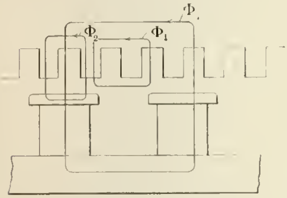


FIG. 2.—PATHS OF REACTANCE FLUXES.

The vector diagrams of Figs. 3 and 4 show the conditions prevailing in a synchronous alternator with constant impressed e.m.f. and zero field excitation. In these diagrams, which are not drawn to scale, the current I has been resolved into its components I_e and I_m, with reference to the variation of the reactance.

Generally speaking, the direction of E_{s3} is that of E_0, the e.m.f. which would be induced in the alternator when running with normal field m.m.f.

In Figs. 3 and 4 let

I = total current.

I_e = component of I in time-phase with the internal e.m.f.

I_m = component of current I in time-quadrature with the internal e.m.f.

E = constant impressed e.m.f.

I_r = e.m.f. consumed by effective resistance of armature.

E_{s1} = e.m.f. consumed by reactance due to flux ϕ_2.

E_{s2} = e.m.f. consumed by reactance due to flux ϕ_2.

E_{s3} = e.m.f. consumed by reactance due to flux ϕ_2.

Θ = time-phase displacement between current I and impressed *e.m.f.* E.

E'_{s2} = projection of E_{s2} upon I.

E'_{s3} = projection of E_{s3} upon I.

Again, let

a = number of phases, and T = torque of alternator, in "synchronous watts."

From Figs. 3 and 4:

$$T = a\,I\,E \cos \Theta$$

$$T = a\,I\,[E'_{s3} - (E'_{s2} + Ir)]$$

In this equation the product aI (I_r) represents the power consumed by the copper loss; thus this quantity can neither reappear as electrical power in the line in the case of a generator, nor as mechanical power at the shaft when the alternator is operating as a synchronous motor. Hence the useful internal torque: that is, the torque representing the available power will be reduced to zero when $E'_{s3} - E'_{s2} = 0$; in other words, when $E'_{s3} = E'_{s2}$.

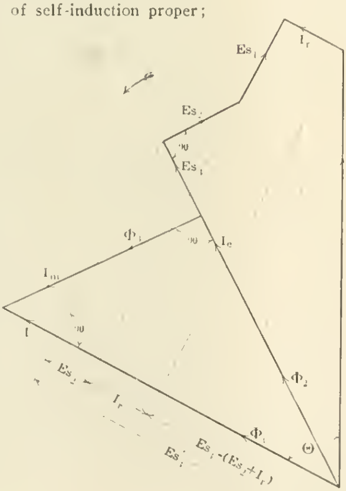


FIG. 3.—TIME-PHASE RELATION OF CURRENTS AND E.M.F'S. IN A SYNCHRONOUS MOTOR.

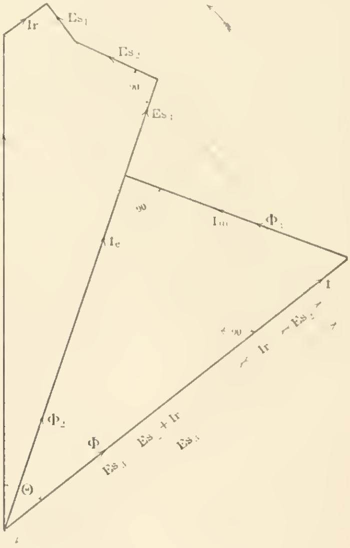


FIG. 4.—TIME-PHASE RELATIONS OF CURRENTS AND E.M.F'S. IN A SYNCHRONOUS GENERATOR

Assuming proportionality between the m.m.f. and the magnetization, which seems permissible, one may write: $E_{s2} = I_eX_2$: $E_{s3} = I_mX_3$. That is, for a certain current and time-phase displacement E_{s2} is proportional to X_2, and E_{s2} is proportional to X_3. With constant impressed e.m.f. and zero field excitation, the torque of the alternator vanishes only when the reactance of the component of the current in time-phase with the internal e.m.f. is equal to that of the component in time-quadrature therewith, a condition never met with in modern alternators of large size.

As will be seen from Fig. 4, the alternator without field excitation can act as a generator only when the current demanded by the line contains a large leading component.

In summing up, then, one may state that if an alternator with constant impressed e.m.f. loses its field excitation entirely, it may drop the load and fall out of step. In the majority of cases, however, the torque of the machine does not disappear, and if conditions are favorable the alternator will carry considerable load, although there will be large wattless currents. For a given phase displacement the torque of the alternator will be the greater the greater the difference between the reluctances of the main path of the field magnetism and of the electrical space-quadrature path of the magnetism produced by the armature m.m.f.

Convention of the National Electric Light Association.

The annual convention of the National Electric Light Association was opened at the Auditorium Hotel, Chicago, Tuesday of this week, and was still in session at the time of going to press. Following are abstracts of papers scheduled to be read at the various sessions, which extend over Tuesday, Wednesday, Thursday and Friday.

REPORT ON PROGRESS.

The report of the Committee on Progress, Mr. T. C. Martin, chairman, occupied 58 pages and was devoted as usual to a review of the events and developments of the year. It showed that for the first time in its history the association has over 5000 central station systems to draw upon for membership. The statistics of American growth were compared with those of Germany, France and England, and data were given as to conditions in Paris and London. A large section discussed the subjects of rates, franchises and methods of State regulation, giving recent rulings and decisions, and recent methods adopted by member companies. Newer central station work was dealt with next, particularly the plant at Ellicott City, Md., enclosed within the dam itself; the 100,000-volt Grand Rapids-Muskegon line, and the oil burning plant at Pittsfield, Mass. Special street lighting effects were next taken up, as exemplified at Denver, New York, Pittsburg and Chicago, and billboard lighting methods were described. This was followed by data on the lighting of the Marshall Field store in Chicago. The section on lamps was prefaced by data as to illuminating engineering, government specifications for lamps and meter testing in various places. Under the topic head of relations with employees, the educational methods of the New York and Brooklyn Edison Companies were briefly described, and the Scranton agreement with the men, as well as the new "service supervisors" in Denver. Mr. Martin then devoted considerable space to the new metallic filament lamps and the newer forms of arcs, citing results reported from many cities. New mercury-vapor lamps were also noted. Electric heating and motor data and developments were then summarized, and the closing section of the report dealt with relations with the public, including such matters as exhibitions, prepayment meters, show windows, free wiring, etc.

GAS ENGINES.

The committee on gas engines, consisting of Mr. Wm. C. L. Eglin, chairman, and Messrs. J. E. Klumpp and I. E. Moultrop, presented a 172-page report dealing with the more important points concerning the design features and operating characteristics of modern gas engines and producer plants. Although the committee was unable to present any definite figures as to efficiencies, it stated that the efficiency of a combined gas engine and producer is higher than that of a combined plant of steam boiler and engine, and the former must command the attention of all companies using fuel for producing electrical energy. The mechanical features of gas engines have been so simplified that continuous operation can be expected with no more attention than that given to steam engines of equal rating. Gas engines are now being operated in nearly every field occupied by the steam engine. The committee stated its belief that gas engines will be used with increasing satisfaction in central station work. Gas producers have not reached the stage of development attained by the gas engine. Before the gas-engine generating station can be generally accepted and be compared with the steam-engine equipment, there must be developed a type of producer utilizing successfully the cheapest and poorest forms of commercial fuel. At the present time the cost of gas engines is much in excess of that of steam engines for the same output. However, it seems possible to build a combined producer and gas-engine equipment for costs approximately that of the combined steam-boiler and engine plant, when all auxiliary and buildings are included.

LIGHTING OF LARGE INTERIORS.

In a paper entitled "Illuminating Engineering" Mr. W. D'A. Ryan discussed the various methods of illuminating interiors that are now in use. He expressed the opinion that as time advances concealed and semi-concealed methods of lighting as applied to large interiors will become more general, and the painful exposed high-intrinsic-brilliancy sources of light, so common to-day, must necessarily vanish as the public becomes educated to higher standards of illumination. As an example of the cases where for architectural, or other, reasons it is desirable to light large spaces by totally concealed sources, mention was made of the arrangements for illuminating the waiting-room of the new Union Station at Washington, D. C., by means of inverted arc lamps. The arc between the carbon electrodes of the lamp is arranged to form above the mechanism, and in this particular case the lower electrode is positive. The reflector is adjustable so that the light can be turned to the proper place on the ceiling or side walls, and a diffusing screen covers the arcs so as to eliminate strong contrasts. Notwithstanding the large cubical contents of the waiting-room and the fact that the lamp arrangement is of the totally-concealed class, the efficiency is remarkably high and compares favorably with exposed sources, due to the fact that the excessive intrinsic brilliancy of such sources is entirely eliminated by the system and the eye is permitted to adjust itself properly for the general illumination.

In one of the Lynn factories of the General Electric Company a practical test is being conducted to determine the cost and relative merits of various lighting systems suitable for illuminating the erecting bay containing 4200 sq. ft. of floor area. The lighting units represented include series and multiple tungsten, tantalum and carbon incandescents, alternating- and direct-current enclosed arcs, ranging in current from 5 to 10 amp each, magnetite arcs, short-life yellow-flame arcs, long-life white- and yellow-flame arcs, low-periodicity lamps connected to opposite phases so as to eliminate frequency effect in light on the working level, and so forth.

The work is being extended and will eventually embrace all types of electric illuminants. Data are being compiled on the basis of operating cost per 100,000 British candle lumen hours, for 1000, 2000, 3000 and 4000 hour-years, and at various rates for energy. The figures include initial cost of installation, interest, depreciation, maintenance, and so forth. This entire demonstration is to be permanent and open at all times to engineers and others interested, and the data referred to will soon be available for general distribution.

LOW-PRESSURE STEAM TURBINES.

The combination of a high-pressure steam engine exhausting into a low-pressure turbine and the latter exhausting into a condenser was treated in a paper by Mr. J. W. Kirkland. The author claimed that this arrangement will improve the performance of many existing steam-engine stations, that have heretofore been uneconomical, to such an extent as to make them compare advantageously with many more modern and larger stations. While the best net economy of a combination of engine and turbine will be gained when the engines used are most efficient, the gain by the use of low-pressure turbines will be such as to produce very satisfactory saving in connection with engines of poor economy.

Test results were reported to show that by combining a low-pressure turbine with an existing steam engine, the combination using 50 per cent more steam than formerly, the output may be increased by 100 per cent. Low-pressure turbines are now used by the Philadelphia Rapid Transit Company, by the East St. Louis & Suburban Company, and in a street-railway generating station at Scranton, Pa.

ENERGY DISTRIBUTION IN SUBURBAN DISTRICTS.

Mr. George H. Lukes presented a paper discussing in detail the various factors affecting the distribution of electrical energy in suburban districts under the following heads: Transmission lines, details of line construction, substations, transformers, local distributing systems, secondary distribution, overhead construction, arrangement of wires on poles, voltage regulation, distribution losses, lightning protection, street lighting, underground construction, and pole-line records.

MAINTENANCE OF METERS.

A paper by Mr. H. D. King reported the results of tests tending to show that when watt-hour meters do not run at the proper speed the regulation will be incorrect, and if the speed is low, the central station will lose by reason of the energy not registered. He claimed that induction-type meters are more accurate and are more easily tested and calibrated than commutator-type meters.

MOTOR LOADS FOR SMALL STATIONS.

A paper by Messrs. Charles Robbins and J. R. Bibbins reproduced the load-curves of the Bradford (Pa.) Electric Light Company, using these as bases for discussions of the effect of motor loads in decreasing the cost of energy per kw-hour. Anaylsis seemed to show that the cost varied from 0.75 cent to 2.1 cent during the month of December, and from 1.0 cent to 2.3 cents during July. The station cost per kw-hour varies inversely with the load factor. The authors discuss the development of a motor load for improving the load factor, and outline methods for encouraging the use of motors. They state that central stations should undertake to sell the motors and install them ready for operation. They would then be able to advise with the consumer concerning the most desirable selection of units, the method of their control, and to assure for the users the many advantages resulting from their use.

TUNGSTEN LAMPS FOR STREET LIGHTING.

Mr. P. D. Wagoner presented a paper containing a large amount of data relating to various illuminants that may be used for street lighting and showing the superiority of the low-voltage tungsten lamps for this purpose. He stated that tungsten lamps have a life of 1500 hours when operated at a consumption of 1.25 watts per candle, the illumination remaining fairly constant throughout the life, while the illumination from a carbon-filament lamp decreases by from 25 to 50 per cent. The tungsten lamp can be operated satisfactorily at a frequency as low as 25 cycles, the flicker being more difficult to detect than that of the carbon-filament lamp.

For series street circuits the lamps are fed with energy from constant-current transformers at 4, 5.5, 6.6 or 7.5 amp. The lamps deliver 32, 40, or 60 cp, consuming 40, 50 or 75 watts.

N. E. L. A. BULLETIN AND HANDBOOK.

Mr. Alex. J. Campbell, editor of the *Question Box*, in a paper entitled "The Future of the Question Box" explained the part performed by the *Question Box* in the affairs of the N. E. L. A. It is a means of obtaining answers to specific questions, and also of exciting and maintaining interest in the association work among members who would otherwise take little part. Experience has indicated that better results can be obtained by introducing certain changes, and Mr. Campbell suggested that the recommendation of former-editor, Mr. Paul Lüpke, that a handbook be published be carried out, and that the *Question Box* be continued as a part of the monthly *Bulletin* now issued by the assiciation. He suggested that either a single editor or a committee be appointed to publish for next year a handbook that shall consist largely of compilations from previous issues of the *Question Box*, supplemented by such new material as can be gathered during that time. Immediately upon its publication there should be appointed a revision committee to produce a more complete handbook at the end of three years.

PROTECTION FROM LIGHTNING.

The committee on protection from lightning, of which Mr. R. S. Stewart was chairman, submitted a report dealing with lightning troubles during 1907. Data were received from 196 companies. Of these, 77 expressed themselves as satisfied with their lightning protection, and 86 as not satisfied. Those unsatisfied did not necessarily have any lack of faith in their existing types of arresters, for many of them felt that they needed more arresters or more effective ground connections. Of the 29 companies using overhead grounded wires, 24 expressed themselves as entirely satisfied with the results; the other five are dissatisfied because of breakage in the wire, and because of shocks to linemen. When heavy upper wires or galvanized-iron cables are used, the danger of breaking down is reduced to a minimum. If the overhead ground wire is insulated from the poles and if linemen use the same care in handling this wire as they use in handling the high-tension wires, there should be no danger of shocks.

The past year has been one of progress. Many of the central-station companies have studied the problem of lightning protection required by their own plants and have installed protective apparatus where needed. The engineering societies have contributed several valuable papers and discussions. The manufacturers have redesigned some of their protective apparatus so as to increase the efficacy. The shunted-gap arrester has been built with resistors of varying resisfances; those of low resistances shunting a few gaps, those of larger resistances being connected across a larger number of gaps. The object of this design is to make the arrester sensitive to oscillations of both high and low frequency.

The most important development of the past year has been that of the aluminum electrolytic arrester, which has been given long service tests in several plants and has demonstrated its lasting qualities to the satisfaction of the manufacturers. Replies from four companies who have used aluminum arresters the past year indicate that the arrester has operated satisfactorily in actual service.

GRAVITY UNDERFEED STOKER.

Mr. S. J. Lenher presented a paper outlining the advantageous features of a form of stoker combining the underfeed principle with the inclined grate. He claimed that the combination eliminates all of the undesirable features of the horizontal fuel-bed, and retains all of the desirable features of the inclined grate; it does away with all necessity for manual disturbance of the fire and automatically deposits the ash and clinker on the dumping plates at the bridge-wall, whence they are periodically dumped to the ash pit.

The stoker consists of a series of inclined air-boxes supporting stationary, horizontal, perforated cast iron tuyére plates. Between each series of tuyére plates are placed two cylindrical rams, the upper ram feeding only such coal and coke as is delivered from the upper; the two rams move in unison, the upper having a travel of 10 in., and the lower a travel varying with the nature of the fuel.

The resultant of ram action and inclined grate is the gradual downward movement of the fuel-bed; the lower ram continuously breaks up the fuel, insuring a thorough mixture and proper distribution of air and depositing the ash on the dumping plate at the bridge wall. This dumping plate is unperforated, as combustion is complete before the ash reaches it; it is hinged to the blast-box which supports the inclined air boxes, and is operated from the boiler front. The dumping of the ash is a routine matter, governed by the nature of the fuel and rate of combustion. In practice, dumps are made in from three to six hours.

No special furnace or arch construction is required, and no supervision is necessary other than to maintain the proper relation between fuel-feed and air-supply. The author stated that under test with the stoker the combined furnace and boiler efficiency at 100 per cent rating was 70.6 per cent; at 125 per cen rating, the efficiency was 79.8 per cent, and at 185 per cent rating, the efficiency was 72.7 per cent.

PHOTOMETRIC PRECISION.

A paper by Dr. A. E. Kennelly and Mr. S. E. Whiting described measurements, made by several observers, to determine the precision of four different types of photometers, designated as the "contrast," the "equality," the "concentric" and the "grease-spot," respectively. Each of these photometers was used with one homochrome pair and one heterochrome pair of luminous intensities.

In the homochrome comparisons the color of the light was that of carbon-filament lamps operating at a specific illumination of 0.24 mean spherical candle-power per watt (0.27 mean spherical hefner per watt). In the heterochrome comparisons, one color was that of a carbon-filament lamp operating at a specific illumination of 0.19 mean spherical candle-power per watt (0.21 mean spherical hefner per watt), and the other color was that of a tantalum-filament lamp operating at 0.55 mean spherical candle-power per watt (0.63 mean spherical hefner per watt).

The tests, which covered 31 sets of observations representing 850 individual balances, showed that the precision of a single balance in homochrome tests was about two and one-half times as great as that of a single balance in heterochrome tests.

In the homochrome tests the probable error in the ratio of nearly equal luminous intensities, for a single balance, was about:

0.5 per cent, in 22 seconds, for the contrast photometer.
0.75 " " " 15 " " " equality "
1.0 " " " 17 " " " concentric "
1.5 " " " 22 " " " grease-spot "

The contrast photometer was thus three times as precise as the grease-spot photometer.

In the heterochrome tests, the probable error in the ratio of nearly equal luminous intensities, for a single balance, was about 1.66 per cent, in 16 seconds, from any of the types of photometer varying from 1.4 per cent to 1.9 per cent.

In the homochrome tests, the contrast photometer was distinctly superior in precision to any of the other types. In the heterochrome tests, however, the relative superiority of the contrast photometer was greatly reduced.

The error of an observer in measuring the ratio of two luminous intensities may be analyzed into a constant error, or constant personal equation of the individual, and an accidental or variable error of observation. The constant error, or "steady set," of an observer is presumably unchanged by taking a number of successive measurements; whereas the variable error, or probable error of accidental inaccuracy, is theoretically capable of being reduced, in the aggregate, by increasing the number of successive measurements in a series. Excluding all observations made with the grease-spot photometer, it appears from comparing mean ratios of luminous intensities by different observers on the same lamp setting, that the average constant error in homochrome tests was about one-third of the probable error of a single observation; but in the heterochrome tests it was about double the probable error of a single observation.

Constant errors of different photometrists can be detected and estimated only by comparing the mean ratio of luminous intensity obtained by the photometrists in successive series with the same lamp setting; whereas the probable error, or probable accidental inaccuracy, of a balance, or of a mean ratio of luminous intensity, can be determined for a single photometrist by permitting him to take a sufficiently long series of observations (say, 25) with the same lamp setting.

TAPE.

A paper by Mr. Paul Lüpke dealt with the "tape" used in the management of companies. He stated that in laying down the laws for a company the intimate interdependence of the departments must have most careful consideration, else there can be no successful parallel operation. The necessity for specialization under modern conditions often places at the head of a department a man whose knowledge of the operation of other departments is confined to what might be termed a course in the intra-company correspondence school, and in that case the value of an efficient clearing house cannot be overestimated. Without it rules will clash, the same information will be asked for in half a dozen different ways, multiplying uselessly the labor necessary to get it together, the general good will be sacrificed to the whim of the individual, meritorious effort will be strangled and ambition embalmed.

The company man needed and wanted is he who can stoutly and with ability defend his own opinion while a matter is under discussion and open to argument, and who, if overruled, is broad enough to bring his best efforts, with true loyalty, to bear upon making an unqualified success of the opinion that prevailed; in short, a company man must be able to abide by the decision of the court and go to work. Concerted action of men who have minds of their own must always be based on a compromise. There is need for honest, loyal, collective individualism.

JOINT POLE-LINE CONSTRUCTION.

A paper by Mr. Paul Spencer presented a detailed specification for the joint use of poles, which was recently prepared for the Public Service Corporation of New Jersey and for the New York & New Jersey Telephone Company by a joint committee representing the two companies. This committee consisted of Mr. John A. Barrett, electrical engineer of the American Telegraph & Telephone Company; Mr. Bancroft Gherardi, then chief engineer of the New York & New Jersey Telephone Company, as representing the telephone company, and Mr. Dudley Farrand and the author, as representing the electric-light company.

GROUNDING OF SECONDARIES.

The committee on the grounding of secondaries, of which Mr. W. H. Blood, Jr., was chairman, submitted a report discussing a rule which had been presented to the Underwriters for their consideration. According to this rule, transformer secondaries of distributing systems *must* be permanently grounded when the difference of potential between the ground and any part of the circuit would be less than 150 volts, but *must not* be grounded when the difference of potential between the ground and any part of the circuit would exceed 150 volts. The committee asked for the unanimous indorsement of a resolution showing desirability of having a rule of this nature inserted in the "National Electrical Code."

ECONOMICAL OPERATION OF THE SMALL CENTRAL STATION.

The subject of the design and operation of the small central station in a district having a population not exceeding 20,000 was discussed in a paper by Messrs. J. T. Whittlesey and Paul Spencer. The authors claimed that no piece of apparatus or any appliance should be installed that can not justify itself, not only on the basis of the economy promised by the manufacturer of the appliance, but also on the most conservative basis; full consideration being given to its first cost, its depreciation, the additional labor that its use may entail, and the question of extensive repairs, which can be made in a small plant only with difficulty. They give estimates tending to show that in a poperly-designed station having a load of 600 kw and an annual output of 1,320,000 kw-hours, the total operating cost should not exceed 1.4 cents per kw-hour with coal at $3 per ton. When the station equipment is increased to provide for twice the output, the operating cost should not exceed 1.17 cents per kw-hour.

HIGH-TENSION SUBSTATIONS.

Mr. S. G. Hayes outlined the general features and necessary equipment of stations receiving electrical energy over high-tension transmission lines, citing as examples the stations of the Niagara, Lockport & Ontario Power Company, the Chicago, Lake Shore & South Bend Railway Company and the Provincial Light, Heat & Power Company, of Montreal.

COMMERCIAL POSSIBILITIES OF TUNGSTEN LAMPS.

Mr. W. W. Freeman presented a paper containing a compendium of incandescent-lamp practice and opinions of member companies as to the value of high-efficiency lamps, including the graphitized-filament lamp with a consumption of 2.5 watts per candle, the 2-watt tantalum lamp and the 1.25-watt tungsten lamp. He outlined the policy of the Edison Electric Illuminating Company, of Brooklyn, with reference to supplying tungsten lamps, as noted on page 962 of our issue for May 9, and stated that every improvement should be encouraged and offered to the public upon reasonable terms at the earliest moment practicable. The tungsten lamp can compete successfully, with the incandescent gas lamp on even terms as to cost, and with all of the superiority of electric service as a premium. The most inviting field for the immediate exploitation of the large tungsten units is in competition with the so-called "gas-arcs" now in use, which type of lamp can be rendered practically obsolete.

Underground Conduit System at Davenport, Iowa.

By A. J. Quigley.

About two years ago the electric light, railway and gas properties of the three cities, Davenport, Ia., Rock Island and Moline, Ill., were brought together under one management, and J. G. White & Company, of New York, took charge of the construction and reconstruction which this consolidation necessitated. These three cities, which practically form one community, show a combined population of about 100,000, half of which is in Davenport. Davenport City Councils in years past seem to have persistently advocated the principle of competition in public utility service. The result was that Davenport had two electric light, two electric railway, and two telephone companies. The wires were so numerous as to be unsightly, and in some cases dangerous. As one of the first steps in bettering this condition, the City Council required the new company to construct in the down-town district of Davenport an underground conduit system to take the principal wires. The writer having been on the tri-city contract in the capacity of assistant superintendent from the beginning of the work, and actively engaged in the engineering supervision and construction of the conduit system, will attempt in this article to bring out the principal engineering features of the work which may aid others confronting similar problems. While some of the details brought out necessarily have to do with local conditions only, the general plan is applicable to conduit systems in general.

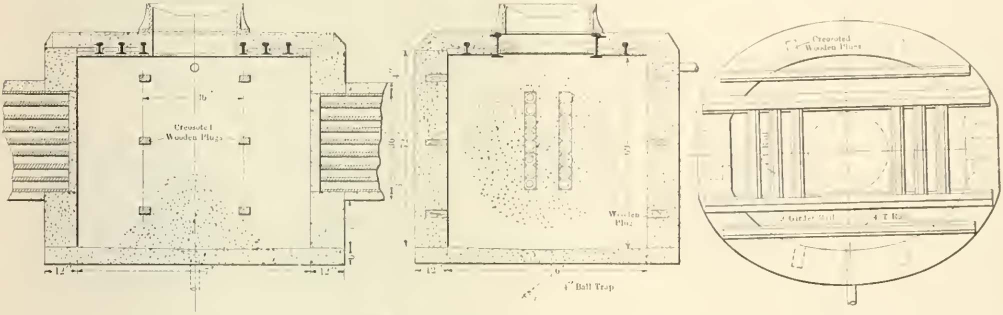


FIG. 1.—CROSS-SECTIONAL AND PLAN VIEWS OF STANDARD MANHOLE.

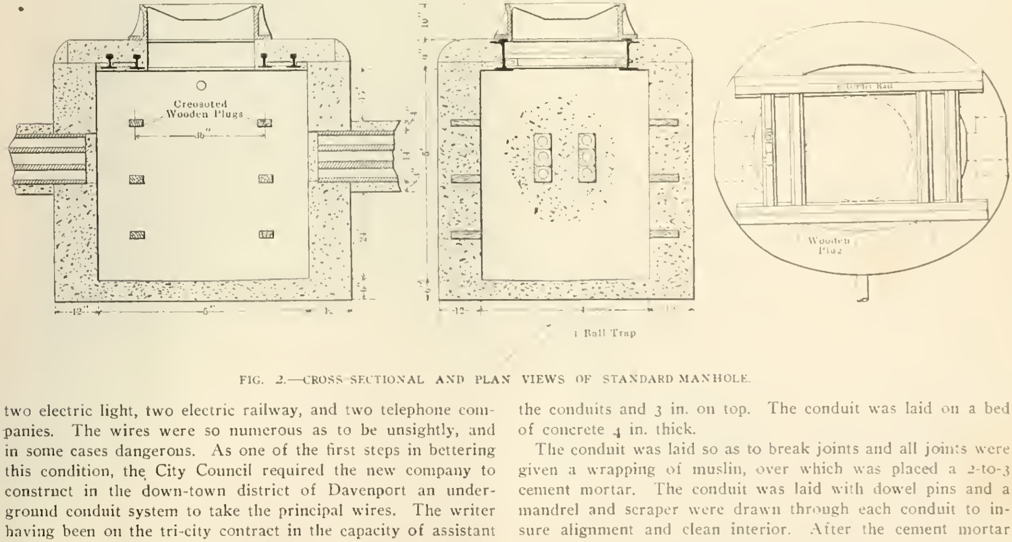


FIG. 2.—CROSS SECTIONAL AND PLAN VIEWS OF STANDARD MANHOLE.

The underground conduit was installed in a section fronting on the Mississippi River for a distance of 11 blocks and extending back from the river a distance of five blocks. In order to provide for present needs and for growth in the immediate future, the system was made up principally of nine and of 16-way duct from which four-way laterals branch out as required. It was estimated that approximately 250,000 duct-feet of conduit would be required, together with 50 large manholes and 200 handholes. On this basis local contractors bid on the work.

The electric light company furnished the duct, manhole castings, handhole castings, steel reinforcement for manholes, and iron pipe for laterals; the contractor furnishing all other necessary materials, such as cement, sand, lime, tools, mandrels, muslin for joints, etc. Figs. 1 and 2 herewith show the standard manhole construction, and Fig. 3 shows standard types for various multiple ducts. The trenches were excavated so as to allow a fill of 20 in. over the completed conduit, and were given such a width as to allow for 3 in. of concrete on each side of the conduits and 3 in. on top. The conduit was laid on a bed of concrete 4 in. thick.

The conduit was laid so as to break joints and all joints were given a wrapping of muslin, over which was placed a 2-to-3 cement mortar. The conduit was laid with dowel pins and a mandrel and scraper were drawn through each conduit to insure alignment and clean interior. After the cement mortar at the joints had set, the tops and sides of the conduit were covered with 3 in. of concrete. The grade is such that the ducts drain toward the manholes. Lines having more than 20 ducts are divided into two sections by a vertical fill of 3 in. of concrete. The composition of the concrete is one part Portland cement, three parts of sand, and six parts of broken stone. After completion each duct was cleaned and tested by drawing through it a brush and scrapers, and a test block of wood 20 in. long and 3 in. in diameter. On the end of the block was fastened an iron washer 3⅜ in. in diameter. In each duct was also left a No. 12 galvanized-iron wire running between manholes for the purpose of drawing in the cable.

The manholes have inside dimensions of 6 ft. x 7 ft., and a depth in the clear of approximately 6 ft. The floors and walls are of concrete 8 in. thick, and a sewer-tile drain is inserted in the floor of each manhole and connections made to the sewer. The roof of the manhole is of reinforced concrete construction, old rails being used as reinforcement. Wood strips are inserted in the walls as indicated to furnish means for supporting the cables.

The handholes are spaced three to the block. The standard handholes are 30 in. x 36 in. x 24 in. deep, and handholes 24 in. x 24 in. are also used at the end of laterals. The walls of the handholes are 6 in. thick and are laid on a 4-in. floor of concrete. The standard depth for handholes is 2 ft. below street level. Suitable openings were left in the handholes for iron-pipe laterals to desired distributing points.

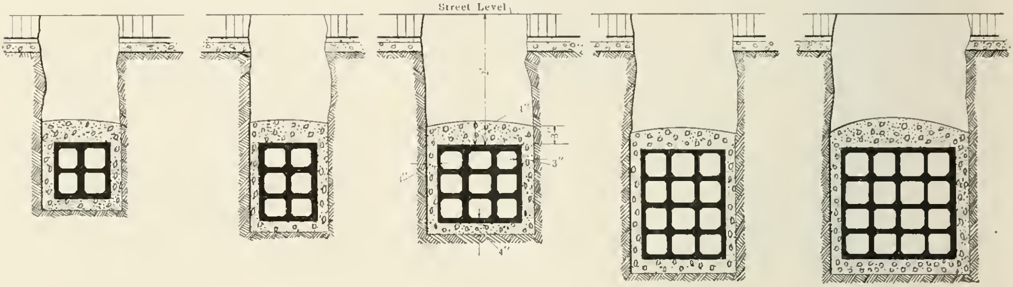


FIG. 3.—STANDARD TYPES OF VARIOUS MULTIPLE DUCTS.

The contract was let at practically a lump figure under the above specifications, and work has been carried on in a satisfactory manner during this season. No trouble of any consequence was encountered with the exception of threading in the pull-in wires and trouble developed here largely because the extremely heavy rains of the early season had caused the ducts to be choked up with dirt. Even with this handicap, however, it was necessary to dig up only two places in the whole system. The mandreling was done by means of ½-in. iron pipe cut into sections about 5 ft. long, and one after another of these was screwed on and shoved through the ducts until in some cases a total length of over 400 ft. was being pushed into section. When connection between manholes had thus been established, a No. 12 galvanized-iron wire was drawn back, and the mandrel disjointed section by section.

Without giving exact costs on this system, it may be stated that duct should be purchased for slightly under 5 cents per duct foot, and the cost for the work of laying same complete should range from 13 cents to 6 cents per duct foot according to the number of ducts placed in one trench. In the Davenport installation, the number of ducts ranged from four to 21 per trench. The approximate total cost would show as follows, figures given to include all materials as well as labor:

250,000 duct feet of conduit laid, complete. Average for all styles, 12¼c	$30,625.00
48 manholes, complete, including sewer connections, at $125	6,000.00
150 large handholes, at $58	8,700.00
50 small handholes, at $22	1,100.00
	$46,425.00
Add 7½ per cent for engineering, supervision and contingencies	3,482.00
Total	$49,907.00

The original estimate showed that $50,000 would be the cost of this system complete ready for the installation of the lead-covered cables, and judging by the results obtained here (assuming equivalent labor and material conditions) the writer believes a system of this size and style should be built in other like localities for approximately that amount of money.

The additional cost of lead-covered cables, subway transformers, etc., must largely depend upon the character of service being rendered and the amount of connected business. At the best, however, the cost for cables will be very heavy, easily running to five or six times the cost of the conduit system proper. Thus, in Davenport it is estimated that the lead-covered cables for the system will, when installed complete, cost the higher limit, so the cost will be:

Conduit system	$50,000.00
Cables for same	300,000.00
Total	$350,000.00

It will be seen, therefore, that the installation of an underground system for electric light and power work is a serious financial problem, the more so since no direct cash returns can be expected to accrue because of having made such an investment. Such expenditures must rather find explanation in the desire of the progressive management to satisfy, on the one hand, the demands of the public for civic improvements, and, on the other, the call from its own operating forces for improvements which tend to minimize possibilities of breakdowns.

New Telephone Patents.

DESK STANDS.

Now that telephone desk-stand sets, or portable sets, are so commonly used, the development of a set of this type cheap to manufacture and free from trouble has become very important. In response to the demand there are to-day a large number of very effective and well designed sets.

One feature to be considered with the desk-stand set is the weight of the base. Of course, the lighter the base the more easily the set is knocked over, while, on the other hand, a heavy base becomes of inconvenience to the subscriber because of the common practice of holding the set in the hand. Some designers favor the heavy base and some the light base. Among the latter is Mr. A. M. Knudsen, of Chicago, who recently patented a desk stand with a pressed thin sheet-metal base, the use of sheet metal being primarily to lighten the weight of the base. The sheet-metal base piece is strengthened within by an apparatus plate which supports the moving parts and which is secured to the end of the vertical stem tube. Mr. Knudsen has also included in his design certain improvements in the switch-hook with a view to simplifying it. He has assigned his patent to the Kellogg Switchboard & Supply Company.

COMBINED TELEPHONE AND FIRE ALARM SYSTEM.

W. S. McLewee, of Yardley, Pa., has been granted a patent for a combined telephone and fire-alarm system. With this system a signal box is associated with the subscriber's set, which box will cause the subscriber's line lamp at the telephone exchange to glow, at the same time a distinctive signal is given upon it, so that the operator may recognize at once that the incoming call is a fire alarm. The operator is charged with the responsibility of observing the number of the called line and repeating this to the fire department, in order that it may know the location of the fire. The present patent relates chiefly to the details of construction and the connection of the apparatus.

TELEPHONE INSTRUMENTS.

A. E. Beecham, of Polkton, N. C., is the inventor of a new transmitter for loud-speaking purposes. The microphone button consists of a small glass tube, sealed at both ends, carrying two electrodes extending at an angle to each other throughout the length of the tube, each occupying about 30 deg. of the circumference, the nearer edges of the electrodes coming almost in contact. A mass of granular carbon lies upon the electrodes. The tube is exhausted so that the parts work within a vacuum. One end of the tube is secured to the center of the diaphragm and one loosely hung at the edge of the diaphragm. The diaphragm is used in a horizontal position. It is claimed that this transmitter will operate with very heavy currents without deterioration.

A novel type of receiver has been brought out by W. T. Boyd, of Ellenton, Fla. Mr. Boyd abandons the usual ear cap and substitutes therefor adjustable ear tubes, one of which is to be used with each ear. These ear tubes are designed to press lightly in the orifice of the ear, but to cling with sufficient power to support the receiver and leave both hands of the user free.

SERVICE METER SYSTEM.

From time to time there has been a demand for a call registering device to be located at the subscriber's premises and to be operated under control of the exchange whenever a call is successfully completed. I. Kitsee, of Philadelphia, Pa., has obtained a patent for such a system of registering calls. He provides at the exchange a switch, which, upon being depressed, throws upon the subscriber's line a battery of opposite sign to that used during normal signaling and conversation. The registering device is polarized and does not respond to the normal exchange current, but responds with one count to each application of the reversed current. As soon as a call is successfully completed the operator, by depression of this reversed battery key, sends out the recording potential upon the subscriber's line and registers the call at his station in his presence.

LETTERS TO THE EDITORS.

Telephotography.

To the Editors of Electrical World:

SIRS:—I was much interested to read your editorial in the issue of May 9, 1908, describing the Belin system of telephotography because of the fact that this "new" system is said to be the invention of a Frenchman, Edouard Belin, of Nancy. Your statement, "so far as we are aware, however, the up-and-down motion of a stylus upon photographically indented paper has not been brought out before" is in error, and the assertion that a swelled gelatine relief is used is also erroneous, because swelled gelatine reliefs are *soft* and have to have plaster casts made of them before they can be used otherwise. What is used is a wash-out gelatine after the same is developed in hot water and dried. This process was described in the ELECTRICAL WORLD of Feb. 17, 1900, on page 247, in an article contributed by myself. It—the Amstutz process—was also described in detail in the *Scientific American* of April 6, 1895; mentioned before the Royal Photographic Society of London in 1899, and redescribed in the *Inland Printer* of February, 1908. It was also mentioned by William Gamble in the *British Journal of Photography* of 1898, on page 70, and described at length in the book entitled "Beiträge zum Problem des Elektr. Fernsehens," by R. Ed. Liesegang, published in 1899 at Düsseldorf, Germany. Mr. A. Michaut, writing in the *Revue Universelle*, Paris, of May 9, 1895, after illustrating the machine, said, "In conclusion let us congratulate Mr. Amstutz on this new discovery with which he has enriched our civilization, and let us engrave his name on the most luminous pages of the Golden Book of Inventors of our country." *Le Genie Civil*, of Paris, May 18, 1895, also illustrated and described the process.

By way of corroboration, Mr. T. Thorne Baker, F.C.S., F.R.P.S., technical director of the Korn systems of photo-telegraphy, in London, on March 10, 1908, read a paper before the Royal Photographic Society on "Photo-Telegraphy" in which he said: "Mr. Amstutz, of Cleveland, worked out a method of transmitting pictures, which is of great interest, as M. Belin's recent invention for photo-telegraphy is practically identical with it. A photographic gelatine relief picture was fixed by Amstutz to a revolving cylinder, and a stylus traced a spiral path over the surface, rising and falling as the relief occurred and thereby varying the resistance in an electrical circuit. * * * Except that M. Belin uses the current variations to actuate a galvanometer and obtains a photographic impression by light instead of a mechanical power, the systems are practically identical. * * * Belin's method of transmitting pictures is an old one revived."

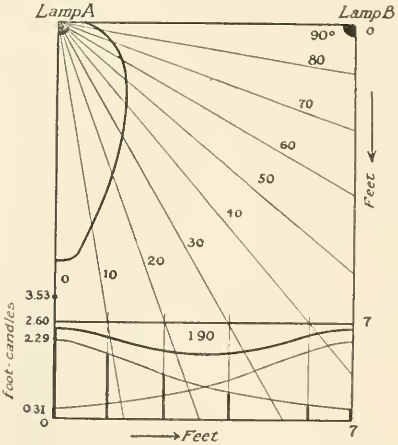
It is of interest to call attention to a United States patent application of mine, dated Jan. 19, 1891, in which the receiving was taken care of by means of a graded tint slide controlled in front of a lens system and a pinhole by the variable line current whose variations were modified by a selenium transmitter at the sending end. All of this early work was ahead of the psychological moment when the public demanded the introduction of such a system. Nevertheless, the merit of a claim of priority is independent of any psychological phases of the question.

CHICAGO, ILL. N. S. AMSTUTZ.

Uniform Illumination of Horizontal Planes.

To the Editors of Electrical World:

SIRS:—In your issues of Dec. 21, 1907, and March 21, 1908, articles by Mr. Alfred A. Wohlauer deal in an interesting manner with the uniform illumination of horizontal planes. These articles would be of much greater value if the author had not based his demonstrations on assumptions which are not realized in practice. Mr. Wohlauer has made use of a polar candle-power curve, the intensity of which decreases towards zero at 45 deg. from the vertical, and disappears beyond that angle. However, it is not possible to obtain a candle-power curve of the shape assumed by Mr. Wohlauer, even when reflectors are used, because they cannot reduce existing intensities; moreover, combinations of prisms and prismatic globes are quite unsatisfactory for this purpose.



POLAR CANDLE-POWER CURVE

If, as in all practical cases, the illuminant radiates light beyond 45 deg. from the vertical and in a horizontal direction, it is necessary to consider the light from all of the lamps suspended above a certain surface to be illuminated. Referring to the accompanying polar candle-power curve, if the light from only one lamp is considered an illumination of 2.6 ft.-candles is obtained just below the lamp. If, however, the light from four symmetrically arranged lamps is considered, the illumination below one lamp will be 3.53 foot-candles, which value will be further increased when more lamps are used. Thus, the actual results are quite different from the conclusions reached by Mr. Wohlauer.

Berlin, Germany. Ernst W. Weinbeer.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Heating of Motors.—W. Hartnell.—A paper read before the Leeds section of the (Brit.) Inst. Elec. Eng. In modern machines the heat produced by losses in the teeth and armature disks is serious, with dense magnetic flux in the air-gap, and can be kept within reasonable bounds only when a moderate surface speed of armature is used, while the heat due to the carbon brushes is considerable with low voltages. With a surface speed of 1500 ft. per minute the loss due to friction and to the drop in volts between the carbon and copper may easily be equal to from 1.50 to 1.75 watts per ampere per brush. The heat thus produced can be dissipated only by heating the motor itself, by radiation, or by conduction to a flow of cool air; that is, by ventilation. The relative change in the value of these effects, for a series of motors of an assumed average weight, cooling surface and loss of watts, as the size of the motor increases, may be seen from Fig. 1. In this diagram the vertical scale should be multiplied by one to get the cooling surface; by 10 to get horse-power; by 10 for loss in per cent; by 100 for weight in pounds; by 1000 for surface area in square inches, and by 1000 for loss in watts. The author also gives an account of several experiments which he has made. The heating and cooling of a magnet coil are shown in Fig. 2. The convex curve shows the gradual rise to a maximum temperature of an overloaded field coil of a dynamo (without an armature) and the concave curve the shorter interval of time to reduce the higher temperature after the current is cut off. Thus, in this curve, if any line *A B C D* be drawn, *A B* represents the time required for the temperature to rise by a particular value *B E* (measured outside the coil) and *C D* the time to cool. For the higher temperature which illustrates practical work *C D* is small compared with *A B*. The dotted line shows the average internal temperature calculated from the reduced current as the temperature rises. The coil was fully exposed to the air, and it was noticed that the temperature between the coil and the magnet ring was the same as outside the magnet ring near the pole. In enclosed motors the outside of the case may at times be 20 deg. Fahr. cooler than the magnet coils inside. The advantageous cooling with intermittent loads can be obtained only when there is a considerable difference of temperature between that of the air and the highest permissible temperature of the motor. If the air be very warm, so that this difference is comparatively small, the motor gets hot in less time than it cools. It will be seen in Fig. 2 that *G H* is less than *K L*. The final conclusion of the author is that totally-enclosed motors are under great disadvantages and that in general their use can be avoided.—Lond. *Elec. Eng'ing*, April 16.

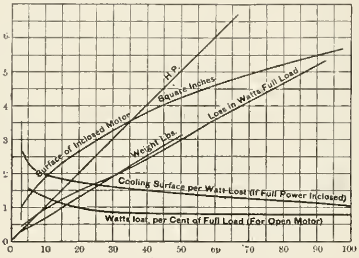


FIG. 1.—HEATING OF MOTORS.

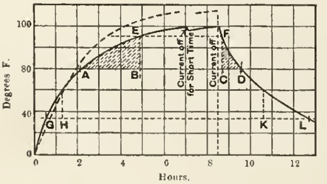


FIG. 2.—HEATING OF MOTORS.

Single-Phase Motor.—J. Mueller.—An illustrated article on the single-phase series motor of the Oerlikon Company. The motor is simply a series machine (with compensated armature reaction) provided with auxiliary windings which are so excited as to produce perfect commutation. One of its advantages is that it can be operated at will by alternating current or by direct current. However, the formulas of the author show that if the motor is to run at the same speed, the direct voltage alternating voltage should not be equal. For instance, if the alternating e.m.f. is not above 250 volts at the terminals of each motor the direct voltage for the same speed should not be above 225 volts. For use on ordinary traction systems it is therefore necessary to connect two motors in series.—*La Lumière Electrique*, April 11.

Train-Lighting Dynamo.—S. Iglesis.—Continuation and conclusion of his illustrated article on the Iglesis-Regner dynamo giving constant current at variable speed, and its application for train lighting. The principle of this machine has already been noticed in the Digest.—*La Lumière Elec.*, April 4 and 11.

Voltage Curves.—E. Siedek.—An article on the distortion of voltage curves in loaded single-phase and polyphase generators. The subject was studied by means of the oscillograph. The experimental results agree very well with the theoretical considerations.—*Elek. und Masch.*, April 5.

Lamps and Lighting.

Units of Illumination.—B. Monasch.—An article on the inconsistencies in the present international terminology relating to illumination. The author thinks that the unit lux should come into universal use. He refers to the great variety of units employed in several countries for candle-power, etc. The following conversion factors are given for units of illumination:

	Factor for conversion into desired unit.					
Results expressed in	1. Lux	2. Hefner-foot.	3. Candle-foot.	4. Candle-meter.	5. Carcel-meter.	6. Bougie-meter.
1. Lux (Hefner meter)	1	0.0929	0.0848	0.9132	0.093	0.8849
2. Hefner-foot	10.76	1	0.9132	9.84	1.001	9.52
3. Candle-foot	11.78	1.095	1.	10.76	1.097	10.43
4. Candle-meter	1.095	0.1016	0.0929	1	0.1018	0.969
5. Carcel-meter	10.75	0.9986	0.9115	9.817	1	9.513
6. Bougie-meter	1.13	0.105	0.0958	1.031	0.1050	1

—Lond. *Electrician*, April 17.

Arc-Lamp Coupling.—An illustrated article on a new arc lamp coupling, with a description of the mechanical details.—Lond. *Elec. Eng'ing*, April 16.

Sockets.—L. Neumann.—Some recommendations on details of construction of incandescent lamp-sockets and fittings.—*Elek. und Masch.*, March 29.

Power.

British Power Company.—An abstract of last year's report of the North Metropolitan Elec. Power Supply Company, which is now one of the most advanced companies selling energy in England. The number of kw-hours sold was 11,000,000, which is an increase of about 40 per cent over the value for the year before. The total cost per kw-hour sold, not including capital charges, was 1.73 cents.—Lond. *Elec. Eng'ing*, April 16.

Traction.

Surface-Contact System.—An illustrated description of the mechanical details of the Robrow surface-contact system which is being installed on a British tramway line.—Lond. *Elec.*, April 17.

Steam-Railroad Electrification.—L. H. Parker.—An article reviewing the reason for the new tendency, its growth, application of alternating current and advantages of electrification, and giving some concrete examples and types of equipment.—*Stone & Webster Pub. Serv. Jour.*, May.

Installations, Systems and Appliances.

High-Tension Direct-Current System.—In high-tension direct-current systems it has been the usual practice to use a number of direct-current generators (each coupled to its prime mover) in series. It is necessary to insulate each generator from earth, and consequently the generators have been supported on insulating bases, and coupled by means of insulating couplings to their respective prime movers. A recent English patent of A. S. Highfield shows a method for avoiding the use of these insulating couplings. The prime mover, which, according to this invention, may be a large unit, is coupled to an alternator. The alternator supplies energy to a constant-current transformer, the secondary winding of which is divided up into a number of equal sections. Each of these sections supplies energy to a rotary converter, the direct-current sides of the rotary converters being connected in series. Only the rotary converters need be insulated from earth, and no insulating couplings are required. When the demand on the station is small, one or more of the converters can be short-circuited and this will not affect the current, as the transformer is designed for constant current. Instead of a single transformer, several in parallel can be used.—Lond. *Elec. Eng'ing*, April 16.

Wires, Wiring and Conduits.

High-Tension Cables.—C. Feldmann and A. Herzog.—An illustrated translation in abstract of their recent German paper on the manufacture and testing of high-tension cables.—Lond. *Elec. Rev.*, April 17.

Calculation of Alternating-Current Lines.—A. Blondel.—A paper giving a résumé of the fundamental principles and formulas for calculating alternating-current transmission lines, taking into account inductance and capacity. The author takes up in succession the following problems: The determination of the constants characteristic of the line per unit of length; calculation of current and voltage at the end of the line as functions of the values at the transmitting end; the numerical determination of the different quantities either by a graphical method or by a trigonometric calculation. Numerical examples are given.—*La Lumière Elec.*, March 28.

Rise of Temperature of Conductors.—M. Gacogne.—Usual formulas for calculating the rise of temperature of electric conductors assume its proportionality with the watts without taking account of the increase of resistance. The author considers separately operation at constant current and at constant voltage and calculates the rise of temperature, taking into account the change of resistance. The cooling effect is assumed to be proportional to the external surface and temperature elevation (Newton's law).—*La Lumière Elec.*, March 21.

Electrophysics and Magnetism.

Electric Discharges Through Gases.—J. J. Thomson.—His concluding lecture before the Royal Institution on the general subject of electric discharges through gases. He gives the following illustration of the appearance of a vacuum discharge-tube: The cathode is like the power station where the conductivity of the gas is manufactured. The positive particles are drawn into the intense field of the cathode, and their bombardment causes the cathode to emit negative particles, which, repelled at great velocity, produce more negative (and simultaneously also positive) particles by their collision with the gas molecules. In the tube the current must be the same for every cross-section, and the current intensity can be maintained both by a large number of particles at low velocity and by a small number of particles at high velocity. In the cathode glow there are many particles and only a small velocity is needed. But further away from the cathode, particles are diffused and sent to the walls of the vessel, and if the current is to be maintained, the electric force must rise again. At such spots the particles will again attain a sufficiently high velocity to render the gas luminous; the increased number of collisions will then once more give more particles, the electric force will diminish, and in this way the bright and dark patches of the striations are obtained. Anything that will tend to increase the rate of loss of negative particles will bring the luminous patches nearer up to the cathode. It is the stream of negative particles from the cathode which carries the current. However, there is also a stream of positive particles from the anode, produced by the anode fall of potential, which, though to a certain degree dependent upon the gas pressure and the nature of the anode, is practically about 20 volts. While in gas discharge-tubes we have to deal with currents of milliamperes at very high potentials, arc discharges involved currents at several amperes at comparatively low potentials. In the gas discharge-tube the chief fall of potential is at the cathode, in the arc discharge at the anode. In the arc the gas plays only a secondary part and the phenomenon is practically a discharge of electricity from incandescent solids. The brush and point discharges also depend on the motion of electrified particles, which when traveling at velocities above a certain limit produce a fresh supply of negative particles by their collision with molecules. The same issue contains a paper by J. J. Thomson on the carriers of positive electricity.—Lond. *Electrician*, April 17.

Electrochemistry and Batteries.

Primary Cell.—A note on the Wedekind primary cell, which is a copper-zinc caustic potash cell. The positive element consists of a cast-iron case which also forms the outer containing vessel. The inner faces of this case are copper plated, and are provided with slots and pegs to hold the oxide of copper active material. The whole forms a solid black mass. During discharge this mass becomes red through conversion to copper. Recharging is accomplished by baking the case for three or four hours in an oven.—Lond. *Elec. Engineer*, April 10.

Electrolytic Art.—An illustrated article on a process used in England for producing bas-reliefs or art metal work by electrolysis. The process is specially used for the manufacture of flush switch plates, ornamental domes for surface switches, door plates, bell-push covers, etc. No details of the process are given.—Lond. *Elec.*, April 10.

Units, Measurements and Instruments.

Reichsanstalt.—An official report of the work of the (German) Reichsanstalt in 1906. The platinum-platinum-rhodium thermo-element was compared with the nitrogen gas thermometer for temperatures up to 1600 deg. C. The following formula gives the thermo e.m.f., *E*, of the standard element in microvolts for temperature t between 600 and 1600 deg. C.

$$E = 3{,}600 \log_{10}\left[1.3 + \left(\frac{t}{1000}\right)^2\right] - 1590.$$

The melting point of palladium was found to be 1575 deg. C. ± 10, that of platinum 1789 deg. The manganin standard resistors have well maintained their resistances. For electrolytic rectifiers with aluminum electrodes, neutral aluminum borate is very suitable as the electrolyte. An alcoholic solution of boric acid seems to allow the use of even higher voltages. A considerable amount of work was done on hysteresis. Special alloy steel for electrical purposes (containing silicon) has, in addition to other valuable properties, an unusual high initial permeability. Of incandescent lamp investigations, tests of 10 16-cp, 220-volt carbon-filament lamps are noted; the average useful life was 640 hours at the end of which the candle-power had dropped to 80 per cent of the initial value; the specific consumption having simultaneously increased from 3.5 to 4.5 watts per horizontal hefner candle. A great many metallic-filament lamps were tested, also quartz-globe mercury-vapor lamps.—*Elek. Zeit.*, April 23.

Permeameter.—C. V. Drysdale.—A note on a (Brit.) Phys. Soc'y paper describing a plug permeameter which is an instrument in which a drill is employed to cut a conical hole in a casting or forging, at the same time leaving a pin 1/10 in. diameter standing in the middle. A wrought-iron plug carrying a bobbin with magnetizing and search coils completes the magnetic circuit, forming a miniature permeameter. The readings are taken by means of an ammeter and ballistic galvanometer in the ordinary way, or by the aid of a portable direct-reading test set. When this instrument was first used, it was found, as would be expected, that the values of the induction given by it were too low, and it had been supposed by some that this was due to imperfection in the magnetic joint. The author, on the other hand, had attributed it to end effects and to the shortness of the specimen. Investigations which have been made confirmed this view, showing that the amount of the end effect can be fairly closely compensated by correcting the value of *H* in the same ratio for all specimens. The instrument is accurate within 2 or 3 per cent, which is as satisfactory as most other permeameters.—Lond. *Electrician*, April 17.

Electric Measurement of Small Lengths.—M. A. Guillet.—A French Academy paper describing an electric method for measuring short lengths or displacements. The method is based on the variation of the mutual inductance produced by a very small displacement or by a deformation of one of the coils used. The method is extremely sensitive.—*La Lumière Elec.*, March 28.

Testing Insulators.—W. Weicker.—A fully illustrated description of the testing laboratory of the Hermsdorf porcelain works, which manufacture high-tension insulators.—Lond. *Elec.*, April 24.

Telegraphy, Telephony and Signals.

Induction Effects of High-Tension Transmission Lines on Telephone Wires.—O. Brauns.—A paper communicated from the German Imperial Telegraph Experiment Station and read before the Berlin Electrical Society. On some parts of the 34,000-volt, three-phase transmission system in the Urft Valley district, telephone lines are run within the neighborhood of the transmission lines and serious disturbances, due to induction of electrostatic charges, have been experienced. On one telephone line which had formerly an earth return, the disturbances disappeared after the line had been equipped with a full metallic circuit. But on branch connections of this line, which are equipped with single metallic conductor, the disturbances remain; they were due to electrostatic charges induced from the two-conductor main telephone line. By providing a proper earth connection for the latter, the troubles in the branch connections were removed. In this connection extended experiments were made by the Telephone Department. It was found that while electromagnetic induction from the transmission line appeared to have comparatively little effect on the telephone line, measurable electrostatic charges were induced from the former on the latter, even if the distance between the two was as much as 800 yards. On the basis of the experimental research, formulas have been worked out which enable one to predetermine the electrostatic effect with an accuracy sufficient for practice. If the currents produced by this effect in the telephone line are of the order of magnitude of 10^{-5} ampere, the telephone line must be equipped with a full metallic circuit. This construction removes the difficulties in sound transmission in this line itself, but the electrostatic charges are thereby not removed. Hence if this line has single conductor branch connections, troubles will be experienced in the latter. They are to be expected, if the induced e.m.f. in the main telephone line is above 5 volts. In such cases it is necessary to provide the main telephone line with suitable earth connections. Besides the troubles in transmission of speech, there may also be danger to persons touching the telephone wire. Under normal conditions there is no danger, but in the case of an accidental earth on the high-tension transmission circuit, the voltage induced in the telephone line may be increased 13 fold. The author sets up the requirement that under normal conditions a person touching the telephone line should not be subjected to an e.m.f. of more than 10 volts. It is shown that if a two-conductor telephone line runs for a length of 30 km (19 miles) at the side of a 40,000-volt transmission line a distance of 15 m (about 50 ft.), a person with an internal resistance of 2000 ohms will be subjected to an e.m.f. of 12.2 volts, when touching the telephone wire under normal conditions; this will be increased to about 160 volts in case of an accidental earth on the power transmission line. To prevent such accidents, proper earthing of the telephone line is necessary. The same issue contains an account of the discussion which followed the reading of the paper.—*Elek. Zeit.*, April 9.

Telephone Experiments.—Heilbrun.—An illustrated description of a lecture room apparatus for demonstrating the physical laws of telephony. The horn of a phonograph of simplest construction is removed and replaced by an elastic band while the pin which slides along the revolving record is fixed to the diaphragm of a microphone. The microphone, the source of current, the lecture-room galvanometer and a loud-speaking telephone are connected in series. If now the phonograph is started it does not send sound waves into the lecture room directly, but through the intermediary of the telephone. The sounds produced are said to be much superior to that of ordinary talking machines. With this arrangement it is possible to demonstrate quite a number of telephone laws; for instance, the influence of different frequencies, the relative advantages of different systems of connections, etc. The galvanometer needle is seen to make regular oscillations. Of course it does not reproduce the minute current oscillations of the microphone. The oscillations of the galvanometer needle are due to the fact that the mean value of the microphone resistance is considerably greater during the speaking period than when the microphone is at rest. This is most remarkable during whistling. It is, therefore, incorrect to state as is usually done that the resistance of the microphone during speaking oscillates around the value at rest. It really oscillates around another average value.—*Elec. Zeit.*, March 26.

Leakage and Insulation Resistance of Telephone Lines.—B. S. Cohen, B. Gati and C. V. Drysdale.—An article by Cohen referring to the statement sometimes made that an increase in leakage would considerably improve the transmission qualities of a telephone line. If, however, the practical application of leakage is considered, with the dimensions of the factors for the general run of commercial telephone lines, any increase in leakage sufficient to give the distortionless condition is accompanied by such an increase in attenuation as to render the line unworkable in a great majority of cases. The author takes exception to two statements in the recent paper of Drysdale. He emphasizes that quite a considerable deviation from Heaviside's theoretical distortionless condition is not only permissible but desirable. In conclusion he says that telephone engineers should not imagine that low insulation on telephone lines may, so far from being a disadvantage, even prove beneficial from a transmission point of view. So far from this being the case, it is essential that all lines, whether cable or open wire, loaded or unloaded, should be kept at the highest practical insulation point consistent with due economy.—Lond. *Elec.*, April 10.—B. Gati expresses in a letter the opinion that the Boer War cost Europe the belief of telephone engineers in high insulation. All telephone cables are badly constructed because cable manufacturers thought that the insulation resistance for direct current and the dielectric resistance for telephone frequencies are the same thing. But the dielectric resistance in a telephone cable is never as high as one megohm at a telephone frequency of 1000 periods per second. The term insulation resistance is misleading. There is considerable loss due to dielectric hysteresis and electrostatic influence. These reduce the effective value of the insulation resistance. C. V. Drysdale replies briefly to Cohen and Gati with whom he agrees in a general way.—Lond. *Elec.*, April 24.

Alternating-Current Transmission in Cables.—B. S. Cohen.—A reply to the recent letters of Gati and Drysdale. The writer thinks that the cable manufacturers are quite justified in attaining and maintaining high insulation. The cost of attaining high insulation in paper-insulated cables is not by any means an expensive item in cable construction. The question of variation of insulation, when measured by direct current, and by alternating currents of the nature of those with which the cable is actually used, emphasizes the importance of making all measurements with speech-frequency currents, and the introduction of simple and reliable methods of producing and using such currents is undoubtedly of the first importance.—Lond. *Elec.* May 1.

Demonstration of the Propagation of Alternating-Current Waves in Cables.—C. V. Drysdale.—A note on a (British) Phys. Soc'y paper, in which the author describes a vacuum-tube apparatus for demonstrations of this kind. The propagation of alternating-current waves in conductors has been frequently exhibited by the aid of a helix, notably by Fleming and G. Seibt, and the former has proposed the use of vacuum tubes to show the distribution of potential. The author had noticed that in a tube laid parallel to the helix the brightness was proportional to the slope of potential and, hence, to the current. The apparatus, therefore, consisted of a wooden stand which supported a helix about 6 ft. long, a vacuum tube just above it and a series of 18 vertical tubes below it. On feeding the helix with energy from a high-frequency resonance circuit, nodes and loops of potential and current were simultaneously visible in the two sets of tubes, and these were approximately in space quadrature with one another. Experiments were shown in which the frequency of the supply was varied, and the capacity of the helix was altered by introducing an earthed wire inside it. Resistance, capacity and inductance were also connected successively to the receiving end, and the effects were approximately in agreement with theory.—Lond. *Elec.*, April 17.

Telegraph and Telephone Cables.—F. Tremain.—A paper read before the New Castle section of the (Brit.) Inst. of Elec. Eng. on the construction and use of paper-insulated lead-sheathed telephone and telegraph cables.—Lond. *Elec.*, April 24.

Testing Telephone Cables.—B. Gati.—If telephone cables are tested with direct current only, the insulation resistance alone is measured, while all other losses which occur with currents of the frequency of telephone currents are not considered. The author shows that the total effective dielectric resistance of a telephone cable may be directly determined by means of the barretter.—*Elek. und Masch.*, March 29.

Wireless Transmission of Photographs.—An illustrated description of the method of H. Knudsen for transmitting photographs by a wireless method. In this system the transmitter consists essentially of a traveling carriage, operated by clockwork, carrying a light style moving backward and forward. The style travels over the surface of the picture to be transmitted so that every part of the surface is traversed once during the complete operation. Mechanical action alone is relied on for giving the radio-telegraphic impulses, the style being norally at such a height that a gap exists in the relay circuit controlling the current to the primary of the coil. If the style is pushed up, a contact is made completing this circuit. In order, therefore, to operate this system, it is necessary to so prepare the picture that those parts which are dark are in relief as compared with the parts that are light, or vice versa. This is effected by "dusting" the usual photographic negative with a powder (for example, of iron), which adheres to the dense parts of the negative, but not appreciably to the transparent parts. The sensitive plate on which the photograph is taken is made with a much thicker film of gelatine than usual; after development, and before it is quite dry, it is "dusted" with the powder, which adheres to those parts that are most damp (that is, the dense parts), but not to the parts that are dry. Thus the dense parts of the negative become raised. Consequently, when the style traverses a dense patch, waves are transmitted. The receiver is a similar instrument, but in this the style is normally raised, being depressed when a wave is received, this being effected by a coherer and relay circuit. The plate for receiving consists of a glass plate with a blackened surface; experimentally lampblack may be used, but in practice some more permanent coating would be adopted. In this way a negative is at once obtained corresponding with the original picture or negative. It is found that a quarter of an hour is sufficient to transmit a 5-in. by 4-in. picture.—Lond. *Elec.*, May 1.

Wireless Telephony.—V. Poulsen.—An illustrated lecture held at the London Institution, dealing especially with a comparison between the properties of damped and undamped waves. A small-scale demonstration was made by telephony without wires in the lecture hall. It was stated that sound has been transmitted electrically over a distance of 460 km (about 280 miles) without wires.—Lond. *Elec.*, April 24.

Undamped Oscillations.—O. M. Corbino.—A paper describing a new method of obtaining undamped oscillations with a shunt-wound motor, without condenser, being based upon the following principle: A shunt motor, with armature and field magnets of laminated iron, when subjected to an alternating sinusoidal potential difference applied to its terminals, behaves like an inductive resistor whose inductance may have a negative value. Hence, the apparatus is equivalent to an inductance in series with a capacity. For a certain speed the inductance and the equivalent capacity are independent of the frequency. The formulas for determining the conditions are given under which the system may be transversed indefinitely by alternating currents having a certain period of oscillation.—Lond. *Elec.*, April 24.

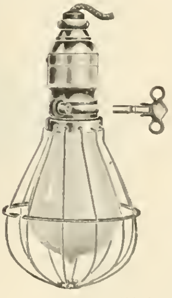
Miscellaneous.

Works Management.—E. Thomas.—A paper read before the Manchester section of the (Brit.) Inst. of Elec. Eng. on the principles of management of engineering workshops, with special reference to shop routine, lists of materials, drawings, records, etc., and the day-work as compared with the piece-work or premium system. In the discussion which followed, C. C. Gerard gave a detailed description of a cost-keeping method in use by the Ferranti Company.—Lond. *Elec. Eng'ing*, April 16 and 23.

Brit. Inst. Elec. Eng.—Mr. W. M. Mordey has been nominated for president for next year.—Lond. *Elec.*, May 1.

New Lock Lamp Guard.

The elimination of a serious problem which confronts every user of incandescent electric lamps, that of having his lamps stolen, seems to have been practically and cheaply overcome. The Crescent Company, Valparaiso, Ind., is placing on the market a new lockable lamp guard, styled the "Protector L" by the makers. As shown in the cut herewith, the wires forming the body of the guard are anchored by one end in the button at the point in such a way as to permit of a hinge movement of the two halves of the guard. This allows for the ready insertion of the lamp. The wires at the other end are rigidly made fast in a stamped steel collar. In the construction of this collar lies the salient feature of the guard.

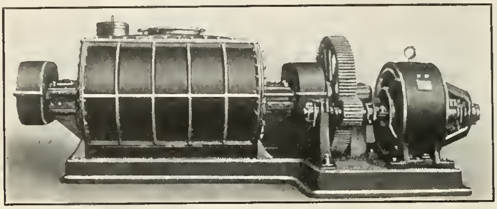


Lock Lamp Guard.

The collar consists of two segments, each segment having ears at both ends to correspond with the ears on the opposite segment. One of these ears is threaded to receive a small lock screw carried in and made part of the corresponding ear of the opposite segment. The head of this lock screw is counter sunk in a metal collar made part of the ear which carries it. By means of these screws and threaded ears it is possible to lock rigidly the guard to the lamp socket with what is aptly called a "Bull-dog grip." The manner of placing the metal collar, together with the triangular shape of the screw head, makes it impossible to remove the guard in any way, other than by using the key furnished with the guard for that purpose. There are no detachable or loose parts to the guard which can be misplaced or get out of order. The guards are light in weight, have a neat, trim appearance and are turned out in a silver luster finish, making them not only serviceable in factories, shops and like places where they are apt to receive rough handling, but also in offices, theaters and amusement places, hotels, or in fact anywhere where good appearance is a factor.

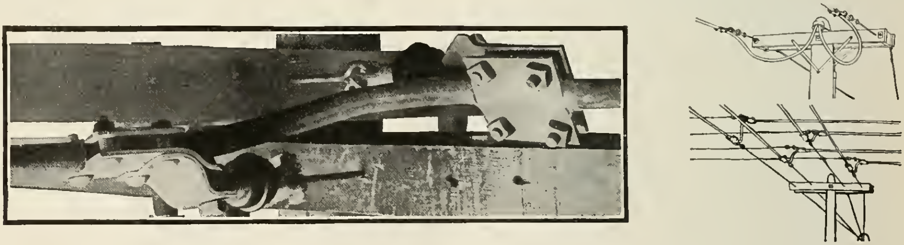
Foundry Blowers.

In the average foundry power is required for but a short time in the afternoon to operate the blower. When once a heat has been started the supply of air must be kept up until the heat is off. This requires a source of power which is absolutely reliable. As the demand is very heavy at this time and but small at all the remaining time, as low an investment cost as possible is desirable. For these reasons electric motors are being adopted by foundrymen as the most satisfactory power, especially where current may be purchased from a central station. Electric drive by power that is thus supplied shows many marked advantages over all other methods.



FOUNDRY BLOWER.

The illustration shows a very satisfactory blower driven by an electric motor suitable for foundry work. The blower is manufactured by the P. H. & F. M. Roots Company and the motor by the Westinghouse Electric & Manufacturing Company. The sturdy appearance of this outfit is readily observed, and the reliability under hard service fulfils the promise made by the appearance. The use of adjustable, self-oiling bearings is a particularly satisfactory feature of these blowers.



FIGS. 1, 2 AND 3.—CABLE CLAMPS IN USE.

The blowers are designed for a range of speed variation of approximately 1½ to 1 to allow a variation in the melt to be made if at any time this becomes necessary. For this purpose direct-current motors are frequently used, as they permit the desired changes in speed, when specified in ordering the motor. In many installations it is not necessary to be able to adjust the speed of the blower, so that the constant-speed characteristics of the induction motor permit its use where alternating current is available. A large number of applications have been made in this way and have given entire satisfaction.

The approved method of driving is by gearing direct from the motor, permitting the use of a moderate-speed motor, thus reducing the original cost, and at the same time doing away with belt drive, which is not entirely satisfactory. The selection of the size of the motor depends upon the conditions to be met in the foundry. In general, a pressure of 16 oz. may be considered as a fair value for the blower to meet. As the capacity required in the motor is approximately 5 hp for every 1000 cu. ft. of air required per minute at 16-oz. pressure, the required size of the motor is readily determined, when the capacity of the cupola is known. An allowance of 30,000 to 33,000 cu. ft. of air is usually made to melt one ton of iron.

As the pressure may increase slightly above 16 oz. toward the end of the heat, the power required also increases. But the overload capacity of the motor is able to take care of this increase. If the pressure is to be materially different from 1 lb. for any long-continued period, the motor capacity should be determined with this in mind. The power will increase or decrease in direct proportion to the increase or decrease in pressure.

The purchasing of power from a central station is attractive to the average foundry, because the central station can actually sell the power cheaper than the foundry can make it. This is because the central station can use its machines for supplying power all through the day to other persons and, therefore, does not receive all its investment returns in a few hours, as the foundryman would have to do if he invested in an electrical plant.

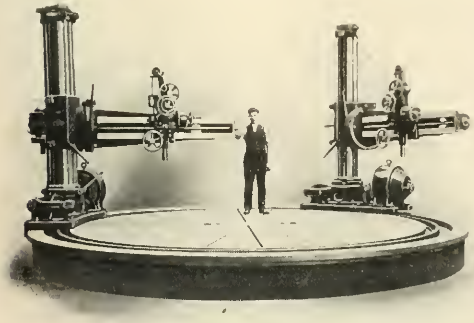
Erection of Aerial Cable Lines.

In order to make a "spliced corner" in an aerial cable line there is required a length of from 3 ft. to 4 ft. of cable, while from 8 ft. to 10 ft. may be thrown away at each end. A considerable loss is occasioned by linemen estimating the length necessary for the splice, an excess being allowed in each case in order to be on the safe side. When it is considered that the time consumed in making a splice may amount to three hours, by three men, it will be appreciated that a "spliced corner" is an expensive part of a cable line. It is claimed that by the use of Kearney cable clamps there can be made a saving equal to twice the cost of the clamps. A good view of the clamps is given in Fig. 1, while the other illustrations show a number of the uses to which the clamps can be put in aerial cable lines. These clamps are manufactured by W. N. Matthews & Brother, 219 North Second Street, St. Louis, Mo.

Universal Radial Drill.

The accompanying illustration shows a 6-ft. universal radial drill, which has recently been constructed by the Niles-Bement-Pond Company for exportation. As will be noticed, there are two drills mounted on a single 20 ft. bed-plate and each drill is independent of the other. The power for each drill is provided by a 5-hp Westinghouse motor mounted as a part of its drill. The adoption of an interpole motor was decided upon to provide for a wide range of speed without mechanical speed-changing devices. The motor selected can be varied from 400 to 1600 r.p.m., and will deliver its full rated horse-power for 12 hours continuous service at any speed within its range.

The motor is used not only for driving the spindle, but by a special clutch may be made to move the column about the bed-plate and bring it to any desired position. Either direction of traverse may be obtained by a reversing switch, which is not shown in the illustration. The use of a variable-speed interpole motor of wide range permits the drills to be run at all times at their maximum speed, regardless of the size of hole to be drilled, as the speed of the motor may be varied by small steps to suit the work being done. To provide for the circular movement of the columns by mechanical drive would have been very difficult, if not impossible. By the individual electric motor the difficulties are overcome in the simplest manner.

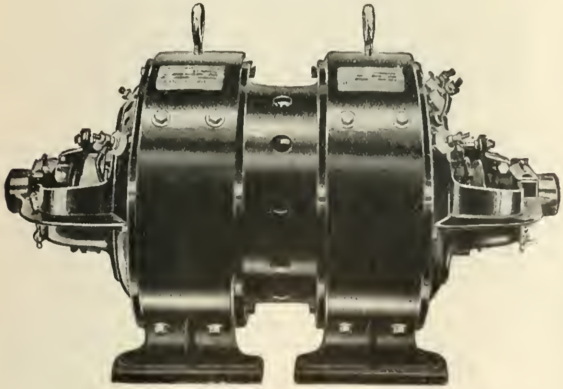


UNIVERSAL RADIAL DRILL.

As each drill column must move half way around the bed-plate, an armored cable protects the wires connecting to the motor and supplies the necessary flexibility. The controllers for starting and governing the speed are mounted one on either side of the bed-plate on a special frame, which also carries a double-pole, double-throw switch for reversing the direction of rotation of the motor.

Motor-Generator Set.

The motor-generator set illustrated herewith comprises two regular motor or generator frames supplied with the regular commutator end heads and joined together by a ventilated union ring, which brings the machines into rigid alignment. The shaft, which runs clear through and is journaled in the outer end-plates, has two armatures mounted upon it, one of which may be wound for any suitable voltage direct current, and the other of which may be wound for either alternating or direct current of any practical voltage. Both sets of fields are connected with the motor line, and the generator winding is compounded so as to give any characteristic desired to the voltage, the motor armature-current passing through the series coils on the generator end. The shunt winding of the generator is usually provided with a rheostat for adjusting the voltage, while an ordinary motor-starter is used on the motor end for starting and stopping the set.



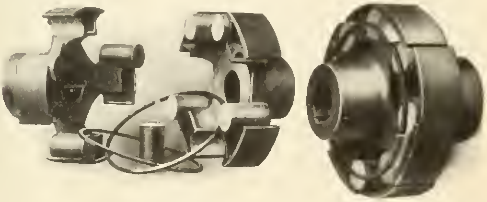
MOTOR-GENERATOR SET.

When used for alternating current, the machine is ordinarily wound to run at 1800 r.p.m., thus giving a frequency of 30 cycles when equipped with two poles, 60 cycles with four poles, or 120 cycles with eight poles. By using a field rheostat in the motor end, the speed may be varied to adjust the frequency over quite a wide range, as desired.

These motor-generator sets are quiet in operation, of high efficiency and much more compact than when built as separate machines, mounted on sub-base and coupled together with the usual couplings and in the usual manner. For charging storage batteries, when wound for direct current, they are found useful, and in signaling and wireless telegraph work they are usually wound for delivering alternating current. When of the latter type and intended to be used on shipboard, they are provided with substantial thrust bearings for counteracting the effect on the armatures of the rolling of the ship. These sets are manufactured by the Robbins & Myers Company, Springfield, Ohio.

Flexible Insulated Coupling.

The accompanying illustration shows an improved flexible insulated coupling manufactured by the R. D. Nuttall Company, of Pittsburg, Pa. The coupling consists of two interlocking spiders of cast iron, which are insulated by means of rubber cylinders. Aside from these the only other parts are two steel rings used to hold the rubber cylinders in position. The rubber members provide ample insulation and, at the same time, give the desired flexibility. The coupling is made in sizes from 5 hp up.



FLEXIBLE INSULATED COUPLING.

This flexible coupling is especially desirable where electric motors are direct-connected to machinery which is subject to vibration, as, for example, a tube mill or a coal pulverizer in a cement plant, where the coupling relieves the motor from the shocks and jars of the machine. In addition, the end thrust of the crusher is overcome and the motor bearings run without undue heating.

Standard Electric Light Pole.

POLE.

The accompanying illustration shows a standard electric-light pole manufactured by the Pittsburg Pole & Forge Company, of Pittsburg, Pa. The pole is made up in a number of lengths and with a number of various cast-iron bases and equipments for carrying both wires and arc lamps. The main feature of the pole is the solidity of the joint or joints, as the case might be. In the pole shown the sections are joined by a patented hot process giving a solid swedged joint having the same diameter and thickness the entire length. It is said to be impossible to telescope the sections by overloading or by hydraulic pressure; the pole bending before the joint gives. The joint is also said to be proof against corrosion by water. The Pittsburg Pole & Forge Company has done much in the way of original designing to meet certain practical requirements, and consequently it is not at all uncommon to find its poles used in many of the large cities of the United States.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade, on the whole, during the week, was somewhat better than during the preceding week. Good crop reports and the belief that the securities market is a forecast of improved conditions, is doing a great deal to inspire confidence, although caution is the watchword. Collections showed considerable improvement, especially in New York City, and money is easy, with low rates for long time loans being conspicuous. Railway earnings for April showed a decrease of 19.9 per cent from April, 1907, the largest monthly decrease as yet reported. April exports showed a decrease of 5.7 from March, and 15 per cent from April, 1907. Some increased demand was felt in the iron and steel lines, and the feeling prevails that the bottom has been touched in those trades. Bank clearings were smaller than for the preceding week, which were, however, the largest in six months. The various electric companies report an increase in orders over the previous week and a firmer tone to the situation. The Allis-Chalmers Company is in a stronger position physically as well as financially, than it was a year ago, and lately has obtained several good-sized contracts for work which were held up on account of the panic. The next annual report of the company, it is predicted, will show a marked contrast to the last annual report, with its deficit of $225,000. The company is operating about 65 per cent of its capacity. According to the officers of the Westinghouse Electric Company, there are enough orders on hand at present to keep the plant at Pittsburg busy for some time to come. As yet, owing to economies in production, it has not been found necessary to increase the working force. The General Electric Company and the Western Electric Company, report an increase in demand for finished products, though the totals are still far behind the totals of a year ago. The export business continues to be the strongest feature of the situation.

MR. MARCONI ON TRANSATLANTIC COMMUNICATION.—At a recent meeting of the Marconi Wireless Telegraph Company in London Mr. Marconi expressed himself as satisfied with the progress of transatlantic wireless communication and said that the results of the work done during the last 7½ months had confirmed his belief that transatlantic service has and will furnish a new and economical means of communication between America and other distant countries. He said: "Experience shows what modifications and extensions will be necessary for continuous operation on a 24-hour basis at high speed. It also shows what obstacles, such as interference with other stations and the difficulty of transmitting from long distances during the daytime, will have to be overcome. For some months the majority of our messages have been carried across the Atlantic during the day, and no interference with ship-to-shore communication has been caused by the powerful long-distance transatlantic stations. There has been no attempt to work up high speed, but as high as 24 words a minute have been achieved, and with slight modifications I am convinced that as high as 30 words a minute can be attained. As the result of a recent development it will be possible to effect duplex working, so that each station may send at the same time it is receiving. This arrangement applied to transatlantic stations would double their effective rate to 60 words a minute." The company authorized 250,000 7 per cent shares for extension of operations. It was stated that the maritime branch of the company had placed instruments upon 118 ships up to the close of 1907, and that the number of words transmitted during the year was 1,868,540, with net receipts of £37,935 ($189,675).

WIRE INSPECTION BUREAU.—In reply to circular letters sent out by the Wire Inspection Bureau to inspection departments all over the country asking their co-operation with the bureau to maintain a high standard of service and to notify the bureau promptly of any wire which did not appear to be up to standard and help the bureau to obtain samples of such wire, many very favorable replies were received, which indicate that the bureau can count on effective co-operation from the majority of the inspection departments. These replies are encouraging to the bureau, as the efforts now being made to maintain a high standard for code wire will be greatly aided by such assistance, and they seem to substantiate the views held by the bureau that the best interests of municipality and insurance departments will be served by inspectors continuing their co-operation with the Wire Inspection Bureau.

MOTORS FOR LINOLEUM PLANT.—A feature of the new power-house equipment of the Nairn Linoleum Company, at Kearney, N. J., will be the 1000-kw, 60-cycle, Allis-Chalmers steam turbine alternator purchased some time ago. In addition to the installation of this unit in the power-house, contracts have recently been placed for 28 Allis-Chalmers induction motors ranging from 5 to 50 hp in capacity and aggregating 850 hp. The installation of these motors for driving a portion of the factory marks the beginning of its conversion from mechanical to electrical drive throughout the entire plant. The Nairn Linoleum Company is one of the largest establishments of its kind in the world, being a branch of the Scotch company, located at Kircaldy, near Edinburgh, Scotland. The American plant is on the Passaic River, from which the condensing water for the turbines is obtained.

WIRELESS STATION FOR PLAZA HOTEL.—The guests of the Plaza Hotel, New York's newest and largest hostelry, will shortly be able to communicate with friends on transatlantic steamers without leaving their apartments. The work of installing a wireless station on the hotel roof, 319 feet above the street level, has been begun, and the three steel flagstaffs already on the roof reduces to a minimum the expense of constructing the station. The De Forest system will be used, and the management of the hotel will own the station, which it will build and operate. An operator will be at the station every day, and arrangements will be made for telephone communication between the operator and every room in the hotel.

NIAGARA ENERGY FOR SYRACUSE & SOUTH BAY RAILWAY.—A new substation will be erected for the Syracuse & South Bay Electric Railway Company, of Syracuse, N. Y., to receive energy from the transmission lines running from Niagara Falls to Syracuse. After the e.m.f is reduced from 60,000 volts to 500 volts, the energy will be used to operate an extension of the Syracuse & South Bay line. The order for the equipment of the new substation, consisting of transformers and switchboards, was placed with the Westinghouse Electric Company last week.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has applied to the Secretary of State to increase the capital from $125,000 to $1,250,000. The old capital was all common, and the new issue will consist of $500,000 6 per cent preferred and $750,000 common stock. Most of the new capital has been subscribed, and the money received for the stock will be used in erecting a new plant at Oakley, Hamilton County, in the near future.

ROCKY MOUNTAIN TELEPHONE COMPANY STRIKE SETTLED.—The strike of linemen and operators of the Rocky Mountain Bell Telephone Company, which has lasted for nearly a year, and almost completely paralyzed the Bell telephone business in Butte, has finally been settled. In the agreement which the company and labor unions have signed, and which will be in force for a year, the company yields almost every point and dismisses the injunction suits which the company brought against the labor unions.

TURBINES FOR BUENOS AIRES.—An Italian firm in Legnano, Italy, has just completed a 12,000-hp steam turbine, which is said to be the largest hitherto built in Europe. This turbine is the first of three machines to be manufactured for a generating station which the firm is installing at Buenos Aires. The consumption of steam guaranteed by the makers of the new 12,000-hp turbine is 13.86 lb. per kw-hour.

PLANT FOR JACKSONVILLE, FLA.—The municipal lighting plant at Jacksonville, Fla., has contracted for another 1500-kw Allis-Chalmers turbine, and one 300-kw motor generator.

THE COPPER MARKET.—A decided change for the better, in sentiment at least, was noticed in the copper market during the last week, a feeling of optimism that found its reason for being, perhaps, in the strength of copper stocks, since the metal conditions changed but little, and prices gained only about ⅛ of a cent a pound. All the leading copper interests insist that the copper metal situation shows distinct improvement, not only for export, but also for domestic consumption. The railroads are still out of the market, but there was an increase in inquiry from street railroads, and it is expected that they will be in the market for large amounts as soon as the matter of bond issues has been settled satisfactorily. American consumption is still about 50 per cent below normal, but it is claimed that few producers are selling below 13 cents, and that stocks are not accumulating. The foreign demand continues good, with an indication of still heavier demand from England and the Continent. Advices from abroad state that the copper consumption in Germany for the first three months of the current year was 77 per cent larger than for the corresponding period last year, and that in England the increase of consumption for the same period was 40 per cent, and in France 15 per cent. The domestic situation is still far from satisfactory, but should confidence continue to gain strength in the next few months, as it has in the last few months, there will undoubtedly be a rush to buy copper, as there has been formerly, under conditions similar to those that prevail now. On Monday there was an advance of ⅛ of a cent on both spot and future deliveries. Closing prices on the Metal Exchange were as follows:

Lake	12.75 @ 12.87½c.
Electrolytic	12.62½ @ 12.75
Castings	12.37½ @ 12.62½

The London market was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	58	5	0	58	10	0
Standard copper, futures	58	17	6	59	5	0
Market	Firm.			Firm.		
Sales of spot				200 tons		
Sales of futures				1,100 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£65	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

WESTINGHOUSE BUSINESS IMPROVEMENT.—During the opening week of May the business of the Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company has, it is stated, for the first time since last October shown an improvement of a character which recalls the busy days of last year. While there have been indications of an improvement in the business of both companies, ever since the first of the year, the increase was very slight and the orders were mostly confined to those departments engaged in the manufacture of smaller apparatus for the large electric lighting, railway and power plants which needed the additional apparatus to keep up with the natural growth of their business. New business has been very scarce so far, because electrical enterprises contemplated last year received a set-back with the financial depression of last October. It is stated, however, that the orders received by the Westinghouse companies during the first two weeks in May, several of which are of fairly good size, confirm the opinion that business confidence has again returned. A large addition to the forces in the shops has as yet not been necessary, because the methods of economy and improvement in the production departments inaugurated last year at the East Pittsburg plants are amply adequate to cope with the new work, although there have been a number of operatives added as the occasion demanded it. Among the contracts received is one from the Berwind-White Coal Company, of Windber, Pa., for the complete installation of a central mining plant, consisting of steam turbines, turbo-generators, rotary converters, transformers, motors and switchboard appliances. This will be one of the first plants of its kind in the country, inasmuch as the current will be transmitted from one plant to a number of others, instead of each mine having its own isolated plant. The new plan is said to save considerable in the cost of operation and maintenance. The railway department of the Electric Company also received an order for six motor-generator sets of 850 hp each, and transformers, from the Pacific Railway Company, which is constructing an electric railway in the suburbs of Los Angeles. The turbine department of the Machine Company and the railway department of the Electric Company also obtained a contract from the Washington, Alexandria & Mt. Vernon Railroad for power-house and rolling stock equipment, including one 2000-hp steam turbine.

ELECTRICAL TRADE IMPROVING IN SOUTH AMERICA.—Mr. J. K. Robinson who represents the Westinghouse Electric and Westinghouse Machine companies in Chili, Bolivia, Peru and Ecuador, reports that the serious financial depression which has prevailed in those countries during the last few months shows sign of betterment, and that the sentiment has vastly improved among trade interests. The currency, especially in Chili, is still way down, but the general trend of feeling is optimistic, and preparations are being made with a view to resuming work on a number of large enterprises, which was stopped on account of the panic. He reports, among other recent orders, from South America, a contract for a central station equipment for a town in Chili, consisting of a 1000-hp bituminous, pressure, gas producer plant, to be supplied by R. D. Wood & Company, with a 500-hp, 4-cycle, vertical gas-producer engine, direct-connected to a 350-kw, alternating-current generator, and a direct-connected exciter, to be furnished by the British Westinghouse Manufacturing Company, Ltd. The equipment includes a 17-panel central-station switchboard and necessary cranes, which will be furnished by the Westinghouse Electric Company, of Pittsburg. Shipments are being made to a large nitrate plant in Chili of two electric hoists, Lidgerwood make, four entirely enclosed 40-hp Westinghouse motors, two 85-kw generators and 20 electrical motors of various sizes. Also a central-station switchboard and apparatus, four motor-driven centrifugal and four motor-driven triplex pumps from the Gould Manufacturing Company. To another nitrate plant are being shipped one motor-generator set and a complete lighting installation. The British Westinghouse Electric & Manufacturing Company has obtained a contract for the equipment of a power plant, consisting of two 120-kw, three-phase, alternating current generators, a central-station switchboard and numerous motors.

LAST YEAR'S TURBINE BUSINESS.—Retrospective of the development during the past years of the steam turbine, the accompanying figures reported by the Westinghouse Machine Company are interesting as tending to controvert the general impression that the turbine business suffered heavily during the year. Although one month's business in 1906 still holds the record at 62,100 kw, the year 1907 was marked by an average demand quite as large. As late as July, orders for 34,750 kw were taken during that month as compared with 25,750 for July, 1906. For the first nine months of each year the demand for turbines was, in 1907, 158,550 kw, and in 1906, 152,400 kw; or, taking the middle six months of the year, from April to September inclusive, thus excluding the usual mid-winter activity as well as the late depression, the average per month is as follows: 1907, 15,833 kw; 1906, 14,365 kw. Thus it is apparent that up to the period immediately preceding the depression of October the demand for turbine equipment showed a steady increase. It is interesting to note in this connection the ultimate results of commercial activity of the past few years. Had the business of the company kept on increasing at the same rate as prevailed during 1904 and 1906, the year 1910 would have been marked by an annual output of 1,912,000 kw, or the rate of 160,000 kw per month.

LARGE ORDER FOR CURLING IRONS.—The Vulcan Electric Heating Company, Chicago, informs us that it has just taken an order for 72,000 electric curling irons, to be delivered at the rate of 3600 per month until the order is filled. The name of the purchaser is not made public, but it was stated that an extensive advertising and selling campaign will be carried out by the purchaser, and it is expected the irons will easily be disposed of. This is probably the largest single order for electric heating appliances ever placed.

PERFORATED POSTAGE STAMPS.—The Postmaster-General has issued an order permitting the perforation of postage and special delivery stamps, as a means of identification to prevent theft. The Merchants' Association of New York has issued a bulletin, showing how practical advantage may be taken of the new ruling, and gives a list, with prices, of perforators adapted to the purpose.

Financial Intelligence.

THE WEEK IN WALL STREET.—Openly professional, and based on the future rather than on present conditions, the market continued on its upward course last week, reaching the highest levels since the panic, and recording on Friday the largest amount of business transacted since the beginning of the year. The number of shares which changed hands on that day was 1,212,000. The activity of the market has been fairly well distributed along the list, the average increase in security values since Jan. 1 being more than $20 a share. There was surprisingly little in the week's news to justify the advances, and the decrease in export and import trade, the falling off in railway earnings, and the dull condition of trade would seem to justify a bear rather than a bull market. But the feeling on the Street prevailed that it was impossible for things to get any worse, and therefore the only alternative was an upward movement. The bond market during the last few weeks has been exceedingly active, the total amount of sales since Jan. 1 being $349.800,000, as compared with $201,900,000 for the same period in 1907, and it is estimated that by July 1 the sales of bonds for the first six months of the current year will be double the total amount of bond sales for 1907, besides establishing a record over any other year in the history of the Exchange. During the week $8,000,000 more gold was engaged for foreign exportation, making a total of $25,000,000 exported, but money continues to accumulate, and foreign shipments, and the likelihood of immediate withdrawals on the part of the Government are viewed without alarm. The market of Monday, this week, saw another excited rise in prices, with sales of more than a million shares and with the interest centering in leading railroad securities. There was little news that could be used as a basis for a further bull movement, and the general public figured very little in the buying, most of it being done by those of a speculative turn and by the agents of those who have been engineering the upward movement. Closing prices were as follows:

'NEW YORK.

	May 11.	May 18.	Shares sold.		May 11.	May 18.	Shares sold.
All-Ch.	8	9⅝	4,215	Int.-Met., com.	11⅜	12⅛	29,155
All-Ch., pfd.	21½	25⅛	6,125	Int.-Met., pfd.	31⅜	32	39,845
Amal. Cop.	63⅞	69⅜	395,085	Mackay Cos.	63	64½	730
Am. D. T.	39*	39*	———	Mackay Cos., pfd	64	66¼	900
Am. Loc.	50½	51⅛	19,480	Met. St. Ry.	29	25	200
Am. Loc., pfd.	102	103½	300	N.Y. & N.J. Tel.	105*	105	———
Am. Tel. & C'bl.	50*	60	———	Steel, com.	37⅛	39⅛	466,415
Am. T. & T.	117½	117¾	1,450	Steel, pfd.	102⅛	103¼	36,940
B. R. T.	50¾	52⅛	140,205	W. U. T.	51¼	58⅝	5,815
Gen. Elec.	137	140	3,340	West'h, com.	47	53¼	18,764
Hud. R. Tel.	—	—	———	West'h. pfd.	60	70	1,100

PHILADELPHIA.

	May 11.	May 18.	Shares sold.		May 11.	May 18.	Shares sold.
Am. Rys.	44⅝	44¾	———	Phila. Elec.	8¾	8⅞	———
Elec. Co. of Am.	10	9⅞	———	Phila. R. T.	18¼	16⅝	———
Elec. Stor. B'ty.	32¼	32	———	Phila. Traction.	91	92	———
E. S. B'ty, pfd.	—	—	———				

CHICAGO.

	May 11.	May 18.	Shares sold.		May 11.	May 18.	Shares sold.
Chicago City Ry.	160	160	———	Met. Elev., com.	19	17	———
Com. Edison.	91¾	94¼	———	Met. Elev., pfd.	49	54	———
Chicago Subw'y	—	19⅞	———	National Carbon.	61¼	62⅛	———
Chicago Tel. Co.	118¾	122½	———	Nat. Carbon, pfd.	107½	110	———

BOSTON.

	May 11.	May 18.	Shares sold.		May 11.	May 18.	Shares sold.
Am. Tel & Tel.	117½	118	———	Mass. E. R., pfd.	44	43	———
Comb'ind Tel.	109¾	—	———	Mex. Tel., pfd.	—	—	———
Edison El. Ill.	214	214	———	New Eng. Tel'p.	113¾	113½	———
Gen. Elec.	137½	140⅛	———	W'st Tel. & Tel.	6¼	6⅛	———
Mass. Elec. Ry.	9¾	10	———	W. T. & T., pfd.	65½	65½	———

*Last price quoted.
Shares sold are for week May 4-9.

WESTINGHOUSE REORGANIZATION COMMITTEES.—Of the 3800 stockholders of the Westinghouse Electric & Manufacturing Company, more than 1200 have responded to the request to subscribe to the new stock, and more than $1,000,000 has already been raised. Of the $10,000,000 required it is assured that $4,000,000 will be cared for by the Merchandise Creditors' Committee, between two and three millions by the Security Investment Company, $1,000,000 has been raised among the stockholders, leaving only $2,000,000 necessary for the successful conclusion of the plan. A circular issued by the Merchandise Creditors' Committee to the stockholders, dated May 15, says in part: "Under the plan advanced by the Merchandise Creditors, the Merchandise Creditors show their confidence in the future of your company by abandoning their position as your creditors and becoming your partners. This should be especially valuable to the future of the company, as there are some 1,500 Merchandise Creditors in all—an influential host of friends and workers. The Merchandise Creditors have responded promptly to the call of their committee, as those having claims amounting to $3,600,000 out of a total of $4,250,000 have already signed our agreement. A large proportion of the remainder is already promised, and we believe that practically the entire amount will join the plan. The Merchandise Creditors are willing to support this plan because they believe that, under such a readjustment of the company's affairs as it contemplates, the stock of your company will reach par, or better, within the next two years, and thus enable them to realize the full amount of their claims. If this supposition on their part be correct, it must certainly follow that your interests will be fully protected and conserved. We believe that the combined support of the creditors and the stockholders, together with the assured careful and conservative management of the business and all its varied interests (in which all classes of creditors will be strongly represented), will result in eventually making the stock of the company more valuable than it has ever been. On the other hand, if the $6,000,000 of new capital which the stockholders are called upon to raise is not subscribed, we see no alternative other than a sale of the company's assets on foreclosure. We trust you will do your part; otherwise the effort of this committee and that of all the creditors of your company will have been of no avail. Inasmuch as the time granted by the readjustment committee for securing the necessary subscriptions for new stock is rapidly passing, we trust that you will not delay in sending in your subscription to your committee in response to the urgent request which you have received from it, as by so doing you will make it possible for the Merchandise Creditors and all other creditors to join you in a plan of reorganization which should insure your company's becoming strong, successful and profitable. In order to give the stockholders every possible chance to preserve their equity, the company, with the approval of the various reorganization committees and receivers, has commissioned its salesmen at the various branch offices throughout the country, to make personal calls upon the stockholders. At present there are 18 or 20 representatives from the Boston office devoting their time to seeing New England stockholders who have not already subscribed to their portion of the stock."

BRITISH WESTINGHOUSE.—At the annual meeting of the British Westinghouse Electric & Manufacturing Company, the chairman said: "With a 2 per cent lower payroll, more than 10 per cent additional value of apparatus was produced in 1907. Percentage of cost of selling to amount of orders booked was less than in 1906, and the total increase of shipments was about 17 per cent. Export business showed considerable increase. Orders show a gain of more than 30 per cent over the preceding year. Competition is more severe than ever, and prices have been on a descending scale notwithstanding high raw materials. At the moment trade is slack, with little prospect of revival until after the summer. The company is meeting the situation by efforts to increase the volume of business and effect operating economies." For the calendar year 1907 the company reports trading profits of $461,915, from which are to be deducted charges of $405,255, leaving a balance of $56,660. Indebtedness to the American companies has been liquidated by transfer of shares in the Traction & Power Securities Company and the company has lately issued $1,250,000 out of $1,500,000 6 per cent debentures authorized.

AMERICAN LIGHT & TRACTION COMPANY.—For the quarter ended March 31 the American Light & Traction Company, of New Jersey, reports gross earnings of $659,093, an increase of $31,079 over the first quarter of 1907, and expenses of $12,000, leaving net earnings of $647,093, an increase of $31,079 over the same period in the previous year. Preferred dividends of $213,543 and common dividends of $101,410 were paid, leaving a surplus of $332,140, representing an increase of $14,177 over the surplus for the same period in 1907. The total surplus was $155,640.

KEYSTONE TELEPHONE COMPANY.—The Keystone Telephone Company, of Philadelphia, combined companies, reports for March gross earnings of $89,153, an increase of $3,758 over March, 1907, and a net of $44,661, an increase of $1,125 over the same month in the previous year. The gross for the nine months ended March 31 was $787,975 and the net $373,840, an increase of $32,224 over the corresponding nine months of the previous year.

WESTERN POWER PLANT RUMOR UNCONFIRMED.—The report that several large light and power companies doing business in the State of Colorado are contemplating a merger, and that representatives in New York are holding meetings with that end in view, found no confirmation in this city. The companies said to be interested in the alleged merger are the Denver Gas & Electric Company, the Northern Colorado Power Company, the Central Colorado Power Company, the Summit Power Company, and the Eastern Colorado Power Company. "While there are several companies concerned in these deals," the report states, "there is considered in reality only three interests, the General Electric Company, the Westinghouse Company and the McMillan syndicate. There are several auxiliary corporations of the Central Colorado Power Company existing in the State which have obtained options on practically all of the feasible sites in the State." All three of the interests named denied that there was any truth in the rumor. Mr. Henry L. Doherty, who holds a controlling interest in the Northern Colorado Power Company and the Central Colorado Power Company, stated that as far as these two companies were concerned, the report was groundless, and that no steps had been taken or considered with a view to such a merger. "This report is by no means new," said a representative of the General Electric Company, who is thoroughly conversant with the power situation in Colorado, "and probably originates with a certain person who lives out in Denver and who holds a large block of the stock in one of the companies mentioned. Whenever he wishes to dispose of a slice of his holdings, he gives an interesting merger story to the newspapers. Then, when the stock jumps a few points on the strength of the report, he sells on the bulge and settles back to plan for another coup."

MINORITY STOCKHOLDERS BLOCK PACIFIC GAS & ELECTRIC NEW BOND ISSUE.—Less than 10 per cent of the holders of the $4,500,000, 6-per cent serial debenture bonds, of the Pacific Gas & Electric Company, a $30,000,000 corporation controlling the California Gas & Electric Corporation, have halted, through the aid of the courts, the plan of the company to exchange its debenture bonds for a like issue of 30-year mortgage bonds. The Industrial & General Trust Company, Ltd., and other plaintiffs obtained from Justice Dowling, in the Supreme Court, an ex-parte injunction restraining the Pacific Gas & Electric Company, the Trust Company of America, Frank A. Vanderlip and others, from carrying out the exchange plan. The court also restrained the Trust Company of America from exchanging the deposited debentures or any receipt for them for the mortgage bonds of the Pacific Gas & Electric Company. A motion to vacate the injunction was argued before Justice Greenbaum, sitting in the Supreme Court, New York, on May 4, but the answer has not yet been filed by the justice. It was said at the office of N. W. Halsey & Company, who are interested in the financing of the company, that the exchange plan had been approved by 90 per cent of the debenture holders, and that the opposition was almost entirely on the part of foreign bondholders. "It only remains to be seen," said an officer of the company, "whether less than 10 per cent can successfully oppose the wishes of 90 per cent, which is not at all likely."

MEETINGS AND DIVIDENDS.—The directors of the Philadelphia Electric Company have declared the regular semi-annual dividend of 2½ per cent. The regular quarterly dividend of 2 per cent has been declared by the directors of the Kings County Electric Light & Power Company. The American Telegraph & Cable Company's 5 per cent dividend, guaranteed by the Western Union Telegraph Company, will be paid upon maturity on June 1. The directors of the Laclede Gas Light Company have declared the regular quarterly dividend of 1¼ per cent on the common stock, and the regular semi-annual dividend of 2½ per cent on the preferred stock, both payable June 15. The Kansas City Railway & Light Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable June 1.

MONTREAL STREET RAILWAY.—Although the gross earnings of the Montreal Street Railway Company for the month of March were $288,674, an increase of $17,086 over the corresponding month in 1907, the expenses of $202,390 showed an increase of $16,929 over the same month in the preceding year, making a March net for 1908 of $86,284, an increase of only $157 over the March net in 1907. The interest, rent, etc., reduced the March surplus to $34,027, a decrease from the surplus of the corresponding period last year of $8,888. The gross for the six months (Oct. 1 to March 31) was $1,747,137, expenses $1,145,866, and net $601,171. Interest, rent, etc., $272,282, leave a surplus for the six months of $328,989, as compared with a six-months surplus in 1907 of $286,513.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report of the American Telephone & Telegraph Company, including all the associated Bell Telephone operating companies, not including long-distance lines, for the month of March gives a telephone revenue of $9,790,100; operating and maintenance expenses of $7,229,700, leaving a balance for dividends of $2,296,200. The total net earnings from Jan. 1 to March 31, 1908, were $8,650,400, an increase of $926,200 over the same period in 1907. Charges of $1,973,600 were an increase of $285,300 over the same period last year, leaving a balance for dividends for the quarter of $6,676,800, an increase of $640,900 for the first three months in 1907.

UNION ELECTRIC BONDS SOLD.—Announcement is made by N. W. Harris & Company that the entire $2,500,000 bonds of the Union Electric Light & Power Company, of St. Louis, have been sold. The proceeds from this bond issue will enable the North American Company to clear off the remainder of its floating debt, and will place its finances in a strong position. The prospect of a resumption of dividends by the company is regarded as improved materially by this transaction, and it was said by one in close touch with the affairs of the company that the directors are likely to order the resumption of dividends within a few months.

INTERBOROUGH NOTES FIND READY MARKET.—Without putting up a single dollar, the syndicate formed by J. P. Morgan & Company to underwrite the $25,000,000 three-year, 6 per cent note issue of the Interborough Rapid Transit Company made one of the quickest profits ever realized in a similar undertaking in Wall Street. The participants of the syndicate realized about 2¾ per cent, 2 per cent was allowed to the bankers for the formation and management of the syndicate, which brought the total commission paid by the Interborough Company, including expenses, up to 5 per cent, or $1,250,000 on the $25,000,000 issue.

UTICA GAS & ELECTRIC COMPANY.—For the year ended Dec. 31, 1907, the Utica Gas & Electric Company reports gas sales of $290,308, electric sales of $476,707, making a total of $767,105, an increase of $67,949 over 1906. Total operating expenses were $373,133, an increase of $66,763 over 1906, and the total net earnings $399,595, an increase of $2,382. Interest charges of $219,500, including interest on refunding extension 5-per cent bonds, were an increase of $80,078 over 1906, leaving a surplus of $180,095, less than the surplus for 1906 by $77,696.

GENERAL ELECTRIC DIRECTORS CHOSEN.—At the annual election of the General Electric Company the following named directors were elected: Gordon Abbott, Oliver Ames, C. A. Coffin, W. H. Crane, T. J. Coolidge, Jr., B. E. Sunny, George P. Gardiner, Henry L. Higginson, J. P. Morgan, J. P. Ord, Robert Treat Paine, 2d, Marsden J. Perry, E. W. Rice, Jr., Charles Steele and S. L. Schoonmaker. The above were all re-elected with the exception of B. E. Sunny, of Chicago, who succeeds Frederick P. Fish, resigned.

INTERNATIONAL RAILWAY COMPANY.—A report of the International Railway System of Buffalo for the quarter ended March 31, 1908, shows gross earnings of $987,631, expenses of $660,262 and a net income of $327,368, with a total income of $343,226, as compared with the total income of the corresponding quarter last year of $345,655. Deducting charges of $282,430, gives a surplus of $60,796, a decrease from $96,798, the surplus for the same quarter last year.

CHICAGO TELEPHONE COMPANY CHANGES.—Mr. John M. Clark has resigned as chairman of the Chicago Telephone Company board of directors, President Wheeler succeeding him, and Mr. B. E. Sunny has succeeded Mr. Arthur D. Wheeler as president. Mr. Clark continues as a director. Mr. Sunny was formerly connected with the Chicago Telephone Company, and for some years has been a vice-president of the General Electric Company.

GEORGIA RAILWAY & ELECTRIC COMPANY.—The report for March of the Georgia Railway & Electric Company shows a gross of $281,074, as compared with $274,783 for the same month in 1907, an increase of $6,290. The net earnings were $141,832, as compared with a net of $143,416 for March in 1907, a decrease of $1,583.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

GLOBE, ARIZ.—The Globe Electric & Gas Company, which has been reorganized, is planning to make improvements to both the gas and electric departments, which will involve an expenditure of about $150,000.

BERKELEY, CAL.—The Pacific Gas & Electric Company, of San Francisco, has applied for a permit to construct a substation, the cost of which is estimated at $12,000.

ESCONDIDO, CAL.—The Escondido Mutual Water Company is contemplating utilizing the water power from its reservoir to generate electricity. It is proposed to locate the plant below the dam, where a fall of about 450 ft. can be obtained.

EUREKA, CAL.—At the annual meeting of the Humboldt Water & Power Company permanent organization was effected and the following officers were elected: N. H. Falk, president; J. N. Lentell, vice-president; R. L. Boehne, secretary; Bank of Eureka, treasurer. Water will be carried from Mad River, and 15,000 inches have been claimed by the company for the purpose of supplying this city. The proposed system is to be a combination of water supply and water power.

LONE PINE, CAL.—The Four Metals Mining Company is making preparations to construct an electric power plant at the foot of the Sierras as soon as a permit can be obtained from the Forest Service.

MARTINEZ, CAL.—The Board of Supervisors of Contra Costa County has granted A. W. Maltby and Joseph Napthaly permission to construct and operate an electric railway through the Alameda and Contra Costa County tunnel.

PASADENA, CAL.—Contracts have been awarded by the City Council for equipment for the electric light plant as follows: To the California Electric Company, of Los Angeles, for 15,800 lb. No. 6 triple braid weatherproof drawn copper wire, for $2,464; to J. B. F. Kieruiff, Jr., & Company, of Los Angeles, for poles, cross arms and braces, for $5,843. Herman Dyer is city clerk.

REDDING, CAL.—The Northern Light & Power Company expects to deliver electricity for lamps and motors in Redding before the end of the year. The power house on South Cow Creek, 25 miles east of Redding, is ready for the machinery, orders for which have already been placed. The pipe line will be 3600 ft. long and will deliver water under a 715-ft. pressure.

SONORA, CAL.—The Stanislaus Electric Power Company has filed a notice of an appropriation of 8000 cu. inches of water of the Middle Fork, of Stanislaus River, at a point above McDonnell's Flat.

TURLOCK, CAL.—T. J. Burrow, Jr., of Amador, has applied to the City Trustees for a franchise to erect transmission lines in the city of Turlock.

TELLURIDE, COL.—The Telluride Power Company has filed with the County Recorder a mortgage of $10,000,000, in favor of the Citizens' Saving & Trust Company, of Cleveland, Ohio, covering an issue of six per cent bonds, secured by rights, plants and franchises in Colorado, Utah and Idaho. Of the above issue, $2,500,000 will be used to redeem outstanding bonds and take up floating indebtedness, and the remainder will be used for further development of the company's business.

EAST NORWALK, CONN.—The contract for installing the new electric lighting system has been awarded by the lighting committee to W. M. Sheehan & Company, for $5,150.

NEWARK, DEL.—The Elk River Heat, Light & Power Company, which is building a large power plant on the Elk River, three miles from Newark, has its plant nearly completed and will soon put it in operation. The company proposes to furnish electricity for lamps in Newark, Kembleville, Oxford and West Grove, and will also furnish electricity to farmers for motors to operate small machinery.

SEAFORD, DEL.—Madison Willin contemplates installing a dynamo in his plant to furnish electricity for from 500 to 1000 lamps of 16 cp, in connection with a water-power plant already installed.

WASHINGTON, D. C.—Bids will be received until May 26 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal., schedule 1154—electrical supplies, etc. Charleston, S. C., schedule 1176—universal cable saw bench, motor driven fan and condenser outfit. Bids will be received until June 2 as follows: Boston, Mass., schedule 1206—two electric motors. Also until June 9 as follows: Mare Island, Cal., schedule 1191—batteries, wireless material, 10 portable ammeters. Applications for proposals should designate the schedules desired by number. E. B. Rogers is paymaster general, U. S. N.

LUDOWICI, GA.—The city is considering the proposition of establishing an electric light plant.

ST. MARIES, IDAHO.—Poles are being erected for the electric lighting system to be installed in this town. As yet the location of the power plant has not been decided upon. It is expected to have the plant completed and in operation by next fall.

ALBION, ILL.—Fred L. Hisgen, of Evansville, Ind., has applied for a franchise to erect an electric light plant in Albion.

CHICAGO, ILL.—The South Shore Gas & Electric Company, of Hammond and surrounding towns, is negotiating with the Sanitary District Board of Chicago to obtain electrical energy from the drainage canal plant near Lockport to furnish electricity for motors in Hammond and vicinity.

CHICAGO, ILL.—It is reported that the Cosmopolitan Electric Company has submitted a proposition to the Trustees of the Sanitary District of Chicago offering to take all the electrical energy that it now produces or will produce in the future at the rate of $21 per horse-power per year. Roger Sullivan is secretary of the company.

CONCORD, ILL.—Plans are being considered by the Chicago, Burlington & Quincy Railroad Company to install a complete telephone system on its line from Concord to Herring.

GALESBURG, ILL.—The Galesburg Union Telephone Company will soon commence work on the extension of its system, which will include the erection of a telephone line from Galesburg to Yates City and also to Kewanee, Monmouth, Macomb, Rock Island and Watertown.

GENESEO, ILL.—The Concrete Engineering Company, of Martins Ferry, Ohio, has been awarded the contract for erecting the power house of the Geneseo Electric Light Company. The old building was destroyed by fire several weeks ago.

HARMON, ILL.—The Green River Telephone Company contemplates making many extensions to its system.

MASCOUTAH, ILL.—The Looking Glass Prairie Telephone Company expects to extend its lines from this city to Turkey Hill.

NORTH CHICAGO, ILL.—The contract for the equipment of the electrical power plant at the Great Lakes naval station has been awarded to the D'Olier Engineering Company, of Philadelphia, Pa., for $126,550.

COLUMBUS, IND.—The Central Indiana Lighting Company contemplates extensive improvements to its plant, including the construction of a new power plant and improvements to its street railway system. As yet nothing definite has been decided.

INDIANA HARBOR, IND.—The C. H. Geist Company, a gas and electric corporation, of Chicago, Ill., has purchased the electric plant formerly owned and operated by the city of East Chicago, Ind. The company will in the future be known as the Indiana Harbor & East Chicago Electric Company. The officers of the company are: C. H. Geist, president; C. H. Weak, vice-president, and C. W. Fox, secretary and treasurer.

LANESVILLE, IND.—The Harrison County Telephone Company is planning to build an additional telephone line between this city and Corydon to take care of its increasing business.

IOWA CITY, IA.—The Iowa Telephone Company has been granted permission to rebuild its system in this city.

KEOKUK, IA.—Hugh L. Cooper, of New York, N. Y., representing the Keokuk & Hamilton Water Power Company, has applied to the City Council for a franchise to furnish electricity in this city and to operate an electric railway. The company proposes to erect a dam on the Des Moines River and transmit electricity to cities in Iowa, Illinois and Missouri.

FRANKFORT, KY.—Plans will be prepared and submitted to the Capitol Commission by Prof. Paul Anderson and L. K. Frankel, of the State University, Lexington, Ky., for a power house and installation of plant to furnish electricity for lighting, heating, etc., for the new capitol. An appropriation of $460,000 has been made for completing and furnishing the building.

HALL, KY.—The Upper Rockhouse & Beaver Creek Telephone Company has commenced work on the construction of its telephone line from Hall to Colson, Ky., a distance of about 18 miles, and is also planning to build a number of short lines. The company is in the market for equipment and construction material.

PADUCAH, KY.—The Paducah & Cairo Interurban Company has been granted a franchise in this city. The interurban line will extend from Paducah to East Cairo, Ky., where a ferry boat will be operated to Cairo.

SERGENT, KY.—The Letcher County Home Telephone Company will construct a telephone line from the Kentucky River to Margaret, and also a line between Whitesburg, via Mayling to Thornton.

AMITE CITY, LA.—The plant of the Central Light & Power Company was nearly destroyed by the tornado. It is said that the company will not rebuild the plant unless the city will guarantee it $150 per month. It is expected that the City Council will agree to the guarantee.

TURNER, MAINE.—The East Hebron Telephone Company, which has been granted a franchise in this city, contemplates extending its telephone lines in Turner, Hebron and Minot.

FREDERICK, MD.—The Washington, Frederick & Gettysburg Railway Company has decided to proceed immediately with the extension of its line from Lewiston to Catocin Furnace, to connect with the Monocacy Valley Railroad to Thurmont, which the company recently purchased. The extension will be about three miles in length.

BOSTON, MASS.—The Senate has passed the bill removing the limit of capital stock, which may be issued by gas and electric companies. Under the present law the capital stock of companies is limited to $1,000,000. Under the new law the capital stock may be increased to such amounts as may be authorized by the State Board of Gas and Electric Light Commissioners.

GRANITEVILLE, MASS.—The citizens are considering the question of lighting the streets of the town.

NORTH EASTON, MASS.—A committee has been appointed to look into the question of establishing an electric light plant and report at the next annual meeting. The street lighting contract expires next year.

MONROE, MICH.—The Toledo, Ottawa Beach & Northern Railway Company has notified the City Council that it will apply for a franchise through the city. The railway will be extended from Monroe to Detroit.

PORT HURON, MICH.—It is reported that the Michigan United Railways has made arrangements for a bond issue of several million dollars to provide funds for the completion of the Lansing-Jackson interurban railway and the building of a road from Kalamazoo to Benton Harbor, and extensions of the street railway systems in Lansing, Battle Creek and Kalamazoo. Sanford W. Ladd is counsel for the company.

BEMIDJI, MINN.—The Northwestern Telephone Company contemplates making extensive improvements and extensions to its system in this city.

BRECKENRIDGE, MINN.—The Wilkin County Telephone Company is planning to erect about 20 miles of rural telephone lines.

BUHL, MINN.—Plans are being considered for improvements and changes in the municipal electric light and water plant. Oscar Clausen, of St. Paul, is engineer.

SAVANNA, MINN.—The Chicago, Milwaukee & St. Paul Railway Company has decided to install a telephone system between Savanna and Chicago.

CARROLLTON, MISS.—The Carrollton Electric Light Company has decided to rebuild its plant, which was destroyed by fire about a year ago. The company will dispose of the old machinery and install new equipment throughout.

NATCHEZ, MISS.—The Southern Light & Traction Company contemplates extending its lines to the National Cemetery and to Washington.

VICKSBURG, MISS.—The plant and holdings of the Vicksburg Street Railway & Lighting Company has been purchased by the Bullis Company, and will be reorganized under the name of the Vicksburg Power Company. S. S. Bullis is president of the Bullis Company.

CHILLICOTHE, MO.—A new telephone system will be installed by the Mutual Telephone Company, recently organized, in this city to connect with other mutual companies in the county.

NEVADA, MO.—The Missouri Light & Traction Company has awarded the contract for all improvements to be made to its property to the Freeborn Engineering & Construction Company, of Kansas City, Mo.

RICHMOND, MO.—The Richmond Electric Light Company has submitted a proposition to the City Council offering to sell its entire plant and holdings to the city for $18,000. The Council had authorized the Mayor to appoint a committee to make investigations in regard to the value of the plant and its purchase by the city.

GREELEY, NEB.—Extensive improvements are to be made to the local system of the Greeley Telephone Company, which was recently purchased by E. D. Gould, of Kearney, and others. The new owners expect to construct a number of new lines.

SEWARD, NEB.—Bids will be received until June 3 at the office of the city clerk for furnishing labor, material and apparatus for an addition to the municipal electric light system as follows: Brick addition and foundation for machinery, Corliss engine, generator, exciter and switchboard. John Martz is engineer.

LANCASTER, N. H.—The contract for lighting the streets of the town has been awarded to Messrs. Jones & Linscott for a term of five years. The company has been furnishing a day service, but will equip its plant for a 24-hour service. A new water wheel and a 75-kw generator has recently been installed in the plant, and an entirely new street lighting system will be erected. The Lancaster & Jefferson Electric Company has provided street lamps for the town for nearly 18 years.

NEWARK, N. J.—The finance committee of the Board of Freeholders has appropriated $10,000 for the installation of a larger electric light and power plant in the penitentiary. The equipment will consist of a 150-hp boiler, an 80-hp engine and generator. An appropriation of $26,500 for the installation of an electric plant at the court house was requested, but was deferred for action later.

BROOKLYN, N. Y.—The contract for installing electrical equipment in addition to and alteration in School 24, Borough of Brooklyn, has been awarded to T. Fred Jackson, New York City, for $8,813, by C. B. J. Snyder, superintendent of schools.

GENEVA, N. Y.—The new power plant which is to be erected by the Geneva-Seneca Electric Company will be located at Border City, and will furnish electrical energy to Geneva, Seneca Falls and Waterloo. The equipment of the plant will consist of 4500-kw, three-phase, 60-cycle generators direct connected to steam turbines. The capital for the new plant will be furnished by the Electric Securities Corporation, the holding company of the Geneva-Seneca Electric Company. The cost is estimated at $150,000.

HOOSICK FALLS, N. Y.—The Schaghticoke Electric Company has awarded the contract for the construction of its power house to the Hudson Valley Construction Company, of Troy, N. Y. Viele, Blackwell & Buck, 45 Wall Street, New York City, are the consulting engineers.

NEW YORK, N. Y.—Preparations are being made to equip the Hempstead division of the Long Island Railroad to be operated by electricity.

NEW YORK, N. Y.—Bids will be received until May 25 by C. B. J. Snyder, superintendent school buildings, for installing electric equipment in new Public School No. 100, Borough of Manhattan.

SOUTHAMPTON, N. Y.—The Public Service Commission, second district, has authorized the Suffolk Light, Heat & Power Company to issue $15,000 in bonds, the proceeds to be used for extensions and improvement to its plant.

CLEVELAND, OHIO.—The contract for the 1000-kw unit for the South Brooklyn municipal electric light plant has been awarded to the Westinghouse Machine Company, of Pittsburg, Pa., for $34,725.

CLEVELAND, OHIO.—The temporary restraining order enjoining the Cuyahoga Light & Power Company from placing underground conduits on Prospect Avenue was dissolved after a motion to that effect before Judge Babcock was granted. This move was anticipated on account of the franchise given the light and power company recently.

MT. VERNON, OHIO.—Extensive improvements are contemplated by the Mt. Vernon Telephone Company, including the rebuilding of its plant at Gambier, and the reconstruction of the line between Mt. Vernon and Fredericktown. The cost of the work is estimated at about $8,000.

NORTH BALTIMORE, OHIO.—The electric light and power plant owned by Dr. A. G. Henry has been sold to the Goodloe Company, of Toledo, for $30,000.

SIDNEY, OHIO.—The Sidney Telephone Company is in the market for the following supplies: Phantom repeating coils, galvanized iron wire, insulated wire, 1000 poles, insulators, storage batteries, etc. C. R. Bleakley is manager.

SPRINGFIELD, OHIO.—The property of the Washington Traction Company was purchased by George W. Baker, of Greenfield, at a receiver's sale for $36,667. Mr. Baker states that he will extend the railway from South Charleston to Washington C. H., Jeffersonville, Hillsboro and Greenfield. The road will also be brought into this city over its own right of way and a power house will be erected.

WEST POINT, OHIO.—The power plant of the Youngstown & Ohio River Railroad located in this city has been placed in operation and is now furnishing electricity to operate the cars between West Point, Lisbon, Salem, Columbiana and Youngstown. It is said that the necessary capital to complete the road into East Liverpool will be available at an early date.

CHICKASHA, OKLA.—The Chickasha Interurban Railway Company, which has leased the property of the Oklahoma City, Lexington & Sulphur Interurban Railway Company, has been offered the following bonus to extend the railway to the following points: Sulphur, $30,000; Wynnewood, $20,000; Davis, $20,000.

EL RENO, OKLA.—The city has applied to the secretary of the Board of Agriculture for permission to construct a canal across the bend of the North Canadian River, near El Reno, for power and irrigation purposes.

OREGON CITY, ORE.—Plans are being considered for the construction of an electric railway from Oregon City to the coal and cement fields in the eastern part of the county. F. M. Swift, of Portland, is interested in the enterprise.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until June 6, for furnishing the following supplies: Shop machines, pumps, electric motors, wire cable, steel tubing, electric marine fixtures, etc. Blanks and general information relating to this circular (No. 442) may be obtained from the office of the general purchasing officer, or the offices of the assistant purchasing agents, 24 State Street, New York City, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and Chamber of Commerce Building, Tacoma, Wash.; also from the U. S. engineer offices in the following cities: Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala. Lieut.-Col. H. F. Hodges is general purchasing officer

BLOOMSBURG, PA.—The United Telephone & Telegraph Company expects to construct a telephone line between this city and Cabin Run, and will also build a new line between Espy and Almedia.

EXCHANGE, PA.—The People's Ideal Telephone Company contemplates extending its lines from this city to Muncy

KUTZTOWN, PA.—The Kutztown Rural Telephone Company is contemplating the extension of its system to Eagle Point, Mill Creek Valley and New Smithsville.

MILLERSBURG, PA.—Plans are being considered by the Farmers' & Merchants' Rural Telephone Company to construct a new telephone line from this city to Freytown and thence to Crosskill Mills, Hamlin, Mount Aetna and Myerstown.

MONTOURSVILLE, PA.—The Montoursville Passenger Railway Company has increased its indebtedness from $75,000 to $150,000.

WEST CHESTER, PA.—The West Chester & Wilmington Street Railway Company has awarded the contract for the construction of its entire railway between Wilmington, Del., and West Chester, Pa., to the Eastern Construction Company. The line will be about 16 miles long.

YORK, PA.—Plans are contemplated by the York Haven Water & Power Company for extensive improvements to its plant, which will increase the output of the plant at York Haven from 10,000 to 20,000 hp. The plans call for the construction of an addition to the power house 280 ft. in length, 10 General Electric generators and 20 water wheels, manufactured by the Poole Engineering & Machine Company, of Baltimore, Md. An electric crusher will be installed at the quarries. The company also proposes to extend its high-tension transmission lines to Lancaster and other cities in the lower part of Lancaster County, and to Spring Grove and Hanover. E. F. Baker is general manager of the company.

ALBION, R. I.—The Town Council is considering a proposition submitted by the Albion Light & Power Company to furnish electricity for lighting the town. The company proposes to furnish electrical energy to light the mill and tenement houses of the Valley Falls Company. The present charter of the company only permits it to operate within a radius of one mile. If the charter is amended, it is said that the price for electric lamps furnished the town will be greatly reduced.

ABBEVILLE, S. C.—The city is considering the question of issuing $25,000 in bonds to purchase and improve the plant of the Abbeville Light & Power Company. J. L. McMillan is mayor.

PARKSVILLE, S. C.—The Twin City Power Company contemplates the construction of a large power plant on the Savannah River near Parksville.

CANOVA, S. D.—Proposals will be received by W. T. Gough, secretary of the Vermilion Telephone Company for material for construction of 13 miles of telephone line.

AUSTIN, TEX.—The Water and Light Commission has adopted plans for rebuilding the dam across the Colorado River here, at a cost estimated at $750,000. F. M. Maddox is Mayor.

PARK CITY, UTAH.—Among the new construction work contemplated by the Independent Telephone Company of this city is the erection of new telephone lines between Park City, Kamas and Heber.

BRATTLEBORO, VT.—The citizens have voted to authorize the Board of Bailiffs to take the necessary steps to procure from the next State Legislature permission for the Village of Brattleboro to purchase or construct a municipal lighting plant.

PETERSBURG, VA.—Plans are being made by the Dinwiddie County Telephone Company for several extensions to its lines.

RICHMOND, VA.—The receivers of the Richmond Passenger & Power Company have agreed to extend its transmission lines to Highland Park, a newly incorporated town north of this city, if enough patrons can be secured to pay the company for the cost of the work.

HARRINGTON, WASH.—The Big Bend Electric Light Company has purchased the Harrington electric light plant, formerly owned by William Brodie. The price paid for the plant was $15,000. The new company will take possession of the plant June 1.

LIND, WASH.—The Big Bend Light & Power Company has applied to the Council for a 30-year franchise to operate a water and light plant in this place.

SEATTLE, WASH.—Plans have been prepared by L. B. Youngs, superintendent of the Water and Lighting Department, for a substation to be erected in West Seattle, at a cost of $10,000.

TACOMA, WASH.—The special water committee on May 1 decided to recommend to the City Council that the Commissioner of Public Works purchase immediately an air compressor of at least 150 hp, with necessary motors and other equipment, and that plans be prepared for a building for the machinery; also that data be secured relative to the size of pipe required to replace the section of the Clover Creek flume now used to carry the well water to the pump house.

VANCOUVER, WASH.—Franchises have been secured by the Washougal-Sunnyside Telephone Company and the Ridgefield-Sara & Vancouver Farmers' Union Telephone Company to erect their lines over and across certain roads in Clarke County.

MILLVILLE, W. VA.—The Winchester & Washington City Railway Company has placed contracts for equipment for its plant as follows: To the Dayton Globe Iron Works Company, of Dayton, Ohio, for two pair of turbine wheels, with a rating of 1000 hp each; to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., for generators of 500 kw each.

BRUCE, WIS.—Plans are being prepared by Oscar Clausen, of St. Paul, Minn., for an electric light and water plant.

CASHMERE, WIS.—The Valley Power Company is contemplating installing a water and power plant in Cashmere, and proposes to furnish electricity to light the city and to operate the pumping plant at $40 per horse-power per year. About 50 hp will be needed.

CUMBERLAND, WIS.—The Common Council has decided to call a special election to vote on the proposition to issue $25,000 in bonds, the proceeds to be used to improve the electric light plant and to build a city hall.

MADISON, WIS.—The contract for the construction of the building for the separate heating, lighting and power plant for the new State Capitol has been awarded by the Capitol Commission to T. C. McCarthy, of Madison, for $108,000. The contract for the smokestack, which will be 200 ft. high, will be let soon.

WAUPUN, WIS.—The State Board of Control has awarded the contract for the power plant for the state prison to the Rathbun-Jones Engineering Company, of Toledo, Ohio, for $25,600.

CHEYENNE, WYO.—It is reported that Daniel Hewitt, of Colorado Springs, Col., president of the Interstate & Improvement Company, and S. G. Griffin will make application to the City Council for a franchise to operate an electric light and street railway system in this city. It is proposed to construct an electric railway through Cheyenne to Fort Russell, a distance of 5 miles. The cost of the proposed system is estimated at $75,000.

EDMONTON, ALB., CAN.—Alfred Bowen, of San Francisco, Cal., representing capitalists of Kansas City, is negotiating for the purchase of the partially completed electric street railway system.

EDMONTON, ALB., CAN.—City Engineer Keeley is making arrangements for the immediate construction of the civic power plant at a cost of $140,000.

LADYSMITH, B. C., CAN.—The ratepayers voted in favor of the installation of an electric lighting system. For further information address Mayor Nicholson.

NELSON, B. C., CAN.—The municipal electric light plant and the substation of the West Kootenay Power & Light Company were destroyed by fire, causing a loss of about $50,000. The plant of the Electric Tramway, leased by the city, was also entirely destroyed.

VICTORIA, B. C., CAN.—The British Columbia Electric Railway Company is planning to make many improvements to the local system, and will make extensions in and around the city, the cost of which is estimated at $2,000,000. The company is advertising for bids for the construction of the first section of the Chilliwack-Westminster electric railway from Westminster to Cloverdale, a distance of 12 miles.

MERRITON, ONT., CAN.—The Council has decided to install a municipal electric plant. For further information address G. B. Wilson.

PORT HOPE, ONT., CAN.—The plant of the Port Hope Electric Light & Power Company was completely destroyed by fire May 8, causing a loss of about $50,000.

FORT ERIE, ONT., CAN.—A bill has been passed in the Provincial Legislature giving the Fort Erie Ferry Railway Company permission to extend its railway along the frontier. The company proposes to build a railway from Chippawa to Port Colborne. Frank J. Weber is president of the company.

TORONTO, ONT., CAN.—Bids will be received by Adam Beck, chairman Hydro-Electric Power Commission, until June 2, for the construction of the Toronto-Niagara Falls, St. Thomas-Niagara Falls transmission line: (a) steel transmission towers; (b) transmission line cable; (c) erection, complete, of transmission system, according to plans and specifications to be seen at the Commission's office. Tenders will not be considered unless on form supplied by the Commission.

MONTREAL, QUE., CAN.—The Saraguay Electric & Water Company has been formed for the purpose of taking over the property and holding of the Saraguay Electric Light & Power Company. A bill has passed the Quebec Legislature granting the new company very extensive powers. The territory of the new company embraces the entire Island of Montreal, including the City of Montreal, the Island of Bizard, and the counties of Two Mountains, Laval and Terrebone. The company is contemplating increasing its output by several thousand horse-power during the present year. Its present plant is located in Cartierville. The company is capitalized at $3,000,000, and the directors are W. M. Ramsay, H. Lamporte, E. Champagne, Gaspard de Serres, and Charles Brandeis, all of Montreal.

PRINCE ALBERT, SASK., CAN.—The City Council has decided to replace the present electric lamps on the streets with arc lamps, supplying electricity from its own electric plant. For further information address C. O. Davidson, clerk.

PRINCE ALBERT, SASK., CAN.—The City Council has decided not to dispose of the municipal electric lighting plant and contemplates operating a municipal street railway system with it.

SAN ANGEL, MEX.—The United States & Mexican Trust Company, agents for Colonia Altavista, have secured the right of way for a street car line from the lower plaza in San Angel to the Inn. Arrangements have been made with the Tramways Company to build the road and operate it in connection with its general system. The company has recently installed an electric pumping plant.

New Industrial Companies.

THE LACKAWANNA ELECTRIC SHOE POLISHING COMPANY has been incorporated with a capital stock of $50,000 by F. P. Christian, J. A. Judson and W. L. Shrader, of Scranton, Pa.

THE BALL-COOLEY ENGINEERING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by Conrad Hubert, of New York, N. Y.; Walter Ball, of Rochester, N. Y., and John F. Cooley, of Boston, Mass.

THE INTERNATIONAL GENERATOR COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $100,000 by J. E. Whiting,

W. P. Jesup and F. C. Pringle. The company proposes to manufacture machinery, engines, motors, etc.

THE CARQUINEZ ELECTRIC & CONSTRUCTION COMPANY, of Martinez, Cal., capitalized at $20,000, has been incorporated by E. W. Jensen, Jos. Niayo, C. L. Pingree, F. C. Woolcott and M. C. Arnold.

MERRILL-RUCKGABER-FRASER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $35,000, by A. F. Ruckgaber, O. Merrill, of Brooklyn, N. Y., and C. E. Fraser, of Richmond Hill. The company proposes to do a general engineering and contracting business.

THE BENNETT-STODDARD COMPANY, of Augusta, Maine (electrical engineers), has been incorporated with a capital stock of $10,000. The officers of the company are: C. B. Stoddard, president; Irving Bennett, secretary, and C. S. Bennett, treasurer, all of Augusta, Maine.

THE GEORGE R. TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Trenton, N. J., has filed articles of incorporation with a capital stock of $50,000. The company proposes to manufacture electric specialties and the incorporators are: G. R. Trumbull, N. B. Trumbull and J. H. Delp.

THE WEIDENTHAL-GOSLINER ELECTRIC WORKS, of San Francisco, Cal., has been incorporated with a capital stock of $100,000 by S. H. Weidenthal, Herbert Gosliner and S. M. Samter. The company has just taken new quarters at the corner of Mission and New Montgomery Streets, this city.

THE CAMPBELL-STAGG COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 by William G. Campbell, Henry E. Moore, of New York, N. Y., and De Peyster Stagg, of Hackensack, N. J. The company proposes to manufacture mechanical and electrical devices, etc.

THE DARLEY ENGINEERING COMPANY has filed articles of incorporation with the Secretary of State at Wilmington, Del. The capital stock of the company is placed at $100,000 and the incorporators are: Harland B. Tibbetts, James G. Gregg, both of New York, N. Y., and John T. McGovern, of Brooklyn, N. Y.

THE DICTAPHONE COMPANY OF AMERICA, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000. The company proposes to manufacture and deal in phonographs, dictaphones, etc. The incorporators are: Theodore F. Mumphrey, Horace Barnard, of New York, N. Y.; Howard S. Fisher, of Greenwich, Conn.; Henry G. King, Jacob W. Binder, William H. MacGregor, of New York, N. Y., and John C. Button, of Rochelle Park.

Company Elections.

LAKEPORT, CAL.—At the annual meeting of the Sonoma & Lake County Railway Company the following-named officers were elected: A. E. Dickenson, president; J. E. Fulton, vice-president; D. F. McIntire, secretary; J. R. Garner, treasurer, and W. P. Mariner, general manager.

WATERBURY, CONN.—At the annual meeting of the Waterbury-Milldale Tramway Company the following officers were elected: Charles H. Clark, of Milldale, president; John H. Cassidy, of Waterbury, secretary, and E. S. Todd, of Southington, treasurer.

SPRINGFIELD, MO.—At the annual meeting of the Springfield Traction Company the following-named officers were elected: George E. McComber, of Augusta, Maine, president; W. A. Bixby, vice-president and general manager; N. J. Cunningham, secretary, and E. B. Lewis, of Chicago, Ill., treasurer.

New Incorporations.

ONTARIO, CAL.—Articles of incorporation have been filed for the San Bernardino Telephone & Telegraph Company, with a capital stock of $200,000. The directors of the company are: J. A. Fletcher, R. P. Carter, L. R. Kennedy, J. N. Hartley and R. L. Dunbar, all of Ontario.

SAN FRANCISCO, CAL.—The Keystone Electric Company has been incorporated with a capital stock of $10,000 by S. H. Foster, Geo. Nolan, William W. Goldnamer. A. P. Harris, attorney.

CHICAGO, ILL.—The Kenilworth Lighting Company has filed articles of incorporation with a capital stock of $25,000. The incorporators are Girard A. Ellingston, Albert V. Horn and Julius L. Hecht. The company proposes to operate a heating, light and power plant.

MONTROSE, ILL.—The Montrose Mutual Telephone Company has been incorporated, with a capital stock of $9,000, by G. B. Tope, Rueben A. Isley, Campbell J. Elliott, M. F. Wallace, T. O. James and others.

HANFORD, IA.—The Hanford Telephone Company has been chartered with a capital stock of $10,000 and the following named officers elected: H. Diercks, president; A. J. Talbred, vice-president; C. S. Hansen, secretary and treasurer.

SIOUX CITY, IA.—The Farmers' Mutual Telephone Company has been organized to take over the property of the Pierson Independent Company. The follpwing named officers have been elected: O. L. Cole, president; J. F. Brooks, vice-president; Oscar Pixler, secretary, and J. H. Benson, treasurer.

MASON CITY, IA.—The Farmdale Telephone Company has been incorporated, with a capital stock of $10,000, and the following officers elected: G. W. Gibbs, president; D. E. Elson, secretary and treasurer.

BONNER SPRINGS, KAN.—The Wyandotte County Telephone Company has been organized, with a capital stock of $75,000. The directors are: T. S. McKinnon, of Tonganoxie; J. A. Thompson, of Edwardsville; J. D. Waters, J. D. Coon and W. S. Twist, of Bonner Springs.

DIXIE, KY.—The Dixie Telephone Company has been formed, with a capital stock of $1,000, by J. T. Walkers, David Dayler and S. K. Lewis. The company contemplates the construction of a telephone system to Hartley. About 15 miles of line will be erected and the company is in the market for construction material.

JACKMAN, MAINE.—The Jackman & West Forks Telephone Company has been incorporated with a capital stock of $10,000 by Charles L. Andrews, of Augusta; Henry P. McKenny and L. A. McKenny, of Jackman.

FORT FAIRFIELD, MAINE.—Articles of incorporation have been filed for the Fort Fairfield Light & Power Company. The company is capitalized at $21,000, and the officers are D. E. Edwards, president; H. T. Powers, treasurer and clerk, all of Fort Fairfield, Maine.

EDMORE, MICH.—The Farmers' Home Telephone Company has been organized to construct a telephone system in the Cutler and Savage districts.

OTTAWA LAKE, MICH.—The Whiteford Farmers' Telephone Company has been chartered with a capital stock of $6,000, with headquarters at Whiteford Center, post office address Ottawa Lake.

ELBOW LAKE, MINN.—The Farmers' Home Telephone Company has been organized to construct a telephone system and the following named officers have been elected: Peter Martinson, president; Elbur Felstrom, vice-president; T. Pederson, secretary, and Nels Anderson, treasurer.

FERGUS FALLS, MINN.—The French Telephone Company has been formed to construct a telephone line from Pelican River to Fergus Falls and thence to French Station.

FRUITLAND, MO.—The Farmers' Mutual Telephone Company has been formed in this city and the following named officers elected: A. P. Williams, president; W. W. Randol, vice-president: William Wessel, secretary, and Theodore Leimer, treasurer. The company proposes to establish an exchange at Pocahontas, and extend its lines to Leemon, Fruitland, Shawneetown and other points, and, ultimately, to Jackson.

CULBERTSON, MONT.—The Montana Star Telephone Company has been organized to construct a telephone system from Redstone and Plentywood to Culbertson and thence to Glasgow. Exchanges will be established at Homestead, Medicine Lake, Plentywood, Redwood and other places.

FREEHOLD, N. J.—The Freehold & East Windham Telephone Company has been incorporated, with a capital stock of $12,000 and the following directors elected: W. J. Griffin, of East Windham; Harry Phinney and R. C. Lacey, of Freehold.

BERLIN, N. Y.—Articles of incorporation have been filed for the Berlin Electric Light, Heat & Power Company by James C. Cowie, W. C. Baxter, of Troy, and Victor M. Allen, of Petersburg. The company proposes to operate in Berlin, Petersburg, Grafton and Stephentown.

ROCHESTER, N. Y.—The Rochester, Syracuse & Utica Telephone Company, a reorganization of the Independent Telephone Securities Company, operating in Central New York, has filed a certificate of incorporation with the Secretary of State. The capital stock of the company is placed at $1,500,000 and the directors are: E. W. Beck, G. R. Fuller, W. Roy McCane, of Rochester; E. B. Odell and C. H. Poole, of Utica; H. S. Holden and A. H. Cowle, of Syracuse.

NEW PHILADELPHIA, OHIO.—Articles of incorporation have been filed for the Columbus, Canton & Eastern Transit Company. The company is capitalized at $200,000, and the incorporators are Michael Leibold, W. J. Wise, W. W. Snyder, Clyde J. Krusely, Frank G. Kneugler, F. O. Richards, C. A. W. Reiser and C. S. Rhodes.

CLEVELAND, OHIO.—The Wheeling & Western Traction Company has been incorporated, with a capital stock of $1,000, by A. E. Townsend, T. H. Bierbach, Josiah Wolf, Nathan Fromstine and Herbert Goldpaden.

DILLONVALE, OHIO.—The Mt. Pleasant Electric Light & Power Company has been incorporated with a capital stock of $20,000 by John F. Frasher, Howard T. Roe, O. L. Roe, J. S. Paxton and G. W. Carson.

NEWARK, OHIO.—Articles of incorporation have been filed for the Ohio, Lake Erie & Eastern Railway Company. The capital stock of the company is placed at $2,000,000 and it proposes to construct a railway from Mount Vernon to Wooster. A bond issue of $2,000,000 has been authorized by the directors. The officers of the company are: Frank L. Owen, president; J. F. Shrontz, vice-president; F. E. Elliott, secretary, and J. H. Chilcote, treasurer.

ADA, OKLA.—The Farmers' Independent Teelphone Company has been organized with a capital stock of $6,000, and the following named directors elected: H. M. Parkhurst, J. M. Paney, E. F. Paugh, J. M. Kennedy, F. W. Leferve and T. P. Holt, all of Ada.

DEER CREEK, OKLA.—Articles of incorporation have been filed for the Deer Creek Telephone Company, with a capital stock of $240, by A. R. Squire, W. A. Shipley, C. W. McKowan and others.

KORN, OKLA.—Articles of incorporation have been filed for the Korn Valley Telephone Company. The company is capitalized at $1,200 and the incorporators are: D. D. Weins, of Weatherford; J. J. Warkenton and P. F. Schmidt, of Korn.

MERIDAN, OKLA.—The Springvale Rural Telephone Company has been incorporated, with a capital stock of $2,000, and the directors are: Lee Smith, S. R. Rushet, W. Jamison, W. Jennings, R. Lowell, John Vincent and A. C. Hamlin, all of Guthrie. The company proposes to erect a telephone system at Evansville, post-office address, Meridan.

Obituary.

MR. LAVELLE MORGAN BLANDING, president of the Binghamton Electrical Construction Company, of Binghamton, N. Y., died at his home on May 2. Mr. Blanding was connected with the Blanding family, of Providence, R. I., and was for years engaged in the drug business. Although he was not very actively engaged in the electrical business, he made a number of friends in the industry who will lament his loss.

MR. JOSEPH REYNOLDS TILLINGHAST, secretary of the Electrical Jobbers' Association and widely known among electrical men, died from apoplexy in Englewood, N. J., on Sunday, May 10. He is survived by a widow. Mr. Tillinghast was born in New York City, Sept. 19, 1844, which made him sixty-four years old at the time of his death. He was the son of Philip Tillinghast, of the well-known manufacturing and commission dry goods firm of Hunt & Tillinghast. Mr. Tillinghast was a graduate of the public schools and attended New York University. After completing his education he traveled abroad for two years, and on his return took charge of his father's woolen mills at Leeds-on-the-Hudson, and later at Bennington, Vt. In 1868 he married Miss Katherine Swift, of Bennington. At one time Mr. Tillinghast was general agent for a prominent insurance company of Providence, R. I., and for several years was associated with the banking firm of Phelps, Dodge & Company. About four years ago he became secretary for the Electrical Jobbers' Association, with offices at 261 Broadway. His son, J. R. Tillinghast, Jr., who died about five years ago, was a graduate of Williams College and a prominent physician of New York City. The following tribute paid to Mr. Tillinghast by one of the great number of his friends gives a fair idea of how he was regarded by his social and business friends: "One of the strongest characteristics of the late Mr. Tillinghast and the one which did the most to make him a popular man among business men, was the absolute and unswerving loyalty which he showed toward his friends. He was the very soul of trustworthiness, an untiring worker and thoroughly unselfish, a high type of man, strong, both in character and ideals. Perhaps the best thing that I can say about him is, that under no conditions, no matter how trying, was he ever anything but a gentleman, in the highest sense of the word." Mr. Tillinghast was the first secretary for the Electrical Club.

Personal.

MR. T. W. MEACHEM, president of The New Process Raw Hide Company, Syracuse, N. Y., has been elected president of the Chamber of Commerce of Syracuse.

MR. WILLIAM PLATTEN has tendered his resignation as superintendent of the light and water plant at Bluffton, Ohio, and has accepted a position as manager and superintendent of the light and water plant at North Attleboro, Mass.

MR. HERBERT C. PETTY was elected, May 13, a director of the Crocker-Wheeler Company. Mr. Petty accepted a position in the sales division of the company January, 1903, and was advanced rapidly to the position of contract manager. His election as director is a recognition of the esteem and confidence which he commands among the stockholders of the company.

MR. THOMAS F. MULLANEY was tendered a complimentary dinner at the Engineers' Club, New York, on May 6, by his friends of the General Electric Company. Mr. Mullaney has just severed his connection of over twenty years to take up work as chief engineer of the Third Avenue Railroad Company, of New York, to which position he was recently appointed. In the early days of the electrical business Mr. Mullaney was connected with the Thomson-Houston Electric Company and later with the General Electric Company. He has always been prominent among construction and operating electrical engineers. Mr. Mullaney has a host of friends throughout the world whose good wishes go with him in his new position.

Unclassified Items.

SAULT STE. MARIE, ONT., CAN.—The power houses of the Tagona Water & Light Company and the Lake Superior Power Company were destroyed by fire May 18, causing a loss of $300,000. The water, lighting and street car systems are affected, but it is expected that electricity for the street railway system will be furnished from the steel plant auxiliary.

SUMMERVILLE, S. C.—An election will soon be held to vote on the proposition to light the streets of the town. The Council is considering the question of entering into a contract with the Crystal Ice & Cold Storage Company to furnish the necessary electrical energy.

CANON CITY, COL.—Plans are being made to organize a company to build an electric power plant and railway which will connect the important towns in the Arkansas Valley from Garden City, Kan., to Canon City, Col. The company will be known as the Kansas-Colorado Power & Railroad Company and will be capitalized at $15,000,000.

PITTSBURG, PA.—The Meyersdale Construction & Equipment Company has been incorporated with a capital stock of $100,000, by H. D. Brenn, W. A. Wood, of Pittsburg and W. W. Stand, of Belleville. The company proposes to construct and operate railways.

ITHACA, N. Y.—The Ithaca Street Railway Company has been granted a franchise to double track its system on certain streets of the city, in return for which the company is to pay the city a rental of $500 per year.

ST. PAUL, MINN.—J. W. Mossop, vice-president of the St. Paul, Minneapolis & Seattle Electric Railway Company has applied to the City Council for a franchise to construct and operate a double track railway from the present terminus of the Rice Street line to Como and Phalen Boulevard.

WILMINGTON, DEL.—The Street and Sewers Directors have granted the Peoples Railway Company a franchise to lay its tracks on Church Street from Seventh to Fourth, and to run its cars near the wharf of the Wilson Line of steamboats.

ST. ANDREWS, FLA.—The St. Andrews Electric Light & Power Company has been formed to furnish electricity for light and power, and to build a 15-ton ice plant. J. H. Drummond is interested in the enterprise.

MITCHELL, S. D.—The plant and holdings of the Mitchell Gas Company, including the electric light plant was purchased by D. A. Mizener for the Mitchell Illuminating & Power Company at a receiver's sale for $25,010. The new company has increased its capital stock to $200,000, and proposes to extend and increase the operation of the plant.

WEATHERFORD, OKLA.—The City Council has authorized plans prepared for an electric light system.

SNYDER, OKLA.—The construction of an electric light plant and water works system are among the improvements contemplated for Snyder.

SACRAMENTO, CAL.—The Board of Supervisors of Sacramento County has granted the Western Power Company a franchise to erect transmission lines through the county. The amount paid for the franchise was $100.

ELGIN, ILL.—The Aurora, Elgin & Chicago Railway Company has appropriated $80,000, for the construction of a substation, which will be located in Elgin, and for which bids for construction are now being received. Edwin C. Faber is general manager, and Edmond A. Bell, chief engineer.

PERRY, N. Y.—The Rochester, Scottsville & Caledonia Railroad Company, which proposes to construct an electric railway from Rochester to Glen Iris Park, has secured a franchise through the town of Perry.

EL CENTRO, CAL.—Extensive improvements are to be made to the power plant located at Holtville, on the Alamo River. An additional turbine and generator will be installed, which will increase the output of the plant by 1000 hp.

WINDBER, PA.—Contracts have been placed by the Berwind-White Coal Company with the Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company for the construction and equipment of a central power plant, which will furnish electrical power for operating the various mines of the company in central Pennsylvania. The new station will be located at Windber, and the equipment will include two 1500-hp steam turbine engines and six 500-hp rotary converters, 18 transformers, two 500-hp motors and two motors of 225 hp. The Berwind-White Coal Company is planning to abandon the individual power plants at the different mines and will furnish electrical energy for all of its mines from the new station when completed.

KIRKSVILLE, MO.—The plant and holdings of the Kirksville Electric Company have been purchased by the parties interested in the development of the coal fields just west of the town. It is understood the consideration for the plant was between $45,000 and $50,000. The new company has been organized under the name of the Kirksville Light, Heat & Power Company.

INDIANAPOLIS, IND.—The contract for electric wiring the Coliseum and other buildings at the State Fair Grounds, the driveways and amphitheater, has been awarded by State Agricultural Association to the Standard Electric Machine Company, of this city, for $18,049. The contract for furnishing electricity for lamps during the State Fair has been awarded to the Home Heat & Light Company, at $6,500.

Business Notes.

STANDARD ELECTRICAL WORKS.—In our issue of May 2 mention was made of the fact that the United States Standard Electrical Works Company, of Racine, Wis., had changed its name to the Standard Electrical Works Company. The name of the company should have been Standard Electrical Works instead of that given.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., has purchased the foundry formerly operated by the Northwestern Foundry & Supply Company, of Detroit, which was the manufacturer of cast iron soil pipe and fittings and plumbers' specialties, and will operate the plant in the manufacture of blower, exhaust fan, engine and heater castings.

SCHAEFFER MACHINE WORKS.—Chas F. Schaeffer has withdrawn from the Gray's Ferry Machine Co., and will operate the Schaeffer Machine Works at Thirty-ninth Street and Gray's Ferry Road, Philadelphia. The plant mill be designed as a modern machine shop and equipped with the latest type of machine tools.

MR. HERBERT H. HAMMOND, for the past five years secretary and sales manager of the Standard Electric Time Company for all of New England except Connecticut, and all of the territory along the New York Central lines, with an office in Boston, has recently resigned to accept the position of manager of the Electric Time Department of the Dey Time Register Company, Syracuse, N. Y. This company will manufacture complete programme clock systems for schools and factories, and will specialize particularly in synchronizing time registering clocks from a self-winding master regulator. Mr. Hammond is now making his headquarters at the Dey factory in Syracuse.

SPLITDORF IGNITION SPECIALTIES.—C. F. Splitdorf, of New York, the well-known ignition specialist, has opened a well-appointed and commodious store for the sale of his coils, plugs and other ignition specialties at 319 Michigan Avenue, Chicago. Mr. B. P. Houlihan, who for some years has been manager of this firm's San Francisco branch, and who is well and favorably known among the trade, will be in charge of the new store.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 12, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

887,061. CLOSED CIRCUIT THERMOSTAT; George H. Bowen, Boston, Mass. App. filed June 20, 1907. A thermostatic circuit controller designed to be wholly enclosed within a glass tube and having a fusible member forming part of a circuit and heated by contact with the walls of the tube.

887,071. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Nov. 11, 1903. Complete cord and signal circuits for city exchange system.

887,077. SLEET CUTTER AND SCRAPER; Frank L. Dye, Springfield, Ill. App. filed Jan. 28, 1908. In addition to the usual trulley wheel, the patentee has a supplemental wheel mounted on a supplemental pole section which has a toothed thread so as to cut away the ice in advance of the usual wheel.

887,087. ELECTRIC THERMOSTAT; Harry G. Geissinger, New York, N. Y. App. filed May 29, 1907. An apparatus for regulating and controlling temperature. Has a thermal couple comprising a rigid channel-shaped element having closed ends, and a flexible element having its extremities abutting against said closed ends and supported in the rigid element by such contact.

887,088. SYSTEM OF TEMPERATURE CONTROL; Harry G. Geissinger, New York, N. Y. App. filed July 3, 1907. A system of control which permits the regulation of temperature in each room or apartment to be made independently of that in the other rooms. Each room has a separate thermostat acting on the electro-magnetically operated air valves of the heating system.

887,096. ELECTRIC INTERRUPTER AND INTERMITTER; John Robert Kelley, Cincinnati, Ohio. App. filed Aug. 8, 1907. Interrupter for use with induction coils and the like for interrupting a primary current into a very great number of separate impulses. Has an anode consisting of a tube or hollow cylinder of platino-iridium, and a gold core within said cylinder.

887,106. ARMATURE WINDING MACHINE; Charles H. Lewis, New Haven, Conn. App. filed June 15, 1905. Relates to machines for winding wire on armatures, by which a plurality of armatures may be wound simultaneously, and in which the wire is guided and the tension regulated automatically. Has a series of armature holders with a common axis of rotation and adapted to grip a plurality of armatures so that they will rotate on the same axis.

887,107. WIRE FASTENER FOR INSULATORS; Fred M. Locke, Victor, N. Y. App. filed Nov. 24, 1905. The insulator has an open groove on its upper surface with slightly undercut edges. The wire is held in the groove by a pair of conical plugs which are engaged endwise over the wire and fastened together.

887,123. ELECTRODE FOR ELECTRIC FURNACES AND PROCESS OF MAKING THE SAME; Edgar F. Price and Frank J. Tone, Niagara Falls, N. Y. App. filed Jan. 8, 1906. An electrode for furnaces comprising a mixture of electrically produced graphite, amorphous carbon and a binder.

887,124. VOICE-SCREEN FOR TRANSMITTER-MOUTHPIECES; Robert H. Ralston, Denver, Col. App. filed Sept. 1, 1906. A funnel adapted to be applied to an ordinary transmitter to direct speech thereinto.

887,127. ELECTRIC ARC LAMP; Victor Watson Riley and Herbert William Rowing, London, England. App. filed March 10, 1906. A feeding mechanism for electric arc lamps of the type in which the upper carbon is fed by gravity and separated from the lower carbon by a solenoid-operated clutch. Relates to details of construction.

887,157. ELECTRIC ALARM THERMOMETER; Wilhelm Walther, Homburg, Germany. App. filed March 12, 1907. An alarm thermometer having a mercury tube with a pair of platinum contacts which serve to complete one or more electric arcs in each of which an electric alarm device is provided. Has a wire gauze shield which surrounds the mercury tube, so that the alarm will occur before the tube breaks.

887,166. ELECTRIC PUSH BUTTON; Henry Wilhelm, New York, N. Y. App. filed Aug. 1, 1907. Construction of push button having a sheet metal casing which is assembled upon a porcelain block carrying the contact springs.

887,169. SIGNAL OR SWITCH APPARATUS AND SIGNALING SYSTEM; Adoniram J. Wilson, Westfield, N. J. App. filed Oct. 15, 1902. Provides a signal apparatus in which the signal is adapted to assume at least three positions. Makes use of fluid pressure motors for operating the signal. Has liquid gas motors, the liquid gas being stored in a tank in proximity to the signal.

887,220. APPARATUS FOR PRODUCING VOLTAIC HIGH CURRENT ARCS; Harry Pauling, Gelsenkirchen, Germany. App. filed Sept. 30, 1907. An apparatus for the production of voltaic high current arcs in which the arcs are produced by means of diverging electrodes and by a current of gas which blows the discharges along the electrodes so as to form arcs of the required lengths which break and extinguish after attaining a definite length.

887,221. LIGHTNING ARRESTER; John Pearson, Somerset, Wis. App. filed Nov. 24, 1905. Provides an improved lightning arrester which will allow a free discharge from a line to the ground of abnormally high static charges such as produced by lightning, but which will offer great resistance to the dynamo or line current and not permit such flow thereof to the ground as would short circuit the generator and thereby impair the good running condition of the system.

887,222. MEANS FOR AUTOMATICALLY CONTROLLING VOLTAGE AND POWER FACTOR OF GENERATORS OPERATING IN MULTIPLE; John Pearson, Somerset, Wis. App. filed March 1, 1906. Provides means for automatically controlling the fields of generators located in distant stations, whereby the same will be operated in multiple when delivering electric energy over the same transmission line.

887,231. TELEPHONE-TRANSMITTER; Elmer R. Corwin, Clyde, Ill. App. filed Dec. 27, 1906. Details of microphone contact and diaphragm.

887,233. CALL-REGISTER FOR TELEPHONE SYSTEMS; William W. Dean, Elyria, Ohio. App. filed Oct. 18, 1906. The combination with a transmitter, of signaling and registering devices, and means for supporting said signaling and registering devices from the front plate of such transmitter inside of the chamber formed by the back of such transmitter.

887,253. VALVE OPERATING MECHANISM; William B. Jackson, Madison, Wis. App. filed Oct. 6, 1905. A valve operating mechanism for controlling the opening and closure of large valves controlling water flow through pipes or pen-stocks.

887,260. OPERATOR'S SELECTIVE RINGING-KEY FOR TELEPHONE SYSTEMS; Kay H. Manson, Elyria, Ohio. App. filed Nov. 15, 1904. Mechanical features of keys including detent rollers by which they are held depressed.

887,261. ELECTRICAL SIGNALING AND SWITCHING APPARATUS; Ray H. Manson, Elyria, Ohio. App. filed June 14, 1905. A combined self-restoring drop and jack. Relates to mechanical features of construction of the drop shutter.

887,263. CONNECTION SWITCH; George K. Thompson, Newton Highlands, Mass., and Frank R. McBerty, Evanston, Ill. App. filed Dec. 7, 1904. A telephone plug is enclosed in a conical housing which fits over and encloses the jack so as to afford adequate protection against injury from accidental high potential currents on the line.

887,266. PROCESS FOR CONCENTRATING NITRIC ACID; Harry Pauling, Gelsenkirchen, Germany. App. filed Aug. 13, 1906. A process consisting in electrolyzing aqueous nitric acid and passing the nitric oxides, formed at the cathode, into the acid surrounding the anode.

887,287. RAILWAY SWITCHING APPARATUS; John D. Taylor, Pittsburg, Pa. App. filed Jan. 11, 1904. Railway switching apparatus in which a number of switches are operated and controlled from a central station, the controlling levers interlocking with one another to prevent conflicting routes. Includes complete electrical and mechanical features. Has means for governing the passage of cars or vehicles along a railway.

887,288. APPARATUS GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY AND THE CONTROL THEREOF; John D. Taylor, Edgewood Park, Pa. App. filed Oct. 26, 1904. Relates to modifications of the above.

887,289. APPARATUS FOR CONTROLLING THE PASSAGE OF TRAINS; John D. Taylor, Wilkinsburg, Pa. App. filed Oct. 26, 1904. Covers additional modifications.

887,290. CONTROL OF APPARATUS GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY; John D. Taylor, Pittsburg, Pa. App. filed Aug. 23, 1906. Covers still further modifications.

887,291. SAFETY CONTROLLER FOR ELECTRIC SWITCH OPERATING APPARATUS; John D. Taylor, Pittsburg, Pa. App. filed Dec. 8, 1906. Relates to electric switches and a means by which they are selectively displaced to one position or the other by successive closures of an operating or pilot circuit.

887,326. OXIDATION OF NITROGEN BY MEANS OF ELECTRICITY; Demetrio Helbig, Rome, Italy. App. filed Jan. 23, 1905. The art of oxidizing atmospheric nitrogen which consists in passing the gas to be treated through a chamber having surfaces of its walls of ionizing material, striking an electric arc within the chamber and ionizing the gas therein, and increasing the length of the arc until the flame passing across the arc fills the chamber and intercepts the stream of gas passing through the same.

887,331. ELECTRIC WATER HEATER; Oscar Johnson, of Seattle, Wash. App. filed Dec. 20, 1905. A water heater making use of a cylindrical casing with a number of nesting cylindrical partitions between the water flows and which constitute resistance elements.

887,333 ELECTRICAL HEATING ELEMENT; Frank Kuhn, Detroit, Mich. App. filed Oct. 15, 1907. Construction of sad-iron having a central chamber in which a resistance element is received The resistance element is held in place by a spring which establishes the electrical connections.

887,336. ELECTRIC INSULATOR; Herman Mieth, Vallejo, Cal. App. filed May 29, 1906. A construction of insulator for high-potential transmission lines and wireless installations. Has a rod with a main cylindrical casing, and an auxiliary cylindrical casing extending upwardly into the main casing over said rod and the interposed insulation.

887,357. WIRELESS TELEPHONE; Nathan B. Stubblefield, Murray, Ky. App. filed April 5, 1907. A telephone system for use on canals and rivers and, depending on magnetic induction. The boat or conveyance has a flat coil in proximity to the telephone line extending along the path of travel.

887,358. WALL BRACKET; George F. Swortfiger, Newark, N. J. App. filed May 1, 1905. A cast-iron bracket having a plurality of prongs adapted to receive insulators in an offset relation to one another, whereby the line connections may be easily made.

887,439. TROLLEY WHEEL FOR ELECTRIC CARS; George C. Stratton, Camden, N. J. App. filed July 18, 1907. The wheel is journaled between a pair of concentrically revoluble plates having radially projecting spokes or arms designed to close over the trolley wire.

887,442. CONTROLLER; Lewis L. Tatum, Norwood, Ohio. App. filed June 28, 1906. The controller drum has a pair of cams thereon each engaged by the spring-impelled detent rollers and which co-operate together to prevent improper movements of the controller drum.

887,473. TELEPHONE-RECEIVER; William Gibson, Danbury, Conn. App. filed Aug. 23, 1907. A telephone-receiver formed in two parts from vitreous material, combined with a screw threaded metal ring on one part, and a screw threaded metal collar interlocked with the other part.

887,476. APPARATUS FOR ELECTRIC OXIDIZING OF ATMOSPHERIC NITROGEN; Demetrio Helbig, Rome, Italy. App. filed Jan. 5, 1906. The combination with a chamber having a wall surface of ionizing material and a gas entrance and a gas exhaust, of electrodes at opposite sides of said chamber and located adjacent to the walls thereof for producing an electric arc across the same.

887,482. ELECTROCOSMETIC FACE MASK; Gustave C. Lammers, Oakland, Cal., and Sanford Bennett, Alameda, Cal. App. filed Aug. 26, 1907. A device for the treatment of the face, comprising a rigid mask folded to fit an individual face and formed of material capable of conducting an electrical current to the surface of the skin.

887,483. ELECTRICALLY PROPELLED VEHICLE; Joseph Ledwinka, Philadelphia, Pa. App. filed Aug. 3, 1907. A driving unit comprising two vehicle supporting wheels which are maintained in axial alignment, but are relatively rotatable by independently controllable motors. Is particularly applicable to trucks for trolley railway cars.

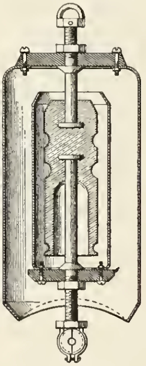
887,496. OUTLET BOX COVER; George B. McBean, Chicago, Ill. App. filed Jan. 4, 1907. A cover for outlet boxes adapted for attachment to a box and having an integral tubular socket and radial ribs connecting the rearwardly extending portion of the socket to the inner face of the cover, said ribs being integral with the socket and the cover. Has suitable terminals carried by the socket at its inner end.

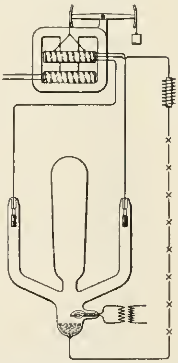
887,501. ELECTRICAL CUT-OUT; Philip Thomas McNally, Mandan, N. D. App. filed June 28, 1907. A cut-out device by which a small circuit wire from the power house is extended to the cut-out device at a remote point, to operate an electromagnet and give the initial impulse for bringing into service another magnet which throws the switch.

887,504. AUTOMATIC SWITCH FOR TROLLEY LINES; Joseph Nelson, Cape May, N. J. App. filed Aug. 30, 1907. The trolley pole has a pair of special contact rollers adapted to engage plates alongside the trolley wire and selectively energize magnets controlling the switch point.

887,514. OPERATING MECHANISM FOR RADIATOR VALVES, ETC.; William H. Pearce, Chicago, Ill. App. filed June 28, 1906. Operating mechanism for radiator valves. Makes use of a special spiral wire the free extremity of which moves between contacts to constitute a thermostat and which selectively energizes electromagnets controlling the valves of the radiator or similar device.

887,520. INSULATOR; John Wm. Rehling, Allegheny, Pa. App. filed Sept. 6, 1907. A generally rectangular porcelain block having a pair of projecting lugs with roughened surfaces between which the conductor is received in a zig-zag path.


887,336—Electric Insulator.


887,660—Starting Device for Mercury-Vapor Apparatus.

887,521. DYNAMO ELECTRIC MACHINE; Henry G. Reist, Schenectady, N. Y. App. filed Jan. 24, 1902. A rotatable element for a generator designed to withstand very high centrifugal stresses. The rim of the rotatable element is made of steel plates which are interlocked together with great strength and rigidity.

887,525. LIGHTNING ARRESTER; David B. Rushmore, Schenectady, N. Y. App. filed Jan. 5, 1907. Has a plurality of spark gaps arranged in groups and connecting the line conductor to the ground. Some of the groups are shunted by graduated resistances.

887,527. SERIES MULTIPLE SWITCH; Howard R. Sargent, Schenectady, N. Y. App. filed May 22, 1905. A means whereby two or more incandescent lamps can be connected either with all the lamps extinguished or with all in series to give a dim light, or with one lamp only to give a brighter light, or else the full illumination. Is made in the form of an ordinary turn-button snap switch.

887,533. APPARATUS FOR TELEPHONING; Frederik Sindingchristensen, New York, N. Y. App. filed May 17, 1901. A telephone apparatus comprising line-conductors, condensers arranged at intervals therealong and joined in parallel thereby, a grounded induction coil joined to one end of one of said line-conductors, a transmitter circuit for affecting said induction coil, and a grounded receiver connected to the remote end of the other line-conductor.

887,539. MOVABLE PLATING APPARATUS; George P. Stevens, Chicago, Ill. App. filed Aug. 27, 1907. Has a tank and a support for the work elevated above the intended level for the solution in the tank, and means for reciprocating such support.

887,559. REVOLVING MULTIPLE FUSE BLOCK; Enoch Westerdahl, Thief River Falls, Minn. App. filed May 27, 1907. Makes use of a cylindrical drum notched to receive a plurality of fuses about its periphery and rotatable to position the fuses successively in a circuit.

887,576. RAILWAY SIGNAL; Sofrony Bayas, Los Angeles, Cal. App. filed April 15, 1907. The patentee provides a pair of special trolley wires which are adapted to be energized by a generator within the locomotive cab and actuate alarm signals in case another train should be on the same block or section.

887,598. ELECTRICAL CONDENSER SUITABLE FOR USE IN WIRELESS TELEGRAPHY AND OTHER PURPOSES; Lucien Henri Delloye, Paris, France. App. filed March 26, 1906. An electrical condenser comprising a pair of wire nettings imbedded in a block of glass.

887,612. CONTROLLING MEANS FOR ALTERNATING-CURRENT MOTORS; Augustine R. Everest, Lynn, Mass. App. filed June 22, 1905. In combination with an alternating-current motor adapted to be operated from a single-phase source of supply having different connection for starting and for running, a normally open switch included in the starting connections, a magnet winding in series with said motor, and means controlled by said magnet winding for closing said switch to establish starting connections.

887,639. DYNAMO ELECTRIC MACHINE; Louis R. Horning, Norwood, Ohio. App. filed Feb. 28, 1906. Has a plurality of brushes and brush studs, and straight insulated links joining adjacent brush studs for the purpose of bracing some to prevent vibration.

887,642. VAPOR ELECTRIC APPARATUS; Alexander McLeod Jackson, Schenectady, N. Y. App. filed Dec. 9, 1903. Mercury vapor apparatus comprising main electrodes and an auxiliary electrode, and a current-limiting resistance in circuit with the auxiliary electrode and located in heat-transferring relation to said auxiliary electrode.

887,645. ANTISEPTIC LINING OF TALKING AND HEARING TUBES FOR TELEPHONES; Hermann Jankelowitz, Gera, Germany. App. filed May 25, 1907. Antiseptic lining for telephone transmitters and receivers consisting of a plurality of superposed sheets of antiseptic paper rolled up from a long strip with lateral projections registering with each other.

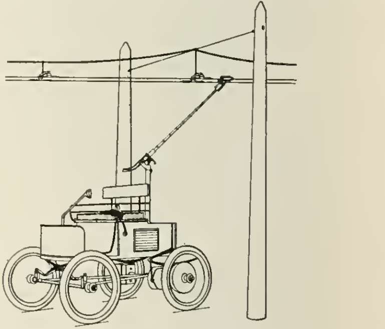
887,659. RECTIFIER SYSTEM; Osias O. Kruh, Schenectady, N. Y. App. filed Sept. 17, 1907. A mercury arc rectifier having main electrodes and starting electrodes, and inductive means for preventing the shifting of the cathode spot from one of the main electrodes to one of the starting electrodes.

887,660. STARTING DEVICE FOR MERCURY VAPOR APPARATUS; Osias O. Kruh, Schenectady, N. Y. App. filed Oct. 14, 1907. Has a hermetically sealed tube with electrodes and a starting conductor having a surface of barium oxid and a protecting shield.

887,666. ELECTRIC WATER PURIFIER; James F. Lester, New York, N. Y. App. filed Nov. 28, 1906. Has a series of filter drums through which the water is passed, and a drum containing concentrically arranged circular plates which are electrified to pass an electric current through the fluid.

887,681. ELECTRIC SIGNALING; Francis W. Maxstadt and Francis W. Maxstadt, Jr., New York, N. Y. App. filed May 10, 1907. A construction of bell having a sheet metal base which is bent to form a support for the bell at one end and a support for the armature at the other.

887,691. ELECTRICALLY DRIVEN VEHICLE; William B. Potter, Schenectady, N. Y. App. filed June 25, 1903. A trolley for use on electric automobiles and the like, having a pair of trolley wheels connected by a universal joint to the trolley pole and maintained by springs in contact with a pair of trolley wires, regardless of the position of the pole.


887,691—Electrically-Driven Vehicle.

887,723. ELECTRICAL SWITCH; John D. Hilliard, Jr., and Charles E. Parsons, of Utica, N. Y. App. filed May 13, 1905. Oil bath switch having a pair of contact elements supported within depending bell-shaped insulators, and a movable contact displaced by a rod extending upwardly from the bottom of the receptacle.

887,735. PROCESS OF RECOVERING NICKEL FROM SILICIOUS ORES; Adolphe Chalas, Philadelphia, Pa. App. filed Sept. 6, 1907. Consists in smelting the ore and producing ferro-nickel, casting the alloy into anodes, electrolytically dissolving the anodes, continuously precipitating the dissolved iron by circulating the electrolyte in contact with a body of a precipitating agent, and redepositing the dissolved nickel.

887,737. MAGNETIC BLOW-OUT FOR MAKE AND BREAK DEVICES; Stephen Dudley Field, Stockbridge, Mass. App. filed Dec. 12, 1907. A means for instantaneously extinguishing the spark that occurs at the make and break contact point when the primary circuit of an induction coil is broken. The spark is caused to take place in a magnetic field.

12,793 (reissue). APPARATUS FOR THE REGULATION OF ELECTRIC SYSTEMS; George A. Wells, Jr., New York, N. Y. App. filed June 22, 1906. A means for relieving electrical systems from the widely varying stresses caused by the changing demands of a fluctuating load. Has means for temporarily storing the energy in a fly-wheel from which it is subsequently absorbed by the system.

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ADVERTISE IN THE ELECTRICAL WORLD.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, MAY 30, 1908. No. 22.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

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EDITED BY T. C. MARTIN AND W. D. WEAVER.

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Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,250 copies are printed.*

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THE ELECTRIC LIGHT CONVENTION.

Chicago has many advantages as a convention city, and to this may be attributed in some degree the great success of the meeting of the National Electric Light Association last week, with 2000 persons in attendance. Large as such a gathering seems, it might well have been larger, and is in a sense symptomatic of the magnitude of the industry. How much larger it might be is indicated by the simple fact that Illinois alone has over 400 systems, a large proportion of which are entitled to membership; yet we doubt very much whether 50 Illinois companies had any representation. If the total number of central station systems eligible for active or Class A membership be taken into account, it will be seen that the association, vigorous and growing as it undoubtedly is, has still plenty of room for expansion. It is this situation that gives special interest at this time to the Doherty scheme of federation and of increasing the area of contact. This plan, noted elsewhere, has some elements of doubtful value, but it is certainly well worth trying on its merits. What Mr. Doherty is aiming at is the welfare and participation of the smaller companies, whose inertia and apathy it is so difficult to overcome, yet who are after all the chief beneficiaries of association work. They need the association just as much as the association needs them as factors in the exertion of its influence; and their accession will help in many directions. The main difficulty with regard to "sections" is keeping them alive. If they have not sufficient vitality from within, none that the central body can supply will prevent them from falling into a moribund state, as the American Institute of Electrical Engineers has found out.

Besides gaining new member companies, it is important that the association, or any such body, should constantly import young and coming men into its inner circle of authority. This is only another means to maintenance of health. It prevents the formation of cliques and "rings," which, wholly honest and public-spirited, can believe only in the merit of things done in one way and which are usually averse to novelty and experiment. The association again is fortunate in this respect. The retiring president and secretary are both young men; the incoming president and secretary are, if anything, even younger; while the other officers, including the executive committee, are nearly all new men, unhampered by prejudices and limited only by the good traditions of past management that explain the excellent repute and high standard of this national body—as great a force in electrical industry as the Institute is in electrical engineering.

The Street Railway Association has worked out its salvation by having affiliated bodies that conduct meetings and discussions. The Electric Light Association is now trying the plan of two or three sessions at once "in parallel," but looks askance at any scheme which would tend to split it up centrifugally. The officers believe that the members can sift themselves apart automatically for such sessions, yet come together again as a related and integral whole for any joint debate or discussion necessary. The double sessions last week were successful, and will probably be repeated with evolutional improvements. Such profusion of work adds of course to the bulk of the transactions, but it is neither desirable nor necessary that every word should be printed. A paper or a remark does not gain in value or permanence of interest merely because it is delivered in conversation, and thinking out aloud will stand lots of editing.

Protection from Lightning During the Year 1907-1908.

An interesting and useful report of the committee of the National Electric Light Association on protection from lightning was read at the recent convention in Chicago. The report contains data derived from nearly 200 operating companies, whose transformers aggregated nearly three-quarters of a million kilowatts. The committee has carried on its investigations from the preceding year, so that the statistical form of the report has the advantage of being the same as that made a year ago. The two successive annual reports show that there has not been much change in respect to damage from lightning. In 1907 there were 3.2 interruptions per annum per company and in 1908 there were 3.18. In 1907 there was one injury to apparatus for every 166 kw capacity installed and reporting. In 1908, there was one such injury to every 188 kw capacity installed. There were fewer transformers but more meters injured during the latter year. The number of poles split was more than doubled in the latter year, one particular company having had very bad luck with its pole line. Meteorological statistics as to the relative frequency of thunderstorms in the two years compared do not appear to have been obtained from the Weather Bureau.

Specifications for Street Lighting.

At the recent convention of the National Electric Light Association in Chicago, the final report of the committee of 1907, to consider specifications for street lighting, was presented by Mr. W. D'A. Ryan, in a paper which condenses the results of 15,000 photometric observations. These observations were mostly carried out in the streets of United States cities with a form of portable photometer. The photometer was set up on a tripod in the street 250 ft. away from the street arc lamp under test. The value of this final report lies in the practical nature of its observations and in their great extensiveness. It cannot be said in future that information has not been placed at the disposition of the members of the association as to the actual behavior of arc lamps on city streets. In the early days of electric arc-lighting, photometry was in a very undeveloped state. It is difficult to measure arc-lamps with precision to-day, in spite of greatly increased facilities and experience. It was doubly difficult to do so at that time. The lack of agreement between the measurements of different observers left a vacancy for imagination to supply, and because a certain type of open arc lamp was found occasionally to approach 2000 candles in the most favored direction, with the best of attention in the laboratory, it was unfortunately named and classified industrially as a 2000-cp lamp.

A committee of experts considered this matter in 1894 and reported at that date to the association that it was hopeless to test arc-lamps of this character by photometer. They realized that if lamps were tested in the street for candle-power, according to specifications, that no two measurements would be likely to agree, and that probably few would come up to 2000 cp under practical conditions. They therefore defined a 2000-cp open arc lamp as one which consumed 450 watts at terminals, with no sensible resistance in series with the arc. This was like defining the speed of a horse in terms of the amount of hay it consumed daily; but it was really the most sensible resolution to adopt under the existing conditions. It defined the amount of power that the central station should supply to its series lamps, and if these were properly trimmed, with ordinarily good carbons, it was left to be inferred that the arc lamp would do the rest. As a matter of fact, such arc lamps commonly gave about 1300 cp in the most favored zone, which was depressed about 50 deg. below the horizon, and in the horizontal direction along the street they only gave about 350 cp. They poured light into a ring almost immediately underneath them, for the benefit of casual insectivorous toads, but they were very weak in the direction along the street where the light was most needed by pedestrians, equestrians or drivers.

The 450-watt rating served satisfactorily for about 15 years, and then troubles began, owing to the activities of inventors who produced arc lamps capable of emitting more candle-power horizontally along the street than the 450-watt carbon arc, and which also required less power to operate them. Here was an advantage alike to the citizen and to the power-station, but it upset the good old 450-watt rule. What was the use of adhering to a rule that a 2000-cp arc lamp was one which consumed 450 watts or six-tenths of a horse-power, if a new lamp gave a better light down the street where it was needed and yet only took 300 watts? This opened up the whole question of street photometry, and forced the problem of such photometry into practical consideration. A committee was appointed by the association in 1906 to reconsider the question. By that time there were a number of different types of street arc lamps in competition. The committee recommended that the candle-power rating of such lamps should be abandoned, and replaced by a rating in terms of normal illumination at a distance along the street of from 200 ft. to 300 ft. from beneath the lamp. This was a desirable and an expedient change, in order to get away from invidious comparisons with the 2000-cp arc lamp called for in many old contracts. But it was really chasing a devil around a stump, because a defined illumination at a definite distance is equivalent to an inferred candle-power in that particular direction; so that the candle-power definition is only hidden from view as an ostrich hides its head in the sand to escape observation.

The observations reported in the excellent and laboriously prepared report to the Chicago convention show that the normal illumination at 250 ft. from beneath the lamp tested reached as much as 0.012 foot-candle in particular tests of the magnetite lamp, corresponding to 750 candles in the lamp, down to as low as 0.002 foot-candle in particular tests of the 9.6-amp direct-current series open arc-lamps corresponding to 125 candles—the same type of lamp that had an original rating of 2000. The average values reported were, however, equivalent to 575 cp for the magnetite lamp, 400 cp for the 6.6-amp direct-current series enclosed carbon lamp, and 256 cp for the 6.6-amp direct-current series open carbon lamp. The X-ratings proposed in terms of illumination appear to be conservative and satisfactory, so that in view of this report the committee and the association are to be congratulated upon the resolutions adopted for future street-lighting specifications. The moral of the whole story as it has developed itself historically, is the great industrial importance of development in applied science. Had arc-light photometry been developed in 1875 and 1880 to a higher stage than the relatively crude condition then attained, arc-light installers and users would not have named the lamps then used lamps of 2000 cp, when actually in the horizontal direction they only gave less than a quarter of that intensity. The error thus fallen into has gone on adding inconsistency to misconception until even to-day we have not emerged from the confusion.

THE AIR-GAP CORRECTION COEFFICIENT.

The last number of the *Journal* of the British Institution of Electrical Engineers contains an original communication by Mr. P. H. Powell upon the correction which should be applied to the apparent area of a dynamo air-gap, when the rotor is slotted, and the teeth project over the slots to a greater or less extent, as is usually the case. The problem may be alternatively presented by inquiring what magnetic flux gets into the rotor through the spaces between the teeth in addition to the flux which passes across the air-gaps into the external surfaces of the teeth. The method of inquiry pursued was hydrodynamical. That is, two glass plates were set parallel to each other, so as to form two walls of a box. The space inside the box was occupied by a wax model of the iron parts, occupying half of one tooth pitch, and a number of jets of liquid were forced through the box in such a manner that their forms could be examined and photographed. It is known that the forms of these liquid jets correspond to those of the invisible flux lines in the iron and air around a polar tooth, assuming that the iron is far from being completely saturated. The photographs, which present beautiful liquid contours, indicate that if the teeth are not highly saturated they shield the slots magnetically to a very considerable extent, except, of course, when very broad slots exist. Only a comparatively few flux lines lose their way into the interior of the slots and terminate on the walls or floors of these slots. The corresponding numerical correction factors are given for about 30 different ratios between the tooth pitch and other geometrical factors. For the ratios that occur more commonly in practice, the correction factor averages about 15 per cent. It must be remembered, however, that it is common practice to attain a very high magnetic density in the teeth, and this will tend to throw more flux into the passageways between them and so increase the correction factor.

The method used requires considerable experimental skill, but has the advantage of presenting the outlines of the inferred flux paths directly before the eye. It makes the invisible visible by analogy. Even if the method is limited insofar as relates to the question of magnetic saturation in the iron, it offers a delightful experimental method of displaying the outlines of magnetic flux paths, under complex geometrical conditions, to a large audience. One of the experimental difficulties referred to in the communication is the prevention of air bubbles from being formed in the castings of the wax layers. The method resorted to is described as having been the mechanical agitation of the apparatus during the period of casting by causing an electric bell to vibrate and hammer the dish containing the wax and glass plate during the period of casting. A preceding research has already been published, in the same journal, for the cases of teeth without projections over the intervening slots, i. e., simple rectangular teeth and simple rectangular slots. The research lately published, therefore, completes the series. The previously published research gave results that admitted of being checked mathematically and seemed to sustain the check satisfactorily. This time our present condition of mathematical analysis gives up the attempt.

ELECTRICAL INSPECTION.

The subject of proper inspection of interior wiring in small towns was thoroughly gone over at the recent Nebraska Electrical Association Convention. There were no dissenters from the opinion that poor interior wiring is inimical to the central-station industry. It was admitted that whatever advantage might be gained by cheap, shoddy work, such as an increase of the company's connected load by virtue of the low price charged the consumer for this kind of work, it is a questionable advantage which will ultimately injure the business. To the question of how best to secure proper inspection of interior wiring neither the central-station men, the representative of the underwriters nor the city electrical inspector, who took part in the discussion, had any very satisfactory answers to offer. Inspection involving fire risks primarily lies with the insurance companies, owing to their financial interest. It is, however, a well-known fact that insurance companies have in the main attempted to evade this expense by securing city electrical inspection in the larger cities. There is, of course, an element of justice in having this done by a city, just as it is proper that a city should tax itself for the maintenance of a fire department. In large cities the matter of expense of inspection is not as serious as it is in the small towns. In the latter there are several methods of securing wiring inspection and protecting consumers and the general public. One is for the insurance companies to send inspectors—a plan which has never, so far as we know, been worked with any satisfaction because of the expense involved in sending competent inspectors at the proper time. To reduce expense, various makeshifts have been resorted to, such as assigning to one man inspection of everything entering into a risk, including the electrical part of the work, or having the chief or some other officer of the fire department educate himself for an inspector of electrical wiring.

The central-station company in the small town is usually the most competent to conduct electrical inspection, and also should have a direct interest in seeing that good work is done. As a matter of fact, it is practically up to the central-station company to do what inspecting is done in most small towns at the present time, and it is likely that this will be the condition of affairs for some time to come. The plan is open to only two real objections. One of these is that the company is itself a wiring contractor bidding for work along with other wiring contractors, and might therefore be considered a prejudiced judge of what constitutes good work. The other objection is that sometimes the central-station company fears to condemn bad work because of offending a prospective consumer. The latter objection, however, can be largely overcome by diplomatic handling of any case and by explaining to a consumer that whatever ruling against bad work is made is in the interest of the consumer's safety and the general reputation of electric service, and that the company has everything to gain by getting the consumer connected rather than by refusing to connect until the wiring is properly installed. It is certain that the small central-station company which refuses to encourage good wiring and which gives service to a lot of buildings which never should have been connected, is inviting trouble for the future.

Boston Edison Company to Supply Tungsten Lamps.

In line with the recent action of the New York and Brooklyn Edison Companies the Edison Company of Boston has issued to its customers a circular announcing that tantalum tungsten lamps will be made available to its consumers. The circular sets forth the advantages in efficiency and economy of the new lamps over the old lamps which have been in general use by electric light companies for the last 20 years. Referring to life, the circular states that the life of the carbon lamp averages 400 hours, while that of the tungsten is about 1000 hours and of the tantalum, 750 hours.

Electrical Manufacturers' Club Meets at Hot Springs, Va.

Twenty-two members of the Electrical Manufacturers' Club, representing large electrical manufacturing interests, met at Hot Springs, Va., from May 14 to May 18, for the semi-annual gathering of the organization. Twice a year the members come together to discuss general conditions, compare notes and to enjoy the relaxation from business routine which such an outing affords, the object of the organization being to enable the men in the same lines of electrical business to meet one another socially as well as in business life. There was no set program, the members driving, playing golf or indulging in other recreations according to their tastes, meeting each night about one large table at dinner to talk over the general electrical situation. The concensus of opinion was that the electrical business will begin to show symptoms of the activity of a year ago as soon as the presidential nominations are decided. All the representatives agreed that the business of each month since the beginning of the year has shown an improvement over the business of the preceding month. The officers of the association are: Mr. George A. Cragin, of the American Steel & Wire Company, president; Mr. H. T. Paiste, of the Paiste Company, vice-president; Mr. B. M. Downs, of the Brookfield Glass Company, secretary; Mr. J. H. Mason, of the Simplex Wire Company, treasurer. The annual meeting will be held at Hot Sprngs, Va., in October.

Improvement of New York Subway.

Mr. Bion J. Arnold has submitted his fourth report on the New York Subway to the Public Service Commission of the First District of the State of New York. This report, which is entitled "The Capacity of the Subway," analyzes the fundamental design of the subway, points out how further increase in its capacity can be obtained, and directs attention to certain defects or omissions in the present arrangement that should be avoided in future subways. He stated that the capacity of the present subway, as now operated, can be increased fully 60 per cent, and possibly 75 per cent, without greatly changing its construction; that it will be possible to construct new subways with a capacity from two to three times as great as that now being realized with the present subway, and that the operating expenses and fixed charges for future subways can be reduced to an amount that will make it possible not only to produce a satisfactory return on the investment, but also to set aside a fair amount each year to take care of depreciation.

Mr. Arnold recommends an increase in the number of tracks at Ninety-sixth Street, where the greatest amount of congestion takes place, in order that the four tracks upon the present level may be used exclusively by the express trains. Considerable improvement can be made by running longer trains. The number of cars on local trains should be increased from five to seven, and on express trains from eight to ten. By running these trains at the rate of 40 per hour on each track instead of the present 30, the carrying capacity of the present subway will be increased by 75 per cent.

City Lighting in Boston.

There is no longer much likelihood that the city of Boston will install a municipal lighting plant for the electric lighting of the City Hall, the old Court House and the old Probate Building, the group of buildings on Court Square where municipal departments now have complete occupancy. Mayor Hibbard gave some attention to this scheme when he first came into office, and was inclined to regard it with considerable favor, believing that with the boiler and heating plant necessarily required for these buildings, the electricity could be developed by the city with comparatively slight expense. Removal of restrictions formerly preventing the wire connections under or over the streets also invited attention to the project. But the Mayor is earnestly working for economy, and the complications are now such that the installation is, for the present, practically abandoned, awaiting the general recommendations of the finance commission as to municipal lighting. Meanwhile, one move toward economy has been the consolidation of the lamp department with the street department, displacing Superintendent of Lamps D. J. Hern and placing his department in charge of Superintendent of Streets Guy C. Emerson, a graduate of the Massachusetts Institute of Technology, whose first prominence as an engineer in Boston was in connection with the construction of the first subway by the transit commission. Superintendent Hern's last report, issued recently, shows that all kinds of lamps increased in number in Boston from January, 1907, to January, 1908, excepting double-mantle naphtha and Welsbach naphtha. The figures are:

	Jan., 1908.	Jan., 1907.	Incr'se.
Welsbach gas	10,685	10,071	614
Welsbach naphtha	1,446	1,791	—345
Electric arc	3,796	3,784	12
Electric incandescent	41	32	9
Fire alarm	188	179	9
Triple-mantle gas	180	175	5
Triple-mantle police	19	...	19
Double-mantle naphtha	16	21	—5
Total	16,371	16,053	318

It is regarded as hardly likely that legislation to apply the sliding-scale principle generally among Massachusetts lighting companies will be passed by the present Legislature. It looks rather as if the subject would be delegated to a special recess committee of the Legislature, or possibly to the gas and electric-light commission, with two special commissioners added, with instructions to report to the next Legislature.

There are numerous influential citizens in Massachusetts, particularly in Boston, who have great faith in the sliding-scale principle of regulating the price of gas; and the experience of the Boston Consolidated Gas Company has been such as to suggest popular favor for the scheme as applied to smaller companies throughout the State. But when the companies presented a draft of a sliding-scale bill the other day that would meet the situation satisfactorily to them, these citizens and the Public Franchise League balked, claiming that the bill meant a recapitalization of the companies, and began to argue for more time for legislative discussion before any final action should be taken.

Now that Boston's famous finance commission, in conducting its investigations looking to greater municipal economy, has turned its attention to the lighting of the city it is expected that the forthcoming report of Commissioner George U. Crocker, former city treasurer, who has recently returned from a month's tour of important European cities, may prove of considerable interest. Mr. Crocker inquired into cost and methods of lighting in London, Paris, Berlin, Vienna and Budapest, and he is expected to hand in figures on which some comparison may be made of lighting costs and efficiency in Boston as compared with foreign centers. Just now he is finding it a considerable task to reduce a mass of information based on the metric system to the system employed in this country. So far he has given no expression of his impressions and findings other than to cite the extensive use of the electric flaming arc in Europe. Boston has already experimented with the latter, but not in any general way.

Annual Meeting of the A. I. E. E.

At the meeting of the American Institute of Electrical Engineers held on May 19, it was announced that the following officers had been elected: President, Mr. L. A. Ferguson; vice-presidents, Messrs. C. C. Chesney, Calvert Tounley, and B. Gherardi; managers, Messrs. D. B. Rushmore, H. E. Clifford, C. W. Stone and W. G. Carlton; treasurer, Mr. Geo. A. Hamilton; secretary, Mr. Ralph W. Pope.

President H. G. Stott stated that at the Washington conference on the conservation of the natural resources of the country, which had been called by the President of the United States, the four presidents of the national engineering societies, namely, electrical, civil, mechanical and mining, drafted a set of resolutions for presentation to the conference. These resolutions recommended the appointment by the various States of technical commissions to investigate the conditions in each State, and also of a national commission, the commissions to be composed of representative men of the highest character, and also that another conference be called when the commissions were ready to report. The resolutions adopted at the conference were based on the above resolutions submitted, though reported in somewhat different form.

Machinery Club Opening.

With approximately 3000 members and guests present, the Machinery Club of New York, on the afternoon of May 21, formally began its existence in its rooms on the two top floors in the Fulton Building, at 50 Church Street. Before the club opened its membership numbered 1100, many of whom represent various electrical interests in New York and other parts of the country. All the rooms were ready for inspection at 1 o'clock and a reception committee of 96 members was on hand to receive the members and their friends. The prevailing, genial "holiday spirit" which was omnipresent made the opening a great success and augurs well for the future popularity of the organization. The main dining room, seating 500 persons, was decorated with carnations and festoons of greenery, and in the center of the room an orchestra of 10 pieces was stationed. An elaborate buffet lunch was served, not only in the main dining hall, but also in the grill room, the ladies' dining room and the private dining rooms. The success of the club is no longer in question; in fact, it was assured before the doors were opened. It has members in 127 cities and in Mexico, Cuba, Japan and some of the cities of Europe. As time elapses the Machinery Club undoubtedly will become one of the most powerful and popular of the down-town organizations. Formal exercises were omitted, the only feature of the occasion being a speech of welcome by Mr. George A. Post, of the Standard Coupler Company. Mr. Post is one of the governors of the club and also serves on the executive committee.

Introduction of Tungsten Lamp in New York City.

The subject of the effect with respect to customer's bill, of the introduction in New York City of the tungsten lamp, came up for discussion at a meeting on May 20 of the Public Service Commission of the First District. Mr. John W. Lieb submitted for the New York Edison Company tabulations giving the saving to customers from the use of the tungsten lamp.

One table was based on the supposition that the customer is entitled to free lamp renewals under the contract, and shows that for each unit cost at the present rate, the effect of the reduced current consumption is equivalent to a reduction in the rate itself of 60 per cent. Another table shows that, at the rate of 10 cents per kw-hour, including lamp renewals, or at the rate of 9½ cents per kw-hour, assuming that he gets a discount of one cent for making his own renewals, and again assuming that these renewals would cost him one-half a cent, his saving would be 49.05 per cent over the use of the carbon lamp. Mr. Lieb concluded that no consumer of the Edison Company would ever be required to pay more if he used the tungsten lamps than he would when using the carbon filament lamps, assuming that the amount of illumination is the same in each case. The tendency of the introduction of the tungsten lamp is to equalize the rates between the small and the large consumers, providing there is no conflicting contract stipulations.

Mr. Frank W. Smith, of the United Electric Light & Power Company, Mr. Walter F. Wells and Mr. C. G. M. Thomas testified in reference to their respective companies, that in certain cases some consumers might, by the use of tungsten lamps, be required to pay more per unit for current, but in no case would he pay more for the total illumination.

Meeting of Cleveland A. I. E. E. Section.

At a meeting of the American Institute of Electrical Engineers, held in the rooms of the Civil Engineers' Club in the Caxton Building on May 18, Dr. C. P. Steinmetz delivered an address on the progress of improvements in electrical devices and equipment during recent years. The talk was a very interesting one and was listened to by the largest number of engineers that have yet attended any of the meetings. Dr. Steinmetz said that the financial depression had caused a temporary suspension of active business and had given the engineers an opportunity to push development in various directions and complete, to some extent at least, those things which had been in an imperfect condition for some time. More has been done within the past year in this line than ever before in the same time.

He referred to the development of the tantalum and tungsten lamps, which are close competitors of the arc lamp in efficiency. The development of the lamp has required much money and this is still a large factor in the cost of the lamps and will be until they are brought to a manufacturing status somewhere near that of the carbon filament lamp. The first tungsten lamps were very delicate and had to be used in a vertical position. Improvements have been made in this filament until it is now quite strong, and it is believed that eventually it will be equal in this respect to the carbon filament.

Dr. Steinmetz talked at some length on alternating series commutating pole motors and explained the advantages in their use in car operation. He said that engineers had been able to secure a very much increased power through perfect control of the magnetic flux and that good commutation had been secured by the introduction of the commutating field. He explained that severe sparking for a few seconds did no damage and that sparking had been almost entirely eliminated.

Another subject that was treated of quite extensively concerned lightning and the protection of electrical systems by the use of arresters of the types perfected only very recently. They are of such a character that they form little resistance to discharges of high voltage but prevent the machine current from following. Aluminum plates in the arresters act as a resistance up to certain voltages, when the counter e.m.f. becomes such that the current of higher voltage will flow across the plate as if there was no resistance in the line, but the machine current, being lower, does not follow. Dr. Steinmetz explained a number of experiments made on transmission lines in Colorado and discussed the subject in a most interesting manner. He spoke briefly of steam economy and compared the turbine and reciprocating engines along this line.

After the completion of his address, Dr. Steinmetz was asked to discuss the development of the luminous arc and its application to lighting. He said that the mercury rectifier, formerly very delicate, had been improved until it is now fairly durable. The time will come when its lasting qualities will be almost indefinite. He spoke of one rectifier that had been used for 15,000 hours under his observation, and said that it was as good now as at first. In order to prevent injury to the rectifier, care should be taken in starting up, and at first the current should be confined either to a light or no load. Care should also be taken to prevent the arc from jumping backward, as this destroys the vacuum. Occasionally the glass will break from different causes, but on thoroughly understanding the instrument this can usually be avoided.

The officers chosen for the ensuing year are as follows: Chairman, Mr. C. E. Ricker; secretary-treasurer, Mr. F. M. Hibben. Board of managers: Prof. H. B. Dates, H. L. Wallau and George B. Dusenberrie. The next meeting will not be until the third Monday in September.

Electrical Show at Grand Rapids, Mich.

By Lewis W. Bailey.

Grand Rapids, Mich., has demonstrated the possibilities of an electrical show in a city of 100,000 inhabitants, and the results are satisfactory to the exhibitors, though the attendance was limited by the rains that prevailed throughout the week.

The exposition, which was arranged as an educational exhibit, was conducted by the Electrical Show Association, organized for the purpose, and it is the first show of the kind to be held in Michigan. Mr. M. B. Wheeler, of the Wheeler Electric Company, is president of the association, and Mr. William J. Fenton is secretary. Floor space to the amount of 15,000 square feet in the furniture exposition building was leased for the occasion and space allotted to 35 principal exhibitors, representing nearly one hundred electrical manufacturers and power companies. The show was open from 10 o'clock in the morning until 11 o'clock at night, and a good orchestra was present to supplement the work of the electrical pianos, the motor horns and the sparking of the wireless telegraph apparatus. An admission fee of 25 cents was charged and special tickets were issued for school children, admitting them for 10 cents. Parties of pupils were organized to visit the exposition and report what they saw to their schools.

A great electric sign hung across Monroe Street, a lane of incandescents bordered Ottawa Street to the exposition building, and another brilliant sign across the street in front of the entrance marked the way to the show. Inside, myriads of lights were strung in festoons from the ceiling, illuminated the booths and electrical signs flashed on every side. Gay buntings hung from pillars and draped over dividing walls added to the attractiveness of the scene.

The most elaborate of the exhibits was that of the Grand Rapids-Muskegon Power Company. It consisted of a miniature seven-room cottage, attractively furnished, thanks to Grand Rapids furniture dealers and decorators. In a mahogany furnished parlor an electric grate, equipped with luminous radiators, provided heat, an electric piano played catchy airs, pretty lamps lighted the room, and even an electric corn popper for the children and a cigar lighter for the father were supposed to add to the comforts. The dining room, equally as well furnished, contained chafing dish, coffee percolator, bread toaster and other ingenious devices. Bedrooms equipped with massage apparatus, hair dryers, electrically heated shaving mug and curling irons were open to inspection, while in the bathroom was a water heater. The kitchen contained the electric stove, fitted with switches which turned the current on the various cooking devices located on a convenient kitchen cabinet. An electrically operated dish washer, motor-driven washing machine, air-cleaning device for carpets and rugs and a refrigerator with an artificial ice-making machine electrically driven, added to the convenience of the place. The motor-driven sewing machine and the ever-handy telephone were not lacking.

A Clarke wireless telegraph station was a part of the exhibit of the M. B. Wheeler Company, which also had an attractive electrical fountain as a center piece. The Grand Rapids Railway Company fitted up a rest room, in the center of which was exhibited a model street car fender and a Brill truck. A section of Shanghai rail, laid as in the street, was so arranged as to show a cross section through a glass plate. Other street car novelties were arranged in the booth, and a series of pictures of the company's two resorts, North Park and Ramona.

The Citizens' Telephone Company demonstrated a section of its automatic switchboard. The Lewis Electric Company and the Neumann Sign Company had some striking lighting effects. The latter displayed the inner workings of the motors and machinery which keep the flash signs in operation. An exhibit of especial interest in Grand Rapids, where floods are an annual occurrence, was the seepage pump of Erwin & Company, of Chicago, which pumps the water from a wet basin and stops when the basement is emptied. Everywhere the effort was made to interest consumers or prospective users of electricity in the devices and supplies on exhibition, and that the efforts were not unavailing is shown in that talk of next year's show has already begun among the promoters and exhibitors.

Boston Branch Meeting, American Institute of Electrical Engineers.

The regular monthly meeting of the Boston Branch of the American Institute of Electrical Engineers was held at the Edison Building, on May 20, Prof. Puffer being in the chair. Papers on "Lightning Protection" were read by Messrs. J. F. Vaughan and W. J. Neall.

In the discussion which followed, Prof. Puffer raised the issue of special devices being needed on the ground connection to enable direct lightning strokes to pass downward through the overhead grounded wire and to fan out in the earth. Mr. Neall replied that the construction work done with overhead ground wires, arrester, spark-gap and tell-tale papers, was very carefully carried out to avoid any discrepancy in interpretation, and stated that investigations of poles splintered by lightning discharges showed that in every case the pole below the surface of the earth was intact.

Prof. D. C. Jackson stated that his former skepticism in regard to the value of the overhead grounded wire had been dispelled by the results on the Taylors Falls line, as described in Mr. Vaughan's paper, and congratulated the institute upon such definite studies of these phenomena.

Prof. Hooper, of Tufts College, emphasized the desirability of grounding the overhead wire at every pole. Low impedance in the ground is rather more desirable than very low resistance as measured by a Wheatstone bridge. He cited the use of a galvanized-steel overhead grounded cable on a new line built for 88,000 volts for the transmission of electrical energy into Rio Janeiro, Brazil. During the past season many unusually severe lightning storms have been experienced, but not an insulator was lost or the service interrupted. The insulators are 18 in. in diameter and 18 in. high, and the full line voltage has not yet been applied. The only argument against the overhead wire seems to be the power lost in it, and investigations of this are desirable. Protection along the entire length of the line should be installed.

Mr. Vaughan stated that copper was used as the overhead ground lead on the Taylors Falls line in order to make the construction consistent throughout in durability and reliability. On account of the lower first cost in a Southern case, where the line could be more readily shut down for repairs, steel was recommended. Mr. M. V. Ayres suggested that the presence of direct-current feeders and other low-tension wires on the same poles with his 13,000-volt line, but beneath the latter, exercised a shielding effect in lightning protection. He could recollect but one case of insulator puncture positively caused by lightning during five summers in 30 miles of three-phase, 13,000-volt line operation. Prof. Puffer urged the importance of finding out more clearly just how the lightning stroke is distributed in the earth in the vicinity of the ground wires, and Mr. Vaughan stated that, in his practice, nests of distributed pipes are being recommended in the construction of station grounds.

Prior to the reading of the papers, the following officers were elected: Chairman, Prof. A. E. Kennelly; vice-chairman, Prof. D. C. Jackson; secretary-treasurer, Mr. A. L. Pearson; executive committee, Messrs. J. W. Corning, G. S. Gibbs, G. C. Shood, J. F. Vaughan and J. B. Wiard.

Toronto A. I. E. E. Section.

At the annual meeting of the Toronto section of the American Institute of Electrical Engineers, held May 15, Secretary W. G. Chace reported that eight meetings have been held this season, as follows: An inaugural meeting in October, one each in November, January, February, April and May, and two in March. Two meetings, the fourth and sixth, were addressed by visiting members of the institute, Messrs. Moody and Rushmore, and four meetings by members of the section. Only once were the New York papers made use of during the winter.

The attendance at the meetings has averaged between 30 and 40. The expenses have aggregated $130.65. The following officers were elected for the ensuing year: Chairman, Mr. W. A. Bucke; vice-chairman, Mr. H. W. Price; secretary, Mr. W. G. Chace; executive committee, Messrs. E. Richards, W. H. Eisenbois and R. J. Clark.

Sliding Scale System of Lighting Prices.

Before the Massachusetts legislative committee on public lighting, Mr. J. E. Pillsbury, counsel for the Massachusetts Gas Companies, argued last week in favor of a new bill for a sliding scale system for the regulation of prices and dividends of gas and electric companies. The bill provides that the standard rate of dividend for every company accepting the act shall be 6 per cent per annum and the standard price for gas the maximum price charged for the year preceding such acceptance shall not exceed $1.20 per 1000 cubic feet. The bill provides that no company accepting the act shall pay dividends in excess of the standard rate except that if during the year ending June 30 the maximum net price per 1000 cubic feet has been less than the standard price fixed for the company, it may during the following year pay dividends exceeding the standard rate in the ratio of one-fifth of 1 per cent for every one cent of reduction below the standard price. Dividends shall be reduced vice versa according to price. Existing indebtedness shall be deducted from valuation, but without prejudice to right to capitalize such indebtedness on payment. Mr. Pillsbury argued for the bill on the ground that a similar scale in Boston had worked to the betterment of the consumer in reducing price while dividends had been increased.

United States Government Examination for Electrical Engineer.

The United States Civil Service Commission announces an examination on July 22, 23 and 24, 1908, at the numerous places throughout the country where civil-service examinations take place, to secure eligibles from which to make certification to fill one or more vacancies in the position of electrical engineer, at an entrance salary of from $100 to $200 per month, in the Reclamation Service, and vacancies requiring similar qualifications as they may occur. Eligibles from this examination may be appointed as electrical engineers or assistants for the design, installation, or operation of hydro-electric and steam power plants in the West.

The examination will consist of the subjects mentioned below, weighted as indicated:

Subjects	Weights.
1. Mathematics, applied mechanics, mechanics of materials (pure mathematics through calculus, computations of stresses in metal beams, structures, etc., tensile and compressive strength of concrete, etc.)	10
2. Hydraulics (computation of horsepower, plan of connection, water-wheel design, arrangement of pipe, friction losses, discharge of orifices, velocity head, etc.)	10
3. Theory and practice of electrical engineering (design, construction and operation of modern alternating-current power, transmission plants)	15
4. Steam turbines and engines	10
5. Drawing and design (layout of hydro-electric and steam-power plant, buildings and machinery)	20
6. Training and experience (rated on application)	35
Total	100

Competitors may also be examined in one or more of the following-named optional subjects: 1. Centrifugal pumps (design and installation). 2. Turbine water-wheels (design and installation). 3. Gas engines. Applicants must indicate which, if any, of the optionals named above they desire to take.

Certifications for appointment will be made (1) of eligibles having the highest ratings on the basis subjects; (2) of eligibles having the highest ratings on the basis subjects and one or more of the optional subjects combined, giving the basis a weight of 2 and the optional or optionals considered each a weight of 1; (3) of eligibles having the highest ratings on one or more of the optional subjects combined and who have also passed on the basis subjects. In making certification as above indicated, no optional in which the rating is less than 70 per cent will be considered. Applicants must indicate in their applications that they have had at least eight years' experience in connection with electrical engineering work in one capacity or another. Graduation in electrical engineering from a reputable technical university will be accepted as two years of this experience. Applicants who have not had sufficient training and experience to entitle them to a rating of at least 70 per cent in that subject will not be admitted to the examination. The use of engineers' handbooks, such as Foster, Kent, Trautwine, or other similar work, will be allowed in connection with the fifth subject, drawing and design. The age limit is 25 to 45 years on the date of the examination, and the examination is open to all citizens of the United States who comply with the requirements.

Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at any place at which civil-service examinations are held, for application Form 1312. No application will be accepted unless properly executed and filed with the Commission at Washington prior to the hour of closing business on July 11, 1908.

Awards of Exposition of Safety Devices.

The award of two gold medals and the distribution of 45 diplomas in connection with the Exposition of Safety Devices in New York, was made May 18 at a luncheon at the Engineers' Club, Mr. Charles Kirchhoff, chairman of the Committee of Direction of the American Museum of Safety, presiding.

Dr. W. H. Tolman, director of the Museum of Safety, announced that there had been 112 entries for the Exposition held at its rooms during the last few weeks. Many of them were new and held at once the interested attention of the engineers and other technical men. Through the co-operation of the *Scientific American*, a gold medal was offered for the most meritorious invention at the Exposition in the field of transportation. The members of this jury are: Prof. F. R. Hutton, Cornelius Vanderbilt, John Hays Hammond, H. H. Westinghouse, George Gilmour, Samuel Sheldon and Stuyvesant Fish, who reported as follows:

"The Jury of Award to select from the safety devices exhibited at the Exposition of 1908 the most meritorious invention in the field of transportation among those brought together, present the following report as their recommendation and award:

"After extended conference and consideration upon the rules which should govern the procedure of the jury, it was agreed:

"1. That the term 'field of transportation' covered by the deed of gift of the *Scientific American* medal included the devices and apparatus having to do with the safety of transfer of the public and of the operatives in control on the railways, by elevators and on the water.

"2. That by the terms of another provision for a Jury of Award for devices and meritorious invention in the field of transportation by motor vehicle, this section of transportation was specifically excluded.

"3. That devices usable in transportation in which safety was a secondary although necessary element, and hence subordinated to a primary purpose other than safety, were not to be considered in competition. Safety must be the primary and perhaps the only object to be sought by the device.

"4. That devices exhibited which were meritorious inventions were not necessarily entitled to award if there existed other devices not exhibited seeking the same object and having equal or greater claims for consideration.

"Within these limitations the jury decided that any devices to claim consideration must possess the following elements or attributes; and that device exhibiting these qualities to the highest degree should receive the award, viz.:

"1. Applicability, wide or narrow. Does the device procure safety for a large number of persons, or in a great variety of conditions? 2. Practicability. It must be capable of being used successfully. It must not be too cumbrous or intricate to apply or to operate. 3. Simplicity. It must not be so complicated that experts are required to handle it or to keep it in repair and operation. 4. Reliability. It must not be liable to derangement, causing failure to work in emergency. 5. Durability. It must not be so delicate or require such fine adjustment that when installed it will not last in service. 6. Commercial availability. It must not be too expensive in first cost to install, or in operation to maintain."

In applying the above rules and requirements to the exhibits shown in the exposition of 1908 the jury awarded the medal tendered by the *Scientific American* to the Rich marine fire indicating and extinguishing system, and made honorable mention of the Whelin Quadrant Davit Company and the Simmen Automatic Railway Signal Company.

The gold medal offered by Mr. Francis H. Richards, the inventor, for the best device in the field of motor vehicles was awarded to the Non-Explosive Safety Naphtha Container Company, with honorable mention to the Rutherford Wheel Company. The jurors for this department were Dr. S. S. Wheeler, Mr. Caspar Whitney and Mr. A. G. Batchelder. The winning device can be applied to a gasoline or naphtha can, making the explosion of its contents impossible.

Among other awards yet to be made is that of a gold medal offered by the Travelers' Insurance Company for the best invention in the Departments of Mines and Mining.

A few of those at the luncheon were Commissioner Darlington, of the Health Department; Secretary Larney, of the Fire Department; Deputy Fire Chief Whitney, Dr. S. U. Treadwell, ex-President of the Long Island Medical Association, and Chief Engineer Gilmour, of the Travelers' Insurance Company.

Touching upon the movement to make the museum permanent, a letter was read from Bishop Potter, who has accepted the chairmanship of an educational committee to push the matter. In the letter the bishop says:

"I have gone over your plan for a campaign in the interests of social and industrial peace through a museum of safety devices and industrial hygiene. The plan is practical, of far-reaching importance, and commends itself to my best judgment. I hope that you can find a hearing in every center of influence in our country, particularly the organizations of industrialists and those of labor."

Electrical Inspection; Nebraska Convention Discussion.

At the convention of the Nebraska Electrical Association, at Omaha, May 6 and 7, the question of electrical inspection, and especially inspection in the smaller towns, was discussed at length by central-station and inspection men present. The discussion was started with a paper by Mr. Waldemar Michaelsen, city electrician of Omaha, who enjoys a high reputation for his work in electric inspection and problems connected therewith. He said that one of the popular ideas of an inspector is that his principal duties are to make trouble by condemning work to make a show of his authority.

He reviewed the development of electric light and power work from a distribution voltage of from 50 to 110 volts, up to transmission voltages, and said that the central-station men in the small town was apt to condemn certain requirements because disregard of these had never caused any trouble in that particular town under his particular notice. He said that absence of observed trouble with such limited experience was not conclusive. For example, the central-station man might say that open exposed link fuses, not enclosed in cabinets, had never caused a fire in his town, and that their enclosure was nonsense. If one looked up the record of electrical fires for the whole country, however, he would learn that the open-link fuse, unprotected by a cabinet box, was one of the commonest sources of fire. The National Electrical Code was based on the result of experience the country over, and is the law in many parts of the country. He mentioned the fact that in Europe the governments and not the underwriters make the wiring rules. If it were not for the electrical inspector, the grade of electrical work would not be as good as it is now.

Mr. L. E. Watson asked as to the policy of electrical inspectors on infringement of present rules by old installations made before the rules were as strict as recently. Mr. Michaelsen replied that no reform could be accomplished in a minute. These changes must come gradually. In Omaha all new work is done according to the Code. When additions to old work are inspected, it is customary to look over the old part of the work as well as the new, as some changes might be required on exposed parts of old work. For example, if open-link fuses were found in a location where flying hot metal might set fire to something, the owner's attention was called to the danger and change to enclosed fuses required.

Mr. H. A. Holdrege, general manager of the Omaha Electric Light & Power Company, said that Mr. Michaelsen had sufficiently convinced his company of the desirability of strict electrical inspection to cause it to employ an inspector of its own to look over all wiring done outside of the city limits of Omaha to which the company was asked to connect. This had been brought about by the evident necessity of some supervision of the kind in districts which the city inspection of Omaha did not cover. As an example of what was occurring before this inspection was established, he cited the case of a moving-picture theater in South Omaha, where the arc lamp for the picture lantern was operated from wiring done with No. 14 lamp cord. In some cases they found wiring done with No. 16, 18 and 19 wire. One cottage was even wired-up with weatherproof iron wire such as telephone companies sometimes use.

Mr. E. A. Bullock, of Norfolk, said that in the country towns an underwriters' inspector would sometimes condemn an old building wired in the early days of the industry by the central-station company. The owner would then go for the central-station manager, complaining bitterly that the company had wired the building originally and that it should have done a better job, not understanding the great advance that has been made in the requirements. Mr. H. A. Holdrege said that the requirements on old wired buildings were analogous to fire-district requirements. For example, a city might extend the fire district within which all new buildings must be of fireproof construction, but this did not mean that all wooden buildings within the extended fire district must be torn down. It simply applied to new buildings.

Mr. V. W. Bergenthal said that very few laws are retroactive and apply to things done before the laws were passed. He cited an annoying experience that he had with his own house in St. Louis and the troubles in getting the small wiring contractor to do proper work. He raised the question whether it would not be a good thing to have licensed wiremen. Mr. Michaelsen said that in Omaha they had a master electrician's license. He thought this better than licensing of the wiremen because it is the boss who is responsible for the work, and the man who will pass a good examination to get a license is not necessarily a good workman or honest in his work. He thought it impracticable to have insurance inspectors covering general fire risks inspect also for the electrical risk. Such men knew no more about electrical wiring and risk than the electrical man would know about other hazards. As to the owner of the building wired 20 years ago who objects to rewiring because the wiring was approved at the time it was put in, he would ask him what had become of the suit of clothes he wore when the building was wired. This would set him to thinking as to whether it was not possible for wiring as well as clothes to wear out in time.

Mr. E. J. Sullivan thought that the central-station manager should condemn bad work in his town before the work was condemned by some outside inspection. The manager would then be in a much better light before his customers than if it appeared he was so lax that outside inspection was needed.

At another session Mr. W. S. Boyd, of Chicago, representing the Underwriters, addressed the meeting on inspection in small cities. Mr. Boyd had previously been in session with the insurance committee of the association to take up this question without agreement having been reached; the insurance committee was continued to take up this subject further, and report next year. Mr. Boyd reviewed the various methods suggested for securing electrical inspection in small cities. One plan was to have the fire chief an electrical inspector, in which case, of course, he would have to become sufficiently educated in electrical matters to be competent. In some cases this had worked very well; in fact, in one case he had in mind the fire chief ultimately resigned to become an electrical contractor, and as a contractor he was a stickler for a high grade of work. Another plan was to have work inspected by other electrical contractors than the one doing the job. This was, of course, open to objections. As to the cost of providing electrical inspection, it could be borne by the merchant having the wiring done or paid for out of the general fund. In some States inspection was paid for out of the general taxes. Such a course was justified fully as much as providing for fire protection out of the general taxes, because safety of electrical wiring concerned all the people in a community. In general, the underwriters favored inspection by municipal inspectors. As a rule, the municipal electrical inspectors were the most competent of any class of municipal employees. State electrical inspection was recently proposed in Illinois, but was defeated because of opposition to it by small central-station companies. Some of the most active opponents of the measure had the most dangerous wiring conditions in their towns and conditions which would be likely to cause trouble. He said that insurance companies, like other capitalists, were likely to be thrown into a panic by successive losses in a town, and when such losses occurred, they called for a general inspection. In such a case the electrical inspector for the underwriters would go through the town and give it such a thorough cleaning out that trouble and discontinuance of electric service by consumers was sure to follow. It was to the interest of central-station companies to keep matters in such a condition that such extreme measures would not be resorted to.

Mr. Michaelsen, discussing this, said that the central-station men in the small towns were entirely to blame for the poor wiring in a town. What the central-station man needed was backbone to refuse to connect to wiring which he knew was not as it should be, and to call the consumer's attention to old wiring which ought to be repaired. Some central-station men had said that they did not wish to condemn wiring because of offending consumers and that they would prefer to have some inspector take the responsibility of condemning the work rather than to do it themselves. He pointed out that it took just as much backbone for a city or insurance inspector to condemn a job as it did for the central-station man. The city inspector realized very well that by condemning work he might make himself unpopular with people who could influence his appointment. The insurance inspector knew that condemnation of a job might mean cancellation of the policy. It was the inspector with the backbone that would do the best, whether he were employed by a central station, city, or insurance company. He showed how it was quite possible for a central-station man or any other inspector to condemn bad wiring without causing offence, if diplomatic. If the inspector or central-station man would go carefully over the work with the owner and explain to him just what the points of danger were, and what was likely to happen if the defects were not corrected, the owner would usually be thankful that these things were called to his attention and frequently would go even farther than the inspector wanted. On the other hand, a simple condemnation of the job without reasons was likely to make any owner wrathful. There are some classes, however, to which nothing will appeal but peremptory orders.

Traveling theatrical companies had been especially difficult to handle in Omaha. He told one story of a theatrical company which went to a great deal of trouble to try to persuade him to allow them to perform in Omaha without certain lamp guards required by the regulations. They maintained that they could not get the guards made in time for the evening's performance, and pleaded various excuses, but later produced the guards from their own railroad car when it was found that the city electrician would not permit the performance without them. Electrical contractors were to blame for lack of backbone in not insisting on being allowed proper time to do wiring in daylight hours, just as plumbers and other workers on a building are allotted a certain period. Instead of that, in Omaha it was customary for the electrical contractor to be obliged to sandwich his work in nights, Sundays and other odd times when the other contractors on the building would give them the chance. He thought that city inspection should be free, because of the tendency of owners to avoid inspection and the fees connected therewith. If city inspection is free, owners are anxious to obtain it. Free inspection of special holiday show-window wiring had kept his department busy in Omaha last Christmas. Probably few would have applied for it if a fee had been charged. He favored free State inspection ultimately, but in the meantime thinks there should be free city inspection.

Mr. E. A. Bullock, of Norfolk, Neb., thought that entirely too much had been said about the electrical hazards and not nearly enough about the various other hazards, especially the moral hazard. In fact, the moral hazard in Nebraska towns was so much greater than all other hazards put together that the electrical hazard was as nothing beside it. He had lived in Norfolk many years, and could count on the fingers of his hands the honest fires. The honest insurance-premium payers are the ones who pay for this, and he, for one, was thoroughly tired of paying for this large moral hazard. Insurance companies were entirely to blame for this in not investigating more thoroughly the causes of fires and the moral hazard. Agents would insure properties up to the fullest extent and then companies would pay losses without protest for fear of losing business in the future. Mr. Boyd replied that more attention had been given to the electrical hazard than to others because of the technical points involved. Any ordinary person knows about the dangers of flues, hot stove-pipes, gasoline stoves and the like, but the electrical hazard requires the attention of technical men. That was the reason more was heard about the electrical hazard than about the others.

CURRENT NEWS AND NOTES.

TELEPHONE COMPETITION IN CUBA.—The advisory commission at Havana has adopted a new telephone law which is stated to open the telephone business in Cuba to competition.

CONVEYING MACHINERY.—Among the papers to be presented before the coming Detroit meeting of the American Society of Mechanical Engineers, is one which will treat in detail the subject of conveying machinery. This paper, which will be in two parts, has for joint authors Messrs. S. B. Peck and George E. Titcomb.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.—Officers of the Northwestern Electrical Association met at Chicago during the week of the N. E. L. A. convention and mapped out a program for the convention to be held at Milwaukee next January. Prof. Meyer, of the University of Wisconsin, expert for the Wisconsin commission, will address the convention, and it is expected that this will form one of the most attractive features of the program. Those present at this committee meeting were Messrs. P. H. Korst, president; John S. Allen, W. R. Putnam, J. H. Harding, R. N. Kimball and L. L. Tessier.

TRAIN MOTORMEN ADMITTED TO BROTHERHOOD OF LOCOMOTIVE ENGINEERS.—The Brotherhood of Locomotive Engineers has voted to admit to membership the engineers of all electrically-drawn trains on steam railroads. It will probably be Sept. 1 before the extension of membership is made effective.

NEBRASKA "QUESTION CLEARING HOUSE."—The Nebraska Electrical Association, in place of the annual question-box that some assocations have, has established a "clearing house" for questions. Mr. L. E. Watson, of Beatrice, is the clearing-house committee. When he receives a question from a member, he mails it on a postal card to the members most capable of answering. Questions of policy are referred to the executive committee.

TRAIN DISPATCHED BY TELEPHONE.—The Chicago, Milwaukee & St. Paul Railroad is preparing to install telephones for train dispatching between Chicago and Milwaukee and between Chicago and Savannah. The Rock Island Railroad is also making plans to adopt a telephone system, and the first switchboard will be installed at Topeka, Kan., for the Kansas Division of the southwest district. The Alton and the Burlington lines are also contemplating replacing the telegraph by the telephone for train dispatching purposes.

CITY INSPECTION FEES.—The Toledo (Ohio) Electrical Company is preparing to test the right of the city to collect fees for making inspections of electrical work. A judgment was rendered against the company some time ago for $85.38 for making inspections of work done by the company. An appeal from the City Court to the Common Pleas Court will be taken. The electrical companies claim that the city discriminates against them because inspections of other lines of work are made without cost.

TRANSMISSION AT 125,000 VOLTS.—Mr. F. E. Greenman, superintendent of the Grand Rapids-Muskegon Power Company, of Grand Rapids, Mich., in a paper on the "Water-Power Development of Michigan," read before the Chicago branch of the A. I. E. E., May 22, said that his company, on June 1, will probably raise the voltage on one of its transmission lines from 72,000 (the present operating voltage) to 125,000. This is to be tried on the steel tower line which has been described in these columns.

MARSEILLES INTERNATIONAL ELECTRICAL EXPOSITION.—The Grand Palais of the Marseilles International Exposition is almost finished, the electrical or "luminous" fountain is completed and pronounced a decided success, and installations of exhibits are now being placed. The Electrical Society of Marseilles will erect a handsome pavilion on the grounds. The wireless telegraph station has been finished and during the exposition regular communication will be maintained with the wireless station on the Eiffel Tower in Paris, and with a government Mediterranean station.

NEW YORK ATTORNEY-GENERAL CANNOT SUE TELEGRAPH COMPANIES.—Judge McCall, of the New York Supreme Court, has denied an application by Attorney-General Jackson, of that State, for permission to institute a suit to annul the charters of the Postal Telegraph and the Western Union Telegraph Companies on the ground that these two companies have entered into an agreement to raise rates and create a monopoly. The court decided that the papers submitted did not establish any merit in fact or warrant in law for granting the permission sought.

CHICAGO MUNICIPAL CURRENT.—Preliminary steps have been taken to substitute current from the sanitary district power plant for that of the municipal electric lighting plant, the council having authorized an investigation of relative costs. Should the plan become effective the city's steam plants could be transferred at little expense to distributing stations for the sanitary district current. The city's law department holds that frontage consents are necessary before the poles and feed wires of the sanitary district can be placed in the city streets. A test case has been brought by the town of Cicero, and another test case probably will be brought by Chicago.

NEW YORK, NEW HAVEN & HARTFORD RAILROAD GOVERNMENT SUIT.—Attorney-General Bonaparte has caused to be filed against the New York, New Haven & Hartford Railroad Company a suit charging the existence of a combination in the restraint of trade and maintaining a monopoly within the meaning of the anti-Sherman act. Among the specific charges is one that the company acquired control over approximately 500 out of 600 miles of electric railway in Connecticut, 400 out of 500 miles in Rhode Island, and about 600 miles in Massachusetts, which railways, prior to such control, were engaged in active competition with the New York, New Haven & Hartford Railroad Company.

POWER PLANT RID OF EELS BY ELECTRICITY.—The run of eels in the rivers and creeks in the section of northern California, near Ukiah, is said to exceed any known for years. The canal built by the Snow Mountain Power Company, from its power houses in Potter Valley, has been swarmed with them, and they piled up at the power station in a manner that threatened to clog the wheels. There seemed to be no way of getting rid of them until electricians sunk a large meshed piece of wire netting in the canal where the eels congregated and when it was well covered several thousand volts were turned into it. The eels were then gathered up and hauled away and buried. Several wagon loads of them have been killed by this means already, according to the account. The Fish Commissioners are particularly interested in this method of destroying eels, as they are one of the greatest destroyers of young trout known.

INTERNATIONAL CONGRESS FOR PREVENTION OF ACCIDENTS.—The eighth International Congress for the Prevention of Accidents will be held in Europe the present year. Its sessions are held every three years and are always attended by influential government officials, publicists, social economists, men of affairs and professors. The reports of the congress are made by eminent specialists, so that the volume of these proceedings is the record of the world's latest and best advances in accident prevention. Of especial value will be the report of an international committee on the "standardization," so to speak, of accidents, their causes, duration and results, so that a world standard may be agreed upon as the basis for a comparative study. Membership in this congress is only $2, which entitles the subscriber to all the reports and the complete proceedings. The membership fee may be sent to Dr. W. H. Tolman, 231 West Thirty-ninth Street, New York, by whom it will be acknowledged and forwarded to Rome.

HENRY'S EARLY TELEGRAPH LINE.—The library of Princeton University contains a manuscript written by Prof. Joseph Henry, which includes a statement relating to his early work in telegraphy. In 1830 Henry, then in Albany, experimented with a telegraph employing a bell for receiver. Later, at Princeton, he erected a telegraph line, and referring to this, the statement says: "I think the first actual line of telegraph, using the earth as a conductor, was made in the beginning of 1836. A wire was extended across the front campus from the upper story of the college library building to the philosophical hall, on the other. Through this wire signals were sent from time to time from my house to my laboratory." The operator at the other end of the line was usually his wife. Parts of Professor Henry's apparatus are still in the Princeton University museum, among them being his giant electromagnet, nicknamed "Big Ben" by the students for whom he constructed it. By electrical communication controlled from his house, this magnet lifted or released a weight of 3000 lb. in his laboratory.

The Post Falls Development of the Washington Water Power Company—II.

By C. S. MacCalla.

TURBINES.

Each water-wheel consists of a pair of 64.5-in. Francis turbines mounted in a steel flume and on a horizontal shaft of forged steel, tapering from 12 in. in diameter at the generator end to 9.5 in. at the other end, and arranged to deliver water into a center discharge case, the latter being bolted to a cast-iron draft tube ring and connected to the draft tube. The wheel shaft extends through packing boxes and a gland on flume head-covers, and is supported externally by ring oiling bearings. The shaft is flanged to receive the runners and one end is flanged to bolt to a flange on the end of the generator shaft. The runners—one right-hand and one left-hand—are made of best grade gun metal cast in one piece, the flange on the runners being bored and drilled to fit the wheel-shaft flange.

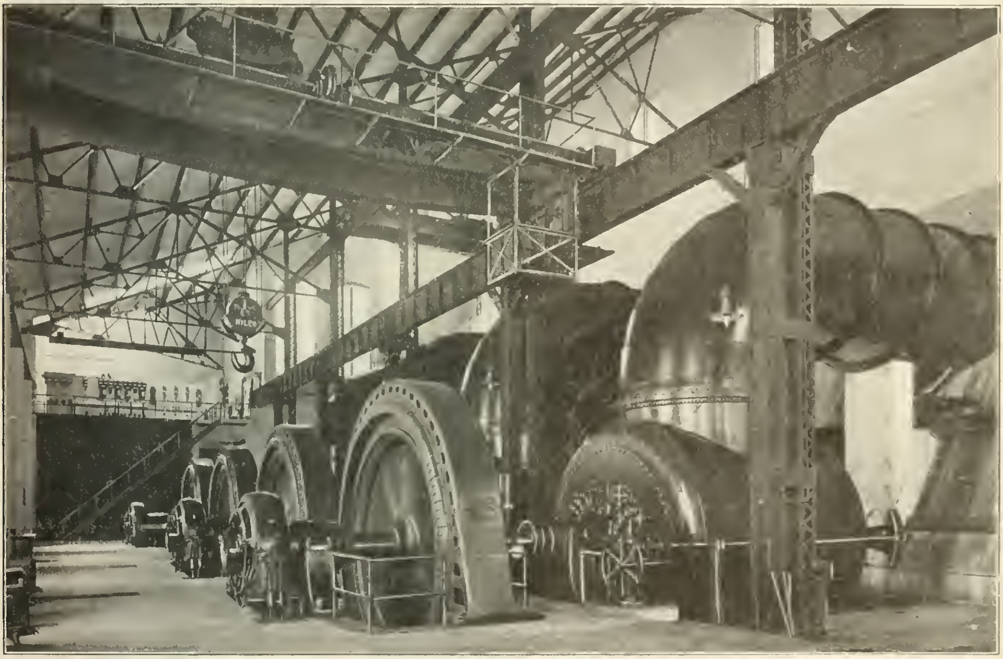


FIG. 7.—INTERIOR VIEW OF POST FALLS STATION, SHOWING TURBINES, GENERATORS AND SWITCHBOARDS.

The intake or feeder pipe is 11 ft. 3 in. in diameter and is built of 5/16-in. steel. It is about 50 ft. in length along the center line to the flume shell. The velocity of the water in the feeder pipe with full load on the generator is 7.25 ft. per second. The flume shell is made of 1/2 in. steel, 14 ft. 6 in. in diameter and 14 ft. long. The flume heads are of cast iron, heavily ribbed and provided with a split cover of sufficient size to allow the runner, gates and end of discharge case flange to be removed. The flume is also provided with two manhole covers, drain pipes and valves and lifting rings.

The gates for regulating the quantity of water for the runners are of steel swing-gate pattern, with external operating mechanism connected by a segment gear to a type N Lombard governor shaft.

Each draft tube is 10 ft. 0 in. in diameter at the top and 12 ft. at the bottom; it is 30 ft. long and is made of 5/16-in. steel plate.

The wheel is so located with respect to tail water that the center line of the shaft is 21 ft. above the low-water elevation.

Each unit is guaranteed to deliver on the turbine shaft 3260 hp at an efficiency of 80 per cent when the turbine gates are from 0.70 to 1.00 open and when operating under an effective head of 50 ft.

Three of the water-wheels are type B Victor turbines, built by the Platt Iron Works Company, and the fourth was built by the I. P. Morris Company. The fifth wheel is being furnished by the Platt Iron Works and is similar to the first three machines.

Each alternating-current generator is rated at 2250 kw, three-phase, 60-cycle, wound for 2300 volts, and are Y-connected with ungrounded neutral. It is of the revolving-field type and runs at a speed of 138 r.p.m. Four of the five machines are furnished with extended shafts for the accommodation of direct-connected overhung exciters. Each exciter is of 60-kw rating at 125 volts, and is capable of exciting two of the alternators when the latter are at full load current operating with 80 per cent power factor.

The alternators are guaranteed to have a full-load efficiency of 95.5 per cent., 94.5 per cent at three-quarter load and 92 per cent at half load, and to give a rise of potential of not to exceed 8 per cent when full non inductive load is thrown off.

The generators will, at 100 per cent power factor, carry full load for 24 hours with a rise in temperature not to exceed 40 deg. C. above that of the surrounding air, the latter being at 25 deg. C., and will carry a 25 per cent overload for two hours with a rise in temperature not to exceed 55 deg. C.

Each generator weighs 141,500 lb. and has a fly-wheel effect of 1,280,000 ft.-lb.

The exciters have a guaranteed efficiency of 85 per cent at full load and 84 per cent at half load and will carry 15 per cent overload for one hour without movement of brushes and without injurious sparking.

The transformers are wound for 2300 volts, delta-connected on the low-voltage side and 60,000 volts on the high-voltage side, the latter being star-connected, with the neutral point grounded. The transformers are oil-immersed and water-cooled, each transformer tank having 2200 gal. of oil and requiring 18 gal. of water per minute through the cooling coils.

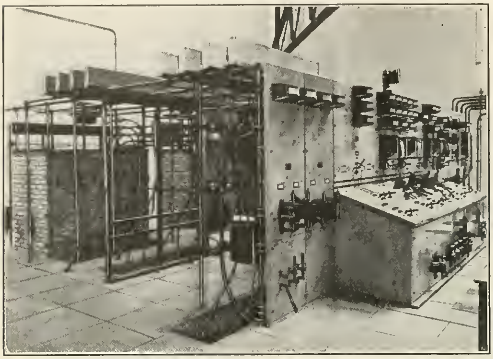


FIG. 8.—GENERAL VIEW OF SWITCHBOARD.

Each transformer weighs, without oil, 40,000 lb., and including oil, the total weight is 57,600 lb.

The transformer efficiencies are as follows: Full load, 98 per cent; three-quarter load, 97.7 per cent; one-half load, 97 per cent, and one-quarter load, 94.5 per cent.

Each transformer is placed in a brick cell, the front of which is closed by a steel rolling door. The oil piping is such that the oil may be drawn off into barrels or discharged directly into the river below the tail-race. The cooling water is piped from the forebay through the dam and discharges into the tail-race. Each transformer is mounted on 6-in. wheels, carried on axles placed in the base casting. These wheels operate on a steel track in the transformer compartment, in front of which is operated a transfer table so that any transformer may be rolled by its own wheels onto the transfer table and thence through the door into the generator room where it can be handled by the electric crane.

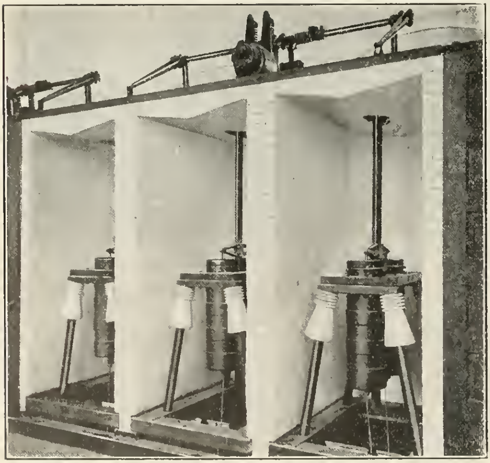


FIG. 9.—MOTOR-OPERATED CIRCUIT BREAKER IN FIREPROOF COMPARTMENTS.

Behind the main board, on auxiliary marble panels, are mounted the 2300-volt generator disconnecting or selector knife-switches and above these, mounted on a pipe framework, is a 2300-volt transfer bus. By means of these switches a generator may be operated directly with its own transformer or be connected to the transfer bus, and by means of this, connected to any other transformer. A small amount of power is furnished locally from the transfer bus through automatic oil circuit-breakers. In the 2300-volt circuit, between each generator and the knife-blade selector switches, is placed a triple-pole solenoid-operated oil switch located in a fire-proof brick compartment. These switches are equipped with overload definite time-limit relays of the diaphragm type.

One of the most important parts of the plant is the Tirrill regulator mounted on a panel at one end of the bench board. This instrument, acting upon the field coils of the exciters (the latter operating in multiple), regulates the alternating voltage and compensates for fluctuations in pressure incident to a load of varied character, including a large proportion of induction motors, mine hoists, street and interurban railways, etc.

A small storage battery with induction motor-generator charging set is used for the operation of the solenoid and motor-driven switches which may, however, be operated from the exciter circuits.

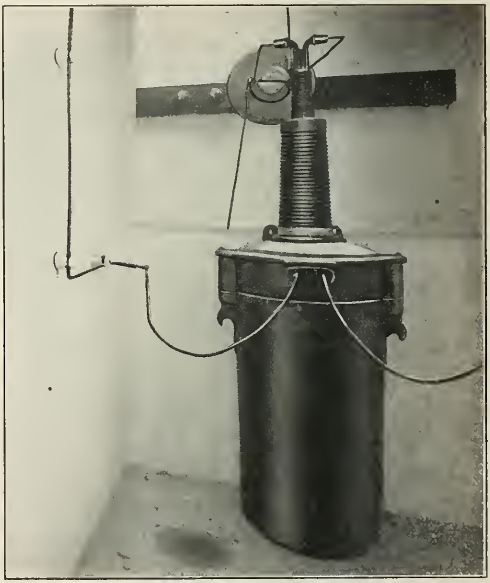


FIG. 10.—TRANSFORMER FOR 60,000 VOLTS IN CONCRETE COMPARTMENT.

The building is lighted principally by alternating current, but direct-current circuits are provided which may receive energy from the exciters in an emergency.

The electric crane receives energy from one of the spare 125-volt exciters.

The 60,000-volt switching is done in a building adjoining the 2300-volt switchboard and transformer rooms. The high-voltage leads from the step-up transformers pass through the brick wall of the compartments and thence up to the oil switches. The leads are of bare wire mounted on porcelain insulators 14 in. in diameter spaced 24 in. between wires. A brick barrier separates the leads of adjacent transformers.

The 60,000-volt oil-switches (Fig. 9) are automatic triple-pole, the oil pots in each phase being placed in a separate fire-proof brick cell, the three cells of each switch being closed by a wooden door lined with sheet asbestos. The switches are motor-operated and equipped with overload time-limit relays. These relays, as well as those controlling the 2300-volt solenoid-operated switches, are connected to series transformers placed in the 2300-volt circuit, it being considered advisable in this way to reduce to a minimum the liability of interruption to service by installing as few series transformers as possible in the 60,000-volt circuits. The only transformers of the latter kind are those controlling the switches and instruments in the three outgoing transmission lines. The high-voltage series transformers are placed in fireproof concrete compartments placed behind the 60,000-volt switch cells (Fig. 10). The secondaries of the series transformers are grounded to a heavy copper wire connected to each of the six 11 ft. 3 in. feeder pipes placed in the concrete dam and connected to the water-wheel casings and draft tubes.

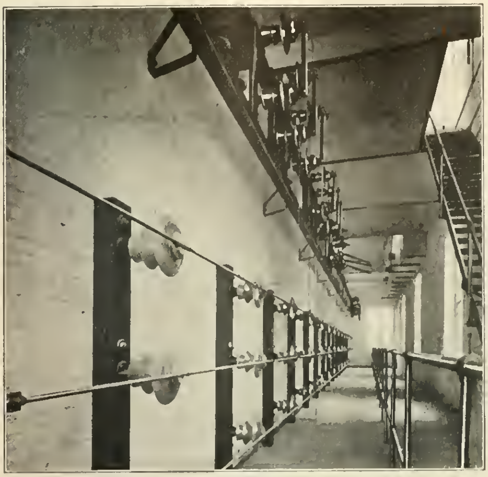


FIG. 11.—ONE OF THE TWO 60,000-VOLT BUS ROOMS.

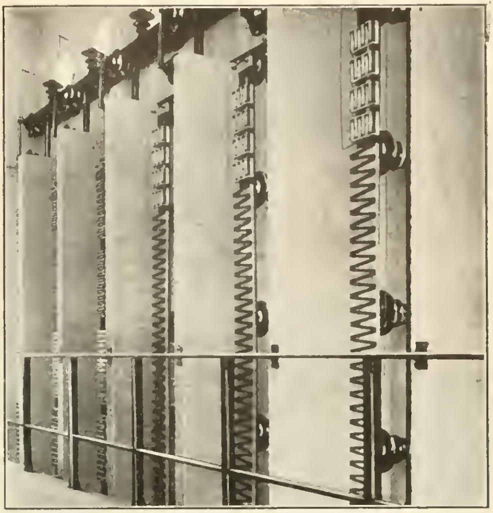


FIG. 12.—THE 60,000-VOLT LIGHTNING ARRESTERS.

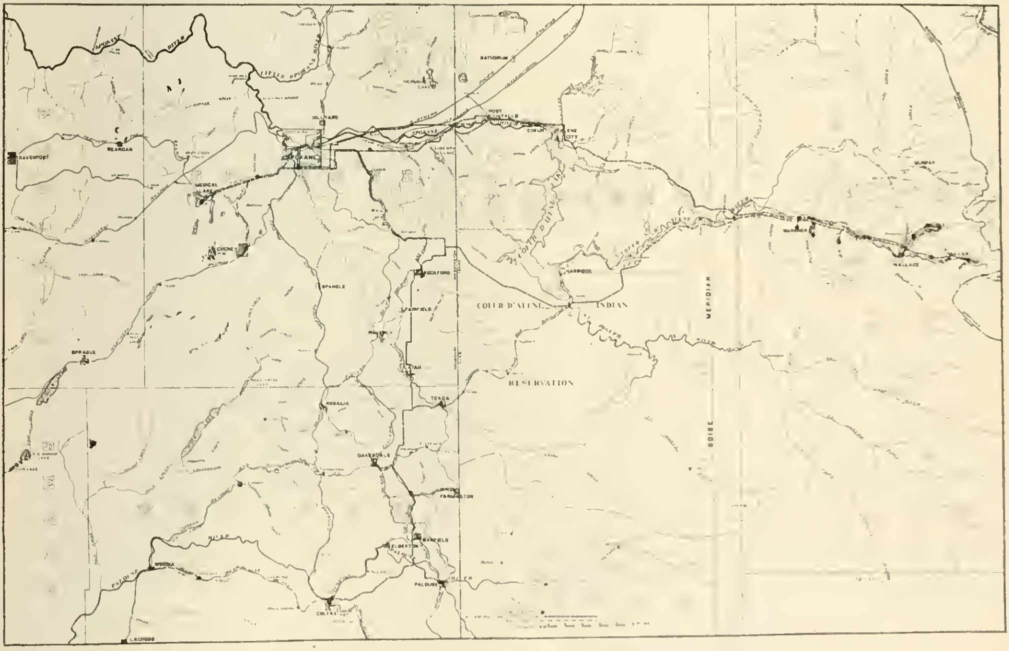


FIG. 13.—MAP SHOWING LOCATIONS OF THE 60,000-VOLT TRANSMISSION LINES.

Directly below the high-voltage oil-switches, extending the full length of the building and dividing the lower floor into two rooms, is a brick wall, upon opposite sides of which are mounted the 60,000-volt, three-phase busbars (Fig. 11), each set of which is carried on porcelain insulators 14 in. in diameter with 24 in. between wires. Each set of busbars is connected to each oil switch by three single-pole knife switches. A disconnecting switch is used with each lightning arrester. The arrester (Fig. 12) consists of a series of brass cylinders and air-gaps in conjunction with a spark-gap and carbon resistors and is of the G. E. multiplex-type

The Post Falls plant also furnishes energy at 22,500 volts for the operation of the Cœur d'Alene & Spokane Railway Company, a 40-mile, 600-volt interurban line using direct current. The railway company takes three-phase, 60-cycle current from Post Falls, which is nearly at the center of distribution of the road, and thence transmits energy to step-down and rotary converter substations. Energy was formerly furnished from another substation, but upon the completion of the Post Falls plant the transformers were moved there. These consist of three single-phase, oil-cooled Stanley transformers wound for 2300 volts on the primary and 22,500 on the secondary. They are placed in a fireproof room at one end of the 2300-volt switchboard gallery, and are controlled by a triple-pole automatic solenoid-operated switch, mounted in a brick cell and connected in the 2300-volt circuit. Air-break disconnecting switches are placed in the 22,500-volt leads.

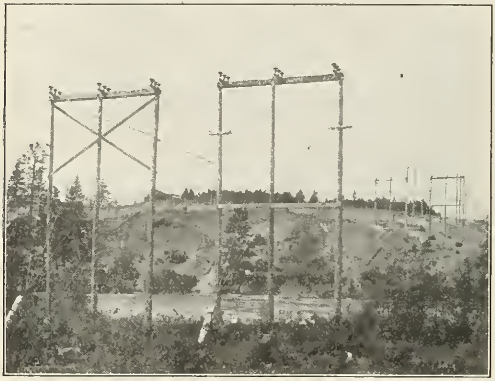


FIG. 14.—TRANSMISSION LINES CROSSING SPOKANE RIVER.

All of the electrical apparatus, with the exception of the three oil-cooled transformers, was furnished by the General Electric Company.

The Post Falls plant is connected to the Spokane plants by two entirely separate 60,000-volt transmission circuits (Fig. 13), one a direct tie line, and the other having branches, one to the Cœur d'Alene silver-lead mining district in Idaho, 100 miles away, furnishing energy to all the principal mines and mills, and the other to the "Palouse Country," in southeastern Washington, where energy is used for operating flour mills and for municipal and commercial lighting, etc. An additional 60,000-volt line, 117 miles in length, which is now under construction, will furnish energy in the territory to the west of Spokane, lying in the "Big Bend" of the Columbia River.

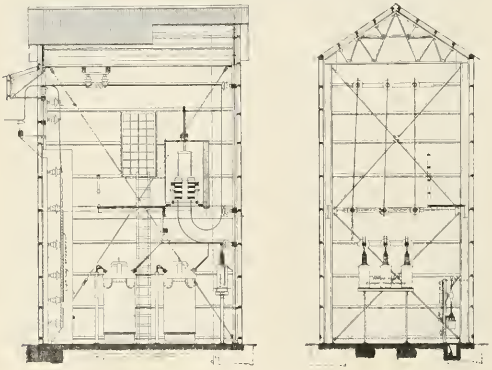


FIG. 15.—ARRANGEMENT OF STANDARD STEEL SUBSTATION.

In Spokane energy is distributed for the operation of more than 200 miles of interurban electric railways and 90 miles of city lines; for the operation of the Great Northern and Northern Pacific railway shops; to iron works and factories of all sorts, as well as for municipal and commercial lighting.

In transmission line work both copper and aluminum are used, the former being No. 2 solid medium-hard-drawn, with wires placed at the corners of a 42-in. equilateral triangle and carried on cedar poles spaced 125 ft. apart. The more recent construction has been with No. 0 stranded aluminum, with 84 in. between wires, carried on 45 ft. cedar poles spaced 200 ft. apart. On the "Big Bend" line, now under construction, stranded aluminum is used with an 84-in. spacing, on 45-ft. cedar poles set 300 ft. apart. The lines are graded to compensate for inequalities in the contour of the country The insulators used on the 60,000-volt line are of porcelain, 14 in. in diameter and 12.5 in. high, and are made in four parts and cemented together.

A metallic circuit telephone line of No. 8 hard-drawn copper, which is carried on a cross-arm below the 60,000-volt wires, connects with all substations and patrolmen's houses.

The transmission wires are transposed (120 deg.) once in every mile, except where the line parallels other transmission lines or telegraph and telephone lines for a distance of a mile or more, in which case an integral number of complete transpositions (360 deg.) is made in the distance in which the lines parallel each other. The telephone line is transposed (360 deg.) twice as frequently as is the transmission line. No trouble whatever has been caused to the long-distance telephone lines which parallel the transmission lines in a number of instances for considerable distances.

The standard 60,000-volt substation construction is shown in plan in Fig. 15 and in cross-section in Fig. 16. Energy is distributed at 2300 volts, 60 cycles, three-phase. In the substation shown the energy is used for the operation of flour mills and for general industrial purposes, as well as for lighting. For the latter, automatic three-phase induction regulators are used to compensate for fluctuations in transmission line voltage, as well as for line loss in the local 2300-volt feeders. The step-down transformers are three-phase, oil-insulated, water-cooled, and wound for 2300 volts secondary and 60,000 volts primary, the latter being star-connected with the neutral brought out to ground. The substations are built of brick, although in some instances an angle iron frame construction is used (Fig. 16), covered with galvanized corrugated iron. The oil switches are of the same general type as are used in the Post Falls station, except that they are hand-operated and electrically-tripped, and are automatic, but without time-limit relays.

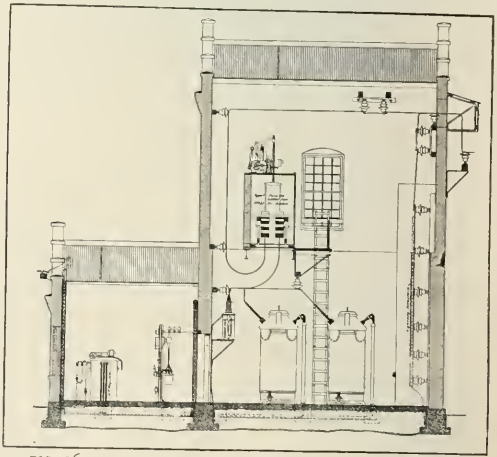


FIG. 16.—SECTIONAL ELEVATION OF ROCKFORD SUBSTATION.

The Post Falls development, with the exception of the controlling works in the North Channel, was designed in its entirety by the engineering staff of the company in Spokane, under the immediate direction of Mr. C. S. MacCalla, who was also in charge of construction. The North Channel works were designed by Mr. A. O. Powell, late of the U. S. Engineer Office, St. Paul, Minn. With the exception of the rock excavation and a small amount of concrete work, which was done under contract, the entire development was made by the construction forces of the company under the immediate direction of Mr. W. C. Weeks.

* * *

Operation of Large Hydro-Electric Station Switching Apparatus.

By F. E. Conrad.

Notwithstanding the tendency to standardize apparatus in central station construction, it will be found that switchboards are modified to suit each individual installation, or in other words, each switchboard is designed especially for the apparatus it is to control. However, the general principles underlying the design are very much the same, and the great difference in appearance is due chiefly to the selection of instruments and the different mechanical methods of applying the operating devices, and also to the switch and rheostat mountings.

In the design of some switchboards, some very important factors apparently are not given proper consideration, so that in some instances prompt and efficient service is out of the question. Any instrument or appliance tending to complicate the switchboard or that is not absolutely necessary should be excluded. Reliability is of prime importance. Everything about the switchboard should be rugged, simple and designed with the knowledge that it must stand hard service and abuse. Instruments will be subjected to enormous momentary overloads due to short circuits, loss of load and consequently excessive voltage, effects of lightning, etc. It is especially important that remote-control switches should be reliable.

It is not necessary to have delicate instruments on the main switchboard, as they are never used for testing when precise results are desired; portable instruments being invariably used. For instance, the needle of an indicating wattmeter will be continuously swinging even on a steady load, especially when there are a number of alternators running in parallel, due to the cross currents that hold the machines in step, and it is unnecessary to have precise readings for the report. There are, of course, exceptions; the voltmeter used when regulating the busbar voltage should be accurate and should be checked up frequently with a standard; the frequency indicator should also be correct, as well as the watt-hour meter.

It is a great advantage for the attendant to be able to see the scales of all instruments from a central point, and where there are a number of machines operated in parallel to have the panels arranged in a long line is a distinct disadvantage. It is preferable to have the board arranged in the form of a semi-circle. The voltage could then be controlled from a central point where it would be only a step from any machine master switch. This arrangement would be very convenient in case of trouble.

Compactness is a very desirable feature, but should not be carried to extremes. Switchboards of the kind under discussion are usually of the bench board type, and owing to the small space necessary for vertical edgewise instruments, the remote control devices occupy more room than the instruments, and in such cases the instruments should be spaced to correspond to the location of the balance of the appliances for that particular generator. That is, the field switch, instruments, plug receptacles, pilot lamps, switch handles or master switches, relays and rheostat hand-wheel for one generator should be grouped together on a separate panel, or occupy a section of a panel. By this means the apparatus belonging to one generator is grouped as a unit, and in emergencies this simplifies the work and reduces the liability to error.

Each generator should be provided with an indicating wattmeter, which may be either of the polyphase or a single-phase type and calibrated to read total power for the machine; an ammeter to show current in one leg of the circuit, and a field ammeter. It is hardly necessary to say that in large stations of this class all main generators are three-phase units with the load approximately balanced. The field switch and relay should also be on the front of the board, together with the rheostat hand-wheel; although the latter may be located on a stand at a convenient place. If the generator switches are mechanically operated, there are two operating handles; or if the switches are of the remote control type, there are two small master switches with tell-tale lamps to indicate whether the main switch is open or closed. If conditions warrant, the generator time limit relay may be cut out, and the main switch may be opened by the attendant.

Two sets of busbars will require two totalizing panels. These should be equipped with three voltmeters, one for each phase; three ammeters, one in each leg, and a polyphase watt-hour meter, or two single-phase watt-hour meters to show the total output of the station. There should also be a power-factor indicator and a recording voltmeter. A recording wattmeter is a great convenience, as it provides an accurate load curve. A synchronizer should be placed in plain view from any part of the board, and a voltmeter should be placed in the circuit of the incoming generator with the same plug that cuts in the synchronizer. A large, open-scale voltmeter for use in regulating the bus voltage, and a frequency indicator under it may be grouped with the synchronizer on the totalizing panel.

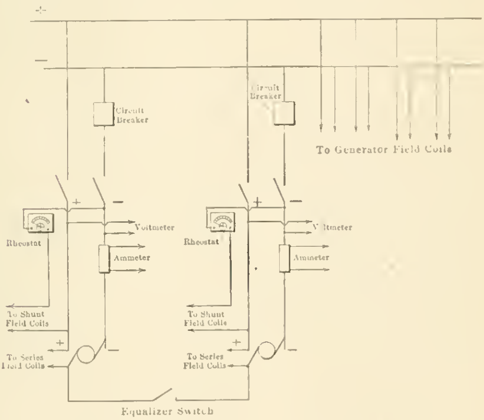


FIG. 1.—DIAGRAM OF EXCITER BOARD WIRING

All switchboard instruments should have a scale 30 to 50 per cent higher than full load capacity to allow for overloads; but watt-hour meters should be carefully selected with regard to the probable load they will have to carry regularly, and as they are more accurate near full load, their normal capacity should be somewhat lower than the full-load capacity of the station. They will then also indicate light loads quite accurately. Assume that a board is designed to control 12 three-phase, 2000-kw. revolving-field alternators which are direct-connected to water turbines and which generate 60-cycle current at 2400 volts. The voltage is stepped up to 40,000 volts for transmission, over three high-tension lines, each feeding one or more substations. Each high-tension line is in duplicate, and each substation has duplicate apparatus. The high-tension oil switches on the incoming lines are non-automatic in the substations, also the lightning-arrester equipment at the power house transformer room is more sensitive than that in the substations, and the high-tension oil switches at the power house end are equipped with time-limit relays. This arrangement tends to concentrate trouble at the power house where there is a larger force of men to take care of it

The exciter should be used only for exciting the field coils of the main generators and feeding the station lighting circuits. All motors for pumps, cranes, machine tools, etc., should receive energy from a small set of transformers connected to the main busbars. This arrangement will require no governor on the exciter units, which may be operated with hand-set gates. When running at full speed, one or two additional machines can be cut in with no change of gate, the voltage being adjusted by means of the shunt field rheostat. A slight drop in the speed takes care of the additional load.

Fig. 1 is a diagram of the exciter board wiring. It is an advantage to use single-pole switches so that in case the exciter refuses to build up or builds up reversed, the equalizer switch may be closed, and the switch on the cable coming from the terminal of the series field or the positive terminal (Fig. 1). Care should be taken to keep the switch connected to the terminal coming direct from the brushes (Fig. 1) open, as the switch should only be closed when cutting the machines in parallel, when their voltages are equal. This will connect the series field coils of both machines in parallel, and cause the machine to build up in the proper direction. If the switch should be double or triple pole, the lead must be disconnected at the armature terminal. Sometimes the spare exciter is needed in a hurry, and single-pole switches would thus save valuable time.

After the system is in operation and carrying load, there should be no shut-downs, unless these are absolutely necessary or are due to accidents. It will therefore be necessary to be able to change exciters while carrying load, and to prevent variations in the main bus voltage. This must be very carefully done, and with hand-regulated machines will require an attendant at each exciter turbine gate. When the spare unit is ready, the operators will give the signal to start, closing the shunt field circuit and circuit breaker, also the equalizer switch. The main switches should be placed about an inch from the clips, ready to be jammed shut when the machine is up to voltage. The shunt field rheostat should be cut out so the machine will build up quickly, and the load on the other exciter should be noted. As the voltage picks up resistance should be cut in gradually; this tends to give the machine more speed for the same voltage. When the rheostat resistance is nearly all in circuit the voltage should be allowed to rise as the attendant gradually opens the gate, and when it is equal to the voltage of the other exciter or one or two volts higher, the main switches should be closed. A signal may then be given to stop the other exciter, and the attendant gradually closes its gate while the attendant at the spare exciter continues to open its gate. When the spare exciter has a load equal to that noted before starting to change units, the circuit breaker of the exciter to be stopped should be tripped regardless of any load indicated on the instrument. The operator should be careful not to wait until the machine has no load; because even when the gate is fully closed, and the machine is running as a motor, the load on the spare exciter will continue to increase. The one to be stopped will indicate some load, and as this condition increases, the exchange current between the machines becomes excessive and the circuit breaker will have to be tripped on a heavy current. The spare exciter will also have too great a gate opening, causing a sudden rise in the voltage when the circuit breaker is tripped and this will affect the main bus voltage so that the exciter gate opening will have to be immediately reduced. The gate should be set so that when the voltage is normal the rheostat may be adjusted either to raise or lower the voltage. The gate should be latched in this position, and should not be changed without a signal from the switchboard operator.

The exciters are, of course, compound wound and should never be cut in parallel unless the equalizer switch is closed. When it is desirable to operate the exciters in parallel, the load may be adjusted between the two machines by manipulating the rheostat. Cutting out resistance tends to raise the voltage and increase the load and it is sometimes necessary to make a slight change in the gate opening. Rheostat hand wheels, when properly installed, reduce the voltage when given clockwise rotation, as this cuts resistance into the field circuit and decreases the field current. Counter clockwise rotation of the hand wheel cuts out resistance, allowing an increase in the field current, with consequent increase of voltage.

When switching in a spare exciter in an emergency, it is of course best to close the switches when the voltage is one or two volts higher than that of the machine in service; however, if the voltage of the spare unit should be even 8 or 10 volts higher, it is safe to close the switches. The writer has done this with no bad results and with machines rated at 300 kilowatts. The switches of the spare unit should never be closed when the voltage is lower than that of the machine in service, as it will cause a drop in the main bus voltage. The contact surfaces of large circuit breakers should be cleaned before closing, as a quantity of dust may cause heating when the current is heavy.

In taking up the actual operation of the main switchboard, the writer will assume that each generator is equipped with an indicating wattmeter, giving the load directly in kilowatts, an ammeter giving the current in one leg of the machine circuit, a direct-current field ammeter, a double-pole field switch with auxiliary clips for a kicking coil, a set of receptacles for a six-pole plug that will connect one phase of the machine to the synchronizer, another phase to a voltmeter and the third phase to an incandescent lamp. The two main generator switches are of the remote-control type, so there will be two small master switches to operate them. Each generator switch will have two tell-tale lamps, one green for open and a red for closed, a small switch to operate the signal lamp, a field rheostat hand wheel, and a time limit relay. There are also two totalizing panels, each equipped with three voltmeters, three ammeters, one polyphase watt-hour meter, one recording watt-hour meter, one power-factor indicator, one recording wattmeter, a synchronizer with two pole plugs and receptacle, together with the voltmeter and lamp that is plugged on the generator while synchronizing, and also the voltmeter used when regulating the voltage, and a frequency indicator. Five of the 12 generators are equipped with governors, the remaining seven are started, stopped and the load adjusted on them by hand, the gate being latched to keep it at the desired point. Enough governor machines are run to take care of the variation in the load. The time limit relay on the generator switches are cut out, making the switches now automatic, and in case it is necessary, it can be opened by the operator.

The station report should consist of hourly readings of the load in kilowatts, amperes and field charge of each generator; the main bus voltage, exciter voltage and load, a reading from the watt-hour meter, power-factor meter, and as it is a water-power station, a record should be kept of the height of head and tail water in the remarks column. A complete record of anything unusual, any trouble with cause as near as can be ascertained; in fact, any information that would be probably useful in the future in looking up past happenings should also be written down. All this information should be kept in as clear and concise a manner as possible. Other items, such as weather, temperature, etc., may be incorporated in the report. A record of service of other apparatus, such as transformers, lines, etc., is useful in case of failure, as it can then be definitely ascertained just what service the defective apparatus has given.

After the machines, transformers, lines, etc., have been tested with working voltage and the plant is ready for operation, an exciter is brought up to speed and voltage and kept there. A generator field switch is then closed, and the generator brought up to speed and its main switch closed. This excites the main bus, and the three voltmeters on the totalizing panel will indicate the voltage. The generator field rheostat should now be adjusted to bring the bus voltage to its normal value of 2400 volts. The instrument transformer ratio is 20 to 1, and using the open scale voltmeter it will indicate 120 volts. On this class of instruments there is a small pointer which is set at the voltage it is desired to maintain, and the needle will coincide with this pointer when the voltage is normal. Any variation will be easily noticed by the attendant. The generator is without load, and this first waterwheel should have a governor, which should now be carefully adjusted to hold the machine at proper speed, so the frequency indicator will stand at 60 cycles. The field charge as indicated on the direct-current ammeter should be noted, as all the main generators are similar. When starting up additional machines, the field current can be adjusted to this value before starting, and no further adjustment is necessary while synchronizing, a difference of a few volts one way or the other being immaterial.

A bank of transformers may now be connected to the live bus, and the high-tension selector switches closed, thereby cutting in a set of high-tension busbars. A transmission line can now be cut into circuit. Each substation on the line should be notified by telephone that the line is about to be cut in; the proper set of selector switches is then closed, and lastly, the main line oil switch. The substations' attendants may then be notified to cut in the transformers and feeders, and customers may proceed to use the energy.

At the main switchboard, it will be found, that as transformers, lines, etc., are cut in, there is a continual drop in the voltage and the generator wattmeter indicates some load. As the load increases, the voltage continues to decrease, and the generator rheostat should be adjusted so as to increase the field strength until the voltage is normal. It is the duty of the operator to watch the voltage and keep it normal. As the load decreases, the voltage increases, and the field charge must be reduced. In this case it requires 112 amperes in the field circuit to generate 2400 volts when running at normal speed.

Now, suppose the load on this one generator has increased and varies from 1500 to 1800 kilowatts; that is, the load has a swing of 300 kilowatts, and at this load, it requires a field charge of 210 amperes to maintain the proper voltage. To provide for a further increase in the load another generator must be put in parallel with the first one. This will require the use of the synchronizer. This instrument not only indicates the exact instant when the incoming generator is in step with the bus to which it is to be connected, but also shows the approximate difference in the speed or frequency, and whether the incoming generator is running too fast or too slow. At the instant the moving hand or needle passes the painted hand on the dial, the machines are in step, and the object is to close the main switch at this instant. However, there is another factor which must be taken into consideration, and that is the speed with which the needle passes this point. Suppose the frequency of the busbar is exactly 60 cycles per second, and the incoming machine is running at such a speed that its frequency is 59 cycles per second; then the needle of the synchronizer will make one complete revolution per second. To illustrate, suppose the frequency of the bus current is five cycles per second and that the frequency of the incoming generator is four cycles per second, as shown by the dotted curve, Fig. 2. At the zero point *a* the machines are in synchronism, but instantly after passing this point, or, say, at *b*, their voltages differ by an amount equal to *c-d*, and the machines are receding from synchronism until the central point of the diagram is reached at *e*, when the zero point in each machine coincides, but the voltages generated immediately after passing this point are in opposition; they then approach each other until the point *f* is reached, when they are again in synchronism. Obviously the time represented by point *e* would be the worst time to connect the machines together, while that represented by the point *f* would be the best. Now, as the needle of the synchronizer is over the painted hand at the exact instant of synchronism, which occurs when the machines are operating under the conditions represented at *a* or *f*, hence at *e* the needle would be displaced 180 deg. or would be directly opposite the painted hand or half a revolution away. It can be seen that the last time for the switch to be closed is at *f* or an instant before, or as the needle approaches the painted hand. There is less disturbance to the system if the switch is closed an instant too soon than if closed too late, and the less difference there is in speed the better. As previously stated, the frequency of the bus circuit is 60 cycles per second and that of the machine 59; the needle will therefore make one revolution per second; if the machine frequency is 59½ the needle will move slower.

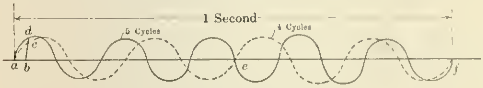


FIG. 2.—FREQUENCY CURVES.

In order to cut in the second generator the field switch should be closed and the field current adjusted to the proper value—in this case, 112 amperes. At the same time, the exciter voltage should be 125 volts. As the additional load caused by cutting in the field coils will cause a slight drop, the six-pole plug should be placed in the receptacle. This connects the machine to the synchronizer. On the totalizing panel, the two-pole plug should be inserted so as to connect the other side of the synchronizer to the busbar. The machine may then be started and as it picks up in speed, the synchronizer commences to vibrate rapidly. When the machine approaches normal speed, the synchronizer commences first to revolve rapidly, then gradually, slowing down when the speed of the machine is nearly normal. The operator should now hold the master switch ready to close, and when the needle is moving very slowly and is about 1 in. away from the painted hand the switch should be closed. In doing this, the attendant must use his judgment; the idea is to close the main switch contacts as the needle passes slowly over the painted hand on the dial.

With remote control switches, there is an appreciable space of time between the time of closing the master switch and the instant when the switch contacts come together. This must be allowed for by closing the master switch before the needle gets to the proper point. As soon as the switch contacts close, and the machine is connected to the bus, the needle will remain stationary at the painted hand on the dial. If it slowly comes to a stop at any other point, it shows that the speed is the same, but that the machines are not in step, and if it starts to revolve in the opposite direction, it indicates that the incoming machine is running at too high a speed. When the machine operates too fast, the needle will revolve rapidly, suddenly stop and reverse its rotation. No attempt should be made to get the machine into step until its speed is reduced and brought to its proper value.

When the switch contacts close, if the synchronizer needle jumps forward, it shows that the switch was closed too soon; if the needle is jerked backward, it shows that the switch was closed too late. It is better to close the switch too soon than too late. It is immaterial which way the needle commences to revolve when the machine is coming up to speed; but usually there are arrows on the dial to denote if the machine speed should be raised or lowered, and if the needle does not rotate in the proper direction its direction of rotation may be reversed by transposing one pair of terminals.

There is always the possibility of making a bad shot, and immediately after closing the switch the operator should glance at the machine ammeter, and if there is indication of a short circuit, the switch should be opened instantly. On machines of large size, a generator will pull into step if the synchronizing current does not exceed, say, 200 amperes; but this would be an extreme case With a little practice and care the synchronizing current can be kept at a very low value, say, from 20 to 50 amperes.

As soon as the generator switch is closed, the gate may be opened slowly and the machine loaded up, care being taken always to keep some load on the governor machine at the lowest swings; and there should be enough governor machines in service so that at the heaviest swings their gates will not be fully opened. For instance, if the load is swinging from 8500 to 12,000 kilowatts seven generators should be used, three of them with governors; four could be set at about 1700 kilowatts each, which would take care of 6800 kilowatts. The governor machines would then have about 200 kilowatts on a low swing, and a little over 1700 kilowatts on a high swing, and under such conditions very good regulation may be obtained. For heat results, the machines should have approximately equal loads, and the field current adjusted to the same value; but different values in the field currents do not make so very much difference in the regulation, as cross currents between the different machines equalize the voltages, as well as keep the machines in step. If a generator has an abnormally high field current, it will cause the machine to carry an excessive load. A machine of this class will carry approximately 3.7 kilowatts per ampere at a power factor of .90 and at a load of 1800 kilowatts the current would be about 525 amperes. This includes cross currents; and an excessive field current would raise this to 600 or 650 amperes. With the swing in the load there will be a continual variation in the speed; for the same swing in the load this variation decreases, as the number of machines in service increases, or in other words, the fly-wheel effect of the machines improves the regulation. However, this variation in speed causes a variation in the bus voltage, and with hand regulation by means of the generator field rheostats it is useless to try to prevent this fluctuation. Any variation in voltage caused by a variation in speed should not be corrected by adjusting the rheostats, as the governors will restore the speed to normal and with it the voltage. From this it is evident why the frequency indicator should be placed directly over or under the voltmeter used when regulating the voltage, as the attendant can see at a glance if it is necessary to use the rheostats to restore the voltage to normal.

When a decrease in the load makes it necessary to cut out a machine, its field current should be reduced to the same value as that used when starting a machine, in this case 112 amperes. The field currents of the other machines must be increased to hold the voltage up. After closing the gate until the instruments indicate no load, the main switch is tripped. With this system on a low head, with the turbines close to forebay and good governors, properly adjusted, the regulation may be as close as 1½ to 2 per cent on a mixed load.

The switchboard attendant should keep in touch with the character and amount of the station load. He will then know what load to expect and how many machines it will be necessary to have in service at any time. He should also know the relative importance of the loads on different lines and feeders, so that in case of trouble he can give preference to the most important line. A private telephone system installed on the transmission line poles will enable the main switchboard attendant to keep in communication with any substation operator. The latter will receive instructions from the former as to opening or closing feeder circuits, transposing lines, etc., or any necessary changes to eliminate trouble and restore normal service. If possible, it is also well to have a public telephone service installed, so as to have a separate line of communication in case of trouble with the private line. Much trouble may be prevented by watchfulness and attention to details. Defects in apparatus if promptly repaired will often prevent a serious breakdown. The flash caused by opening a switch carrying a heavy current is not only unpleasant, but injurious to the eyes, and it is a good plan for an attendant to cultivate the habit of closing his eyes when opening field switches or tripping circuit breakers.

Dynamometer Wattmeters

In a paper read before the Physical Society of Great Britain, Mr. C. V. Drysdale gave an account of an investigation of the theory of the wattmeter, including the effects of shunt inductance and capacity, mutual inductance, eddy currents, waveforms and of iron. It pointed out that the theory of the wattmeter is much obscured by the use of a correction "factor." The correction of a wattmeter should always be applied as a difference and not as a ratio. It is practically as absurd to apply a correction factor to a wattmeter as to an instrument with a zero displacement.

Preliminary Inspection and Testing of Watt-Hour Meters.

By Joseph B. Baker.

In a previous article (March 7) the writer gave a list of the tools and other apparatus comprising a meter inspector's equipment for testing meters at their place of installation. The following general instructions apply to the testing of unsealed commutator-type and induction-type meters with indicating instruments, on consumers' premises, when two men working together (tester and helper) are employed to make the tests.

The method of testing with voltmeter, ammeter and stop-watch, or with indicating wattmeter and stop-watch (applicable to alternating-current meters) is selected for the presentation of general testing instructions for the reason that this method is the one which has been the longest in use, and is still perhaps the one which is most frequently employed. The "standard-resistance" method, using calibrated resistance, voltmeter and stop-watch, is described briefly herein as a special case of the indicating-instrument method.

In regard to the respective duties of tester and helper it will be assumed that the tester is the man in responsible charge, who carries the instruments, takes the instrument readings, and directs the general conduct of the tests, and that the helper, as the less experienced man, carries the balance of the testing equipment, and takes care of the preparations for the test and the cleaning up afterward. In some companies the taking of the instrument readings is assigned to the helper, as this part of the testing work requires less experience than the observations at the consumer's meter.

The information given represents the present meter practice of several central-station companies, and is drawn from various sources. It is presented somewhat in the form of direct instructions for the sake of clearness and not with any idea of "laying down the law" or with any pretensions of covering all that there is to be known on the subject.

It is customary among many central-station companies to issue written or printed instructions for the government and information of their meter readers and inspectors. There are several advantages of this plan: The instructions give effective assistance in "breaking in" new employees; and the writing and occasional revision of the matter by the heads of the meter department leads to close attention to details, stiffens the general sense of responsibility, and tends to the adoption of improved methods and the elimination of old and inferior ones, so that the matter when kept well co-ordinated and up to date constitutes the final authority among the company's employees.

Upon arriving at the customer's premises the testers should first of all civilly make their presence known to the proprietor or person in charge of the place, and show their meter inspectors' badge. As in all visits of public-service employees, tact and judgment should be used in order to make the test as little of an annoyance to the customer as possible. The men should realize that the testing of a customer's meter, when it means the invasion of his busy office or store, or his private residence, by two men laden with apparatus, may at times be a considerable annoyance to him, and they should, therefore, make as little disturbance and get through their work as quickly and quietly as possible, and be careful to "leave things cleaned up after them."

After recording on the test card the time of arrival, and before removing the meter cover, the tester compares the number on the meter case with the number on the test card, and notes the condition of the seal, and whether the meter is level. The dials should be read by both the tester and helper, independently, and the reading entered on the test card.

The "test card" carried by the meter inspector should be a printed form, having space provided for entering any and every routine or special observation that may be made in testing or inspecting consumers' meters. The form when filled in should itself constitute the permanent record of the meter inspection, and not be simply a set of notes for transcribing. It should therefore be got up in durable and convenient shape for filing. On the test card used by some companies space is provided for more than a single test, the card being kept in the files of the clerical section of the meter department at all times when it is not in actual use by the meter inspector.

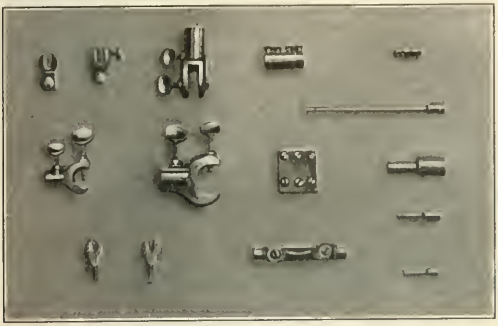


FIG. 1.—ASSORTMENT OF CONNECTORS.

The next thing is to make sure that current is on the mains, noting at the same time whether more than one lamp has to be turned on before the meter will start. The inspector then sets up his instruments (placing them on a box or table if possible, and inserting the potential plug only), and gives the register a preliminary inspection for loose dial hands and defective mechanism. Once placed in position for a test, the instruments should not be moved during the test. The helper in the meantime may be laying out the tools, removing the meter cover, getting the lamp bank (or rheostat) ready for work, and taking an independent check reading of the dial.

In many companies inspectors are instructed to refrain from spinning the shaft of the meter at this stage—or, in commutator meters, touching the commutator or brushes, or, indeed, tinkering with any part of the meter—previous to taking the "as found" readings, as so doing may materially affect the friction and resistance of the moving element, and thereby give misleading results in the tests which follow, particularly the result of the light-load test.

The tester should then remove such wires as are necessary, and if the customer is using electricity the necessary temporary connections should be made so as to continue the service during the test. Fig. 1 shows a useful assortment of connectors that may be carried for making temporary connections in meter-testing work.

In making connections for any method of testing, the potential feed of the meter should not be disturbed, as the opening of this circuit would allow it to cool down from its normal operating temperature and thereby tend to make the meter run fast during the test. The potential wires for the voltmeter must feed from the same point as the potential wires for the consumer's meter.

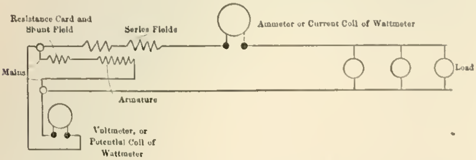

Resistance Card and Shunt Field
Series Fields
Ammeter or Current Coil of Wattmeter
Mains
Load
Armature
Voltmeter, or Potential Coil of Wattmeter

FIG. 2.—CORRECT CONNECTIONS OF INDICATING INSTRUMENTS IN TESTING WATT-HOUR METER.

The correct method of connecting up meter and instruments in testing a commutator meter on the consumer's premises is shown in the accompanying elementary diagram, Fig. 2. The voltmeter should not be connected at a point between the meter and the load (as in Fig. 3), since for such connection not only would the energy taken by the voltmeter be registered by the watt-hour meter under test, causing considerable error in the light-load test of the watt-hour meter, but the indications of the voltmeter would be reduced by the fall of potential through the watt-hour meter, causing considerable error (increasing with the load) in the voltmeter readings. In case a wattmeter is used instead of the voltmeter and ammeter, the current coil of the wattmeter is to be connected in the place of the ammeter in Fig. 2, and the potential coil in the place of the voltmeter.

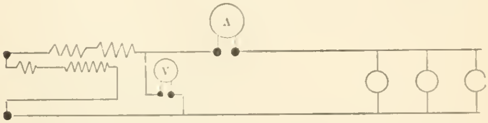


FIG. 3.—INCORRECT CONNECTIONS OF INDICATING INSTRUMENTS IN TESTING WATT-HOUR METER.

The practical connections for testing a commutator meter on artificial load, on two-wire and three-wire services, respectively, are shown in Figs. 4 and 5. The connections require the use of jumpers, *A*, and the including in the consumer's installation of two cut-outs instead of one.

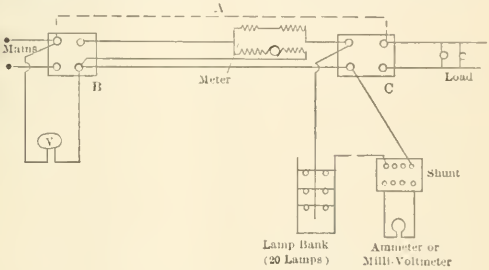


FIG. 4.—CONNECTIONS FOR TESTING A TWO-WIRE METER ON "ARTIFICIAL LOAD."

As good contacts should be made on the potential leads as in the main circuit, to avoid introducing error in the voltmeter indications. The tester should then make the other connections necessary for the tests. These connections include:

The completing of the current circuit through the lamp bank (or other load) and ammeter, when the test is to be made on artificial load. The making of this connection is greatly facilitated, especially in testing meters of large capacity, if a shunt, with milli-voltmeter calibrated in amperes, is employed instead of an ordinary self-contained ammeter.

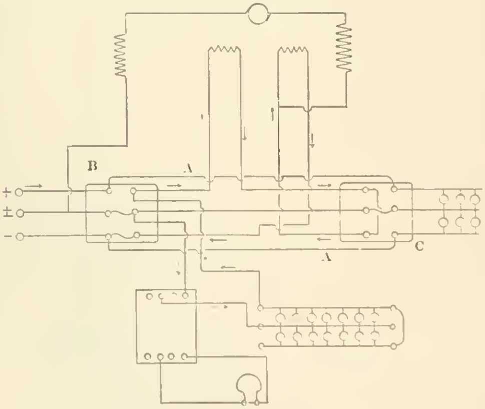


FIG. 5.—CONNECTIONS FOR TESTING A THREE-WIRE METER ON "ARTIFICIAL LOAD."

The cutting-in of the ammeter on the consumer's load when the latter is to be used as the test load, either with measuring instruments or without them.

The substituting of a portable calibrated resistance for the consumer's load, without ammeter, when employing the "standard-resistance" method; or the substitution of a storage battery or series transformer for the service mains, in testing direct-current and alternating-current meters, respectively, when employing the low-potential method.

The standard-resistance method of testing consists in the employment of a specially constructed resistance, calibrated in the watts taken by it on various voltages, as shown by a table accompanying the resistance. For use in testing alternating-current meters the resistance must be strictly non-inductive, and for testing either alternating-current or direct-current meters it to rise of temperature during the test. Lamp banks may be employed, if recalibrated from time to time to check the increasing resistance of the lamps in use.

This method of testing may be regarded as a special case of testing on artificial load, and will be easily understood, after the foregoing description of the general indicating-instrument method, without the need of a lengthy, separate description. By connecting the standard resistance across the line and in series with the field coils of the meter to be tested and reading the voltage on a voltmeter, the load on the meter (i. e., the "instrument watts") is at once determined for comparison with the "meter watts," given by counting the revolutions of the meter disk and multiplying by the proper constant. The method is usually employed only for testing the smaller sizes of meters, and the resistance boxes are designed for making both light-load and full-load tests of the consumers' meters.

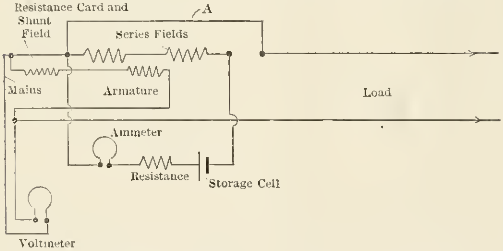


FIG. 6.—CONNECTIONS FOR TESTING A COMMUTATOR METER WITH PORTABLE STORAGE BATTERY AND RESISTANCE.

It is sometimes not practicable to utilize the consumer's load for testing the meter, or to interrupt the consumer's supply in order to substitute an artificial load, or to load a meter of large capacity for testing the meter on the service current. Thus, in the case of a large residential installation, for example, it may be undesirable either to bring on the premises a bulky artificial load or to go through the house turning on lamps.

In such cases direct-current commutator meters may be tested conveniently by passing through the field a low-voltage current of same amperage as the regular load current of the meter. A portable storage battery is used for supplying the series-field coils through a small adjustable resistance, and exciting the armature and shunt-field coils from the full service voltage; the series-field coils of the meter being cut out of the consumer's circuit by a jumper, *A,* and the storage battery connected through them, as shown in Fig. 6. Fig. 7 is a view of a single-cell portable storage battery and resistance for this purpose. Similarly, alternating-current (induction) meters may be tested by using a small portable series transformer for supplying the current-field coils through a small adjustable resistance, the potential field coils being excited from the full service voltage, as shown in Fig. 8. By these means the necessary "load" is applied at low voltage and under perfect control.

Whether the meter is tested with energy from the service mains or from a storage battery, it should be ascertained that the voltmeter is poled right on the mains, and that the connections are brought to the right scale binding posts before closing the voltmeter circuit. In the case of a multi-scale voltmeter it is safest to connect the voltmeter leads to the binding posts of the highest-reading scale first, in order to avoid the risk of damaging the instrument by burning it out or by bending its pointer by an excessive voltage or a reversal. Similarly before closing the load circuit through the ammeter, the full-load current taken should be predetermined roughly in order to avoid exceeding the capacity of the ammeter.

When the ammeter consists of a milli-voltmeter and separate shunt, the shunt may, of course, be connected in circuit without noting its polarity. Before connecting the flexible leads to the instrument, however, the polarity of the shunt binding-posts and the approximate current flowing through the shunt should be determined, in order to avoid injury to the milli-voltmeter.

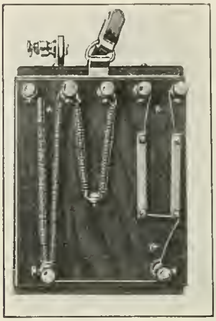


FIG. 7.—STORAGE BATTERY ARRANGED FOR TESTING METERS ON POWER CIRCUITS.

Another thing to be determined before cutting the meter in on the load is whether the meter "creeps"—i. e., whether the moving element revolves when no load is on. If any creep exists, the time required to make one revolution of the disk should be noted in the report, observing also whether the creep is continual or is set up intermittently by occasional vibration of the building by passing trucks or cars, or by the operation of machinery, and estimating the number of watt-hours which would be registered in 24 hours due to creep from all causes.

TESTING PROCEDURE.

During the actual test, by any method requiring two men, it is customary in many companies for the "tester" to read the instruments and make the computations; the "helper" counting the revolutions of the meter disk, under the direction of the tester, by following the spot on the disk, observing meanwhile the general behavior of the meter and calling the attention of the tester to any abnormal features of its operation—such as slow or jerky running, sparking at commutator and excessive friction of brushes, or between worm and worm gear—after the timing of the meter is completed.

Care should be observed to enter all observations and records upon the test card at the time they are taken. Nothing should be written, erased or changed on the test card after leaving the premises.

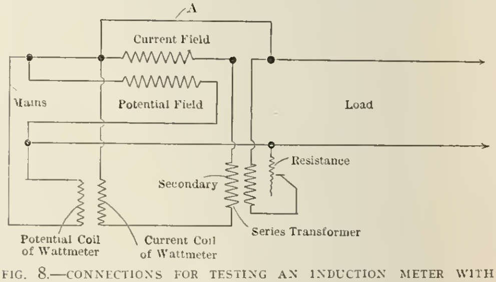


FIG. 8.—CONNECTIONS FOR TESTING AN INDUCTION METER WITH PORTABLE CURRENT TRANSFORMER AND RESISTANCE.

As soon as the tester is ready with his instruments, and with the watt-hour meter running on the given load, the helper holds the stop-watch on the revolutions of the meter disk, announcing the start of his count by the word "on," counting the revolutions aloud during an interval (specified in advance by the tester) of 60 seconds or less, but preferably of not less than 40 seconds, and announcing the finish of the count by the word "off." At the word "on" the tester begins to take readings on the voltmeter and ammeter (or wattmeter in testing alternating-current meters), taking several pairs of readings (or several wattmeter readings) in the period elapsing between the words "on" and "off," announced by the helper, in order to average for varying voltage or varying load; and being audibly assisted in distributing the readings by the count of the helper.

The necessity and main object of "meter testing" (i. e., testing of the meter followed if necessary by its recalibration) is to keep the speed up to the proper point on light-load. Hence it is important to make the light-load test of the meter at or near the load at which abnormal friction affects the accuracy of the meter most strongly. The induction meter, on account of its lighter rotating element and freedom from rubbing contacts, is more sensitive on light loads than the commutator meter, and the loads given have been agreed upon, in the practice of many companies, as the "light loads" at which the two types of meters should be tested.

Having obtained the disk revolutions and "instrument watts" at light-load and full-load, as described, and knowing the disk constant of the meter, the accuracy of the meter at light-load and at full-load is readily determined. The slide rule should be used in making computations, thereby saving time and errors.

The following equations, directly applicable to meters of the Thomson type, are presented. For two-wire meters: If K (= watt-hours per revolution) is the "disk constant" of the meter under test, and R is the observed number of revolutions in T seconds:

$$\text{Meter watts} = (3600 \times K \times R) \div T \qquad (1)$$

and

$$\text{Per cent accuracy} = \text{Meter watts} \div \text{Instrument watts} \qquad (2)$$

Equations (1) and (2) should be used in computing the "as found" accuracy.

Another way of arriving at the per cent accuracy is to compare the actual time in seconds, T, consumed by the meter in making R revolutions with the time that would be required if the meter were perfectly accurate. On this supposition

$$\text{Allotted time} = (3600 \times K \times R) \div \text{Instrument Watts} \qquad (3)$$

and

$$\text{Per cent accuracy} = \text{Allotted time} \div T \qquad (4)$$

Equations (3) and (4) can be used to advantage in calibrating when the wattage can be kept constant by the use of a rheostat or lamp-bank load.

Three-wire meters may be tested as two-wire meters by connecting the field coils in series (thereby obtaining an average accuracy of both fields) in one side of the circuit, connecting the load and the potential circuit on that side, and using one-half of the disk constant. The full-load should be one-half of the rated wattage of the meter; the light-load for a commutator meter being one-twentieth of the rated wattage, and for an induction meter one-fortieth of the rated wattage. If the meter is tested as a three-wire meter, two sets of instruments are necessary, one for each side of the meter, and the actual calibrating constant marked on the meter must be used.

Polyphase watt-hour meters are most conveniently tested as single-phase watt-hour meters, by connecting the potential coils in multiple and the current coils in series, and dividing the calibrating constant by two. Either side of the meter may be tested separately, however, by connecting one potential coil only at a time and using the actual calibrating constant.

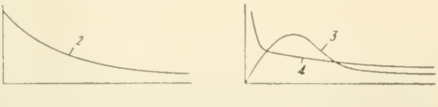
Primary meters, which are used with either series transformers or potential transformers, or both, may be tested as secondary meters. The value of K to be applied in the preceding formula is $k \div rf$, in which k is the meter constant, as marked on the disk of direct-reading meters and on the dial of non-direct-reading meters; r is the product of the ratios of the primary and secondary windings of the series and potential transformers, and f is the correction factor for transformer ratio errors.

It has been found that for watt-hour meters having a straight line accuracy curve, results obtained on the above two loads will more fairly represent the accuracy of the meter than results obtained on any other two loads.

Mr. George Ross Green, in a paper entitled "American Meter Practice," presented at the International Electrical Congress of St. Louis, 1904, says: "It is usually customary when testing meters showing a 'straight line' curve, to test on loads of about 5 per cent and 75 per cent of the rated capacity of the meter on alternating-current circuits, and on loads of about 10 per cent and 75 per cent on direct-current circuits. In the case of complaint and special tests, however, the meters are usually tested on loads of 5, 25, 50, and 100 per cent of the rated capacity of the meter, in order to ascertain more closely the degree of accuracy throughout the range, thus enabling the company, by considering the loads most frequently used, to determine more nearly the actual error, if any exists."

Reactive-Coil Phenomena.

When the source of e.m.f. is withdrawn from a simple reactive coil, either by breaking a direct current or by subsidence of the wave of an alternating current, the voltage upon and current therein induced falls off from the initial value, at first somewhat rapidly and then more slowly, in an exponential curve, as shown in curve 2 of Fig. 1; the controlling elements being the reactance and the resistance of the circuit. But when a closed secondary coil is added, the primary current at first falls off very rapidly, at a rate approximately corresponding to the self-inductance reactance of the stray field between the primary coil and the secondary coil. At the same time, there appears in the secondary coil a current which rises at first very rapidly, and then more slowly, reaches a maximum, and then gradually drops. As soon as this rise of current in the secondary coil slows up and ceases, the fall of the primary current also becomes less rapid and ultimately very slow so that the primary current is maintained over a period much greater than is the case without the secondary coil. This interaction of the two coils is shown in Fig. 2 where curve 3 represents the rise and fall of the secondary current, and curve 4 represents the changed primary current due to the retarding of the drop in voltage by reason of the counteraction of the secondary coil.

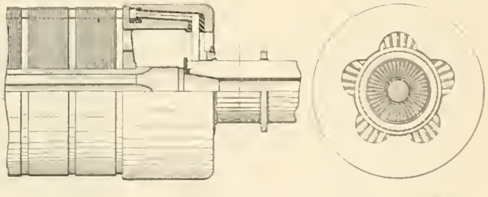


FIGS. 1 AND 2.—REACTIVE COIL PHENOMENA.

According to a patent issued April 7, Dr. C. P. Steinmetz proposes to employ short-circuited secondaries in connection with the reactive coils of mercury-vapor rectifiers in order to obtain a discharge curve extending over a long period of time. The secondary coil has fairly good mutual inductance with the main coil, but there is some stray field between the two coils.

High-Speed Direct-Current Generator.

The accompanying illustrations show a form of direct-current turbo-generator construction disclosed in a patent issued to Mr. B. A. Behrend on April 28. The end-ring, or bell, which supports the end of the coils which project beyond the commutator-end of the core, extends inwardly to the clamping-ring for the commutator, the latter ring supporting the former. The clamping ring is threaded externally, and is provided with a nut which bears against the end-ring and thus holds it in position. The armature is simple in construction and compact, and is able to withstand the enormous stresses at high speed without danger of any of its parts being displaced or injured.



FIGS. 1 AND 2.—HIGH-SPEED DIRECT-CURRENT GENERATOR.

Chicago Convention National Electric Light Association

DETAILS were given in the ELECTRICAL WORLD of May 23, by telegraph, with regard to the opening exercises of the thirty-first convention of the National Electric Light Association at the Auditorium, Chicago. Subjoined will be found a continuation of the report, with a résumé of such papers and discussions as have not been previously referred to or upon which further action was taken.

The convention as a whole may be spoken of as the most successful in the history of the association. The attendance at the regular exercises was most exemplary, and although the meeting room would easily accommodate 500 people, there were times when it was unduly crowded. In fact, at one of the sessions the doors were literally stormed, and after standing-room was at a premium there were still crowds clamoring to get in, resenting the statement that it was difficult to find room for them. During part of the week parallel sessions were held, and even this experiment did not seem to lessen the interest in any degree, as neither meeting suffered from the division, and both were extremely well attended by at least two or three hundred of the members. When one considers the distractions of a great convention, the exhibits, the entertainments, the opportunities to transact business, and the local commercial engagements of the members, such facts speak volumes for the earnest spirit that pervades the association as a whole.

On Friday morning—the last day of the meeting—members were still being registered, and the total had reached 1850. As there were a number of members present who had not called for their badges and others who were attending because of the discussions of subjects in which they were interested from an outside standpoint, it can readily be seen that the attendance of well over 2000 is accounted for, and the estimate of the authorities was that at least 2200 persons had attended during the week. Of these 247 were ladies—rather a small proportion, but enough to prevent the convention from being of a wholly serious and matter-of-fact character. Note is made elsewhere of the various entertainments and functions provided for the amusement of visitors. The weather at the opening of the week was of a disagreeable character, but as the meeting advanced conditions improved, and from Wednesday onward the climate and temperature were ideal, and many favorable opinions were expressed with regard to the attractions of Chicago as a summer resort. The attendance at the exercises was maintained until the last moment, including the extra session of Friday afternoon, necessitated by the various discussions.

The new ticket elicited general and hearty approval, President Eglin having taken a most active, public-spirited share in the work of the association for many years past, while the other offices were also filled notably with younger men, whose energy and influence are expected to develop the association along progressive lines. Over and above all was heard the universal expression of thanks and gratitude toward the Commonwealth Edison Company for its lavish but judicious and dignified hospitality, leaving nothing undone that could minister to the comfort and convenience of every visitor. The administrative work of the association, under Miss Billings, was also attended to with minute care, registration being rendered easy, copies of papers being available for all concerned; while the meetings were conducted with precision and smoothness, so that there was no lost motion at any time. It is probable that the plan of holding separate parallel meetings may be renewed at the next convention as a means of disposing of the plethora of papers and business affecting the technical and commercial interests of the industry.

THE CONVENTION IN SESSION, MORNING OF THIRD DAY.

The following is a statement in condensed form of the proceedings of the four days' convention beginning Tuesday, May 19, and ending Friday, May 22.

The session was opened Tuesday morning by the address of President Dudley Farrand, of Newark, N. J., which was briefly summarized in our telegraphic report of last week. This was followed by the presentation of the annual report of central station progress by Mr. T. C. Martin, which he summarized briefly. This covered such a wide range of subjects that the discussion of it was left to be taken up at various times during the convention in connection with the special papers on the various points mentioned.

Next in order was a paper by Mr. George H. Lukes, of Chicago, entitled "Distribution in Suburban Districts." This was discussed at length, and as a result of one question brought up in the discussion a committee was appointed to report at a later session to draft a resolution as to the sense of the association on what constitutes a "high-tension" circuit, such a question having been asked the association by the Public Service Commission of New York through Mr. H. M. Edwards. This committee reported on Friday, as noted later. A paper on "Tape," prepared by Mr. Paul Lupke, of Trenton, N. J., was read by Mr. T. C. Martin.

ACTION ON GROUNDING SECONDARIES.

The report of the committee on grounding secondaries was made by Mr. W. H. Blood, Jr. This report was discussed at the beginning of the Tuesday afternoon session. The report, as noted in our issue of last week, favored the adoption of a rule by the underwriters whereby the transformer secondaries of distributing systems must be permanently grounded when the difference of potential between the ground and any part of the circuit would be less than 150 volts. When the difference of potential between the ground and any part of the circuit would exceed 150 volts, they must not be grounded. After discussion in the afternoon session the resolution as presented by the committee was adopted.

CHANGES IN ORGANIZATION PROPOSED.

The next number on the program was the report of the committee on "Organization" by Mr. Henry L. Doherty, of New York. This proposed important enlargement of the scope of association work, which included taking in the various State electric light associations, was referred to a committee. President Farrand appointed the following on this committee: Messrs. W. W. Freeman, of Brooklyn; F. M. Tait, of Dayton, Ohio; L. A. Ferguson, of Chicago; W. H. Blood, Jr., of Boston; Arthur Williams, of New York.

A paper on "Power Development in Small Stations" was presented by Messrs. Jas. Robbins and J. R. Bibbins, of Pittsburg. This was discussed at length. "The Small Station and Its Mechanical Operation" was the subject of a paper by Mr. J. T. Whittlesey and Mr. Paul Spencer. Mr. A. J. Campbell, editor of the Question Box, presented a paper on the "Future of the Question Box."

STANDARD CLASSIFICATION OF ACCOUNTS ADOPTED.

The committee on "Uniform Accounting," consisting of Messrs. H. M. Edwards, auditor of the New York Edison Company; E. J. Allegaert, auditor of the Public Service Corporation of New Jersey; E. W. Brunderett, general auditor of the United Gas & Improvement Company, Philadelphia; John L. Bailey, treasurer, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.; Frank L. Dame, Electrical Securities Corporation, New York, presented a report recommending a classification which was a modification of that presented last year. This classification, it was stated, is approved by the accounting committee of the American Street & Interurban Railway Association and other allied interests. After a brief discussion the report of this committee was adopted.

CANDLE-POWER STANDARD.

A resolution was then read which was sent in by Dr. A. E. Kennelly, secretary of a joint committee consisting of subcommittees of the American Institute of Electrical Engineers, American Gas Institute and the Illuminating Engineering Society. This resolution in regard to the common unit of candle-power was as follows:

Whereas, A joint committee composed of sub-committees of the American Institute of Electrical Engineers, American Gas Institute and the Illuminating Engineering Society have prepared resolutions favoring the determination of a common unit of candle-power for the United States, and with the expectation of ultimately obtaining an international agreement upon a common unit of luminous intensity to be used throughout the world, and

Whereas, Such committee recommends that during the interval required for the consummation of international action, a common candle unit be used, which shall be 2 per cent less than that now maintained at the Washington Bureau of Standards,

Resolved, That this association hereby approves the recommendation of the said joint committee, and further

Resolved, That the secretary be instructed to address a letter to the director of the Bureau of Standards at Washington, D. C., enclosing a copy of these resolutions and requesting that the Bureau of Standards maintain as its working candle unit from this time on until definite international action shall have been taken, a common unit 2 per cent lower than that which it is maintaining at the present time. Further

Resolved, That the secretary be instructed to address to such similar foreign societies as may be interested, a statement of the movement in the United States toward a common international candle unit (enclosing a copy of these resolutions) and requesting the co-operation of such foreign societies in advancing the movement.

This resolution was adopted. The meeting then adjourned until Wednesday morning.

Wednesday morning the first item on the program was a paper by Prof. A. E. Kennelly and S. E. Whiting, of Harvard University, on "Some Observations on Photometric Precision." As the authors were not present, Mr. Preston S. Millar, of the Electrical Testing Laboratories, read this paper in abstract. This was discussed by Messrs. J. B. Klumpp and Preston S. Millar. A paper on "Low Pressure Steam Turbines," by Mr John W. Kirkland, of Schenectady, N. Y., was next read and discussed at some length.

Following this the secretary announced that Mr. L. A. Ferguson, chairman of the entertainment committee, desired to make an announcement, and incidentally remarked as a matter of interest in connection with said chairman that he was yesterday, by a vote of 1766 to 99, elected president of the American Institute of Electrical Engineers. The announcement was received with long-continued applause, much to the embarrassment of the unsuspecting chairman of the entertainment committee, who was not expecting that the secretary would thus take advantage of his request to make a few simple announcements in connection with the entertainments. The convention then took up the report of the committee on "Gas Engines," by Messrs. W. C. L. Eglin, of Philadelphia; J. B. Klumpp, of Philadelphia; I. E. Moultrop, of Boston, and C. H. Williams, of La Crosse, Wis. After Chairman Eglin read this voluminous report in abstract, there was a long discussion. Mr. L. A. Ferguson, chairman of the committee on "Meters," presented the report of that committee, the members of which are Messrs. L. A. Ferguson, Chicago; Alex Dow, Detroit, and J. E. Montague, Brooklyn.

On Wednesday evening the first paper taken up was that by Mr. P. D. Wagoner, of Schenectady, on "Series Incandescent Systems with Tunsten Lamps," which brought out considerable discussion. The meeting then passed into executive session, and heard the report of the secretary and treasurer. The receipts for 1907 were $31,254.19; expenses, $23,805.14; balance, $7,359.05.

The report of the committee on "Public Policy," of which Mr. Arthur Williams was chairman, was presented by Mr. Samuel Insull, of Chicago. This was discussed at great length and received. A paper on the "Status and Commercial Possibilities of High-Efficiency Lamps" was read by its author, Mr.

W. W. Freeman, of Brooklyn. Discussion of this was left until the following day.

A nominating committee to nominate officers and executive committee for the ensuing year was elected as follows: Messrs. N. F. Brady, J. B. McCall, E. H. Davis, C. R. Huntley and P. T. Glidden.

When Thursday morning's session was called, Mr. C. R Huntley, of Buffalo, past president, announced the death of Mr. R. C. P. Holmes, of the Commonwealth Edison Company, who was found dead on the streets early that morning, supposedly as a result of an assault for robbery. The convention immediately adjourned until 1:30 p. m. out of respect to this member.

COMMERCIAL DAY PROGRAM.

On Thursday afternoon the convention was opened with a discussion of a paper on the "Commercial Possibilities of High-Efficiency Lamps." This naturally proved a very interesting subject and brought out much discussion. President Farrand then gave the chair to Mr. Henry L. Doherty, past-president of the association, who by previous arrangement had been selected to take charge of the Commercial Day program. This Commercial Day program was opened with an address by Mr. L. A. Ferguson, of Chicago, on "The Relationship Between the Engineering and Commercial Departments." This was followed by a number of reports or symposiums on commercial topics prepared by various committees of editors. The first of these was by Mr. H. J. Gille, of Minneapolis, on "Preparation for a Campaign." After the discussion on this, the subject, "The Contract Agent and the Representative," was taken up by Mr. V. A. Henderson, of Memphis, Tenn. This was supplemented by Mr. M. E. Turner, of Cleveland, and discussed by various others.

At this point the chairman called attention to the serious illness of Mr. J. Robert Crouse, of Cleveland, to whom he referred as "a man practically unknown to us three years ago, but who by his aggressive work has commanded our complete respect." Mr. Crouse, he said, had been taken down with nervous prostration, largely due to the work done in behalf of this association. He might be unable to get back to his duties for many months. Mr. Doherty believed the association could have afforded to lose the services of almost any other man for the next few months rather than those of Mr. Crouse. Mr. Arthur Williams also spoke feelingly of the work done by Mr. Crouse in arranging the first Commercial Day program, which was held at the Washington convention last year. He moved that the chair appoint a committee to draft suitable resolutions of regret for Mr. Crouse's absence and hope for his speedy recovery, which motion was carried.

The chairman also spoke appreciatingly of the work done by Mr. C. W. Lee in arranging the Commercial Day program. Mr. L. D. Mathes, editor of the paper on "Display Room," presented that report, which was discussed. As it was time to adjourn and the Commercial Day program was not completed, it was then decided to continue the program over into the parallel session which was for Friday morning at 10:15 o'clock. In order to get through with the work the commercial meeting Friday morning was called to order about 8:45, at which time the Commercial Day program was continued. The reports edited by Mr. Charles A. Parker, of Detroit, Mich., on "Advertising," were read and discussed. A report on "Publicity," edited by Mr. Percy Ingalls, was briefly abstracted in Mr. Ingalls' absence by Mr. C. W. Lee. A report edited by Mr. George N. Tidd, of Scranton, on "The Evolution of New Business Building," was then presented.

COUNCIL OF PROGRESS AN INNOVATION.

The regular Commercial Day program was interrupted at this point to listen to addresses which had been arranged for that hour under the head of "Council of Progress." Hon. Leslie M. Shaw, ex-Secretary of the Treasury, spoke on "Conservatism." Mr. John R. Morron, president of the Diamond Glue Company, of Chicago, gave an address on "Commercial Progress." Mr. W. D. Robertson, of the Robertson Electric Company, Buffalo, N. Y., spoke on the "Sons of Jove." Mr. George Macbeth, president of the Macbeth-Evans Glass Company, Pittsburg, spoke on the "History of Lighting Science." After these addresses the delayed Commercial Day program was resumed. A report edited by Mr. Frank B. Rae, Jr., of New York City, on "Creating Demands for Electricity," profusely illustrated with lantern slides, was read by Mr. Geo. Williams, of Cincinnati, and met with a very cordial reception. A paper on "Illuminating Engineering as a Commercial Factor," illustrated with lantern-slide views, was presented by Mr. V. R. Lansingh. Mr. Joseph F. Becker, editor of a report on "The Electrical Contractor," presented his paper, which closed the session.

In the regular session Friday morning the first paper taken up was entitled "Receiving Stations Operated from High-Tension Lines," by Mr. A. W. Hayes, of Pittsburg. This was immediately followed by the report of the committee on "Protection from Lightning, and Other Static Disturbances," by Mr. R. S. Stewart, of Detroit. This report drew out considerable discussion. The secretary at this time announced that the registration of those in actual attendance at the convention was approximately 1800, which was by 150 the largest convention ever held by this association. He estimated that about 200 failed to register, which would bring the attendance to substantially 2000. Mr. H. D. King, of Hoboken, N. J., read his paper on the "Value of the Care and Maintenance of Meters," which was briefly discussed.

DEFINITION OF "HIGH-TENSION."

The convention then listened to the report of the special committee which was appointed to consider the question of the definition of "high tension." Mr. Paul Spencer, chairman of that committee, which consisted of himself, Mr. G. H. Lukes, of Chicago; Dr. C. P. Steinmetz, of Schenectady; Mr. E. H. Davis, of Lewiston, Pa., and Mr. I. E. Moultrop, of Boston, made a report to the effect that it had carefully considered the question raised at the sessions of Monday morning as to the limitations implied in the term "high tension." The committee feels that the terms "low tension," "medium tension," "high tension," and "extra high tension" are purely relative and that no definite voltage limitations can be stated that would cover at all satisfactorily the conditions to which these terms are applied. The adoption of the term "high tension," as applied to a voltage over a certain stated amount, may carry with it the unwarranted implication that voltages in excess of such a stated figure are under all conditions hazardous. As far as overhead line construction is concerned, any line voltage can be safely installed and operated if the methods of construction are adapted to the voltage carried. Therefore, in view of the purely relative value of the term "high tension," the committee unanimously recommended that no definite resolution be adopted at this time. The report of the committee was adopted.

Mr. Paul Spencer, of Philadelphia, presented the specifications for construction of joint poles agreed upon by conferences between the engineers of the large telephone and electric light companies of New Jersey, which specifications are also now the standard for the Bell Telephone Companies the country over.

The "Self-Synchronizing of Alternators" was taken up in a short paper by Prof. Morgan Brooks, of the University of Illinois, and a practical demonstration of synchronizing was given. A synchronizer and ammeters were mounted on a board in front of the audience and connected with a motor-generator at the Harrison Street station of the Commonwealth Edison Company. This motor-generator was connected to the busbars at a varying number of degrees out of step without excessive rush of current, as shown by the ammeters.

A paper on "Illuminating Engineering" was presented by Mr. W. D'A. Ryan, of West Lynn, Mass. This was immediately followed by the final report of the 1907 committee to consider specifications for street lighting, of which Mr. Ryan was chairman. This report gave figures from tests which were lacking in the committee report of 1907. On Friday afternoon this report was accepted.

At this point Mr. H. L. Doherty was given the chair in order that discussion on the Commercial Day program might be completed. The report of Mr. George N. Tidd was discussed, especially with reference to the importance of keeping up active work for new business during the financial depression. The question of co-operation with the contractors was also discussed.

Mr. J. E. Montague, of Niagara Falls, presented a resolution of thanks to the licensed manufacturers of incandescent lamps for their financial support of the Co-operative Electrical Development Association. Mr. F. M. Tait, of Dayton, Ohio, was called upon to report on the subject of "Co-operative Commercialism" in the absence of Mr. J. Robert Crouse. Mr. Tait's report was to the effect that owing to Mr. Crouse's illness, but little could be said. Owing to the recent financial conditions most of the money which had been underwritten was being withheld and the work of the association was at a standstill until conditions were more favorable. Chairman Doherty said that he doubted if any had appreciated the full meaning of the work of Mr. Crouse until recently. He and others expressed themselves to the effect that the work being pushed by Mr. Crouse should not be allowed to languish during his illness. The matter was finally left in the hands of a standing committee on this subject. Resolutions were presented and carried, expressing sympathy and wishes for the recovery of Mr. Crouse. On motion of Mr. Dow, of Detroit, a special vote of thanks was voted to Mr. C. W. Lee and his "numerous, able, vigorous and (thank God) young" assistants who carried out the Commercial Day program. The chairman in closing the Commercial session remarked that when it came to a test of interest as to commercial versus other subjects, the relative attendance in the two meetings this morning proved that the commercial era had been ushered in.

SOLICITORS' HANDBOOK PRIZES AWARDED.

The prizes offered by the Co-operative Electrical Development Association for different sections of a solicitors' handbook were then awarded. These prizes amounted in all to $2600, with interest at 6 per cent from the time the prize money was turned over to the association, making in all over $2700. The Solicitors' Handbook terms of competition divided the handbook into three sections, with first, second and third prizes for each section.

For the light section the first prize of $500 was awarded to a joint production of Messrs. R. Borlase Matthews, of London, Eng., and C. T. Wilkinson, of Schenectady, N. Y. The second prize of $300 in the light section went to Mr. James L. Wiltse, of Brooklyn, N. Y., and the third prize of $200 to Mr. H. W. Hillman, of Grand Rapids, Mich.

In the power section the first prize of $500 went to Mr. Paul H. Bate, of Chicago, Ill.; the second prize of $300 to Mr. C. A. Graves, of Brooklyn, N. Y., and the third prize of $200 to Messrs. Matthews and Wilkinson, of London and Schenectady.

In the heat section the first prize of $300 went to Messrs. Matthews and Wilkinson, of London and Schenectady; second prize of $200 to Mr. James L. Wiltse, of Brooklyn, and the third prize of $100 to Mr. La Rue Vredenburgh, of Boston.

A resolution was adopted expressing appreciation and thanks to the retiring president and vice-presidents, secretary and treasurer, the assistant secretary and treasurer and her efficient office organization. Mr. T. C. Martin, chairman of the committee on "Memorials," reported that suitable memorials would be written covering the following deceased members: Lord Kelvin, W. A. Kreidler, R. C. P. Holmes, Edward R. Coffin, Prof. C. P. Matthews, Hon. E. P. Pagem, Addison F. Hunie, Walter I. Barnes, W. H. Hammond, James Hislop and C. H. Newhall. Mr. Alex Dow presented a resolution which gracefully acknowledged the debt of the association to the Commonwealth Edison Company, Chicago, and its president, Samuel Insull, chairman of the reception committee; to Mr. Louis A. Ferguson, vice-president of the Commonwealth Edison Company, chairman of the entertainment committee; to Mr. Homer E. Niesz, chairman of the hotel committee; to Mr. Frank H. Gale, chairman, and Mr. Walter Newmueller, secretary of the exhibition committee; to Miss Harriet Billings, assistant secretary and treasurer, and to her assistants; to Miss Edith Myers, chief of the registration bureau, and her assistants, and to the *Convention Daily*, conducted under the direction of Mr. C. W. Lee.

ELECTION OF OFFICERS.

The following officers were elected for the coming year: President, Mr. W. C. L. Eglin, Philadelphia, Pa.; first vice-president, Mr. Frank W. Frueauff, Denver, Colo.; second vice president, Mr. W. W. Freeman, Brooklyn, N. Y.; secretary and treasurer, Mr. John F. Gilchrist, Chicago, Ill. Members of the Executive Committee: For the full term, Messrs. C. L. Edgar, Boston; Alex Dow, Detroit; Arthur Williams, New York; for the unexpired term of Mr. Samuel Scovil, Mr. R. M. Searle, Rochester.

THE NEW PRESIDENT.

Mr. William C. L. Eglin, who has just been elected president of the National Electric Light Association, is well known to most of the members of the association, having served as an officer for the past three years, during two of which he acted as secretary and treasurer of the association. Although this office is an honorary one, it was developed in his administration to one of great activity. Many changes were made in the organization and the system of carrying on the increased work of the association, on account of the rapid growth in its membership and the many new and important subjects requiring the association's attention. Mr. Eglin has also served on a number of important committees of the association, notably the steam turbine committee and the gas engine committee, both making exhaustive reports. His active business experience has been in connection with the various electric lighting companies in Philadelphia. He became connected with the Edison Electric Light Company of Philadelphia in 1880, and later with the various consolidated companies culminating in the Philadelphia Electric company, which owns and operates all of the electric lighting companies in the city and county of Philadelphia. He is at present the electrical engineer of this company.

PRESIDENT W. C. L. EGLIN.

Mr. Eglin has contributed many articles on important technical subjects to the American Institute of Electrical Engineers and to the technical press. With the work of the institute, he has long been identified, having served as chairman of the Philadelphia branch, and he is at present one of the vice-presidents of the institute.

He was, for a number of years, active in the work of the Engineers' Club of Philadelphia, having served on its board of management, as chairman of the information committee and as vice-president. He is a member of the Engineers' Club of New York, the American Electrochemical Society and the Illuminating Engineering Society. He has also served on various committees of the Franklin Institute of Philadelphia.

He is also a member of the prominent clubs in Philadelphia — Union League, Merion Cricket Club, Manufacturers' Club, Bryn Mawr Polo Club, Pen and Pencil Club, Aronimink Golf Club and Magnetic Club; and of the Mohawk Club, Schenectady, N. Y.

Convention Notes.

The Secretarial Work of the convention was unusually well done, due in large measure to the fact that Mr. W. W. Freeman, the secretary, has given unremitting attention to the affairs of the association throughout the year, meeting President Farrand at the New York headquarters at least once a week. As the new secretary, Mr. J. F. Gilchrist, is located in Chicago, it may prove difficult, however, to maintain this plan. All the general convention work was as usual in the capable hands of Miss Harriet Billings, the assistant secretary, whose well-drilled staff, supplemented by a large corps from the Commonwealth Edison Company, made things move with entire smoothness and satisfaction. Miss Edith M. Myers was as usual in charge of the registration bureau, issuing badges, etc., and in her efficient discharge of this task was assisted by some very competent and pretty young women, students in the university.

A Murray Luncheon.—A beautiful luncheon party was given in honor of Mrs. T. E. Murray on Friday, before her return to New York with Mr. Murray, the well-known vice-president of the New York Edison Company. A big table at the Auditorium Annex was covered with American Beauty roses and broad red ribbon, and around it sat a score of friends, including President and Mrs. Dudley Farrand, past Presidents Doherty, Blood, Davis and Williams, Mr. and Mrs. Alex. Dow, Mr. and Mrs. W. W. Freeman, Mr. and Miss Eglin, Mrs. L. A. Ferguson, Mrs. J. B. McCall, Mr. N. F. Brady and Mr. T. C. Martin. Several appropriate toasts were given.

A Thomson-Houston Reunion.—A movement was started during the N. E. L. A. convention to bring about a reunion of the men who used to be employed by the old Thomson-Houston Electric Company. The movement was given such an impetus by the members of the "old guard" present that it is now planned to have a general meeting of the men still living who were associated with the Thomson-Houston Company at any time from its inception until it was absorbed by the General Electric Company. In order to make it possible for all, no matter in what capacity they were employed, to take part in the event, it is planned to hold the meeting in January of next year coincident with the Chicago Electrical Show. The object of calling together the old "boys" formerly engaged by this pioneer corporation is purely social, but it is expected much good will come to the participants. In order that some idea may be obtained of the number of persons that may be expected to join in the reunion, it has been suggested that each one employed by the Thomson-Houston Company up to the time of its absorption send his address to Mr. George Cutter, South Bend, Ind., who will keep the name and address on file. Any suggestions on method of procedure, plans, etc., that may be made will be given careful attention. On the number of letters received will depend the preparations that are to be made for the event.

A Convention Tragedy.—It may be considered remarkable that holding over 30 conventions and visiting every part of the country, the association has hitherto escaped any serious disaster or tragedy in connection with any of its members. Last week that happy record was broken and marred by the assassination of Mr. R. C. P. Holmes, the amiable and popular purchasing agent of the Commonwealth Edison Company, who had been most active and energetic in the entertainment of members, to many of whom he was a warm personal friend of 20 years standing. After a dinner of the purchasing agents on Wednesday evening, and chatting till about midnight with members, of whom the present writer was one of the last, he left the hotel for home, only to be murdered and robbed of all his valuables, before he had gone more than a few blocks. Consternation and grief prevailed next morning when the sad news was known, and as a tribute to his memory, the convention adjourned as a body on Thursday morning, and did not reassemble until the afternoon. Mr. Holmes was a pioneer in the central station field, and had been in Chicago from the early days of the Western Edison Company, growing with it until at the time of his death he had a position of great responsibility. None who knew him will forget the bluff, kindly Englishman, whose end was the more tragic that it came in the very midst of the generous hospitality that he loved to extend.

The Rochester Delegation.—Mr. R. M. Searle, general manager of the Rochester (N. Y.) Railway & Light Company, had with him a party of no fewer than nineteen members of his official family. So large a delegation attracted considerable attention, and when inquiry was made of Mr. Searle on the subject, he said: "If you want an analysis of my reasons for bringing so large a delegation to the meeting, I would say: 'First of all, I know the great value of association work, and I also know that I can get the enthusiasm here engendered into each man who is in direct contact with the public. Every man on a staff must be well trained, and he cannot be up-to-date unless he is abreast of the art. Now, nineteen men, each saturating himself with that which appeals most to him, can disseminate it in turn with profit to his own force of employees, especially when he thus gets it at first hand. Each man with me here is the head of a department. I cannot secure one man at a salary equal to the combined expense of these nineteen men, who could or would individually distribute the beneficial instruction derived from the association through nineteen company channels. In other words, I get results from nineteen trained men, nineteen times as quickly and nineteen times as effectively as I would from just one or two. At first glance it may look extravagant, but it is the highest economy. I could already tell you of good secured that would pay the cost of the entire trip.' "

Power Plant Garden Party.—On Wednesday afternoon a most delightful visit was made to the Fisk Street turbine power house of the Commonwealth Edison Company, on the banks of the Chicago River. This stately plant was fully described in the May 16 issue of the Electrical World, but no article can do justice to the care and thought bestowed on it, or to the completeness and beauty of the whole. It is a great cathedral, devoted to the religion of power, and a feeling of worship is inspired by the gigantic machines, the towering walls, the long-drawn aisles. Hundreds of visitors, received graciously by President Insull and his staff, wandered all over the place, admiring something new at every turn, and then were escorted out on to a broad green lawn, skirting the river, where, with exclamations of surprise, they found a huge marquee, quite in garden party fashion, where five o'clock tea and other refreshments were served. Each visitor took away a handsome pamphlet telling the story of the plant, with pictures, and including the reproduction of a photograph taken when the association held its previous meeting at Chicago in 1903. At that time the building was in process of construction, and many members thought it rather ambitious, but the foresight of the management was justified, for it now contains 10 units of 110,000-kw capacity, and now another station is being built just across the river to be known as the Quarry Street Station. As Mr. Insull stated, not alone is the system keeping pace with the growth of population, as to number of customers, but of late it has taken on new loads in great big blocks of thousands of kilowatts, for railway service and the like.

The Exhibit Organization.—The Class D member of the N. E. L. A. met in the green room of the Auditorium Annex at 4 o'clock, Thursday afternoon, and unanimously re-elected the present exhibition committee for the ensuing year. The committee, which was elected on Dec. 6, 1907, and which had charge of this year's exhibits, is composed of Mr. F. H. Gale, General Electric Company; J. C. McQuiston, Westinghouse Companies; Mr. H. S. Heger, Allis-Chalmers Company; Mr. Rodman Gilder, Crocker-Wheeler Company; Mr. H. M. Post, Western Electric Company; Mr. C. P. Frey, Weston Electrical Instrument Company; Mr. Benj. Wall, Metropolitan Engineering Company; Mr. James I. Ayer, Simplex Electric Company, and Mr. S. E. Doane, National Electric Lamp Association. A set of by-laws, which had been carefully prepared by the committee, was adopted. The by-laws provide for nearly every contingency that may arise and give the committee a basis upon which to work. During the early part of the meeting the chairman reviewed the work done by the committee, which it was stated had been entirely in harmony with the work of the association. As an expression of the exhibition committee's appreciation of the untiring efforts of Homer E. Niesz, of the Commonwealth Edison Company, a beautiful traveling bag was presented to him. Mr. Niesz acted this year as a local member of the committee and was instrumental in effecting the arrangements which made the exhibition a success. Mr. C. A. Tupper, Allis-Chalmers Company, who had charge of the placing of the exhibits in the exhibition hall, was given a vote of thanks for the efficient way in which he did the work, and a vote of thanks was also extended to the management of the Chicago Electrical Show for the loan of exhibit hall fixtures. The report of the treasurer, which was read, showed Class D, which represents the supply members of the association, to be in a healthy financial condition.

The White City.—On Tuesday evening the members of the convention, one thousand strong and weak, visited the White City, the lakeside summer resort of Chicago, and opened its season, admiring greatly its lavish illumination.

Luncheons and Dinners were given during the week by Mr. and Mrs. Insull, Mr. and Mrs. Freeman, Mr. and Mrs. Farrand, Mr. F. W. Willcox, Mr. R. D. Lillibridge and others. One of the most interesting affairs of this kind was the Stone & Webster luncheon at the Midday Club, when 24 members of the organization assembled under the leadership of Mr. W. H. Blood, Jr., past president of the N. E. L. A.

Sons of Jove.—This genial and congenial body of men delighting in mingled mystery, mischief and magnetism, and all devoted to the promotion of electrical development held a "rejuvenation" on May 20, at the Auditorium, attended by over 200 members. No fewer than 23 candidates were admitted. Then a banquet was served over which Mr. J. E. Montague presided. The Sons went home in the cold gray dawn of the morning after, but were all on hand for the opening of the business sessions.

Pictorial Breakfast Food was the clever description of the cartoon given by Mr. John T. McCutcheon in his lecture on caricature before the ladies of the convention on Wednesday afternoon at the Art Institute. A very clever and interesting talk was given, every point being emphasized by a sketch on the blackboard, and this was supplemented by a number of offhand delineations of leading members of the association. Afternoon tea was then served in the Rembrandt room, presided over by Mesdames Farrand, Insull, Ferguson, McCall, Dow, Freeman, Donohoe and Eglin, and accompanied by Tomaso's Mendelssohn Orchestra.

A Chicago Store.—A quite unique entertainment was provided for the ladies—and some of the men—in a luncheon given at the famous store of Marshall Field & Company on Wednesday. A tour of inspection was made of the establishment, whose magnitude may be inferred from the fact that there are no fewer than 300 managers of separate departments, and special attention was paid to the scheme of lighting, Nernst lamps being used throughout, giving, so far as opinions could be elicited, very thorough satisfaction. The luncheon was exquisite in quality and service, giving a further idea of the resources of the industry on which that commercial genius, Marshall Field, stamped his imprint so deeply.

The Theater Parties.—On Thursday evening the attendants at the convention were entertained by the local committee at two theaters. One large party witnessed the performance of Elsie Janis in "The Hoyden," and another saw Christie McDonald in "Miss Hook of Holland." What are known as "gags" were plentifully distributed throughout the dialogue of both pieces, and no guilty author of convention paper was allowed to escape; while references to electrical conditions, local and national, were brilliant and bristling at every turn. The honors of the occasion rested with Mr. Doherty, who was not satisfied with being roasted in song and story, but insisted on bearing away with him from the theater the one trophy of a very pleasant evening. A sketch of it would make an appropriate tailpiece for the Chicago transactions.

Co-operative Development.—Never were more sincere regrets expressed at the absence of a member than were those heard on every hand in regard to Mr. J. Robert Crouse, Jr., whose program of co-operative electrical development has literally revolutionized the lighting and power industry in the last three years and given it a stimulus beyond estimation. He has broken down under the burden of his splendid aims and ambitions, all unselfish and for the common good, and it is simple truth to say that no other young man has ever come forward in the electrical field so determined as he to promote the use of electricity. His return to health and activity will rejoice a host of friends and admirers of Mr. Crouse, who with every temptation to the enjoyment of life on its easy side, has sacrificed everything to the pursuit and achievement of a lofty idea.

Visiting Presidents.—Among the presidents of other electrical bodies attending the convention were Mr. J. R. Strong, head of the National Electrical Contractors' Association, and Mr. A. C. Lindemuth, of the International Independent Telephone Association, which has its headquarters in Chicago. The latter organization is growing rapidly, and Mr. Lindemuth, with the help of Secretary Harney, made a thorough expert study of the N. E. L. A. methods of handling convention badges, passes, papers, registration, committees and other items, with a view to the adoption of some of the features at the next telephone convention. Another president in attendance was Mr. L. A. Ferguson, whose election by the American Institute of Electrical Engineers, was greeted with great enthusiasm on Tuesday night. He received 1766 votes, the largest number ever cast for an institute presidential candidate.

An Electrical Transition.—Originally a telephone engineer, Mr. B. E. Sunny, who for at least a score of years past has had charge of Thomson-Houston and General Electric interests in Chicago, has gone back to telephony, and the present convention served as the psychological moment of his atavism. It was his success in telephony that first attracted attention, but it is easy to understand that the pulling forces in two different directions have given Mr. Sunny some anxious moments during the last few months. The Bell telephone system has gained a valuable representative, but it must have given Mr. Sunny a heart-strain more than once as old friends in the lighting industry came up to him and told him how sorry they were to think they would not see him now as much as in the old days. Mr. Sunny has already become president of the Chicago Telephone Company and vice-president of the American Telephone & Telegraph Company, and even last week found his new duties so overwhelming that the convention saw all too little of him.

Automobile Trip.—Through the courtesy of the Board of Governors of the South Shore Country Club, the ladies attending the convention were invited by the N. E. L. A. to a luncheon at the club on Thursday. Automobiles were provided by the association to take the ladies through the south boulevards and parks to the club. More than 200 ladies accepted the invitation. The start was made from the Auditorium at eleven o'clock. The weather was perfect and the parks wore their prettiest spring gowns, decorated with lilacs, azaleas and other blossoms to welcome the party and vie with them in their beauty. Arrived at the club, the ladies were able to enjoy the lake breezes wafted across the lawns and flower beds which, together with the ride, bestowed upon every one an appetite for the delicious luncheon which was served in the clubhouse. In the afternoon the automobiles were placed at the disposal of the ladies for a couple of hours' drive through the parks, and the party arrived back at the hotel at five o'clock. Mr. John J. Schayer and Mr. Godfrey H. Atkin had charge of the arrangements, and the ladies were enthusiastic in their thanks and appreciation of the excellent manner in which the committee had provided for their comfort and entertainment.

Discussion of N. E. L. A. Papers.

Our issue of last week contained abstracts of papers read at the convention of the National Electric Light Association, held in Chicago during last week. Below are given accounts of the discussions following the presentation of these papers:

GAS ENGINES.

An interesting discussion was brought out by the reading of the report of the Committee on Gas Engines, of which Mr. W. C. L. Eglin was chairman. (See page 1102 of our issue for May 23.)

Prof. Charles F. Lucke called attention to the recently-organized gas-power section of the American Society of Mechanical Engineers, which takes up technical questions of detail in connection with gas engines. Those interested can join this section and receive its proceedings for $5 per year without becoming a regular member of the A. S. M. E. He called attention particularly to the point that the gas engine does not vary in efficiency with the size of the unit in the same proportion that a steam installation does. In a station of 20,000 kw and over, he doubted whether gas will produce energy at a lower cost than steam. On the other hand, he had no doubt of the ability of the gas engine plant in small units to make more money than other plants. Gas-engine installations will earn most in proportion to competitors when the cost of fuel is high and when the individual load factor is high. The load factor influences the fixed charges. A gas-engine station should not be as much subdivided as to units as a steam-engine station, because the economy of the gas engine on light loads is generally better in proportion to full-load economy than that of the steam engine.

Mr. J. R. Bibbins said that American practice with reference to producers will not be satisfied until there are improved methods of mechanically removing the ashes, and methods whereby the producer supplies its own steam or vapor and completely eliminates tar. If a holder is to be used, it should be for the purpose of equalizing the quality of the gas, not for storage. In an 800-hp plant at Bradford, Pa., the average cost of repairs during the last nine years when the plant has been in operation has averaged 0.89 per cent of the value of the engines. This result shows the possibilities when a plant is kept in good order under intelligent supervision.

Mr. Harold Almert spoke on the results of gas-engine practice up to the present time, and said that the gas engine has not been a very satisfactory source of energy as yet, owing partly to the difficulty of getting the proper kind of man to look after it.

Mr. R. M. Searle, of Rochester, said that nearly all of the failures of gas engines installed are due to employing incompetent men to take charge of them. The gas engine requires high order of intelligence, because it is essentially a complicated machine.

Mr. H. L. Wills, of Savannah, who spoke along the same line, remarked that those investigating gas engines should not pay so much attention to the engine, but a little more to the engineer.

Prof. Lucke said that it is easier to train an intelligent machinist to run a producer than it is to instruct an experienced steam engineer.

TUNGSTEN LAMPS FOR STREET LIGHTING.

In the discussion of the paper by Mr. P. D. Wagoner, of Schenectady, on the foregoing subject, which was abstracted on page 1103 of our last issue, Dr. C. P. Steinmetz said that it is interesting to note that even though the tungsten lamp shows such good efficiency in comparison with other illuminants suited to lighting suburban and residence districts, there is even in this case a slight advantage shown by the luminous arc over the incandescent lamp in efficiency of light production. The luminous arc, whether of the magnetite or titanium types, or the flaming-carbon type, is superior in efficiency to the tungsten incandescent lamp. The superiority of the incandescent lamp for certain kinds of outdoor illumination must be found in the ability of the incandescent lamp to be used in smaller units. The great handicap of the arc is that it is a large unit. Where very high brilliancy of illumination is required, the incandescent lamps will never be able to compete with the luminous arc. Each illuminant, therefore, has its legitimate field in which it cannot be beaten by the other. It would be regrettable if engineers were to be scared off from the use of tungsten lamps by comparing the photometric output in candle-power per watt of the tungsten lamp and the luminous arc. Comparing the different incandescent lamp units, the old carbon-filament lamp expense of illumination was mostly the cost of energy and a very small part of it for lamp renewals. In the tungsten lamp the main part of the cost is for lamp renewals. With the tungsten lamps and the possibilities in the future development of these lamps, the doom of the Welsbach mantle seems to be close at hand.

Mr. V. R. Lansingh called attention to the possibility of wasting less light among the trees and against the nearest houses and redistributing the light so as to throw a larger percentage lengthwise of the street. This result is being accomplished in the city of Washington.

PHOTOMETRIC ACCURACY.

In connection with the paper of Dr. A. E. Kennelly, and Mr. S. E. Whiting on photometric precision, given in abstract on page 1104 of the May 23 issue, Mr. J. B. Klumpp, of the United Gas & Electric Company, said that this paper tends to belittle the accuracy of observations by the Bunsen or Leeson disk. Readings by the inexperienced will probably be more in error with a Bunsen-Leeson disk than with a contrast photometer, but he believed the observations can be made by an experienced operator just as accurately as with the contrast photometer. He had known many observations between gas and pantane lamps where the color is practically the same and where the observations of different readings had been within from ¼ to ½ per cent for a series of over a thousand readings. The same readings were produced a month later with an accuracy within the same percentages.

Mr. Preston S. Millar, of the Electrical Testing Laboratories, considered that the errors obtained in the tests reported were larger than might be considered typical for observers in constant practice. To substantiate this a test was made at the Electrical Testing Laboratories in New York, following the methods outlined in the paper. With a Bunsen photometer having a Leeson disk instead of a grease spot, the probable error for a single setting in a series of 25 was .4 per cent instead of 1.5 per cent, as stated in the paper. With the contrast Lummer-Brodhun photometer, the error was .24 per cent instead of .46 per cent, as given in the paper.

LOW-PRESSURE STEAM TURBINES.

In discussing the paper by Mr. J. W. Kirkland, abstracted on page 1102 of our issue for May 23, Mr. W. L. R. Emmet called attention to the fact that the great advantage of the low-pressure turbine is that it is better than the condensing engine, and its most valuable field is that now occupied by the condensing engine, the low-pressure turbine and condenser being substituted for the present condensing equipment without changing the engine equipment proper. He made the rather startling assertion that while the Fisk Street station of the Commonwealth Edison Company (which the convention was to visit that afternoon) was producing energy at the largest rate and at the lowest cost at which it has ever been produced through the application of turbines, nevertheless there is no engine station in the country which cannot by the use of low-pressure turbines obtain a steam consumption rate practically as low as that at the Fisk Street station. The reason for this, as explained in Mr. Kirkland's paper, is that the engine is inefficient at low-pressure ranges, whereas the turbine is highly efficient throughout this range. Steam turbines generally operate better in the larger sizes because the fixed losses in the high-pressure ranges are very great, and small turbines, unless they can be run at excessive speeds, are relatively inefficient. However, the low-pressure turbine in the small sizes is practically as efficient as in the larger sizes because its rotor moves in an atmosphere very highly attenuated, and the friction loss is small. Consequently, a 300-kw or a 400-kw engine can exhaust into a low-pressure turbine and thereby greatly decrease the water rate. The ease of obtaining vacuum has also been improved, because with this combination the steam will be delivered to the turbine at a pressure above atmospheric, and consequently no air leaks into the engine. The reason why the vacuum in the reciprocating engine is often poor is that the engine sucks air at every stroke, and a very small amount of air renders high vacuum impossible. With the reciprocating engine a high vacuum is not sufficiently valuable to make it worth while to take special precautions to preserve it. In a turbine, a high vacuum is very valuable and all losses should be avoided. Very often the existing condenser will produce a high vacuum if a turbine is used between the engine and the condenser.

GROUNDING OF SECONDARIES.

The report of the committee on the grounding of secondaries, which recommended the adoption of a resolution favoring the insertion in the National Electrical Code of a rule requiring that secondary circuits be grounded where the difference of potential between any conductor and ground would be less than 150 volts, and prohibiting grounding where this difference of potential would be in excess of 150 volts, was noted on page 1104 last week and commented on editorially.

In discussing the report, Mr. H. B. Gear, of the Commonwealth Edison Company, Chicago, said that it did not state the reasons why the maximum potential between one wire and ground was limited to 150 volts rather than 250 volts. The recommendation of the committee permitting only 150 volts would prevent the grounding of secondary circuits of 220-volt motor users. Such customers are entirely too numerous to be left out of account, and they should be protected as much as the lighting consumers. A No. 4 ground wire, as suggested by the report, is unnecessarily large, as a No. 6 in many cases will answer all purposes.

Mr. J. W. Cowles, of Boston, said that the matter of requiring the grounding of secondaries had been delayed too long. In Boston the grounding of secondaries is required as a part of each consumer's installation. Ground connections are usually made to water pipes. He favors the protection of the ground wire in exposed places by an iron pipe rather than by a wooden molding. The theoretical disadvantages of greater inductive effect with the iron pipe is less than the practical advantages offered in mechanical protection against injury.

The resolution of the committee was unanimously adopted.

ENERGY DISTRIBUTION IN SUBURBAN DISTRICTS.

The discussion of the paper by Mr. Geo. H. Lukes, which was noted on page 1103 last week, was opened by Mr. Farley Osgood, who remarked that it seems hardly necessary to discuss the matter of frequency for transmission or suburban distribution work, 60 cycles being the proper frequency for lamps and motor work. Even when street railway work is to be done 60-cycle rotary converters can be used with safety. However, the existence of a heavy proportion of railway load might warrant 25-cycle equipment. Where transmission pole lines carry low potential circuits as well as high-tension circuits it is good practice to have the lower cross-arms separated by at least 40 in., thus making it safe for men to work on the low-potential wires. Porcelain insulators are, without question, better than glass, and owing to the recent combination of the glass insulator manufacturers, they can be obtained for an equal or lower price.

In the East the use of angle-iron arms in addition to iron pins on wooden poles is being introduced. The number of poles destroyed by fire from electrical causes on lines using this type of construction is remarkably low. He emphasized the necessity brought out by Mr. Lukes for building substations of sufficient size to take care of future requirements. Lack of this consideration has cost lighting companies as much money during their periods of growth and attending reconstruction as any one weakness on the part of the men responsible for the welfare of the companies. Some of the larger companies have a prognostication department, which makes studies of future development of localities for a period of 25 years.

As to local distribution, the usual practice in the East is to distribute energy locally by two-wire single-phase, except for large motor users, in which case the four-wire two-phase scheme is used. Orinarily it is undesirable to connect motors of greater than 10 hp rating on a single-phase lighting circuit, although in the territory which has a small day lighting load, as large as 20 hp can be used with safety. He favored the placing of secondary wires on the lowest cross-arm as the safest for circuits on which work is continually being done by linemen.

He said that a pipe driven in the ground does not make a satisfactory ground connection; neither does a copper plate surrounded by charcoal. His company feels that the only method that can be used with security is grounding to water mains or service pipes near the main. It is better to go to considerable expense in running overhead ground wires to obtain a water-pipe ground connection rather than to accept any other kind.

Distribution losses should be watched most carefully in such a way that they may be anticipated and the necessary reinforcements to circuits be made before complaints are received from customers. He urged the importance of obtaining clear and legal right-of way permits from abutting property owners for pole lines. Many companies are lax in getting these, because at the time a pole line is built no objection is raised.

Mr. Peter Junkersfeld said that companies frequently are tempted to overload street pole lines run in streets primarily for street lighting purposes by putting on them wires for general energy distribution purposes. If alleys are available in some cases it is desirable to build the principal lines in the alleys, thus duplicating pole line investment to a certain extent for the sake of preventing agitation for placing wires underground. It is well to be very careful in street lines not to get them loaded up so heavily that the company will be forced to place its wires underground, when by a little foresight this requirement will be postponed. In generating stations attention can be concentrated on the design when they are built, but pole line extension goes on from day to day as a matter of routine work and for that reason is likely to be handled carelessly.

Mr. H. B. Gear agreed with Mr. Osgood that the water-pipe system should be used for the grounding of secondaries whenever it is available, but in Chicago the places where the water pipes are available are so few that it is absolutely necessary to provide other means for getting a ground connection. After several years' trial of both copper plates buried at the base of the pole and of galvanized iron pipes driven into the ground, it was found that the galvanized pipes afforded fully as good and in many cases better ground connections than the copper plates, the galvanized pipe being far cheaper to install. The nature of the soil affects the resistance of the ground in different places. It is therefore necessary to make tests in different parts of the city to ascertain what can be done and how many ground connections are required. In some outlying places where water pipes are not available, two connections are installed. He thought two ground connections good for any overhead secondary system, because a ground wire is likely to be accidentally broken or cut

As to the four-wire three-phase system for energy transmission lines, the entire load in South Chicago, which is from 500 to 600 kw,. seven miles from the nearest 60 cycle station, is carried on a four wire three-phase line regulated at the station, no attendant being kept at the receiving end. A substation building was provided only for the housing of transformers and as headquarters for trouble men. The same thing is done in another locality. The voltage regulation secured in these circuits by this means is as good as from the 2200-volt, four-wire feeders transmitting energy directly from the substation. The phases may be very much unbalanced, and yet the regulation is as good as when balanced. Therefore, the four-wire, three-phase system for transmission purposes as well as for distribution has some great advantages over the three-wire, three-phase system.

Dr. C. P. Steinmetz criticized the transmission line construction shown in Mr. Lukes' paper, which does not provide an overhead grounded wire above the transmission wires. In a system using this construction, extending over considerable territory where thunderstorms are frequent, it becomes almost impossible to guard the system from disturbances from lightning. A customer obtains an unsatisfactory impression if he must prepare to use candles whenever a thunderstorm threatens; that is the case with many transmission lines. He also spoke of the common practice of operating with two transformers connected in open-delta on a three-phase circuit. While this is satisfactory for operating a small motor at a primary e.m.f. of 2200 volts, it is a dangerous combination to use on e.m.f.'s above 2200 volts. This combination is liable to high-voltage disturbances of mysterious origin. In the last year he has heard of more trouble from the use of two transformers connected in open-delta on a three-phase system than from all other causes combined. It is far safer to use single three-phase transformers if one does not wish to use three transformers.

ECONOMICAL OPERATION OF THE SMALL CENTRAL STATION.

In discussing the paper by Messrs. J. C. Whittlesey and Paul Spencer (see page 1104, May 23), Mr. C. M. Young, of Columbus, Ga., said that the station engineer may not be very energetic or realize the importance of determining the unit cost of production, but once it is determined, he is more likely to become enthusiastic about small economies to reduce them. It is an excellent idea for small stations to engage a consulting engineer from time to time to analyze their conditions and show where they can be improved.

Mr. C. A. S. Howlett described a 75-kw central station in a very small town which gives day service. The engine arrangement is unusual, a small engine being attached by a clutch to one end of the generator shaft, and a large engine to the other end. The small engine is run during hours of light load.

Mr. T. W. McNamee, of Wabash, Ind., said that in the station in which he is interested an accurate daily record of the evaporation per pound of coal proved to be of great value. The variation with different kinds of coal, which were supposed to be of good grade, were found to be from 6.5 lb. to 8 lb. of water evaporated per pound of coal. Without the evaporation record they would not have known what results the coal was giving. To measure the water supplied to the boilers a small pump is attached to the feed pump so as to make the same number of strokes as this pump. The small pump, which is of one-tenth the size of the feed pump, forces cold water from a tank through a meter and back to the tank again. By applying a constant reading of this cold-water meter the amount of boiler feed is determined. The cold-water meter can easily be calibrated by actual measurement of the water passing through it.

Mr. Harold Almert, of Wichita, emphasized the necessity of connecting and disconnecting boilers and engines at the proper time. In small plants boilers and engines will be operated up to their normal rating, but about the time they begin to show economy by virtue of being operated at nearly full load, additional units are started, thereby decreasing the economy. Engineers and firemen operate the equipment in this way because the boiler pressure can be allowed to vary between wider limits without making trouble, and in general the machinery need not be as closely watched. In one station a saving of 40 per cent was accomplished by simply working the boilers and engines nearer the rated full load.

Mr. R. M. Searle, of Rochester, pointed out that obtaining maximum economy in a boiler plant necessitates always burning the number of pounds of coal per square foot of grate which will give the maximum amount of carbon dioxide in the flue gases. To do this, it is necessary to employ a small grate surface on light loads, otherwise an excess of air goes through and practically the boiler is being heated with hot air.

Mr. Whittlesey agreed that it is undoubtedly more economical to force boilers up to as high an output as possible for a couple of hours rather than to use additional boilers.

MOTOR LOAD FOR SMALL STATIONS.

The discussion on the paper by Messrs. Robbins and Bibbins, an abstract of which appeared on page 1103 last week, was opened by Mr. F. L. Dame, who said that the tendency of solicitors is to install motors that are too large for the class of service required in alternating-current work. The motors then operate at a low-power factor and a fictitious load is put on the generating apparatus which cuts down the useful output. Mr. N. T. Wilcox, of Lowell, said that some stations are already trying to protect themselves and are adding a certain definite amount to the service-charge for every per cent that the power factor falls below 80. This plan makes it an incentive to the consumer to keep the wattless current at a low value.

Mr. Paul Spencer said that practically every motor installation is provided with excess rating in machines and the company should insure that the consumer is not installing too large motors. One way to prevent this is to put a penalty, not on the low-power factor, but to require a minimum or fixed charge per horse-power on the motor itself so as to induce the consumer to use the smallest possible size of motor that will handle his business.

Mr. J. M. Cranford, of Jasper, Ala., said that he lived in a town of 2500 people and is rendering day service throughout the whole year. The small motors, such as for fans, sewing machines, etc., help out the load. The company wishes to supply more energy to motors, and is not concerned much about their size or power factor.

Mr. J. S. Cartwright, of Knoxville, spoke of having secured the co-operation of the motor manufacturers to the extent of getting motors loaned on trial for several months. He also suggested that a central station should co-operate with a good live contractor in the town. While his company does not run a sales department, it carries 3-hp, 7-hp and 10-hp motors in stock most of the time, so as to have them available if anyone wants to make a trial.

REPORT ON METERS.

A committee, consisting of Mr. L. A. Ferguson as chairman and Messrs. Alex. Dow and J. E. Montague, submitted a report relating to some of the developments in meters during the past year. Notes were made of so-called "watt-demand" indicators with which watt-hour meters must be used to measure energy, and of recording wattmeters which may be used simultaneously as a maximum demand indicator and an energy meter by integrating the area of the chart to obtain the value of the watt-hours. The committee called attention to inaccuracies in watt-hour meter records that may be caused by external fields, stating that an error of from 5 to 10 per cent may be produced by placing direct-current watt-hour meters too close together.

In the discussion, Mr. Geo. A. Sawin expressed the opinion that the values for errors given in the report represent the maximum rather than the probable values. Mr. S. M. Bushnell, who was responsible for the tests upon which the report was based, said that the values referred to maximum errors.

Mr. Alex. Dow, in discussing the importance of testing meters in position, said that the fact that meters register correctly in the laboratory does not prove that they will operate correctly on the consumer's premises.

UNIFORM SYSTEM OF ACCOUNTING.

A committee, consisting of Mr. H. M. Edwards as chairman and Messrs. E. J. Allegaert, E. W. Brundrett, John L. Bailey and Frank L. Dame, submitted a report outlining a system of accounting for electric lighting companies. The following classification was made of expense accounts, the scope of each class being indicated: Production, cost of electric energy delivered to station terminal board; transmission, cost of conducting energy to substation and delivering it to the distributing system; storage battery, cost of storing energy; distribution, cost of conducting electric energy from substation terminal board to customer's premises; municipal street lighting, cost of operation of street lighting system; commercial expense, all office expenses in connection with customers' accounts; new business, cost of securing new business; general administration and miscellaneous expenses.

The report was discussed by Mr. J. B. McCall and Mr. R. S. Searle, both of whom favored the classification proposed by the committee. The report was adopted unanimously.

AMENDMENTS TO CONSTITUTION.

Mr. H. L. Doherty, as the committee on organization, presented a report suggesting certain changes in the constitution in order to render the National Electric Light Association the basis for a complete organization of the entire central station business of the country. Acting upon the suggestions made in Mr. Doherty's report, a committee, consisting of Mr. W. W. Freeman, as chairman, and Messrs. L. A. Ferguson, Arthur Williams, F. M. Tait and W. H. Blood, Jr., recommended amendments to the constitution according to which exhibitions and contests under the officers of the N. E. L. A. may be held at places designated by the executive committee, local sections of the N. E. L. A. may be formed in any State and a company section may be organized by any Class A member company from its employees, provided they are members of the N. E. L. A. Moreover, the executive committee is authorized to call a national conference upon any designated subject when requested to do so by 15 Class A member companies. The recommendations of the committee as outlined above were adopted.

New Telephone Patents.

TRAIN SIGNALING SYSTEMS.

For a long time there has been discussed at frequent intervals the possibility of establishing telephone communication between trains scattered along a section of railroad and the signal towers. Some of these systems have contemplated a continuous means of communication between moving trains and stationary points, while others have merely contemplated the setting off of a signal which will notify the engineer to stop and call. Patents for two systems have been issued, one of each kind.

The system of F. L. Odenbach, of Cleveland, Ohio, is of the former class. He provides an overhead trolley wire above the railroad track with a trolley secured to each train in contact therewith. Upon each train he includes a source of potential, such as a generator or battery, which is in circuit with a commutating device driven continuously by an axle of the train. His signaling devices comprise an indicating instrument of the galvanometer type and an incandescent lamp. The generator of each train is so connected to the trolley and track that if a short-circuit or another train comes within a predetermined distance controlled by the voltage of the system a flow of current will be indicated upon the lamp and by the motion of the galvanometer. Under a short-circuit the lamp in the cab of a train will be flashed by its own commutator under the influence of its own generator only, while when two trains come within the danger zone the currents supplied to the rail and trolley by the two trains will overlap, causing a peculiar variation of the signal, from which can be interpreted the relation and motion of the trains. Switches are provided by which the signaling apparatus may be cut out and telephone apparatus substituted in the circuit, so that the engine men may communicate with each other over the trolley wire.

The second system is the invention of E. Sughroue, of Bartley, Neb. He employs the telephone lines, now so frequently running along the railways for despatch and other purposes, to convey his talking currents. In addition, the operation of the signals requires a special wire. Distributed along the right of way are rocket boxes, the ignition of the rockets being under the control of percussion caps. A group of these rockets is connected up in series to a single signal circuit. When it is desired to stop a train on one of these sections, current is sent over the signal wire, operating at each rocket box an electrical trigger in the shape of a vibrator. This trigger explodes the caps, fires the rockets and signals the engineer to call up on the telephone line. A further feature of the rocket box is a trip bar, which is set upon the explosion of the rocket, which trip bar is designed, through a linkage, to trip the throttle lever latch in the cab and thereby shut off the steam, in case an attempt is made to run by the signal.

SWITCHBOARD CIRCUITS.

The Dunbar two-wire type of central energy system, in which a controlling relay serves to disconnect a subscriber's line from the signaling apparatus, and simultaneously connected to the switchboard jacks, is well known and has been used with many variations.

C. A. Simpson, of Chicago, Ill., has adapted this main principle to a three-wire system, his control relay being connected to the third, or sleeve, contact of the jacks, the third strand of the cords serving to furnish current for this control relay. This system definitely separates the busy test and signaling circuits from the talking circuits, while the other features are practically exactly those of the Dunbar type. Mr. Simpson has assigned his patent to the Kellogg Switchboard & Supply Company.

Another patent assigned to this company is one recently issued to E. H. Rupe, of Chicago, Ill., for a thorough ringing trunk circuit for use between toll boards and switchboards of the two-wire Dunbar type. With this class of service it is desirable to have the toll operator control all ringing, the switching operator merely connecting the desired subscriber to the trunk. With this end in view a ringing relay is provided in the trunk, which serves in lieu of a ringing key. There is also provided a ringing control relay, which normally holds the ringing relay circuit severed. The toll operator, by means of a ringing key, puts a ground upon the trunk circuit in such a way as to release this ringing control relay during the depression of the key, thereby causing through the ringing relay a signal upon the desired line.

LETTERS TO THE EDITORS.

Overshooting of Tungsten Incandescent Lamps.

To the Editors of Electrical World:

Sirs:—I have read with interest the articles by Mr. John B. Taylor on the "Overshooting of Tungsten Incandescent Lamps" and the editorial notes thereon in the Electrical World of May 16 and of April 25. In this connection the theory of occluded gases in the cold filament appeals to me strongly for the following reasons:

In Mr. Taylor's article, Fig. 2, page 1046, the period of time between *A*, when the current is first turned on, and the first visible record of the light, is only about one-fifth as long as the time between *D*, the second time the current is turned on, the first subsequent visible record of the light. Assuming the temperature to be the same at *D* as at *A*, the increment of temperature is about five times as great the first time the lamp is lighted. Assuming, however, the filament to be still hot at *D*, which assumption is, of course, necessary to the theory of a lag of resistivity behind the temperature, the increment of temperature is about 10 or 12 times as great the first time the lamp is lighted as it is after the lamp has been turned off for two-thirds of a second. This would mean that the initial current at *A* was not less than, and possibly much more than, 10 or 12 times the initial current at *D*, and as the voltage is the same in both cases, the resistance was at least 10 or 12 times as great at *D* as at *A*, a difference which, I believe, is greater than is found to be the case. Also, assuming a time lag of resistivity, I fail to see why there was not an appreciable, though probably less pronounced, overshooting at *D* as well as at *A*. It would be very interesting and somewhat enlightening in this connection to know just how long the current has to be turned off to cause this phenomenon of overshooting to occur on relighting.

On the other hand, it would seem possible that the increased incandescence on first lighting is caused by a chemical reaction between the filament and traces of occluded gases, as, for instance, the filament absorbing and occluding, much after the manner of platinum, minute quantities of oxygen; part of this oxygen when the filament is moderately heated combining with traces of carbon or some other impurity in the filament, or even with the tungsten itself, and producing this temporary incandescence from the mere heat of the chemical reaction. This is merely a conjecture, as the existence and the nature of a chemical reaction in this case could be determined only by elaborate experiment.

In any event, it would be interesting and possibly of some practical usefulness to know the exact nature of this phenomenon, as it may have a decided influence upon the life of the tungsten lamp when used with a sign flasher or under similar conditions. I do not know whether or not series of life tests of tungsten lamps under these conditions have been made, but the results of such a series of tests would be of interest.

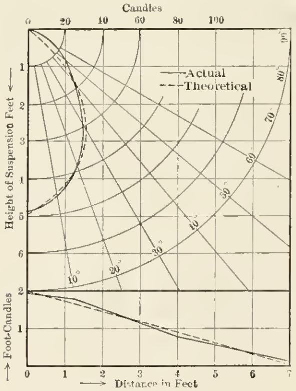
Milwaukee, Wis. James J. Doyle.

Uniform Illumination of Horizontal Planes.

To the Editors of Electrical World:

Sirs:—In your issue for May 23, Mr. Ernst W. Weinbeer calls attention to certain features of two of my articles which appeared in previous issues of the Electrical World, wherein my assumption did not agree with existing conditions. In the articles referred to it was distinctly stated that the polar candle-power curve selected was given a certain form for theoretical reasons. However, the discrepancy between the assumed form and the forms that can be obtained is not of sufficient importance to detract from the value of my articles.

Moreover, I do not agree with Mr. Weinbeer that the polar candle-power curve selected cannot be realized in practice. I believe it is possible to give to the candle-power curve of a lamp any shape desired, and it is not difficult to concentrate the whole light flux from a lamp on an area corresponding to a certain polar-angle, just as the total flux is frequently utilized in only one hemisphere.



POLAR CANDLE-POWER CURVE.

It was shown in one of the articles mentioned above that by the use of a prismatic reflector there can be obtained a polar candle-power curve approximately equal to the one assumed by me. I may now add that by the use of mirror reflectors one can completely fulfill all demands. As indicated by the accompanying table and illustration, excellent results can be obtained with a so-called "X-Ray" reflector.

Comparison Between Theoretical and Actual Candle-power and Illumination Curves.

Angle Degrees.	Light in candles. Theoretical.	Light in candles. Practical.	Illumination in foot-candles. Theoretical.	Illumination in foot-candles. Practical.
—	98	97	2	1.98
10	87	92	1.72	1.8
20	77	77	1.3	1.3
30	62	55	.83	.74
40	37	37	.34	.34
50	—	25	—	.13
60	—	15	—	—
70	—	—	—	—
80	—	—	—	—
90	—	—	—	—

Theoretical—Illumination curve a straight line. K = 1. $I_0 = 2.07$. D = H = 7.

Practical—Illumination curve of a No. 700 National X-Ray Reflector.

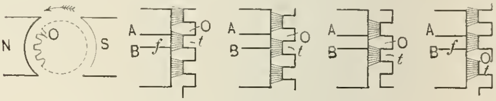
The writer believes that the use of the theoretical polar candle-power curve assumed in my article is fully justified, because by the use of such curves it is possible to place the calculations connected with illuminating engineering on a thoroughly scientific, as well as practical, basis.

New York, N. Y. Alfred A. Wohlauer.

Loop vs. Cutting Lines of Force.

To the Editors of Electrical World:

Sirs:—With reference to Mr. Carl Hering's statement as to the "Loop vs. the Cutting Lines of Force Laws" in an article in your issue of March 14, and also a paper printed in the March number of the American Institute of Electrical Engineers, I should like to ask an explanation of a fact which seemingly belongs neither to the former nor the latter law of induction. Let us suppose a conductor embedded in a slot of a toothed armature of an ordinary direct-current machine. Now, for the sake of simplicity, let us assume that all flux pass through the teeth but nothing through the slots, also that the conductor has no connections at either ends—that is, it is simply a straight wire, so that no "looping" law applies in the case. Now, revolve the armature in the direction indicated by the arrow head. Consider a small portion of the field magnet, such as *A B*; a glance through Figs. 2, 3, 4 and 5 will convince us that the flux density at *A B* varies from a maximum to zero, and when the conductor passes from the point shown in Fig. 2 to that of Fig. 5, the flux "*f*" has not remained fixed, but has passed along with the tooth "*t*." In a word, the conductor never "cuts" the flux nor does the flux cut the conductor. According to Faraday's law, the conductor must cut flux to generate any e.m.f. Now, it is a plain fact that the conductor does generate an e.m.f. in passing through from Fig. 2 to Fig. 4, although it never cuts any flux. An interpretation may be made to the effect that although the conductor does not actually cut the flux, the effect will be the same as if it did, because in passing from Fig. 1 to Fig. 5, the conductor must cross the flux "*f*," as is clear from the figures. But the fact is that the conductor never crosses the flux "*f*," which disappeared before the conductor came to the portion *A B* and reappeared after it went through it. If the conductor were connected with another one under different polarity, as is done in any actual case, the generation of e.m.f. may easily be explained by the "Looping Theory" of Maxwell.



FIGS. 1, 2, 3, 4, 5.—LOOP VS. CUTTING LINES OF FORCE.

Ithaca, N. Y. S. Sano.

Grounding the Secondary.

To the Editors of Electrical World:

Sirs:—Under date of March 14 you publish some remarks in regard to the attitude of the Underwriters toward the rule proposed by various electrical interests for grounding secondaries, in which you rather reflected on the Underwriters for not having taken prompt action when this rule was suggested to them. We replied to this article, our letter appearing in the issue of March 21.

We notice in the issue of May 23 that you have now become fully informed of the details of the proposed substitute for Rule 13 A, as presented at the Chicago meeting of the National Electric Light Association, and we are pleased to note that you are no more ready to accept this proposed substitute off-hand than were the Underwriters, and that you also feel that you would like to be advised why certain provisions were introduced in the rule in just the form they appear.

This editorial of yours in the present issue of the World is naturally pleasing to us, because it fully justifies—so far as your opinion is concerned—the action of our sub-committee in recommending that the proposed substitute be referred back to them for further conference and consideration.

We were fully aware at the time this recommendation was made that the electrical interests were not a unit in regard to the 150-volt limit, and we were also confronted with what seemed to us a very inconsistent position for the Underwriters to take, unless there was some good and sufficient reason given, that we should compel the grounding where the voltage was not over 150, and go to the other extreme and forbid it when it was over 150.

It seemed to us, that in a matter affecting life, it might be "better to prohibit entirely such classes of installations than withhold protection from those endangered by them."

Boston, Mass. C. M. Goddard.

Series Transformers.

To the Editors of Electrical World:

Sirs:—The article by Mr. Harrar in your issue of May 16 contains some valuable information, but is rather misleading in two points. The diagram (Fig. 5) giving the wattmeter error in terms of the power factor of the secondary circuit has different lines for different phase angles, and it might be inferred that each one of these lines gave the change in error with power factor for a particular transformer. This is not the case, since the angle varies in each transformer with the power factor, and for some low value of the power factor becomes zero. For this value there is no error if the exact ratio be known and used. It is thus evident that the angle used is not the angle at unity power factor, but the actual angle at the given power factor, and this is a variable for any transformer.

I assume that the curves have been computed without respect to the change in ratio, since this cannot be included in the computation unless other constants of the transformer are specified.

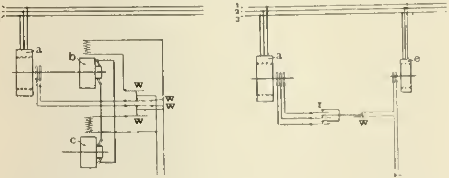
The second point occurs in the specific example computed In explaining the increase of ratio with decrease of load, it is stated ". . . as the iron loss varies as some power of the induction greater than unity the per cent decrease in watts loss is less than the per cent decrease in induction or in load." The fact is that the decrease in *watts* is *greater*, but as the voltage drops in proportion to induction, the energy component of current decreases at a slower rate than the load; and it is this energy component of current which affects the ratio at high power factors.

Washington, D. C. M. G. Lloyd.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Compensation of Pressure Variations in Alternating-Current Networks.—A. Heyland.—Variations in pressure in alternating-current networks are often produced by variations of load on motors, especially by alternations in the wattless components of the currents. The present article describes several arrangements which not only compensate both this drop, but may produce excitation of certain motors connected to the network by variations in the main current, thus giving an effect analogous to "compounding" in direct-current systems. The principle is explained in Fig. 1, where 1, 2 and 3 are alternating-current mains, *a* a motor connected to them, *r* its starter or regulating rheostat and *e* an alternating-current machine coupled to the network, excited by continuous current (+ and —), whose excitation may be regulated by means of the resistor *w*. If the motor *a* has a large starting torque, the current at starting will be maximum, and will diminish until the short-circuit position of the rheostat *r* is reached. Further, the voltage drop in the network, caused by this motor, will be a maximum at starting, and will decrease for normal working. It is, therefore, very easy to make the resistors *r* and *w* interdependent, say, by connecting them mechanically, so that the excitation of *e* is varied approximately in the same degree, but in an inverse sense, as the voltage drop produced by *a*. The voltage drop of the network may thus be compensated, or even raised, when *a* is overloaded. Instead of connecting the resistor mechanically, *e* may be regulated in any other appropriate manner which is dependent on the working of *a*. Another application of this principle is shown in Fig. 2. A motor receives energy from a motor-generator, the object of which is to obtain economy in starting and regulation.



FIGS. 1 AND 2.—COMPENSATING PRESSURE VARIATIONS.

The alternating current motor is *a*, and *b* is the direct-current generator of the set, while *c* is the motor, in this case of the continuous type, connected to it. The regulating resistors of the different machines are represented by *w*, *w*, *w*, *w*, and it is supposed that these are connected up in an appropriate manner in order that the excitation of the alternating-current motor *a* may be regulated automatically, according to the operation of the motor-generator and the state of the load, in such a way that the line voltage may be conveniently regulated. Quite a number of other arrangements involving the same principle are also described and illustrated.—Lond. *Elec.*, April 24.

Direct Current Generators.—E. Korrodi.—An illustrated article on direct-current generators for lighting, industrial and tramway service. Combined lighting and traction plants have a smaller total generator equipment than separate plants, as the combined maximum demand is much less than the sum of the two maxima, and fewer spare sets are required with only one type of generator. This advantage is, however, somewhat reduced by an increase in the size of the generators, which, in the case of ordinary direct-current machines at from 440 to 480 volts and from 500 to 550 volts, is about 30 per cent, and is partly due to the more severe commutation conditions at the lower voltage. As the size of interpole machines depends upon the product of maximum current and maximum voltage, their increase in rating is only 15 per cent. Thus, it is possible to build interpole machines of sufficient size to carry the maximum overload, under any condition of voltage, more economically than those of the ordinary non interpole type, and with at least as good performance.—Lond. *Elec.*, May 1

Lamps and Lighting.

New Incandescent Lamps.—A continuation of the long serial on recent progress in incandescent lamp invention. The firm of J. Lux, in Vienna, has patented a method of making tungsten lamps, based on the property of amidoderivatives of diphenyl to form compounds with tungsten. The same firm uses the following method for finding any weak points (of thinner diameter) in the filament produced: The long filament wire is electrically heated for about a second in air to a predetermined temperature. Any weak points which have a reduced cross-section light up and are at the same time oxidized so that when cooled they show the color of the oxide and can be cut out. The Wolframlampen A. G. makes tungsten filaments by starting with tungsten compounds like tungsten oxide, etc. The compound is finely powdered and mixed with pure water so as to form a plastic mass. It is then strongly compressed by hydraulic pressure and formed into rod or filament form. After the filaments have been dried they are embedded in a refractory material, like magnesia, etc., and placed in a closed graphite crucible, which is heated to from 1500° to 1800° C., dry hydrogen gas being simultaneously passed through the crucible during the whole period of heating. After from 12 to 24 hours the tungsten-compound filaments are reduced to pure metallic tungsten filaments free from carbon. It is also possible to start with powdered tungsten, but when it has been made up with water into a plastic mass they can be pressed into filament form only after having been mixed with finely-powdered sulphur. Less sulphur is used than is necessary for converting the tungsten into the sulphide. These filaments are treated in the way as described above in a hydrogen atmosphere with simultaneous heating, whereby the tungsten is converted into sulphide and at once reduced again to pure metallic tungsten. Another process of the same company relates to the deposition of a layer of tungsten on carbon filaments. This is done under reduced pressure (preferably at 200 mm of mercury) in an atmosphere of a vapor of a tungsten compound with a reducing gas like hydrogen, while the carbon filament is electrically heated. In order to get filaments of the same composition it is preferable to carry out this process by connecting a number of the filaments in series. If one of them has a smaller diameter than the others then it will be heated to a higher temperature and will receive a thicker deposit so that the final filaments are of equal cross-section. Before this process has been completed, each filament should receive a very small preliminary cover of tungsten.—*Zeit. f. Beleucht.*, April 10.

Metallic-Filament Lamps.—An illustrated review of various types of new metallic-filament lamps on the market in England. Besides the well-known osram and tantalum lamps and others, which have already been mentioned in the Digest, the following are noticed: The "Aegma" lamp (nature of the filament not stated) is built for any e.m.f. between 1 and 140 volts, the specific power consumption being between 1 and 1½ watt per hefner candle, and the life from 800 to 1000 hours. Another company builds "series units" of 6 cp or more and joins a number of such units (up to 10) by means of special fittings in a single lamp holder. Whenever the filament in one unit breaks, a resistor of equivalent resistance is automatically substituted. This substitutional resistor and the automatic device are provided within the series unit itself. The series units cost 25 cents, or 33 cents with the safety fuse complete. Where several are used to form a cluster, the failure of one unit means that the original candle-power (50 or 100) can be maintained at a cost of a single unit of 6 cp or so only. The "simplex" is a tungsten lamp consuming 1 watt per hefner candle and having a life of 1000 hours. It is made for voltages from 50 (25 cp) to 250 (50 cp). The "Orieco" lamp is claimed to have a filament different from that of other metallic-filament lamps, none of the component parts used by other manufacturers entering into its production. In another lamp use is made of a platinum-rhodium filament on which there is deposited a layer of oxides of rare earths, which become incandescent through the heat developed in the metallic filament; such lamps are made for 25 volts, with candle-powers of 8, 16 or 20.—Lond. *Electrician*, May 1.

Generation and Transmission.

Hoisting for Canals.—A. Hundt.—The first part of a detailed fully-illustrated description of an electric hoisting installation of the Dortmund-Ems Canal, in Germany, for overcoming a difference in level of from 14 to 16 m. The canal boat to be raised floats within a water tank supported by a number of floating bodies; the floating force, which drives the latter upward, is so chosen in relation to the total weight that the whole system is approximately in equilibrium at any height. A comparatively small amount of energy is, therefore, sufficient to raise the tank. A 150-hp direct-current motor is used. The tank with the boat is raised with a speed of 0.111 m per second. The current is 800 amp at starting, but drops to 100 amp after five seconds and increases again to about 350 amp on account of variation of the flotation force.—*Elek. Zeit.*, April 16.

Induction Motors.—G. Stevenson.—A paper read before the Glasgow section of the (Brit.) Inst. Elec. Eng., advocating the use of squirrel-cage induction motors for electric driving in preference to slip-ring motors, even for motors up to 100 hp. The author described the application of friction clutches to electric driving with squirrel-cage motors, and finally criticised the regulations of local authorities and supply companies with regard to the installation of squirrel-cage motors.—Lond. *Elec. Eng'ing*, April 23.—In the discussion which followed most of the speakers disagreed with the author's view that squirrel-cage motors, in conjunction with friction clutches, are superior to slip-ring motors.—Lond. *Elec. Eng'ing*, April 30.

Rolling Mills.—H. Crowe.—An illustrated paper read before the Cleveland Inst. of Engineers on a form of the Ilgner system for driving reversing rolling mills, with a series of records of current consumption in actual cases. The general advantages of electric-motor driving over steam engine are also pointed out.—Lond. *Elec. Eng'ing*, April 23.

Paraffine Engine.—An illustrated description of the Allen vertical four-cycle paraffine engine.—Lond. *Elec.*, May 1.

Traction.

Single-Phase Locomotive.—W. Wechmann.—An illustrated description of the first single-phase locomotive used by the Prussian State Railways on a trial road near Oranienburg. The locomotive has two four-axle trucks. Three axles are equipped with a single-phase motor of the Winter-Eichberg type rated at 350 hp at 450 r.p.m. for one hour, or at 250 hp at a speed of 500 r.p.m. for continuous operation. The ratio of gearing is 1 to 4.21. The maximum speed of the locomotive is 50 km per hour. Drawings of the locomotive are given.—*Elek. Zeit.*, April 23.

Emergency Brake.—An illustrated description of an emergency brake of exceedingly simple construction devised by P. J. Pringle. The special feature is that it operates on the rail groove instead of the rail tread. There is provided a steel shoe or skid, shaped to enter the groove of the rail, which can be dropped in front of the car wheel, causing the wheel flange to mount the trailing end of the skid so as to bring upon it the weight normally carried by the wheel. The brake is only intended for emergency stops, and is somewhat violent in its action.—Lond. *Elec. Eng'ing*, April 30, and Lond. *Electrician*, May 1.

Electric Traction in Austria.—von Ferstel.—An account of the work done by the Bureau of the Austrian State Railways for studying and preparing for the introduction of electric traction. The chief incentive is the rapid rise of the price of coal. The Austrian Government Department which operates the railways had to pay a 64 per cent higher price for coal during the last two years. The bureau is making a general investigation of all water power westward of Salzburg which could be developed for electric-railway operation, and has already made a survey of 12 water-powers, with an aggregate rating of 40,000 hp.—*Elek. Zeit.*, April 16.

Water Power for Electric Traction.—W. Conrad.—A paper read before the Electrical Society of Vienna discussing the chief principles to be considered in the choice and development of water powers in the Alps for the use of electric traction. The author deals at some length with the necessity of artificial storage of water.—*Elek. und Masch.*, April 12 and 19.

Installations, Systems and Appliances.

Leoben.—An illustrated description of the electric station of Leoben, in Austria, utilizing a water power. There are two 500-hp Francis turbines driving two 5200-volt, three-phase generators.—*Elek. u. Masch.*, April 12.

Lowell.—An illustrated article on electric-power supply in the city of Lowell, with its textile industry. The equipment of the new power house is described, the principal feature being the use of turbine generators.—*Stone & Webster Pub. Serv. Jour.*, May.

Lightning Protection.—J. F. VAUGHAN.—A review of the causes and effects of lightning disturbances in electric circuits and their remedies. The different protecting devices are briefly described and notes are given on their installation, care and inspection, and a method of keeping records.—*Stone & Webster Pub. Serv. Jour.*, May.

Regulations.—Proposed police regulations concerning erection, operation and supervision of electric installations.—*Elek. Zeit.*, April 16.

Wires, Wiring and Conduits.

Heating of Cables with Intermittent Load.—R. APT.—The author shows that Oelschlaeger's formulas for temperature change of resistors through which currents pass intermittently may also be used for the temperature change of cables and insulated conductors at intermittent load. The formula for heating is $t = T\ ln\ (\tau_m \div (\tau_m - \tau)$ and that for cooling is $t = T\ ln$ $(\tau_m \div \tau)$, where t is the time in minutes, ln means natural logarithm, τ is the increase of temperature and τ_m is the maximum temperature (which the cable or conductor, when being heated, will ultimately reach). T is a constant which is proportional to the mass and the specific heat, and inversely proportional to the surface and the heat loss per unit of surface; it is independent of the temperature, the current used, the period of intermittent operation, etc. T is called by the author the "time-constant" and is measured in minutes, and gives the time in which the temperature rise becomes 0.633 times the maximum temperature increase. The curves for τ as function of t are exponential curves. That the above formulas can be applied for cables is shown by plotting the heating curves for one and the same cable at different (constant) currents, each curve relating to a certain current; then it is found that all the curves have the same time-constant. On the basis of experimental measurements of the heating and cooling of cables, buried in earth, the time-constant has been determined by the author, the results being given in Fig. 3, in which curve *I* relates to single-conductor cables, II to three-conductor cables, both for 700 volts. The ordinates give the time constant in minutes, the abscissas the copper cross-section of a single conductor of the cable in square millimeters. Thus, a 700-volt, 150-sq. mm single-conductor cable has a time-constant of 28 minutes; a 700-volt, 3 × 240-sq. mm three-conductor cable one of 57 minutes. Other things being equal, the time-constant increases with the diameter. An intermittent load, as distinguished from a constant load, is characterized by the ratio p of the maximum current at intermittent operation to the maximum current at constant load and is called the overload coefficient. If c is the maximum permissible current at constant load, then $p\ c$ is the maximum permissible current at intermittent load. If the time of a full period is P and that portion of the time of a full period during which current is turned on is called a, then the overload coefficient p is found by means of the equation:

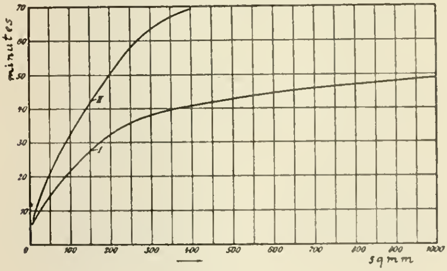


FIG. 3.—HEATING OF CABLES.

$$\frac{P}{a} = 1. - \frac{T}{a}\, ln \left(p^2 - e^{\frac{a}{T}} (p^2 - 1) \right) \quad \frac{a}{T} \text{ meaning the power;}$$

The overload coefficient p is, therefore, a function of $\frac{a}{T}$ and $\frac{a}{P}$ the first ratio is characteristic of the cooling conditions of the cable (on account of the time-constant T), while the second ratio is characteristic of the intermittent load. If p is calculated from the above formula and the results are plotted diagrammatically, Fig. 4 is obtained. If, for instance, the time of a full period of intermittent operation is $P = 5$ minutes, that part of the time during which the cable carries current is $a = 1$ minute, then $a \div P = 0.2$. If further the time-constant of the cable, as found from Fig. 3, is $T = 10$ minutes, then $a \div T = 0.1$ and we find, from Fig. 4, the overload coefficient $p = 2$. For the operation of cranes the author considers the following two characteristic cases: First, $a = v$ minute, $P = 2$, $a \div P = 0.5$; second, $a = 1$, $P = 5$, $a \div P = 0.2$. Curve I, of Fig. 5, gives p for the first case and curve II gives p for the second case as function for the time-constant, T in seconds. Approximate calculations of the maximum permissible current at intermittent load are usually based on the mean square of the current over the whole period P; in this case, one obtains the overload coefficient p independent of the time-constant; this approximate value of p is represented in Fig. 5 by the two thick horizontal lines, being asymptotes to the two p curves. This approximate calculation is, therefore, permissible only for large values of $a \div P$ and for large values of the time-constant T. For the two cases of crane operation, defined above, Fig. 5 gives directly the coefficient p by which to multiply the permissible maximum current for constant load in order to ascertain the desired permissible maximum current for intermittent load.—*Elek. Zeit.*, April 18.

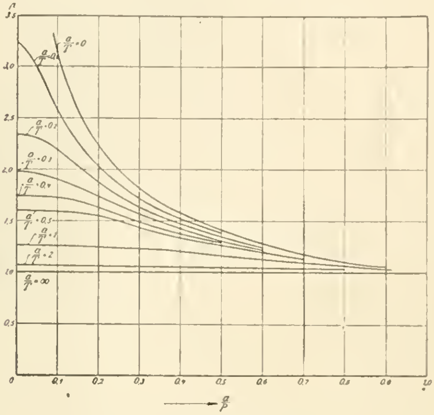


FIG. 4.—HEATING OF CABLES.

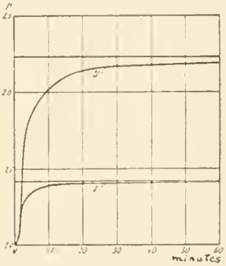


FIG. 5.—HEATING OF CABLES.

Bituminous Conduits.—An illustrated article on fiber conduit, which is claimed to maintain its mechanical strength much below the melting point of bitumen. The foundation consists of wood fiber treated in such a manner, and built up under such pressure, as to form a homogeneous wooden tube, which, after slow and careful drying, produces a conduit of considerable mechanical strength. It is then thoroughly impregnated with the bituminous compound, which, owing to the absorbent nature of the fiber, soaks into the entire structure and so closes up the pores as to make the conduit absolutely watertight.—Lond. *Elec.*, April 24.

Underground Cables.—D. W. Roper.—An illustrated paper describing some unusual burn-outs of underground cables with a full account of the discussion which followed.—*Jour. Western Soc. Eng'rs*, April.

Wiring Materials.—The set of rules which have been issued by the Transvaal Minister of Mines for overhead electric transmission lines in the Transvaal.—Lond. *Elec.*, April 10.

Electrophysics and Magnetism.

Discharge in Monatomic Gases.—F. Soddy and T. D. Mackenzie.—A Royal Society paper giving an account of an experimental investigation of electrical discharges in monatomic gases like helium, argon and neon. The monatomic gases in general appear to be what has been termed electrically inert, and if the effectiveness of a molecule in permitting or resisting the passage of a discharge is to be associated with the number of relatively free electrons it contains, the monatomic gases appear, from their electrical as well as from their chemical inertness, to be relatively deficient in easily displaceable electrons. But this point of view carries with it the corollary that their chemical inertness is relative rather than absolute, since even in the purest state the monatomic gases are undoubtedly capable of conducting and becoming ionized.—Lond. *Elec.*, April 24.

Colloids.—A. Mayer and E. Salles.—An account of experiments made on the movement of colloids under the influence of an electric field. As a typical colloid the authors used the trisulphide of arsenic, AsS_3. It is usually supposed that the particles of colloid solution are uniform in size, and have all the same electrical charge, if any. This would imply a uniform rate of transportation. Such a uniform rate is, however, not observed. In fact, the repulsion of one electrode is greater than the attraction of the other, so that if a small column of the colloid solution is enclosed in a long column of liquid, the front end of the repelled column advances less rapidly than the rear portion. The authors make it very probable that the whole motion is not due to any charge of the colloid particles themselves, but that these are dragged along by the motion of ordinary electrolytic ions evolved from them. There is no motion at all unless the e.m.f. suffices to produce traces of electrolysis. The speed increases more rapidly than the e.m.f. The addition of an electrolyte, like KCl, increases all the speeds. Moreover, the preceding colloid may be observed to thicken, while the following colloid thins out. The electrolytic view is corroborated by observations with the ultramicroscope.—*Comptes Rendus*, April 13; Lond. *Elec. Eng'ing*, April 30.

Electrochemistry and Batteries.

Electrolytic Corrosion.—W. W. H. Gee.—A paper read before the Manchester section of the (Brit.) Inst. of Elec. Eng. giving a concise summary of the electrolytic corrosion of iron and steel, lead and aluminum on the basis of the observations of many experimenters, with special reference to electrolysis of underground pipes, structures, etc., by railway return currents. Mention is also made of electric endosmose. The effect is a common cause of faults in buried conductors, which are usually found at the negative main. On the negative side there is a constant strain on the insulation tending to drive water through the insulation to the copper. When the water gets in, electrolysis of the alkaline salts that are in solution takes place, and alkalies or alkaline metals are produced. The free metals in contact with water liberate hydrogen which, when mixed with air, forms an explosive mixture that may have caused some of the mysterious detonations that have taken place in mains. The endosmose trouble will be aggravated at high voltages and may prove an obstacle in high-pressure direct-current systems. An account of the discussion which followed is also given.—Lond. *Elec. Eng'ing*, April 9; A complete reprint of the paper, with discussion, in Lond. *Elec.*, April 24, May 1.

Electrolysis of Sodium Chloride.—J. B. C. Kershaw.—A review of the electrolytic alkali and bleach industry in 1907 of the whole world. There were 36 plants working, with a total available power of 52,000 kw. Some notes are given on the Townsend cell and the McDonald cell used in this country.—Lond. *Elec.*, April 24.

Units, Measurements and Instruments.

Thermal Treatment and Magnetic Properties.—J. G. Gray and A. D. Ross.—It is generally known that the process devised by Ewing and called "de-magnetization by reversals" is not quite the equivalent of de-magnetization by annealing. The fact is, that with most materials the magnetic susceptibility is higher after the annealing process than it is in the same specimen after the process of demagnetizing by reversals. Thus, if a rod of iron be annealed from a high temperature and its I-H curve obtained, and then demagnetized by reversals and again submitted to measurement, the second I-H curve lies below the first curve. The present authors have made an experimental investigation in which they employed thin rods of various ferro-magnetic materials, and made their observations by the magnetometer method. They increased the fields up to 125 C.G.S. units, and used for annealing all temperatures from 900° C. downward. They found in all cases that specimens submitted to thermal treatment are in a sensitive state as regards magnetization compared with the same material submitted to demagnetization by reversals. The effect is produced to a slight degree in some cases by temperatures as low as 100° C., but becomes larger as the maximum temperature approaches 700° C. After this latter temperature is passed there is little alteration in the sensitiveness produced by annealing. The rate of cooling from the higher temperatures, if not very rapid (as, for instance, by quenching), has little influence on the magnitude of the effect. The sensitiveness is permanent; that is, does not diminish with the mere lapse of time, but mechanical agitation reduces the sensitiveness. Of course, magnetic treatment produces great changes in the magnetic character of the annealed material. For instance, if the I-H curve for a newly-annealed piece be drawn as the field is increased to, say, 10 units, diminished to —10 units, increased again to +10 units, and so on cyclicly, the ascending loops fall lower and lower and the final I is about 20 per cent lower than the I at field 10. In general, cyclic reversals of field between definite limits bring the magnetic susceptibility, etc., to lower values for fields lying between those limits; but so long as the field is not changed in sign the sensitive state persists almost unimpaired. The effect of the magnetic treatment is always shown most prominently at that field value where the permeability is greatest, and tends to zero as saturation is approached. The authors found that the most striking effects are given with hard steel, though similar properties are found in cast-iron and cobalt. The effect is almost absent in soft iron.—*Proc. Royal Soc. of Edinburgh*, April; Lond. *Elec. Eng'ing*, April 23.

Electric Hygroscope.—J. Pionchon.—A description of a novel device for the detection of minute traces of moisture. It is based upon the property of a clean glass surface of attracting moisture in proportion to the moisture of the atmosphere in contact with it. A glass tube, 10 cm long, closed at one end, is silvered inside and out to within 1 cm of the open end. The bottom is then cut off, leaving a fresh cut, which separates the two silvered surfaces. This cut is the sensitive portion of the instrument. The cut is, however, not left in the rough state, nor fused, but is polished with fine emery. Wires are connected with the inner and outer coatings, and are inserted in a circuit containing a galvanometer and a 100-volt battery. The deflection of the galvanometer is then found to vary greatly with the moisture of the atmosphere. The mere approach of a moist body affects it. The hand held at a distance of 1 cm produces various effects in accordance with the part which happens to be near the sensitive surface. The back of the hand produces a deflection of 3 or 4 cm. The point of a finger throws the spot off the scale. The amount of moisture liberated by the heat of the hand from a paper tube is easily detected. A valuable property of the new hygroscope is the constance of the zero, which is rapidly recovered.—*Comptes Rendus*, April 13; Lond. *Elec. Eng'ing*, April 30.

Measuring Small Alternating Currents.—An article describing thermal instruments for the measurement of small alternating currents of high frequency. The Duddell thermal ammeter, which is based on the measurement of thermo e.m.fs., is described and illustrated.—Lond. *Elec.*, May 1.

Telegraphy, Telephony and Signals.

Longitude by Wireless Telegraphy.—B. de la Grye.—Details of his proposals for an international hour signal by wireless telegraphy. Chronometers and occultations are to be supplemented by a daily hour marked by a wireless wave capable of being received all round the world. The Eiffel Tower station has a range of 1300 miles, and would cover the busiest portions of the Atlantic. For a world-wave, something larger would be necessary. The Peak of Teneriffe has been proposed. It is 3710 m high, with an average gradient of 13½ deg. The possibility of such a service has been acknowledged by Becquerel, chairman of the Wireless Commission, instituted by the French government, and by Admiral Gascard, who is in charge of the wireless service to Morocco. The latter does not, however, think that Teneriffe is necessary. A sea strand, 6 km long, such as is available at Guetn'dar, Senegambia, in the region of the trade winds, would be more convenient and quite effective. A beginning might be made with a service from the Eiffel Tower. The world-signal would have to be dispatched at midnight, in order to get the maximum range of transmission along the dark half of the globe. The proposals have been referred to the Astronomical, Geographical and Physical sections of the Academy.—*Comptes Rendus*, March 30; Lond. *Elec. Eng'ing*, April 16. In connection with this subject, E. Guyon quotes a resolution adopted by the Bureau des Longitudes on Jan. 22. The resolution, after referring to the gratifying success of the Morocco naval service and the hour-signals from Camperdown (Halifax), draws special attention to the usefulness of the Paris-Brest hour-service inaugurated by C. Tissot with the aid of the Eiffel Tower installation. The resolution further details the steps which would be necessary for the establishment of an international service for the determination of longitude at sea. A determination of longitude requires an observation of an astronomical phenomenon involving right ascension, such as the southing of the sun or a star, and a simultaneous reading of time. The difference in time between the chronometer reading and the time at which the same astronomical event takes place under the standard meridian is the longitude expressed in time. A wireless service of time would eliminate all errors involved in the rating of chronometers. Such a service can only be efficiently organized by an international committee of electricians and seamen. M. Guyon had been instructed by the Bureau des Longitudes to take the first steps toward the organization of such a committee.—*Comptes Rendus*, April 13; Lond. *Elec. Eng'ing*, April 30.

Wireless Telegraphy.—Last year's report on Marconi's wireless Telegraph Company with some notes on transatlantic transmission. The report does not look with favor upon the international radiotelegraphic convention, which is regarded as a result of foreign intervention.—Lond. *Elec.*, April 24.

Miscellaneous.

Machines for Winding Coils.—O. Hartmann.—An illustrated description of various machines for winding magnet coils.—*La Lumière Elec.*, April 18.

Metric System.—C. E. Guilleaume.—The conclusion of his article on recent progress in the application of the metric system. The author gives a review of legislation in different countries and describes various instances in which the use of the metric system has made progress in different industries.—*L'Industrie Elec.*, May 10.

Laboratory.—L. Fabre.—A profusely illustrated description of the electrical laboratory of the Institute of Technology, at Karlsrühe.—*La Lumière Elec.*, April 25.

Arrangement of Manufacturing Plants.—G. M. Brill.—A long and fully illustrated paper discussing the best location, arrangement and construction of manufacturing plants.—*Jour.* Western Soc. Eng'rs, April.

BOOK REVIEW.

The Standard Handbook for Electrical Engineers. Written and compiled by a staff of specialists. Second edition, corrected. New York: McGraw Publishing Company. 1250 pages, illustrated. Price, $4.

In this new edition of the Standard Handbook the typographical and other errors that naturally will appear in the original issue of a book of its class have been corrected. By the use of a different paper, the weight of the book has been decreased and its thickness reduced by a quarter inch. A notable improvement of the same order is the adoption for this edition of a thumb index to sections. While, as a rule, a thumb index is of little value in a handbook, in this specific case it is of particular importance for the reason that index references are to sections and paragraphs, not to page numbers.

Double-Flow Steam Turbines.

There has recently been installed in the Brunot Island generating station of the Pittsburg Railways Company a horizontal steam turbine of the balanced-thrust type, which possesses many interesting constructional features. The turbine is built on the double-floor principle, such as employed in hydraulic turbines. This principle has been applied in low-pressure turbines designed to utilize exhaust steam from reciprocating engines, as illustrated in Fig. 1. The high-pressure machine resembles the low-pressure turbine, with the addition of a high-pressure impulse element mounted at the center of the rotor, as shown in Fig. 2. The impulse element acts like the high pressure cylinder in a double expansion or triple-expansion reciprocating engine.

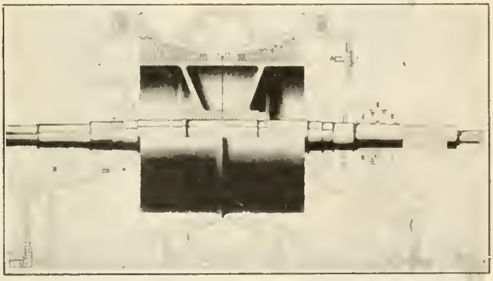


FIG. 1.—SECTIONAL VIEW OF ORIGINAL LOW-PRESSURE DOUBLE-FLOW DESIGN.

The low pressure section of the turbine being in two parts, receiving steam from opposite directions, there is no resultant axial thrust in this section. A balance-piston of modest diameter overcomes the thrust of the high-pressure section. It is claimed that, as a result of the increased speed permitted by the double-floor arrangement, there is a large reduction in the weight of the individual parts to be handled in assembling. Moreover, the impulse element is well adapted to high pressure and supertemperature.

In the construction of the blades use is made of a special compound metal known as "Minnot," which consists of a steel core covered with a thin copper sheathing chemically welded to the steel in such manner that the blades may be drawn cold from the original ingot into the required finished section without affecting the bond between the copper and the steel. Experiments have shown that the copper offers a high resistance to chemical corrosion, resulting from bad feed water carried over in the steam during priming, while the integrity and strength of the steel core is not lost.

Fig. 3 indicates the method by which the blades are reinforced. Comma-shaped holes are punched in the blades at any desired point of reinforcement. The blades are then strung onto a comma-shaped lashing wire through these holes. After the blades have been caulked into the rotor or stator, the tail of the comma-shaped lashing wire is sheered over by a tool, as shown at the center in Fig. 3. This process wedges the tail of the lashing wire into the contracting space between the face and back of the adjacent blades, acting as a strut while the lashing wire itself acts as a tie, thus securely interlocking the blades and preventing vibration. Moreover, the short section remaining in the blade after being sheared off acts as a key to prevent a possible broken blade from injuring adjacent rows.

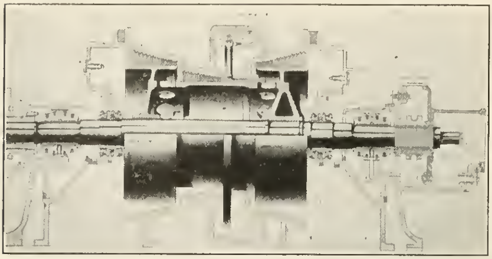


FIG. 2.—SECTIONAL VIEW OF NEW HIGH-PRESSURE DOUBLE-FLOW TURBINE.

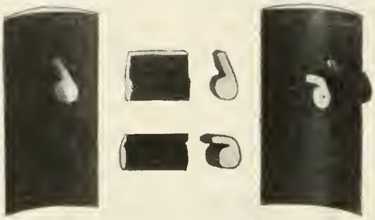


FIG. 3.—METHOD OF REINFORCING BLADES.

The system of governing used in the double-flow turbine is essentially the same as that employed in the single-flow type, namely, the "puff" system. There being a constant number of admissions per minute with a variable duration of admission according to the load. In case of over-speeding, the main throttle valve is automatically closed by means of a spring-balance plunger located at the end of the main shaft. Normally the pressure of the spring is so adjusted that the plunger is held to its seat; should the turbine speed for any reason, however, exceed a predetermined value, the end of the plunger emerges, trips a relay valve and operates a quick-closing throttle. It is to be noted that this throttle valve is closed by releasing the pressure beneath its piston, so that any accident to the pipe connections of the speed limit device would instantly bring the turbine to rest.

A 3000-kw turbine of the above-described type has been in use in the Brunot Island station for nearly one year, while three 5000-kw turbines of the same type are in course of erection. The electrical ends of the turbine units are revolving-field generators of the special construction used for direct connection to turbines. They are wound for three-phase alternating-current at 11,000 volts and 25 cycles. An interesting feature of their operation at the Brunot Island plant is that they are run in electrical parallel with two-phase, 6600-volt generators driven by reciprocating engines. They are fitted with the usual cooling air ducts, air being taken in from under-floor connections. The generators were built by the Westinghouse Electric & Manufacturing Company, and the turbines by the Westinghouse Machine Company, of Pittsburg, Pa.

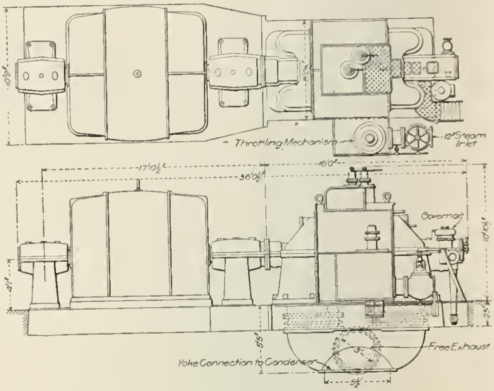


FIG. 4.—DIAGRAMS OF DOUBLE-FLOW TURBINE.

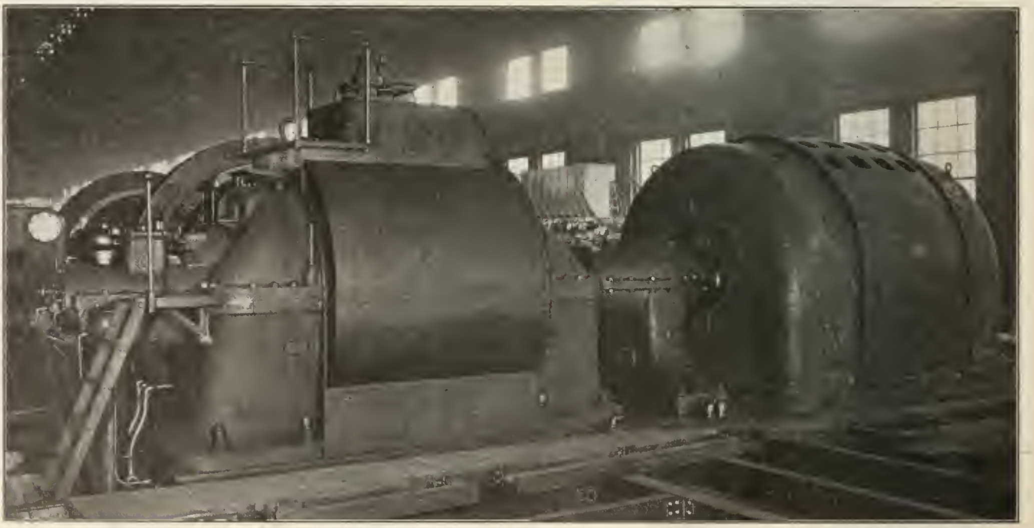


FIG. 5.—GENERAL VIEW OF DOUBLE-FLOW STEAM TURBINE.

Exhibit Notes Chicago N. E. L. A. Convention.

The exhibits of supplies and apparatus at the Chicago convention of the National Electric Light Association last week were very attractively arranged in the hall on the ninth floor of the Auditorium Hotel. At 8 o'clock Monday evening President Farrand threw in the main switch controlling the general lighting of the hall. What made this event particularly remarkable was the fact that tungsten lamps were used entirely for the lighting of the hall. The brilliancy of the illumination was generally commented on as admirable, and the whiteness of the light, as compared with that of a few incidental carbon filaments nearby, was generally eulogized by visitors. The plan of lighting has already been described and note has been made elsewhere of the splendid work of the exhibits committee. It may be mentioned that in addition to the exhibits and persons noted below, there were several hundred firms and individuals in attendance not exhibiting or even bringing samples, but contributing by their presence to the extraordinarily representative character of the gathering as a whole.

The Excello Arc Lamp Company hung nine flaming arcs to "burn up" the front of the Auditorium, and enable the delegates to locate the headquarters building. Messrs. G. W. Armstrong, H. W. Fowzer and W. R. Smith, of the Chicago office, looked after the company's interests.

The Gregory Electric Company held a continuous reception in its booth. The company's exhibit consisted of a number of photographs of its modern and well-equipped shops. A large proportion of the business done by this company is in connection with the handling and repair of second-hand dynamos and motors. The company was ably represented by A. Louis Kuehmsted, president; A. O. Kuehmsted, G. C. Besold, J. D. Zook, J. A. Vincent and E. H. Nagelstock.

The Crocker-Wheeler Company exhibited small direct-current and alternating-current motors and lighting transformers. The alternating-current transformers exhibited were of a new type manufactured by this company. Up to a short time ago the company had never made alternating-current induction motors in the smaller sizes, from 25 hp down, but has now found it profitable to do so. The exhibit attracted the attention of a great many visitors who are well acquainted with the efficiency of the Crocker-Wheeler apparatus. Pamphlets describing the 50,000-hp hydro-electric plant of the sanitary district of Chicago, located at Lockport, Ill., were distributed. The representatives of the company included Mr. Rodman Gilder, H. E. Kerber, H. A. Brown, Julian Roe and William F. Sullivan.

Pettingell-Andrews and Central Electric Company.—At the combined booth of the Pettingell-Andrews Company and the Central Electric Company, a number of interesting specialties were shown. Among these were the O. K. fuse-block cover and a meter-connection block, which are of great interest to central-station men, who recognize the importance of unaccounted-for current. The remote-control switches were shown in several different forms, and weatherproof oil switches and O. K. ground clamps were in evidence. The meter-connection block and D. W. selective type of entrance switches make an interesting combination for service installations in which no exposed wires are left on the customer's premises. The work of testing and replacing meters is simplified by their use. So much stress has of late been placed upon the subject of high efficiency lamps and reflectors that many central-station men lose sight of the artistic effect that may be obtained in electric illumination through the use of simple brackets and hangers. In order to show what may be accomplished at small expense, the Pettingell-Andrews Company and the Central Electric Company equipped their combined booth with a number of simple brackets of original design which attracted no little amount of attention. These fixtures were samples of the class of work that can be turned out at the company's plant. Messrs. F. S. Price and G. E. Palmer represented the Pettingell-Andrews Company and H. W. Young the Central Electric Company.

H. W. Johns-Manville Company.—One of the first things to attract attention at the H. W. Johns-Manville exhibit was the way the booth and sign were illuminated. The new "Linolite" system of lighting was used and its advantages for this kind of illumination clearly indicated. A series of tubular electric lamps, each 1 ft. between centers, with a filament extending from one end to the other, are placed in the focus of a powerful aluminum reflector, the depth of which is 1 in. and the width 1½ in. Linolite in its present form is very largely used for lighting show windows, show cases, general illumination, etc., in which instance the reflector is furnished in any desired length to give a continuous line of light. Several new forms of Linolite lamps were shown with parabolic reflectors for desk and picture lighting, signs, etc. A large line of Victor portable and switchboard instruments, including a portable lamp-testing meter, were also shown and demonstrated. The latter instrument is a convenient one for testing incandescent lamps. It indicates the voltage, current consumed and watts at a glance. It is calibrated for 150 and 300 volts, 0.75, 1.5 and 150 amp. All shunts are self-contained. The two of smaller capacity have universal binding posts. This instrument weighs less than 15 lb. complete. A switchboard and sample board made of ebony asbestos wood were shown, and several new forms of Noark fuse devices, which include service and subway boxes of the latest types. The company's interests were looked after by Messrs. T. G. Younglove, E. B. Hatch, F. G. Frumveller, J. W. Perry and H. M. Frantz.

The Allis Chalmers Company exhibit included samples from the stock of the power and electric apparatus manufactured by the company. One of the interesting features of the exhibit was a board which contained samples of all turbine blading of different sizes as used in the 1500-kw steam turbine. The company also showed one of its type K motors for direct current use, standard type induction motors for alternating-current use, a new type A.L. lighting transformer, and new Allis-Chalmers friction clutches. On the walls of the booth, framed illustrated title pages of 52 power and electrical bulletins were hung. During the sessions of the convention particular attention was called by the company's representatives to the four Allis-Chalmers gas engines and generators being installed at the plant of the Illinois Steel Company, in South Chicago. Each installation consists of a horizontal twin tandem double-acting gas engine turning at a speed of 83 r.p.m., direct coupled to a 2000-kw, 25-cycle, three-phase, 2200-volt, alternating-current generator. The company claims these are the largest engines in the world operating on blast-furnace gas. The engines are practically duplicates of the electrical units to be installed at Gary, Ind. The Allis-Chalmers Company has had gas-engine driven electrical units of 300 to 1000 kw in operation on both alternating- and direct-current load, but these are the first of the large units to be put in service. The company was represented by President W. H. Whiteside, W. J. Heger, assistant to the president; James Gardner, of the Chicago office; B. A. Berne, A. H. Whiteside, C. A. Tupper, E. T. Adams and Messrs. Frankenfield, Van Zandt, Catlin, Marburg, Smith, Davies, Nicholson, Burdick, Jeffrey, Collins, Hall, Vrabek, Watson, Howe, Keene, Kerr, Peck, Williamson, Bogen and Dennison.

Mr. Alfred T. Webb was on hand for the E. E. Cary Company.

Mr. W. F. Hubley, of the American Transformer Company, was in attendance.

Mr. Frank L. Driver, of the Driver-Harris Wire Company, spent a couple of days at the convention.

The Ansonia Electrical Company, Ansonia, Conn., had President Thomas Wallace in attendance.

Mr. J. H. Mason, of the Simplex Electrical Company, Boston, put in an appearance at this convention and greeted his many friends.

The Okonite Company was represented by Mr. George T. Manson. He was deeply interested in Mr. Paul Lupke's paper on "Tape," and may possibly bring out an annotated edition with reference to the Manson brand.

Mr. John H. Dale, of the Dale Company, was most effusive and enthusiastic over the new tungsten fixtures his company is putting on the market. Mr. Dale has just returned from a European trip and knows all about tant and tung.

Habirshaw Wire Company, of New York, was represented by general sales manager Mr. J. B. Olson, who had with him several samples of a remarkably resistive non-abrasive wire for running through trees. The outer coatings are extremely tough, and practical tests show it to be enduring to a phenomenal degree.

The Fort Wayne Electric Works showed its type K meters, meter calibrator, fan motors, drill motors, small induction motors and a portable motor for drilling purposes. The drill motor is fitted with a handle and chuck in such a way that it can be conveniently carried to any location in the building. The company also showed a number of adjustable wall brackets for fans. Representatives of the works included F. S. Hunting, A. A. Serva, W. J. Goll, T. J. Ryan and W. C. Knight.

Fig. 1.—Exhibition Hall, Looking West.

National Electric Lamp Association.—The engineering department of the National Electric Lamp Association showed a number of tungsten and tantalum lamps and made demonstrations of a 25-watt tantalum lamp. This lamp, as shown, gives 12½ cp from a bulb of the same size as the ordinary 8-cp carbon lamp. The ordinary Edison base is used. The representatives of this company gave practical demonstrations, attempting to refute the theory that the tungsten lamp is fragile, by rigging a small automobile tungsten lamp on a vibrator in such a way that it was given severe jars without breakage. Mr. S. E. Doane, chief engineer, was present in the association's interests.

The Sangamo Electric Company exhibited a working model of direct- and alternating-current meters. The meters were mounted on marble panel slabs. The company also exhibited a cabinet of the essential parts of the meters, showing in detail the parts which go into the construction of the apparatus; also a type F alternating-current meter, which was exhibited for the first time, and a Mercury motor meter, which has the same general features as the motors heretofore manufactured by the company. The special features of this meter are its extremely high torque and its improved mechanical construction and fine adjustments. The Electric Applicance Company, distributing agents for the Sangamo Electric Company, aided that company in demonstrating the valuable points of the Sangamo meters. The affairs of the companies were looked after by Messrs. F. J. Alderson and L. C. Lamphier.

General Electric Company.—The booth of the General Electric Company attracted the usual amount of attention. The company showed several new devices, among which was an aluminum cell lightning arrester, commonly known as an electrolytic lightning arrester. The arrester on exhibit was made for a 12,500-volt circuit, but the company manufactures this type of arrester for taking care of voltages up to 120,000. The cones of the electrolytic arrester are built up on a single standard and are mounted in oil tanks. The cones are partially filled with a suitable electrolyte, the normal voltage for each cell being 400. When the voltage exceeds the normal, or 400, the film which is formed on the surface of the aluminum cone is punctured and allows the normal current to pass to the ground through the cells. The discharge capacity of the aluminum cell is approximately 1000 amp per square inch. In the manufacture of the cones, the materials are treated to an acid bath, which forms a thin film on the surface of the cone. This film has a counter e.m.f. of 400 volts. When a discharge takes place, the film becomes thicker, due to the flow of current. When the film becomes thick enough to make the counter e.m.f. of the cell higher than the line voltage, the discharge ceases. The action of the electrolyte on the film reduces the film to its normal thickness, when it is again ready for another discharge. In addition to the arrester, the company had on display a horn-gap disconnecting switch. This switch is provided with an auxiliary antenna for charging up the arrester periodically. An oscillograph record showing graphically various curves and changes due to reactance, capacity, etc., was also shown. Other things exhibited at the booth were large and miniature tungsten lamps, a full line of electric-heating devices, meters, flame- and magnetic-arc lamps, new developments in small motors, sectional fuses, type H, form H transformers and tungsten street-series lamp brackets with radial-wave diffusers. Two 250-watt tungsten lamps, the first of this large size exhibited, were among the lamps lighting the exhibit. Among the representatives of the company were the following: E. W. Rice, Jr., J. R. Lovejoy, C. D. Haskins, P. D. Wagoner, F. G. Vaughan, D. R. Bullen, E. E. Gilbert, W. L. R. Emmet, C. W. Stone, N. R. Birge, C. B. Burleigh, C. P. Steinmetz, J. W. Kirkland, Theo. Beran, A. D. Babson, H. J. Buddy, A. D. Page, T. E. Bibbins, F. H. Gale, G. L. Thompson, D. B. Rushmore and F. W. Willcox.

Fig. 2.—North End of Exhibition Hall.

The Condit Circuit Breakers were spoken for by Western Manager Fisher.

The Duplex Metals Company was represented by Avery P. Eckert, sales manager.

Mr. D. J. Burns was on hand looking after the interests of the Ward Leonard Electric Company.

E. H. Kellogg & Company's cylinder oils were well spoken for by E. T. Brawley, who has many friends in the electrical and power fields.

President Kenyon, of the Diehl Manufacturing Company, attended the convention. This is the first one in three years which has been favored with his presence, but not from lack of interest.

The Electric Service Supplies Company showed a number of samples of the Locke insulator, including one of the suspension type, designed for use on a 100,000-volt transmission line. The company also exhibited Garton-Daniels lightning arresters, Sampson cordage, arc lamp suspension cord, a line of strain insulators and a Keystone lamp guard. In attendance were Messrs M. S. Earl and E. R. Mason.

The Simplex Electric Heating Company exhibited an electric range, waffle iron, percolator, flatirons, coffee and teapots, heating pads, sterilizers and traveling outfitters' heaters. This latter heater is so constructed that the stove can be packed inside of the utensils. Mr. James I. Ayer was in charge and was assisted by Messrs. H. R. Hixson, J. N. Macalister, E. R. Jacobs, Roger Williams and J. G. Brobeck.

The American District Heating Company explained to visitors the value of its heating system. Models of underground construction for district heating in connection with heating systems where exhaust and live steam is used, were shown. The company also showed condensation meters used for weighing condensation for selling steam on the meter basis of charge. This device is known as the "watch-dog of the treasury." Various fittings and devices used in connection with central-station heating were shown. One of these fittings is of recent design and is used in making variable joints in steam pipes. Those in attendance looking after the company's interests included Robert Hall, H. C. Kimbrough, H. C. Eddy, H. Zuckerman and J. A. Bendure.

FIG. 3.—EXHIBITION HALL, LOOKING EAST.

The Western Electric Company exhibited a number of types of arc lamps, including the lamp with the "Trimming Indicator." The indicator of this lamp is so arranged that it drops down automatically when the carbons have been used up, thus doing away with the danger of having a large waste from the removing of partially burned carbons. The lamp is intended to burn 24 hours without attention. The company also showed a short arc lamp which had a total height of 20 inches. This lamp is especially adapted for use in buildings where the ceilings are low so as to obtain the best possible distribution of light. They also showed a working model of an intercommunicating telephone system. This system is devised to allow the various departments of the central station and the company's offices to be connected and called without the aid of a special operator, simply by pushing a button. There was also shown in the booth a line of Universal fan motors which can be utilized for desk and wall purposes. The interchangeable feature of this fan is dependent upon a split base, the bottom of which can be removed or added to the fan part at leisure. Other apparatus shown were 3-hp direct-current and 2-hp induction motors; also a sample line of wire grips for construction purposes. The company distributed souvenirs during the convention. All of its sales managers were in attendance, and Mr. H. M. Post had automobiles running between the company's Hawthorne works and Chicago every hour during the day to take those who cared to visit the company's factory.

The Westinghouse Exhibit occupied space in full view of the elevator landing at the entrance to the exhibition hall. The company exhibited, among other things, its heating apparatus, into which field it recently entered by the acquisition of the Hadaway Electric Heating & Engineering Company, formerly of New York. The apparatus that was exhibited in this line was taken from regular stock, and comprised a 2-qt. glue pot, 15-lb. narrow tailors' goose iron, an 18-lb. wide tailors' goose iron, some 5- and 7-lb. sad irons, and a 5-in. x 7-in. veluring stove, such as is extensively used in the finishing of silk hats. Parts of the electric sad iron were dis-assembled to illustrate their substantial construction. A full line of Westinghouse arc lamps was displayed, as well as fan motors, including 16-in., 12-in., and the latest style of 8-in. fans, with a full line of current-measuring instruments for switchboards. Meters and portable electrical instruments were also shown. The exhibit was lighted by Westinghouse tungsten lamps arranged tastefully around the exhibit and on a wheel which was kept revolving. The greatest novelty of the Westinghouse exhibit, however, was the line of tungsten lamps of low candle-power used together with auto-converter reducing sockets. These lamps are of 8, 12 and 20 cp, taking 1.25 watts per candle, and operating at 25 volts. The reducing socket, which is an autoconverter in a neat brass shell, reduces from 100 to 25 volts for this purpose. The list price of these sockets is $3. The type A single-phase motor, which is automatically self starting with full-load torque, was also shown. The rotor contains an automatic clutch which picks up the load after the motor has started. The company was ably represented by Messrs. S. Q. Hayes, E. T. Penrose, W. B. Wilkinson, G. M. Bates, Samuel Chase, C. E. Miller, W. P. Jend, J. A. Britt, C. F. Medbury, H. P. Davis, T. P. Gaylord, G. B. Griffin, C. B. Humphrey, S. L. Nicholson and C. S. Cook. The Westinghouse Machine Company was represented by J. R. Bibbins and C. C. Chapelle, and the Westinghouse Companies' publishing department by J. C. McQuiston.

FIG. 4.—SOUTH END OF EXHIBITION HALL.

The Shedd Electric Manufacturing Company had Manager Shedd in attendance.

The National Carbon Company was represented by A. E. Carrier, sales manager, of New York.

One Hundred Per Cent.—This was the thirty-first convention and T. H. Brady, of New Britain, Conn., has attended thirty-one of them.

Mr. W. J. Wallace, president of the Eck Dynamo & Motor Company, looked out for the success of its line of fan motors and power motors.

The Shelton Electric Company exhibited vibrators and hot and cold airblast hair dryers. The exhibit was in charge of Mr. W. G. Shelton.

The Hauserman Metal & Manufacturing Company, which makes nameplates for machinery, made a neat little exhibit and gave away nameplate souvenirs.

G. M. Gest showed at his booth photographs of installations of underground conduit systems as made throughout the United States. Representatives of Mr. Gest were Messrs. J. A. Doyle, W. T. Jackson and E. D. Tillson.

The German-American Electric Company gave a continuous demonstration of its flaming arc lamps. Twelve lamps were in service nearly all the time during the period the exhibit hall was open. This company's lamps are of the gravity-feed type. Lambert Schmidt, president, was in charge.

The Sprague Electric Company exhibited its well-known R. T. motors, flexible steel armor motors, fans, flexible conduits and fittings and stamped steel boxes and fittings. The company had quite a staff representing it at the convention. Among these were Messrs. A. Anixter, D. I. Cooke, H. H. Hornish, E. B. Kittle, J. F. Richards and E. M. Terwin.

The Pittsburg Transformer Company exhibited its standard and efficient high and low-tension type of transformers. Marked improvements have recently been made in the efficiency of transformers by this company through the adoption of the new silico-vanadium steel in the manufacture of the cores. It is claimed this steel reduces the core losses from 30 to 40 per cent below former figures. Mr. C. L. Leininger, Miss Lake and H. G. Steele were in attendance.

The Duncan Electric Manufacturing Company's exhibit consisted of house type and several styles of switchboard wattmeters. A graphic recording wattmeter, being the latest Duncan development, attracted the interested attention of engineers generally. This instrument was shown in operation as adapted to totalizing the entire output of a plant on one meter, including all types of generators, such as different voltages on direct current, single-phase, two-phase and three-phase alternating current. It is claimed to be the only known system whereby this result can be accomplished. The exhibit was in charge of Adrian Tobias, assisted by J. Clarke.

Wagner Electric Manufacturing Company.—At the booth of the Wagner Company were shown a 5-hp single-phase motor of late design, a 10-hp polyphase motor and a set of standard Wagner instruments. The large material allowance and ample weight of the larger motor in comparison with many other motors of the same capacity attracted much favorable comment. The attractive exterior finish of the Wagner motors, as well as their interior efficiency, have come to be almost a trade mark of the company. Among the many representatives of the company present were Messrs. V. W. Bergenthal, W. B. Clarke, D. Emerson, B. Faxon, E. W. Gownheindt, E. W. Goldschmidt, A. H. Mustard and T. T. Richards.

Central Electric Company.—The exhibit of the Central Electric Company consisted of a complete line of new Lexington high-tension porcelain insulators; a working exhibit of the universal flat rate controller which is attracting much attention with the use of tungsten lamps; a full line of D & W fuses, cut-out boxes, B. A. remote-controlled switches, and the Okonite products for which the company is general Western sales agent. A complete line of International indicating instruments and S. E. automatic circuit-breakers were attractively mounted into working exhibits. Among the company's representatives in attendance were Messrs. C. E. Brown, F. R. Bryant, H. Caird, W. M. Hincher, C. J. Kadau, G. A. McKinlock and A. Mungle.

The General Storage Battery Company exhibited at its booth samples of the "Bijur High Duty" Planté battery plates. These plates are constructed of cast-lead grills firmly welded into a gridiron frame. Owing to a special permanization process, the negative plates retain their original capacity indefinitely. The design of the grill for both the positive and negative plates permits a free circulation of the electrolyte entirely through the plate, thus reducing the voltage changes, and allows for ample expansion room, thus rendering the plates non-buckling. The General Storage Battery Company also manufactures the Bijur regulator, which, when used in connection with a battery and generating plant, reduces all fluctuations to a steady average load. Mr. A. Bradley was in attendance.

The Triumph Electric Company exhibited its new automatic starter for induction motors, recently placed on the market, which has already attracted a great deal of attention. The starter is so arranged that it is impossible to leave the switch in the starting position. The fuses attached to the starter are not in circuit while the blades of the switch are in starting position. When the handle of the switch is released, the switch automatically flies to the running position and throws the fuses into circuit. The transformer and the switch base are made up into one unit. The company has also brought out recently a switch of the same type as the above for use on small-sized motors which do not require transformer starters. Several motors, ranging in size from 1 to 40 hp, were also shown. The company was represented by Messrs. J. C. Hobert, W. H. Jacobs, C. S. Reno, S. Senstius, E. S. Ford and F. L. Merrill.

The Federal Electric Company was busy all the week demonstrating the new Willis straight-line meter, of which this company is the sole distributor. Five of these meters were on exhibition at the Federal Company's booth. This is a commutator type of meter. The following are a few of the advantages claimed for the meter: The 600-watt size starts on 2 watts. It cannot be successfully tampered with. It is the only meter on the market which registers on a cyclometer dial in numerals instead of by pointers. Its current consumption on potential in all 110-volt sizes averages only 2 watts. It is a zero-temperature coefficient meter. Its cyclometer integrating index has instantaneous-action number-wheels. It does not creep on potential and is absolutely at rest when a customer's light is not on. The several styles of Federal clusters for tungsten lamps, which have been adopted as standard by many central stations, as well as the company's regulation porcelain enameled steel electric sign, were also on exhibition. Mr. J. M. Gilchrist, general manager of the company, looked after the company's interests and was assisted by H. I. Markham, L. G. Shepard, H. F. Willing and S. C. Wackenfeld.

The Minerallac Company showed a line of insulating compounds and electric specialties. The most important of the exhibits was a printing attachment for recording wattmeters. This attachment prints the registration of the integrating wattmeter at intervals of 15, 30 or 60 minutes, as desired. It enables central-station men to construct a load curve for each customer with accuracy, thus obtaining all the essential information upon which to base rates to power consumers. It is claimed this attachment is more accurate than a graphic recording meter, and as it prints the registration in plain figures, disputes regarding the reading are eliminated. The company also exhibited the Excello flaming-arc lamp, for which it is special agent for Cook County. A 440-watt miniature arc lamp, giving a mean hemispherical candle-power of 600, which is the latest production of the Excello Arc Lamp Company, was also shown. The Minerallac insulating compound has been especially developed by this company for high-tension and underground cable jointing. By means of it several men from large central stations claim to have entirely eliminated cable-joint failures. The exhibit was in charge of Mr. R. F. Pierce, assisted by Mr. W. E. Pemberton.

The Switchboard Equipment Company displayed its single-pole circuit breaker.

Hugo Reisinger and "Electra" carbon were looked after by Manager C. A. DuBosch.

Mr. Harry P. Moore, sales manager for Chase-Shawmut Company, vouched for the well-known specialties of this company.

American Electrical Works sent Mr. F. E. Donohue, of the New York office, to look after its interests, not only in the convention, but at golf tees and five o'clocks.

The Franklin Electric Manufacturing Company, with factories at Hartford and Middletown, Conn., was represented by P. S. Klees and Western representative Thorpe.

The Standard Paint Company distributed literature describing P. & B. paint, electric compounds, varnishes and tapes. The interests of the company were looked after by Mr. B. C. Beckman and Mr. E. F. Engle.

The American Electric Heater Company distributed from its booth a souvenir paper weight which was an exact miniature reproduction of the company's 7-lb. flat-iron. The representatives were Messrs. B. H. Scranton, Robert Kuhn, Frank Kuhn, E. Dewey and Bert Dewey.

The W. D. McJunkin Advertising Agency exhibited sample advertisements and cards relating to electric light service, such as this company writes for central stations. Those who demonstrated the efficacy of the concern's advertising methods were Messrs. J. Brown, J. Benson and W. D. McJunkin.

The Chicago Pneumatic Tool Company gave at its booth a practical demonstration of the Duntley electric vacuum cleaner. The cleaner exhibited was equipped with a one-sixth horse-power motor and a special double-acting piston pump with a 7-in. cylinder and a 1-in. stroke. The weight of the machine is about 60 lb.

The D & W Fuse Company showed non-arcing fuses and fuse boxes. Owing to the ill-health of Mr. L. W. Downes, the general manager, Mr. Sisson, who usually attends the convention, was unable to be present. The company, therefore, was without direct representation, but its various agents took care that it did not suffer in this respect.

The Philadelphia Electric & Manufacturing Company called special attention to its rust-proof paint. The company showed a large line of incandescent street light fixtures for tungsten lamps, a line of underground appliances, such as fuse boxes and metallic wrappers, and its general line of arc lighting appliances. Mr. A. H. Manwaring was in charge of the exhibit.

The Chicago Fuse Wire & Manufacturing Company showed a large supply of enclosed fuses and blocks, sectional switch boxes, conduit boxes and covers. The display was mounted on very neat display cabinets, such as are furnished customers by the company. Among the company's representatives were Messrs. S. S. Merrill, C. T. McDonald and W. W. Merrill.

Dossert & Company, Inc., exhibited a full line of Dossert connectors, including a number of new devices for heavy cables for central-station work. One of the principal exhibits is an equalizer, as used on the Williamsburg Bridge of New York, to equalize the voltage between two cables on a positive feed. In this case the two feeders are joined without being cut. The cables carried are of 2,500,000 circ. mils cross-section each Messrs. H. B. Logan and C. A. Flynn represented the company.

Otis Elevator Company.—An automatic elevator of very interesting design was exhibited by the Otis Elevator Company. The exhibit shown was especially adapted for service in hospitals, residences and apartments. This company furnishes elevators which may be operated by direct current, single-phase and polyphase current. The movement of the elevator is governed entirely by a single push button. Messrs. W. J. L. Banharn, C. G. Comstock, Jr., M. H. Christopherson, W. N. Dickinson, H. A. Fulton, G. R. Fiedler, E. M. Hill, A. A. Merrill, J. H. Miller, O. E. Nord and F. S. Porter were in attendance.

Studebaker Automobiles.—Because of the absence of a proposed exhibit of the Studebaker Automobile Company, that company will undoubtedly obtain as good results through publicity as though it had been possible to make the exhibit. The company planned on exhibiting one of its well-known electric wagons, but it was found impossible to get the vehicle into the hall, although a start was made as far as the parlor floor. The company's representatives were very much in evidence during the convention, and took advantage of the publicity gained by their inability to get their exhibit into the hall. J. A. Coittenden was in attendance.

The Electrical World was most conveniently located in the exhibit hall, its booth being immediately opposite the entrance to the meeting room. It is needless to say that the issue of May 16, with over 350 pages, by far the largest number of an electrical journal ever issued, attracted much attention and many admiring comments, one delegate hailing it as the "herald of our new prosperity." The 18-page article on the Commonwealth Edison system was very timely. An exhibit was made in the booth of electrical books published by the McGraw Company, particularly the new edition of the Standard Handbook for Electrical Engineers, of which work over 6000 copies have already been sold. The new *McGraw Electrical Directory*, listing over 5000 central stations, was also in demand. The paper was represented by Messrs. Wakeman, Martin, Cravath, Church, Elliott, Caldwell, Hunt, Hitt, Mock, Doyle and Wadsworth.

The Vulcan Electric Heating Company exhibited soldering irons in various sizes, iron heaters, electric meat inspection branding irons and electric Marcel waving and curling irons. The curling irons shown were among the most interesting things seen in the exhibit halls. They are identical in shape and manipulation with the regular Marcel waving tongs used by professional hairdressers and possess all their merits. They have automatic regulation, which maintains the temperature continuously at a point which is absolutely safe for use on the hair, and they have flexible cords attached by a swivel arrangement which allows perfect freedom of operation. The handle is overbalanced so that the heated portion of the tool is automatically lifted clear of the dresser top. The handles are covered with insulating material to prevent the hand from being burned by the heated tool. The continuous heating referred to incidentally gives the benefit of steady work without interruption. They are much more cleanly than those heated by gas flame. The representatives of the company claim that the best possible proof of the superiority of the device is shown by the fact that the Marcel wave produced in the hair by its use has been shown to last 50 per cent longer than waves made by gas-heated Marcel irons, because ideal temperature is maintained in the iron at all times.

The G & W Specialty Company exhibited at the booth of the Electric Service Supplies Company six types of potheads for single and multiple conductors. The exhibit was installed on a miniature pole located at the rear of the booth, showing the exact method of installation. The method of making connections between underground cables and overhead lines and the typical use of potheads for central-station purposes, attracted a good deal of attention. The disconnecting feature of the pothead is one of the strong arguments presented by the company for its adoption. The company also had on exhibition a line disconnector, which is designed to eliminate the use of cradles or guard wire networks, where lines of high voltage cross telephone and other wires. The disconnector works automatically, and is so arranged that if the wire is broken at any point, the broken ends disconnect themselves at the insulators and fall free to ground, thus eliminating the danger of property loss through crossed wires. This company's new grounding cap was also shown. This is for making transformer ground connections with galvanized iron pipe. It serves both as a connector and as a mechanical protection while driving the pipe. The ground wire is slipped under the cap, the cap is placed over the end of the pipe and the pipe driven. The cap is thus forced over the pipe and ground wire so as to make a good electrical and mechanical connection.

The Haller Sign Works, Inc., exhibited on the sixth floor of the Auditorium sample illuminated signs designed to be used for advertising purposes.

The National Automatic Advertising Company exhibited its automatic stereopticon machine, which should be a good source of central station revenue.

The Albert & J. M. Anderson Manufacturing Company showed the Anderson electric time switch for throwing on and off electric signs and for use on other flat rate circuits.

The International Electric Meter Company occupied space in the combined Central Electric and Pettingell-Andrews Company booth. The company exhibited direct-reading meters and station wattmeters. Representing the company were Messrs. W. W. Cheney, A. Benson and J. S. Jackson.

The Universal Manufacturing Company exhibited flat rate controllers, which act to flicker automatically the lamps when the maximum number contracted for is exceeded. There are a number of conditions for which this controller is proving specially suitable, and this company has recently been taking some notable orders.

The Condit Electrical Manufacturing Company displayed in its booth the largest assortment of oil-circuit breakers that has ever been shown at an exhibit of this kind. The circuit breakers manufactured by this company range in capacity up to 1500 amp and are made for voltages ranging from 6600 to 33,000. A pole-line switch exhibited called forth much favorable comment from central station men. Another device that attracted some attention at this booth was the L. S. type of switch, which is used for the protection of small induction motors.

Construction Details of Revolving-Field Alternators.

All apparatus for the modern central station is necessarily of a high grade, but for no part of the equipment is a higher standard set than for the generating units. This fact is particularly evident in the case of alternating-current installations.

The Western Electric Company had until recent years devoted its attention chiefly to the manufacture of direct-current apparatus. The increasing demand from central stations for alternating-current units of large size, however, led to its purchasing a large tract of land at the extreme west of Chicago and erecting shops, affording excellent facilities for the manufacture of all types of electrical apparatus. Immediately the manufacture of alternators was undertaken, and now forms a large part of the company's business.

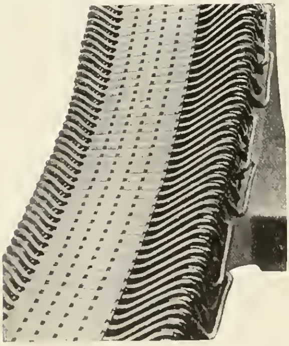


FIG. 1.—STATOR WINDING.

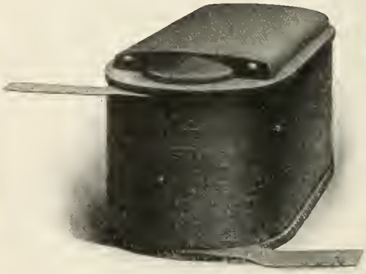


FIG. 2.—RIBBON-WOUND FIELD COIL.

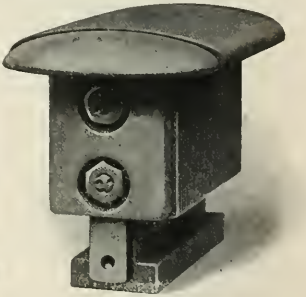


FIG. 3.—POLE CORE.

The accompanying illustrations show some of the features of the alternators built by this company. Fig. 1 is typical of the stator winding of all types of machines. The radiating surfaces, as shown, are large and well exposed to the windage of the rotating field. The ribbon-wound field coil, shown in Fig. 2, is used on the larger machines, and practically all of the engine type machines. This scheme gives good radiation and also brings the flat surface of the strip in a position to resist the stresses due to the centrifugal effect produced by the rotation of the fields. Fig. 3 shows the pole core used on the belted type machine. These poles carry a wire-wound coil, which is impregnated after winding under vacuum. The losses in the pole are kept low by using laminated sheets of metal in their construction. Fig. 4 shows the laminations of which the rotor used on the belted and high-speed water wheel type machines is constructed. A single lamination of the pole is also shown, which illustrates the method of construction. The completed pole is held in position by double taper keys.

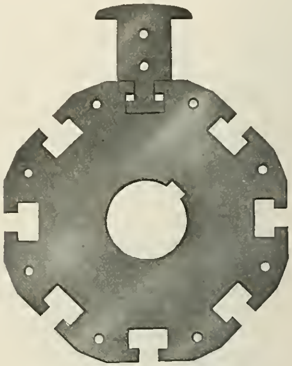


FIG. 4.—ROTOR LAMINATION.

New Use for Manganese Steel.

A good example of how the development of one industry helps another is found in an order for manganese steel disks recently placed by the Cutler-Hammer Clutch Company, of Milwaukee. This company, in addition to manufacturing magnetic clutches, makes a specialty of lifting magnets for handling pig-iron and scrap metal. The growth of this latter business and the natural desire of the manufacturers to perfect every detail of their product has led to the adoption of manganese steel for coil shields—the coil shield being the flat disk fastened to the under side of the lifting magnet for the double purpose of protecting the magnetizing coil and interposing between the two poles of the magnet an area of non-magnetic material. Brass, which is non-magnetic, has heretofore been used for this purpose. Ordinary steel will not do because it is a magnetic metal and would serve to conduct the magnetic lines of force from pole to pole, instead of compelling them to seek a passage through the material to be lifted. Manganese steel seems to be the ideal metal for this purpose. It is non-magnetic, like brass, and infinitely harder—so hard, in fact, that the continued hammering of the pig-iron or other metal on the under surface of the magnet makes not the slightest impression on it. The 50-in. magnets recently furnished by the Cutler-Hammer Clutch Company to a number of steel mills in the Pittsburg district are all equipped with manganese steel coil shields instead of with the brass coil shields formerly used.

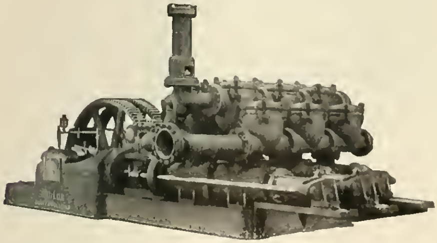
Luminous Arc Lamp for Electric Car.

The accompanying illustrations show an arc lamp for use on railways cars, for which many advantages are claimed over the carbon-arc lamp. The upper electrode of the lamp is a copper forging and the lower electrode is an iron tube filled with a special composition. Thus the lamp is of the so-called "luminous arc" type. In the top of the lamp casing is an opening for a draft tube on the top of which is a hinged cast-iron cover which protects the arc from wind and rain. The parts of the mechanism are attached to an aluminum frame in such a manner as to render the parts readily accessible. The reflector, which is of the parabolic type, is made of spun brass heavily nickeled. A dimming effect for application through thickly-populated districts is obtained by reversing the polarity of the electrodes of the lamp. It is stated that the life of the upper electrode is from 2000 to 3000 hours, and that of the lower from 50 to 75 hours. This lamp has been placed on the market by the General Electric Company, Schenectady, N. Y.

FIGS. 1 AND 2.—MECHANISM OF LUMINOUS ARC LAMPS.

Mine Pump.

The Goulds double-acting, triplex plunger mine pump was originally designed for mine service, but has since been adopted for various duties. It is said to have proved particularly effective in accumulator work or where constant high pressures combined with large capacities have to maintained. The construction is such that the pump can be taken to pieces and lowered through an ordinary mine shaft, and when assembled requires but little head room. It is built to withstand continuous hard service under the most exacting conditions, all working parts being easily reached from the outside without dismantling, and is particularly adapted for operation by electric power.



MINE PUMP.

The frame consists of two heavy, cast-iron bed plates, doweled together and supporting the main bearings, guides, cylinders and all working parts; the crank shaft is of forged steel in two pieces, each having a single throw with a gear at the inner end to carry the center crank pin; the crank shaft bearings are babbitted, hammered and bored to secure perfect bearing surface, and have wedge and screw adjustments of special construction to keep the shaft in alignment. The pinion shaft bearings are of babbitt metal; the double gears are of charcoal iron, the pinions being steel forgings, both machine-cut from the solid; the crossheads are fitted with adjustable shoes which are babbitted and run in bored guides; the connecting rods are of steel with forged steel strap and wedge adjustment with bronze boxes at each end; the six cylinders are all of separate charcoal iron castings fitted with bronze linings; the plungers are of hard cast iron, carefully machined and ground true and smooth, outside packed; the glands are of hard cast-iron and easy of access for adjusting and repacking. The valve boxes are of separate charcoal iron casting, each containing a set of suction and discharge valves which are easily examined by the removal of the valve box covers. Power for driving may be applied at either side of the pump. For electric power intermediate gearing and auxiliary shaft are provided. The pump is made by the Goulds Manufacturing Company, Seneca Falls, N. Y.

Single-Phase and Polyphase Motors.

The accompanying illustration shows a type of motor arranged especially for driving machine tools. The flanges on both sides of the motor are machined, and they are drilled and tapped at 30-deg. intervals so as to make the direct application of the motor to the driven machine possible in any position. Moreover, the frame of the motor is such that it may be used with the special support employed for attaching direct-current motors to the machines.

It is stated that in the design of these motors high efficiencies have been obtained by the liberal use of the active materials; low temperature rise is assured by providing adequate ventilation, while the power factor is kept high by employing partially-closed slots and small air-gaps. In order to eliminate the trouble sometimes encountered with motors having small air-gaps special attention has been given to the shafts, which are very rigid and supported very close to the rotor The bearings

THREE-PHASE INDUCTION MOTOR

are made of phosphor bronze and are of the ring-oiling type, each bearing being provided with two oil rings.

For constant-speed work the motors are provided with squirrel-cage secondary windings on the rotors. For variable-speed duty, such as driving printing presses, the motors are provided with coil-wound rotors, variable resistance being inserted in the secondary circuits for changing the torque-speed characteristics.

The single-phase type of motor is practically the same as the polyphase motor in external appearance, but it has a combined induction-motor and repulsion-motor winding on the rotor. It is stated that this machine possesses a large starting torque, and runs at a high power factor with low temperature rise.

The above-described motors have been placed on the market by the Jenney Electric Manufacturing Company, Indianapolis, Ind.

Electric Heat Applied to Stereotyping.

A striking example of the advantages of electric heating over steam or gas heating is afforded by the Hadaway electrically-heated stereotypers' matrix dryer. The stereotyping process in every newspaper office is one in which the time element is of the greatest importance. Every minute counts and much experimenting, at great expense, has been undertaken for the sake of reducing the time. With the other methods developed to the utmost, the electric method shows a saving in time of from 50 to 60 per cent. In addition to the saving in time, the Hadaway matrix drier possesses a number of other advantages. The bed which contains the heating element is solid and has no tendency to give like the cored bed. The liability of the bed to explode from excessive pressure is entirely eliminated. Electric heat can be more closely regulated and is absolutely reliable.

STEREOTYPERS' MATRIX DRIERS.

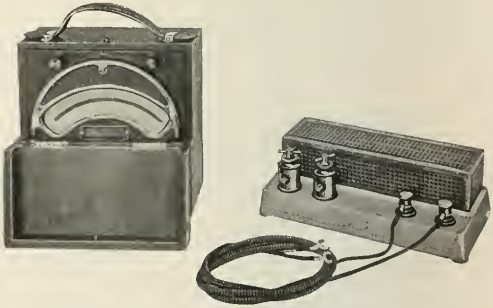
The heating element consists of a steel resistance grid, embedded and hermetically sealed in fireproof insulation in a heavy bedplate, immediately below its upper surface. As the result of this construction, the surface of the bed plate attains a very high temperature and the solid metal below serves as a thermal storage reservoir. The cold form draws the heat very rapidly from this surface, so that the type is very quickly brought to the temperature required to thoroughly dry out the matrix. The grid is practically indestructible. The fireproof insulation does not deteriorate when continually subjected to high temperatures. It has a high dielectric strength and good heat-transmitting qualities. This device is manufactured by the Westinghouse Electric & Manufacturing Company.

A New Line of Direct-Current Portable Instruments.

A new line of direct-current portable instruments, known as type DP, has been placed on the market by the General Electric Company. This type of instrument has been designed especially for laboratory and general testing purposes, and includes a complete line of ammeters, voltmeters, milameters and milli-voltmeters with the necessary portable shunts. These instruments are constructed on the well-known D'Arsonval principle, the coil of wire carrying the current to be measured, or a shunted portion of it, being wound on a rectangular frame mounted on jeweled bearings. This frame is free to move in the annular space between a soft iron core and the pole pieces of a powerful permanent magnet.

The case enclosing the mechanism of the instrument is of drawn steel with a cast iron cover, thus thoroughly protecting the instrument from the influence of stray fields. The magnets used are of the highest grade of magnet steel obtainable, and their permanency is assured by improved processes of ageing and hardening. High torque is secured through efficient design. The scales are uniform throughout their entire range and are very legible. To eliminate errors due to parallax, the instruments are equipped with flat pointers viewed on edge and a mirror is placed under the scale.

The ammeters are made self-contained in capacities up to and including 30 amps. For higher ranges up to 2000 amps. a milli-voltmeter with scale marked directly in amperes is used with a portable shunt. These shunts are designed to give a uniform drop of 200 milli-volts at full-load rating, and are, therefore, interchangeable. The milli-voltmeters used with these shunts are also interchangeable. The portable shunts are mounted on a base of aluminum alloy and are protected by a perforated sheet metal casing. This gives a very light and durable construction. They are furnished with a leather handle to facilitate transportation. If desired, two or three shunts can be furnished combined in one case.



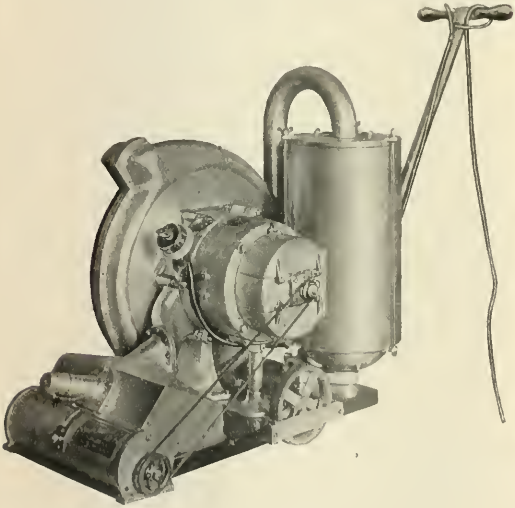
MILLI-VOLTMETER WITH SHUNT.

When an instrument is desired for a class of work which does not require extreme precision, a milli-voltmeter of this type can be used in connection with switchboard shunts, the instrument giving full scale deflection when subjected to a 60 milli-volt drop in potential; or a tap may be brought out at 60 milli-volts on the standard 200 milli-volt voltmeter, enabling it to be used with both portable and switchboard shunts. Where it is desirable to use one instrument to cover a wide range of current, a milli-voltmeter can be employed with any combination of single, double or triple rated shunts. The standard capacities of the portable shunts have been so selected that regardless of the capacities chosen, the scale readings may be quickly determined.

The voltmeters are furnished self-contained in capacities up to and including 750 volts, and with either single or double scales. Instruments for measuring very low voltages and currents have scales marked in milli-volts and mil-amperes.

Combined Electric Carpet Sweeper and Vacuum Cleaner.

A very serviceable cleaning device which at once meets the requirements of the ordinary home as well as those of the largest public building is shown herewith. The renovator is constructed of aluminum with the exception of the motor, which is of standard construction. The vacuum is produced by a centrifugal exhaust fan driven directly by the motor without intermediate gears. The entire outfit is portable, being mounted on wheels and being provided with a handle for moving it about. Its operation is as follows: At the bottom and in front of the machine is a rotary brush driven by a small belt from the motor. As the machine is moved over the surface to be cleaned the brush loosens all the clinging, tight dirt and smooths and straightens out the nap or pile of the carpet. A strong suction of air works around this brush and carries the dirt and dust in the collector at the rear. In addition to the great amount of work accomplished by the rotary brush, hose connections are provided which may be used in conjunction with or independent of the cleaning with the brush. The non-collapsible hose is fitted with a nozzle or tool at one end and to the suction at the other end. As the tool passes over the surface to be cleaned the dirt and dust are sucked up, passing up through the hose to the collector. The latter is removable, so that the accumulations can be dumped into some receptacle for final disposition. By means of the hose attachments every crevice can be reached and dust can be removed from every article used. Not only can the floors and rugs be thus cleaned, but pictures, curtains, blankets, beddings, trunks, etc., can also be deprived of dust by the same means. By reversing the hose connection, the air current is reversed, and air under pressure can be used to freshen up bedding after it has been cleaned. The machine is practically noiseless in operation, and since there are no pumps, plungers or cylinders, no adjustments are required. The renovator can be equipped with either direct- or alternating-current motors, which are supplied with energy through a flexible cord attached to a standard socket. The renovator's wide range of usefulness makes it one of the most serviceable of household devices, and its mechanical simplicity has commended it to central-station managers as a valuable addition to energy-consuming devices. The cost of operation is said to be very reasonable. The machine is manufactured by the Electric Renovator Manufacturing Company, of Pittsburg, Pa.



ELECTRIC CARPET SWEEPER AND VACUUM CLEANER.

Mercury Rectifier Battery Charging Outfits.

As is well known, the mercury rectifier provides a means of converting alternating current into direct current without the use of any moving machinery. The commercial applications of rectified alternating current for various purposes during the last few years have proved satisfactory and are steadily increasing. The Westinghouse Electric & Manufacturing Company has recently introduced a number of improvements in the details of the Cooper Hewitt mercury rectifier. Fig. 1 shows a rear view of a rectifier panel used for battery charging. The essential apparatus consists of an auto-transformer, a two-pole, alternating-current knife switch, a starting switch, a shunt and starting resistance mounted in one case, a regulating reactance, rectifier bulb, ammeter, voltmeter and direct-current circuit-breaker. The panel is 36 in. high by 16 in. wide, and is supported on a standard pipe frame. The auto-transformer is mounted on the floor directly under the panel; all other apparatus is affixed to the panel. The rectifier bulb is supported in a metal ring having a stem which projects through the panel for convenience in tilting the bulb at starting. Only one size of the bulb is required for any current up to 30 amp direct current, and this bulb may be used on any usual commercial alternating-current circuit. The auto-transformer is designed for 60-cycle circuits. The rectifier outfits for automobile charging are furnished to cover the usual range of 10 to 20 and 20 to 44 cells. They are arranged to operate on standard line voltages of 110 and 220.

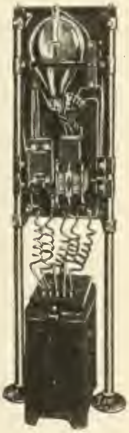


FIG. 1.—REAR VIEW OF CHARGING OUTFIT.

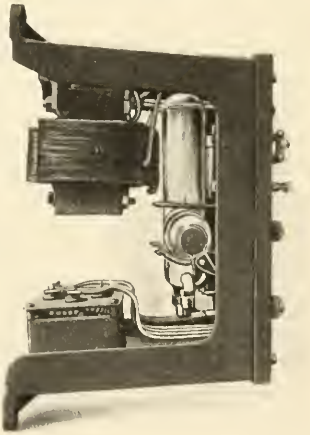


FIG. 2.—SIDE VIEW OF SMALL RECTIFIER PANEL.

Fig. 2 shows an outfit for ignition-battery charging. These sets are made in two ratings of 5 amp and 10 amp, respectively, and each size is arranged to be bolted to the wall. The standard sets are wound for 60-cycle, 110-volt circuits. The smaller size is capable of charging from one to six cells of not over 5 amp rating in series, and the larger size, three to 10 cells of 10-amp rating in series. The essential parts consist of the rectifier bulb, auto-transformer, starting and shunt resistances and regulating reactance. As shown in the illustration, the auto-transformer and resistances are mounted back of the panel within the frame so that they are well protected from mechanical injury. The 5-amp set occupies a wall space of 13¾ in. x 16⅝ in., and the front projects 10 13/16 in. from the wall. The 10-amp panel requires a wall space of 14⅜ in. x 10 in. and projects 12 5/16 in. from the wall. No meters are provided with small outfits.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Trade last week reflected the varied weather conditions and was rather "mixed." In some sections of the country there was a slight improvement in both retail and wholesale trade over the preceding week and general business reports, as a whole, were slightly more optimistic. Crop reports from the North and South were much better. Spring wheat is in apparently perfect condition and with increased acreage. Coal and lumber trades show signs of increasing activity, but the textile manufactures are very dull. On May 13, the number of idle cars on the side tracks all over the country was 404,375, which was 8963 less than on April 29, the time of the last report of the American Railway Association. This is the first time in two months that an increase in the number of cars idle has not been reported. The position of the steel trade shows more strength. Buyers in the pig-iron market with good orders at prevailing prices, brought about the long-awaited turn in that metal and sales of pig iron for the week exceeded all transactions since Jan. 1, being conservatively estimated at 100,000 tons. Prices for steel products were reaffirmed at a conference of the heads of leading steel interests during the week, and these figures will hold throughout the summer in all probability. Money is easy, with funds continuing to accumulate in the banks. Bank clearings for the week were greater than for the previous week, showing but a slight decrease from the same week last year. Stock market activity was largely responsible for the bank clearings' total of $2,630,000,000, the largest, with one exception, since the beginning of the year. Collections continue backward but are improved over a month ago. *Bradstreet's* reports 284 business failures for the week ended May 21, as compared with 281 in the previous week, 165 in the corresponding week in 1907, 170 in 1906, 179 in 1905 and 184 in 1904. Electrical interest during the last week centered at the convention of the National Electric Light Association at Chicago, which was largely attended by representatives from every part of the country. The tungsten lamp was fully discussed at the convention, and as a result it is expected that central-station men all over the country will follow the example of the New York companies in putting the tungsten lamp within reach of the consumer. The lamp manufacturers already report a good demand for the lamp, a demand which is steadily growing, and which bids fair, as the station men and consumers become familiar with the properties of the lamp, to be greater than the lamp manufacturers can handle. The business of the Westinghouse Electric & Manufacturing Company is running at about 50 per cent of normal, which is fairly typical of the other large electric manufacturing companies. Most of the electrical business is made up of small contracts.

ELECTRICAL EXPORTS.—For the month of March, 1908, the Government report shows that exports of electrical instruments and apparatus for scientific purposes, including telegraph and telephone instruments, fell off to the extent of $146,457 from March, 1907, when the exports of this class totalled $590,999. For the nine months ended March 31 the totals, while not up to the totals of the same period last year, were considerably over the totals of 1906, when the exports of this class were $4,654,800. In 1907 they reached $6,305,191 and fell to $5,281,944 in the nine months under consideration. During these nine months British North America headed the list with imports valued at $1,065,579, Brazil was second with imports of $960,283 and the United Kingdom third, with imports of $520,081. Exports of electrical machinery, totalling $690,636 for March of the current year, showed a heavy falling off from March, 1907, when the exports amounted to $919,825. The totals for the nine months ended March 31, 1908, however, showed a considerable increase over the corresponding period in 1907 and 1906, being $6,800,048 against $6,375,622 and $5,736,935 respectively, in the two years under comparison. For the nine months ended March 31, 1908, Japan headed the list of the countries importing American electrical machinery, with imports valued at $1,236,142; Mexico was second with imports of $1,137,442; British North America third with $712,411; Brazil fourth with $682,726, and the United Kingdom a close fifth with $652,394. The excellent showing for March of the current year, considering the business situation, and the record total for the nine months ended March 31, is noteworthy in view of the quiet condition of the domestic electrical business, which is estimated at less than 60 per cent of the normal at the present time.

PLANT IN FLOUR MILLS.—During the past year the Washburn-Crosby Company, of Minneapolis, Minn., has built a large concrete elevator, all the machines in which are operated by individual induction motors, ranging in size from 10 horse-power to 75 horse-power. The Westinghouse-Parsons steam turbine furnishes three-phase current at 460 volts. An elevator load varies greatly, so that the load on this turbine runs from 25 per cent to 150 per cent, and as the period of light loads predominates the power factor is very low. In order to help this power factor the company has installed a 150-hp synchronous motor to operate a small mill which it recently built. This motor runs with a 75 per cent leading current. This raises the power factor on the generator very materially and improves the regulation. It is at present installing a 1500-kw Allis-Chalmers steam turbine. This will furnish current for the 1000-hp induction loader, directly connected to the main shaft of a 3000-bbl mill, also for the 400-hp motor which drives the wheat-cleaning house and a 200-hp motor for running a small model mill. The company hopes to have this machinery in operation about July 1.

COPPER GOSSIP, issued by the National Conduit & Cable Company, says: "The principal center of interest in Europe is the standard market. Producers, agents and dealers, as well as speculators, can always count on the ability of the London market to put through any sort of a copper deal that may suit the fancy of the operators who engineer important movements at that point. Sales of refined copper to foreign consumers lately have been on a moderate scale, but with a renewal of activity in the standard market a better demand from manufacturers would undoubtedly develop. An upward movement on the side would encourage European buying for consumption and speculation although professional 'bear' operators may continue to contest the efforts of 'bull' leaders to land prices on a higher level. There are large stocks at foreign centers, and unless consumption improves heavy supplies will remain a feature of the European situation. They represent material secured at low prices, however, and the holders can afford to hang on until the prospect of a profit is in sight. There is a feeling in the trade that the course of the market will broaden and strengthen."

ALLIS-CHALMERS TURBINES.—The Allis-Chalmers Company has just made a shipment of eight turbo-generator units aggregating 9500 kw in capacity. Two 1500-kw units were shipped to the Youngstown (Ohio) Sheet & Tube Company; one 1500-kw unit to Jacksonville, Fla.; one 500 and one 1000-kw unit to the Celluloid Company, of Newark, N. J.; one 1500-kw unit to the Tremont and Suffolk Mills at Lowell, Mass.; one 1000-kw unit to the Athens Electric Railways of Georgia, and a similar unit to the Nairn Linoleum Company, Kearney, N. J. Since these shipments orders have been received for a 500-kw turbo-generator unit from the city of Austin, Tex., and for a similar unit from the Salsich Lumber Company, at McKenna, Wash. The latter company has also ordered an 80-kw alternator driven by a Chandler-Taylor engine; a 15-kw steam-driven and a 15-kw motor-driven exciter set; a four-panel switchboard; a 20-hp induction motor for driving a centrifugal pump and two 15-hp induction motors.

RECEIVERS OF AJAX LINE MATERIAL COMPANY DISCHARGED.—Mr. Albert Scheible, president of the Ajax Line Material Company, Chicago, informs us that, having succeeded in securing the discharge of the receiver, the company has resumed business at the old stand. While at present trade conditions are not nearly ideal, the company believes that it can make steady headway and in time show every one of the friendly creditors who co-operated in re-establishing the business, that their support during the recent trying months is deeply appreciated.

THE COPPER MARKET.—Expectations of a substantial improvement in the copper situation, which seemed to be justified by the advance of the metal about a week ago Monday, were not realized, and speculative buying met with such an abundance of metal that the market speedily weakened both here and in Europe. One of the largest selling agencies reported sales at 13 cents, but buyers were scarce, and the sales at this price were all for small amounts. On Wednesday, May 20, prices advanced ⅛ of a cent, and there was considerable speculative buying. The optimists pointed to the fact that the present supplies are one-fifth of those a year ago and the stocks one-half or less, and professed to believe there was ground for permanent improvement in the situation. The pessimists, on the other hand, took the view that with 100,000,000 lb. in surplus stocks and with 100,000,000 to 125,000,000 lb. in European warehouses and with imports and a monthly production considerably in excess of the present consumption, there was no alternative except a further decline in prices. The pessimists seemed to be confirmed in their views when on Thursday there was a small price decline in London, which had the effect of unsettling conditions here. It was reported that there were urgent offerings of Japanese metal and that other foreign interests were pressing the market. Abundant supplies and continued light demand during the remainder of the week made a situation quite the reverse of the beginning of the week. The United Metals Selling Company reported sales on Monday last at 12⅞ cents a pound, and one of the largest producers asserts that the demand continues to show a moderate improvement. On account of the falling off in business and low bank rates, due to the accumulation of money, a number of consumers have invested a part of their surplus funds in increasing their copper stocks. On the first day of this week prices on all grades were reduced to the basis of 12¾c. for electrolytic and the dealers were slightly pessimistic, as there are three or more sellers, apparently, for every buyer. Exports from the port of New York since the first of the month were 16,420 tons. Monday's closing prices on the Metal Exchange were as follows:

Lake	12¾	@	12⅞
Electrolytic	12½	@	12¾
Castings	12⅜	@	12½

The London market was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	56	17	0	57	0	0
Standard copper, futures	57	12	6	57	15	0
Market	Easy.			Steady.		
Sales of spot				400 tons		
Sales of futures				800 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

GENERAL ELECTRIC ORDERS.—The total of orders received by the General Electric Company for the first quarter of 1908 was $10,033,172, the smallest for a like period in the last four years. In 1907 the total for the quarter was $18,602,962, an increase over the $14,639,997 of 1906, which in turn was a big increase over the $12,020,715 of 1905. In 1904 the total of $9,943,279 was the lowest in the last six years for the first quarter, showing a heavy falling off from the $11,460,437 of orders received for the first quarter of 1903. Sales billed for the first quarter of 1908 amounted to $9,208,826, a big drop from the $16,035,060 in 1907, and a decrease from the $10,339,164 in 1906. In 1905 sales billed amounted to $8,672,691 for the first quarter; in 1904, $8,966,966, and in 1903, $8,245,822.

ALLIS-CHALMERS COMPANY has recently placed orders for 15,000 tons of pig-iron and over 1,000,000 lb. of copper, a pretty good indication of its faith in the immediate future and of its needs. The company is now employing at the West Allis shops in Milwaukee over 7000 men.

Financial Intelligence.

THE WEEK IN WALL STREET.—The essentially speculative character of the recent rise in securities and the unstable foundations of this advance were disclosed last week when the market tumbled headlong Tuesday, on a strong profit-taking movement, said to come from the sources which have been steadily pushing the market upward. The followers of the market quickly realized that the apex of the upward movement had been reached, for the moment at least, and quickly joined in the profit-taking, still further depressing the market. Dulness and irregularity prevailed on Wednesday, and the reactionary bull movement which started on Thursday was short-lived. During the remainder of the week the market was unsettled and depressed. There were few news developments during the week which could be used to advantage by bear operators. As a whole, the industrial situation has shown substantial improvement during the last few months and crop reports continue favorable. It became evident early in the week that there was little chance that Congress would not take any steps during this session to modify the currency laws, but this had been discounted by the Street. Gold exports to the amount of $30,000,000 have been engaged, mostly by Berlin, as that is the only foreign money center where interest rates are high enough to justify such heavy withdrawals. The government deficit for the fiscal year up to the end of May was $62,500,000, against a surplus of $65,000,000 at the same time last year, and this condition of affairs, coupled with the heavy gold withdrawals, is exciting apprehension among the bankers. Among the securities which figured prominently during the week were the Steel stocks, which were strong on the news of betterment in steel conditions; the copper stocks, including American Smelting and Amalgamated Copper, and Consolidated Gas, which was marked upward rapidly on indefinite rumors. At the opening of the market on Monday there was some further selling on stop-loss orders which carried prices somewhat below those of Saturday, but thereafter the general trend of the market was upward, with prices closing, in many instances, the highest of the day. Closing prices were as follows:

NEW YORK.

	May 18	May 25	Shares Sold.		May 18	May 25	Sbares Sold
All.-Ch.	9⅝	9¼*	3,500	Int.-Met., com.	12⅛	12¼	16,950
All-Ch., pfd.	25⅛	24	6,400	Int.-Met., pfd.	32	32⅞	22,480
Amal. Cop.	69⅜	65¼	322,700	Mackay Cos.	64½	66	1,400
Am. D. T.	39*	39*	—	Mackay Cos., pfd	66¼	65	200
Am. Loc.	51⅛	49¼	15,460	Met. St. Ry.	25	27	—
Am. Loc., pfd.	103½	103*	1,600	N. Y. & N. J. Tel.	105	105*	—
Am. Tel. & C'bl.	60	60*	—	Steel, com.	39⅝	37½	541,761
Am. T. & T.	117¾	117½	1,700	Steel, pfd.	103¼	101⅝	35,975
B. R. T.	52⅛	51	123,445	W. U. T.	55⅝	57¼	6,580
Gen. Elec.	140	133½	15	West'h, com.	53¼	51	8,374
Hud. R. Tel.	—	—	—	West'h. pfd.	70	67	602

PHILADELPHIA.

	May 18	May 25	Shares Sold.		May 18	May 25	Shares Sold
Am. Rys.	44¾	44¼	—	Phila. Elec.	8⅞	8¼	—
Elec. Co. of Am.	9⅞	10	—	Phila. R. T.	16⅝	15¼	—
Elec. Stor. B'ty.	32	30	—	Phila Traction.	92	—	—
E. S. B'ty, pfd.	—	—	—				

CHICAGO.

	May 18	May 25	Shares Sold.		May 18	May 25	Shares Sold
Chicago City Ry.	160	160	—	Met. Elev., com.	17	18	—
Com. Edison	94¼	94¼	—	Met. Elev., pfd.	54	54	—
Chicago Subway	19⅞	21¾	—	National Carbon.	62⅛	63	—
Chicago Tel. Co.	122½	122	—	Nat. Carbon, pfd.	110	110	—

BOSTON

	May 18	May 25	Shares Sold		May 18	May 25	Shares Sold
Am. Tel. & Tel.	118	117½	—	Mass. E. R., pfd.	43	—	—
Comb'ind Tel.	—	—	—	Mex Tel., pfd.	—	—	—
Edison El. Ill.	214	214	—	New Eng. Tel'p.	113½	112	—
Gen. Elec.	140⅛	134½	—	W'st Tel. & Tel.	6⅛	6¼	—
Mass. Elec. Ry.	10	—	—	W. T & T., pfd.	65½	—	—

*Last price quoted.
Shares sold are for week May 18, May 25.

PHILADELPHIA ELECTRIC STOCK.—Philadelphia Electric stock, having been credited with $1 per share paid in, on account of surplus earnings which went into plant, in addition to the recent $1.25 cash assessment paid, stockholders in reality are getting a higher rate of cash dividends return than heretofore, on the actual cash paid in by them. They have paid in so far $11.25 cash on their stock, and on this amount the semi annual dividend, just declared, amounting to 2½ per cent on the paid-in value of the stock, $12.25, is 30⅝ cents a share. This dividend of 30⅝ cents a share is a return of 5.4 per cent per annum on the $11.25 cash investment in the stock, an advance from 5 per cent, the former return. At the market price of 8¾ for Philadelphia Electric stock the dividend yield is 7 per cent.

RECEIVER FOR FAYETTEVILLE ELECTRIC COMPANY.—In the United States Circuit Court at Raleigh, N. C., Mr. H. H. Carr, general manager of the Raleigh Electric Company, was recently appointed receiver of the Fayetteville Gas & Electric Company, of Fayetteville, N C

WESTINGHOUSE REORGANIZATION COMMITTEES.—The report of the merchandise creditors' committee of the Westinghouse Electric & Manufacturing Company and the report of the stockholders' committee, which will be submitted to the reorganization committee on June 1, will show sufficient progress in the plans of the respective sub-committees to warrant further time for the complete realization of the plans for reorganization. As far as the merchandise creditors' committee is concerned, the success of the plan is assured. Mr. George Verity, chairman of the committee, reports that of the $4,250,000 represented by the committee, it is assured that the $4,000,000 of assenting stock which was guaranteed will be taken by the creditors in exchange for their claims, and the committee expects, before it finishes its work, to arrange to take care of $4,250,000 of assenting stock, or the entire amount represented by the merchandise creditors. The large number of stockholders and the difficulty, in many cases, of reaching them, has necessarily made the progress of the stockholders' committee much slower than the work of the merchandise creditors' committee, but the response has been steady and substantial, and with subscriptions of more than $1,000,000 the committee will be able to make a showing on June 1 which will amply justify the continuance of its efforts. "We have arranged so that a Westinghouse representative shall call upon each individual stockholder who has not as yet subscribed to the new stock," said a member of the stockholders' committee, "and that takes considerable time, as some of the stockholders are extremely hard to reach, either because they are traveling or because they live in distant places. The difficulty, also, is to convince each person that no matter how small his holdings may be, his help is absolutely necessary for the success of the plan. When we have succeeded in impressing that point of view on a stockholder we have usually had no more trouble." About 1400 of the entire 3800 stockholders have been reached to date. Following the second circular issued by Mr. Westinghouse urging upon the stockholders the necessity for co-operation, the responses increased materially, and as the time for subscriptions draws to a close it is expected that the replies will come in with a rush. The first payment of 25 per cent by the holders of the new issues of common and preferred stock was made on Monday, May 25. Many of the stockholders anticipated the payments. Another payment of 20 per cent of the amount subscribed by each stockholder will fall due on Aug. 1, 1908, 15 per cent on Jan. 1, 1909, and 15 per cent on April 1, 1909. In a recent interview in Pittsburg, Mr. J. W. Marsh, chairman of the merchandise creditors' committee, said in reference to the working out of the plan of reorganization: "All indication points to the successful completion of our plan. The progress so far has been very satisfactory, and it appears that the creditors and stockholders have at last come to a full realization that it is up to them to place the Westinghouse Electric & Manufacturing Company in the strongest possible position. Next week will tell the tale, as there is still much to be done. While there are many creditors who have signed the agreement and have sent it in to us, there are yet a few who seem to hesitate, and upon these I wish to impress the fact that they ought to do like those others have done. The same is true with the stockholders. The committee is receiving additional subscriptions every day, still it has not yet received them all. But if between now and June 1, which time we have to make good, all join in a strong pull and a pull together, the plan will be an accomplished fact. I hope that every stockholder who has not already subscribed will see the wisdom of doing so right away. The Westinghouse Electric & Manufacturing Company is one of the most important factors among the industrial plants of the Pittsburg district, and to preserve its integrity as a Pittsburg enterprise, there is, to my mind, scarcely any sacrifice too great to make." In his discussion of the matter in a general way Mr. Marsh inferred that there was the one great danger of failure through over-confidence, and the fact that because so much has been done successfully to this end that the individual creditor and stockholder would not think it incumbent upon himself to act with the others. All are needed to make the matter safe and sure.

DIVIDENDS.—The directors of the American Railways Company have declared the regular quarterly dividend of 1½ per cent, payable June 15, to stock of record May 29. The directors of the Rochester Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable June 1 to stock of record May 15. The directors of the Norfolk Railway & Light Company have declared a regular quarterly dividend of 1½ per cent, payable June 5 to stock of record May 25. The Mackay Companies have declared the regular quarterly dividends of 1 per cent on the common and preferred stocks, payable July 1 to stock of record June 13. The directors of the Pensacola Electric Company at a meeting May 20 decided that it was inadvisable to declare the usual semi-annual dividend of 3 per cent, due June 1, 1908, on the cumulative preferred stock. The income of the company was impaired by a strike on the part of its employees, which resulted in materially increased expenses, and a loss in earnings through a boycott. The strike is now ended and expenses and earnings are returning to the normal basis.

LITTLE ROCK RAILWAY & ELECTRIC COMPANY.—The report of the Little Rock Railway & Electric Company gives an April gross of $35,559 as compared with $49,139 for the same period in 1907; expenses and taxes were $27,607, leaving an April net of $27,952, as compared with $23,530 for April, 1907. Deducting interest and sinking fund, or $9,566, left a surplus for the month of $18,386 as compared with $14,844, the surplus for April, 1907. The reserve fund of $3,000 made the net April surplus $15,386. The gross for the four months was $219,068. Expenses and taxes of $109,046 rendered a four months' net of $110,022. Deducting interest and sinking fund charges amounting to $37,066, left a surplus for the four months of $60,956 as compared with $54,755, the surplus for the corresponding four months of the previous year.

KNOXVILLE RAILWAY & LIGHT COMPANY.—The Knoxville Railway & Light Company reports gross operating earnings for April of $45,992, against $47,127 for April, 1907. Expenses and taxes are $22,640, a decrease of $2,026 from the previous year. The net for April was $23,352, a decrease of $1,109 from the net of the corresponding month of the previous year. Deducting interest and charges of $11,394 left a surplus of $11,958. The gross for the four months ended April 30 was $174,009; expenses and taxes were $95,986, making the net for the four months, $78,023. Deducting interest charges of $45,862 left a four months' net surplus of $32,161, as compared with $27,728 net surplus for the corresponding months in 1907.

THE PENSACOLA ELECTRIC COMPANY has passed the semi-annual dividend of 3 per cent on the 3000 6 per cent cumulative preferred shares, due for payment June 1. Stone & Webster, the general managers, state that the income was impaired by a strike and boycott, which are now ended, and with the restoration of normal conditions it is hoped that dividends will soon be made up. The trouble was purely of a temporary nature and the territory that the company serves is prosperous, though adversely affected by the business depression. Better discipline will result now that the menace of constant labor troubles has been removed.

TELLURIDE POWER COMPANY FILES $10,000,000 MORTGAGE.—The Telluride Power Company, of Salt Lake City, has filed a mortgage of $10,000,000 to the Citizens' Savings & Trust Company, of Cleveland, covering an issue of 6 per cent 30-year gold bonds, secured by rights, plants and franchises in Colorado, Utah and Idaho. Of the $10,000,000, $2,500,000 will be used to take up floating indebtedness, and the remainder for further indebtedness. The company has an extensive system of power plants and power transmission lines in the three States mentioned.

MICHIGAN STATE TELEPHONE.—The report of the Michigan State Telephone Company for the quarter ended March 31, 1908, showed gross earnings of $804,021 against $726,724 for the same period last year. Expenses, taxes, etc., were $600,714, making the net for the quarter of $203,307, as compared with $259,659 for the same period in 1907. Deducting interest charges of $104,463 and preferred dividends of $34,248, left a surplus of $64,596, which is at the rate of 7.3 per cent per year on the $3,500,000 common stock. The net gain in telephones in March was 653 and in April 628.

AMERICAN TELEPHONE BONDS AND MASSACHUSETTS BANKS.—The Massachusetts Senate is considering an amendment to the Savings Bank Bill which would authorize the Massachusetts Savings Banks to invest in the $53,000,000 American Telephone 4 per cent collateral trust bonds, due 1929.

ENGLISH MARCONI COMPANY INCREASES STOCK.—At a special meeting of the Marconi Wireless Telegraph Company in London last week, it was voted to increase the capital stock to £750,000 by creating 250,000 preferred shares.

NORFOLK & PORTSMOUTH TRACTION COMPANY.—The annual report of the Norfolk & Portsmouth Traction Company and allied companies for the year ended Dec. 31, 1907, shows gross earnings of $2,616,458, an increase of $896,912 over 1906. Operating expenses were $1,655,654, an increase of $541,771 over the preceding year. Net earnings were $960,803, as compared with net earnings for 1906 of $605,663, an increase of $355,140. The total income was $958,520 and interest and taxes $704,808, making a balance of $253,712, an increase over the balance for 1906 of $149,436. Extraordinary expenses of $126,507 were reported, thus giving a surplus of $127,204, an increase of $34,960 over the surplus of the previous year. President Williams said in part in the report: "Financial conditions have been such that it has been impossible for the company to sell upon advantageous terms sufficient bonds to take care of its construction expenditures. Arrangements have been completed for notes of two, three and four-year maturities, secured by collateral. A large proportion of the floating debt of the company has been liquidated through the sale of these notes since the close of the fiscal year, Dec. 31, 1907. Notwithstanding the difficulties attendant upon the operation of the properties during the period of reconstruction, and the disappointment in attendance on the Jamestown Exposition, the results of the operations of the properties owned and controlled by your company during the year 1907 were, upon the whole, satisfactory."

TO AID WESTINGHOUSE STOCKHOLDERS.—Stockholders of the Westinghouse Electric Company who are unable to subscribe to their pro rata share of the new "assenting" stock may be cared for by the banking firm of Dominick & Dominick, of 115 Broadway, which agrees to purchase the necessary shares for any stockholders and give the stockholder one year from July 1, 1908, in which to take up the stock. The firm agrees to take up and pay for 25 per cent of the new stock to which a stockholder is entitled to subscribe, the latter to deposit his old stock as security for the loan, in addition to paying 6 per cent interest from July 1, 1908, and $1 commission on each share purchased. Any stockholder not taking up his stock by July 1, 1909, will be sold out. A member of the firm stated that this offer was not made in the expectation of considerable profit, but at the request of the Westinghouse Company. Under the reorganization plan, the stockholders must subscribe to $6,000,000 of the new stock at par. If they fail to do this the property will be sold for the benefit of the creditors; but if the plan is put through, which seems extremely likely, it is expected that the stock, which is now selling in the neighborhood of 50, will advance 30 or 40 points.

SEATTLE ELECTRICAL BONDS.—A syndicate composed of Lee, Higginson & Company, N. W. Harris & Company and Estabrook & Company, has purchased $2,500,000 of Seattle Electric Company consolidated and refunding, mortgage, sinking-fund 5 per cent bonds, due Aug. 1, 1929. The same syndicate bought $2,500,000 of these bonds last July, which were quickly placed among investors. This new issue will provide funds to pay off the existing floating debt of the company incurred in property extensions and will leave a substantial balance to be added to working capital. The Seattle Electric Company represents a capital investment of more than $140,000,000 and controls practically all of the street railway mileage, electric lighting and power business in that city, which has, it is stated, increased in population from 80,671 in 1900 to 240,000 at the present time.

MANHATTAN RAILWAY BOND ISSUE.—The Public Service Commission of the First District, New York, received last week an application from the Manhattan Railway Company for permission to issue $10,818,000 in bonds to refund the first mortgage bonds of the Metropolitan Elevated Railway Company, which become due on July 1. Permission was also asked to issue $894,000 in bonds for the purpose of repaying the company for the cost of extending the lines in the Bronx from Tremont Avenue to Bronx Park. With the petition there was filed a statement which showed that the gross earnings of the company for the year ended March 31, 1908, were $14,254,322, other income $462,173, operating expenses $6,182,366 and gross income from operation $8,534,129. May 22 was the date set by the Commission for the first hearing on the application.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report of the American Telephone & Telegraph Company for April shows total earnings of $3,642,424, an increase over April, 1907, of $578,060; expenses of $192,925, an increase over 1906 of $6,008. Net earnings for April were $3,449,499, an increase of $572,052, and the surplus $2,801,445, an increase over the surplus of April, 1907, of $528,113. The total earnings for the first quarter, from January 1 to April 30, were $10,755,823, against $9,076,324 for the first quarter of 1907, an increase of $1,679,499. Expenses were $719,112, leaving net earnings of $10,036,711, an increase over the net for the same time the previous year of $1,639,512. Deducting interest and dividends, the net surplus is $4,409,516, an increase over the net surplus for the same time in 1907 of $944,036.

MONTREAL STREET RAILWAY.—The report of the Montreal Street Railway for the month of April shows gross earnings of $280,736 and expenses of $170,141, leaving an April net of $110,595 against a net for April, 1907, of $108,213. The April surplus for 1908 was $59,250 against a surplus for the same month in the previous year of $62,896. The gross for seven months ended April 30 was $2,027,872, an increase over $1,873,683, the gross for the corresponding months in 1907; expenses were $1,316,007 against $1,240,079, leaving a seven months' net of $711,865 as compared with $633,604, the net for the corresponding seven months in 1907. The report gives a surplus for the seven months of $387,878, an increase over last year's surplus for the same period, which was $349,408.

KEYSTONE TELEPHONE REPORT FOR APRIL.—The April report of the Keystone Telephone Company gives gross earnings of $87,807, an increase of $398 over the gross April earnings for 1907. Expenses were $41,719, a decrease of $810 from the expenses for the same period in the previous year, and the April net was $46,088, an increase of $1,208 over the period in comparison. The gross for ten months ended with April, 1908, was $875,785 against $819,890 for the corresponding ten months in 1907, an increase of $55,895, expenses $455,856, an increase of $22,462 over the period in comparison, and the ten months' net $419,929 against a net of $386,496 for the same time in the preceding year, an increase of $33,433.

NORTHERN OHIO TRACTION.—The report of the Northern Ohio Traction Company for the month of April showed gross earnings of $129,804. Expenses were $82,252, leaving an April net of $47,552 as compared with a net for April, 1907, of $49,955. Charges were $44,029, and the April surplus $3,523 against an April surplus in 1907 of $7,553. The gross earnings for the four months ended April 30 were $505,889, expenses $324,883, and a net for the four months of $181,006. Deducting charges of $172,889 left a surplus for the four months of $8,117, a decrease from the surplus of 1907 of $23,889; 1906 showed a deficit of $10,385.

UNITED RAILWAYS OF ST. LOUIS.—The report of the United Railways of St. Louis for April shows gross earnings of $865,691, a decrease of $19,232 from April, 1907. Expenses of $570,663, a decrease of $12,376 for the same time last year, and a net for April of $295,028, a decrease of $6,856 from April, 1907. Charges were $232,274, making a surplus for April of $62,754, a decrease from the April surplus of 1907 of $8,238. The four months' net was $1,123,744, an increase of $50,304 over the first quarter of 1907. The four months' surplus of $191,308 was an increase of $42,404 over the first quarter of the preceding year.

PACIFIC LIGHT & POWER COMPANY.—The report of the Pacific Light & Power Company, of Los Angeles, for the year ended Dec. 31, 1907, shows gross earnings of $1,281,055 against $1,332,534 in 1906, a decrease of $51,479. Reduced operating expenses and expenditures enable the company, in spite of the decreased gross earnings, to show a net of $740,230 against $690,093 for 1906, an increase of $50,146.

CUMBERLAND TELEPHONE & TELEGRAPH.—The April report of the Cumberland Telephone & Telegraph Company shows gross earnings of $511,378, an increase of $25,220 over April, 1907, and a net of $206,845, an increase of $16,760 over the corresponding month last year. The surplus, after deducting charges, was $169,264, an increase of $17,492 in the two periods under comparison.

AMERICAN LIGHT & TRACTION STOCKHOLDERS.—The number of the stockholders of the American Light & Traction Company has doubled in the last four years, the number now being 1800. The greater part of the increase has been since the panic in October, when the company's stock sold way down. Since that time about 175 new stockholders have been listed.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

FORT SMITH, ARK.—The Pan Telephone Company contemplates making improvements to its system which will involve an expenditure of about $300,000.

OSCEOLA, ARK.—Plans are being made to erect a copper toll line from Osceola to Festus, Mo., a distance of 180 miles, by the Southeast Missouri Telephone Company, the Tri-State Telephone & Telegraph Company and the Cape Girardeau Telephone Company, the cost of which is estimated at $30,000. The lines will be erected on poles already placed.

ROGERS, ARK.—The city is considering the question of purchasing the electric light plant and water works system. E. W. Homan is mayor.

ALAMEDA, CAL.—The Municipal Electricity Commission has awarded the contract for a new boiler for the electric light plant to the Risdon Iron Works for $5,100. The commission also contemplates installing a heating and water plant to warm the water used by the turbine engine.

CHICO, CAL.—An electric power plant has been installed in the mines of the Steifer Mining Company, near Magalia, at a cost of $20,000.

DOWNIEVILLE, CAL.—The Sierra Mercantile Mining & Power Company is planning to construct a hydro-electric power plant at Downieville. Richard Phelan is general manager.

LOS ANGELES, CAL.—The Elysian Park Improvement Association is considering the question of obtaining gas and electric service for the Elysian Park District.

LOS ANGELES, CAL.—Announcement has been made that work will commence immediately on the conversion of the Southern Pacific Railroad Company's line from this city to Santa Monica into a double-track electric railway as part of the Los Angeles-Pacific Railway system.

OAKLAND, CAL.—The directors of the San Francisco, Oakland & San Jose Consolidated Railway Company have authorized a bond issue of $7,500,000, of which the proceeds of $3,000,000 will be used for additions and improvements to the property. The company contemplates the construction of a railway to the proposed capitol site in North Berkeley and also a line through the county to Hayward, and from there to San Jose. E. A. Heron is president of the company.

OROVILLE, CAL.—It is reported that the Pacific Electric & Gas Company is contemplating the construction of another power plant at Bucks Valley. The company is endeavoring to purchase several hundred acres of land in Bucks Valley, about 45 miles from this city, to be used as a reservoir site, where it is said that between 45,000 and 50,000 hp can be developed.

PALO CEDRO, CAL.—The Northern California Power Company has commenced work on the construction of a 60,000-volt transmission line from its substation at this place to Kennett, where a substation will be constructed, with an output of 7000 hp. The company will furnish electrical energy for operating the Mammoth Mine and smelter at Kennett and will also furnish electricity for the electric process iron smelter at Heroult. The transmission line will be 16 miles in length and will transmit 20,000 hp.

SACRAMENTO, CAL.—Judge J. B. Devine, representing W. T. Tarrett and other capitalists, of San Francisco, has applied to the Board of Supervisors for a franchise for a street railway in and about Oak Park, Gould and Carleton. The proposed railway will be about six miles in length.

SAN DIEGO, CAL.—Bids will be received at the office of the constructing quartermaster, Fort Rosecrans, Cal., until June 2 for constructing electric wiring and fixtures, heating, etc., for post exchange and gymnasium building at Fort Rosecrans. Information furnished on application. Plans and specifications can be seen at the office of the quartermaster at Fort Rosecrans and at the office of the chief quartermaster, Chronicle Building, San Francisco. Lieut. Earl McFarland is quartermaster.

SAN FRANCISCO, CAL.—The Southern Pacific Company has applied to the Board of Public Works for permission to erect a hospital and power-house in the block bounded by Baker, Lyons, Hayes and Fell Streets. The power-house will furnish heat and light for the hospital. The cost of the entire work is estimated at $265,000.

SAN FRANCISCO, CAL.—A comprehensive plan for lighting the new retail district of the downtown section of the city has been submitted to the Board of Supervisors by the Permanent Downtown Association, an organization composed of merchants, property owners and other business men in the district bounded by Sutter, Powell and Market Streets. The scheme contemplates 160 poles, averaging about eight poles to a block and three to the short blocks. The supervisors have accepted the plan; it now remains for them to furnish electricity for the lamps, and when arrangements have been made the poles will be erected free to the city.

SAN JOSE, CAL.—The Tuolumne Water Power Company has applied to the Board of Supervisors of Santa Clara County for a franchise to erect transmission lines and conduits for the transmission of electricity on the roads and public highways in Santa Clara County for a period of 50 years. The franchise will be awarded to the highest bidder, for which bids will be received until June 15.

SANTA ROSA, CAL.—The contract has been awarded for the construction of the transmission line from the generating plant of the Snow Mountain Power & Water Company on Eel River, Mendocino County, through Hopland, Cloverdale, Healdsburg, Windsor, Santa Rosa and Petaluma.

SONORA, CAL.—S. L. Stovall has filed notice of appropriation of 10,000 cu. in. of water from the middle fork of the Tuolumne River, which will be developed to generate electricity.

SONORA, CAL.—G. F. Wakefield, of San José, has filed a notice of appropriation of 45,000 miner's inches of water on the Middle Fork of the Tuolumne River; also all public lands to be flooded, the water to be conveyed to Moccasin Creek Mouth, where it will be used for the generation of electricity and for irrigation purposes in Tuolumne and other counties.

COLORADO SPRINGS, COL.—Plans are being made by the Manitou & Crystal Park Railroad Company to commence the construction of its railroad, which will involve an expenditure of about $500,000. J. K. Vanatta is president of the company.

COLORADO SPRINGS, COL.—The Colorado Springs Electric Company has decided to make extensive improvements to its plant on West Cucharas Street. Work will commence at once, and it is expected to have it completed before fall. The output of the plant will be increased to 1500 kw. The cost of the improvements is estimated at $100,000. As soon as the litigation with the Empire Power & Water Company is settled the Colorado Springs Electric Company will begin work on its power plant in Ute Pass. The company have already secured reservoir sites, but nothing further has been done.

LYONS, COL.—The Rocky Mountain Hydro-Electric Company contemplates the construction of a power plant on North Street, Vraim Creek, eight miles from Lyons, where it will develop 4250 hp, which will be transmitted to Denver, a distance of 42 miles. The cost of the plant is estimated at $370,000. L. H. Dieterich, of Lyons, is resident engineer, and R. M. Jones, 1142 Humboldt Street, Denver, is chief engineer.

HARTFORD, CONN.—Bradley & Hubbard, of Meriden, have secured the contract for furnishing electrical fixtures for the State Arsenal.

MIDDLETOWN, CONN.—The Middletown Electric Light Company has decided to postpone the erection of its new plant until next year.

WILMINGTON, DEL.—The West Chester & Wilmington Electric Railway Company has been granted a franchise to build an electric railway from the northwestern city limits to Washington, where it will connect with the People's Railway.

WHITE SPRINGS, FLA.—Surveys are being made by D. G. Zeigler & Company, of Atlanta, Ga., for the development of water power, located about three miles from White Springs. It is said that about 23,000 hp can be developed.

ABBEVILLE, GA.—The citizens have voted to issue $12,000 in bonds for the construction of a municipal electric light plant. P. A. McDaniel is mayor.

ATLANTA, GA.—A trust deed conveying all franchises to build and operate a railroad on the streets of Atlanta through College Park, Monroe and other cities to Augusta to the Chicago Title & Trust Company and W. C. Niblack has been filed by the Atlanta & Carolina Railroad to secure the issuance of $6,000,000 in bonds. James W. English is president of the railroad company.

JACKSON, GA.—The Central Georgia Power Company, of Macon, has awarded the contract for the construction of its dam, power house, etc., for its hydro-electric plant near Jackson to Lane Brothers, of Richmond, Va. Changes made in the size of the power house and equipment will increase the cost of the plant to $2,500,000. J. G. White & Company, of New York, N. Y., are the engineers.

LAGRANGE, GA.—Plans are being considered to improve the municipal electric light plant, which will involve an expenditure of from $12,000 to $15,000. J. D. Edmundson is Mayor.

MACON, GA.—The Flint River Power & Electric Company has petitioned the State Railroad Commission for permission to issue $10,000,000 in bonds and $12,000,000 in stock, the proceeds to be used in connection with the development of water powers on Flint River. This company is a subsidiary of the Central Georgia Power Company, of Macon, which was recently granted permission to develop water powers on the Oconee and Ocmulgee Rivers. The committee is reported to have decided to recommend favorable action on part of the commission.

SAVANNAH, GA.—During the past year the Savannah Lighting Company has made extensive additions to its power plant, which include the installation of a 350-hp Babcock & Wilcox boiler with superheater and economizer; one 500-kw, 2200-volt, two-phase Allis-Chalmers-Bullock turbo-generator set, with complete equipment of condensing apparatus manufactured by the Wheeler Condenser Company. The company is now installing an additional 500-kw unit of the same output with auxiliaries, including condenser, circulating pumps, etc., and nine additional panels for switchboard at the power house. The substation has been remodeled and nine additional panels added to the switchboard to take care of the distribution of about 20 miles of overhead transmission lines through the residence portion of the city. H. L. Wills is manager.

COEUR D'ALENE, IDAHO.—A number of prominent mine owners of Coeur d'Alene contemplate the construction of a power plant to furnish electrical energy for the mines in this section. It is said that H. M. Lancaster has taken an option on a site at Slate Creek where 25,000 hp can be developed.

MINIDOKA, IDAHO.—Bids will be received at the office of the U. S. Reclamation Service, Federal Building, Chicago, Ill., until June 19 for furnishing electrical apparatus for use in connection with the power and pumping development at Minidoka dam, Minidoka Irrigation Project. The cost of the material to be covered by immediate purchase is estimated at $55,000, and that of the optional material about $100,000. Further information may be obtained at the Chicago or Washington offices, or of O. H. Ensign, 25 Carroll Block, Madison, Wis., chief electrical engineer.

BLOOMINGTON, ILL.—It is reported that the plant of the Union Gas & Electric Company has been purchased by an Elmira syndicate headed by Edwin Witherby. The price paid for the plant is reported to be $400,000.

CHICAGO, ILL.—The City Council has entered into a contract with the Sanitary District Board to purchase electricity for the municipal electric lighting system at the rate of $15 per horse-power per year. It is said that the steam generating plants will be converted into distributing stations. The new arrangement will enable the city to light the streets of the city at a great reduction in cost.

HILLSBORO, ILL.—The Mississippi Valley Interurban Railway Company is preparing to extend its railway system in Bond, Christian, Montgomery and Sangamon Counties. John E. Melick, of Springfield, is president of the company. B. F. Bond is superintendent of construction, with headquarters in Hillsboro.

JACKSONVILLE, ILL.—Plans are being prepared for a new electric light plant for the city to cost $20,000. C. W. Brown is consulting engineer.

LIBERTYVILLE, ILL.—Plans are being prepared for the North Shore Electric Company for the construction of a substation at Lake Bluff. The power plant will be located on the road to Libertyville.

CHANDLER, IND.—The Home Telephone Company has applied for a franchise to extend its lines to and through Boone.

GEORGETOWN, IND.—An independent telephone company has been organized by the residents of Georgetown and the farmers of the surrounding country to construct a telephone system to connect with the exchange at Crandall.

RICHMOND, IND.—The Richmond Light, Heat & Power Company contemplates extensive improvements to its plant at a cost estimated at $60,000. E. E. Witherby is general manager.

BELLEVUE, IA.—The Council is considering the question of erecting a dam on the creek to furnish power to operate the municipal electric light plant.

CLINTON, IA.—The question of establishing a municipal electric light and ice plant in this town is under consideration, and a committee has been appointed to obtain information and estimates of the cost of the same. For further information address I. L. Herman.

COLFAX, IA.—James Donahue, of Davenport, has been granted a franchise to build an electric car line from this city to the Hotel Colfax, a distance of one mile, and has also secured the right of way.

ELDORA, IA.—Work has commenced on the final surveys of the Iowa Railroad Company, which proposes to construct an electric railway 127 miles in length, which will connect Waterloo, Cedar Falls and Des Moines and intervening cities. The power plant will be located at Eldora. The company also plans to furnish electricity for lamps to towns along the route of the railway. Andrew Stevenson, of Chicago, Ill., is president.

MASON CITY, IA.—The Western Electric Telephone Company has purchased the property and holdings of the Northern Telephone Company for $15,000. The company is planning extensions to its system, which will involve an expenditure of over $200,000.

SIOUX CITY, IA.—All bids opened by E. E. Homer May 11 for the construction of pumping and power plant, including machinery, also for repairs on hospital building and for electric wiring of various buildings at the County Poor Farm have been rejected.

ATCHISON, KAN.—The contract for the installation of the ventilating, heating and power plant for the high school has been awarded to Lewis Kitchen, Kansas City, Mo.

BALDWIN, KAN.—The City Council has granted a franchise to Rawlings & Company, of Chanute, for a railway system through Baldwin. The line will run from Coffeyville, through Independence, Chanute and other cities to Baldwin. Later a railway will be built from Baldwin to Lawrence.

CONCORDIA, KAN.—The city has entered into a contract with the Concordia Electric Light Company to furnish electricity to operate the pumping station at the water works.

STOCKTON, KAN.—The City Council is contemplating the purchase of the local electric light plant. If the plant is purchased improvements will be necessary.

TOPEKA, KAN.—The Board of Trustees has decided to install an entire new steam plant in the municipal electric light plant. The present plans provide for an entire new set of boilers, a water purifier, a steel stack about 100 ft. high, with rearrangement of some of the pole lines. New lamps will be purchased. The plant will be built to provide for 500 lamps. As yet it has not been decided whether new generators will be purchased. The cost of improvements is estimated at about $35,000.

JACKSON, KY.—The local electric light plant has been reorganized under the name of the Jackson Electric & Hydraulic Company. It is said that the company proposes to construct an ice plant in connection with the electric light plant.

AMITE CITY, LA.—The City Council on May 13 voted to sign a contract with the Central Light & Power Company pledging $100 per month for street lamps. Work has commenced on the rebuilding of the plant.

FRANKLINTON, LA.—W. A. Erwin is considering the question of installing an electric light and ice plant in Franklinton.

LAUREL, MD.—An election will soon be held to vote on the proposition of issuing $15,000 in bonds to improve the municipal electric light plant.

ADAMS, MASS.—The Adams Electric Light Company is making arrangements to extend its transmission lines to the plant of the Universal Carbon Trust Company, which will operate its plant by electricity.

CLINTON, MASS.—Plans are being prepared for the construction of a new power plant for the Bigelow Carpet Company, which the company proposes to construct in the rear of its new mill on Union Street. The new plant will furnish power to operate both the new and the old mills. Charles T. Main, of Boston is the architect.

CLINTON, MASS.—The Legislative committee on ways and means has reported to the House a recommendation for the appropriation by the State of $115,000 for the purchase and installation of machinery for the development of electrical power at the Wachusett dam and a further appropriation of $7,000 for the necessary changes and additional work at the power house.

MARION, MASS.—The Marion Gas Company has decided to introduce electric service in connection with its gas business. The capital stock of the company will be increased and further arrangements made later.

SHELBURNE FALLS, MASS.—Wilcox & Halligan, proprietors of the local electric light plant, have applied for permission to incorporate. It is proposed to erect a larger plant and to supply electricity for motors as well as lamps.

SHREWSBURY, MASS.—The citizens on May 13 voted to construct and maintain a plant for the distribution of electricity for lamps and motors in this town to cost not more than $16,000. It is proposed to purchase electrical energy to operate the system. The committee favors a five-year contract with the Marlboro Electric Light Company. The street lighting committee was authorized to construct the plant and if necessary sign contracts for a term of ten years for electrical energy for the system. The lighting system will consist of 175 tungsten lamps of 30 cp.

WEST MEDWAY, MASS.—The citizens have voted to appropriate $2,700 for lighting the streets by electricity.

CEDAR SPRINGS, MICH.—Application for a franchise to furnish electricity in this city has been made to the Common Council by Burlingame, Bender & Company, of Grand Rapids. The company proposes to construct a power plant at Morley and offers to furnish energy for arc lamps at the rate of $60 per lamp per year and for incandescent lamps at 10 cents per kw-hour.

GRAND RAPIDS, MICH.—The Canal Street Improvement Association has awarded the contract for the erection of 17 steel arches to the Grand Rapids Electric Company and the Grand Rapids-Muskegon Power Company will furnish electrical energy for the lamps.

HONEYVILLE, MICH.—An independent telephone company has been organized by the residents of this city to install a local system.

JACKSON, MICH.—The Commonwealth Power Company will spend $50,000 in repairing the dam at Plainwell, which was washed out by a storm in the spring.

LUDINGTON, MICH.—The Stearns Power & Lighting Company has placed an order for electrical equipment which will double the capacity of its plant here. A new 1,000-hp Corliss engine and generator of equal capacity will be added to the plant and other improvements will be made. The transmission line will be extended to Scottville.

PELICAN RAPIDS, MICH.—The Pelican Telephone Company will soon commence the construction of a telephone line between this city, Lida and Maplewood.

PONTIAC, MICH.—The Interstate Long Distance Telephone Company has been granted a 30-year franchise to construct and operate a telephone system in this city.

BIRD ISLAND, MINN.—A telephone company has been organized by the business men of this city to build a local system. The company is planning to install exchanges in this city and Olivia, and may extend its system to Renville and a number of neighboring towns.

FERGUS FALLS, MINN.—The Union Engineering & Construction Company, of Chicago, Ill., has been awarded the contract for completing the concrete dam and power house for the municipal electric light plant. The company submitted the only bid, in which it offered to complete the work, minus the machinery, for $40,000 and to allow the city $2,000 for the present power house and machinery, making a net bid of $38,000.

ST. CLOUD, MINN.—The Public Service Company contemplates the construction of a new power house which will have an output of 1600 hp.

WATKINS, MINN.—The system of the Watkins Telephone Company at St. Nicholas is being overhauled, and a number of new lines are to be erected.

JEFFERSON BARRACKS, MO.—Bids will be received by Captain O. W. Bell, constructing quartermaster, U. S. A., until June 15 for the construction of a complete electric lighting system, including wiring all buildings, constructing pole lines, generating station buildings, steel stack, furnishing electric fixtures, transformers and apparatus; furnishing and installing boilers, engines, elevator, pumps and generators. Also the alternate proposal to furnish electricity for lamps will be received.

SPRINGFIELD, MO.—The Springfield Traction Company has decided to extend its Elm Street line for a considerable distance.

BILLINGS, MONT.—It is reported that by a deal recently concluded between the Yegen Brothers and a representative of the Madison River Power Company the electric power plant of the former changes hands for a consideration of $200,000. It is announced that the Madison River Power Company has secured options on all the electrical power plants east of Billings, including those at Columbia Falls, Forsythe, Big Timber and Livingston, and will, if the negotiations are concluded, run a transmission line from the Dakota line to this point from one central station. It is said that the company is also negotiating for options on power plants west of Butte which would give it control of the entire State excepting Butte, Helena and Great Falls.

SOUTH OMAHA, NEB.—The Independent Telephone Company has been granted a franchise in this city to erect a telephone system and proposes to install a plant at a cost of about $200,000 and will give this city connection with Omaha and other cities in Nebraska.

ELKO, NEV.—An independent telephone company has been formed to build a telephone line between this city and Mountain Home, and later may extend the line from Mountain Home to Boise, Idaho. F. A. Sewell and others are interested in the enterprise.

GOLDFIELD, NEV.—An electric pump has been installed at the foot of the 500-ft. incline on the Kewanas.

RENO, NEV.—Bids will be received until June 1 by the Board of Aged and Indigent Insane for the construction of a power house and a wooden stave pipe line, about 45 ft. in length. F. L. Wildes is secretary of the board.

RENO, NEV.—The Truckee River General Electric Company will have its transmission line extended to the Rawhide mining camp soon. The main line will be tapped on the Douglass Ranch and the energy will be reduced at a point near the site for the new Selby mill. The lamps will be installed at once on the completion of the line.

MANCHESTER, N. H.—The Board of Mayor and Aldermen has adopted a resolution authorizing Mayor Reed and Alderman Geisel, chairman of the street lighting committee, to enter into a contract with the Manchester Traction, Light & Power Company for a term of five years. The contract calls for not less than 584 lamps at $90 per lamp per year.

NEWPORT, N. H.—The Newport Electric Light Company is making arrangements to install additional equipment in its power plant. Myron W. Tenney is treasurer and manager.

IRVINGTON, N. J.—The Public Service Commissioners are considering the question of establishing a municipal electric light plant. Eugene Turton is city attorney.

TRENTON, N. J.—Plans are being considered by the New Jersey & Pennsylvania Traction Company for extensive improvements to its system, which will involve an expenditure of about $160,000. It is proposed to enlarge the power house at Yardley to furnish additional energy required for the system.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company is planning to furnish electricity to the manufacturing plants in Binghamton, Lestershire and Endicott. Plans are being made to extend its high-tension transmission line through the manufacturing district, and also to extend it down the valley to Lestershire and Endicott. Contracts have already been placed with the Globe Store for its new elevator service, the Osgood Scale Works and the Jones Scale Works.

BROOKLYN, N. Y.—The East River Terminal Railroad Company has filed an application with the Public Service Commission for a certificate of public convenience and necessity to construct and operate a railway on a number of streets in the Borough of Brooklyn. The company proposes to do a freight business exclusively.

BROOKLYN, N. Y.—Contracts have been awarded by C. B. J. Snyder, superintendent school buildings, for installing electric equipment for schools in Borough of Brooklyn as follows: To the Commercial Construction Company, of New York City, for School 128, at $9,952, and School 75 for $8,224, and to Cowden & De Young, 237 Broadway, New York City, for School 156 at $16,140.

BUFFALO, N. Y.—The Appellate Division of the Supreme Court has decided against the New York Central Railroad and its objections to the proposed Buffalo, Genesee & Rochester Electric Railway and permits the road to be built.

BUFFALO, N. Y.—Governor Hughes has signed the Hill-O'Brian bond bill, which authorizes the city to issue $50,000 in bonds, the proceeds to be used to place the wires of the Police and Fire Departments in under ground conduits.

GLOVERSVILLE, N. Y.—Governor Hughes has signed Assemblyman Mill's bill extending the powers of the Board of Water Commissioners of this city so as to allow it to construct reservoirs and other works necessary to the water system of Gloversville, including the erection of a transmission line to supply electrical energy to operate the water gates and other apparatus connected with the system.

NEW YORK, N. Y.—Bids will be received until June 1 by C. B. J. Snyder, superintendent of school buildings, for installing electric equipment in alterations and additions to School 90, Borough of Manhattan.

NEW YORK, N. Y.—The permission granted to the receivers of the New York City Railway Company by Judge Lacombe, of the United States Circuit Court, to issue receivers' certificates to the amount of $3,500,000 for the purpose of rehabilitating the property was affirmed May 20 in a decision handed down by the United States Circuit Court of Appeals.

NEW YORK, N. Y.—Judge Lacombe, of the United States circuit court, has granted the petition of Frederick W. Whitridge, receiver of the Third Avenue Railroad Company, the Dry Dock, East Broadway & Battery Railroad Company and the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company for permission to issue $2,500,000 of receivers' certificates, to be used for rehabilitation of the roads. As receiver of the Union Railway Company, Mr. Whitridge may also issue $750,000 of like certificates. Provision is made for an expenditure of $3,706,000 in improving and extending the systems, the outlay to be paid out of the proceeds of the certificates and the earnings of the various lines. Of this amount $1,500,000 is to purchase new cars; $750,000 for the construction and equipment of two new power stations and a new car barn; $250,000 is to be set aside for the construction and equipment of an extension of a surface line along Pelham Parkway from Fordham station to the Bronx Zoological Park.

NIAGARA FALLS, N. Y.—The Niagara Falls Lighting Company contemplates issuing bonds, the proceeds of which will be used to construct a power plant.

PLATTSBURG, N. Y.—The Home Telephone Company is planning to place its wires in conduits in the principal streets in the city.

PLATTSBURG, N. Y.—A franchise has been granted to the Mountain Home Telephone Company to erect a telephone line through this city to Saranac Lake and surrounding country.

ROCHESTER, N. Y.—The Public Service Commission of the second district has granted the Rochester-Corning-Elmira Traction Company permission to issue bonds to the amount of $4,210,000 and capital stock to the amount of $3,880,000. The company applied for permission to issue $8,000,000 in bonds.

CHARLOTTE, N. C.—The plant of the Patterson Manufacturing Company at China Grove will soon be operated by electricity, which will be furnished by the Southern Power Company, of this city. The Patterson Manufacturing Company is also erecting a large plant at Kannapolis.

BUCYRUS, OHIO.—F. H. Froehlich, of Toledo, consulting engineer, has been engaged by the city to take charge of matters pertaining to the establishment of a municipal electric light plant. The city has two plans under consideration—one the construction of a plant to be owned by the municipality and the other involving the sale of a franchise to a private corporation. Mr. Froehlich has prepared the plans for the proposed municipal electric light plant and in case the plant is to be built will have charge of the construction.

CHILLICOTHE, OHIO.—The water power of Paint Creek will be utilized to generate electricity which will be transmitted to Cincinnati, Springfield, Dayton, Columbus, Chillicothe and other cities within a radius of 175 miles. The main power plant and distributing point will be located at Alum Cliffs, where a 90-ft. dam is to be constructed.

CINCINNATI, OHIO.—Plans are being prepared by Bausmith & Drainie, architects, Johnson Building, for a power house to be constructed on Sixth Street west of Main Street.

DAYTON, OHIO.—Permission has been granted to the Dayton City Railway Company to construct tracks on Lehman Street. The company will also construct a line from Southeast Dayton to Northwest Dayton.

LOGAN, OHIO.—The Village Council is considering the question of building a municipal electric light plant. D. V. Thurness is mayor.

MARION, OHIO.—It is reported that the citizens of Marion have raised sufficient funds to construct an electric railway between this city and Upper Sandusky. It is said that work will commence on the construction of the road within a short time.

SNYDER, OKLA.—An electric light plant, to cost $100,000, is to be erected in Snyder.

WEATHERFORD, OKLA.—The City Council has been petitioned to call an election for the purpose of voting on the proposition to issue $20,000 in bonds with which to extend the water system and construct a municipal electric light plant.

PORTLAND, ORE.—The City Council has granted a 25-year franchise for an interurban railway from Portland to Hillsboro via Mount Calvary Cemetery. H. Wittenberg is interested in the enterprise.

FRANKLIN, PA.—It is reported that the plant of the Franklin Electric Light Company has been purchased by Frank Custer, of Franklin.

HAMBURG, PA.—The Hamburg Electric Light Company on May 1 took over the plant of the Hamburg Electric Light, Heat & Power Company and will make additions to the plant to provide for a power service. The company is now installing a 60-kw, 220-volt, direct-current generator, erecting additional lines for power service, and will be in the market for an engine and boiler. The arc lighting system will be changed from open to enclosed arc lamps. The officers of the company are: H. L. Houck, of Scranton, president; W. L. Houck, of Scranton, secretary and treasurer, W. M. Bell, of Conshohocken, general manager, and Frank H. Curtis, local manager.

HARRISBURG, PA.—The Mt. Holly & Gettysburg Street Railway Company has been chartered, with a capital stock of $18,000, to build an electric railway three miles in length from Mt. Holly Park to Hunters Run and State Belt Railroad. The new road will practically be an extension of the Carlisle & Mt. Holly Electric Railway. It is expected that the road will be extended to Gettysburg. The directors are: T. M. Nelson, of Chambersburg; A. H. Nelson, W. M. Alexander, C. H. Mullin, William McGowan, W. T. Pascoe and Frank A. Birmingham.

LANCASTER, PA.—The Lancaster & York Furnace Street Railway Company contemplates extending its lines from Millersville to this city, a distance of six miles.

MAUCH CHUNK, PA.—The plant and holdings of the Carbon Street Railway Company were sold at auction to A. S. Keck, of Allentown, L. Lentz and J. M. Driesbach, of Mauch Chunk, who held the bonds of the company, for $20,000. The new owners will operate the plants at Mauch Chunk and Lehighton.

NORRISTOWN, PA.—Plans are being considered to place the wires of the municipal electric light plant underground, bids for which work will be received in June. W. G. Risdon is superintendent.

UNIONTOWN, PA.—The City Council has awarded the contract for street lighting to the West Penn Electric Company, of Connellsville, to run until Jan. 1, 1912. Under the terms of the contract the company is to furnish 156 arc lamps at $70 per lamp per year each.

WEST CHESTER, PA.—Plans are being made by the United Telephone Company for extensive improvements to its local system, which includes the installation of a new cable system. The cost of the work is estimated at $50,000.

WESTERLY, R. I.—The Town Council has granted a franchise to the Ashaway & Westerly Railway Company on condition that the road would be completed within one year.

ABBEVILLE, S. C.—The city has entered into a contract with the Abbeville Water, Light & Power Company whereby the city is to become owner of the electric light plant. As the franchise of the company would expire in a little over a year and the electric plant is in need of repairs the company did not care to go to the expense of making them for so short a period, so the city decided to purchase the property and operate it. The price to be paid will be about $12,500 and the city will spend in addition the same amount to put the plant in good condition. It is proposed to call an election to vote on the proposition to issue $25,000 in bonds for this purpose.

BEAUFORT, S. C.—An election will soon be held to vote on a bond issue to purchase the present water works plant or the erection of a new plant and installation of an electric lighting system. For further information inquire of C. A. Townsend.

TOWNER, S. D.—The Northern Valley Telephone Company has been granted a franchise to build telephone lines along the county roads.

WOLSEY, S. D.—It is reported that Mr. Hatcher has been granted a franchise to establish and operate an electric light system in this city.

CHATTANOOGA, TENN.—George Becking, of this city, has been awarded the contract for the construction of the new power house at the Central Depot for $8,000.

CHATTANOOGA, TENN.—Work has been started on the construction of the power-house of the lock and dam at Hale's Bar for the Chattanooga-Tennessee River Power Company. Wilson & Baillie Manufacturing Company, of New York, N. Y., have the contract for the work and expect to have the plant ready for the installation of machinery by Oct. 15. The company is working 24 hours a day, and in order that the crews may work at night it has been necessary to install an electric lighting plant. A large Westinghouse generator is being installed to furnish electricity for lighting the system. At present two small dynamos are in use, which will be held to use in case of emergency. John Bogart, 16 Exchange Place, New York, N. Y., is engineer for the power company.

EL PASO, TEX.—Permission has been granted by the War Department to Mr. Tobin, of this city, to construct a street car line into the military reservation at El Paso.

GALVESTON, TEX.—All bids opened on April 13 for furnishing and installing series arc lamps along the Galveston County Boulevard have been rejected, and new bids will be received on June 8. John H. Murch is county auditor.

PRAIRIE VIEW, TEX.—Bids will be received until June 8 by the Agriculture and Mechanical College, College Station, for electric wiring, etc., for a building to be erected at Prairie View.

TAYLOR, TEX.—The Citizens' Electric Light & Power Company has purchased new equipment for its plant, including new dynamos, boilers, engines and other apparatus, and will discard the old equipment purchased from the Taylor Electric Light Company.

BEAVER CITY, UTAH.—Orders have been placed by the Indian Queen Mining Company with the Utah Mining Machinery & Supply Company for electrical equipment, consisting of a 50-hp compressor, three sets of machine drills and other apparatus, to be installed in the Indian Queen Mine in Beaver County. Electricity for operating the machinery will be supplied by the Beaver County Power Company from its new plant near Beaver City, the transmission line to be tapped at Newhouse.

SALT LAKE CITY, UTAH.—The Salt Lake City & Ogden Railway Company has decided to equip the portion of its road in Ogden to be operated by electricity immediately. The work as now planned will involve an expenditure of about $500,000 in Salt Lake and Weber Counties. The company attempted to get a temporary permit to operate steam cars in Ogden. Simon Bamberger is president of the company.

ROANOKE, VA.—Plans are being prepared by the Roanoke Water Power Company to light the streets and public places in the city, for which the company has a five-year contract. About 250 arc lamps will be furnished. R. C Camp is general manager

SEATTLE, WASH.—The contract for the construction of the Seattle-Tacoma Shore Line Interurban Railway has been awarded to A. D. McInnes. Merle J. Wightman is chief engineer of the company.

SPOKANE, WASH.—Bids will be received until June 23 at the office of James Knox Taylor, U. S. supervising architect, Washington, D. C., for the installation of a conduit and electric wiring system in the U. S. post office, court house and custom house at Spokane.

WENATCHEE, WASH.—The Wenatchee Electric Company is planning to erect a power plant on the Icicle River near Leavenworth. The plant will have an output of 12,000 hp.

ALLENTON, WIS.—The Allenton Telephone Company is planning to extend its system west of Allenton.

ATHENS, WIS.—The Athens Telephone Company contemplates the construction of a number of rural lines.

CHILTON, WIS.—The citizens are contemplating establishing a municipal electric light plant, and a committee has been appointed to investigate the matter. T. J. Glenn is chairman of the committee.

CUMBERLAND, WIS.—The Town Council is considering the question of holding an election to vote on the proposition to issue bonds for the erection of an electric light plant and city hall.

MADISON, WIS.—Bids will be received until June 10 by Lew F. Porter, secretary of the Capitol Commission, for furnishing the pumping apparatus required for the heat, light and power plant now being erected at the capitol, consisting of two horizontal duplex, direct acting steam pumps, with a rating of 400 gal. each per minute; two horizontal motor-driven centrifugal fire pumps having a rating of 2,000,000 gal. per 24 hours. Plans may be seen and specifications and blank proposal forms secured at the office of the commission.

MILWAUKEE, WIS.—It is reported that bids will be received in July for installing a heating and power plant in the Auditorium Building, the cost of which is estimated at $10,000.

MILWAUKEE, WIS.—Permission has been granted the Plankinton Light & Heat Company to distribute energy for lighting and heating within the territory bounded by the Milwaukee River, Wells Street, Clybourn Street and Sixth Street. The company owns tunnels extending from its power plant westwardly to Third Street and smaller tunnels running under Grand Avenue to connect with the Loan & Trust Building and other buildings on the north side of Grand Avenue. It now proposes to continue the tunnel from Third Street under the alley adjoining the Davidson Theater to Fourth Street.

EDMONTON, ALTA.—The Public Works Department has awarded the contract for the construction of 700 miles of long-distance telephone lines to the Northern Electric Company, of Montreal and Winnipeg.

CRANBROOK, B. C., CAN.—Plans are being prepared by the Cranbrook Electric Light Company for the construction of a hydro-electric power plant to be erected on the St. Mary's River, eight miles from Cranbrook. The equipment will consist of three units of 500 kilowatts each. The company proposes to construct transmission lines to Morgie, a distance of 25 miles, and to Marysville, five miles distant. A. L. McCulloch, of Nelson, is consulting engineer.

KINGSTON, ONT., CAN.—It has been found that the municipal electric plant is supplying electrical energy to the street railway company below cost. The company pays 1.66 cents per kw-hour at the switchboard, and it costs the city 1.94 cents per kw-hour to produce it. It is expected that the question of municipal ownership of the street railway will be submitted to the people at the election next January.

PRESTON, ONT., CAN.—The Town Council has authorized the Mayor and Clerk to enter into a contract with the Hydro-Electric Power Commission for 600 hp at the rate of $23 per horse-power per year. Of this the town is liable for 60 per cent of the total.

TORONTO, ONT., CAN.—The Toronto Electric Light Company has been granted permission to erect a substation at the corner of Tecumseh and Defoe Streets to cost $20,000.

WOODSTOCK, ONT., CAN.—The City Council has authorized the Mayor to enter into a contract with the Hydro-Electric Power Commission for 1200 hp, to be delivered by Dec. 19, 1909.

AIRDRIE, SASK., CAN.—A rural telephone company is being formed here. About 26 miles of pole line will be erected.

WOLSELEY, SASK., CAN.—The Central Light & Power Company writes that it will install additional equipment in its plant in the near future, which will consist of a 150-hp gas engine and suction gas producer and a 90-kw, alternating-current generator.

New Industrial Companies.

THE HENRY F. FARROW COMPANY, of Cambridge, Mass. (electricians), has been incorporated, with a capital stock of $10,000, by Henry F., William G. and William S. Farrow.

THE GENERAL ELECTRIC INSPECTION COMPANY, of St. Louis, Mo., has been incorporated, with a capital stock of $50,000, by Oscar F. Sparta, James K. Gregg and Jesse W. Bassett.

THE BLAKE ELECTRICAL COMPANY, of Portland Maine., has been incorporated, with a capital stock of $100,000. The officers are: H. C. Plummer, president, and C. L. Marston, of Yarmouth, treasurer.

THE W. S. KILMER COMPANY, OF NEW YORK, N. Y., has been incorporated, with a capital stock of $1,500, by William S. Kilmer, George W. Fowler and William Siebenmorgen, of New York City. The company proposes to do electrical work.

THE McMORROW ENGINEERING & CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $10,000, by Patrick McMorrow, James W. McMorrow and Charles P. McMorrow, all of New York, N. Y.

THE MUSSO ELECTRICAL TRANSMISSION COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $50,000, by Guiseppe Musso, William P. Voorhees, Charles C. Finkler, of New York.; Charles L. Bowler, of Monmouth Beach, N. J. The company proposes to do a general mechanical and electrical engineering business.

THE TWENTIETH CENTURY ELECTRIC & REPAIR COMPANY, of Akron, Ohio, has been organized for the purpose of doing a general electric, power and repair business. The officers of the company are as follows: C. J. Begler, president and general manager; George J. Shaffer, vice-president; J. M. Hassler, secretary, and F. M. Hanson, treasurer.

THE CARQUINEZ ELECTRIC & CONSTRUCTION COMPANY, Martinez, Cal., has been incorported with a capital of $20,000. The principal place of business of the company will be in Martinez and branches will be maintained at Concord, Antioch and Crockett. E. W. Jensen is the president of the new company, Joseph Mayo is secretary, and the district managers are C. L. Pingree at Concord, F. C. Woolcott at Antioch and M C. Arnold at Crockett. The purpose of the company is to do a general electrical construction business, to install motors and plants and to deal in electrical supplies. Electrical cooking utensils will also be handled by the company.

New Incorporations.

HUMPHREY, ARK.—The Humphrey Telephone Company has been organized, with a capital stock of $10,000, to construct a telephone system in Humphrey and to construct a line to Altheimer. The officers of the company are: J. T. Stokes, president; C. M. Anthony, vice-president; S. Sachs, secretary, and J. F. Quartermous, treasurer.

LOS ANGELES, CAL.—The Glendora Light & Power Company has been incorporated with a capital stock of $20,000 by J. A. Jones, C. S. Whitcomb, J. A. Weaver, W. Y. Hall and W. E. Wamsby.

RIVERSIDE, CAL.—Articles of incorporation have been filed for the Whitewater Land & Power Company for the purpose of locating, acquiring and developing water rights. The capital stock of the company is placed at $500,000, and the directors are H. Edwin Moore, J. E. Cowles, Arthur E. Poole, of Los Angeles; John E. Coffin, of Whittier, and W. B. Scarborough, of Monrovia.

WILMINGTON, DEL.—The United Electric Company of Cuba has filed articles of incorporation with a capital stock of $50,000. The incorporators are: Louis M. Harvey, Willard D. Farnune, Robert E. Hollinsworth, of Havana, Cuba.

ALTON, ILL.—Articles of incorporation have been filed for the Wood River, East Alton & Bunker Hill Traction Company to construct an electric railway from the site of the new Standard Oil Works, in Madison County, to Gillespie, where it will connect with the Illinois Traction system. The directors are J. T. W. Rudesill, R. M. Smith, S. B. Knepper, D. R. Maxey and B. A. Campbell, of East St. Louis.

CARMAN, ILL.—Articles of incorporation have been filed for the Carmen Farmers' Telephone Company, with a capital stock of $2,500. The incorporators are F. F. Rehling, Thomas Dixon, H. N. Vaughn and others.

DE KALB, ILL.—The Exchange Telephone Company has been organized to construct a telephone system, which is to cover all of De Kalb County north of the Burlington Road.

RUSHVILLE, ILL.—The Pokeberry & Rushville Mutual Telephone Company, of Pokeville Schoolhouse, has been incorporated, with a capital stock of $180, by George S. Garrick, John H. Boice and Henry J. Schroder.

PLEASANT GROVE, IND.—The Silver Valley Telephone Company has been organized and the following officers elected: Carl Holtz, president; Frank Reynolds, vice-president; Jesse Dowden, secretary, and Thomas Bridgewater, treasurer.

FULLERTON, KY.—The Fullerton Power & Light Company has been incorporated by Albert Smith, Frank Swearingen and others.

FORT FAIRFIELD, MAINE.—The Fort Fairfield Light & Power Company has filed articles of incorporation, with a capital stock of $21,000. The officers of the company are: D. E. Edwards, president; H. T. Powers, treasurer.

JACKSON, MICH.—The South Bunkerhill & North Henrietta Telephone Company has been incorporated, with a capital stock of $1,000, by A. A. Call, B. D. Grow, J. L. Artz, George C. M. Titus and others.

PIPESTONE, MINN.—The Pipestone Creek Telephone Company has been organized and the following-named officers elected: J. V. Pierce, president; Herman Buhman, vice-president; E. S. Crossman, secretary, and Henry Gulch, treasurer.

WESTBROOK, MINN.—The Westbrook Telephone Company has been incorporated, with a capital stock of $5,000, by P. J. Johnson, Alfred Arenson, L. L. Hedman, I. O. Iverson and Martin Uvaas.

REEDS, MO.—The Spring Independent Telephone Company has been incorporated to install a local system and to erect a line to Larussell, by J. E. Poncot, Adam Palmer, Joseph Luys, Jesse Burks, G. A. Luys, I. Whaley and others. P. O. address, Reeds Rural Route No. 2.

GLENDIVE, MONT.—The Montana Eastern Telephone Company has been incorporated to construct a telephone line from Glendive to Miles City. The officers of the company are: H. J. Haskell, president; William Lindsay, vice-president; Frank C. Hughes, secretary and manager, and L. R. Barnett, treasurer.

JOY, NEB.—The Pleasant Valley Telephone Company has been organized by John A. Robertson, Harry Spindler, Lysle McRoberts, George Hansen and others. The company has taken over the Verdigris lines from Scottville to O'Neill, and contemplates extensive improvements and extensions to the system.

BAYONNE, N. J.—The Patapsco Electric Company has been incorporated, with a capital stock of $500,000, to generate and distribute electricity. The incorporators are Charles S. Noe, Frederic C. Earl and George Carrigan, of Bayonne, N. J.

ERIN, N. Y.—Articles of incorporation have been filed for the Erin & Swartwood Telephone Company. The capital stock is placed at $750, and the directors are Samuel Houck, J. J. Hollenbeck, Charles W. Park, Marshall F. Drake, Chauncey E. Rosekrane, J. C. Munson, of Erin, and Tyler Woolever, of Swartwood.

MIDVALE, OHIO.—The Midvale Telephone Company has been incorporated, with a capital stock of $10,000, by Robert Jackson, L. G. Kay, C J. Hallstrom, George W. Williams, A. M. Reed and others.

NORTH BALTIMORE, OHIO.—The North Baltimore Light & Power Company has been incorporated with a capital stock of $30,000 by H. B. Goodloe and others.

OTSEGO, OHIO.—The Northwestern Telephone Company has been organized for the purpose of building a telephone line from this city to Cambridge. The officers of the company are: H. A. Duff, president; Elmer Duff, vice-president; James Stewart, secretary, and Daniel Duff, treasurer.

PLYMOUTH, OHIO.—The Plymouth Telephone Company has filed articles of incorporation, with a capital stock of $4,100, by E. L. Wescott, W. W. Mann, W. G. Holcomb, M. M. Castle and others.

ADAIR, OKLA.—Articles of incorporation have been filed for the Adair Telephone Company. The company is capitalized at $5,000 and the incorporators are: A. W. Herron, S. P. Ferguson, R. E. Delozier and others.

HEWITT, OKLA.—The Hewitt Telephone Company has been incorporated with a capital stock of $1,500, by A. B. Davis, T. J. Pollack, of Sneed; C. J. Gill, of Hewitt; P. R. Davis, of Healdton, and S. T. Ganaway, of Wheeler.

INDEPENDENCE, OKLA.—Articles of incorporation have been filed for the Independence Telephone Company. The capital stock is placed at $1,000, and the incorporators are: J. C. Husted, J. H. Todd, J. L. Goodrich, J. W. Sherrod, B. M. Carr and J. H. Pope.

OKLAHOMA CITY, OKLA.—The Oklahoma City Belt Line Railroad Company has been incorporated, with a capital stock of $250,000. W. W. Bierce, of Oklahoma City, is one of the incorporators.

OKLAHOMA CITY, OKLA.—The Algonquin Light & Power Company has been incorporated, with a capital stock of $100,000, by T. F. Speelman, of Chicago, Ill., and R. S. Galer, of Hanna, Ind., and others.

OKLAHOMA CITY, OKLA.—The Oklahoma, El Reno & Shawnee Rapid Transit Railway Company has been incorporated with a capital stock of $1,500,000. The incorporators are Chas. A. Huber, J. A. Niblo, W. M. Sawyer and S. L. Niblo, of Oklahoma City, and Chas. E. Davis, of Lugert.

SAPULA, OKLA.—Articles of incorporation have been filed for the Farmers' Mutual Telephone Company, with a capital stock of $50,000, by E. E. Coulter, of Chaney; F. M. Moyer, of Alexander, and E. M. Smoot, of Shattuck.

STILWELL, OKLA.—The Stilwell Public Service Company has been incorporated with a capital stock of $50,000 by W. H. Davis, of Stilwell; B. H. Whitaker, of Westville, and Clyde F. Burns, of Chicago, Ill.

WEATHERFORD, OKLA.—The Weatherford Telephone Company has been incorporated, with a capital stock of $15,000, by S. S. Wilks, L. O. Wilks and F. Pigg, all of Weatherford.

CONDON, ORE.—The Wasco County Electric & Power Company has been incorporated to build an electric railway from Condon to Antelope, Madras and Bend, with branches to Howard and Dayville. It is expected that large power plants will be erected on the Deschutes and John Day Rivers to generate electricity to operate the railways. The incorporators are: George S. Carpenter, of Fossil; Mark W. Gill, W. H. Grindstaff, Dr. H. I. Kenney, R. L. Donald, H. J. Martin, O. B. Hathaway, E. P. Schow, C. D. Charles and F. S. Munn.

LINNTON, ORE.—The Home Telephone Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are: M. Crandall, W. F. Harriss, J. C. Noyes and others.

PRINEVILLE, ORE.—The Bear Creek Telephone Company has been incorporated by John Milliorn, James Cram and W. F. Kong.

BALFOUR, PA.—The Farmers' Rural Telephone Company has been organized to construct a telephone system between Carlisle and this city.

HARRISBURG, PA.—The Schuylkill & Dauphin Traction Company has been granted a charter, with a capital stock of $25,000, to build an electric railway connecting towns in Lykens Valley with lines in Schuylkill County at Tower. The incorporators are: J. W. Mayer, secretary; Edgar D. Rank, Malcolm G. Stewart, L. H. Schappell and N. D. Yoder. W. E. Harrington, president of the Eastern Railways Company, controlling the lines about Pottsville, is interested in the company, and as soon as preliminaries can be arranged the Lykens & Williams Valley Electric Railway Company will be absorbed by the new company.

NEWVILLE, PA.—The Big Spring Electric Company has been chartered with a capital stock of $15,000, by D. H. Keller, of Newville; C. W. Hosfield and John Hosfield, of Shippensburg.

PITTSBURG, PA.—Articles of incorporation have been filed for the O'Brien Electric Light Supply Company by W. H. Smith, R. R. McElhany and F. G. Strathmann, of Pittsburg. The company is capitalized at $25,000.

VANDLING, PA.—The Anthracite Telephone Company has been organized to construct rural telephone lines in Susquehanna County. The officers of the company are: S. S. Jones, president; Andrew Mitchell, Jr., vice-president; M. D. Lathropel, secretary and treasurer.

WASHINGTON, PA.—The National Telephone Company, which is a consolidation of the State Mutual Telephone Company, the State Mutual of Canonsburg, the Claysville Telephone Company, the West Alexander Telephone Company, and three farmer companies, has been organized here. The company represents a combined capital of $100,000, and the following officers have been elected: John A. Howard, of Wheeling, president; W. C. Handlan, of Wheeling, secretary, and T. B. Lee, of Crafton, general manager. The new company contemplates making many extensions to its system.

NINETY-SIX, S. C.—The Independent Telephone Company of Ninety-Six has been organized. E. S. Moorer, of Andeson, S. C., will have charge of the construction of the plant.

GEDDES, S. D.—The Farmers' Telephone Company has been organized, with a capital stock of $10,000, for the purpose of constructing an extensive farmers' telephone system in South Dakota. The officers of the company are: K. Schipper, president; C. A. Van Zante, secretary; Peter Nieveen, treasurer, and Nicholas Poelstra, manager.

NASHVILLE, TENN.—Articles of incorporation have been filed for the Home Telephone Company of Trousdale County. The capital stock is placed at $1,000 and the incorporators are: J. H. Rickman, P. E. Burnly, J. B. Johnson, E. M. Haynie, Albert Wakefield and J. E. Faust.

NEW KNOXVILLE, TENN.—The Auglaize Telephone Company has been incorporated with a capital stock of $10,000, by George W. Hall and others.

TELFORD, TENN.—Articles of incorporation have been filed for the Telford Mutual Telephone Company. The capital stock of the company is placed at $5,000.

BULVERDE, TEX.—The East Bulverde Telephone Company has been formed by Alfred Toepperwein, of Bulverde.

DAWSON, TEX.—The New Telephone Company has been organized in this city. D. D. Sawyer is manager.

RICHLAND, TEX.—The Richland Telephone Company has been organized by J. I. McCrary, W. P. McCrary and others, of Richland. The company proposes to install a telephone system in this city, and to extend its lines to Pisgah Ridge, Currie and Corsicana.

SAN ANGELO, TEX.—Articles of incorporation have been filed for the San Angelo Power & Traction Company. The company is capitalized at $50,000, and the incorporators are T. M. Vaughan, J. A. Williams and W. D. Fuller.

SOMERVILLE, TEX.—Articles of incorporation have been filed for the Somerville Light & Ice Company by J. D. Giddings, R. E. B. Bledsoe, of Somerville, and others. The capital stock of the company is placed at $25,000.

WAXAHACHIE, TEX.—The Buena Vista Telephone Company has been organized with a capital stock of $2,000, by C. W. Davis, D. L. Owen and L. J. Paul.

LEDA, VA.—Articles of incorporation have been filed for the Leda Telephone Company. The capital stock is placed at $10,000, and the following officers elected: E. O. Hubbard, of Leda, president; R. L. Coleman, of Riveville, vice-president; W. T. Shotwell, of Cody, secretary and treasurer.

WOODLAWN, VA.—The Galax Mutual Telephone Company has been incorporated, with a capital stock of $7,995, and the following-named officers elected: C. D. Dobyns, president, and W. C. Winesett, secretary and treasurer.

BAKER, WASH.—The Skagit River Telegraph & Telephone Company has been organized, with a capital stock of $5,000, and the following-named officers elected: R. J. Kellogg, president and treasurer; E. C. Miller, vice-president, and J. K. Merz, secretary.

LANGLEY, WASH.—The Whidby Telephone Company has been organized and the following-named officers elected: C. E. Freese, of Clinton, president; J. S. Cattose, vice-president; H. M. McLeod, of Langley, secretary, and H. Bosshard, treasurer.

VASHON, WASH.—The Vashon Island Telephone Company has been incorporated, with a capital stock of $20,000. H. Harrington is president.

ORIENT, WASH.—Articles of incorporation have been filed for the Orient Water Power Company by Arthur Phillips, E. D. Sanders, H. D. Merritt, H. P. Bouffleau and A. D. Mars. The company proposes to furnish water for domestic purposes to the town of Orient and also to generate electricity.

HUNTERSVILLE, W. VA.—The Hills & Browns Creek Telephone Company has been incorporated with a capital stock of $5,000, by C. D. Moore, C. Beverage, Peter McCarthy, C. K. Moore, J. W. Grimes, all of Huntersville.

BROWNSVILLE, WIS.—The Otter Creek Telephone Company has been organized to install a telephone system in this city. F. M. Hollinveck is secretary.

COON VALLEY, WIS.—The Coon Valley Farmers' Telephone Company has been organized in this city and is planning to erect telephone lines between Stoddard and Westburg.

DEER PARK, WIS.—The Deer Park Telephone Company has been incorporated, with a capital stock of $750, by John T. Thompson, Adelbert H. Chadwick and Frank Jabusch.

MAYVILLE, WIS.—The Mayville Rural Telephone Company has been incorporated, with a capital stock of $2,400, by Albert Zastrow, F. A. Justman, H. F. Ringle and others.

MILWAUKEE, WIS.—The Independent Telephone Construction Company, of Milwaukee, has been incorporated, with a capital stock of $10,000, by H. D. Critchfield, S. B. Wayland and R. W. Dunlap.

MILWAUKEE, WIS.—The Southwest Prairie Telephone Company, of Sterling, Vernon County, has been incorporated, with a capital stock of $1,000, by A. P. Bringe, Scott Sanwick, George T. Jerman and others.

MOYIE, B. C., CAN.—The Moyie Telephone & Electric Light Company has been incorporated, with a capital stock of $10,000.

BINBROOKE, ONT., CAN.—The Barton & Binbrooke Telephone Company has been organized by T. E. Tidy, of Hannon; H. Johnston, of Binbrooke; W. Kennedy, of Barton, and N. Laidman, of Binbrooke.

WEST FLAMBOROUGH, ONT., CAN.—The West Flamborough Telephone Company has been organized to construct rural telephone lines. W. C. Hubbell, of Thamesville, is interested in the enterprise.

CANORA, SASK., CAN.—The Canora Rural Telephone Company will soon apply for a charter with power to erect rural telephone lines centering at this city. J. W. Fennell is interested in the project.

Personal.

MR. F. P. FISH has resigned as a director of the General Electric Company. Mr. Fish has during the past year been withdrawing from all corporations with which he was connected, for the purpose of devoting his time entirely to the practice of law.

MR. R. B. FRANCIS, formerly of the Federal Electric Company, Chicago, has recently become sales manager of the Royal Enameling and Stamping Works, of Des Plaines, Ill., with offices at 156 Fifth Avenue, Chicago. This company makes enamelled steel for all purposes, including enamelled reflectors and signs.

HARRIS, CRAVEN & VON BORRIES.—This new firm of engineers and contractors has been formed at Louisville, Ky., with headquarters in the Paul Jones Building. It will do general engineering, but will specialize in civil and mining work and telephone and conduit construction. Mr. J. T. Craven is a railroad engineer of five years' experience, and Mr. W. J. Von Borries has been chief engineer and superintendent of large coal mining properties. Mr. W. R. Harris has had an experience of 14 years, including telephone construction, sewer work, power plants, railway construction and conduit systems for all classes of cables and mains.

MR. ROBERT DAHLANDER has resigned the position of chief engineer for the Swedish State Railways and is now president of the Municipal Gas & Electric Corporation, of Stockholm. Mr. Dahlander was born in Goteborg in 1870 and graduated from the Royal Technical Institute of Stockholm in 1890. He has held positions with several large electrical manufacturing and operating companies in Sweden and abroad, and in 1903 was employed by the board of directors of the Swedish State Railways as expert to supervise the tests to determine the expediency of adapting electric motive power for propelling the trains and also the relative merits of apparatus now available. These tests are now completed, and Mr. Dahlander's report, which has been awaited with great interest by engineers all over the world, has been submitted to the government. The report is published in Swedish, but will be translated into English and German later.

Obituary.

MR. WILLIAM P. BOARDMAN died at his home in Deshet, S. D., May 21, and will be buried in Binghamton, N. Y. Mr. Boardman built the first street railway in America, and superintended the construction of the old New York & Harlem Railway, the line which now nearly corresponds with the Fourth Avenue Railway, and connected the Bowery with Harlem, in New York City.

WILLIAM DANA EWART.—The death at Rome, Italy, on Sunday, May 3, of William Dana Ewart will be noted with keen regret by those whom his genial disposition had made his friends and also by the many others to whom his most prominent invention has made his name familiar. Mr. Ewart was born in Ohio about 56 years ago, and at a comparatively early age gave evidence of an inventive mind and rare mechanical ability. He was the inventor of the malleable-iron, detachable drive chain, first known under his name and in later years as link-belt, which has formed an important part of agricultural and other duplicate machinery and has to possibly a greater extent than any other single invention helped the wonderful progress in the development of elevating and conveying machinery during the past 30 years. This drive chain has been continuously manufactured by the Ewart Manufacturing Company and exploited by the Link-Belt Machinery and Link-Belt Engineering Companies, till in 1906 all three companies were consolidated into the Link-Belt Company, a corporation in which he was largely interested and whose fortunes are still largely directed by his former associates. Mr. Ewart, whose abilities brought their proper reward, was not only an inventor, but a man of executive capacity, possessing a rare gift for harmonizing differences and securing co-operation. His health becoming impaired, he retired in his early prime from the activities of business and sought renewal of physical strength under more favorable climatic conditions abroad.

WILLIAM DANA EWART.

Legal.

AN INJUNCTION TO STOP CONDEMNATION PROCEEDINGS.—An application was made May 19 in the Supreme Court at Columbia, S. C., by John C. Meekin for an injunction restraining the Central Carolina Power Company from instituting condemnation proceedings to secure certain rights at the power development to be made by the Central Carolina Power Company on Broad River between Frost's Mill and Alston. The temporary injunction was not granted, but an order to show cause why the injunction should not be granted was signed by the court and made returnable May 25. The petition alleges that the Act of 1906 granting the charter of the concern is unconstitutional, in that it is special legislation; that it proposes to give rights of a navigable stream to private parties; that it takes private property without the consent of the owner. The Central Carolina Power Company is said to be owned by A. E. Gonzales and W. H. Lyles, of Columbia, S. C.

PRESUMPTION THAT WIRES ARE DEFECTIVE IN CASE OF INJURY BY CONTACT.—Under the law of Missouri, when injury or death is caused by coming in contact with an electric wire, it is conclusively presumed that the insulation on the wire was defective. And it was held not necessary for the plaintiff, in an action against an electric light company for damages for the death of an employee, to prove that the insulation was worn off the wire at the point of contact, where the death occurred under the following circumstances: The plaintiff introduced evidence tending to prove that the kind of insulation used on defendant's wires, at the time and place of the injury, was not reasonably safe for a place of that character; and that "circular loom," a better and safer, insulation could and might have been used by the defendant. The deceased at the time of his injury had been repairing some wires, to reach which it was necessary to pass the wires of the defendant company on his way up the pole. He was familiar with their location, the current they carried and the danger incident to coming in contact with them. The job was an emergency job, and all linemen were pushed. He mounted the pole in safety, and the injury occurred while he was on his way down to the ground. Von Trebra v. Laclede Gaslight Co., Supreme Court of Missouri, 108 S. W., 559.

TELEPHONE COMPANY'S LIABILITY FOR REFUSAL TO RENDER SERVICE IN ACCORDANCE WITH CONTRACT.—The contract between a telephone company and municipal authorities, under which the company was granted franchises to operate lines, provided that the company would render telephone service to parties not living on its lines if such parties would construct a line to within 1½ miles of one of the company's exchanges. In such event the company was entitled to $2 per year for each instrument used. Acting under this provision, another telephone company, with the knowledge of the defendant company constructed a line five miles long, which brought it within 1½ miles of one of the defendant's exchanges. The defendant company, however, refused to connect with the new line, and the company constructing it brought an action for damages to cover the loss it had sustained by the defendant's refusal to connect the lines. The defendant claimed that it was ready and willing to construct a line such as had been erected by the plaintiff company and to furnish telephone service at the regular subscriber's rate of $1.65 per month for each instrument. But it appeared that the defendant company made no offer to construct the line until after the plaintiff company had started the work and, in fact, had it nearly completed, and so it was held that the plaintiff company was entitled to recover damages. If upon being informed of the plaintiff company's intention the defendant had expressed its readiness to construct the line a different case would have been presented. Under the existing facts the defendant was liable as for a breach of contract. Cumberland Telephone & Telegraph Co. v. Cartwright Creek Telephone Co., Court of Appeals of Kentucky, 108 S. W. Rep., 875.

ELECTRIC COMPANY NOT LIABLE FOR INJURY CAUSED BY ITS WIRES UNLESS NEGLIGENCE ON ITS PART IS SHOWN.—An electric light company is not liable for the death of a person resulting from contact with the company's wires merely upon the showing that such an accident occurred. Where one, who went on the roof of a building to inspect some work which had there been done by his employees, and the evidence in the case showed nothing more than that the deceased was found after the accident with the wire which caused his death still clutched in his hand, it was decided that the company was not liable. It was not shown in what manner the deceased came to touch the wire, and, though he was rightfully upon the premises where the accident occurred, still his death might have been directly due to his own negligence. While electric companies are bound to use the highest degree of care practicable to avoid injury to everyone who may be in lawful proximity to their wires, yet the ordinary person is held to know that danger attends contact with the electric wires, and it is his duty to avoid them so far as he may. If one heedlessly brings himself in contact with such a wire, and is injured in consequence, his imprudence must be regarded as a contributing cause, and will prevent a recovery. It is the duty of a plaintiff seeking to recover, when the gravamen of the action is the alleged negligence of the defendant, to show a case clear of contributory negligence on his part. In other words, he must establish a prima facie cause of action, resulting exclusively from the negligence and wrong of the defendant, before the latter need answer at all. In the words of the court: "It may be that the unfortunate man who here lost his life stood clear of contributory negligence, and that his death resulted from something for which he was not responsible, not being under his control; but there was nothing shown in the case upon which such a conclusion could rest." Haertel v. Pennsylvania Light & Power Company, Supreme Court of Pennsylvania, 69 Atl. 282.

Trade Publications.

PRISMATIC REFLECTORS.—The F. Bissell Company, Toledo, Ohio, has issued a bulletin devoted to Holophane reflectors and clusters which it now carries regularly in stock.

SOLDER.—The L. B. Allen Company, Chicago, Ill., has issued a booklet devoted to soldering paste and a leaflet showing how the Allen soldiering stick should be used.

ALTERNATORS.—Belted-type, alternating-current generators rated at from 35 to 200 kw-amperes are treated in Bulletin No. 95 of the Crocker-Wheeler Company, Ampere, N. J.

STORAGE BATTERIES.—Bulletin No. 9 of the General Storage Battery Company, Boonton, N. J., gives a good technical description of "Peimanized" negative storage battery plates.

PISTON PUMPS.—Bulletin No. BK-811 of the Blake & Knowles Steam Pump Works, 115 Broadway, New York, describes vertical duplex piston pumps rated at from 2 to 410 gallons per minute.

COKE-HANDLING MACHINES.—The Covington Machine Company, Covington, Va., has issued an illustrated catalogue devoted to electrically driven machines for drawing coke from ovens and loading it upon cars.

WATER-TIGHT BOXES.—Bulletin No. 21 of the H. Krantz Manufacturing Company, 160 Seventh Street, Brooklyn, N. Y., is a 52-page publication relating to standard and water-tight boxes for all electrical purposes.

TESTING INDUCTION MOTORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued a vest-pocket folder giving directions, symbols and formulas for determining the performance of polyphase induction motors.

THE F. BISSELL COMPANY, of Toledo, O., has issued a neat calendar for May, with a bit of crooked wire tied to it, emphasizing the crookedness of making up for low prices by inferior quality, low weights or short counts.

SWITCHBOARD PANELS.—Constructive details of direct-current switchboard panels for emfs of from 125 to 250 volts are given in an illustrated bulletin of the Crocker-Wheeler Company, Ampere, N. J., designated as No. 97.

VALVES.—The 1908 catalog of the Lunkenheimer Company, Cincinnati, Ohio, is a 564-page publication devoted to descriptions and price lists of brass and iron valves, whistles, cocks, gages, injectors, lubricators, oil pumps, oil and grease cups, etc.

LUMINOUS ELECTRIC RADIATORS consisting of ornamental cast-iron frames, each fitted with a polished copper reflector at the back and with three or more large cylindrical incandescent heating lamps, are described in an attractive pamphlet recently issued by the General Electric Company, Schenectady, N. Y.

PRISMATIC REFLECTORS.—Bulletin No. 6 of the Holophane Company, New York, is devoted to prismatic reflectors for gem meridian, tantalum and tungsten lamps. For use with the latter type of lamp the company recommends bowl reflectors in sandblast on enamel finish, on account of the excessive brilliancy of the lamp filament.

SERIES TRANSFORMERS.—Catalogue 7 of Ferranti, Ltd., Hollinwood, Lancashire, England, describes open type series transformers. The windings are insulated with mica and impregnated linen cloth on porcelain. The transformers are intended for use with measuring instruments and are built for switchboard mounting or in portable form.

HIGH-TENSION INSULATORS.—The Central Electric Company, Chicago, is distributing a 47-page book devoted to various types of porcelain insulators, covering all voltages found in commercial practice. This catalog on insulators will be mailed upon request, and should be found interesting by consulting engineers, and others interested in high-tension work.

STURTEVANT GENERATING SETS.—Bulletin No. 156, of the B. F. Sturtevant Company, illustrates and describes generating sets, direct-connected to vertical compound engines. Sturtevant generating sets of this type are now built in standard sizes, and from 150 to 500-kw, consisting of vertical and compound enclosed engines, direct-connected to ten-pole generators.

NERNST LAMPS IN CHICAGO.—The May issue of the *Glower*, published by the Nernst Lamp Company, Pittsburg, Pa., gives an illustrated description of the large stores and business houses in Chicago. These installations were considered to afford to students of illumination such a broad field for observation that the company felt that it was unnecessary to arrange a special exhibit at the recent National Electric Light Association Convention.

DIRECT-CURRENT MOTORS.—Bulletin No. 98 of the Crocker-Wheeler Company, Ampere, N. J., describes belt-type, direct-current motors rated at from .05 hp to 5 hp. Bulletin No. 99 of the same company gives an outline of the direct-current motor equipment of the Bethlehem Rail & Structural Mills, where 230-volt machines are used. Belt-driven motors rated at from 5 hp to 45 hp and generators rated at from 45 kw to 40 kw are described in Bulletin No. 100.

WEBER GAS ENGINES.—The Weber Gas Engine Company, Kansas City, Mo., has issued a folder which gives details of an electric light plant in a town of about 1000 inhabitants, which, when financial failure was staring them in the face, due to the lack of economy of the steam power plant, bought and installed a Weber gas power plant. The striking economical performance of the new plant, 1 1/5 lb. of coal per hp-hour, including stand-by losses with repairs of less than $5 in three years, turned a deficit into a comfortable dividend each year.

CLEANING MACHINERY.—The General Compressed Air & Vacuum Machinery Company, 4436 Olive Street, St. Louis, Mo., has issued an extremely artistic catalogue dealing with stationary and portable cleaning equipments built under the Thurman patents. The stationary equipments are driven by an electric motor, which starts automatically when conveniently located push-buttons are depressed. The catalogue contains a long list of hotels, office buildings, theaters, residences and clubs where compressed air and vacuum cleaning equipments are now in use.

INSULATING COMPOUNDS.—The Minerallac Company, of Chicago, Ill., has just issued a catalogue describing insulating compounds and electrical specialties. The cover of the catalogue, which is beautifully engraved, is designed to serve as a receptacle for future bulletins as they are issued by the company. The catalogue contains descriptions of methods recommended for eliminating cable-joint failures, descriptions of the quick-action voltmeter switch, portable cable-testing sets, Minerallac cable and conduit-hangers, and the company's printing attachment for wattmeters.

DIRECT-CURRENT MOTORS.—The General Electric CQ motor is described in detail in a 16-page bulletin designated as No. 4584. This motor, which is for direct-current circuits, is made in ratings up to 20 horse-power and for e.m.fs. of 115, 230 and 550 volts. Descriptions are given of belt-tightener attachments, back-geared devices, motor-generator sets consisting of two CQ motors connected rigidly together, etc. The application of the motor to linotype equipments, ventilating outfits, machine tools, etc., is also outlined. The extensive tables of dimensions, capacities, etc., in the bulletin will be found very useful in preparing specifications.

RHEOSTATS.—The Ward Leonard Electric Company, Bronxville, N. Y., has ready for distribution the following new catalogs: Catalog A2, covering motor starters with switch and fuse attached; Catalog A4, covering navy type motor-starting panels, approved by the Bureaus of Construction and Equipment, Repair and Steam Engineering; catalog A7, covering motor-starters equipped with 20 steps of resistance for speed control by field regulation; catalog A9, motor-starters arranged for back of board mounting; catalog A10, reversing motor-starters; catalog A12, self-starters; catalog B1, motor speed controllers; catalog H1, battery charging rheostats, and catalog F1, theater dimmers.

LUMINOUS ARC HEADLIGHT.—Under the title "Two Aids to Better Service," the General Electric Company, Schenectady, N. Y., has issued a folder (No. 3654) calling attention to some of the reasons why the G. E. luminous arc headlight has been adopted. On the front page are pictures of the headlight and the Belmont Tunnel, New York, the "Two Aids to Better Service." Among the advantageous features of this headlight are economy in operation, efficiency, convenience, reliability and low maintenance cost. A list of a few of the roads now using them is included.

WORK ON FIVE CONTINENTS.—An 82-page booklet printed in two colors and containing a choice collection of artistically arranged views from all parts of the world has been published for giving an account of the activities of the following associated organizations: J. G. White & Company, Inc., New York; J. G. White & Company, Ltd., London, England; Waring White Building Company, London, England; Canadian White Company, Ltd., Montreal, Canada. Brief outlines are given of more than one hundred important developments in India, Australia, New Zealand, the Philippines, South America, Continental Europe, the British Islands, Canada, Mexico and the United States. It is stated that the value of contracts now on hand by the associated organizations amounts to more than $50,000,000.

RAILWAY MOTOR CONTROLLERS.—Bulletin No. 4578, recently issued by the General Electric Company, Schenectady, N. Y., describes in a comprehensive manner the essentials of the various standard controllers that are manufactured for railway service, with special reference to the operating conditions for which each type is suited. Among the controllers described are type B, which include the necessary contacts and connections for electric braking, type K for series parallel operation of the motors, type L, also in the series parallel class, but which completely open the power circuit when changing from series to parallel, type R, which are designed to control the motor speeds by means of resistance only, and a brief outline of the Sprague-General Electric type M control system.

ALLIS-CHALMERS CORLISS ENGINES.—Allis-Chalmers Corliss engines are now equipped with a valve gear having a new steel detaching device which does not show excessive wear, due to operation. Wear often becomes so great in inferior types of construction that the pin will loosen with running and serious results follow. This difficulty and others incident to the older style are eliminated by the new arrangement, which is described in Allis-Chalmers Company's Bulletin No. 1505. Another desirable feature in the valve gear and regulator is to be found in the safety stop shown. This consists of blocks of steel on the cut-off cams which come into position and shut off the steam should the governor belt break. An automatic arrangement is also provided so that these blocks are inoperative when the engine is starting.

BOULEVARD LIGHTING SYSTEM.—The Jandus Electric Company has issued a pamphlet descriptive of the Daniels boulevard lighting system, which forms one of the handsomest specimens of trade literature thus far issued from the press. The design is both artistic and effective, and the engraving is of a remarkably high quality. The pamphlet was executed by Corday & Gross, of Cleveland, upon whom it reflects high credit. The publication describes and illustrates the system of boulevard lighting designed by Mr. W. E. Daniels, engineer of the South Park Commission, of Chicago, the manufacture and exploitation of which has been undertaken by the Jandus Company. In this system each unit consists of a reinforced concrete base, shaft and capital, of Ionic design, the whole surmounted by a complete arc-lamp mechanism within a 20-in. opal glass ball globe. The artistic illustrations bring out strongly the highly artistic effect of this disposition, a variation of which is also shown applied to wall brackets.

MOTOR-DRIVEN ICE BREAKER.—This booklet, while devoted primarily to the description of the Creasey ice breaker, contains in addition much information of interest to those who have to do with ice for packing, shipping or refrigerating food products. The Creasey ice breaker, which is manufactured by Joseph S. Lovering Wharton, of Philadelphia, Pa., consists essentially of a revolving cylinder carrying sharp picks, mounted in a suitable frame, which provides for feeding the cakes of ice against the cylinder by gravity. The revolving picks split the ice from the cake, the size being determined by a "comb," through which the pieces must pass before falling out below. The picks consist of round, tapered pieces of steel set in a tapered socket drilled and reamed in a lug cast on the drum. The pick is held solely by friction, no rivets, nuts or wedges being required. The machines are built in a varied range of sizes, from small hand-driven machines for family use up to a machine that will cut from 40 to 50 tons of ice per hour and will take cakes of ice 22 in. thick by 32 in. wide and of any length.

IMPROVED RESISTANCE UNITS.—Bulletin No. 4587 of the General Electric Company has for its subject a new type of resistance unit for rheostats, fixed resistances, laboratory use, etc., which contains many important improvements in design and construction. The unit consists of a wire wound tightly on a specially formed tube. The resistance material has a negligible temperature coefficient so that the ohmic value of the unit is practically the same at all times whether hot or cold. The tube is made up of a durable cylinder treated with a special insulating compound which forms a coating both inside and out. This makes a reinforced construction that is not brittle, and is strong and solid. The unit is made in two forms, one having porcelain bushings at the end with wire terminals, and the other having metal bushings connected to the winding and suitable for holding in metal grips, and of a size to fit into standard fuse holder clips. The Bulletin describes both forms of units and gives the size, ratings, capacities, etc., of the standard types.

TANTALUM AND GEM LAMPS.—Bulletins Nos. 4561 and 4566, of the General Electric Company, have for their respective subjects tantalum and Gem incandescent lamps. In Bulletin No. 4566 the tantalum lamp is specially recommended to central stations as a desirable factor in the reducing of peak load conditions. Stress is laid on the brilliant and attractive quality of light emitted by the tantalum lamps, qualities which make it most desirable for hotels, theatres, cafés, stores and all public buildings. A table shows the actual amount saved in dollars and cents by the use of these lamps. Several pages are devoted to the elucidation of a practical method for the solution of illuminating problems. The illumination table intended for use in connection with this method is comprehensive for 80-watt lamps with three types of holophane reflectors, and by interpolation can also be used for the 40-watt and 50-watt tantalum units. Several curves giving the candle-power distribution with different types of holophane reflectors are also shown. Bulletin No. 4561 contains information in regard to Gem high-efficiency incandescent units. These lighting units are composed of the Gem lamps with varying types of holophane reflectors and are made in 100, 125, 187 and 250 watt sizes. Candle-power values of these lamps are not given, as it is obvious that these values will vary according to the type of reflector used. A method of solving illuminating problems is given, and the subject of illumination in general taken up and treated briefly. This is followed by a specific treatment of the subject with reference to Gem high-efficiency units. Assuming the degree of illumination desired, a problem is worked out, reference being made to the illumination tables for the solution. Two photographs are shown of the interior of a dry goods store before and after the installation of Gem units. The original installation consisted of six-light electroliers with ordinary 16-cp incandescent lamps, placed 7¾ ft. from the floor. The Gem installation consisted of 125-watt, high-cp units with bowl holophane reflectors. These units were installed on the ceiling 14 ft. above the floor.

Unclassified Items.

CASEY, ILL.—The Charleston & Casey Traction Company has been incorporated with a capital stock of $2,500 by H. R. Patton, of Charleston, William Stull, of Charleston, and S. S. Yanaway, of Casey, Ill.

CHARLESTON, W. VA.—The Aerial Tramway Company has been incorporated with a capital stock of $1,000,000, to build and operate aerial tramways and hold patents relating thereto. The incorporators are: Harry Frazier and D. C. T. Davis, of Lewisburg, and others.

KOKOMO, IND.—Articles of incorporation have been filed for the Kokomo, Franktort and Terre Haute Traction Company with a capital stock of $100,000. The company proposes to construct and operate an electric railway between Frankfort and Terre Haute and intervening cities, and to install and operate power plants in cities and towns along the route for the distribution of electricity, and will also operate street railway systems in several of the towns connected by the interurban line. The directors of the company are: Martin W. Eikenberry, Joseph C. Dewees, E. B. Swift, Robert N. Ross and Oliver Guard are the directors.

SUMMERVILLE, S. C.—The Charleston & Summerville Electric Railway Company has decided to increase its capital stock by $400,000. It is expected that work on the construction of the road will commence soon.

WALLA WALLA, WASH.—Rights of way for a power house, flume and water privileges on the South Fork of the Walla Walla River, several miles above the present power plant of the Northwestern Gas & Electric Company have been secured by the Trustees of the Washington & Oregon Traction Company, which proposes to construct a 5000-hp plant in the near future to furnish electrical energy to operate the proposed electric railways in the Walla Walla Valley and surrounding country. Rights of way have been secured by the company to the summit of Blue Mountains, about 330 miles distant from Walla Walla. The new enterurise is being financed by local capitalists and is managed by a board of trustees composed of E. S. Isaacs, Max Baumeister, C. K. Holloway, Allan H. Reynolds, Samuel Drumheiller, John Smith, W. A. Ritz and John L. Sharpstein.

TAMPA, FLA.—It is reported that work will be resumed on the construction of the Peninsular Street Railway about June 1. The road when completed will run from Tampa to Bartow, via Plant City and Mulberry. Work was stopped last fall at the time of the panic. The power house will be located at Plant City. J. F. Davis is superintendent of construction.

DETROIT, MICH.—Sealed proposals will be received at the office of the Public Lighting Commission, 40 Atwater Street, East Detroit, until June 4, for furnishing cedar poles, electric light carbons, copper and steel wire, cross arms, cross-arm braces, Hemingray W. U. No. 5 glass insulators, common black iron pipe and floor flanges for the same; Stombaugh guy anchors, pole pulleys and porcelain insulators. F. T. Bowler is secretary of the commission.

SAN FRANCISCO, CAL.—The United Railroads has awarded contracts for additional electrical equipment at its North Beach power station, which will more than double the present output of the plant, consisting of a new steam turbine, frequency changer, new boilers, and other apparatus. The cost of the work is estimated at $375,000.

MENOMINIE, MICH.—The Menominie Electric Light & Power Company has closed a contract with the Chippewa Valley Railway, Light & Power Company for electrical energy to operate its system.

JEFFERSON, WIS.—The citizens have voted to issue $7,500 in bonds to purchase the interest of Charles Hoppenbach estate in the mill dam across Rock River. The municipality acquires three-eighths interest in the dam, a woolen mill equipped with the necessary power machinery, which will permit the city to furnish a 24-hour service and to furnish electrical energy to factories and other industries.

DELTA, COL.—The plant of the Delta Electric Light Company was destroyed by fire, causing a loss of $9,000.

CUERO, TEX.—The plant of the Buchel Power & Irrigation Company, situated at the dam about three miles from this city, is reported to have been destroyed by fire, entailing a loss of about $40,000.

BOSTON, MASS.—Acting Governor Draper has signed the bill allowing the consolidation of gas companies with gas companies and electric light companies with electric lighting companies throughout the state. The bill especially provides that no gas and electric company shall be consolidated and names separately the Edison Illuminating Company and the Boston Consolidated Gas Company.

EXCELSIOR SPRINGS, MO.—Plans are being considered to construct an electric railway in this city, for which an application will soon be made to the City Council. Henry J. Arnold is interested in the enterprise.

KOKOMO, IND.—It is reported that the Kokomo, Frankfort & Terre Haute Traction Company, recently incorporated, will soon ask for bids for the construction of the first section of the railway between Kokomo and Burlington, a distance of 12 miles. William H. Eikenberry, J. C. Deweiss and E. B. Swift are directors of the company.

EAST ST. LOUIS, ILL.—The stock of the Southern Illinois Traction Company has been increased from $2,500 to $1,500,000.

PITTSBURG, PA.—The Joplin & Pittsburg Railway Company has awarded the contract for the construction of the overhead work, including the wiring, stringing of trolley wire and carrying the high-tension lines from Lowell to Asbury and Turkey Creek station and along the road, to the Smethurst & Allen Company, of Philadelphia, Pa., for $25,000. This amount covers construction work only. The railway company proposes to transmit electrical energy from the Lowell power station to the substations at Turkey Creek and Asbury on three high-tension lines of 30,000 volts each. The poles will also carry three telephone wires, and about 400,000 lb. of copper wire will be used.

OXFORD, MISS.—The Building Committee has recommended to the Board of Trustees of the University of Mississippi that the plans submitted by Engineer Prout, of Memphis, for the power plant for lighting and heating the university buildings be adopted, the cost of which is estimated at $35,000.

CHICOPEE, MASS.—The Board of Aldermen has granted a franchise to the Springfield Street Railway Company to construct and operate a street railway on East Street.

MANHATTAN, NEV.—The California-Nevada Power & Light Company contemplates extending its transmission lines to Manhattan and Round Mountain. It is proposed to extend the lines from Millers siding.

Business Notes.

JOHN T. WILLIAMS & SON have removed their sales office to the Engineering Building, 114 Liberty Street, New York.

BAKER & COMPANY, INC., of Newark, N. J., have moved their New York office to the sixth floor, Cortlandt Building, Hudson Terminal, 30 Church Street.

JENKINS BROS., 71 John Street, New York, have removed their Chicago store from 31 North Canal Street to larger quarters at 226 Lake Street, corner of Franklin Street.

MR. A. A. KNUDSON has removed his offices from the Mutual Life Building to 50 Pine Street, where, with increased facilities in the way of office room and new standard instruments, he is enabled to carry on the work of electrolytic examination to better advantage than in the past.

THE ERNER & HOPKINS COMPANY, of Columbus, Ohio, has secured contracts for rewiring and remodelling the electrical equipment of the plant of the American Bottle Company at Streetor, Ill., and furnishing the complete electric outfit for the new sugar plant of the Ohio & Texas Sugar Company at Brownsville, Tex. W. A. Hopkins is president of the company.

FRINK INSTALLATIONS IN ART GALLERIES, ETC.—The matter of properly lighting galleries, museums, public buildings and individual pictures is more and more becoming recognized as one of prime importance, and as a consequence the expert knowledge on this subject of I. P. Frink, 551 Pearl Street, New York, is increasingly sought. Fifty years' experience in successfully lighting the finest public and private art galleries and public buildings, as well as individual pictures, is sufficient evidence that the confidence in this firm's competency is not misplaced. Among the recent installations by this firm may be mentioned those in the Albany Historical Society, Albany, N. Y.; the Carnegie Institute, Pittsburg, Pa.; the lighting of the mural paintings in the Essex County

Court House, Newark, N. J.; the Camera Club; the Bauer-Folsom Art Galleries; Georges A. Glaenzer & Co.; the Metropolitan Museum of Art and the Museum of Natural History, New York City.

THE UNION ELECTRIC COMPANY has opened a store at 414 Wood Street, Pittsburg, Pa., where it will carry a complete line of electrical supplies.

MR. S. L. GROSSMAN, formerly of the Nernst Lamp Company as sales representative, is now in charge of the sales department of the Safety Electric Company, located at 35 Michigan Avenue, Chicago, Ill., engaged in the renewed lamp business.

MR. W. A. EKBERG, Pacific Coast representative of The Hart Manufacturing Company, Frank Adam Electric Company, Condit Electric Manufacturing Company, The Peerless Electric Company, The Sachs Company, Enameled Metals Company, Hartford Time Switch Company and Willard Storage Battery Company, has removed his offices to 143 Second St., San Francisco, Cal.

THE AMERICAN ELECTRIC LAMP COMPANY OF NEW YORK, whose New York office was located at 26 Cortlandt Street, has arranged with the Central Electrical Supply Company, 29 West Fifteenth Street, to become its sole selling agents in Greater New York. The agency expects to carry at all times a stock of from 50,000 to 75,000 lamps, which should insure prompt delivery of orders.

THE CENTRAL ELECTRIC COMPANY, Chicago, general Western sales agent for "Pittsburg" transformers, has completed delivery on a recent contract for lighting transformers to be used by the South Park Commissioners. The transformers furnished on this contract are the latest high-efficiency type. The same company is delivering a number of the same type of transformer to the U. S. Government for use at Charleston, S. C.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 19, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

887,748. SIGNALING SYSTEM; Garrison Babcock, Rochester, N. Y. App. filed July 7, 1905. A locking out means whereby, when one substation is in use for telephonic or telegraphic purposes, another station is prevented from using the line or interfering with the conversation or signals from the first station.

887,769. ELECTRICAL CURLING IRON; Trevor M. Caven, Kansas City, Mo. App. filed Dec. 11, 1906. Construction of curling iron having a spiral resistance element imbedded in the solid prong and which is controlled by a push button switch in the handle.

887,774. SELF-PLAYING ATTACHMENT FOR PIANOS; George Howlett Davis, West Orange, N. J. App. filed Sept. 21, 1905. The piano has a continuously rotating drum with a friction surface which is engaged by depending arms controlled by electromagnets for each key.

887,776. ELECTROPLATING APPARATUS; Charles E. De Long, Shreveport, La. App. filed Oct. 4, 1907. A small electroplating apparatus comprising a case having a battery and a solution tank, and specially constructed switch connections for controlling the current flow.

887,805. POSITION INDICATOR FOR GRAIN DISTRIBUTING DEVICES; Harry B. Higgins, Minneapolis, Minn. App. filed March 30, 1907. Has a multiplicity of laterally placed storage bins and a distributing device, including a position indicator at a distant point, controlled by a four-wire pilot circuit.

887,822. ELECTRICAL CONTACT; Richard F. LeBrocq, of Etna, N. J. App. filed March 24, 1906. Relates to mechanism for making electrical contacts by delicate automatic mechanism, such as a chronometer. Has a compound lever displaced by a cam and carrying the movable contact.

887,840. PUSH BUTTON SWITCH; Peter A. Paul, Lewisburg, Ohio. App. filed Aug. 15, 1907. Push putton switch having a bridging conductor which is forced into contact with circuit terminals by a cam mechanism. The circuit is broken by the resiliency of the bridging conductor, whereby the latter breaks the circuit when relieved from the action of the cam mechanism.

887,868. TROLLEY WIRE SUPPORTING DEVICE FOR BASCULE BRIDGES; Joseph B. Strauss, Chicago, Ill. App. filed Jan. 28, 1907. A trolley wire supporting device for a bascule bridge. Makes use of a flexible section which is kept stretched taut by a weight.

887,871. ELECTRIC HEATER; Clarence L. Taylor, Alliance, Ohio. App. filed Aug. 24, 1907. The flat-iron is made with a pair of plates which can be separated to include between them a pair of spiral flat windings constituting resistance elements.

887,877. INSULATOR; Henry Trumbull, Plainville, Conn. App. filed March 2, 1907. A form of bushing for outlet boxes and the like, having an insulating sleeve with a flange which is engaged between a pair of metallic collars, one of which is threaded into the wall of the outlet box.

887,887. PARTY-LINE TELEPHONE SYSTEM. Thomas L. Wilson, Ottawa, Ontario, Canada. App. filed May 28, 1907. In a telephone substation, the combination with a plurality of telephones connected in multiple of an auxiliary independent signaling circuit, normally incompleted, a plurality of pairs of leads extending from opposite sides of the auxiliary circuit to the respective telephones, and means operated by the use of any one telephone for connecting the pair of leads corresponding thereto.

887,896. TIE WIRE CLAMP; George Wrigley, Greenville, S. C. App. filed June 21, 1907. Has a pair of sheet-metal plates which are fastened together by bolts so as to strap around an insulator and engage the wire.

887,907. SWITCH BASE; William R. Atkinson, New York, N. Y. App. filed Aug. 16, 1906. Makes use of a porcelain block which has the dimensions of the ordinary wooden molding used with electric wiring and contains grooves registering therewith.

887,918. AUTOMATIC CUT-OFF FOR ELECTRIC CURRENTS; Domingo Cervera Cañizares, Paris, France. App. filed June 26, 1905. An apparatus for cutting off the current at a subscriber's station after a predetermined maximum is attained. Is a form of magnetic cut-out.

887,923. ELECTRIC HEATER AND COOKER; Ella M. Crandall, Dolgeville, Cal. App. filed June 28, 1907. A porcelain block has a sinuous passage therein which contains a spiral resistance element. The whole is intended to be submerged in the water of an outer jacket of the cooking vessel.

887,930. MEANS FOR ATTACHING LINE WIRES TO INSULATORS; Chester J. Elliott, Beaver River, N. Y. App. filed Dec. 14, 1907. A means for fastening line wires to insulators, comprising a stirrup-shaped member made preferably of wire and bent upon itself to form hooks adapted to receive the line wire, the ends of the stirrup-shaped wire being adapted to be drawn together by means of a lever, thereby causing the line wire to be held tightly against the insulator.

887,932. ELECTRIC RAILWAY SYSTEM; Samuel C. Frey, York, Pa. App. filed Nov. 28, 1906. A car stopping and signaling block system adapted for single-track roads, having a signal system and train-stop device whereby the signals are enforced.

887,943. INCANDESCENT ELECTRIC LAMP; Marshall D. Jones, Davenport, Ia. App. filed April 30, 1907. The globe of the lamp is made hemispherical in transverse section and is silvered on its rear face to constitute a reflector. The filament is flattened to correspond with the outline of the globe.

887,947. ELECTRICALLY HEATED SAD IRON; Frank Kuhn, Detroit, Mich. App. filed Sept. 14, 1907. An electrically heated sad iron comprising a base section, a removable hood section, and a heating element secured to said base section within said hood. Has a terminal permanently attached to said heating element and projecting outward through an aperture in said hood.

887,949. THERMOSTAT; Christian J. Letzing, Boston, Mass. App. filed Feb. 28, 1907. A thermostat for use in factories. Has a pair of terminals in the same horizontal line and spring-impelled together, one of said terminals having a fusible washer adapted to permit movement of the spring-impelled terminal.

887,965. ELECTRIC GAS LIGHTER; Raymond A. Rockwood, Monrovia, Cal. App. filed April 10, 1907. Electric gas lighter adapted to be operated by a push button. Makes use of a magnet-displaced ratchet wheel having teeth of alternately different character, whereby successive closures of the circuit alternately turns on and off the gas.

887,980. ELECTRICALLY CONTROLLED SWITCH OPERATING MECHANISM; Karel Willem Gerard Johan Stoffels and Johannes Jacobus Hendrikus Wilhelmus Weenen, Amsterdam, Netherlands. App. filed Jan. 23, 1907. A track switch having a pair of operating magnets selectively controlled by a pair of conductors supported adjacent to the trolley wire.

887,996. COMBINED INSULATOR AND LAMP HANGER; James M. Burge, Decatur, Ill. App. filed Oct. 5, 1906. A bell-shaped hanger has a metallic strap in a groove of the insulator, which has a central hook to support the lamp.

887,998. TELEPHONE AND CIRCUITS THEREFOR; Edward E. Clement, Washington, D. C. App. filed June 20, 1903. Details of subscribers' circuit having a specially constructed and arranged repeating coil.

888,050. FIELD MAGNET WINDING; Julian A. Stratton, Chicago, Ill. App. filed March 31, 1906. Construction of field magnet of direct-current generator, designed to permit of automatically shifting or displacing the magnetic field whereby good commutation may be obtained under varying conditions of load or speed without having to shift the brushes.

888,067. ELECTROPLATING APPARATUS; John T. Daniels, Newark, N. J. App. filed June 7, 1907. Electroplating apparatus having a tank or vat in which the electrolyte is contained and in which is placed a rotatable drum containing the articles to be plated.

888,068. ELECTROPLATING APPARATUS; John T. Daniels, Newark, N. J. App. filed July 29, 1907. Relates to modifications of the above.

888,076. PROCESS OF MAKING BUTTER; George V. Frye and Frank B. Hinkson, Lexington, Ohio. App. filed Oct. 26, 1907. Consists in cooling unripened cream and subjecting the same to an electrolytic action.

888,093. ELECTROPLATING APPARATUS; Willis R. King, Newark, N. J. App. filed Dec. 15, 1905. Form of electroplating apparatus having a hollow drum within the tank or vat and which contains the articles to be plated.

888,096. CABLE TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed May 1, 1907. Has a line with a condenser included therein and a shunt circuit including a polarized receiving instrument, a resistance, and a serially connected condenser.

888,098. AUTOMATIC PHOTOTELEGRAPH; Arthur Korn, Munich, Germany. App. filed May 2, 1907. Selenium cell apparatus having detail features.

888,099. THIRD-RAIL ELECTRIC RAILWAY SYSTEM; Charles Kozesnik, New York, N. Y. App. filed Oct. 30, 1906. A hollow third rail for electric railways consisting of top and bottom portions provided with laterally directed side flanges separated by insulating material, said side flanges and insulating material being interlocked.

888,151. ELECTRIC WATER HEATER; Oscar H. Fiddes and Herman A. Seifke, San Francisco, Cal. App. filed Dec. 18, 1907. An ornamental device for heating water having a hollow standard containing a resistance element through which the water flows. A glass globe is supported on the upper portion of the standard and contains an electric light, so that the device makes an ornamental parlor or table ornament.

888,153. SYSTEM FOR SELECTING ONE OR SEVERAL RECEIVERS CONNECTED TO A COMMON CONDUCTOR; Adolf Franke, Halensee, near Berlin, Germany. App. filed Dec. 23, 1907. An electric system for selecting one of several receivers connected to one common conductor Is particularly adapted for party line telephone systems.

888,154. INSULATOR; Howard Friend, Lexington, Okla. App. filed Oct. 7, 1907. Has a specially formed split casting whicb embraces a two-part cylindrical insulator, so that the single fastening bolt used clamps all the parts tightly in place.

888,157. ELECTRIC AWNING OPERATOR; Egisto U. Giovannoni, New York, N .Y. App. filed Nov. 23, 1906. A device especially adapted for raising and lowering awnings, designed to operate automatically without attention on the part of the operator after being started either to raise or lower the awning to the desired point at which the same is stopped automatically.

888,191. OSCILLATION-RECEIVER; Greenleaf W. Pickard, Amesbury, Mass. App. filed Nov. 9, 1907. An oscillation-receiver, which consists of two electrical conductors, one of which is of hrass and the other of which is a mass of silicon having a polished surface.

888,211. TELEPHONE INSTRUMENT; Minor Waters, Albany, N. Y. App. filed July 12, 1907. In an instrument of the character set forth, the combination with a telephone instrument having a switch, of a receiver support movable toward and from the switch, and switch actuating means operated by the suppert and engaging the switch, a portion of said means constituting a stop that engages the switch to limit the movement of the support away from the switch.

888,223. TROLLEY POLE; George W. Chatmond, Louisville, Ky. App. filed Nov. 7, 1907. Has a pivoted trolley pole with spaced engaging means thereon, and a pivoted supporting member engaged upon said means to hold the trolley pole in selected adjusted positions.

888,235. LIGHTNING ARRESTER; Edward S. Halsey, Palmetto, Fla. App. filed Dec. 10, 1904. A form of lightning arrester or protecting device for removing static charges from electrical circuits and for protecting such circuits from lightning and other abnormal potentials. Has a fluid column designed to be suddenly vaporized and thus automatically interrupt the circuit of an arc formed.

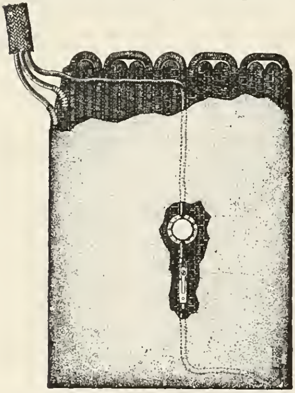
888,241. PROTECTIVE DEVICE; Karl Kuhlmann, Berlin, Pankow, Germany. App. filed Nov. 20, 1906. A means for protecting electrical distribution systems from injurious excess potentials. Makes use of a pair of electrodes for the lightning arrester spark gap, which are movable toward and from one another under the influence of electrostatic forces, so that they approach to permit a lightning discharge, but immediately separate after this excessive potential has passed.

888,275. ELECTRIC CONDENSER; Matthew O. Troy, of Lynn, Mass. App. filed March 31, 1902. A form of condenser having sheets of tinfoil separated by a pair of sheets of paper, one of which is varnished and the other impregnated with wax.

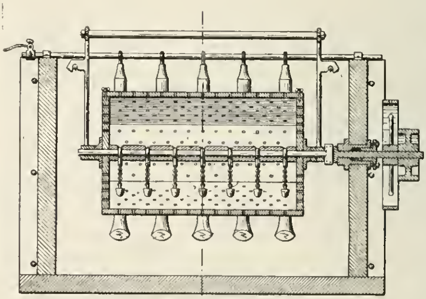
888,277. ELECTRIC HEATER; Hjalmar Wahlquist, Philadelphia, Pa. App. filed Dec. 12, 1907. The cover of the receptacle has a depending tubular body which contains a double spirally wound resistance element.

888,285. ELECTRIC LOCK; Solomon W. Wibel, Nathan J. McAloney and William R. Cunningham, Denver, Col. App. filed Jan. 29, 1906. An electric lock mechanism having a latch with a locking device moved through an electromagnet. The latch has a rigid arm which constitutes the armature of the magnet and is directly tilted upward thereby.

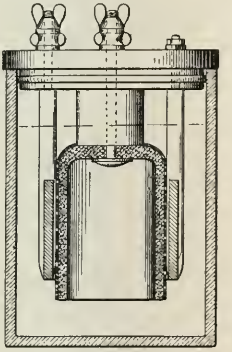
888,304. PRODUCTION OF FERTILIZERS, FILTERING MATERIALS AND THE LIKE.; James Brightmore, Tideswell, England. App. filed Oct. 16, 1907. A process of fixing the nitrogen of the air by taking lime or slag or other waste material and subjecting it to the action of an electric arc while in a moistened condition, and finally exposing the mass to nitrogenous sewage.



888,381.—Electric Heating Device.



888,068.—Electroplating Apparatus.



888,407.—Primary Battery.

888,318. THIRD-RAIL INSULATOR; Lucien Henri Delloye, Paris, France. App. filed Oct. 5, 1905. A method of mounting insulating blocks formed of molded glass, whereby the insulating blocks are securely attached to the rail, but are capable of relative movement to permit expansion and contraction of the rail

888,335. PRINTING TELEGRAPH; Charles L. Krum, Chicago, Ill. App. filed Aug. 22, 1903. A printing telegraph apparatus in which the messages transmitted are reproduced at the receiving station by being printed upon sheets of paper as in ordinary typewriter work. Complete construction of a magnet-operated type-bar machine, including all the electrical features and circuits for a special code having impulses of different strengths, and different polarities.

888,339. COLLECTOR OPERATING VALVE; George Macloskie, Schenectady, N. Y. App. filed July 28, 1906. A current collecting apparatus fur electric vehicles having a casing with a piston and a slide valve, and means for normally maintaining balanced pressure on opposite sides of said piston. Has hand-operated means for relieving the pressure on either side of the piston, according to the direction it is desired to move the valve.

888,340. ELECTRIC BELL RINGER; George Macloskie, Schenectady, N. Y. App. filed Dec. 4, 1906. A device for swinging the usual clapper bell of a locomotive by a solenoid magnet. Makes use of a form of solenoid vibrator having a link connection with the bell and operated by a switch in the engine cab.

888,341. VISUAL SIGNAL; Wilbur L. Merrill, Schenectady, N. Y. App. filed July 21, 1906. A visual signal designed to change its appearance from all sides when operated, presenting a uniform color in all directions at any given time. Designed for use on ships in giving signaling orders. Has a series of vanes which are simultaneously displaced around a drum by means of an electromagnet.

888,349. COMBINED CABLE SUPPORT AND WIRE CLIP; Frederic D. Ogden, Bayonne, N. J. App. filed Sept. 14, 1907. A hanger comprising a sheet metal strap which surrounds the cable and is locked in such relation by a fastening screw which also has an eye to receive the messenger wire.

888,355. FUSE; Ernest Schattner, Schenectady, N. Y. App. filed June 10, 1905. A fuse wire extends through a slot of an insulating barrier disk, said slot flaring in both directions. Has absorbent material surrounding the fuse wire and divided by said barrier.

888,362. MONOCYCLIC SYSTEM OF ELECTRIC DISTRIBUTION; Charles P. Steinmetz, Schenectady, N. Y. App. filed March 30, 1895. A means for so reconstructing existing alternating-current plants of the single-phase type that they may he adapted, at a minimum expense and with the greatest utilization of their existing structure, to the generation of monocyclic currents.

888,376. EXTENSIBLE CHANDELIER; Walter I. Wilson, Los Angeles, Cal. App. filed March 1, 1907. The chandelier has a pair of telescoping tubes within which are a pair of spirally coiled conductors which are extensible to accommodate the varying lengths of the chandelier by an ordinary spring-coil action.

888,378. ADAPTER FOR INCANDESCENT LAMP SOCKETS; Montraville M. Wood, Schenectady, N. Y. App. filed Nov. 15, 1904. An adapter by which a miniature electric lamp may be used with an ordinary Edison socket. Has a porcelain block with an exterior threaded shell of standard size, and a pair of interior threaded shells to accommodate different sizes of miniature lamps.

888,381. ELECTRIC HEATING DEVICE; William S. Andrews and Henry J. Mauger, Schenectady, N. Y. App. filed Sept. 18, 1907. A cut-out for an electric heater comprising spring contact strips arranged in open position and normally sprung to a closed position and sealed by a fusible metal.

888,382. SLIDING CURRENT COLLECTOR; Albert H. Armstrong, Schenectady, N. Y. App. filed Aug. 6, 1906. In place of a trolley wheel, the patentee has a horizontally supported plate with hooked extremities. In order to avoid cutting deep grooves or ruts in the conductor, it is made with a plurality of logitudinally adjustable adjacent bars which can be set to new positions from time to time.

888,389. ELECTRICALLY OPERATED TRACK SWITCH; Fred B. Corey, Schenectady, N. Y. App. filed Dec. 7, 1906. The switch point has a connection with a core of a double solenoid magnet, the sections of which are selectively energized by a relay. Is of the type designed to be thrown in one direction if the car is drawing current, and in the other direction if the car is not drawing current when passing an insulated trolley section.

888,392. BALANCER SET; Richard W. Douglas, Lynn, Mass. App. filed Oct. 1, 1904. An arrangement of the shunt fields and parts allied therewith whereby an increased flexibility of the machine voltages is secured, together with certain other advantages.

888,407. PRIMARY BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed July 21, 1906. A battery designed to obtain a minimum amount of internal resistance, but in which an internal short circuit is impossible. Designed to constitute a convenient primary battery for automobiles, and the like.

888,416. CONTROLLING DEVICE FOR CARS; Theodore Bodde, Westfield, N. J. App. filed March 18, 1907. A means for controlling and stopping a vehicle, car or train. Has a track magnet, and a train magnet carried by the car or train moving along the track, and a safety device operated when the train magnet reaches the track magnet when the latter is in open circuit.

888,417. AUTOMATIC CONTROLLING DEVICE FOR CARS; Theodore Bodde, Westfield, N. J. App. filed July 10, 1907. Relates to modifications of the above.

888,418. TROLLEY CATCHER; Willis C. Burdon, Louisville, Ky. App. filed Sept. 21, 1906. A form of trolley retriever having a spring-impelled reel normally restrained by a ratchet and detent. The detent is released by a too rapid paying out movement of the trolley cord.

888,427. TELEPHONE SYSTEM; Carl W. Sharer, Philadelphia, Pa. App. filed June 13. 1906. In a telephone trunking system, the combination with trunk ringing signals of a supervisory signal in the trunk circuit controlled by the hook contacts of the called subscriber's instrument.

888,447. CONTROLLING MEANS FOR ELECTRIC MOTORS; Harry Ward Leonard, Bronxville, N. Y. App. filed July 12, 1905. Relates to the automatic control of a motor by the movement of a device driven thereby, and to the variation of its speed and direction of rotation. Has automatic means for reversing the rotation of the motor while maintaining the connections of the motor armature circuit unchanged.

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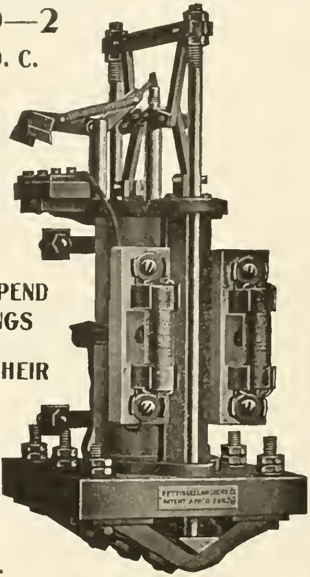

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Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, JUNE 6, 1908. No. 23.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Schofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....................per year, $3.00
Dominion of Canada....................4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 21,000 copies are printed.*

NEW YORK, SATURDAY, JUNE 6, 1908.

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INTRODUCTION OF THE TUNGSTEN LAMP.

The topic which excited interest above all others at the recent Chicago Electric Light convention was that of the tungsten lamp. Two papers were presented on the subject, one by Mr. W. W. Freeman, dealing with it in a general way, and another by Mr. P. D. Wagoner, treating specifically of the application of the tungsten lamp to series incandescent lighting. Greater systematic effort appears to have been made in applying the new lamp to this latter service and to others where the gas flame lamp has been heretofore difficult to meet in competition. than to purposes of general illumination. Recently we have referred to several instances in which central stations have, by means of the tungsten lamp installed on its ordinary lighting mains, easily displaced so-called gas "arcs," and the figures and facts presented by Mr. Wagoner seem to bear out his statement that the tungsten lamp will place series incandescent electric lighting entirely beyond competition from its present naphtha, gasoline and gas mantle rivals. The data which he gives as to the life of the lamp bear out the most sanguine claims made on this score. In one installation of 172 lamps. an average life of 1350 hours was obtained, while in a test conducted on 18 lamps, 12 gave a life of over 2000 hours without perceptible decrease in efficiency. Mr. Wagoner did not hesitate to state that an average life of 1350 hours at 1.25-watts per candle can reasonably be expected from the tungsten lamp, even in its present stage of development. The extraordinary efficiency of the lamp with respect to current consumption has obscured its superiority over the carbon filament lamp with respect to quality of light, length of life and maintained candle-power. Indeed, if the tungsten lamp had an energy efficiency only equal, or even somewhat inferior, to that of the carbon filament lamp, these points of superiority would undoubtedly cause it to displace the carbon lamp almost as rapidly as its aggregate advantages will cause the present occupant of the field soon to become a thing of the past. Moreover, comparisons of tungsten and carbon filament lamps with respect to energy consumption should not be made upon the basis of the rated efficiency of the latter; that is to say, while the average efficiency of the tungsten lamp will not vary far from 1.25 watts per candle, the so-called 3.1-watt carbon-filament lamp may easily have an average efficiency reaching 4.5 watts or even more. Several months ago we noticed a report of measurements of the lamps used on a certain central-station circuit, in which it is recorded that of 363 carbon-filament lamps tested, all but eight showed a consumption which varied from 4.8 to 5.5 watts per candle-power, and that in some instances the consumption approached 15 watts per actual candle-power.

The paper by Mr. Freeman gives a résumé of answers from 501 central stations located in 49 states, territories and countries in which the National Electric Light Association has membership, which were given to comprehensive questions submitted in order to bring out the experience and views of the managers of the plants addressed concerning high-efficiency lamps. These replies indicate that many companies have by means of the tungsten lamp already made notable progress in obtaining business heretofore difficult or impossible to secure. The replies to questions asking for an opinion as to the probable effect of the tungsten and other high-efficiency lamps upon the electric lighting industry, disclosed a remarkable consensus of opinion in favor of the new illuminant; while a few are solicitous as to the effect of the use of the tungsten lamp on the station income, a large majority agree that the tungsten lamp will prove of decided benefit to the industry for the reasons that it will for the first time permit of real competition, so far as price is concerned, with gas and gasoline, and that present customers will utilize the lamp to secure more light for the same money rather than be content with the same light for less money. Throughout, the tone of the replies is jubilant that the industry has at last been relieved of the danger of competition from flame illuminants, which competition has yearly become more serious and threatened in time to displace entirely the incandescent lamp in some classes of service where formerly it was thought to have a permanent status. The discordant note which occasionally appears in the replies does not, as a rule, seem to be justified. Those who appear to consider inevitable great reductions of income are probably not of the class who are now mapping out policies whereby reductions of receipts will be averted by the education of customers to the advantages of a better illumination without increased cost, by well-planned campaigns for the displacement of gas lighting, and programs of renewed solicitation for connecting smaller residences where the oil lamp is still used. The few who would ignore this new lamp on the grounds of its present high price, may be advised to reconsider their condemnation and make a few simple arithmetical calculations involving the relation of lamp cost to illumination cost; until they do this, they are not justified in their adverse attitude, and certainly are not in a position to influence customers to give the new lamp a trial.

The replies appear to indicate a general belief that the price of the tungsten lamp will necessarily remain high. There does not seem to be any real reason for this assumption, though until the processes of manufacture are standardized and labor is thoroughly trained to the new manipulations, the factory costs will naturally be far above the corresponding ones of the carbon-filament lamp, the manufacture of which in recent years has been brought to a wonderful stage of economic production. The material of the new filament is not unduly expensive, and the amount used in a lamp is but a fraction of a grain, which, at the price of gold, would only cost about one cent. On the basis of a labor cost 10 times greater than that of the carbon lamp, the price of the tungsten lamp would not be much more than one-half of its present market price. Finally, there seems to be no probability that a patent situation will exist comparable with that which kept the price of the carbon-filament lamp at a high figure prior to 1891. Plans for the introduction of the tungsten lamp should therefore take into consideration a progressive decrease in cost as makers become more and more familiar with its specific manufacturing requirements. Mr. Freeman also takes up the question of the supply of the new lamp, and in this respect his paper departs from its otherwise optimistic character. With the utmost factory expansion possible, the production for 1908 will not, he states, supply more than 2½ per cent of the incandescent lamp demand of last year; and further, that while the supply of the lamp will increase rapidly, it is certain to be a matter of years before it can be obtained in sufficient number to displace largely the carbon-filament lamp. We cannot, however, agree with the prediction as to the great delay in meeting the full demand for the new lamp. The economics of the case are such, both from the standpoint of central station and consumer, that a price can be paid for the lamp which will make its manufacture highly profitable; and an industry with a capitalization of $1,000,000,000 and an annual revenue of $220,000,000 can, if it chooses, be a powerful factor in shaping to its advantage any situation which involves its interests.

The Engineering of Business.

One of the most interesting developments of the annual program of the National Electric Light Association has been the devotion of at least one full day to the commercial side of the industry. We have already given some details as to the manner in which this part of the work was taken up at Chicago, and our further report, published this week, embodies a good deal of useful data. Possibly to some of our more technical readers it may seem that undue importance has been laid on this general topic and that it occupies too much space, but if they will glance over their own careers and engagements they will perhaps be surprised to note how increasingly their attention has had to be directed to the financial aspects of the operations to which they are daily called as experts. The ideal engineer need not be a politician, but if we gage accurately the whole drift and tendency of the times he ought at least to be an economist, to whom the study of financial and industrial problems is altogether worthy. In the case of the National Electric Light Association there is an extreme appeal to the engineer's friendly interest, for here we have a vast industry trying by scientific methods of commercialism to work out its salvation. The newer capital employed in the art is free in large measure from anterior obligations, but most of the companies and most of the capital are trying by improved business-getting methods and by better selling processes to meet the burden of fixed charges already put upon them by the mistakes and advances of inventors and manufacturers in the past, as well as by the inevitable demands for reconstruction and enlargement. In other words, the "national debt" of the industry has been created quite as much by engineering as by financing, and if the obligations are to be met and extinguished, the engineer must more than ever be competent to give good advice that will help ensure a régime of solvency and profit.

The topics discussed on Commercial Day at Chicago were varied, including the preparation for a business campaign; contract agents and other representatives; the display room; advertising; creating demands for electricity; the evolution of new-business getting; the electrical contractor; illuminating engineering as a commercial factor. The discussions, as was natural, ranged widely over these and kindred points, and brought out a large amount of interesting information. To some extent the perusal of the papers gives the sensation of turning over and over again topics that are rather well worn, but even this is not without its value. As soon as fundamentals are established, one can stop talking about them, and it is evident that in commercial development the central-station systems have still a long way to go. When one company with apparently efficient business machinery is able to hammer only $4 or $5 per capita out of its customers, while another innocent of such formidable organization gets $10 or $11, it is proper that notes should be compared. Moreover, in this arena of test, the Davids that are killing their giants with plain pebbles from the brook are going to earn promotion and permeate the art with new courage and endeavor.

To a certain degree, indeed, there has been a tendency to "force the note" of this commercial development; and it was curious and inexplicable to see in how many instances during the late financial panic business-getting was dropped as though it was a luxury. The benefit of the pause, as of the Commercial Day discussions, was to bring out in high relief, and where they could be assessed, the various advantages of different plans and policies. It is seen that the public is unresponsive to certain appeals and arguments, while others elicit new patronage at every turn. Besides, it is just as well to know when it does not pay to get new business, and there is such a point somewhere, until the plant is lifted to another plane of efficiency and economy and rises once more to the full measure of its opportunity.

Back to the Mill.

During the present week the St. Louis merchants who have been pushing the "Give-us-a-rest-and-sunshine" propaganda, have shown that they are not possessed by any mere theory, but believe that the way to resume is to resume. Hence, they have placed orders for goods to the value of $5,000,000 and many a manufacturer opened his mail on June 1 to find in it the welcome share of this demand for goods. It is needless to say that such a stimulus to production and consumption is opportune; and while you cannot create prosperity by edict any more than you can create intrinsic value by "greenbackism," there is undoubtedly a great deal in the mental attitude and in the point of view. The country being as it is in an essentially sound condition, there is every reason why people should live normally and cheerfully, not seeking wealth and prosperity by self-denial that harks back to the crudest savage barbarism, but by requiring in sensible ways the adjuncts of civilization and exchanging freely that which they can produce themselves for that which others are willing and anxious to give them. The mechanism of credit being restored, trade and commerce can flourish as before.

All signs point to betterment, and most encouraging of all is the renewed opportunity given to labor. It is the artisan who suffers first and most in the deprivation of work and the essentials of life, and to thousands of our fellow citizens the return of prosperity means the abolition of short time schedules and employment where hitherto there was none. But a lesson lingers in the ordeal just endured, and that is the serious incompetency of much labor as the last period of prosperity culminated. It was the universal experience that, never better paid, labor in many lines was never so inefficient; and nothing seemed to cure the evil. The dismissal of whole masses of men, hard as it was in many respects, had at least the remedial effect of throwing off the incubus of labor so costly as to wipe out all possible margin of profit to the producer and employer, and involving extravagant waste of machinery and raw material. We begin the new times of steady work, and business activity, nearer the true economic bases upon which alone real prosperity can be founded.

Proposed German Police Regulations for the Inspection of Central Stations.

Recent numbers of German technical journals have published the text of a proposed German police ordinance for the inspection and supervision of electric power stations, under the direction of the German Minister of Trade and Industry, a notice of which appears in the Digest. The ordinance refers in general to all large electric central stations or installations, and in particular to all such stations of more than 1000-kw output capacity. It divides central stations into high-tension stations and low-tension stations. A low-tension station is defined as one in which the effective pressure of distribution between any conductor and ground cannot exceed 250 volts. This would include an Edison 3-wire system of 220 volts between outers, whether insulated from ground or not, and would also presumably include an Edison 3-wire system of 440 volts between outers, if the neutral conductor were permanently grounded. All large installations are called upon to give notice before hand of their introduction into service, and to require written authorizations, as well as certificates of inspection and tests at periodic intervals from the police department. The expenses of the tests are to be borne by the station or installation, according to an established tariff. A long list of factories is appended to the ordinance, intended to cover all types of factories in which there may be special danger from fire by reason of electric sparks, or in which there may be special danger to persons by reason of electric shock.

The exact provisions for the tests and conditions of a high-tension installation, or of a low-tension installation, are not specifically included in the ordinance; perhaps because if they were, the ordinance, already long, would look like a U. S. Sunday newspaper; but it is to be inferred that the rules are substantially those defined by the Association of German Electrotechnists, which corresponds to our American Institute of Electrical Engineers. The advantage of the ordinance appears to be not merely that it satisfies the German yearning for red tape, but also that it minimizes the responsibility of managers in regard to accidents or injuries. If their installations have been regularly inspected by inspectors carrying the specified number of gold stripes on their arms, and have been duly certified as correct, the range of culpable error in conducting regular business is naturally reduced. The disadvantage of the ordinance appears to be in the opportunity it offers for wearisome inspections with accompanying soreness of heart.

Although it is unquestionably desirable that all installations in our own country should be of the highest practicable type in regard to security of person and property, it is a matter for thankfulness that the inspection and approval of our stations and installations do not lie in the hands of the police. With us the corresponding officer is a fire-insurance inspector or a city electrician in plain clothes and destitute of a night-stick. In Germany, however, the ordinance in question is a natural and appropriate incident to the tacit theory of existence. There, each individual is virtually called upon to show cause and justification for acting in any but the regularly prescribed manner. Here, the tacit theory of existence is that cause and justification must be shown for prescribing the manner in which any individual shall act. The tacit assumption, there, is rigorous adherence to authoritative rule, while, here, it is the inherent right of the individual to do as he likes. The watchword of the one system is order, that of the other freedom. Each has its strong and weak points. With our esteemed German friends, the advantage of a quasi-military system of life is collective efficiency, capacity for organization, discipline, orderliness and obedience to appointed authority. The advantage of our own method is the stimulus. to individual initiative, inventiveness and self-reliance. Our disadvantages are lack of discipline and the liability to the tyranny of unrest. Fortunately for us all, each nation can learn advantageously something from every other.

Telegraph and Telephone Investigation.

The taste for "muck racking" seemed to have lost its edge and zest lately—the result of all overindulgence—and the great public has grown a bit weary of corporate exposure and attack, especially as final research after the first outcry has shown so much of the whole "movement of scandal" to be unwarranted and harmful to the best interests of the nation. It is undeniable that great good has come from the punishment of evildoers in high places, the insistence on respect for the law, and the spread of a higher moral sense throughout the community. But it is felt that with these results the country may well be content temporarily. A warlike position can be maintained, but no man can engage in incessant conflict without repose. One of the greatest English leaders of reform at the beginning of the last century himself coined the phase, "Rest and be thankful," realizing that the work done required its own term of quiet acceptance and interpretation if any lasting good were to come.

Thus, too, with investigation, of which we have had such a ceaseless run the last five years. Just as the period of inquisitorial probing closes, the U. S. Senate starts out again with a resolution calling for an "investigation into all the telegraph and telephone companies engaged in the conduct of an interstate business." As this inquiry is to be made by the Bureaus of Corporation and of Commerce and Labor, it seems well to point out that actual data are already in considerable degree available, and that the census of 1907, required by Act of Congress, will bring such figures up to the hour. If more sensation is the aim, these figures will not suffice, but they are adequate if what is sought for is a sober and useful survey of this great electrical development. In our own State, the same companies are also being subjected to crossfire of this character, by being put under the regulating authority of the Public Service Commission and it would seem that ought to be about the limit. The expense to the authorities and the companies of all this extra work, and the tax upon the bookkeeping staff, is an item that is altogether overlooked, but which must be emphasized in these days of enforced economy.

Daylight and Artificial Light.

In a notable paper presented before the May meeting of the New York section of the Illuminating Engineering Society, Dr. Edward L. Nichols reported the results of numerous tests conducted at various places in this country and abroad, in order to ascertain the quantity and quality of daylight as compared with the light from well-known artificial illuminants. The tests showed a mean annual range in intensity of about 10 to 1 between midsummer and midwinter. Perhaps this fact is not so surprising as the additional observation that illumination in the shade is less for an unclouded sky than for a partly overcast sky. In fact, the maximum daylight illumination occurs when the cloud masses forming within the field of vision reach their greatest density previous to the obscuration of the sunlight. Thus the clouds as secondary sources of light add to the illumination from the sun an amount greater than corresponds to the decrease in sunlight occasioned by their presence.

With regard to its quality, sunlight differs enormously from the light of any artificial illuminant. This result is attributable largely to the higher temperature of the sun—about 6000 deg. C.—as compared with probably 1800 deg. C. of the ordinary carbon-filament lamp, 2000 deg. C. of the tantalum lamp, 2300 deg. C. of the tungsten lamp and 3000 deg. C. of the carbon arc lamp. If the light from each of these sources corresponded accurately with that radiated by a true "black body" at the different temperatures, then the lights from the artificial illuminants would differ among themselves relatively little in comparison with the great difference from the light of the sun. However, daylight is much modified by atmospheric absorption, and the light from artificial illuminants exhibits selective radiation. Nevertheless, the illuminant that gives light having the same quality as daylight, in any of its numerous forms, has as yet not been produced.

Doubtless the higher efficiency of the metallic-filament lamps as compared with the carbon-filament lamp is most largely due to the higher temperature at which they are operated. While it would be improper to state that the limit in temperature elevation has been reached, yet it may well be noted that the possibilities of improving the efficiency by some method other than raising the temperature are much greater than of finding some material that can withstand the higher temperature. The most inviting field for investigation lies among luminescent bodies. Such bodies radiate throughout a contracted portion of the spectrum, and extremely high lighting efficiency can be obtained from a body radiating wholly within the yellow portion of the visible spectrum. Dr. Nichols has expressed his belief in the possibility of combining the radiations from several luminescent bodies so selected as to cover a large portion of the visible spectrum by their overlapping bands, in order to obtain a satisfactory "white light" at the maximum commercial efficiency. This line of investigation, which promises great benefits to everyone, should not be ignored, but should receive the careful consideration of all physicists.

The Complaint Department and the Public.

Of all forms of advertising that may be used by electric lighting companies, probably the cheapest and most effective is a list of thoroughly satisfied customers. The mere fact that a company renders a service of such quality as not to justify complaints does not insure that all of its customers will be satisfied. Indeed, the greatest amount of dissatisfaction may arise from purely imaginary causes, being much augmented when a customer's complaint based solely on suspicion is ignored by the company or treated with contempt. In order to obtain and hold the good will of the public, it is essential for the company to investigate every complaint received and to remove the causes where they exist or to explain satisfactorily that there are not causes when such is the case.

The various causes that lead to complaints from customers, and the methods that may be used to convince the customers of the good intentions of the company, are discussed by Mr. H. H. MacPherson in an article on "The Public Service Corporation and the Public," which appears elsewhere in this issue. The author states that many of the complaints that arise from high bills are caused primarily by incorrect or irregular readings of the watt-hour meters. Such causes can be eliminated only by the exercise of great care by the meter readers. When a customer receives a bill for one month which is unexpectedly larger than that for the previous month, he naturally becomes suspicious of the company's business methods, and sometimes questions its honesty. A statement from the company that an error has been made in the bill may silence the customers, but it will not remove the possible suspicion that the company has been "caught in the act"—which suspicion, however, can be entirely dissipated by a courteous explanation of the circumstances. It would be well for the company to act upon the assumption that the large majority of its customers are human and expect treatment accordingly; even "chronic kickers" can be quieted by being treated as human beings. The good will engendered by a systematic attitude of this nature on the part of the employees of the company who come in contact with the public is a valuable asset which merits the most careful thought.

STANDARD DIAGRAMS FOR CONNECTIONS AND MACHINERY.

The general plan of standard diagrams, or standard abbreviated representations for well-known forms of electrical machinery and connections, is both convenient and useful. A conventional picture for a shunt-motor, for example, consisting of a certain arbitrary grouping of outlines, is convenient, because it appeals immediately to recognition in a complex diagram. It is useful, because it reduces time and labor in perfecting the sketch, and saves the time-honored legend, "*This is a horse,*" of our juvenile readers. The disadvantage of the system is that when carried to great extent, and to intricate detail, it becomes burdensome to the memory and requires a high priest to make and to expound the sacred symbols. Various schemes by well-known authors have been promulgated in this country for the symbolic representation of switches, lamps, motors, generators, etc., on drawings of electrical installations. A number of such conventional symbols are in extensive use, notably those issued by the National Electrical Contractors' Association.

Our esteemed contemporary, the *Elektrotechnische Zeitschrift,* has recently published a new series of proposed German conventional symbols for such machines and their connections. Conventional form has always held a prominent place in German decorative art. The new German edition of symbols and pictures not only offers a definite conventional picture for, say, a shunt-motor, but it also abstracts the use of conventional letters of the alphabet. Thus the letters A and B denote armature terminals, C and D shunt-field terminals, and so on throughout the alphabet, lower and upper cases combined, not to speak of occasional subscripts; so that no less than 73 letters receive specific technical meaning for use on conventional diagrams. The only complete test of any suggested system is its actual trial, and it will be interesting to see with what success the proposed new edition of conventional symbols will be met. It seems at first sight as though it might be carrying convention too far to impress the letters of the alphabet into special duties, seeing how much general work we call upon them to perform. The demand for specific meanings attached to particular letters of the alphabet, for equations and formulas in technical literature, is much greater than for specific meanings on drawings and blue-prints. There is some hope of our reaching international unity on the use of symbols in technical literature, taking each art and branch of science by itself. It is too much to expect that the letter B, for example, shall be exclusively used to designate a magnetic flux-density, since in mechanics, astronomy, acoustics, steam and other branches of science, both pure and applied, this particular use for the letter B does not occur. Nevertheless, if all electric and magnetic technologists agreed to use the letter in this way, international literature would be correspondingly strengthened.

THE MOTOR-DRIVEN CENTRIFUGAL PUMP.

The merits of the centrifugal pump, which now occupies an important place in engineering practice, are well set forth in this issue by Mr. E. N. Percy, who points out the opportunities for a motor load for central stations presented by the use of such apparatus. The facts that the pump has neither suction nor discharge valves and possesses only one moving part having a continuous rotary motion, and that the discharge is in a continuous stream lacking the intermittent impulses found in the reciprocating pump, are certainly strong justification for its use. It is unnecessary to dwell on the operating advantages of a valveless pump without plungers which need packing, or pistons which require new rings from time to time. When operated at a constant speed, discharge takes place at a pressure which does not increase appreciably even when the delivery pipe is suddenly and completely closed. The pump adapts itself better to some conditions of service than to others, the most economical results being obtained when it is driven at the highest possible speed consistent with safety and low maintenance charges. For pumping clean water, high speed is advantageous, and when gritty water or sewage is handled, a moderate speed is desirable in order to conserve the life of the internal parts of the pump.

The most convenient method of driving a centrifugal pump is by means of an electric motor. Under ordinary conditions of operation, the induction motor is well adapted for this purpose, and a more admirable, rugged and simple combination is difficult to obtain. Both the pump and the motor require a minimum of attention, and high speeds are easily secured by the induction motor, although direct-current motors are used to a great extent. The most important of all services for which the centrifugal pump is well adapted is that of mine pumping, and in the anthracite coal regions motor-driven centrifugal pumps are quite common. Moreover, the centrifugal pump has found a wide use in water works and in fire, hydraulic and boiler feed service. In New York City, three-phase, 25-cycle, 6600-volt induction motors direct-connected to centrifugal pumps are used for the new high-pressure fire service. At present the rating of the motors installed is 15,000 hp, the energy being supplied from central station mains. For various purposes in mills, factories, breweries, soap works, sugar refineries, cement works, etc., the centrifugal pump has found a wide application, and as its smoothness of running and its ability to operate without attention become appreciated, there is no reason why it should not be used exclusively for purposes for which it is especially adapted. In electric generating stations, this type of pump possesses advantages over the reciprocating pump for circulating water for condensers as well as oil for the lubricating system. The larger field for its use is outside the generating station, where the load procurable is ordinarily a desirable one, since in most cases it comes on during the day.

Final Arguments on the Long Acre Application.

At the summing up before Commissioner Maltbie, of the New York City Public Service Commission, of the opposing factions in the matter of the application of the Long Acre Company for permission to issue $60,000,000 stocks and bonds, Mr. Talley, representing the Anti-Monopoly Company, delivered a vigorous attack upon the arguments advanced by the Long Acre Company in favor of its application, asserting that the company was not possessed of a clear title to its franchise and that it had not acted in good faith before the commission. Mr. Talley raised the point that the consent of the stockholders of the Long Acre Company to the first mortgage of $1,000,000, dated Oct. 15, 1906, did not appear anywhere in the proceedings, although such consent is on record in respect to the second mortgage. Also, that there did not appear to be any permit from the old Gas and Electric Commission to make the mortgage as apparently required under Sec. 12 of Chap. 737 of the laws of 1905, which requires that a corporation under the jurisdiction of the old commission shall not increase its capital stock or bonded indebtedness without consent in writing from the commission. Since the proposed issue of bonds would be used to retire the old bonds, by granting the company's application the commission would put the stamp of approval and legality upon the first bond issue. Referring to the Manhattan Transit Company as holding the stock of the Long Acre Company, Mr. Talley quoted Section 13, Chapter 737 of the laws of 1905 which says that no such company shall directly or indirectly acquire the stock or bonds of any other corporation, incorporated for and engaged in a similar line of business. The applicants, he stated, have not brought out new ideas or advanced any sound arguments which prove that the proposed competition would redound to the advantage of the citizens of New York. Passing to the lamp for which the Long Acre Company claimed so much, Mr. Talley said:

"Then their expert makes the most extraordinary statement I have encountered in a long while. He says, 'We are going to use a great lamp.' 'Where is the lamp?' says the commission 'In the laboratory.' Why, Mr. Commissioner, there have been 100,000 lamps in laboratories since the introduction of electricity into commercial use. There is not a laboratory in the country dealing in electricity that has not been experimenting on some form of new lamp. I dare say that the improvement of the lamp has been about the least improvement in the field of electricity that has been encountered. Every electric company in this city, in this State and every city in the Union have been bending all their energies, bringing to bear all the forces and power and genius of the engineers of this country to try and invent a lamp with higher efficiency, and there have been three lamps produced, the Gem, the tantalum and the tungsten. And yet Mr. Knipe says they have a great lamp. He doesn't name it; they have not got a patent on it nor do they control the patent. They admit it is still in the laboratory and, therefore, until a lamp is brought out and tried and proved it might just as well have no existence at all."

The difference of the Edison rate of 10 cents for current and the proposed 8-cent rate of the Long Acre Company would soon disappear, he said, under the system of no free lamp renewals by the latter company. The argument that the new company would stimulate better service was met by the statement that one of the functions of the Public Service Commission was the stimulation of better service, and that the commission would be better able to accomplish that end than the new company, as shown by the recent rate reduction to breakdown consumers and the action of the companies in putting the tungsten lamp within reach of consumers. Mr. Talley challenged the applicants to produce William H. Kelly, who, he said, could prove whether or not the applicants had a just and honest title to the franchise.

Mr. J. S. L'Amoreux summed up for the Long Acre Company and asserted that Mr. Talley's argument was manifestly devoted to the interest of other than the party which claims to have some equitable rights in the franchise under which the Long Acre Company claims to act. The question of whether the applicant has in the past properly conducted its business or whether the securities or stocks issued by it have been properly or improperly used are not subjects of inquiry by the commission, he said. The question as to whether competition would be a benefit was not germane to the subject under investigation for the reason that under the charter and under the franchise the right to operate and the right to create competition are assured. He criticised the Anti-Monopoly Company for not having taken legal action before to prove its alleged interest in the franchise and for waiting until the present company was formed before asserting its claim to the franchise. Speaking to Mr. Talley he said: "How much has your expedition increased over such as you exercised two years ago on that subject? What reason have you for having remained silent and inactive? The fear that you had no claim, and there was none that could be sustained? If you were conscious of right would you have remained quiet as you have? Even if you were conscious of the ability to succeed, would you have remained quiet?"

The hearing was adjourned sine die. The opposing attorneys are to submit briefs within five days as an aid to the commission in preparing its report upon the application of the Long Acre Company.

Overhead vs. Duct Distribution for New York Central.

After having been adjourned for a month, the hearing in the matter as to whether the New York Central should be allowed to maintain its overhead high-tension system was continued before the Public Service Commission on May 22. At the previous hearing, on April 22, the question of the cost of putting the system into ducts was discussed exhaustively. Mr. L. H. Bryan, civil engineer for the railroad, testified that the cost of the first section of conduit installed by the company was 60.8 cents per duct-foot. That section consisted of two separate 32-ft. conduit lines running from the power house to St. Mary's tunnel, with 64 ducts in all. The next section, from Westchester Avenue to Melrose Junction, consisting of two 32-duct lines, cost 65.1 cents per duct-foot. A third section cost 60.3 cents per duct-foot, another cost $1.67 per duct-foot, and another $2.23 per duct-foot. Mr. Hubert M. Bassett, of the railroad engineering staff, gave further details about duct construction and the cost of this class of work, and Mr. Charles T. Martin testified as to his experience with cable burn-outs in duct construction. At the hearing on May 22, Prof. G. F. Sever, of Columbia, said that in his opinion there would be many more breakdowns in cable underground transmission lines than from overhead lines of the type of construction employed by the railroad. Mr. Henry Floy, consulting engineer, said that underground systems at voltages of 11,000 and higher were too common to cause special comment and that high-voltage cables, even in ducts more or less filled with water, are in common and successful use. He said that there is no question that the underground construction is the safer. The overhead system is apt to be brought down by derailments, by storms of wind and by ice, or lightning, since no extra pains have been taken by the railroad to guard against the latter contingency; also, by the possibility of short-circuiting by persons throwing wires over the lines—all of which dangers would be obviated by underground construction. Lightning is a serious consideration and, although no injury has been done as yet to the Central lines, Mr. Floy said that the very next storm might do extensive damage and shut down the system for hours. In the case of strikes aerial lines can very easily be put out of commission by short-circuiting and by breaking the insulators by rifle shots at a distance, and such lines are much more difficult to patrol than in the case of underground construction. In the underground 25,000-volt cables at St. Paul, which have been in operation since 1900, there have been three breakdowns in the paper-covered cable in the terminal heads, eight in the joints and two in the cable itself, a total of 13. In the rubber cable installed at the same place there have been four break-downs in the terminal heads, eight in the joints, 14 in the cable itself, making a total of 26, with an average of 4 6/10 break-downs a year. In the opinion of Mr. Floy it was decidedly unsafe for the high-tension lines to be below the telephone and telegraph lines, and he added that in spite of testimony to the contrary, he believed that by the use of proper recording instruments defects and breaks in the system could be more readily determined in the underground system than in the overhead service. In case of the overhead wire coming in contact with one of the steel cars filled with passengers, the car would become charged, but resting on ties and dry earth there would probably be no danger unless a passenger formed a bridge between the car and the ground, in which case instant death would probably result. The hearing was adjourned to June 4.

New York Public Service Commission Imposes a Fine.

Through its counsel, Ledyard P. Hale, the Public Service Commission of the Second District has announced that it has served a summons upon the Economic Power & Construction Company, of Buffalo, in an action for the recovery of a penalty by reason of the failure of the company to file its annual report, as required by the statute. The company was informed that if a report was not filed on or before Feb. 10, 1908, steps would be taken to force the penalty of $100 a day, as prescribed by the statute. It has been contended in some quarters that the company is not under the jurisdiction of the Public Service Commission, but officers of the company have requested forms for the annual report and have promised to have the report filed immediately, with a statement in excuse of the delay. The charter granted the company by the Legislature is a very sweeping one and gives permission to operate in any city of the State without requiring permission from local authorities. Because of this the company has already been in the courts, but in Buffalo it won out in a suit brought against it and in Geneva succeeded in having vacated an injunction obtained against it. The courts have also held that the company does not come under the Public Service Commission. The company has claimed that it is not answerable to any company, as its rights are all cited in its charter. John Boyd Thacher was at one time president of the company and is now a large stockholder and John A. Delehanty is the local attorney. If the full amount of the fine is collected, from Feb. 10 until May 26, the date of the summons, the company will be obliged to pay $9,100.

Meeting of New England Section of Illuminating Engineering Society.

The regular monthly meeting of the New England section of the Illuminating Engineering Society was held at the Edison Building, Boston, on May 27, Chairman Codman presiding. The discussion of a problem in department-store illumination from the standpoint of the tungsten lamp, the gas arc and the Nernst lamp formed the program of the evening.

Mr. J. S. Codman presented the first solution of the problem, using tungsten lamps and the minimum possible number of outlets. The store proper consisted of a rectangular room 154 ft. long, 94 ft. wide and 23 ft. high, with counters and cases around the side walls, a three-sided counter in the middle of the room, and an annex at one end, 54 ft. x 60 ft. Interest centered in the illumination of the main store. Mr. Codman proposed using clusters of 100-watt lamps with Holophane clear-glass bowl reflectors, aiming at an illumination of 3 ft-candles at a height of 3 ft. above the floor, or about the height of the counters. The maximum watts per outlet permitted by the underwriters is 660, so Mr. Codman selected six 100-watt lamps as a starting point, working on the principle that the distance between lamps should be twice the height to be illuminated, to give the proper evenness of lighting. The formula applying to the tungsten lamp when equipped with a bowl reflector is, foot-candles = watts divided by the square of the height in feet above the plane to be lighted. By applying this formula and figuring the actual length of floor to be illuminated at 3 ft.-candles as 148 ft., and the width as 88 ft., the height of the outlets came to 14 ft., making the distance between lamps 28 ft. Six outlets would then be needed on the length of the store and four on the width, making 24 total. A spacing of 28 ft. is a little too large, so a practical spacing of 24 2/3 ft. on length and 22 ft. on width would be satisfactory. With this spacing the height becomes 12 1/3 ft. and the necessary wattage 455 per outlet. The lamps are then 15 1/3 ft. above the floor, allowing for the counters. Four 100-watt lamps per outlet would probably be satisfactory. The store has about 17,260 sq. ft. of floor area, giving an energy consumption of 0.63 watt per square foot.

For the windows, Mr. Codman figured 5.5 watts per square foot, but thought that this might be somewhat reduced by lowering the lamps, provided they did not come within the range of vision. Mr. Cowles, of the Boston Edison Company, suggested the use of more outlets and a smaller wattage per outlet to avoid cross lights and shadows, to which Mr. Codman replied that the question of uniformity depended upon proper spacing and height rather than upon the amount of light emitted by each separate source. He selected the 100-watt lamps because of the lower renewal cost in proportion to size.

The gas solution was presented by Mr. Gifford, of the East Boston Gas Company. He advised the installation of outlets every 5 ft. to enable the merchant to change his illumination in relation to changes of the store arrangement. He aimed to secure 3 to 4 candle-feet 3 ft. above the floor, and recommended four-mantle gas arcs with alabaster pear-shaped globes 12 ft. above the floor and 15 ft. apart each way. The gas consumption per hour on the main floor would be 1040 cu. ft., 135 cu. ft. around the stairs and elevators, and 600 cu. ft. in the windows, or a total of 1775 cu. ft.

Mr. Newington, of the Nernst Lamp Company, presented the solution of the problem from his standpoint. For the window illumination he recommended 88-watt single-glower lamps, located 12 ft. above the base of the window and 2 ft. apart. Under all conditions they should be hidden from the line of vision from both inside and outside the store. For the main store he would use the four-glower type in 9-in. alabaster globes, 18 ft. above the floor and 16 ft. apart. For special lighting over the counters he would use 88-watt lamps 10 ft. apart and 10 ft. above the floor. The watts per square foot in the interior of the store would be 1.3, and for the windows 7.3. Two-glower clusters would do well for smaller local lighting.

Automatic Control of Machine Acceleration and Retardation.

For many years past there has been an increasing tendency to operate, by means of directly connecting electric motors, heavy reversible machinery, such as mining hoists, metal rolls, planers, etc. In many instances the acceleration or the retardation, and in some instances, such as planers, the acceleration and reversal are automatically controlled.

In the case of large mining hoists, for example, the control is so arranged in many instances that the operator has merely to close a switch and the hoist is then automatically accelerated to full speed, and continues to run until the end of the lift is reached, when it is automatically retarded by causing the motor armature to generate a braking current, so as to bring the hoist to rest at exactly the right place.

In recent planer practice the planer bed is automatically accelerated, retarded, reversed, and accelerated again on reverse stroke, and so on, the entire cycle of the operation being automatically effected by automatically controlling the motor.

A patent (No. 888,447), dated May 19, 1908, has been issued to Mr. H. Ward Leonard which is directed to the automatic control referred to. The patent is based upon an application filed by Mr. Leonard in the early part of 1897, and will interest engineers giving attention to the line of work indicated.

Electrical Decorations in San Francisco in Honor of the American Fleet.

The arrival of the Atlantic fleet in San Francisco Bay was the occasion of special electric illumination in San Francisco and other cities on the Pacific Coast. San Francisco was decked in national colors and emblems from the Ferry Building to Twin Peaks, and from North Beach to South San Francisco. Market Street was decorated more lavishly than any other street in the city. From the Ferry Building to Van Ness Avenue poles were set at intervals of about 75 ft. Flags floated from the tops of the poles and from shields at the centers and festooned from pole to pole were strings of 16-cp lamps spaced 4 ft. apart on No. 16 and No. 14 rubber-covered wire. At the Ferry Building the festoons terminated in a huge red, white and blue shield, which at night was brilliantly illuminated by lamps of the same colors. The shield was 40 ft. wide by 50 ft. high and contained 1858 incandescent lamps of 8 cp spaced about 2 ft. apart. The tower of the building was outlined with over 2000 lamps and a very pleasing effect was obtained in the long nave of the building, where the arches were outlined by means of red, white and blue lamps. At the ends of the nave small concentric arches were placed, thus giving an appearance in perspective of a very long thoroughfare.

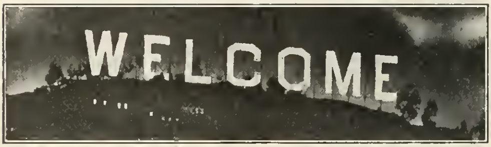


FIG. 1.—SIGN ON TELEGRAPH HILL.

Union Square was brilliantly lighted by incandescent lamps hung in Chinese lanterns. Across the square the St. Francis Hotel was outlined with lamps and with a searchlight and incandescent clusters on the roof. Chinatown was a fantastic glitter. The two principal bazaars were brightly illuminated to the tops of their pagoda towers and the chief thoroughfares had festoons of incandescent lamps suspended in brilliant Chinese lanterns. On Fillmore Street the display was unique. The four-part arches with their rows of incandescent lamps, which are a part of the permanent illumination of the street, formed a basis for more extensive decorations, which included fighting tops erected on the telephone and trolley poles, with little guns threatening the passerby.

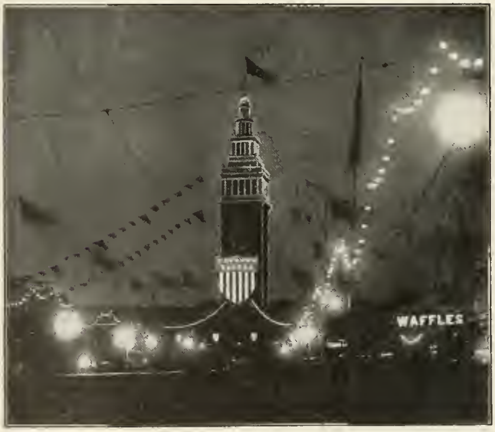


FIG. 2.—LOWER MARKET STREET AND FERRY BUILDING.

The most conspicuous single feature of the illumination was an immense sign of "Welcome" built on Telegraph Hill, facing south and east and overlooking the entire bay region. This sign, built at an elevation of several hundred feet above the bay, threw its illumination for a great distance and was legible at all points on the bay, even at a distance of 30 miles. It was easily read in Berkeley, 10 miles distant. This sign, which is said to be the largest electric sign in the world, is 400 ft. long and the height of the letters is 50 ft. The average width of the letters is 38 ft., the width of the sections of the letters being 8 ft. As a basis for the frame long piles were driven 20 ft. apart. These were planted 3 ft. in the ground and varied in length from 53 ft. to 80 ft. At the highest point of the hill the lowest cross-timber of the sign proper was placed and 20 ft. above this another cross-timber with diagonal bracing in between. Above this were placed three parallel horizontal stringers, 10 ft. apart. All timbering outside of the piles was 4 in. x 6 in. The letters were constructed on these stringers of 1-in. boards, 12 in. wide, painted white. A double row of lamps was run around each letter, spaced 18 in. from the outer edge and 5 ft. center to center. The lamps were spaced 3 ft. apart and were wired on the face of the letters with No. 12 bare copper wire, supported by porcelain knob insulators. Nearly 700 32-cp lamps were used. These were operated on a 110-volt circuit, fed by two 75-kw transformers, the energy being donated by the San Francisco Gas & Electric Company. A running board was placed along the top from which a boatswain's chair was swung for installing the lamps. The sign was illuminated each evening from 7:45 p. m. to 1 a. m. from May 6 to May 18, when the fleet departed for the north. In the construction of the sign 48,300 ft. of lumber was used, 160 turn-buckles and 18,000 ft. of ½-in. galvanized-iron, stranded guy wire. A donkey engine was used to hoist the material to the top of the hill. The sign was built to withstand the heaviest gale and has successfully withstood a velocity of wind that reached 92 miles an hour farther out in the shore. The sign was constructed at a cost of $2,850 by the Martland Electric Company and T. A. Pettus, of San Francisco.

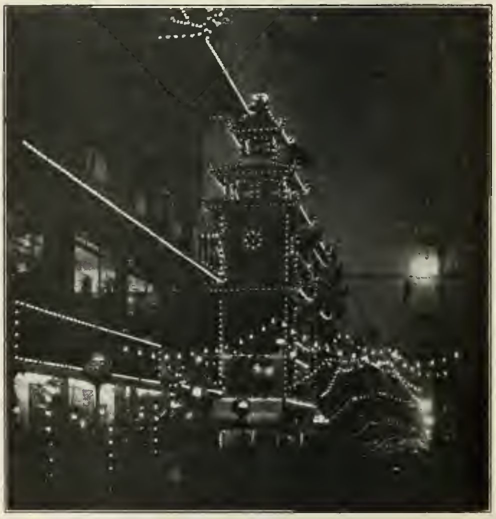


FIG. 3.—ILLUMINATION IN CHINATOWN.

A feature of the decorations in Oakland was a large canopy of incandescent lamps suspended over the junction of Fourteenth Street, Broadway and San Pablo Avenue. From a large centerpiece strings of red, white and blue lamps were run to the corners of the streets. Lamps were also strung along all the principal streets of the city.

Although the illuminations on land were extensive, by far the most attractive was the lighting of the fleet itself. The 27 battleships and cruisers, as they lay at anchor south of Goat Island, were illuminated nearly every night, the lights outlining the ships entire. Every spar and stack was outlined and the name of each ship shone forth in large electric letters across the boat. From 8 to 8:30 p. m. on several evenings further illumination was afforded by the searchlights throwing their beams about the bay and adjacent hills. The electrical display on land and water was a magnificent and memorable one. The power companies joined the merchants in furnishing energy gratuitously, and everyone vied to do his share in the welcome to the fleet.

Electric Railway Engineering Laboratory at the Worcester Polytechnic Institute.

A prominent feature of the recently completed electrical engineering building of the Worcester Polytechnic Institute is the electric railway equipment, which occupies one end of the large general electrical engineering laboratory. Two tracks connecting with the tracks of the local street railway and, in that way, with the suburban and interurban railways of New England, enter the laboratory on space covered by the traveling crane for its entire length. One of these tracks passes over an inspection pit. The second track enters to a testing plant, where a car or locomotive under test rests and runs on wheels carried by axles which transmit the power from the car to special electric absorption dynamometers and fly-wheels. The pedestals carrying these axles may be moved to accommodate cars of any truck or wheel base, and the fly-wheels are so arranged that their weight may be changed to correctly imitate the linear inertia of cars of any weight within wide limits. The car under test is held in place over the supporting wheels by being coupled to a securely anchored end post. This coupling may, for certain tests, include a traction dynamometer.

A portion of the equipment is a double-truck, four-motor interurban car, designed particularly for experimental and testing work, although conforming as closely as possible to standard lines of construction. This car is fully equipped with special apparatus, and is available for experimental and testing work, either on the test stand in the laboratory or on the lines of any electric railway. While on the test stand, the car may be operated by means of its own "K-28" controller, or from either the type M, General Electric, or the electro-pneumatic Westinghouse controller, both of which are mounted on racks at one side of the test plant. The air brakes may be controlled from the motorman's valve on the car or from a duplicate outside.

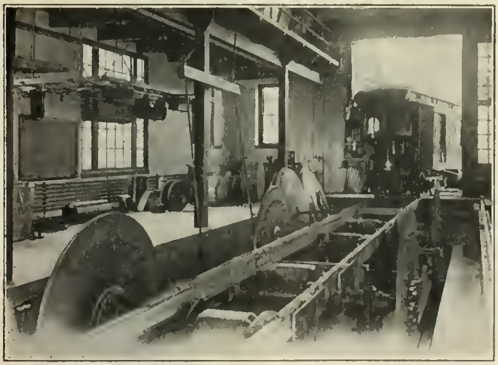


FIG. 1.—CAR-TESTING EQUIPMENT.

The set of recording instruments, which is an important feature of the equipment, was designed and built at the Institute by members of the department who have had wide experience in railway testing. These instruments are capable of making a complete autographic record of car or locomotive tests, and may be shifted quickly from the Institute car to any other. In connection with the Institute car, they are arranged to give an autographic record of the clerical conditions (of bonding, feeder drop, etc.) of any line over which the car may be operated.

In addition to the railway equipment above described, the laboratory is provided with various types of railway motors, controlling, braking, lighting, heating and signaling apparatus, mounted in operative condition, and available for study or tests.

FIG. 2.—GENERAL VIEW OF LABORATORY.

The general laboratory contains a 300-hp motor-generator, from which energy may be obtained for railway testing. The generator of this set is really a double-current machine which may be used as a rotary converter in regular railway substation service.

Power Development at York Haven, Pa.

Improvements that will require the expenditure of more than a half a million dollars have been started by the York Haven Water & Power Company at its power plant on the Susquehanna River at York Haven, Pa. These improvements will consist of the building of an addition to the power house, installation of hydro-electric units, the building of a dredging machine, strengthening the power dam, and the installation of new machinery. The work will be under the supervision of Mr. E. F. Baker, superintendent and general manager.

Several hundred men have been put at work and it is expected that the work will be completed in about one year. The addition to the power house will be 280 ft. long and two stories in height. It will be constructed of brick.

Ten generators will be installed by the General Electric Company, and these will increase the electrical output 10,000 hp. The 20 waterwheels required to operate the generators will be installed and set up by the Poole Engineering Company, of Baltimore, Md.

The improvements to the dam will make it one of the finest pieces of masonry in the country. The stone to be used in this construction is to be taken from the company's quarries. A $15,000 dredging machine is being set up and will be used to keep down the sand and gravel bars which form from time to time near the cribbing. The company's stone quarry, which is one of the best in the section, will be equipped with an electric crusher which will have a maximum capacity of 600 tons every 10 hours.

With these improvements completed, the company proposes to extend the present high-tension lines to Lancaster and other cities in Lancaster County, and to Spring Grove and Hanover. The demands made on the York Haven Power Company from numerous manufacturing plants have necessitated these improvements.

Lightning on a 72,000-Volt Transmission Line.

Mr. F. E. Greenman, in a paper before the Chicago section of the A. I. E. E., May 22, gave some interesting observations as to lightning on a 72,000-volt line of the Grand Rapids-Muskegon Power Company between Grand Rapids and the two power houses of that company. The majority of interruptions to service, he stated, were due to lightning. The pole line has a continuous grounded wire for lightning protection, and the transmission wires are placed two on a lower cross-arm and one on a short upper cross-arm. On the other end of this upper cross-arm is the grounded wire. He did not speak at all favorably of the grounded wire as a lightning protection. In some cases lightning would strike the transmission wire located below the grounded wire. He could not detect that the grounded wire had taken any discharges. Apparently the most satisfactory operation of the line has been obtained when no lightning arresters were connected at the terminals. With no lightning arresters in use, the discharges would enter the substations, but would do no damage. With lightning arresters discharges would sometimes jump to the walls. In cold weather static discharges affect the pins; these are of wood, simply boiled in oil and are destroyed rapidly. Creosoted maple pins are being put on all cross-arms, and these give good service.

Handling Tungsten Lamps at Brooklyn.

Mr. M. S. Seelman, Jr., of the Edison Electric Illuminating Company, of Brooklyn, N. Y., in a discussion at the National Electric Light Association convention, gave an interesting account of the way tungsten lamps are being handled in Brooklyn. A separate company, the Tungsten Lamp Specialty Company, was organized to exploit the tungsten lamp, and especially the 100-watt lamp, among gas consumers, with the clear understanding that it must pay its own way. As it was displacing gas burners that this new company was after, it was deemed advisable to present prospective customers a unit price covering the complete tungsten equipment, including wiring, fixtures, reflectors and lamps. It was not deemed wise for the Tungsten Company to do its own wiring because of possible ill will of contractors. Specifications were drawn covering wiring in molding for a minimum of four 150-watt lamps, not more than six lamps on any one circuit, with a separate switch for window lights and a switch for each circuit, the contractor to hang fixtures, which were to be furnished by the company. These specifications were submitted to the leading contractors in Brooklyn and resulted in the Tungsten Lamp Company securing a blanket price of $2 per outlet and 50 cents per switch. Types of single-lamp fixtures were adopted which cost the company from 45 cents to $1.20, according to style and length of stem. A specific type of reflector was adopted as a standard for general use. The price of the 100-watt lamp when sold separately was fixed at $1.75.

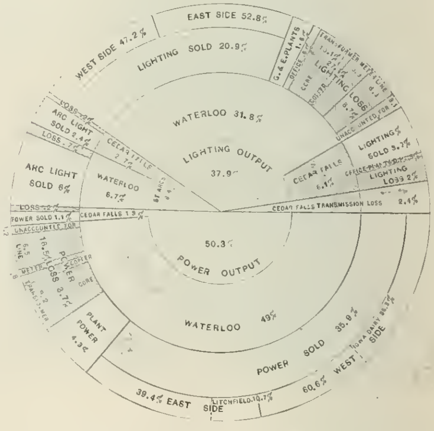
The proposition of the Tungsten Lamp Company advanced to the public was to supply a complete equipment for $7.50 per outlet, including as aforesaid, wiring, fixtures, reflectors and lamps. This price allowed about $2.50 per outlet for office and sales expense. Of course, it was understood that the standard fixtures and reflectors would not suit every installation, and solicitors were furnished with pictures and prices for other fixtures and reflectors. Five solicitors were employed and each one was supplied with a simple kit, consisting of a neat satchel enclosing sample fixtures, reflectors and 100-watt lamps. These solicitors were instructed to let exclusive electric installations severely alone and to confine their efforts as far as possible to stores illuminated altogether by gas. They were also permitted to solicit business in stores partially illuminated by electricity and partly by gas, provided they could put the gas out of business. Business was to be done as far as possible for cash, but installments spreading payment over not more than six months might be accepted where credit was good.

The Tungsten Company has been operating on this basis for about seven weeks, and during that time has secured 50 contracts covering the installation of 312 tungsten lamps. Of these, 42 contracts replaced installations exclusively gas, while eight replaced gas installations partially electric. It is exceedingly pleasing, as well as unusual, to find so many satisfied customers, for in each case the customer is delighted not only with his illumination, but with his bills. The company has given all customers the option of renewing burned-out lamps for $1.75 per lamp or of having the company maintain the installation at 35 cents per month per lamp, which is a guarantee of five months' life. So far 15 customers, with 97 lamps, have taken the maintenance proposition. The others assumed the risk themselves.

Breakage in shipment and handling is very small. The number of defective lamps so far is greater than was anticipated. The majority of lamp failures have been due to faults of construction in the lamp itself. Out of 774 lamps installed, 21 per cent failed and broke, the large majority going out after burning from 10 minutes to 24 hours. The principal trouble seems to be with defective vacuum. On May 1 the Edison Electric Illuminating Company announced to the public its policy regarding tungsten lamps and offered the 100-watt lamps at $1.50. The Tungsten Lamp Specialty Company on the same day also reduced its price to $1.50 and its equipment figure to $7.25 per outlet. The Tungsten Company has handled incidentally some 60- and 40-watt lamps, but its main effort is directed toward the sale of 100-watt lamps. Although in business such a short time, the tungsten company has been able to pay its own expenses.

Analysis of Output at the Waterloo (Ia.) Central Station.

By the courtesy of Mr. Austin Burt, general superintendent of the Citizens' Gas & Electric Company, which supplies electric light and power to Waterloo and Cedar Falls, Ia., we are enabled to present the accompanying chart showing the output of this company's central station for various purposes in 1907. This chart indicates graphically the output of the central station for various purposes and the relation of energy generated to energy sold. The relative amounts of energy generated and sold for various purposes are graphically expressed by the arcs of circles. The areas enclosed have no relation to the percentages shown.



ANALYSIS OF CENTRAL-STATION OUTPUT.

This chart is of much interest because it is seldom that a central station serving a population of about 25,000 inhabitants makes such a complete analysis of output and losses in such convenient form as is here shown. The system is one which is maintained at a state of efficiency better than the average, so that the figures given probably represent as good results as can ordinarily be expected in plants of this size. From this chart it is seen that 50.3 per cent of the total output of the station is for power purposes, which is unusually high, and shows the effect of securing a large amount of manufacturing load. Of this power output 49 per cent goes to Waterloo and 1.3 per cent to Cedar Falls; these percentages being expressed in percentages of the total output, except in the case of the losses, which are in percentages of output for each class. Of the power delivered to Waterloo, 35.9 per cent of the total is sold; so that the ratio of power sold to power generated for Waterloo is about 71.5 per cent. The lighting energy generated for Waterloo is 31.8 per cent of the total and 20.9 per cent of the total is sold, making a ratio of lighting current sold to lighting current generated of 65.5 per cent. For Cedar Falls, which is a town of about 5000, as against 20,000 population for Waterloo, the ratio of lighting current sold to current generated is 61 per cent. There are many other interesting conclusions which a study of the chart will show.

Discussion on Lightning Protection at N. E. L. A.

Following the report of the committee on "Lightning Protection," presented at the National Electric Light Association in May, a discussion took place at which the following were some of the points brought out:

Mr. Farley Osgood, of Newark, inquired whether it was the intention of the committee to recommend the installation of a small single-cell aluminum arrester to protect meters, as suggested in the committee's report. Mr. R. S. Stewart, chairman of the committee, said that this was hardly a recommendation because he did not know whether the manufacturers had developed a cheap enough arrester at the present time for this purpose. Mr. Osgood said he did not doubt that the manufacturer would be delighted to make all that could be used, but he would rather take chances on a meter burning out than bother with an arrester in connection with it.

Mr. Alex Dow, of Detroit, said that when he was a member of the lightning protection committee, complaints made proved that damage to meters is an exceedingly annoying, if not expensive, item. If the line is reasonably well protected at its ends, or at various points which seem to be specially subject to lightning damage, it is certain that all of the meters on the secondary circuit will be reasonably protected.

Mr. Arthur S. Ives, of Poughkeepsie, spoke of the conflicting testimony regarding the efficacy of overhead ground-wires for lightning protection. In some places the use of overhead ground-wires is almost unknown. It has been shown in the statements before the N. E. L. A. and the A. I. E. E. that there may be a considerable theoretical value in overhead ground-wires. Certainly they will give the necessary protection if enough are put up. The question is, if one wire is good, what percentage of the total value is attained thereby?

Dr. C. P. Steinmetz said that an aluminum cell in shunt with a meter is not a mere shunt, but is a short-circuit for excess voltage, and an open circuit for normal voltage so it does not waste an appreciable amount of power; not more than two or three watts at the highest. He cited a case where meters near a wireless telegraph station were burned out whenever the station was operated. He recommended putting two aluminum rods in an ordinary tumbler, filling it with the proper electrolyte and connecting it across the meter. When this was done there was no further trouble. Wireless stations create an electrostatic field somewhat similar to lightning. Regarding overhead ground wires, the nearer one obtains a complete cage around the wires, the better will be the protection. Dr. Steinmetz expressed the opinion that one cannot connect to ground too often. He suggested a ground connection at every pole. The lightning arrester ground circuit need not have the low conductivity of a ground connection for a secondary circuit. On grounded secondaries the ground connection should have as low a resistance as possible, so that in case of a cross between the primary and secondary circuits, the ground circuit can pass almost any current without a serious rise of potential between the circuit and the ground. Therefore, it is very desirable to carry the ground wires to a system of water-pipes or a rail return, even if at a considerable distance. A lightning arrester ground connection will be nearly as safe with a high as with a low resistance, but it is of the utmost importance that it be of the least possible impedance. This condition requires the shortest possible pass from lightning arrester to the ground and a conductor of as large surface as possible, the material of the conductor being of secondary importance. Iron is practically as good as copper, for with these very high-frequency discharges the discharge occurs only at the very surface. Iron pipes driven in the ground will be more effective than a first-class low-resistance ground carried to rails or copper plates. Dr. Steinmetz stated that he had made some study of the ordinary pipe ground-connection, taking daily records for some years, and he believes that a number of ordinary pipes driven into the ground in multiple are really the most effective ground for lightning. The simplest way to guard against ground-pipes becoming dry is to drive them in a lawn. As long as the grass is green the ground is moist and the condition of the grass is a continuous indication.

Regarding the relative amount of protection afforded by a single ground wire, he stated that if a single grounded wire is so placed that all of the current-carrying wires are included within an angle of 60 deg. below the ground wire, the single ground wire will give most of the possible protection—perhaps 75 per cent or more. He would install additional wires only where special danger exists. For instance, when crossing the summit of a range of hills, especially when it is crossed not exactly at the summit, but a little toward the slope, from which thunderstorms generally come. Moreover, in cases where transmission lines pass along a lake or ocean with the prevailing winds coming from the water, a ground-wire is needed on the side of the line toward the water. In general he thinks a single ground-wire protection of good conductivity is sufficient for all except special cases.

Mr. Alex Dow, of Detroit, gave a specific case of a single overhead ground-wire proving valuable. A 4600 volt three-phase transmission line supplying energy to factories was especially susceptible to lightning. At every transformer there was a lightning arrester. The lightning preferred to puncture the transformers, short-circuit the terminal boards and even to jump to the grounded transformer case rather than to go through the arrester, which was grounded over the same wire. This line gave serious trouble for one summer and part of another. It ran a distance out from the city, so that it was not protected by surrounding buildings and trees. This line has been thoroughly protected from lightning for several years by a single ground-wire connected to earth at every tenth pole, this ground-wire being strung on the top cross-arm along with one of the three-phase wires. On other similar lines running into exposed areas beyond the protection which was surrounded at all times by a dense growth of trees, the same construction was found highly effective

Meeting of New York Electrical Society.

The 277th meeting of the New York Electrical Society was held Wednesday evening, May 27, at the College of the City of New York, now located on Amsterdam Avenue, between 138th and 140th Streets, and was well attended, many ladies being present. Preceding the lecture of the evening an organ recital was given in the auditorium by Prof. S. A. Baldwin. The audience then proceeded to the Assembly Hall in the sub-freshman building, where a paper was read by Mr. F. L. Gilman on "Modern Telephone Apparatus and Its Manufacture." Mr. Gilman discussed some of the fundamental conditions peculiar to the telephone industry, tracing their effects through the design and manufacture of telephone equipment. The various phases in the development of modern forms of substation and central-station apparatus were reviewed and several interesting points in the effect of the telephone were touched upon. The lecture was illustrated by lantern slides, and there was a very complete exhibit of apparatus, showing the development of the various instruments from their earliest forms to the modern standards.

After the lecture the party was conducted on a visit of inspection through the various buildings.

Commercial Sessions at the N. E. L. A. Convention.

Business-getting methods were discussed at the recent Chicago convention of the National Electric Light Association according to a "Commercial Day Program" which was prepared by Mr. C. W. Lee. The carrying out of this program required the whole of the afternoon of Thursday, May 21, and the morning and afternoon sessions of Friday. Brief abstracts of the special papers which were prepared by various editors and assistants for the commercial sessions are given below.

PREPARATIONS FOR A CAMPAIGN.

A general outline of the organization and work necessary to accomplish the best results in the sales department, with the least expense or investment, was prepared by Mr. Henry J. Gille as editor, with a corps of 12 assistants. The method by which the work of solicitors can be assigned to best advantage, and the rates that should be paid for obtaining new business were fully discussed. It was suggested that the customers' accounts should be classified so as to determine along what particular line the business is developing. There should be a record of business lost, together with the reason for loss. Careful attention should be paid to complaints; efforts should be made to ascertain if the service has been satisfactory after each complaint has been investigated.

THE CONTRACT AGENT AND THE REPRESENTATIVE.

Mr. V. A. Henderson, as editor, and 24 assistant editors, presented a paper dealing with the qualifications and duties of the one who has charge of the relations between the public and the company. The work which should be performed by specialists and not by the general solicitor, is that dealing with motors, signs and illuminating engineering. Certain duties may well be assigned to women representatives, such as the introduction of domestic devices.

THE DISPLAY ROOM.

The value of maintaining a display room and the methods for arranging display apparatus were treated in a paper due to the combined labors of Mr. L. D. Mathes, as editor, and 13 assistants. It is essential that the apparatus be arranged for a working demonstration of each device displayed. Where possible, the display room should be located in such a manner that customers will pass through it in visiting the business office. In the majority of cases reported the display room embraces the window space as well. On this account it is regarded by some that the window display is the keystone of the arch—that the brightest and most attractive exhibits should be made in the windows, that the same may attract the attention of those who pass.

ADVERTISING.

Mr. Charles A. Parker, as editor, and five assistants, presented a paper on "Advertising," compiled from information obtained from a large number of central stations. In arranging for the paper the editors sent a list of 24 questions to 138 central stations and received complete sets of replies from 54. These questions were intended to bring out points believed to be of value to all central stations. The opinion was expressed that the advertising and marketing of electricity are on a par with the advertising and marketing of any other commodity that can be named.

PUBLICITY.

The relations of the central station with the public were discussed at length in a paper entitled "Publicity," prepared by Mr. Percy Ingalls, as editor, and eight assistant editors. It was claimed that there has been no definite reason for secrecy in the operation of public-utility companies, while numerous advantageous results follow the taking of the public into the confidence of the company. A popular form of publicity has been through the medium of daily talks in fair-sized newspaper display space. In this space the company has been able to explain its methods, tell the object of its existence, and handle a mass of interesting facts and figures, thereby creating renewed interest in the operations of the company. If this copy is handled in a sincere way it becomes productive of untold good. There should be popular talks upon illumination, cooking and heating, dinners to contractors, boosting the city, advertising the installation of large motor units or additions to plant equipment, cultivation of friendship with the newspaper men and the furnishing of live news stories to the papers.

CREATING DEMANDS FOR ELECTRICAL ENERGY.

A paper recording examples of methods that have been applied successfully in producing demands for electrical energy was prepared by Messrs. Frank B. Rae, Jr., and George Williams, as editors, and six assistant editors. The object of the paper was to cause electrical salesmen to realize their opportunities and their ability to create opportunities. Street lighting, electric heating, industrial motor and decorative lighting were characterized as businesses of the "created" type.

EVOLUTION OF NEW-BUSINESS BUILDING.

Opportunities for creating business along existing lines and examples of central stations that have continued methods during depression were discussed in a paper presented by Messrs. George N. Tidd and Duncan T. Campbell, as editors, and 13 assistant editors. In registering a plea for the maintenance of commercial departments and advertising, it was stated that there is no surer way to produce and increase hard times than to cease the effort to secure additional business. The opportunity to obtain additional business with the least investment is greater at this time than ever before, from the fact that the demand already created gives a better chance to place additional equipment than in the past.

THE ELECTRICAL CONTRACTOR.

Specific examples and general discussions of what electrical contractors are doing to assist in creating demands for electrical energy were given in a paper prepared by Mr. Joseph F Becker, Jr., as editor, and 9 assistant editors. It was claimed that in view of the fact that the contractors are particularly well equipped to solicit business from a certain class of possible customers for central-station service, it would be a wise policy to encourage such solicitation in every possible way. In order to bring about closer relations and to offer instruction of a kind that would assist the contractor in advocating the use of electrical energy for various purposes, the central station could profitably give lectures or informal talks at frequent intervals, to which all contractors should be invited. The regular distribution of printed matter, such as would be of assistance to a solicitor, would afford a means of familiarizing the contractor with the arguments used by the central-station solicitor when recommending the use of electrical energy for any particular purpose.

ILLUMINATING ENGINEERING AS A COMMERCIAL FACTOR.

A paper dealing with the importance of illuminating engineering as a commercial factor as proved by the experience of central-station men from different parts of the country was presented by Mr. V. R. Lansingh, as editor, and 12 assistant editors. The application of good illuminating engineering principles results in benefit to the central station by giving the customer the maximum amount of illumination for the lowest expenditure of money possible, a sentiment is created in a community which will successfully resist the efforts of competitors to break in on what should be a monopoly, and at the same time still the oft-heard cry of municipal ownership.

Moreover, by giving to a customer satisfactory illumination at a reasonable figure the central station will obtain a better load factor. There will be an increased use of electric light by the old customers, which in itself will react and increase the number of customers.

Discussion of "Commercial Day" Papers.

QUALIFICATIONS OF THE CONTRACT AGENT.

Mr. W. E. Turner, of Cleveland, in a discussion presented during the Commercial Day program, emphasized the importance of a knowledge by the contract agent of men and conditions. By knowledge of his own men he will place them in positions best suited to their capabilities and tastes. Knowledge of customers will tell him whether they are worth working upon. He should so organize his force that it works more or less as a machine. He considers that there is no doubt that better work may be accomplished through a machine-like organization of young, pliable, intelligent minds than by the more or less independent and loosely-controlled highly-developed representatives. He does not favor elaborate detailed reports concerning the movements of the district and special representatives. He thinks the best field for the woman representative is in the sales department offices. The work of meeting customers with complaints, selling heating and other appliances, selling lamps, taking applications and all the work which deals in the majority of cases with the small customers who come to the office, is dissatisfying to a man, but seems eminently suited to a woman's taste.

Mr. Harold Almert said that in one company with which he is connected an illuminating engineer is employed in the meter department, in the belief that a great many complaints on meters are not due to the meters at all. In 7 cases out of 10 the troubles were found to be due to poorly designed lighting installations or badly located fixtures.

Mr. Alex J. Campbell, of New London, Conn., outlined a plan for promoting the sale of electrical appliances by purchasing them in quantities and getting the local merchants handling similar lines of goods to sell them. For example, one or two hardware stores will be given a supply of electrical appliances that might be sold in these stores. The same thing will be done with drug stores. The central station, which will carry the stock, will fix on it a price which will give to these dealers a fair profit. The dealers will get all of the money that is made in the sale of the appliances. The company will not be making any money out of appliances sold in that way, but Mr. Campbell says he would rather forego that profit than spend several dollars to sell each appliance, as he did last year. He would welcome the day when electric appliances are sold as freely and readily as pie plates and patent medicines.

Mr. H. W. Hillman told of the electrical show held at Grand Rapids during the previous week. Out of the 100,000 people in Grand Rapids he estimated that from 10,000 to 20,000 attended the show. From the comments in regard to it he was satisfied that many of these people will attend next year. Such a show requires a high degree of co-operation between the central station, the contractors, the dealers and the people.

BUSINESS GETTING AND HOLDING.

The following points were brought out in a discussion on "Getting and Holding Business." Mr. J. T. Maxwell, of Philadelphia, urged the necessity of investigating carefully the causes for disconnections in order that the percentage of business lost to business gained be as small as possible. There are certain natural losses, such as failures, fires and going out of business. Leaving these natural losses out of account, the other losses must be carefully watched. This is as important as securing new customers. The solicitor who brings in many contracts because he has made promises and guarantees which the company later on finds difficult in carrying out, leaves behind him a trail that may take many months to counteract. In fact, his employer may never know the amount of damage he has done to the company's reputation.

Mr. F. M. Tait, of Dayton, emphasized the proper handling of complaints. One cannot expect to get all of the business available in any locality unless every complaint is properly and satisfactorily handled. One company employs a very expert complaint clerk whose business it is to see that every customer who leaves the building is thoroughly satisfied and happy.

Mr. R. M. Searle, of Rochester, N. Y., said that his company took in $445,000 of additional gross earnings last year at a cost of $60,000 to get it, the rate of increase being three times as great as during the year previous.

Mr. Farley Osgood, of Newark, N. J., said that one of the greatest difficulties in complaint work is the fact that the representative of the company to whom the customer makes the complaint usually assumes that there is no justifiable complaint. Better progress can be made with customers by sympathizing with them and trying to see their side of the proposition, and by assuming that if there is no just ground for complaint they would not make it. The feeling of the customer when he enters the office that he will not receive any sympathy is one of the surest elements of continued dissatisfaction.

Mr. Arthur Williams, of New York, referring to the apparently high percentages of disconnections reported by some companies, called attention to the fact that the disconnections included all those of persons moving from one place to another. Therefore, many of them do not represent loss of business, but simply changes. Valuable comparisons can be made by dividing business into different classes and determining the relative cost of securing different classes. The cost will be found to vary from five cents or even less per 50-watt lamp or equivalent connected, to perhaps $1. A complaint should be looked upon as an opportunity to get better acquainted with a customer, and to cause him to become better acquainted with the central station man.

Mr. M. S. Seelman, Jr., of Brooklyn, described an experiment that the company has been trying in Brooklyn with its 1500 employees. The officers felt that many of the men might be used to advantage in securing business. A school meeting one night a week was established in which it was offered to teach the employees all of the practical requirements for securing business, lamp practice, details of contracts, methods of estimating expense, etc. As a result, there are now many solicitors who work in the evening, or when not otherwise employed by the company, each one having a local coterie of merchants from whom he is able to secure business which might not otherwise be obtained. On all contracts for new business the commission is 50 per cent of the first full month's bill. No extension business is taken on this basis. Some complications have arisen, and certain modifications are required, but in its main essentials it is a part of the company's practice and will survive.

Mr. Searle, of Rochester, said that it is a good plan to keep in touch with the advertising of "Motors For Sale" in the daily papers. Frequently a man has an idea that he will discontinue the use of a motor before he really intends to sell it, thereby giving the company an opportunity to ascertain why he wants to sell it.

Mr. J. S. Cartwright, of Knoxville, Tenn., emphasized the necessity of distinguishing between profitable and unprofitable business. He thought too much attention is paid by the ordinary run of solicitors to obtain the maximum number of kilowatts connected at the end of the month. The load factor should always be kept in mind. During the past year his company's load factor increased from 26 to 38 per cent; for the three months of the present year, while the gross income has shown a slight decrease, the net income has represented a small increase.

Mr. C. Osborne, of Spokane, Wash., gave some figures on the cost of getting business in Spokane. His report for the last half of 1907 shows that of the total expense incurred by this department, 45 per cent was paid for salaries and bonus, 10 per cent for advertising, 5 per cent for miscellaneous expense, 29 per cent for free work on signs, 11 per cent for free wiring. The cost per call was 84 cents. The cost per order, personal, $8; cost per order, gross, $5; cost per $1 revenue, personal, 15 cents; cost per $1 revenue, gross, 10 cents; cost per $1 revenue, net, 13 cents. Percentage of expense to increased net revenue, 15; percentage of orders, personal, 62; percentage of revenue, personal, 71. Number of calls per order, 9.

Relationship Between Central-Station Engineering and Commercial Departments.

In a paper read at the Chicago Electric Light Convention, Mr. L. A. Ferguson presented the importance of a close co-operation between the engineering and commercial staff of central stations, and set forth the advantages of technical knowledge to those engaged in the management of such properties.

In some quarters, he said, the lines of organization are drawn so hard and fast that there is little or no intercommunication between the engineering and the commercial sides of the business, resulting, perhaps, even in actual opposition and lack of respect one for the other arising out of lack of knowledge of each other's value.

Such a condition is exceedingly deplorable, and there should be no excuse for its existence. This criticism does not imply any advocacy of looseness in organization. The scheme of organization should be clear and well defined, but the operation of it should be sane and reasonable and co-operative in its feeling.

The relation between the engineering departments—speaking broadly and including both the constructive and the operating engineering—and the commercial or business getting departments should be as close as possible, even to bringing them, if necessary, under one head, for their work when considered at their foundations is so dependent one on the other.

The plant and system to obtain the lowest costs of production must be efficiently and economically designed and constructed and the territory covered must be such as to produce sufficient income to bring an adequate return on the investment. This is the province of the engineer, but there is a fallacy in the statement unless we agree on what is an engineer.

The engineer, to fill that specification, must be of the highest, broadest type. He must have other qualifications than the ability to design the power house and calculate the sizes of the conducting wires and cables of the distribution system. He must have broad, sound judgment to determine the income value of any investment, of any extension or of any territory to be supplied. You may say at once this is not for the engineer to decide, but for the manager, or contract agent, or other commercial man, call him by any title you may choose. If we admit this, then we must acknowledge that there should be the most intimate relation between the engineering and commercial departments, and each should be thoroughly acquainted with the work of the other insofar as the return on the capital investment of the corporation is concerned. Unless this be so we may find a condition where the two departments are working at cross purposes, or, perhaps, through lack of proper knowledge, "saving at the spigot and wasting at the bunghole"; the operating department struggling to bring down costs of production by scaling down a few tenths of cents per kilowatt hour while the commercial department is being out-traded in whole cents per kilowatt hour by the clever engineer of the purchaser or perhaps by the unscrupulous bluffer who takes advantage of the weakness of the contract agent who does not know the value of the product he is trying to sell.

The engineer spends the money. The commercial man makes it. It takes brains to do either well. As the engineer must economically and efficiently design and construct the plant and system, so, likewise, must the commercial man economically and efficiently sell the product of the engineer. To do this it is desirable that the head of the contract department should be a technically trained man, either by education or experience.

If the contract agent, or manager of the business getting department, be a man trained as an engineer, either by education or practical experience, he is better able to handle the problems that confront him. Such training develops the analytical mind, increases the reasoning power, promotes sound judgment and teaches the man to differentiate between right and wrong. The man so trained does not do things by rule of thumb; he knows because he knows and acts upon his own knowledge, and does not follow blindly the lead given by others who may perhaps be mistaken in their conclusions.

Such a man is not dependent upon others in his negotiations with the shrewd and clever business man, who perhaps is an experienced man of affairs and generally acquainted with some of the fundamentals of rate making; nor does he have to call for assistance when dealing with the consulting engineer or architect employed by the owner or purchaser with whom he is trying to do business. His knowledge that he is perfectly able to discuss intelligently with his customer the problem at hand in all its phases will give him a distinct advantage over the untrained man and will inspire in himself confidence in his own proposition and furnish the necessary courage to meet any argument or objection advanced by the purchaser.

This courage, shown by the commercial man, will command the respect of the purchaser, and this when once established makes the negotiation easier. The courage becomes persuasion and makes its impression upon the purchaser, resulting in the contract being closed satisfactorily, whereas it might be lost entirely if the purchaser do not feel the confidence in the seller.

We all like to do business with the man who knows his business. The representative of the commercial department engaged in the sale of electricity in large quantities needs all the experience in engineering he can possibly command in order to cope successfully with the arguments advanced by the purchaser as to the cost of production. In many cases the question of steam for manufacturing, heating and other purposes enters into the problem, and it is essential that the commercial representative of the central station company be generally familiar with the cost of operation of apparatus using steam, so that he may be able to demonstrate the economy of central station service notwithstanding these costs.

He should also understand the fundamental underlying cost of production and be familiar with the influence of load factor upon the cost of production in an isolated plant as well as in the central station and be familiar with the load factors of various classes of business. He can only have this knowledge by experience and familiarity with different types of apparatus. He should be familiar in every way with the cost of operating a private plant, from the coal bin to the lamp or motor, being able to point out, if necessary, defects in the calculated costs made by either the architect or engineer. A man of this character should also be familiar with the operating costs of the central station, having at his fingers' ends the costs in detail and the methods of obtaining these costs. He can only do this by being familiar with the detail of construction and keeping in touch with the extension of the company's plants and systems. In this way he will know the difference between the cost of delivering the power from a central station system or from a private plant.

Since it is true that the cost of making electricity depends largely upon the load factor of the central station, the commercial man should know what effect a given piece of business would have on the general cost of producing electricity in the central-station plant, and whether making the contract for a large amount of power would have a tendency to reduce the cost of the whole power generated.

In making up a system of rates for large business it is necessary to have these rates made in such a way that they will bear a relation to the cost of production of electricity at different load factors. In this way only can the scale of rates be justified under the law, and unless the representative be familiar with how to determine the cost of electricity under differing conditions of load factor and quantity he would be unable to discuss intelligently the selling price of electricity in large quantities.

In urging the value of technical training for the contract agent or manager for an electric lighting or power business it is not meant that he should necessarily be an expert in higher mathematics or theoretical electricity; but he should understand the fundamentals of engineering. The volume and variety of business that will be obtained by the central station company will depend largely upon whether the business getting department is captained and made up of men with or without engineering training, either that which comes through a technical education or from practical experience in the draughting room and shop or in working through the various branches of the business. The salesman who does not understand the technique of his business is at once at a disadvantage, requiring the assistance of an engineer, which means a duplication of expense.

In selecting men for both the engineering and commercial departments they should be chosen from as wide a range of education and environment as possible; the engineers, for instance, being taken not from one local educational institution, but from different engineering schools and colleges, so as to obtain the value of diversified view points as developed by the various teaching staffs, thus preventing narrowness of view.

We have heard the argument advanced in isolated cases that technical education is not a good thing for a man and does not produce results, and that technical men do not rise to the head of large institutions. These statements are not borne out by the facts.

While the financial heads of the various industrial institutions may not be technically trained men in the ordinary acceptation of the term, yet the administrative and executive heads of the organization who are engaged in the daily management of the business and responsible for the economical manufacture and sale of the products of the corporation are being drawn more and more from among the technically trained men. Those who argue against the technical man in business must remember that the great industrial development of this country has come within the last 25 years and that in the early days of this development there were few technical men aside from civil engineers and architects.

Fifteen or twenty years ago the principal selling men even in our technical business were those whose qualification was in being a "good fellow," but those days have passed and it is now the man who has the goods and can demonstrate their value through his knowledge of the business that makes the sale.

The purchaser is better fitted to-day than he was 20 years ago, has more general knowledge on all subjects of a technical character, even to having expert technical assistance at his call, and the next 25 years will find the technically trained man the actual head of most industrial undertakings.

There is a tendency among some technically trained men, especially the younger set who have been out of college but a short time and whose minds have not sufficiently matured through wide contact with the world, to feel that they should not devote any of their time and thought and energy to the commercial side of the business in which they are engaged as engineers; that it is unprofessional so to do and beneath their dignity.

That this is a mistaken idea many of them realize in later years, when their success in life has not been as marked as some of their fellow men. They do not appreciate in time that all technically trained men cannot be great scientists and that there is a splendid field awaiting the use of their training if properly applied in the great market of commercial life. On the other hand some of the commercial men seem to think that it is beneath them or perhaps it is too arduous for them to attempt to acquire any engineering information, waiving it all aside as "a mere matter of detail." A little persistent effort on their part to acquire knowledge would very often greatly increase the value of their services to themselves and to the company.

Why are the lawyers who have achieved marked success in their profession sometimes chosen to conduct the affairs of large undertakings? They are technical men. They are business engineers; they have been trained in the theory of what is right and wrong in business. Few lawyers of active temperaments would consider it beneath their dignity to give up a lucrative practice for the presidency of a large corporation or a great business. The same limitations which apply to the engineer as to his capability for the conduct of a large business apply similarly to the lawyer. He must be broadly educated either originally in his college life or in after years through contact with men of broad ideas and of broad experience.

The financier is a technical man; the expert accountant is a technical man—each in his own sphere. Neither would make good managers for large undertakings if they knew nothing of the technique of the other branches of their business or had not the special ability to direct men of technical training, or were not good judges of other men's ability.

Not only should there be close relationship between the engineering and the business-getting departments, but also between them and the accounting department. The accountant must get his figures from the engineer and the accounting must be well done, that the engineer may obtain the proper data to enable him to draw correct conclusions.

Electricity in the New First National Bank, Boston.

In its recently completed new building at the corner of Federal and Franklin Streets, Boston, the First National Bank of that city has employed electricity to an extent unusual in the older banking houses. The new building is a four-story structure of attractive architectural appearance, and the extensive use of electric lighting in its main banking chamber, offices, departments and vaults was a necessity for the preservation of the harmonious decorative effects and the convenience and comfort desired by the organization and its customers. About 40 rooms are included in the building, and the lighting is mainly carried out by carefully arranged 16-cp incandescents, either in chandelier or in special bracketed fixtures. A few large Gem lamps are in use also.

Current is supplied to the bank by a three-wire service of the Boston Edison Company, which is brought into the sub-basement to a panel containing five Wright demand meters and three recording wattmeters for the separation of the various power and lighting services. From the Edison panel, the different circuits are led to a two-panel distributing switchboard of gray marble, also located in the sub-basement. This board carries three spare meters for use in case the plant should ever become an isolated installation, and at present the circuits leading to the different floors and departments are controlled from this board by nine lighting riser switches, one main fan-motor switch, and three elevator switches, one other being left as a spare.

An extensive mechanical heating and ventilating plant is in service in the building, the engineering work having been done by Messrs. French and Hubbard, of Boston. All the wiring is in iron conduit, and the arrangement is such as to permit the most flexible service. Motors are used in the bank for several purposes, including the operation of pumps, elevators, carrier systems and adding machines. For the general ventilation of the building air is drawn into a spray chamber located in the sub-basement, by a 7-ft. fan driven by a 10-hp, 220-volt, direct-current shunt Crocker-Wheeler motor. A Cutler-Hammer starting box is provided for this motor, with a speed range from 520 to 650 r.p.m. This motor also drives a small centrifugal pump which supplies water for washing the air admitted to the building, the air being changed 10 times per hour. Steam coils are provided to enable the air to be warmed to the proper degree. An air pump is installed in this bank to provide the pressure required in the operation of the Johnson system of temperature regulation connected with the heating and ventilating apparatus. This pump is driven by a 5-hp, compound-wound Westinghouse 220-volt motor whose normal speed is 800 r.p.m., the connection between the motor and pump being a single shaft. This pump also supplies the necessary air pressure to deliver the drainage of the sump in the sub-basement of the plant to the sewer, which is at a higher level.

There are two passenger elevators in the building and one freight elevator or money lift. All are Otis machines driven by direct-current motors, and the control of each elevator is automatic, without the necessity of an operator. The push-button system is used to stop the cars at the proper floors

The money lift serves the tellers and the vaults, principally, and runs to the second floor only.

The different departments of the bank are served by the pneumatic single-tube system, there being seven motors for the operation of this apparatus. These motors are all rated at ¼ horse-power each. The bank is also provided with an exhaust fan 4 ft. 6 in. in diameter, which throws the air from the more confined portions of the building to the roof. In the check teller's department are located 22 Burroughs electric adding machines, each motor being rated at 0.1 horse-power, 110 volts, 1225 r.p.m. An 18-station watchman's electric clock system is in service throughout the bank and the Gray telautograph is also in use. The bank is provided with the American District Telegraph service, also. We are indebted to Mr. Hall, superintendent of the building, for the foregoing particulars of the electrical installation.

CURRENT NEWS AND NOTES.

MUNICIPAL LIGHTING RATES IN OHIO.—Mr. D. L. Gaskill, secretary of the Ohio Electric Light Association, Greenville, Ohio, has compiled for the use of the members of the association a schedule of lighting rates of the municipal plants of Ohio.

NEW YORK PUBLIC SERVICE COMMISSION LAW.—The New York Assembly committee on electricity, water and gas supply has reported to the Assembly the bill amending the Public Service Commission law of last year by striking from the bill all limitations of the powers granted to the commission and giving jurisdiction over telephone, telegraph, ferry and stage companies, as recommended by the Governor. The bill in its present form is merely intended to clear the defects found in the law of last year.

INDUSTRIAL TRAINING SCHOOL GRADUATION AT BOSTON.—Fifty students of the Lowell Institute for Industrial Foremen, under the auspices of the Massachusetts Institue of Technology, received diplomas on the evening of May 27. Twenty-one of these were graduated from the electrical courses. Addresses were made by Director Parks, of the school; Acting-President Arthur A. Noyes, of the Institute of Technology; Prof. Elihu Thomson, of the General Electric Company, and Mr. A. Lawrence Lowell, trustee of the Lowell Institute. At the conclusion of the exercises the engineering laboratories of the institute were inspected.

COMMENCEMENT AT WORCESTER POLYTECHNIC.—Commencement week at the Worcester Polytechnic Institute will begin on Sunday, June 7, when the baccalaureate sermon will be preached at Central Church, Worcester, by the Rev. Shepard Knapp. On June 9, at 8 p. m., Prof. George I. Rockwood will deliver the annual engineering lecture, his subject being the "Steam Turbine." The hydraulic laboratory will be open for inspection at Chaffin's on June 10, and on commencement day, June 11, the principal speaker at the graduating exercises will be the Hon. James Logan, Mayor of Worcester, his subject being "Changing Industrial Conditions."

HARRIMAN TO ELECTRIFY SOUTHERN PACIFIC.—Mr. E. H. Harriman has sanctioned the work of converting the Southern Pacific Railroad from Los Angeles to Santa Monica into a double-track electric line as part of the Harriman Los Angeles-Pacific trolley system. Preliminary work has already been begun on this important undertaking and operations will be pushed forward rapidly. What is known as Long Wharf at Port Los Angeles, which extends for more than a mile from the shore, is to be used for both traffic and pleasure. A dancing pavilion will be built at the further end of the pier. This wharf, costing more than $1,000,000, was a hobby of the late Collis P. Huntington, but never was of great advantage to the Southern Pacific. The proposed change will open an extensive section to trolley traffic, but at the same time is an invasion of the so-called Huntington territory. The Los Angeles-Pacific has recently expended $1,250,000 for fine cars, many of which will go on the newly-changed line.

NEW HAVEN TROLLEY SUIT.—Counsel for the New York, New Haven & Hartford Railroad have received from the United States attorney-general the form of the decree which the attorney-general will request from the courts compelling the New Haven to dispose of its Massachusetts trolley holdings. The decree has been framed with a view to conforming to the Supreme Court ruling against the legality of such trolley holdings, and the time for its filing in court depends on the railroad counsel's opinion as to whether it so conforms. If they decide that it does not conform and they are unable to reach an agreement with the attorney-general, the matter in dispute will be argued before the court.

MASSACHUSETTS LIGHTING LEGISLATION.—Acting-Governor Draper, of Massachusetts, recently signed a bill authorizing the purchase, sale and consolidation of Massachusetts gas and electric companies. Under the provisions of the bill any gas company may consolidate with any other gas company doing business in a contiguous municipality, and any electric company may consolidate with any other electric company under similar conditions, but the bill exempts from the provisions of the act the consolidation of the Boston Consolidated Gas Company and the Edison Electric Illuminating Company, of Boston. Acting-Governor Draper has also signed a bill removing the limitation of capital stock, which may be issued by gas and electric light companies. The present limit of the capital stock which may be issued is $1,000,000.

AN UNIQUE RAILWAY COMPANY.—The Winona (Minn.) Interurban Railway Company is, as far as known, the only traction line which does not operate its cars on Sunday, and the only railway in the world whose receipts are used for the education of poor boys. The profits of the road go to the support of the Agricultural School, of Winona, and the Winona Technical School, at Indianapolis, which is graduating a class of practical electricians this year. It is said to be the only road in the world that has no watered stock, while its officers, with the exception of two, serve without pay. The cost of the road when completed will amount to $2,100,000, with a capital stock of $6,000. The bonded debt of the road is from $21,000 to $26,000 per mile. Its roadbed and equipment are excellent, and its management has been complimented by the Indiana Railroad Commission. Notwithstanding that no wheels turn on Sunday, the business done on this system is equal to any other system in the state in proportion to its mileage. The officers of the road are: H. J. Heitz, of Pittsburg, Pa., president; J. F. Byer, vice-president; Rev. S. C. Dickey, general manager, and H. S. Dickey, general superintendent.

HOW IT STRIKES ONE NOVELIST.—Some great novelists seem to like New York life and lighting. The well-known novelist, Amélie Rives, shares the dislike of some authors for prolonged residence in New York. There is a hostile description of Broadway at night in her latest novel, "The Golden Rose," as follows: "The sheets of lilac-tinted light that poured from every side showed her faces avid for pleasure, tense with the greed for the sensations that are purchasable; set, whether smiling or rest, in a predetermined resolution of enjoyment. that turned the tinsel night into an artificial day of labor. She felt that if the Statue of Liberty in the harbor were to call aloud in some great cause, it would be with a fierce, megaphonic shout in which all these street clangors would be blended. She sat silent and dismayed, watching the red glare of the huge advertisement that glowed like its crown jewel on the forehead of this distorted harlot night of Broadway. And she thought of the quiet, snow-wrapped fields of Kingsweather, and of the leafless branches of the trees before her window, quivering with a thousand stars, as in the soft June nights they quivered with the delicate fireflies."

Lighting of the Hotel Albany and the College Inn, New York City.

By H. Thurston Owens.

ONE of the hostleries which New York provides for those whose inclinations are toward late hours and gayety is the Hotel Albany with its café, "The College Inn," at the southeast corner of Broadway and Forty-first Street, shown in Fig. 1. The hotel was well known as the Vendome long before Broadway acquired its title of "The Great White Way" and the building has recently been remodeled at an expense amounting to nearly $400,000. The exterior has all of the embellishments of an up-to-date hotel, namely, the roof is outlined with lamps and there are five illuminated signs, 10 lamp-posts, and a marquee at each entrance. As New York hotels go, its height is not great, being only nine stories, but the building is higher than its immediate neighbors, so that the roof signs can be seen some distance away.

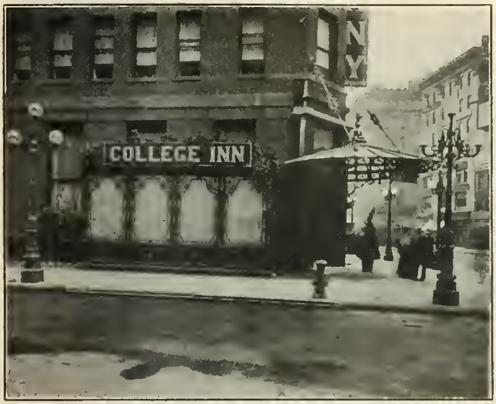


FIG. 1.—ENTRANCE TO COLLEGE INN.

Each sign contains 220 8-cp lamps, and, in addition, one of the signs has a crest with red color lamps. The vertical building sign reads "Hotel Albany" on each side and is equipped with 2-cp lamps, 278 to the side.

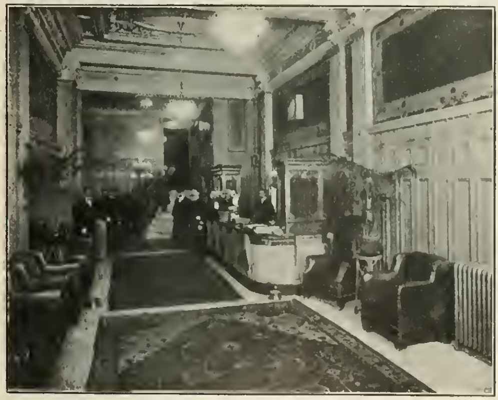


FIG. 2.—REAR END OF LOBBY.

There is a much smaller sign reading "The College Inn" over the entrance to the restaurant, in which there are only 48 2-cp lamps. The lamp-posts along the curb may not be considered aesthetic, but they serve their purpose as spectacular sentinels of welcome. Each is equipped with three frosted globes, enclosing one 50-cp lamp. The roof is outlined by 336 4-cp lamps arranged along the edge. Although a comparatively small hotel, the amount of exterior illumination provided is only exceeded by one other hotel in the metropolis.

The lobby is an interior room with an entrance on Broadway, and parallels the bar, which occupies the corner. The room is rather long, but, nevertheless, has a comfortable atmosphere, due entirely to the skill with which the decorations and illumination have been carried out. The rear end is shown in Fig. 2.

A dark-colored wainscoting covers over half of the walls, the remainder being tinted a cheerful red. The ceiling is paneled, and from the center of each panel hangs a chandelier. These are equipped with 13 16-cp round, frosted lamps; pendant and near the ceiling are 4 25-cp lamps of similar pattern. The carpet is red and the large, comfortable chairs which line the walls are of red leather; numerous palms complete the decorations.

The barroom is one of the most spacious and best appointed in New York. It has several features which would call for comment even if they were found in five and ten million dollar hostelries. The bar covers over half of one side of the room and behind it is a wonderful example of the glass-maker's art —an immense mirror in three sections. On the opposite side of the room, between each of the windows, are two pilasters of green marble with capitals of gold. At the front end forming the entrance is a cupola in art glass, and at the rear an oil painting. The ceiling is beamed and in bright colors, thereby increasing the apparent height of the room. In the center hang two beautiful Louis Quinze crystal chandeliers and on the walls are brackets in the form of torches, as shown in Figs. 3 and 4. The brackets hold 5 50-cp clear tantalum lamps. In addition to

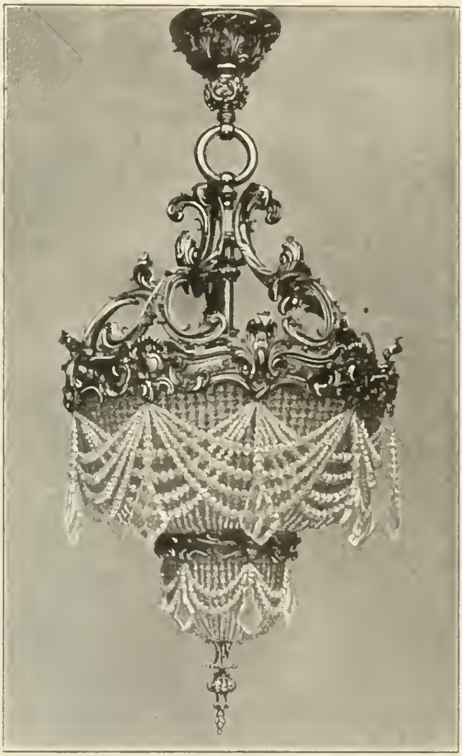


FIG. 3.—CRYSTAL CHANDELIER IN BARROOM.

these there are four ornamental fixtures behind the bar, two being bronze figures, each holding a torch in each hand, and the other two being miniature standards in a niche at each end of the bar.

The ladies' reception room, shown in Fig. 5, is arranged as a foyer at the ladies' entrance on the Forty-first Street side. The decorations in both color and design are similar to those in the lobby. The illumination is furnished by means of pendant frosted balls, and in addition there are art-glass lamps upon the writing tables. In the newels at the foot of the interior stairway are bronze fixtures in the form of cats'-tails, tubular frosted lamps forming the blossoms. The men's writing room is adjacent to the ladies' reception room, and brackets with frosted enclosed globes furnish the illumination.

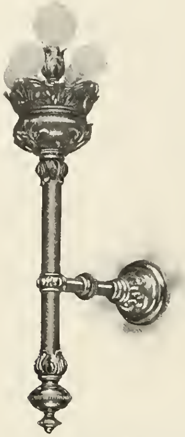


FIG. 4.—BRACKET IN BARROOM.

The dining room completes the list of public rooms upon this floor. It has a low ceiling with large pillars down the center of the room. These are painted white, as is the ceiling, the walls being tinted a soft green. There are crystal ceiling lamps in each panel, and bracket lamps on the pillars and the walls. Table portables with pink silk shades add the necessary touch of cheerfulness.

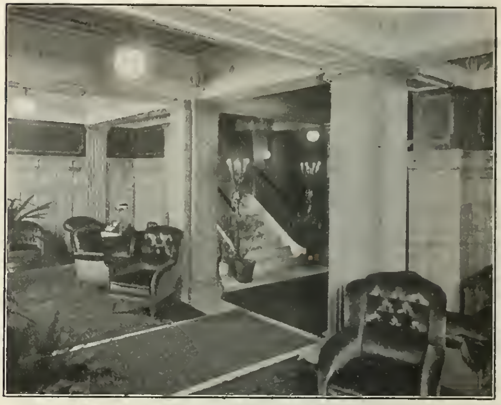


FIG. 5.—LADIES' RECEPTION ROOM.

In the basement is found the College Inn, which occupies almost the entire floor; practically all of the light being artificial. The room is finished in Flemish oak with paneled ceiling of dark brown, the walls being half wainscoted, the upper portion being decorated with original paintings. The only decorations aside from the paintings are the college flags and, as will be seen from the illustration Fig. 6, these are very much in evidence.

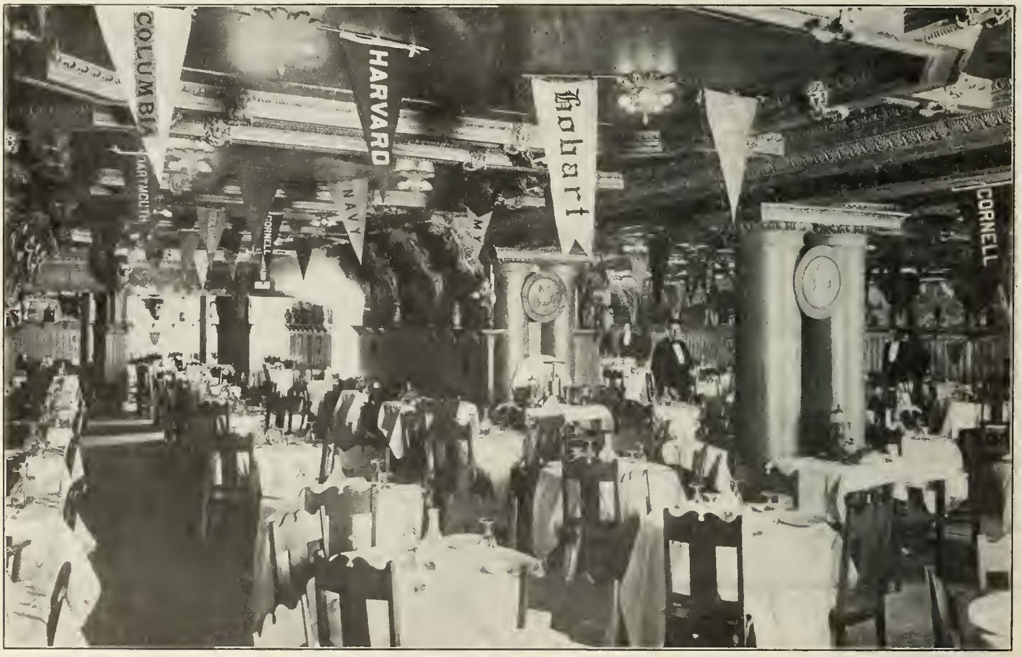


FIG. 6.—GENERAL VIEW OF COLLEGE INN.

In this room the lamps, in the ceiling sunbursts, each of which contains 5 16-cp round, frosted lamps, are in an almost horizontal position. See Fig. 7. Another feature is the lighting of the wall paintings. The top of the wainscoting contains a sheet of thin roughed glass beneath which, at each painting, is placed two 16-cp tubular lamps. The lamps are tinted red, blue or green, the color of the painting determining which one is to be used. Nearly 300 lamps are used for this purpose and they add greatly to the pleasing effect. The coefficient of reflection is probably less than 0.20 and the intrinsic brilliancy of the lamps not over 5 cp per square inch. There is no glare whatever and the general illumination is excellent. The decorations probably represent a large percentage of the college spirit, but gayety is much in evidence. The success of the hotel is due in a large measure to the success of the Inn.

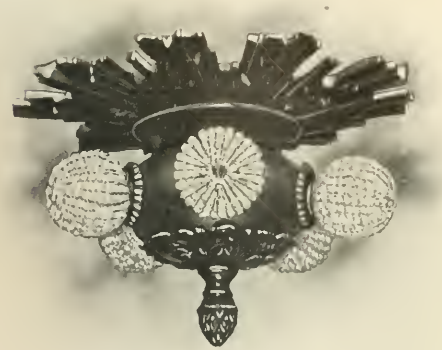


FIG. 7.—CEILING SUNBURST IN COLLEGE INN.

The guest-rooms have chandeliers with opal shades, 16-cp clear-bulb lamps being used. The service portions are equipped with clear-bulb 16-cp lamp clusters with white porcelain reflectors. The only glaring lights are to be found in the barroom, but that is a fault common to all such rooms in the East. The general public forms its opinion of a hotel from its public rooms, and those in this hotel are very successful in one respect—they breathe the spirit of the place as being in formal.

Electric Power Development on the Rio Grande Border.

By W. D. Hornaday.

The first electric railway to be built in Texas and one of the first in the United States was at Laredo. The building of this line in 1889 by the Laredo Improvement Company attracted wide attention, as the use of electricity as a means of rapid transit was at that time just emerging from its experimental stage. The promoters of the Laredo project believed that the town was destined to become a great commercial and manufacturing center, and for a few years it enjoyed a wonderful growth and activity. Shortly after the building of the railway a long period of business depression occurred and it passed through many trying vicissitudes, and the plant was finally taken over by the Laredo Electric & Railway Company. The holdings of this company include the electric lighting system as well as the street railway. The lighting system is unique in the fact that it does an international business, the plant providing lights for the city of Neuvo Laredo, situated on the Mexico side of the Rio Grande.

The business of the Laredo Electric & Railway Company possesses many features of interest. The railway and lighting plant has been completely overhauled and modernized during the last three years and the business extended to an exceptionable degree under the direction of the manager, Mr. Frank E. Scovill. At the time he took charge of the plant in December, 1904, the cars were being run with little attempt to observe a regular schedule and the lighting service was very unsatisfactory. The plant at that time consisted of two 60-kw single-phase machines and a small direct-connected, 64 ampere, 500-volt machine for operating the street cars over the 5¼ miles of railway. The circuits at that time were fairly well loaded. The engines were old, and one of Mr. Scovill's first acts was to purchase two second-hand tandem-compound condensing engines that had been used 14 years, and a couple of three-phase 150-kw generators. The circuits were changed from single-phase, 125-cycles, to three-phase, 60-cycles, and the installation of small motors for power purposes commenced, afterward increasing to larger size motors until the company now has in operation 233 horse-power in power motors, ranging from 2-hp to 40-hp capacity, besides a large number of ¼-hp and ½-hp motors on coffee mills and such small work. When the circuits were changed to 60-cycles there were 26 fans in service. The number of fans has now been increased to more than 200.

The lighting and power business has increased so rapidly that the company has just purchased and finished the installation of a 2300-volt, three-phase generator direct-connected to a Hamilton-Corliss cross-compound engine of 550-hp capacity.

The valley of the Rio Grande adjacent to Laredo has become during the last few years one of the greatest Bermuda onion producing regions in the world. This year's crop, the harvest of which was begun the first part of April, embraces 1500 acres. All of this land must be irrigated, and the only source of water supply is the Rio Grande. This acreage is almost double what it was the preceding year, and next year the acreage will show a still greater increase, it is claimed. It occurred to Mr. Scovill that here was an opportunity for his power plant to render a good service and at the same time add materially to its revenue. Gasoline and coal were the fuel that was being used by the numerous irrigating pumping plants scattered along the river front. The substitution of electricity for this fuel was urged by Mr. Scovill and he finally awakened an interest in the proposition. He personally guaranteed the success of the first pumping plant he sold last August It was installed in time for the watering of the onion seed beds, which work was begun the latter part of September. The installation consisted of a 40-hp, 2300-volt motor, direct-connected to a Janesville No. 8 pump, which was set in a well 36 ft. deep, 12 ft. across, built of concrete, and located upon the bank of the river. The pump was guaranteed to life 1400 gal. of

MOTOR-DRIVEN PUMPING STATION.

water a minute at a total elevation of 75 ft. through 600 ft. of 12-in. pipe. This electric pumping plant has been in operation constantly ever since its installation and attracted much attention among the onion-growers. Two more electric pumping outfits were soon sold and installed and were in successful operation during the onion-growing season. The company received several other applications for these outfits during the fall and winter, but could not get deliveries in time to care for the season's crop of onions. The onions in the Laredo territory are transplanted from the seed beds from Nov. 20 to Jan. 1, and are harvested from about April 1 to May 10.

The first 40-hp line for operating these irrigating pumps was built close to town. The other two pumping stations being farther away, a line had to be built more than four miles from the edge of the lighting district into North Laredo. At present the service for operating these pumps is being furnished from the regular lighting circuits, but the calls for additional motors are so numerous that it will be necessary to build a new transmission line direct from the power plant across the country to North Laredo in order to meet the demand for additional installations. In building this line a step-up transformer will be used at the plant, stepping down again to 2300 volts about the center of the pumping district in order to increase the capacity of the circuits. The company has assurance of enough additional pumping plants to justify this proposed enlargement, and it will be completed same time during the coming summer in time for next season's crop.

In addition to this proposed transmission line to be built to the onion-growing district of North Laredo, another line will be built to South Laredo to operate the pumps of the growers of that section. The South Laredo district onion growers are now securing right of way across the different tracts of land, called porciones, to allow the company to extend its line to them to operate six pumping plants, which will be installed immediately. One of these plants will be of 30-hp capacity motor, three will be of 40-hp and two of 60-hp.

The embarking into the electrical pumping business gives the Laredo plant a day load for nine months of the year in excess of the night load. Mr. Scovill is a believer in the three-phase method of power distribution. He installed the first three-phase machine in Texas in 1895 at Austin. At the time of the break in the dam across the Colorado River at that place, this machine fell with the power house and was covered under 7 ft. of sand for some weeks. It was then taken out, washed off with a hose, taken apart and the sand removed, dried out and used as a motor to drive a Worthington pump at the water works at Austin for some time, afterward being replaced by a larger motor. The same machine is now doing service in the Austin electric-light plant.

In connection with the irrigating pumping plants in the Laredo district, the Laredo Electric & Railway Company made a rate of 5 cents per kw-hour. The cost to the consumer for operating the pumps, being a little less than 4 cents per hp-hour, is said to be much better for the average onion grower than the use of steam or gasoline for pumping purposes, as the electric pumps do not require the service of an expert or constant attention. During the past season one of these 30-hp pumps, operated by electricity, has irrigated 110 acres of onions at a total cost to the consumer of less than $9 per acre for the entire winter's irrigation. When the fact is considered that no rain has fallen in the Laredo section for more than eight months and that the dry soil naturally requires a great amount of water, this record of cost is surprisingly small. As compared with the revenue per acre derived from the crop it is insignificant. The gross receipts per acre from the sale of the crop ranges from $400 to $800.

It is stated that some of the steam-pumping plants have done a little better than the electric plants in the matter of cost, but in figuring their cost the amount that must be expended each year in repairs to their boilers and plants is not included. When these incidental expenses are added, the cost will be found greater than that of the electric pumping stations, it is said. Many of the onion growers claim that the freedom from the worry and expense of operation and making repairs which the electric pumping stations afford them is worth much more to them than whatever slight difference there may be in the cost per hp-hour of their operation.

There are prospects of a good business being built up on the Mexican side of the river in operating irrigating plants with electricity. Onion growing has just been started on that side of the Rio Grande, about 100 acres of the product being raised there this past season. The Laredo Electric & Railway Company has a lighting contract with the city of Nuevo Laredo, Mexico, as well as with Laredo, Texas. In Mexico the concession is held by one of the citizens of Neuvo Laredo and, in turn, the company leased this concession for a term of years. The company furnishes the same 24-hour service on the Mexican as it does on the American side of the river. The principal article of food of the working class of Mexicans is tortillas, which are made of soft ground corn meal. The introduction of electric power for operating the tortilla mills in both of the border towns has displaced gasoline engines in these mills and the company is doing a good business in supplying energy for these motors.

When Mr. Scovill assumed the management of the plant of the company it was in a badly dilapidated condition, and the owners had given up all hope of ever making anything out of it. But the development of the Bermuda onion growing business, the general prosperity of the town and the adoption of modern methods of operating the enterprise, put new life into the concern. It is expected that the present capacity of the plant, which is 1050 horse-power, will have to be nearly doubled within another year in order to meet the demands that are being made upon it for additional power.

The company's lighting and power rates are said to be as low as any in Texas. The city of Laredo has a population of about 3500 Americans and 14,000 Mexicans. It is growing rapidly under the new industrial influences that have been awakened there by the success of onion growing. It is estimated that this year's onion crop will bring to that immediate locality more than $1,000,000 in cash. Much of this enormous revenue will be expended in making improvements with a view to enlarging the industry.

The Public Service Corporation and the Public.

By H. H. MacPherson.

Every business man knows that the expenditure of a given sum of money in pushing his business will bring in much larger net returns from an old customer than from a new one. The practical application of this fact is the most striking characteristic of the present new-business movement by the gas and electric companies. This is unusually noticeable at this time because of the high interest rates prevailing and the consequent unwillingness of managers to use this high-priced money in making extensions. The very latest development along this line is the employing of so-called service supervisors. There is one of these men to every two representatives and working on nothing but old consumers and discontinued services. The better the quality of the service rendered by the company, and the more satisfied the consumer, the greater the net return from this work.

In order to improve the service and satisfy the complaints of consumers each gas or electric company maintains a complaint or investigation department. So far, the scope of this work has been limited to receiving complaints and settling each case upon its merits. The causes of these complaints are not removed, and thus they increase the complaint department expenses.

In the gas and electric business the inherent faults of the large corporation are peculiarly liable to cause trouble. For example the absence of any personal touch often sends a consumer from department to department in an effort to obtain a desired result. This division of authority is hopelessly confusing to the consumer, and an error or two will quickly put him into the class of dissatisfied consumers.

That this condition of affairs is unnecessary and that the remedy is inexpensive and thoroughly practical may be learned from the following lesson from the complaint department.

The object of the complaint or investigation work as conducted by all gas and electric companies is to obtain and keep the good will of the public by receiving complaints and settling them justly. It is universally acknowledged that this work pays large dividends in satisfied consumers. Then it should follow that preventing complaints will pay even better. These complaints and the causes leading to them when properly recorded and analyzed form an immensely valuable fund of information regarding the real opinion of the company held by the public and the causes for holding that opinion.

A surprisingly large percentage of these complaints can be prevented, and at a very small cost, by ascertaining and removing the cause. Each source of weakness thus removed lays bare the cause of some other trouble, and so almost automatically the good work goes on, building up the organization internally and the good will of the public externally; the kind of good will that pays large dividends because the complaints are eliminated by the ounce of prevention, worth in this case many times the pound of cure. The high-bill complaints, the smallest in point of numbers, are highest in the total expense. Their number is lowest in summer and rises to a maximum with the long lighting hours of December. This seasonal variation will exist regardless of the total number of these complaints. There will always be a chronic kicker, and some few people who need to have their imagination talked away into a negligible quantity. But outside of these few it is the great body of honest people who have to feel a real grievance to get them started. A high-bill complaint from one of these people means that he has either lost confidence in the honesty of the company or in the correct reading or registration of his meter. Whether the company is honest, or his meter correct, matters little. His natural suspicion of a public service corporation has been turned to a certainty, otherwise he would not have made a complaint.

That this is true has been conclusively proved by the author by means of a system of records which show numerous cases of people, who previously paid cheerfully, now complaining, through some error on the part of the company. Granting rebates, changing and testing meters, do not mean justice to them, but simply indicates that the company has been "caught in the act" and is trying to get out of it.

A thorough realization of this fact and a determination to keep non-complaining consumers from becoming chronic kickers by removing causes tending to make them become so, is the ambition of the far-sighted manager.

Three-fourths of the high-bill troubles can be traced directly to variations in the amount of the bill caused by over-reading or under-reading of meters, skipping readings or bills for a greater or less period of time than 30 days.

Over-reading and under-reading of meters are the fault of the meter readers, but the bookkeepers are qually to be blamed if these show on the bills, because they can see at once any great variation in the bill provided the number of days between readings is kept always the same. The fact that some meter readers make no errors for nine consecutive months proves that incorrect readings can be prevented. Incorrect readings are nearly always for 1000, 10,000 or 100,000 cu. ft. of gas, or for 10, 100 or 1000 kw-hours of energy. The meter reader is just as liable to read the higher dials wrong as the lower ones, but the bookkeeper will have less trouble in catching the large errors. Therefore, here again it is the small errors that get out on the bill and cause the trouble.

Over-reading usually results in an immediate complaint; a new reading and a corrected bill will satisfy the consumer temporarily. His confidence has, however, been undermined. His next high-bill complaint may result in a new reading which shows the bill to be correct and then he believes that the meter is wrong. The change and test of the meter, even if correct, does not change his opinion; it is too late for anything to change it.

An under-reading produces the same result as an over-reading, but no corrected bill or rebate can be made because the consumer has already received payment of the smaller amount.

When a reading is skipped from any cause whatsoever every effort should be made to obtain a reading as soon as possible. In case the meter reader is unable to reach the meter, an appointment can usually be made for a certain day each month, or the key can be left in an accessible place. The bookkeeper should also see to it that none of his requests for re-reading is ignored. If they are, the bill will not go out at its regular time.

Most of the bills for a greater or less period of time than 30 days are in the main caused by skipped readings, changes in meters, investigations or bookkeeping errors, or by having the reading dates separated by more or less than 30 days on account of carelessness. Bills held on account of changes in meters are especially liable to start trouble, particularly when the meter taken out runs too slowly. The consumer not only has a two-months' bill to pay, but his rate of consumption is largely increased. Of course, he believes that the company has removed a correct meter and substituted a fast one. If before the change is made he is told that it is being done for the sole purpose of keeping all meters in first-class condition, and that in the absence of a reading his will be held, there will be very few complaints from this source.

The element of carelessness on the part of the company appears somewhere, in some form, in every high-bill complaint. The average meter man does not worry if he does over-read or under-read a few meters each month. Neither does the bookkeeping department care whether a bill is for 30 days and $1 or for 50 days and $100.

If these two departments thoroughly understood that just such little things cause three-fourths of all the high-bills complaint, and that this class of complaints in some cases cost a company directly $10,000 per year and upward, they could easily reduce them to a negligible quantity.

Direct-Current Motors, Their Action and Control—VIII.

By F. B. Crocker and M. Arendt.

MOTOR CONTROL BY MULTIPLE VOLTAGE.

Ward Leonard System.

The first of these, historically, is that of H. Ward Leonard,* who employed three generators of 62, 125 and 250 volts, respectively, and grouped them in series in the order named (Fig. 1). Connecting the field across the 250-volt lines, and the armature terminals across *A-B*, 62 volts would be obtained, across *B-C* 125 volts, across *A-C* 167 volts, across *C-D* 250 volts, across *B-D* 375 volts, and across *A-D* 437 volts; or, taking the speed at the highest voltage as the normal value, the various running points would give speeds of approximately

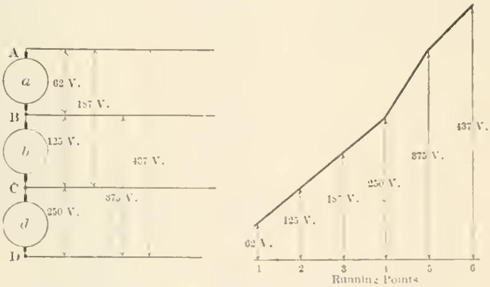


FIG. 1.—WARD LEONARD MULTIPLE-VOLTAGE SYSTEM.

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*U. S. Patent No. 478,344, July, 1892.

1/7, 2/7, 3/7, 4/7, 6/7 and 7/7, a sudden jump in the voltage increment occurring at the fifth point. The 5/7 speed value, or that corresponding to 312 volts, could not be obtained, because to get this voltage *A-B* would have to be added to voltage *C-D*, which would short-circuit the voltage *B-C*.

Crocker-Wheeler System.

The next four-wire multi-voltage system developed was that of the Crocker-Wheeler Company, employing voltages of 40, 120 and 80 in the order given. (Fig. 2.) By connecting the field terminals across the 240-volt lines *AD* and shifting the armature terminals from *AB* to *CD*, to *BC*, to *AC*, to *BD*, to *AD*, six voltages and speeds are obtained as follows:

AB gives	40 volts	*AC* gives	160 volts
CD "	80 "	*BD* "	200 "
BC "	120 "	*AD* "	240 "

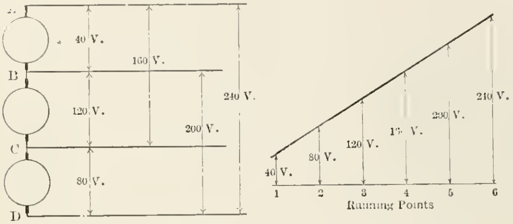

FIG. 2.—CROCKER-WHEELER MULTIPLE-VOLTAGE SYSTEM.

These voltages correspond approximately to 1/6, 2/6, 3/6, 4/6, 5/6 and 6/6 of the rated speed. Thus, with this system, the speeds increase in a straight line, or in an *arithmetical progression*, there being no jumps, but a uniform rise throughout.

Any multiple voltage system may be worked at any reasonable maximum; they differ only in the ratio of voltages. It is desirable, however, to have *standard values for at least the maximum and one of the sub voltages*, in order that standard lamps, motors, etc., may also be supplied from the lines.

Bullock Multiple-Voltage System.

A third multiple-voltage method is that of the Bullock Company employing voltages which increase in *geometrical progression;* that is, the voltages are in the following ratio: $a : ar : ar^2 : ar^3 : ar^4 : ar^5$. As these values must all be obtained in practice from a single system consisting of only four conductors it is necessary that $ar^3 = a + ar$, that $ar^4 = ar + ar^2$ and that $ar^5 = ar^2 + ar^3 = a + ar + ar^2$.

The only factor r which satisfies these conditions is 1.3247; that is, each voltage is 32½ per cent, or about one-third, higher than the preceding. The commercial system according to this plan employs 60, 80 and 110 volts in the order named. These are only approximately in the ratio stated, the theoretically correct values being 60, 79.5, 105.3. (Fig. 3.) The armature voltages and speeds obtained by connecting the armature terminals of the typical 10-hp motor to the various conductors are as follows:

Terminal Volts	$I_a R_a + D_b$	C. E. M. F.	Speed in R. P. M.
60	11.8	48.2	182
80	11.8	68.2	258
110	11.8	98.2	374
140	11.8	128.2	485
190	11.8	178.2	673
250	11.8	238.2	900

The Crocker-Wheeler method gives a speed range which is actually 1 to 8, while the Bullock arrangement gives a speed range of exactly 1 to 5, the total number of controller steps being the same for both.

The efficiency of these multi-voltage systems of control is much higher than that of the armature-rheostatic method for corresponding torque and speed changes. Let us consider the 10-hp motor, the data of which was given in the first issue of December, 1907, and determine its efficiency at rated torque and the various speeds obtained by, for instance, the Crocker-Wheeler multi-voltage system.

The first step is to determine the various speeds at rated torque corresponding to impressed voltages of 40, 80, 120, 160, 200 and 240, respectively, and from these to determine the motor output and efficiencies for the said 10-hp motor:

Voltage Input	Watts Input	$(I_a R_a + D_b)$	c.e.m.f.	r.p.m.$_x$ c.e.m.f.$_x$ 218.2 r.p.m.$_r$	Watt Output $\frac{7570 \times \text{r.p.m.}_x}{825}$	Effic. at Rated Torque
40	1710	11.8	28.2	106.	971	56.6%
80	3190	11.8	68.2	258.	2370	74.2
120	4670	11.8	108.2	409.	3750	80.1
160	6150	11.8	148.2	560.	5150	83.5
200	7630	11.8	188.2	711.	6530	85.6
240	9110	11.8	228.2	862.	7920	86.7

Comparing the efficiency curve (Fig. 4) of the multi-voltage method of speed control with that of the rheostatic method at rated torque, Fig. 1 (February), it is at once apparent how much higher the *average efficiency* of the former method is. An even greater advantage of this method over the rheostatic control is its *better speed regulation* under variable loads. The curves in Fig. 5. and values in the following table show this very clearly:

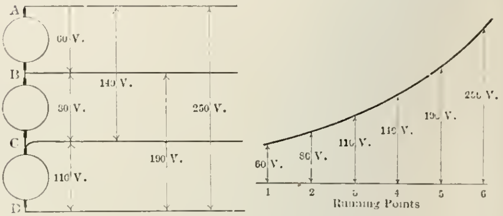

FIG. 3.—BULLOCK MULTIPLE-VOLTAGE SYSTEM.

Speed Regulation, 10-hp Motor.

Multi-Voltage Control			Rheostatic Control Max. V = 240		
R. P. M. Rated Torque	R. P. M. No Load	Per Ct. Speed Change	R. P. M. Rated Torque	R. P. M. No Load	Per Ct. Speed Change
Curve A 106	145	13.7	Curve a 106	854	705
Curve B 258	296	11.5	Curve b 258	865	235
Curve C 409	447	9.2	Curve c 409	875	114
Curve D 560	599	7.0	Curve d 560	883	48.4
Curve E 711	750	5.2	Curve e 711	892	25.2
Curve F 862	910	4.6	Curve f 862	910	4.6

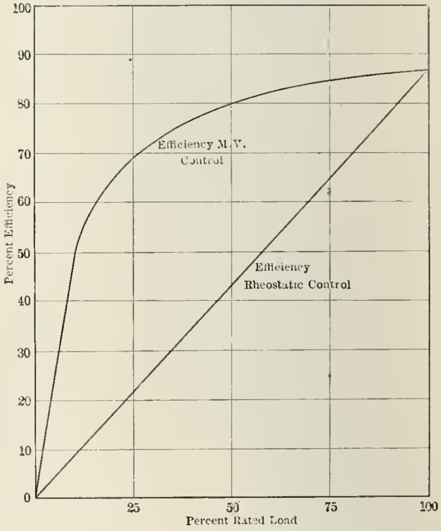

FIG. 4.—EFFICIENCIES OF RHEOSTATIC AND MULTIPLE-VOLTAGE SYSTEMS.

A comparison (by calculation) of efficiency between the field-control methods and the multi-voltage control is impossible, since the one starts at a *minimum speed* and *maximum efficiency*, and the other starts at a *maximum speed* and *maximum efficiency*. Furthermore, the first operates at a *constant* *output* and the second at a *variable output;* hence the two methods call for different types of motors.

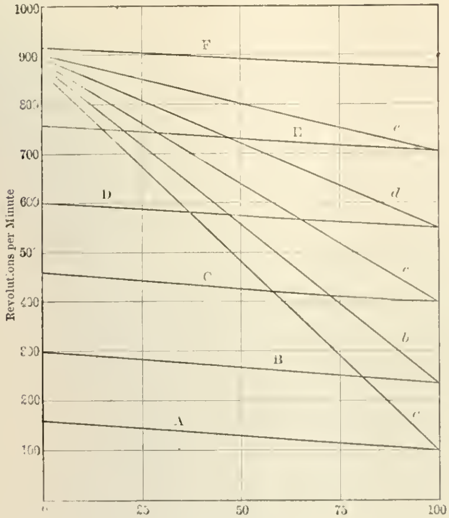

FIG. 5.—SPEED REGULATION OF RHEOSTATIC AND MULTIPLE-VOLTAGE SYSTEMS.

The multi-voltage systems can be supplied by three generators of, for instance, 40, 80, 120 volts, respectively, and each large enough to carry one-third of the total motor load, or by means of one generator of total voltage and load capacity,* and a three-unit balancing set (Fig. 6), each respectively of 40, 80 and 120 volts. These balancers, it has been found by experience, need have only a total capacity of from 5 to 10 per cent of the plant load. This latter method is the more frequently employed as it is cheaper in the following respects:

(a) Lower cost of prime movers, only one instead of either three engines or a system of line shafts, belts, etc.

(b) Lower cost of generator, a large one in place of three smaller ones.

(c) Lower cost of foundations.

(d) Less steam piping.

The motors on the multi-voltage system are ordinary standard machines, which is an important practical advantage. They are so connected that the field is permanently across the 240-volt lines and the six running speeds are obtained by shifting the armature terminals from sub-voltage to sub-voltage by means of the controller drum as shown in Fig. 7. In some cases the changes from one running speed to the next are made gradually by shifting to the next higher voltage with some resistance inserted in the armature circuit and then gradually reducing this resistance until that full sub-voltage is applied to the armature terminals and so on with the various sub-voltages until the maximum pressure is employed. In other instances a combination of variable field resistance and armature-rheostatic control is employed in passing from sub-voltage to sub-voltage, thus obtaining sometimes as many as 36 speed points.

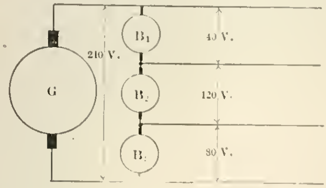

FIG. 6.—MULTIPLE-VOLTAGE SYSTEM WITH BALANCERS.

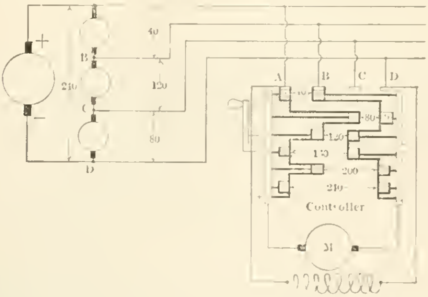

FIG. 7.—CONTROLLER AND MOTOR CONNECTIONS, MULTIPLE-VOLTAGE SYSTEM.

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*Total load capacity is not necessary, as it is not likely that all tools will be operating at once at rated load; in fact, the maximum working load is not likely to reach 50 per cent of the possible load. Total load has been assumed for the sake of simple comparison.

Footlights in a Chicago Church.

Those interested in providing good church illumination have doubtless met with the objection sometimes made by ministers and public speakers of having all light come from above, so that the eyebrows shade the eyes. In the Hyde Park Presbyterian Church in Chicago this has been overcome by placing a pair of footlights in each corner of the pulpit. These footlights are in boxes sunk level with the floor, each box containing a 32-cp lamp with a conical mirrored concentrating reflector pointed in the direction of the minister's face. There is thus one of these lamps on each side and a little in front of the minister. The footlight boxes are covered with diffusing glass so as to soften the glare.

Tungsten Cluster Maintenance in Chicago.

Mention has already been made of the flat-rate tungsten clusters being installed by the Commonwealth Edison Company in Chicago, these flat-rate clusters being turned on and off by the company's patrolmen. The rates on these clusters, which consist of four 60-watt tungsten lamps, are as follows:

Hours of burning.	Days per week.	Weekly charge, per fixture
Dusk to 10 P. M.	6	
Dusk to 12 P. M.	1	$1.15
Dusk to 12 P. M.	7	1.50
Dusk to 1 A. M.	7	1.75

The company also has a proposition whereby it will maintain tungsten clusters connected to a meter. The number of hours' use per day of the clusters connected to meters is determined by the readings of a maximum-demand meter used in connection with all customers' watt-hour meters. For tungsten cluster installations used four hours or less per day, the fixed sum of $1.50 per month per cluster is charged to cover the cost of the fixture, lamp renewals and attendance. Customers sign an agreement that they will not touch the lamps, as the company does all cleaning and maintaining, and the lamps are fragile

Tree Trimming.

At the Nebraska convention, one of the questions taken up in the question box was that of tree trimming. Mr. J. G. Boyd recalled an experience of his in Texas, where the City Council would not authorize the trimming of trees. One of the 2200-volt lines of the company burned off a tree limb. He pointed out that the city was liable for this damage because it did not permit trimming of the tree, after which it did not take the Council long to pass an ordinance permitting tree trimming. Mr. L. E. Watson, of Beatrice, Neb., expressed the opinion that by using proper diplomacy a central station could get permission to trim almost any tree. Much of the trouble about tree trimming had resulted from careless slashing in the past or from not properly approaching the property owners. Mr. L. J. Schwengel, of Holdredge, Neb., in this connection, said that formerly the telephone company on some streets ran their wires above those of the electric light company, with the result that there was continual trouble from falling of telephone lines on the electric light wires. On recent joint pole construction, the telephone wires had been placed below the electric light wires, and there had been almost no trouble since then.

Electric Light and Power at New Bedford, Mass.

By William H. Stuart.

New Bedford, Mass., is a city that has grown from a whaling town of colonial days to a modern, up-to-date city of 83,000 inhabitants with a standing sixth among the cities of Massachusetts in population. When the new mills now building are completed and in operation, the population will be more than 90,000. The industries of New Bedford are the manufacturing of fine cotton goods and yarns, silverware, cordage, chairs, steel tools, engines, and machinery. New Bedford ranks first in the United States in the manufacture of fine cotton goods. The catch of oil and whalebone by vessels owned in New Bedford, an industry long the mainstay of the city, is gradually becoming a thing of the past. Its value in 1907 was $200,000, against $420,000 of the previous year.

In the year 1881 the New Bedford Electric Light Company was organized to light the streets of the city with an equipment consisting of a Thomson-Houston arc generator of 100-light capacity. Matters went along this way until year 1886 when the Edison Electric Light Company was formed to furnish light and power on a considerable scale, and built a plant in the center of the city. Fair progress was made in obtaining incandescent lighting, but no power load to speak of was taken on. In 1888 the New Bedford Gas Light Company purchased the franchise of the New Bedford Electric Light Company and started to produce and sell electric current in competition with the Edison Company. Two years later, in 1890, the New Bedford Gas Light Company and the Edison Electric Light Company consolidated and enlarged the Edison station in the center of the city to take care of all the business of both companies. Three years later, in 1893, a new station was built on the property of the gas company on Water Street. From 1892 to 1896 power was furnished the trolley company to operate its system, which was the first installed in New England.

The present equipment consists of two Dillon boilers of 175 hp each; three Roberts boilers, one of 150 hp and two of 125 hp each, and one Babcock & Wilcox boiler of 416 hp. The engines are five in number, and consist of one Green engine of cross-compound condensing 650 hp; one Harris-Corliss engine of cross-compound condensing, 350 hp; one Westinghouse cross-compound condensing of 300 hp; one Ide simple condensing of 250 hp, and one Armington & Sims simple of 50 hp. There is also a Curtis turbine of 450 hp. A 500-hp Westinghouse producer-gas engine is now being installed. The generators for the arc system are two 125-light Brush machines, one 100-light Brush and one 35-light Thomson-Houston machine.

The lighting and small power generators consist of two 150-kw, one 100-kw and one 50-kw, 2300-volt, three-phase machines with 110-220 volts on the secondary; four 100-kw, six 50-kw and two 25-kw direct-current machines. The power service is 500 volts direct current, furnished by two 100-kw and one 62-kw machines. The steam turbine drives the two 150-kw, direct-current 125-volt machines. The switchboard is divided into four sections. One is for the direct current, 110-220 volts, consisting of five panels, and one for alternating current made up of 10 panels; the third section controls the power, being one large panel. The arc board is composed of three panels. The boards were made by the Hill Electric Company, of New Bedford. The ashes are given to the city for sidewalks. The coal is brought in barges direct to the plant. The boilers are hand fired.

The force required to operate the station consists of 21 men, a superintendent, a chief engineer, three engineers, two firemen, one coal passer, five linemen, six dynamo men and two oilers.

The pole lines are 197,130 ft. in length. There are 1491 poles set in the streets and 90 set on private premises. There is also considerable wire underground in conduits, the total length of conduit being 28,614 ft. The total length of wire in the conduits is 163,363 ft. Transformers for aerial lines are set on poles and are not grouped; vaults are used for those lines on the conduit system. The arc circuits are tested out every day.

The number of public lamps in use in New Bedford is 242 1200-cp lamps at $97.56 per lamp per year. There are also 16 16-cp incandescent lamps, which cost 7 cents per night. The company also lights the neighboring town of Fairhaven, where the number of lamps is 116 16 cp, costing 6½ cents per night, besides three arc lamps. The company also supplies light to the town of Mattapoisett, 7 miles away. The number of commercial arc lamps connected in New Bedford is 245 of 5 amp, 1200 cp, and 110 of 6 amp, 1200 cp. These are distributed among 65 customers. There are 38,416 16-cp incandescent lamps connected and 21 of 150 cp. The total number of incandescent consumers is 1071.

There are 246 motors connected on the lighting circuits and 60 motors on the power circuits. The total horse-power connected in motors is 589½. The largest single motor connected is a 50-hp machine driving a flour-mill grinder. During the year ending June, 1906, 1,490,222 kw-hours were generated; of this number 401,841 were for the street lamps and 812,212 for commercial consumers. Incandescent lamp renewals are furnished free by the company.

The meter department is located at the office, where a spacious room is portioned off for the purpose. When the meters are received from the makers they are tested, given a number and placed in stock. A complete card record is kept of each meter from the moment it is placed in circuit until it is sent to the scrap pile. The meters are tested in circuit, a portable testing set being used. The force of men required to operate the meter department is three. The meters are read each month by 10 men sent from the office, who are not regular employees of the company, working only part time for the company. They are paid 1½ cents an index; some of them read three books a day, there being about 200 to 300 meters in a book. These men also deliver the bills. The meter indexes are placed on a card. The consumers' ledgers are also of the card system. The gas and electric index cards are placed in the same book, so that a meter reader indexes every meter in his territory. The index books are read by different men each month.

The office of the company has a large show and salesroom and a commodious space for the bookkeeping, complaint and cashier's departments. There are also grouped around on the main floor the private offices of the executives of the company.

New Bedford has been thoroughly canvassed by the new-business department. The solicitors have made a house-to-house canvass securing information and placing it on cards, which, when turned in at the office, are placed on file. These cards call for the name and address of occupant, what illumination and power are used, reasons for not using electricity, name of solicitor and date. If a foothold is gained by the request for an estimate or any information whatever, a solicitor is immediately sent to the party and every means taken to secure the prospect as a consumer. Advice and any and all information possessed by the company are at the disposal of the prospect.

The gain in the electric business in the last two years is 4.5 per cent in 1906 over 1905, and 15.4 per cent in 1907 over 1906. As yet the power business is not quite equal to the lighting business, but a determined effort is being made to upbuild it.

One of the features of the company's methods is the matter of deposits to secure payment of bills. The amount required, of course, is controlled by the size of the installation. The lowest amount is $4. At the expiration of one year the consumer's standing is looked up and if all bills have been paid and no trouble has been experienced, the total amount of deposit is refunded plus 5 per cent interest. If the consumer has been found to allow his accounts to run in arrears, the deposit is held.

Electric signs of all types are encouraged, although the company does not furnish them free nor handle them in any way, a reliable sign builder in the city being given all sign work. In the newspaper advertisements of the company the sign builder is referred to and vouched for by the company. All signs are erected and paid for by the consumers. New Bedford has very liberal sign ordinances. The whole city has been canvassed for flatirons and about 125 have been sold outright and are in use.

During "Old Home Week" in New Bedford last fall the company by a very liberal offer to the celebration committee appointed by the Mayor secured quite an amount of permanent business and a large amount of public confidence and free advertising. The offer was to furnish free current for all electrical-display equipment installed specially for that week. The papers were full of news concerning the electrical demonstration and contained many pictures of it. The people commented freely and very favorably on the public spirit of the company, and a great many installations remained permanent, as the merchants found that electrical advertising was of value.

Advertising is carried on extensively by the use of newspapers, circulars, descriptive matter, back of bills and special letters. The newspapers are published in three languages, English, Portuguese and French. The advertisements are changed daily and are illustrated with cuts of various appliances in use showing as near as it is possible the actual benefits of electrical service.

The company issues monthly an attractive booklet called *The Electrical Bulletin.* This has for its principal topics brief talks on methods of illumination. The remainder of the book is used for telling of the general benefits of electric service. This little book of 16 pages is finely illustrated. The back of the monthly bills contains cuts and pointed remarks concerning all the various appliances that are used with electric current, a different subject being broached each month.

The power rates are for the first 15 kw-hours per month per horse-power of demand at 12 cents; for the next 200 kw, 5 cents; for the next 200, 4 cents; for all current over, 3 cents. There is a discount of 5 per cent allowed on this rate if the bill is paid on or before the tenth of the month. The rate for signs is 10 cents per kw-hour net.

The lighting rate is 15 cents per kw-hour for the first 100 kw, 12 cents for next 200 kw-hours, and all over 300 kw at 10 cents with 5 per cent discount for payment on or before the tenth of the month. There is also a primary rate of 20 cents per kw-hour per 16-cp lamp per month and secondary rates of 7 cents and 5 cents, depending on the character of lighting, for all current over. The minimum charge is 75 cents per month per meter. The consumers have the choice of rates. When the two-rate system was placed in commission a letter was sent to each consumer which noted the equipment of the consumer, the total amount paid during the year and the monthly average. Then a comparison was made with the same equipment and consumption using the new rate. A small folder was enclosed, also a reply card. The folder enclosed with the letter explained very clearly the reasons why such a rate was adopted. To explain more clearly to the consumer just what was meant, an easily-understood example was used of the costs that entered into the manufacturing of a book, as follows:

"There are two separate kinds of cost in book making; first there is the cost of getting ready to make a book; second, there is the cost of actually making it. The former includes money paid for authorship, for setting type and making plates and illustrations, and it foots up precisely the same total, no matter whether you are getting ready to make a hundred copies or a hundred thousand copies of the book in question. The latter, the actual cost of making the book itself, such things as paper, printing, binding and so forth, after the 'getting ready' costs are paid, is always the much smaller of the two. The investment in building, boilers, engines, generators and distribution constitutes the first or 'getting ready' cost in the supply of electricity, and coal, oil, labor, etc., constitutes the second or 'actual making' costs. So, then, of two consumers taking five units of electricity a day, the one who takes the five units by the use of 20 lamps burning five hours should have a better rate per unit than the one who takes five units by the use of 100 lamps burning one hour. Each customer uses the same amount of electricity, but one requires investment for 100 lamps and the other for 20 lamps only. The two-rate system automatically gives the best average rate per unit of electricity used, to the consumer who burns his lamps the greatest number of hours each day."

Mr. Charles R. Price, the secretary and treasurer of the company, said in regard to the new business: "New Bedford has had one feature to contend against in the introduction of both gas and electric light, and that was the extended use of sperm and whale oil for lighting purposes. You would be surprised how the inhabitants clung to the use of it. But gradually by diligent work we secured a foothold, and the people, realizing the benefits of modern illumination, began to do away with the oil lamps. We believe in striking when the iron is hot and anything that can be taken advantage of in securing additional business is always eagerly accepted and made prompt use of. We believe in and have great confidence in advertising. Our soliciting force is doing good work, and the increases are satisfactory to the company. We have done very well in securing new business, and next year we hope to better our present record."

The officials of the company are: Mr. George R. Stetson, president and manager; Mr. Charles R. Price, secretary and treasurer; Mr. David W. Beaman, electrical superintendent.

Irrigation with Electrically-Driven Pumps.

By W. P. Johnson.

The irrigation of land along the route of transmission lines and interurban railways for promoting the sale of electrical energy during the off-peak periods in the territory tributary to the lines is a new and profitable field for central-station managers to exploit. Scientific investigation has demonstrated that irrigation is a necessity for the proper maturing of many varieties of vegetables and fruits, and the increase in value of farm land and suburban garden tracts makes it desirable to obtain the maximum production from the soil.

By comparing the yields of two adjacent tracts, Prof. F. H. King, of the University of Wisconsin, obtained the results shown in the following table:

Yields per Acre at Experimental Farm of the University of Wisconsin.

	Corn, Tons.		Potatoes, Bush.		Strawberries, Boxes.		Cabbage, Tons.		Barley, Bush.		Clover, Tons.	
Year	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A	B.
1894	5.1	3.8	....	....	6,867	3,496	....	....	....	....	..	...
1895	5.2	1.3	....	....	8,732	1,030	....	....	51.00	25.00	4.01	1.45
1890	5.1	4.1	394.2	290.5	....	....	22.79	20.04	....	....	3.63	2.25
1897	4.2	3.4	333.9	212.3	....	....	....	....	45.67	44.25	4.43	2.48

A—irrigated.
B—non-irrigated.

The cost of irrigation is rarely over $3 per acre, and the great increase in yield on the investment makes the presentation on the basis of dollars and cents returned on money invested, a very profitable proposition.

The Puget Sound Railway & Power Company operates an electric road between Seattle and Tacoma. It passes through a rich valley where the principal industry is dairying and mixed farming. The writer originated the plan for creating a demand for surplus power of the company's hydro-electric system. The average cost of an electrically driven pumping plant with wooden pipe distributing system of 150-acre tract is $12 to $500 per acre. The platting of farms into 5 and 10-acre fruit and vegetable farms which is now being done is making a denser population which increases passenger traffic, and creates a demand for power at canneries and pumps, etc. Irrigation is necessary because of the light and even rainfalls when crops need it most. The plan based on irrigating a 140-acre farm in White River valley is as follows: The season lasts 100 days, and it is required to supply water to two acres in every 10 days, irrigating 14 acres per day with water raised 14 ft. For convenience one acre covered 1 in. deep with water is called an acre-inch, and this is equal to 27,150 gal. Since it is customary to supply two acre-inches at each watering and 14 acres are watered daily, this is equal to 760,000 gal. of water. By reference to a pump table it will be shown that to be able to complete the watering in eight hours per night, the pump must supply enough water to cover 3.5 acres per hour. An 8-in. pump discharges 1600 gal. per minute or 96,000 gal. per hour, and in eight hours 768,000 gal. would be delivered. This is 8000 gal. in excess of what is required. An 8-in. pump requires 0.82 hp per foot lift and for a 14-ft. lift this is equal to 11½ hp or 92 hp-hours for an eight-hour day. For the season of 100 days, 9200 hp-hours or 6863.2 kw-hours would be required, and if energy is supplied at the rate of 3 cents, the cost for the season would be $205.90, or $1.47 per acre.

Because of the assurance of large and reliable yields owners of canneries can be induced to establish plants along the route of transmission or electric-railway lines. Wherever land is irrigated in the White River Valley by gravity flow or with gasoline-driven pumps, the yield has been doubled and often trebled.

Electric Refrigeration in Philadelphia.

By John Meyer and R. L. Lloyd.

NUMEROUS inquiries received from various electric-light companies throughout the country appear to indicate a lack of knowledge on the subject of artificial refrigeration, and the object of this article is to present the experience in obtaining and retaining this class of business in Philadelphia. To this end it has been considered advisable to go into some detail, possibly of an elementary nature, the object of the authors having been attained if some additional light is shed upon the subject. Representatives of the smaller companies are not afforded the opportunity to discuss this subject with refrigerating engineers to the same extent as the representatives of the larger companies; and, therefore, the facts herein presented may serve to help and guide the representatives of the smaller companies, and may, we hope, be of interest to others as well.

TABLE I.

	Tons.	hp.	Notes.	Yearly L. F.	Total kw-hr. year.	Monthly ave.	Largest month.		Smallest month.		Summer months ave.	Winter months ave.	Spring and fall ave.	Year= times heavy month.	Year= times June.
Dairy	15	30		48.4%	33,351	2,779	5,293	July	00	Feb.	4,801	503	3,034	6.3	7.0
Dairy	3	7	5-hp motor on bottle washer included	56.1%	15,463	1,288	2,294	July	173	Dec.	2,069	292	1,505	6.7	8.3
Residence	¼	1		47.5%	1,112	92.7	141	July	42	Feb.	135.6	61.5	83.4	7.9	8.0
Saloon	3	7½	1-hp motor on brine pump included	62.5%	12,438	1,036	1,383	Sept.	648	Feb.	1,288	677	926	9.0	10.4
Soda Fountain	3	7½	½-hp motor on pump included	61.0%	11,428	952	1,318	Aug.	713	Jan.	1,050	842	964	8.6	14.8
Hotel	4	10	1-hp on brine pump included	101.0%	25,500	2,125	2,760	Aug.	1,663	Feb.	2,604	1,687	2,084	9.2	9.2
Ice cream	2	5	7-hp on pump and ice cream machine included	54.5%	15,008	1,250	2,023	Aug.	975	Jan.	1,830	1,164	126	7.4	8.6
Meat (retail)	1	3	½-hp on meat chopper included	48.3%	3,955	329	731	July	1	Feb.	706	56	226	5.4	5.5
Meat (wholesale)	35	50		107.9%	123,906	10,325	28,492	July	0	Feb.	23,021	1,977	5,978	4.3	6.7
Florist	6	12		40.0%	11,046	920	1,419	June	580	Jan.	1,190	618	953	7.7	7.7
Butcher	6	15	2-hp on meat chopper included	26.0%	9,275	773	1,755	July	155	Feb.	1,604	208	700	5.3	6.0

The motor-driven refrigeration machine has become quite a factor in the power field. The practical side of the subject was discussed in a paper on the "Relation of the Central Station to the Motor-Driven Refrigerating Machine," by Mr. G. W. Goddard before the Association of Edison Illuminating Companies in 1905, and by one of the authors on "Mechanical Refrigeration" before the National Electric Light Association at Atlantic City in 1906. The latter paper dealt with theory to some extent in order to enable the central station man to become more broadly conversant with the subject.

Plants are now being operated in Philadelphia in sizes from a capacity of one-quarter ton of ice, operated by a 1-hp motor, to 35 tons, operated by a 75-hp motor, in some instances there being several units in the same plant. During 1907 the connected load increased 217 per cent, operating over 230 ice-tons capacity of refrigerating machines. Additional power is required to operate brine pumps, deep-well pumps, etc., the use of such motors being necessary adjuncts; auxiliary power of this kind connected during 1907 represented an increase of 284 per cent.

In 1906 we were operating refrigeration machines in the beer saloon, grocery store, residence, drug store, dairy, butcher shop and restaurant, and to-day we are operating, in addition to the above, plants for florists, candy makers, ice-cream makers, fish and game, drinking water for office buildings, pork packers, hospitals, bottlers and fruiterers, all of these plants being in successful operation.

Table I contains data relative to the operation of the various machines, being a complete statement of the conditions one might be expected to find in the various classes. The yearly load factors as shown are determined by multiplying the actual connected load in kilowatts by 3060 hours, and dividing this result into the total kw-hours delivered during the year, the load factor being the percentage of this assumed maximum possible, or 306 days of 10 hours per day.

It has been stated that the yearly bill will be approximately seven and one-half times the highest bill. This fact is disproved by our own experience, in which the yearly bill has been found to vary from 4.3 to 9.2 times the highest month, and from 5.5 to 14.8 times the month of June. This relation will be modified somewhat by the difference in temperature of different localities, but the point to be brought out is the fact that there is no definite relation between the maximum bill and the yearly bill, the factor varying with the different classes of installation and with the difference in temperature in the different localities.

It will be noticed that in the case of the dairy and the meat business, two different installations are cited, a large and a small installation in each class. It seems well to duplicate in these classes to show the relation between the different sizes even in the same class of business. The column headed "Aver-

TABLE II.

1908. Jan.	Temp. of room.	Temp. of box, at start.	Temp. of box, at finish.	Starting time.	Stopping time.	Hours operated.	Hours idle.
3	60°	41°	33°	8.30	12.30	4.00	....
4	65°	40°	32°	8.25	12.25	4.00	20.00
6	66°	41°	32°	8.25	2.25	6.00	44.00
7	66°	38°	33°	8.20	11.20	3.00	18.00
8	67°	40°	35°	8.20	12.20	4.00	21.00
9	69°	42°	32°	8.10	2.10	6.00	19.50
10	65°	39°	30°	8.35	12.35	4.00	18.25
11	65°	38°	30°	8.35	12.35	4.00	20.00
13	77°	49°	36°	8.30	5.00	8.30	43.55
14	66°	40°	32°	8.50	12.50	4.00	15.50
15	70°	39°	30°	8.50	12.50	4.00	20.40
16	63°	40°	32°	8.15	12.15	4.00	19.25
17	64°	40°	32°	9.25	1.25	4.00	21.10
18	73°	42°	32°	8.40	12.40	4.00	19.15
20	69°	44°	32°	8.25	4.25	8.00	44.45
21	70°	41°	35°	8.15	12.15	4.00	15.50
22	63°	45°	31°	8.00	12.30	4.30	19.45
23	65°	42°	32°	8.05	12.35	4.30	19.35
24	68°	40°	30°	8.10	12.10	4.00	19.35
25	64°	38°	29°	8.10	12.10	4.00	20.00
27	75°	44°	32°	8.00	3.00	7.00	44.00
28	68°	38°	30°	8.10	12.30	4.20	17.10
29	74°	42°	32°	8.30	12.50	4.20	20.00
30	55°	35°	30°	8.35	10.35	2.00	18.45
31	71°	40°	32°	8.10	12.10	4.00	22.25

age for the summer months" refers to kw-hours used during June, July, August and September; the column headed "Winter months" refers to December, January, February and March; the "Spring and fall" column applies to remainder of year.

Table II gives the actual results obtained in a small residence type of refrigerator box (shown in Fig. 1), which is cooled by a ¼-ton Brunswick machine. This detail is gone into very fully to show what might be expected in the operation of a residence-type machine. It is very easy from these data to calculate the probable cost when we know that the actual power required is 903 watts input to the motor.

TABLE III.

RECORD OF THE DRINKING-WATER OUTFIT

	Refrigerating Machine.				Temperature.				Meter Dials.		Pump.			
	Time		Hours	Kw	Tank				Start		Time		Hours	Kw
Date.	Start.	Stop.	Operated. h.m.	Hours.	Start.	Stop.	Supply.	Fountain.	Machine.	Pump.	Start.	Stop.	Operated. h.m.	Hours
Jan. 8	3.00	5.20	2.20	4.8	52°	51°	41°	..	1,890	4,260	9.30 7.45 p.m.	5.50 10.10 p.m.	8.20	10.40
" 9	8.45	5.05	8.20	22.2	55°	35°	..	40°	1,914	4,468	8.30	5.50	11.45	12.95
" 10	8.25	3.30	7.05	17.0	33°	33°	40°	36°	2,025	4,727	8.10	5.50	9.40	11.40
" 11	Not operated.				33° in a. m.		40°	..	2,110	4,955	8.25	10.15	1.50	1.85
" 12	Sunday.													
" 13	8.30	3.10	6.40	20.2	36°	36°	41°	39°	2,110	4,992	8.15	5.50	9.35	10.55
" 14	Not operated.				32° in a. m.		42°	39°	2,211	5,193	8.15	5.50	9.35	11.75
" 15	9.00	4.00	7.00	18.8	49°	34°	42°	40°	2,211	5,428	8.10	5.45	9.35	11.25
" 16	4.00	5.20	1.20	3.6	32° in a. m. 48°	44°	41°	50°	2,305	5,653	8.15	5.50	9.35	10.65
" 17	9.30	2.50	5.20	13.8	48°	35°	41°	43°	2,323	5,806 6,073	8.05 7.45 p.m.	5.45 10.10 p.m.	12.05	13.00
" 18	9.10	1.20	4.10	11.2	43°	36°	40	41°	2,392	6,126	8.10	4.30	8.20	7.70
" 19	Sunday.													
" 20	2.55	5.15	2.20	6.4	36° in a. m. 43°	35°	40°	39°	2,448	6,280	8.20	5.50	9.30	8.75
" 21	2.55	5.10	2.15	5.8	33° in a. m. 42°	37°	41°	40°	2,480	6,455	8.20	5.45	9.25	7.70
" 22	10.30	4.10	5.40	15.8	34° in a. m. 39°	35°	41°	40°	2,509	6,609	9.00	5.50	8.50	9.30
Totals			52½	139.6									118.12	126.75

We are inclined to believe that one of the largest uses which will be found for the refrigerating machine in the near future is in the cooling of drinking water for office buildings, schools and public institutions and buildings of all kinds.

Fig. 2 illustrates the equipment installed in the building of the Philadelphia Electric Company, and Table III gives in detail the figures covering the operation for a period of two weeks. The system comprises a two-ton Larson-Baker machine driven by a 5-hp motor. The expansion coils are submerged in a galvanized-iron tank having a capacity of 374 gal. This tank, located in the coolest part of the basement, is 8 ft. 4 in. long, 2 ft. wide and 3 ft. 6 in. deep. The sheet-iron sides are braced by means of angle irons, and the whole covered with hair-felt insulation about 2 in. thick. The piping is 1½ in. in diameter and laid in coils around the inside, reaching from the bottom to within 6 in. of the top. The total length is about 200 ft. coiled 16 times.

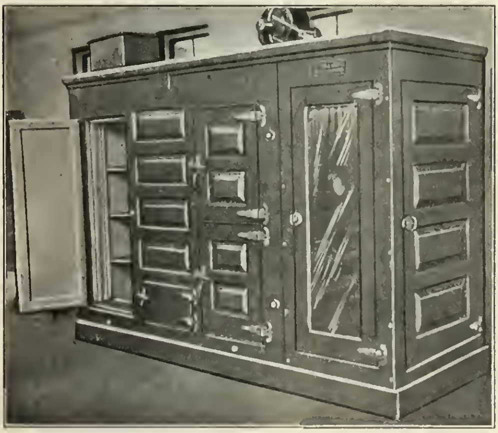


FIG. 1.—RESIDENCE TYPE REFRIGERATOR BOX.

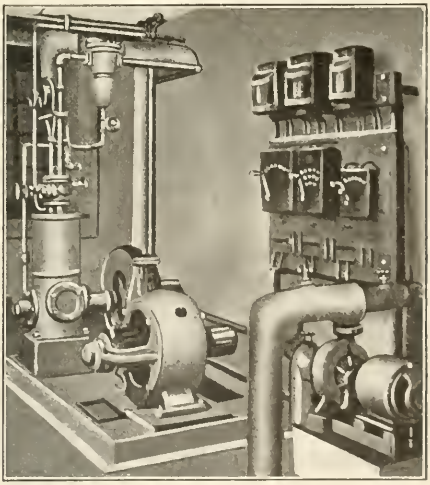


FIG. 2.—TWO-TON REFRIGERATING MACHINE

The water is fed to this tank through filters and is cooled to about 34 deg. It is then pumped through two circuits to reach the various parts of the building where the drinking fountains are located. The front loop is about 200 ft. long, reaching to the roof of the building and down again. The rear loop is about 160 ft. long and does not go above the first floor. These loops are controlled by valves at the pump, so that either one or both can be shut off if occasion calls for it. The capacity of the pump is 40 gal. per minute, which is found ample for this building. This pump is operated and the water kept in circulation all day. As will be noticed, there is generally a difference of about 2 deg. or 3 deg. between the temperature of the water as drawn at the faucet and that in the tank. This is accounted for by the hot walls and piping through which the water circulates. During a period of 20 days from Jan. 8, the refrigerating machine operated on 25.8 per cent load factor for an average operation of 3 hours and 41 minutes per day, while the circulating pump showed a load factor of 125 per cent on an average daily use of 9 hours and 7 minutes. The motor on the circulating pump is a 1-hp, series-wound machine operating at 2400 r.p.m.

The reader is referred to an article in these columns in the first issue published in the Electrical World of March, 1908, entitled "Electrical Refrigeration in a Meat Market," in which the details of the equipment are discussed. The equipment, consisting of two 25-ton machines, each driven by a 50-hp Northern motor, chain-drive, is located within reach of the brine circulating pipe line of a large freezing company.

One of the difficulties encountered in the securing of refrigeration business is the overestimating of the requirements on the part of the engineer and the architect. In general, the architect is dependent upon the user or the consulting engineer for his information, and in many instances is misled by the lack of knowledge on the part of the former and the desire to see a steam plant installed on the part of the latter. In this particular instance the plant has never been operated near its maximum capacity, the average requirements being considerably below the estimates, and in consequence, from the standpoint of efficiency, it presents a somewhat unfavorable condition as regards economical operation.

Generally speaking, electric drive is more economical to operate, and in addition has the advantage of being available at all times, is a clean and simple source of power, and readily understood and operated by even the ordinary attendant. At the prevailing price of ice, the cost of electric energy is about one-half that of ice.

It is with the ice-cream maker that the greatest saving is frequently shown through the adoption of artificial refrigeration owing principally to the saving in both ice and salt bills. It is an acknowledged fact that in the ice-cream business the use of ice is very extravagant. An article published a short time ago in the *Ice Cream Trade Journal* treats of an installation in a retail ice-cream saloon having a capacity of about 400 quarts of ice cream per day during the summer. The investment for some new cabinets and the refrigeration outfit complete amounted to $2,700. After operating the electric refrigeration machine a comparison was made with the costs involved during the same three months of the previous summer when ice and salt were used. The cost of electric power, together with the cost of water and 15 per cent of the investment as a fixed charge, indicated a saving of $427. During the remainder of the year the saving would not be so great, this remarkable showing occurring at the time of maximum business.

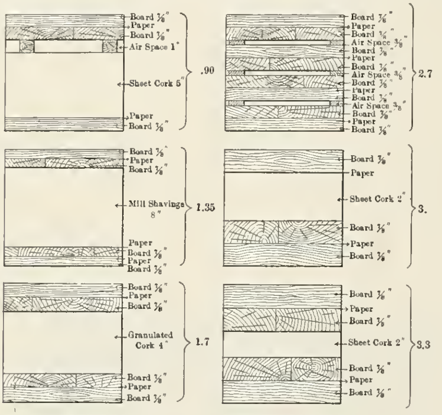


FIG. 3.—REFRIGERATOR INSULATIONS.

Each of the representatives of the various machines make claims and statements which would seem to indicate that his machine is superior to all others. Our experience indicates that there is very little actual difference in the results obtained from the different makes of machines, but that the manner in which the equipment is planned and installed has much to do with the giving of good or poor results. Further, we have found that some representatives seem to prove more successful in one line of business than in another. For instance, one representative has made a specialty among the meat dealers, another with dairymen, a third with candy manufacturers, and so on. Again one man is very successful in small sizes of machines, while others do not seem to be able to properly take care of the small installation. Therefore, we say that above all it is important to have a thoroughly competent refrigeration engineer who has had experience in his particular line to superintend an installation.

Too much importance cannot be attached to the proper insulation in all cases. There seems to be a prevailing opinion among the laity that what ice fails to accomplish, a refrigerating machine can perform. Again, we often hear that an agent will refuse to put in a machine unless the insulation is improved. Both positions are unwarranted.

If we glance at the formula which is used in calculating the amount of refrigeration required, it is at once apparent what a large factor insulation is in the result. The formula is as follows:

$$H = cA\ (t - t^1).$$

In this formula A is the outside surface area of the box or space to be refrigerated; t is the temperature of the surroundings, and t' is the temperature desired in the space to be refrigerated; c is a factor which varies from 1 to 7, dependent on the quality of the insulation separating t from t'. If the insulation is very good, the factor c, which multiplies the result, may be one-seventh as much as in the very poorest insulation. The value of c for an average fair insulation is taken at 3, and the result then is the number of thermal units (British) to be taken care of. Fig. 3 illustrates the construction and values of insulations, the latter varying from .9 to 3.318.

There are 285,000 thermal units required for the melting of a ton of ice. If, therefore, we divide the value of H obtained above by this figure we get the size in tons of the machine required. For example, assume a meat box 10 ft. x 10 ft. x 10 ft., the outside area of which is 600 sq. ft. The temperature desired inside is 34 deg., the probable maximum temperature outside we can assume to be 84 deg.; $t - t'$, or the difference in temperature between the outside and the inside is thus 50. We will assume that c has a value of 3 in this case. $H = 3 \times 600 \times 50 = 90{,}000$. $90{,}000 \div 285{,}000 =$ approximately one-third of a ton. This means that 1/3-ton machine would have to operate 24 hours per day to maintain the desired temperature in the box. As it is undesirable to operate the machine continuously, the same results may be obtained by using a 1-ton machine for, say, about eight hours per day.

Supposing the insulation were poor so that c instead of being taken at 3, were taken at 6, the leakage from each square foot of surface would be equal to 6 instead of 3 thermal units per hour. The value for H now becomes 180,000 and the machine required is one of two-thirds of a ton for 24 hours' operation, or for an eight-hour operation a two-ton outfit would be necessary. This would mean not only a greater increased cost for installation, but a continually higher expense for operation, which would be almost in a ratio of 2 to 1. It is thus very evident that it would be very much more economical to spend even $100 additional on the insulation of the box.

The above deductions do not take care of the contents of the refrigerator boxes, the idea being to illustrate the method of calculation and the importance of good insulation.

The following formula provides for the heat units contained in the materials placed in the boxes. Adding together the results obtained by the two calculations we secure the tons of refrigerating capacity required.

$$\text{Tons} = 0.000003505\ (ws)\ (t - t^1)$$

$w =$ weight of material in lb.

$s =$ its specific heat.

t and $t^1 =$ same as before.

Assume that the above box contained one ton of meat.

The specific heat of beef is 0.8. We will assume that the meat is brought directly from the packing house and that the temperature has risen to 50 deg., and that, as before, $t^1 = 34$ deg.

We then have $0.000003505 \times 2000 \times 0.8 \times (50 - 34) = 0.089728$ ton. Multiplying this result by 3 to obtain the result in 8 hours we get 0.269 ton of capacity to take care of the contents. This is unimportant in this case and can easily be taken care of by the machine already decided upon.

But this is not always the case. In the case of a butcher killing his own beef, a large allowance is found to be necessary, and similarly in the butter business, and with milk that has just been pasteurized.

In conclusion, attention to the suggestions offered in this and in preceding papers will do much to develop electric refrigeration, and the results will surely compensate the majority of the companies for the time and effort expended.

Economical Operation of Small Generating Stations.

At the Chicago convention of the National Electric Light Association, held in Chicago, Messrs J. T. Whittlesey and Paul Spencer presented a paper discussing the design and operation of small central stations. Since many of the so-called labor-saving devices are applicable only to stations of large size, and each additional piece of apparatus in the station is an additional source of possible trouble and cost, the simple design is always the safe one for the small station. Simplicity of design, however, does not mean lack of design, and it is probably of even more importance in the cost of the small plant than of the large plant that it should be arranged at the start so that it can be developed along definite lines.

Every station manager should forecast for himself the development of the load so that he may have some idea of the conditions it will be necessary for him to meet from year to year in the future. It is an excellent plan to assume some reasonable percentage of growth in order to ascertain what point at the end of a period, say 10 years, the expected load on the station may reach, and to draw up some tentative plan to meet such an estimated load, working backward on the problem to ascertain when the additional apparatus will have to be installed, in order that the equipment may keep pace with the growing load.

With such a more or less definite plan in mind the extensions can be made from year to year in the most economical manner, so far as first cost is concerned, and with a uniformity in the design and size of apparatus that will help toward efficient operation. Such a definite plan will also enable the station manager to avoid the costly rearrangement of buildings and of apparatus, which have so frequently been necessary in the past and have swelled so much the station's scrap pile.

It should be remembered that in the future the question of replacement may have to be handled on quite a different basis, so far as the method of charging the cost is concerned, than in the past. Everything points to the fact that all companies, sooner or later, will be operating under restrictions imposed by State commissions and that the value of displaced apparatus can no longer be charged to capital account, as has been done in many cases in the past, but will have to be taken up in some way in the operating account of the station. It, therefore, becomes of the utmost importance that each station should be able to grow along definite lines, utilizing to the end of its useful life all the apparatus it may possess.

EXTENSIONS OF OLD PLANTS.

It is, of course, comparatively easy, if any thought whatsoever be given to the subject, to lay out a new station to provide for some such definite method of growth. Electrical apparatus has now reached such a point of development and of standardization that replacements, due to the changes in the art, are much less likely to occur in the future than in the past.

It is a more difficult problem with an old station, which in many cases is merely a haphazard collection of all sorts and conditions of apparatus, to provide a definite plan to bring order out of chaos. It is, however, always possible to provide that the extensions shall be carried out with some plan in view, and generally possible to make this plan one that will fit in more or less successfully with the existing station. The central-station manager should recognize the extreme importance of his making, as early as possible, an intelligent study of future development and of providing a systematic plan to which he may work.

Assuming that a new station is to be built, certain broad features of the design can be laid down as essential. First of all, the plant will undoubtedly supply alternating-current service, generating and distributing at 2300 volts, polyphase, 60 cycles. One class of apparatus only should be installed, and the entire business, whether for commercial lighting, street lighting or motor, should be supplied at 60 cycles.

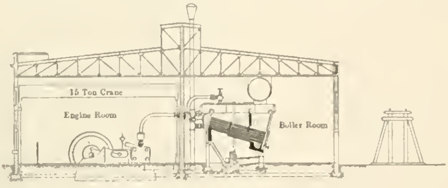


FIG. 1.—CROSS-SECTIONAL ELEVATION OF SMALL STATION.

A site should be selected that will have railroad facilities and, if possible, a supply for condensing water, as a condensing plant will be desirable when the load has increased to a certain point. The site should be of suitable shape and sufficiently large to provide ample facilities for future extensions. It is also desirable that there should be room on this property for stable or store room, as economy in the entire operation of the company will be gained by having all such buildings located at one point. The site chosen should, if practicable, be close to the center of the town. The design of the engine and boiler room should, of course, provide for unlimited extension. This means parallel engine and boiler rooms. The station building should be fireproof, with brick walls, concrete floors and steel roof. A crane in the engine room is desirable, but not necessary. The gutters and flashings should be of copper, and window frames, doors, hardware and other details should be substantial, so as to keep down the cost of repairs.

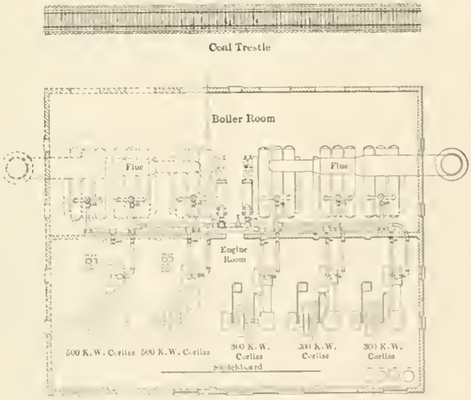


FIG. 2.—PLAN OF SMALL STATION

The stack should be of brick, as steel stacks will in every case be found to be more expensive in the end, because they require a constant maintenance charge for painting and sooner or later they must be replaced.

For a small load, say under 1000 hp, a simple non-condensing station will show the least total outlay, including cost in operation, and interest and depreciation on the apparatus installed.

Consideration should also be given to the fact that in such a station, with only a small number of men employed, it is impossible to obtain, for the wages paid, very expert men and that, therefore, the best results will be obtained by keeping all the apparatus as simple as possible.

The generating unit should be direct-connected with the engines, preferably of the Corliss type, of moderate speed. The boilers may either be fire-tube or water-tube, but should be hand-fired, with no elaborate machinery for handling fuel or ashes. The station auxiliaries should be reduced to a minimum.

The exciters will be belt-driven from the engines, and the only steam auxiliaries will be a feed-water heater and feed pump.

The switchboard design should provide for exciter panels located in the middle of the board, with sufficient space left for all future extensions. A Tirrill regulator will be found most desirable. Its first cost is low, and in a station where labor is to be reduced to a minimum it will be necessary to have such a voltage regulation if good service is to be given. With the exciter panels located in the middle of the switchboard, the generator panels may be extended as needed on one end and the feeder panels on the other. All connections from the generators to the switchboard should be carried in cable under the floor, and the outgoing feeders should also be carried under the floor to a wire tower at the corner of the building.

Fuel should be delivered to the plant on a railroad siding extending the length of the boiler room and parallel to it. If possible a trestle should be installed, so as to provide headroom for dumping the coal from the cars, which can be stored under the trestle and wheeled to the boiler room as needed. Sufficient space should be provided under this trestle to permit of carrying not less than a month's supply of coal at the time of the station's maximum output.

PROPOSED PLANS.

A general plan of the station embodying the above general ideas is shown in Figs. 1 and 2.

It will be noted upon examination of these drawings that the building suggested, which is extremely simple in design, contains no basement, either under the engine or the boiler room. The steam piping is placed overhead with the exception of the free exhaust lines from the engines, and the arrangement is such as to give the shortest possible length of connections from the boilers to the engines.

The omission of a basement is primarily to reduce cost, but it will also result in cheaper maintenance, as it is found that basements in such stations usually become filled up with rubbish which must be cleaned out, and when used to run pipes in, the work of repairs on them is greater than where the pipes are placed overhead. Leaks frequently are allowed to exist, causing constant loss, which would otherwise be immediately noticed and stopped.

While an ash hopper and basement under the boilers keep the boiler room clean and enable more rapid and easier cleaning of fires, they increase the cost of getting out ashes and give additional space to be kept clean. The additional cost is practically prohibitive.

The solid portion of Fig. 2 indicates the building as it would be constructed for immediate needs; namely, a maximum load of 600 kw, containing three 300-kw units. The future extension to take care of the growth in load for 10 years is indicated by dotted lines.

This sketch is given simply to indicate the general features of the type of station recommended in this paper; the details, of course, would be altered to meet local conditions and requirements.

It is assumed that this station is to be built to meet a present maximum load of 600 kw; that this load will be increased at the rate of 10 per cent per annum compounded, and that the load factor will be equivalent to 2200 hours per year for each kilowatt of the maximum demand. This station can be built at a cost of from $125 to $150 per kilowatt.

Assuming the available output as the amount obtainable when the largest unit is disabled and the others are overloaded by 25 per cent, the original installation of three 300-kw units would carry the load safely through three years with one unit out of service, at which time a 500-kw unit would be installed, which would carry the load for five years; a second 500-kw unit would then have to be purchased, which would give an available output more than sufficient to carry the load through the remaining three years.

The complete plans of the station, including the dotted portion, show all of these units installed, with necessary boiler installation. Such a station would have a total output, with the largest engine out of service, of 1750 kw, allowing a 25 per cent overload on the units available for service.

There is given in Fig. 3 an assumed load curve for an average maximum day. On this sheet is also shown the rating of generators running to meet the load, from which it will be seen that the 300-kw unit will be running at approximately half-load during the light portions of the day and night. This would, of course, increase the fuel consumption during these hours over what it might be with a small unit of exactly the necessary size to meet the present load. It is expected, however, that in a very short time the day load would be increased so that the 300-kw unit would be operating under more economical conditions. Should the territory in which the station is operating be of such character that it is impossible to obtain any great amount of day load, it would be desirable, perhaps, to install a somewhat smaller unit than that shown on the plan.

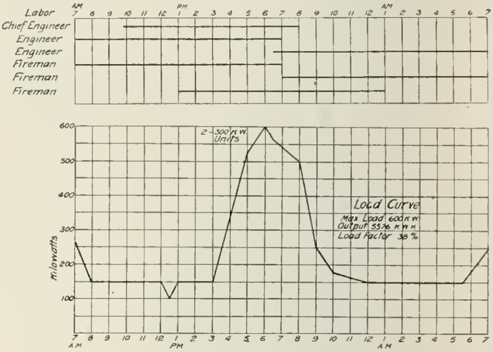


FIG. 3.—STATION LOAD CURVE.

OPERATION.

The operation of such a plant would require a minimum of labor and repairs. From experiences with similar plants, it is learned that a total of six men is amply sufficient, including one chief engineer, two running engineers, two firemen and one fireroom helper. The hours which these men should work are shown in diagram on the load-curve sheet. By lapping the chief engineer and the helper, we should have four men in the plant over the peak of the load.

The overlap covers the afternoon hours, giving the chief engineer the best opportunity to overhaul apparatus and providing him with the necessary help to carry on his minor station repairs.

With the plant as described, there will be practically no continuous repair work, with the exception of that required to keep the boilers in first-class condition. There will be only two single-cylinder, slow-speed engines and one boiler-feed pump running simultaneously during the peak, and only one engine and one feed pump for 20 hours of the day.

As this is a non-condensing plant, the steam pressure will be low, not over 120 lb., which will make it possible, with a small amount of labor and attention, to keep the piping, valves, packings and so forth, in perfect condition, so that there should be no excuse for their not being maintained always at initial efficiency, even with the small station force employed. When the engineer of a station is relieved of the care and annoyance ordinarily caused by condensing apparatus, mechanical stokers.

forced draft and other complications, his whole attention may be given to maintaining the efficiency of the boilers and engines and seeing that they are operated to the best advantage under the load conditions.

OPERATION.

The following particular points are brought up as essential to the economical operation of the station:

In the engine room it will be important for the chief engineer to see that the rating in apparatus running follows closely the load curve. All units should be run at their highest possible efficiency. It is always desirable to run them overloaded rather than underloaded, and the engineer should not be afraid of running the units at their full overload point.

The chief engineer should be provided with an indicator and take frequent cards so that he may know at all times the condition of the valves and cylinders and remedy any defects that may develop.

It is in the boiler room that the greatest possibility lies of wasting or saving fuel and improving the station economy. No positive rules for firing can be laid down in general on account of the difference between fuel and also on account of the various methods of firing adopted by different men.

The cutting in and out of boilers and banking of fires must be watched as closely as the running of the engine room to make the boiler rating meet the loads most economically. With most boilers of good design it is found more economical to overload them 25 per cent above the builder's rating and in order to carry a short peak to go to 50 per cent or more overload rather than cut in an additional boiler. The slight falling off in efficiency of a boiler at these high ratings does not consume as much fuel as that required to keep one boiler banked for use for a few hours a day.

With a non-condensing plant there is no difficulty in getting the temperature of the feed water above 200 deg., so that this point will not trouble the engineer.

The combined boiler efficiency, including the grate and heating surface, can be kept up to the highest point only by constant attention to the condition of the boiler setting and the tubes. Draft gages and thermometers, which cost but little and are very simple to use, will give the engineer exact information with regard to the condition of the boiler and will help the fireman to get the best results from the boiler and the coal. A thermometer should be installed on the feed line into the boiler and draft gages on uptakes and immediately over the fire. A high-reading thermometer for observing the temperature of flue gases should be used by the engineer occasionally, which will be a guide on the efficiency of the boiler. Periodical readings of the draft at different points through the boiler should be made to determine the loss of draft and ascertain if the air leaks are excessive.

One great source of loss of boiler efficiency is the bad condition of boiler-setting, cracks around drums and other points in the setting which admit cold air, decreasing the draft and lowering the temperature. Most plants have an excess draft available from the stack, so that even with a very bad condition in this respect ample draft is still obtainable for burning the coal as fast as is required. This results in a continuous loss unknown to the engineer, unless investigation with draft gage or by torches is made.

Every one is perfectly familiar with the necessity of keeping the boiler clean, both inside and out, to maintain its efficiency. The frequency of such cleaning will depend entirely upon the quality of fuel and water used. An increase of 10 per cent in boiler efficiency can easily be made, even where conditions are not very bad, by repairing the setting and cleaning the boilers.

An automatic damper regulator is essential, especially in a small plant where natural draft is used.

STATION RECORDS.

It is hardly practicable in a small plant for the engineer to make elaborate tests, flue-gas analyses, engine-efficiency or evaporation tests, but the total running results of the plant can be kept very accurately by a proper method of records. The chief engineer is not responsible for two factors greatly affecting the cost, namely, the nature of the load on the plant and the fuel furnished. He can, however, by keeping accurate records, furnish the management with the information necessary to determine whether or not the fuel purchased is the best for the price and how the cost of production can be decreased by improving the load factor. No scientific test is as good as a comparative run of several months under similar conditions.

In many plants of this size the output and the shape of the load curve are very similar from day to day and from month to month, so that, by ascertaining the amount of coal burned and the output, a very accurate comparison can be made with different fuels, methods of firing and handling of the units.

It is essential, then, for the economical operation of a small plant that watt-hour meters be installed on each generator and the daily output kept on the log sheet. The indicating instruments should also be read at sufficiently frequent intervals to enable a daily load curve to be plotted. Every pound of coal and ash should be weighed and a record kept for each shift or period of load.

The engineer will have payrolls and bills for material, so that with a very small amount of bookkeeping he can determine the actual cost of labor, fuel, oil and waste, repairs to buildings, repairs to engines, repairs to boilers, and repairs to electrical apparatus.

It is hardly possible in such a plant to subdivide the labor, as the ordinary repair work and maintenance of apparatus is done by the regular station help, part of whose time is also put into operating. Any extraordinary repairs requiring outside help or machine work will be entered up separately.

The engineer of the plant should not hesitate to try experiments in operating, provided, of course, the service is not endangered; such as different hours of cutting-in and out boilers, overloading and underloading boilers, cutting engines in and out on the load at different hours. These experiments will be of no value, however, unless they follow out a definite program to its final results and unless records are kept accurately and analyzed intelligently to compare the results obtained. Conclusions are often jumped at in station operating which at sight seem apparently correct, but upon analysis prove to be entirely wrong. Good records and a careful analysis are the only proofs that can be accepted.

OPERATING COST.

Item.	Present output Amount.	Present output Per kw-hour.	Double output Amount.	Double output Per kw-hour
Superintendent	$1,000	0.0757 cent	$1,000	0.0379 cent
Labor	5,040	0.3819 "	6,480	0.2454 "
Fuel	9,723	0.7366 "	19,446	0.7366 "
Water	634	0.0480 "	1,268	0.0480 "
Oil and waste	600	0.0454 "	800	0.0303 "
Miscellaneous supplies and expense	500	0.0378 "	600	0.0227 "
Repairs, buildings	100	0.0076 "	100	0.0038 "
Repairs, steam	700	0.0530 "	1,000	0.0379 "
Repairs, electrical	75	0.0057 "	100	0.0038 "
Total	$18,372	1.3917 cents	$30,794	1.1664 cents

Notes.—Coal based upon Pennsylvania bituminous at $3 per ton, 5.5 lb per kilowatt-hour.

Water based upon cost at 10 cents per thousand gallons, 40 lb. per kilowatt-hour.

Superintendent's salary at $3,000, one-third charged to production.

Labor: Chief engineer at $1,200 per year.
Two engineers at $900 per year.
Two firemen at $720 per year.
One helper at $600 per year

IMPROVING OLD-PLANT RESULTS.

In the case of an old plant which is not operating at good efficiency it is difficult sometimes to locate the trouble and correct it. It is, of course, necessary at first to secure accurate records as already described. These, however, will show only the total pounds of coal per kw-hour and will not tell where the losses are.

The easiest point to be attacked first is the engine economy, which can be very readily brought up to its highest possible point with the engines in use. The records will then show if any gain in efficiency has been made.

After having brought the engines up to their best efficiency for the type, the boilers should then be carefully inspected and cleaned up. Boilers that have been neglected will require heavy expenditures to bring them up to a good standard of efficiency. This, however, must be done if the manager is determined to get good results from the plant in the end. No patching or partial cleaning of a boiler should be made unless it is absolutely necessary at the time in order to keep them in operative condition. Thorough repairs only will pay, but they will pay well in fuel saved, as the records will show if they are properly kept.

The operating costs of a small plant are given in the table on previous page. The figures are conservative for a new plant, well-built along the design suggested, and have been exceeded in actual experience. Two columns of cost are given: first for a station having a load of 600 kw and an output of 1,320,000 kw-hours per year, and the other for the same station with twice the output and the additional equipment necessary.

The figures for labor and fuel will vary considerably in different localities and under different conditions of the labor and fuel market.

The Law of Electric Light Companies.

By J. E. Brady.

INJURIES TO PERSONS ON STREET.

It is well settled that damages may be recovered against an electric-light company when a person while on a public thoroughfare is injured through the negligence of such company. Amer. & Eng. Encyc. of Law, Vol. X, p. 870.

A company of this kind, using a thoroughfare or public highway for the purpose of its business, is charged in law with great care, not only in erection of the wires, but in maintaining and keeping them in repair. They must be so kept and conducted that a citizen pursuing the ordinary vocation of life will not come in contact with them. It is the business of the company to so erect them as not to interfere with the safety of the citizens of the community while pursuing their vocations in the ordinary walks of life. Mitchel vs. Light & Power Company, 45 S. Car., 146.

In Lundeed vs. Livingston Electric Light Company, 17 Mont., 32, the facts were these: An electric-light company, in order to strengthen and support one of its poles, ran a guy wire from the pole to a post planted across the street. This post was from 4 ft. to 6 ft. high, and the guy wire was fastened around it 4 ft. or 5 ft. above the ground and extended thence to the pole across the street. One day when the acicdent for which the action was brought occurred, the plaintiff was riding at a moderate gait on horseback along the street. Near the place where the post and guy wire had been put up, a man by the name of B., also on horseback, passed the plaintiff. Here B.'s horse became frightened and for a time unmanageable and shied across the street and ran against the guy wire and broke it near the post to which it was fastened. The broken wire recoiled and wound itself around the waist of the plaintiff, who was riding in the rear of B., pulling her from her horse to the ground and inflicting upon her serious injuries. It was held that the post with wire was an obstruction of the free use of the street in its ordinary and usual use, that such obstruction was the approximate cause of the injury, and that, therefore, the plaintiff was entitled to recover damages. Amer. & Eng. Encyc. of Law, Vol. X, p. 870.

In Excelsior Electric Company vs. Sweet, 57 N. J. L., 224, the plaintiff was passing along a public street on his way to market. When he reached a point in the street over which a lamp of the defendant (an electric-light company) was suspended, it fell and struck his horse. The horse became frightened and ran away, throwing the plaintiff from the wagon whereby he was injured. There was evidence given by experts that the rope used for keeping the lamp in its place was not a proper and safe rope, and that the pulley over which the rope ran, unprotected as it was, was unsuitable, and that the suspension wire used had not the "stoutness or durability to have a lamp like that hanging on it." It was held that the plaintiff was entitled to recover damages.

An electric-light company is guilty of negligence in leaving a broken uninsulated telephone wire in such a position as to endanger the lives of persons using the street; and when the plaintiff's husband, in the proper discharge of his duty as a police officer, while attempting to remove the dangerous nuisance, was brought in contact with the charged wire, and thus without any negligence on his part lost his life, the company was held liable to respond in damages. Dillon vs. Allegheny County Light Company, 179 Pa. St., 482.

The employees of an electric-light company, while engaged in taking down a wooden electric-light pole, lost control of it with the result that it fell upon and seriously injured the plaintiff, who was crossing a public street. The plaintiff introduced evidence to prove that the men engaged in taking down the pole failed to exercise the care required by the circumstances and that the appliances used in the performance of the work were inadequate. It was held that the plaintiff was entitled to recover damages. The court said: "It was the duty of the defendant to furnish sufficient men and adequate appliances for the work of taking down the pole, and it was liable for the consequences of its failure to do so. If it discharged its duty in this respect, it was still answerable for the consequences of the negligence of its employees in the performance of the work." Kyle vs. Southern Electric Light, etc., Company (Pa., 1896), 34 Atl. Rep., 323.

While the plaintiff in an action against an electric-light company was lawfully passing along one of the public alleys of the city, without any fault on his part, he came in contact with a live wire belonging to the defendant company, which wire had become disconnected and detached from its overhead fastenings, and was hanging down to within about 2 ft. of the ground. As the result of such contact, the plaintiff received a severe shock and was seriously injured. The negligence charged against the defendant company, of which there was some proof, consisted in its failure properly to construct its line and its omission to take the necessary precautions to prevent the wires from falling and causing injury in case they became detached from their fastenings. Judgment was here given for the plaintiff. In the opinion, it was said: "That the business of distributing electricity on wires strung over the streets of a city is a dangerous business attended by peril to travelers along the highway, and the necessary precautionary steps to guard the public must be taken." Denver Electric Company vs. Simpson, 21 Colo., 371.

As a rule, where an electric-light wire falls from its proper place and injures a person passing in the street, negligence is not to be presumed from the mere fact of the falling. The rule cannot be better stated, in its generality, than as given in Scott vs. Dock Company (1865), 3 Hurl. & C., 596: "There must be reasonable evidence of negligence. But where the thing is shown to be under the management of the defendant or his servants, and the accident is such as, in the ordinary course of things, does not happen if those who have the management use proper care, it affords reasonable evidence, in the absence of explanation by the defendants, that the accident arose from want of care." Public policy, from sheer necessity, must require of a person or corporation using a current of electricity in high tension along highways, a very high, if not the highest, degree of care, and this high degree would seem all the more reasonable to justify this rule of presumptive negligence in such cases. A wire may have some defect which the most astute care will not discern. A wire originally good may come to be defective, and break, when no human skill could detect its defect. Time and wear deteriorate man and all the means and instruments he uses to gain a living. Paralysis and failure may come upon them at any moment. Whether there is culpable blame is a question for a fair-minded jury.

INJURIES TO PERSONS RIGHTFULLY ON PREMISES.

When a person who, though not upon a public street, is on premises where he is entitled to be in the pursuit of his business, is injured as the result of negligence on the part of an electric-light company, he may hold the company for damages. Amer. & Eng. Encycl. of Law. Vol. X, p. 871. Thus, where a person employed in a hotel was requested by his employer to accompany him upon the roof of the building in the night time for the purpose of fastening some signs which were in danger of being blown down, and the employee, in the darkness, accidentally came in contact with the wires which supplied the hotel with electric light, and upon which the insulation was defective, the company owning the wires was held responsible for the injuries received. Giraudi vs. Electric Improvement Company, 107 Cal., 120. In Griffin vs. United Electric Light Company, 164 Mass., 492, the plaintiff was a tinsmith and, at the time he was injured, was at work with a fellow-servant placing a galvanized-iron conductor on the rear of a building known as the American House. He was standing upon the ground and his fellow-servant was on a ladder near the roof of the building, which was about 20 ft. above the ground. The wire from which the plaintiff received the shock ran along the wall of another building and then ran diagonally across to the wall of the American House, which it entered at a point about 6 ft. from the ground. Inasmuch as the plaintiff was rightfully upon the premises at the time of the accident, it was held that the electric-light company was legally responsible. Quoting from the opinion of the court: "The plaintiff was not a trespasser, or a mere licensee, who must take the premises of another as he finds them. He was rightfully on the premises for the purposes of business. On these premises the defendant had rightfully placed, as the case finds, two electric wires. These were a source of danger unless properly insulated. This fact was recognized by the defendant in insulating them. But it was negligent if it failed to use reasonable diligence in seeing that its wires were kept in a state of repair. This duty it owed at least to every person who, for the purposes of business, was rightfully upon the premises."

The electric-light company was held responsible in damages where a house painter, while in the act of climbing out of a window for the purpose of painting the house, came in contact with an uninsulated electric-light wire, belonging to the company. McLoughlin vs. Louisville Electric Light Company, 37 S. W. Rep., 851. And a policeman was held to have a cause of action against an electric-light company, where he was injured while on duty in a bank, where he was injured by an explosion in a brass pipe, through which ran one of the company's wires, the explosion having been occasioned by a contact outside of the bank between the wire which ran to the bank and a wire carrying an arc current. Yates vs. Electric Light & Power Company, 40 La. Ann., 467. In the case of Ennis vs. Gray, 87 Hun. (N. Y.), 355, the plaintiff, who was a roofer by trade, was injured while at work upon the roof of a building under the authority of the owner of the building, by coming in contact with the wires of the defendant company, which were used for carrying an electric-light current and which were defectively insulated. It was held that the plaintiff was entitled to recover. The court said: "The defendant was engaged in the business of supplying electricity for lighting purposes in houses and streets of the city, and considering the high voltage which it was necessary to carry over the wires, thus rendering the business in the highest degree dangerous unless handled with skill and care, we think that outside of any contractual relation, a duty was created on the part of the defendant, not only toward the public generally, who in the streets of the city might be likely to come in contact with the wires, but also with respect to any individual engaged in a lawful occupation in a place where he was entitled as of right to be."

INJURIES TO TRESPASSERS.

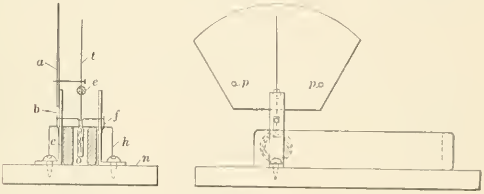
A person who is injured by coming in contact with an electric-light wire, improperly insulated, while in the act of committing a trespass, or in a place where he has no right to be, is not entitled to damages. Amer. & Eng. Encycl. of Law, Vol. X, p. 872. In Hector vs. Boston Electric Light Company, 161 Mass., 558, a lineman in the employ of a telegraph and telephone company was sent to attach a wire to a standard owned by an electric-light company on the roof of a building numbered 45. Instead of entering this building and going upon the roof, he went up through the building numbered 29 and passed over the roofs of the several intervening buildings until he came to the roof of No. 41, which was next to but higher than the roof of No. 45. A number of wires ran from the standard on No. 45 over a small portion of the roof of No. 41. The plaintiff stooped under these wires to see how he could get on the roof of No. 45 and was injured by reason of the insulation being worn off from one of these wires. It was decided that the defendant owed no duty to the plaintiff to maintain an effectual insulation of the wires over other buildings than that on which its standard was placed.

Device for Testing Watt-Hour Meter Armature Circuits.

By L. D. Snow.

The make-up of a home-made and inexpensive device for testing the circuits of high-resistance armatures such as are used in direct-current watt-hour meters is shown in Figs. 1 and 2 herewith. In such armatures on account of there being two circuits from one commutator segment to the next segment, a magneto will fail to indicate an open circuit in one of the circuits or a short circuit between commutator segments, both of which affect the calibration of the meter in about the same manner.

Referring to Fig. 1, *h* is the drag magnet past usefulness in a meter, having lost part of its original strength; *o* represents about 10 turns of, say, No. 29 magnet wire taken from an open-circuited potential coil of a high-torque induction meter of the Thomson type, and made to pass with plenty of clearance between the jaws of the magnets. The ends are brought above the magnet and bent at right angles to the coil, passing through holes in the supports *b*. This provides an axis about which the coil can swing parallel to the jaws of the magnet. The insulation is removed from these ends where they rest on the supports *b*, thus allowing current to pass from one support through the coil *o* to the other support. At *f* a strip of brass is soldered to the supports to take care of any side thrust of the coil. A short wire *t* is fastened to the coil for a pointer on which is placed a weight *e* to counterbalance the weight of the coil. The supports *b* are insulated from the magnet by paper as indicated at *c*. A wood base *n* supports the mechanism and *a* is a cardboard background for the pointer; pin stops are provided at *p*.



FIGS. 1 AND 2.—TESTING DEVICE FOR WATT-HOUR METER ARMATURES.

By connecting this device in series with two or three dry cells and with pin points at the ends of a pair of flexible leads, the circuits can be tested out between commutator segments. In Fig. 2, with the pin points touching on the commutator segments *a* and *b*, the circuit through coil *E* will have about one-eighth of the resistance of the circuit through the other coils. If the device is properly made, coil *E* "closed" will give a good deflection of the pointer; but if coil *E* is "open" the other circuit, owing to its high resistance, will not give a deflection. A "short" between the segments *a* and *b* will show by a decided movement of the pointer. Sometimes two coils such as *F* and *H* will be short-circuited on each other in the armature and this cannot be ascertained by testing each coil separately. If the pin points are touched to the commutator brushes and the armature revolved, a decided movement of the pointer will take place when the brushes are on the segments *b* and *c*. The device is easily made and operated, and by its use many an armature will be saved from an untimely end.

Easily Constructed Electrical Conduit and Service Boxes.

By T. C. Lerret.

It frequently is necessary to meet conditions, in arranging iron-conduit wiring in industrial plants, for which the manufacturers of conduit fittings do not provide appliances. Conduit outlet-boxes are usually procurable only in two sizes, one arranged to take ½-in. and the other ¾-in. conduit. In power, and often in lighting installations, the use of larger conduit is imperative. Fittings can be easily made from rolled-steel plate, or, as it is commonly called, sheet-iron, in a concern's own shop from materials at hand and in a majority of cases at less cost and with less delay than if furnished by a supply house. The reason for this is that, not infrequently, no two fittings on a power job are exactly similar and about as much expenditure would be involved in compiling specifications for what was required as there would be in actually making the fittings. If many of one type are wanted, probably a contractor could furnish them most economically.

Fig. 1 shows some types of boxes that are utilized frequently. All are of the construction herein described and are shown with covers removed. *A* is a pull or splice box which is inserted in a long line of conduit, to provide an opening so that conductors may be available for either pulling-in or splicing. The frequency with which pull boxes should be cut-in is determined by the size, consequently weight, of the conductors and by the number of bends in the run. Conditions and experience must decide this question. Pull boxes for ½-in. and ¾-in. conduit can be supplied from stock by any dealer, therefore money would be wasted by a concern making them for itself for these sizes.

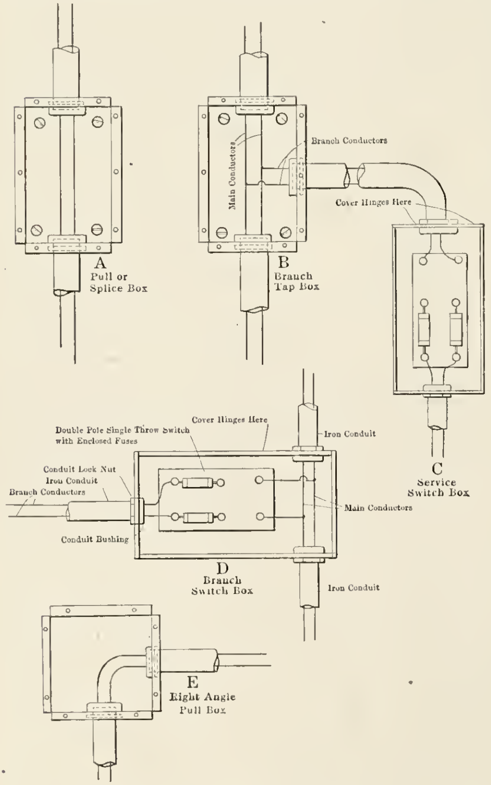


FIG. 1.—SOME USEFUL TYPES OF CONDUIT AND SWITCH BOXES.

A branch tap-box is shown at *B*; it is used at points where it is desired to take branch conductors from a main. Its function is clearly indicated by the illustration. The Underwriters' requirements specify that at each point where the size of conductors is decreased, the smaller ones shall be protected by a cut-out (fuse or circuit-breaker), unless the cut-out protecting the main is of such capacity as to protect the branch, the current allowable in each case to be determined by the Underwriters' table of carrying capacity of conductors. To meet this rule it is nearly always necessary either to place a cut-out in the branch box or to use conductors of the same size as the mains until a point is reached where a cut-out may be conveniently inserted. The condition shown in the figure (Fig. 1, *B* and *C*) often obtains. As an example: Electricity is to be supplied for a traveling hoist installed a short distance from the run of the main. In such a case it is desirable to carry branch conductors of the size of the main conductors to the point where the service switch for the hoist is to be placed and have the fuses in the same iron box with the switch, rather than have the fuses at one point and the service switch at another. This is advisable, of course, only when the distance between the run of the main and the switch box is short. If the distance were great

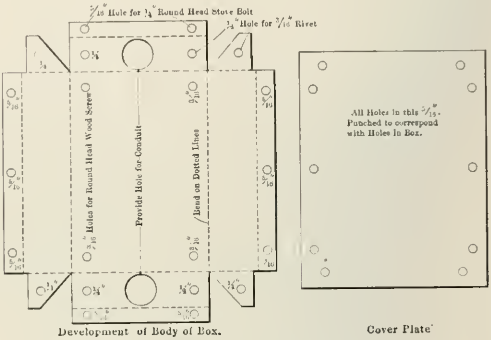

5/16" Hole for 1/4" Round Head Stove Bolt
1/4" Hole for 3/16" Rivet
5/16" Holes for Round Head Wood Screw
Provide Hole for Conduit
Bend on Dotted Lines
All Holes in this 5/16". Punched to correspond with Holes in Box.
Development of Body of Box.
Cover Plate

FIG. 2.—METHOD OF CUTTING SHEET METAL FOR BOXES.

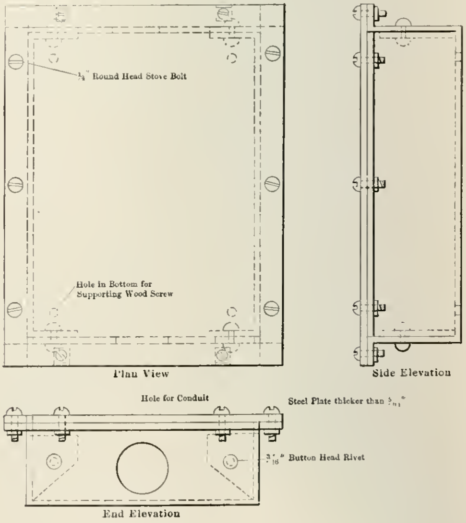

1/4" Round Head Stove Bolt
Hole in Bottom for Supporting Wood Screw
Plan View
Side Elevation
Hole for Conduit
Steel Plate thicker than 5/64"
3/16" Button Head Rivet
End Elevation

FIG. 3.—COMPLETED SHEET STEEL PULL BOX.

the increased cost of larger branch conductors might offset the desirability of having the fuses and switch in the same box.

C shows a service-switch box arranged to contain a double-pole, single-throw switch and enclosed fuses. This type of box is regularly manufactured for certain sizes of conduit, and whether it would be best to make them or not must be decided for each particular case. The branch-switch box shown at *D* is not regularly manufactured and is frequently useful. The illustration clearly shows its application.

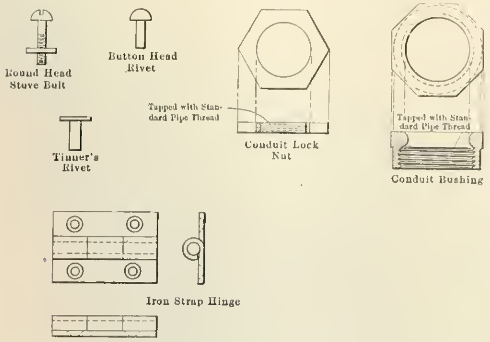
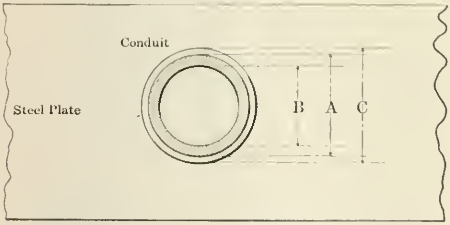


FIG. 4.—SUNDRIES REQUIRED FOR SHEET STEEL BOX CONSTRUCTION.

Pull boxes may be developed in a variety of forms. The one shown at *E* is fitted into a conduit run at a right-angle turn in order that conductors may be easily pulled into the conduit. All of the boxes shown in Fig. 1 are constructed from sheet-iron, the same general procedure being followed in each case. The method shown by Figs. 2 and 3 consists in cutting a piece of sheet-iron to the proper form, punching bolt and rivet holes in it, bending it into shape and then riveting the corner flaps. A sheet-iron cover must be provided also. Fig. 2 shows the pattern or development to which a piece of sheet metal must be cut to bend up into the completed box shown in Fig. 3. The cover plate is also illustrated. No dimensions are given on the illustrations as these are determined by the conditions in each particular case. After catching the idea one can easily lay out his own pattern to meet his own conditions by following the scheme laid out in the sketches. It is best first to lay out on paper a pattern for a box, full size, and allow the mechanic making the box to work from the paper sketch. All rivet and bolt holes should be accurately located and dimensioned on the paper sketch, so as to provide a check against error. The paper drawing may be cut out and folded into the form that the completed metal box should assume.



Nominal Side Conduit	A External Diam.	B Internal Diam.	C Diam. of Hole to Provide
1/2"	.840"	.623"	29/64"
3/4"	1.050"	.821"	1 1/8"
1"	1.315"	1.048"	1 3/8"
1 1/4"	1.660"	1.380"	1 23/32"
1 1/2"	1.900"	1.611"	2 1/32"
2"	2.375"	2.067"	2 1/2"
2 1/2"	2.875"	2.468"	3"
3"	3.500"	3.061"	3 5/8"
3 1/2"	4.00"	3.548"	4 1/8"

FIG. 5.—CONDUIT SIZES AND DRILLINGS.

The only material required for the actual construction and installation of such boxes besides rolled sheet-plate is shown in Fig. 4. All of them are readily obtained commercially. It is specified in the Code that sheet-steel composing the walls of boxes must not be less than .081-in. thick (No. 12 B. & S. gage). This is slightly more than 5/64 of an inch, so that any plate thicker than 5/64 of an inch may be used. If, however, the plate be too thick, punching will be difficult. The minimum thickness is quite heavy enough for all ordinary work. To meet Code rules, boxes must also be well painted or enameled to prevent rusting—or they may be made from galvanized plate.

Stove bolts, shown in Fig. 4, procurable about any plant, are used to hold the cover plates to the box bodies. It is not wise to use a bolt smaller than ¼-in. diameter, as smaller ones can readily be twisted asunder with a screwdriver in the hands of an able-bodied wireman. Bolts ¼-in. x ½-in. will work in most readily, but almost any size on hand can be utilized. All holes should be punched 1/16 in. larger in diameter than the diameter of the bolt that they are to accommodate to insure easy fitting and to provide for slight inaccuracies in measurement. Button-head black iron rivets (Fig. 4) make a neat job, but flat-head tinners' rivets—which are of iron, usually tinned—can be used in case the button-head variety is not obtainable.

Rivets 3/16-in. diameter and ½-in. long will be found to be about right for box construction, but if very heavy plate is used the rivets must be longer. Holes must be provided in all boxes through which the iron conduit can enter. The table in Fig. 5 indicates the proper size of hole to provide for each size of conduit. A sufficient working clearance has been allowed in compiling the table. Conduits are held in position in the boxes by lock nuts and conduit bushings (see Figs. 1 and 4). The bushing screws over the pipe, inside the box, and the rounded surface of its unthreaded orifice prevents abrasion of conductors by rough fins on the end of the conduit. A lock-nut threading on the conduit is set up snugly against the outside of the box for obvious reasons.

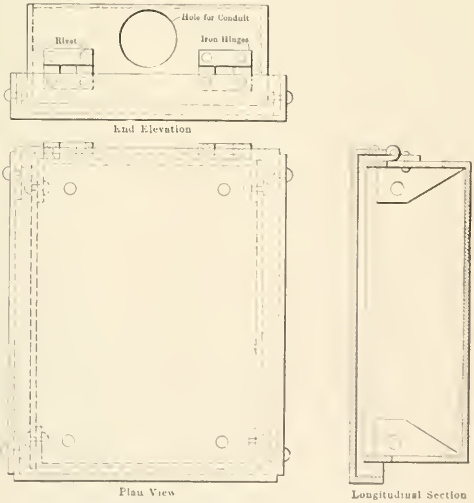


FIG. 6.—DETAILS OF SWITCH OR SERVICE BOX

A switch or service box may be constructed as indicated in Fig. 6. The construction is essentially the same as that of the pull box shown in Figs. 2 and 3. The flanges which are necessary in the pull box for securing the cover are omitted and a tray-like hinged cover is substituted for the cover plate. Common iron hinges, such as shown in Fig. 4, are riveted to the cover and body, as shown in Fig. 6. The inside of the cover should be at least ¼ in. larger all around than the outside of the box body, to give reasonable clearance. It is more trouble than it is worth to try to make a box of this type dustproof and a failure would probably be the consequence of such an attempt. The cover is intended to provide mechanical protection only. Switch boxes, as a general rule, must be deeper than pull boxes to accommodate the switch. The slate switch base can be secured to the box body by stove bolts. Additional holes should be provided in the bottoms of all boxes through which wood screws or bolts may pass to secure the box to the surface that supports it.

In the event that it is undesirable for an individual to do the actual work in constructing the described appliances, it will be found that the average tinsmith is capable of turning out a very acceptable product if a few directions are given him.

Methods of Making Ground Connections.

The following recommendations on the subject of ground connections are included in the report of the committee on grounding of secondaries of the National Electric Light Association, presented at the recent Chicago convention:

The ground connection may be made on each building service, on the transformer or on a common neutral or ground connecting a number of transformers, or at the central station, or at substations.

All ground wires must be of copper, and must be kept out of the building as far as practicable (except in the case of the central station or substation), but any ground wire which is inside of any building or attached to any building or pole must have rubber insulating covering, approved in National Electrical Code for from 0 to 600 volts. No wire smaller than No. 4 shall be used for ground connections.

Ground wires may be attached to poles or buildings by porcelain cleats or knobs. Staples must not be used. The wire must be run in as nearly a straight line as practicable, and where exposed to mechanical injury must be protected by a wooden molding or by an iron pipe, which latter does not require grounding when it contains the ground wire only.

Ground connections for transformers in central and substations, for transformers in banks or connected by common neutrals or grounds, and for individual transformers, must be made to all available underground water or other subsurface piping systems (except that gas-piping systems must not be used), or to a grounded railway return system, or to a metal plate buried in coke below permanent moisture level, or to pipes driven into permanently damp soil. Additional grounds may be connected, but they are not required.

When each building service is grounded, ground connections on transformers are not required. This ground on the service wire must be made on the transformer side of the main switch and cut-out, and the wire should, as far as practicable, be kept out of the building, but should be run into the cellar and connected to the water-piping system, on the street side of water meters and main cock. When the ground wire is run through any part of the building it shall be upon porcelain knobs, in molding or in conduit. Where water pipes are not available, a metal plate or driven pipe shall be used.

Connection to water piping and to driven pipe shall be made through an approved ground-connecting clamp after all rust and scale have been removed, or by soldering into a brass plug which has been screwed into a pipe fitting, or where the pipes are cast iron, into the pipe itself.

Connection to a grounded railway return shall be made by means of a bolt or rivet passing through a rail, holding the wire mechanically tight, after which the rail, bolt and wire shall be carefully soldered together and the joint painted with waterproof paint or equivalent. When a railway return circuit is used for a ground connection to a transformer, or to a bank of transformers where the secondaries are interconnected, or to a secondary main, the use of more than one ground is prohibited.

When a ground plate is used it shall consist of a No. 16 Stubb's gage copper plate with an area (one side) of never less than 10 square feet, and must be increased proportionately when the capacity of the generator or transformer to which it is directly connected exceeds 500 amp; about 2 ft. of crushed coke or charcoal about pea size shall be placed both under and over it; or in place of copper a cast-iron plate of approximately the same area and at least ½ in. thick may be used. The joint between the plate and the ground wire should in all cases be soldered and thoroughly protected against corrosion by waterproof paint or some equivalent.

When driven pipes are used they shall be of iron and not less than 1 in. in diameter, preferably larger. When used for the ground connections of central and substations, and for a number of transformers, the area of the driven portion of the pipe must never be less than 20 square feet and must be increased proportionately when the capacity of the generator or transformer to which it is directly connected exceeds 500 amp.

When used for the ground connection of individual services or for single transformers, the conductivity of the ground must be tested by blowing a 2-amp fuse at 110 volts, and the number, size or length of pipes increased until this occurs, when connection is made between the ground and a neighboring ground of any kind; or this test may be made by blowing the primary fuse in the transformer at the primary voltage.

In central and substations and transformer installations of large size, it is recommended that more than one ground wire be used, and that if ground plates or driven pipes are depended upon, the area be materially increased.

The requirement of 20 sq. ft. of surface area for a pipe ground appears impracticable under ordinary circumstances, as it calls for a length of 58 ft. of 1-in., 40 ft. of 1½-in., or 32 ft. of 2-in. pipe.

Electrically Operated Switchboard—III.

By S. Q. Hayes.

ELECTRICALLY-OPERATED CARBON CIRCUIT-BREAKERS.

In a power plant where generators, transformers and alternating-current feeder circuits are controlled by electrically-operated oil circuit-breakers, it is sometimes desirable to extend the electrical operation to the exciter circuits and to provide solenoid-operated carbon circuit-breakers for their control. Fig. 1 shows two 800-ampere, 250-volt, three-pole, carbon circuit-breakers for this class of service. These circuit-breakers are provided with signal switches to operate indicating lamps on the switchboard.

For large rotary-converters or direct-current generators, it is sometimes advisable to install electrically-operated, carbon circuit-breakers. Fig. 2 shows a 4000-ampere, 750-volt, single-pole circuit-breaker with solenoid operation and signal switch. The general design of the circuit-breaker, which is a modification of a hand-operated circuit-breaker that has been on the market for many years, is clearly shown in the engraving.

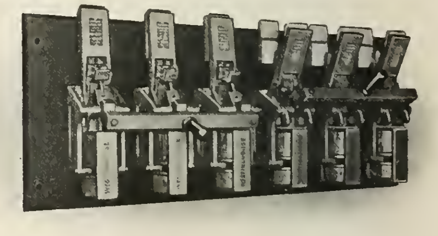


FIG. 1.—THREE-POLE CIRCUIT-BREAKERS.

These carbon circuit-breakers can, of course, be used on low-voltage, alternating-current circuits of large output, and these, as well as the oil circuit-breakers, can be provided with suitable relays to meet overload, underload, no voltage, reverse power or other conditions, and such relays can have instantaneous release, definite time limit, inverse time limit or other desired features.

While different engineers have their own ideas regarding automatic or non-automatic circuit-breakers for various circuits, the following practice is nearly standard:

No fuses or other automatic protection are provided for exciter circuits, as the sudden opening of the field coil circuit of an alternator due to the blowing of a fuse in the exciter circuit or the tripping of an exciter circuit-breaker is apt to injure the insulation of the alternator and cause far greater damage to the plant and involve a larger expense than the overloading or short circuit of an exciter. In a few very large installations with exciters operating in multiple with each other or a storage battery, reverse power circuit-breakers are used to cut out a damaged exciter. Where exciters are used to supply energy both to a field bus and to a direct-current station bus feeding lamps and motors, fuses or circuit-breakers are sometimes supplied to disconnect the exciter from the station bus in case of trouble, while still leaving it connected to the field bus.

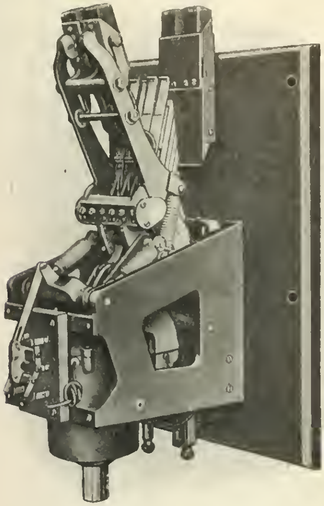


FIG. 2.—SINGLE-POLE CIRCUIT-BREAKER.

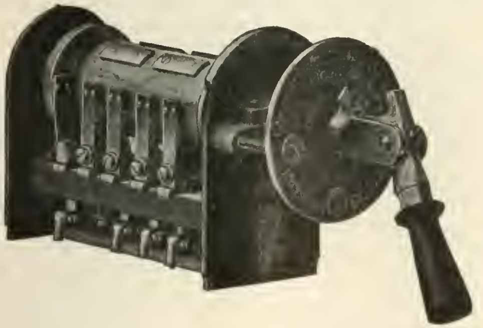


FIG. 3.—CONTROLLING SWITCH FOR AUXILIARY APPARATUS.

As a rule, no automatic protection is supplied either in the field or armature circuits of alternators. The protection is omitted from the field-coil circuits for the same reasons as it is left out of exciter circuits; namely, to prevent the sudden opening of the field-coil circuit by the blowing of a fuse or the tripping of a circuit-breaker. The protection is omitted from the armature circuit of alternators for the reason that most modern machines have sufficient armature reaction to enable them to stand a temporary short-circuit without damage, and for this reason protection is not necessary. Such protection is, moreover, considered a positive disadvantage when synchronizing, for if two machines are thrown together somewhat out of step there will be a passage of energy from the leading to the lagging machine that will pull them into step without damage; but this, added to that which the loaded machine is already carrying, is very apt to blow fuses or trip circuit-breakers.

In some large plants the generator circuit-breakers are made non-automatic on overload, but provided with a reverse-power relay that will trip the circuit-breaker if the generator should receive energy from the busbar for an appreciable length of time. Occasionally these reverse-power relays instead of tripping the circuit-breaker will light a lamp or operate some other signal device that will call the attention of the station operator to the abnormal condition, and it is left to his judgment to adjust the governor, cut out the generator or take whatever steps may seem necessary.

Feeder circuits, as well as the low-tension side of the step-up transformers or the high-tension side of step-down transformers, are usually provided with automatic circuit-breakers, while tie circuit-breakers and those used for the secondary-side of transformers are normally non-automatic. These latter, however, are sometimes provided with a reverse-power relay or a differential relay that will operate in case of a local short circuit in the transformer to cut off both the high-tension and the low-tension circuit-breakers.

ELECTRICALLY-OPERATED FIELD SWITCHES.

Two-pole solenoid-operated field switches are installed and these are provided with auxiliary contacts for cutting in a discharge resistance just before opening the field circuit. No signal switch is ordinarily provided with the field switch as the field ammeter will show whether the switch is open or closed.

ELECTRICALLY-OPERATED FIELD RHEOSTAT.

Field rheostats may be motor-operated and the face-plate provided with a clutch so that in case of trouble to the motor the face-plate may be operated by hand after disengaging the clutch. With this face-plate, a signal switch is provided to actuate a lamp on the switchboard when the arm is bridging two contacts. This face-plate is also provided with a limit switch that opens the motor circuit when the arm has reached the limit of its travel in either direction and the connections are so made that while the motor can no longer be operated in one direction it can be run in the opposite direction.

AUXILIARY APPARATUS.

For the operation of the various circuit-breakers, field switches, etc., a controlling switch similar to that shown in Fig. 3 is supplied. The operating handle and dial are mounted on the front of the switchboard, while the contacts are placed back of the board and are made part of a drum-type controller. This construction removes even the direct-current operating voltage from the front of the board and readily adapts itself for use on 550-volt control circuits. This particular control switch is intended for use with oil circuit-breakers and the handle is so designed that after turning to the trip position it can be lifted to stand at right angles to the plane of the dial plate when a circuit is to be cut out of service for any length of time. In this position all the indicating lamps are disconnected. For use with this controller an electro-mechanical indicator or lamp indicators with colored prisms are supplied.

For making the connections from the controllers to the circuit-breakers, field switches, field rheostats, etc., and from the instruments and relays to the series and shunt transformers, multiple cable is used and this is ordinarily provided with vari-colored braids for the different cables and the assembled cables given a lead or fireproof covering. Such cables are usually installed in conduits, having a nominal diameter of about 1¼ in.

The various other details, such as disconnecting switches, busbars, supports, etc., will be treated in a subsequent article.

The Use of Direct-Current Portable Testing Instruments.

By E. P. Peck.

PORTABLE instruments when used for testing are commonly relied on to give results well within 1 per cent, and many persons rely on them to 1/5 per cent, as some makers guarantee their meters to that accuracy. While there is no doubt that meters come within their guarantee when new and used under the proper conditions, still there are so many conditions that affect the accuracy of results that such accuracy is too much to expect, unless the user knows the causes of error and how to guard against them. Even then, there may be some influence which has been overlooked. When making efficiency tests and meter tests, too much care cannot be exercised to remove all disturbing influences before taking readings.

It has been found that tests made with instruments calibrated specially for the purpose are often so far from what is expected that a re-test is made, though the instruments check O. K. The second test may give proper results when the first was in error several per cent. There is no doubt that if all disturbing influences had been known and provided for that the first test would have been correct. For this reason, no engineer can know too much about portable testing instruments, though their use seems very simple.

The errors in direct-current meters may in general be divided into four classes:

1. Errors in the standards used when calibrating the meter; 2. Inherent defects in the meter, and external influences; 3. Reading errors; 4. Errors due to age or hard usage.

The first class of errors may be kept quite small by using very accurate standards, and spending a large amount of time and work in keeping them up to their highest accuracy and determining any error as soon as it is manifested. In many checks made this is the most important error to be guarded against, for portable instruments are often used as standards for checking other instruments when they have not been checked in months themselves and they may be in error several per cent.

The second class of errors depends primarily on the construction of the individual instrument. These errors vary largely with different instruments, and in a given instrument are different in different portions of the scale, and under different conditions of external influence. Stray magnetic fields have a large effect on unprotected meters of the usual type. We have found errors greater than 5 per cent caused by stray fields in a central station.

These fields are produced by wires carrying current as well as by machinery. When making tests in which large currents are used, the leads to ammeters and wattmeters should be arranged so that they do not influence the readings. Meter testers are often careless in this regard and allow a loop to form in their leads near the meter which may cause large errors in their results.

A meter should never be placed on or near a piece of iron when in use, for the magnetic lines are shunted around the armature and cause the meter to read low. A magnet placed near a meter may cause it to read either high or low, depending on the way it is placed. Therefore, two meters should *never* be placed side by side when in use.

When it is necessary to use a meter where there are external magnetic fields, the average of two readings taken in quick succession with the meter rotated 180 deg. between readings may be used. A position may be found so that the meter reads the same when reversed; in this case it is not necessary to change the meter.

Some types of meters are free from errors due to stray magnetic fields, and any meter is practically free from them if in an iron case. Therefore, switchboard meters as generally built are not appreciably affected.

Changes in temperature cause several different effects in meters. A voltmeter is only slightly affected by changes in temperature, for almost the whole resistance of the meter is made of wire in which the temperature co-efficient is negligible, and the resistance of the copper moving coil is so small that a change of 5 per cent in its resistance is an extremely small per cent of the total meter resistance. There is no appreciable heating due to the energy used in the meter, as it is usually not over 1.5 watts in a 150-volt meter, and the radiating surface is so great that the temperature rise is not noticeable. On account of the very small current used, voltmeters are not liable to errors due to the springs being annealed.

Self-contained ammeters—that is, ammeters in which the shunt is made in the meter case—are free from errors due to changes in room temperature, provided the meter has had time to assume the same temperature throughout its whole mass. The moving coil, adjusting resistance, and shunt, in this type of meter, are usually made of copper, and an equal change in temperature produces the same proportional change in resistance in each part of the circuit, causing the proportion of the current taken by the meter element to be the same.

On account of all the conductors in the meter being copper, thermo-electric currents do not usually cause a noticeable error unless one of the current-carrying leads makes very poor contact with one binding post. This will cause one post to heat more than the rest of the meter, and set up thermo-electric currents which may cause a very appreciable error in a meter for medium currents.

Self-contained meters of a size much over 50 amperes are accurate only when in the circuit a very few minutes. In the case of a 150-ampere ammeter, the error became 3.5 per cent in 30 minutes, the meter reading high. This is due to the copper shunt heating under load, to a higher temperature than the moving coil, and the increased resistance due to this heat caused a greater voltage drop across the meter element. It is very often that a meter of this size or even larger is put in circuit and readings taken for several hours, when the meter after the first 5 or 10 minutes has greatly exceeded the allowable error for close work. In case it is necessary to use a meter this way, it should be short-circuited by a switch, which should be open only when actually taking readings.

A millivoltmeter and shunt may be made practically free from errors due to heating by the current to be measured, for the shunt is made of a metal of low-temperature co-efficient, and the current carried by the meter is so small that it does not heat appreciably. In this class of meter the adjusting resistance in series with the moving coil has also a low-temperature co-efficient, and as a large part of the drop across the shunt is used in this resistance, a change in temperature of the whole meter does not affect the accuracy of the results nearly as much as it would if the resistance was of copper.

When using the millivoltmeter and shunt there are, however, two classes of errors to be looked for. One class is of errors due to bad contact of the millivoltmeter leads, and the other, bad contact of the main current-carrying leads. The first will cause the meter to read low. The second will give rise to thermo-electric currents which may cause the meter to read either low or high. In one case where one side of the shunt was noticeably warmer than the other, an error of 4 per cent was caused in this way. The results may be corrected for this error, as the reading of the meter immediately after the current is cut off gives the correction to be made. The only difficulty is to determine where the corrections should begin. It is manifestly unfair to correct the whole of a long series of readings for an error which was zero at first and rose gradually to a maximum, at which it remained. Therefore it is best to guard against this error by using leads of ample size and making good contacts.

The error due to stray fields should be specially guarded against when using the millivoltmeter and shunt, for these meters are used entirely for very heavy currents and chances of error are large.

A static charge on the glass, generated by rubbing to remove dust will cause the needle to deflect several divisions on many meters. So a meter should not be read immediately after rubbing unless the charge be removed, as may be done by touching the glass with the finger.

The third class of errors is kept small by using the greatest possible care in all readings that are taken. This applies to commercial work as well as the laboratory calibration of the instrument.

Some makers guarantee their meters to 1/5 per cent. If this was changed to 1/5 of a small division it would be better, for the meter is correct to 1/5 per cent of the actual reading only when used at or above 100 divisions. This may easily be seen, for a meter can hardly be read closer than 1/10 of a small division. Therefore when reading on the first long division, or reading 10 amperes on a 100-ampere meter, an error of 1 per cent cannot be detected. The Westinghouse Electric Company publishes a formula for its meters which shows the maximum error in any part of the scale. This takes into consideration the errors of standards used in checking the meter and the possible errors due to friction and in reading. Making the constants in this formula apply to the meters under discussion, it is $\frac{.1R + .1r}{r}$ = per cent accuracy, in which R is the full scale reading of the meter and r is the actual reading.

The first constant is taken as .1 because the reading and friction errors cannot be taken as less than that. The second constant is taken at .1 because the errors in standards and in readings due to variations in the current when checking make a smaller constant than this inadmissible unless more than ordinary care is used. Working this out for a meter with 150-scale divisions, it is seen that the probable errors in using a meter are as follows:

Divisions	150	100	50	10	5
Per cent, error	.2	.25	.4	1.6	3.1

From this it is seen that a meter should not be used below ⅓ of its scale, if an accuracy of over .4 per cent is expected. This class of error should be kept in mind when buying meters for a known service.

The effects of age and hard usage are shown in worn or broken jewels and pivots. If jewels are not perfect the meter will stick in any part of the scale, and will not indicate correctly. Slight tapping will improve the accuracy of the reading somewhat, as the jar enables the movement to reach its true position. This should not become a habit, however, for it is very hard on a good jewel and pivot. With some men the habit is so developed that they will tap a meter even when the pointer is moving smoothly and evenly, and indicating every change in voltage, even the pulsations due to the engine. The same men have been known to knock a moving element entirely out of its jewels in order to make it read when the current was too low to show on the meter.

Long use will often cause parts of the meter to work slightly loose and make small particles of dust and magnetic material to become loosened and block the delicate moving system. A blow or a strain of the metal case covering the instrument will prevent its fitting perfectly to the wooden base of the instrument. This allows small particles of dirt to enter the meter where they soon find their way into the very dense magnetic field in which the moving element works and causes the meter to stick.

A very severe blow may partly demagnetize the permanent magnets and cause the meter to read low. It is possible also for the magnets to be demagnetized by very strong fields due to alternating currents. A voltmeter which was placed near the alternating-current mains of a rotary converter was found to read 350 volts on a 600-volt circuit after a severe short circuit on the rotary. The meter was within 18 in. of the busbars and the alternating currents, probably several thousand amperes for an instant, demagnetized the magnets.

An overload, if severe, will bend the needle. This may be straightened and the meter put into as good shape as before—apparently. One change often takes place which cannot be seen, however. The springs which carry the current into the moving coil have become overheated and annealed. This will cause the meter to read high and may change the proportionality of the scale also. A meter should always be calibrated after being "knocked out."

It is hardly probable that all of the errors mentioned will exist in any one meter, and those present may group themselves so as to make the actual error much less than the sum of all errors would indicate. In most cases all of the errors together are not enough to affect the results excessively, but it is only by the exercise of great care that results may be *always* relied upon.

It must be understood that every part of this discussion does not apply to all classes of meters; but unless the characteristics of the meter used are well known it is best to eliminate the possibility of trouble.

Locating Grounds in Armature Coils.

By W. M. Hollis.

When, in making the usual routine tests of machines for grounds, the armature is found to be grounded, some difficulty may be experienced in locating the precise coil or coils thus affected. Preliminary tests are usually made with a voltmeter by obtaining the voltage across the mains and then the voltage when the voltmeter is connected across the mains and in series with the resistance between the armature wires and the armature core. If V is the voltage on the mains and V^1 is the voltage reading in the second instance; R being the voltmeter resistance and r the insulation resistance, then $r = (V \div V^1) \times R$ very nearly. However, the purpose of the test is merely to locate the ground if the insulation is low. If a bad ground exists and there is also a ground on the other side of the circuit the armature ground will probably manifest itself in the smoking or burning armature coil at the point where it is grounded on the core.

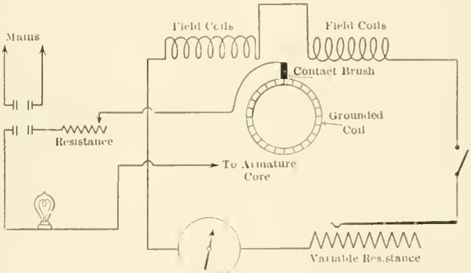


FIG. 1.—CONNECTIONS FOR LOCATING GROUNDED COIL.

If the point grounded cannot be discovered by inspection other means must be employed. One way is to wind a bare copper wire several times around the armature for an open coil armature as, for instance, with some kinds of arc light dynamos, or for an ordinary closed coil armature to use a single brush. One side of the testing main is connected to the brush through a resistance so as to limit the current and the other side of the main is connected to the core through a limiting resistance. The limiting resistances are used, at first, to prevent possible short circuits. In some cases where there are more than one form-wound coil in each slot, or where there are a number of layers of wires in the slots or on the armature core proper, there may be difficulty in finding which coil or turn of wire is grounded without removing the coils one at a time from the commutator segments.

A lamp bank may be used as a suitable limiting resistance, one line wire being connected to the commutator through the lamp bank and the other connected to the armature core. Then if the switches be closed and the resistance decreased, the fault may show up through a burning or smoking of the insulation at the point grounded. Care should, of course, be exercised not to use a greater voltage than necessary to show up the ground, so that unnecessary charring or burning of adjacent coils not grounded may be avoided. If a coil is badly grounded it will have to be replaced, and if there is no damage to adjacent coils the replacing of one coil is not very difficult. No definite statement can, however, be made to apply to all cases, as there are so many different forms of armature windings from the larger machines having two insulated formed coils in each slot where one coil may be replaced without disturbing many of the others, to some of the smaller machines where several coils or many turns are placed in a slot and where a grounded or burned-out coil may make it necessary to take out and replace many of the armature coils. Beyond outlining the method of testing in a general way, the winding will vary considerably in amount for different machines.

If lamps are used as a series resistance and two 110-volt lamps are used in multiple for each 100 volts of the testing voltage to start with, the maximum current possible would be one ampere even with a completely grounded coil, each lamp alone consuming approximately one-half ampere on 100 volts.

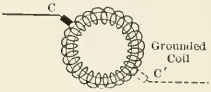


FIG. 2.—APPLICATION OF EXPLORING BRUSH.

Then with these pairs of lamps in series the voltage between the armature coil and the core may be increased in steps of 100 volts by using a proper switching device or by short-circuiting the pairs of lamps until the grounded coil smokes or burns.

Where the tests show that there is a definite ground between the armature coils and the core and where the fault cannot be located by using the testing voltages at hand, another method for finding the defective coil without removing all the leads from the commutator may be used. Where one has the facilities of a laboratory at hand or a sensitive galvanometer, the defective coil may be located with certainty. In place of this, however, satisfactory results can be obtained by using a modified millivoltmeter or a sensitive instrument made from a compass or magnetized needle or small light pieces of steel suitably mounted and surrounded or placed close to a coil having many turns of fine wire. Referring to Fig. 1 the grounded coil is attached to the commutator segment indicated. A contact brush adapted to be moved around the commutator so as to make contact with the segments one after the other is also shown. The galvanometer is shown connected across the field coils in series with a variable resistance and switch. One line is connected from the mains to the armature core through a lamp and the other line is connected to the contact brush through a variable resistance. In starting the test, a high resistance should be connected in both circuits, as the test is a somewhat delicate one and the galvanometer in order to operate correctly must be very sensitive. Referring to the illustration the circuit from the testing mains is made through the contact brush to the commutating segment, thence through the armature coils, one after the other, until the grounded one is reached, when the current passes to the armature core, and thence to the other side of the testing mains. Inasmuch as the galvanometer is in a circuit which includes the field coils of the machine, and there is an inductive relation between the two circuits, if the armature circuit is opened and closed by means of a switch, the current in these coils sets up a magnetic flux in the armature core which then acts upon and sets up a flux in or magnetizes the field cores and this flux in turn sets up an electromotive force in the field coils which sends a current through the indicating instrument. The action is somewhat similar to that between the primary and secondary coils of a transformer and the quicker the make or break of the armature circuit is made the greater will be the effect upon the indicator. The contact breaker may be made to touch the commutator segments one after the other by moving the armature, and the number of armature coils in series between the brush and the grounded coil decreases until the brush rests upon the commutator segment connected to the grounded coil, when there will be no turns in series or at least a minimum number of turns depending upon the armature turns connected to each commutator segment.

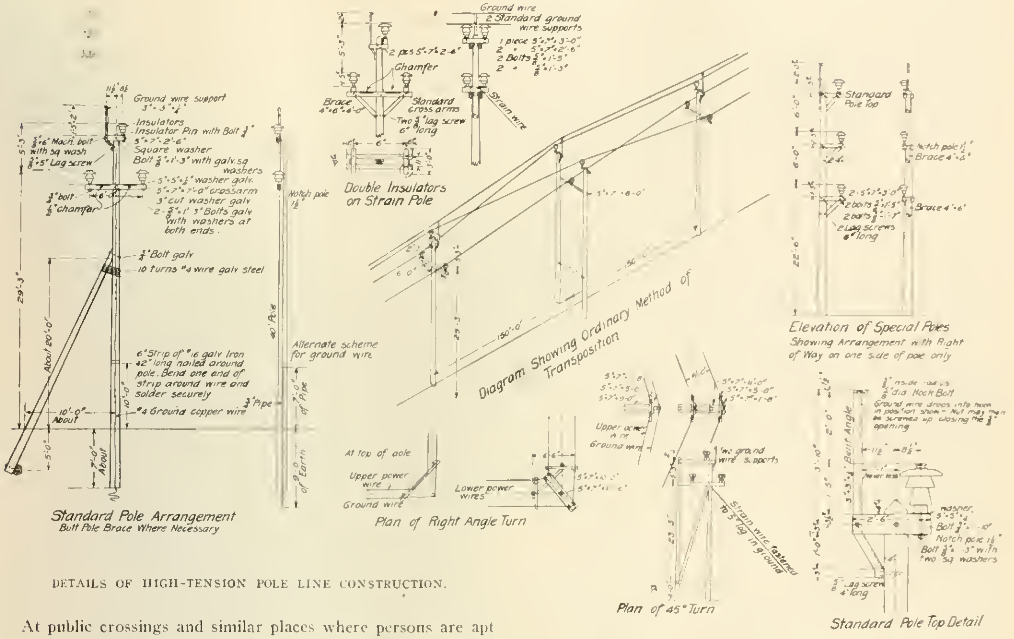
The switch should be opened and closed and the throw of the galvanometer noted each time the contact brush is changed to another segment until a minimum deflection is indicated. The defective or grounded coil is the one upon which the contact coil rests when there is a minimum deflection when the testing circuit is opened and closed suddenly. Fig. 2 shows the position of the contact brush *C* when there will be the large deflection of the galvanometer needle, as there are many armature turns in series between it and the grounded coil. C' shows the position of the brush when there will be a minimum throw of the galvanometer needle and when the brush is in contact with the commutator segment connected to the grounded armature coil. These tests should, of course, be carefully made at first, because the kick or induced voltage in the field will vary widely for different types of machines, with the current used in the armature coils, and with the position of the contact brush with reference to the grounded coil. It is best to start with a very low and steady current through the circuit containing the armature coils and to use a spark gap between needle points in the field circuit, in order to determine whether the voltage induced is likely to be very high. With a gap one-quarter of an inch between needle points a voltage of 5000 or more will jump across the points. After this precaution has been taken to avoid any chance of injury to the galvanometer a high reading voltmeter may be tried, and the armature current or voltage adjusted until a suitable deflection is obtained. If there is a complete ground, the circuit could probably be adjusted so that an ordinary voltmeter may be used; but if the insulation resistance is very low a millivoltmeter or a galvanometer may be required, with the proper arrangement of series resistances or shunts ordinarily used for safe-guarding them.

High-Tension Transmission Line Construction.

The Buffalo, Lockport & Rochester Railway Company's line between Buffalo and Rochester, N. Y., which is now nearing completion embodies in its construction some interesting high-tension transmission line work. The company will use energy from Niagara Falls over the lines of the Niagara, Lockport & Ontario Power Company. The 60,000-volt, three-phase, 25-cycle lines of the latter company will be tapped at Lockport and at South Greece. The substation at South Greece is already connected by a 3-mile run to the transmission company's lines and the railway company has erected a wooden pole line 60 miles long between South Greece and Lockport. This pole line is on private right of way with detours to all villages along the route and presents several interesting features. There are five substations along the route, situated at Gasport, Medina, Albion, Brockport and at South Greece. The substations are all of uniform design and size and will each house ultimately three 400-kw synchronous converters with the usual transformer and switching equipment.

Standard 40-ft. poles are used and the high-tension wires are carried on four-part insulators tested to withstand a tension of 150,000 volts for five minutes. The insulators are mounted on iron pins and have a separable thimble cemented into them for convenience in removing the insulator from the pin if necessary. The insulators for the lower wires are mounted as shown in the engraving on standard 7-ft. cross-arms and are spaced 6-ft. centers; the upper insulator is placed on a 2-ft. cross-arm, to which is also attached the ground wire support. Most of the cross-arms are void of braces, the lower arm being secured to the pole by two ⅝-in. through bolts and the upper arm by a single ⅝-in. bolt and the lower portion of the bent angle iron support for the aerial grounding wire. The latter is of tough phono-electric material and is grounded at every fourth pole.

The grounding wire is carried about 20 in. to one side of the upper high-tension wire and 2 ft. above it, as shown in the detail drawing of this portion of the pole.



DETAILS OF HIGH-TENSION POLE LINE CONSTRUCTION.

At public crossings and similar places where persons are apt to touch the high-tension poles, a 6-in. galvanized iron grounding strip is placed on the pole about 10 ft. above the ground. This trip is wound around the pole and also soldered to the ground wire, so that for a distance of 10 ft. above the ground a person touching the pole, even though the conditions were such that leakage was excessive, would be immune from shock. Where necessary butt-bracing is adopted in preference to guying.

Where detours had to be made around towns along the border of one property over which right of way was secured, a novel variation in the pole line construction was required in order to avoid trespass on adjoining property. In this case each high-tension wire is carried on one side of the pole on separate wooden cross-arms, while the grounding wire is carried on a straight angle iron support screwed to one side of the pole. To avoid disturbing the telephone circuits on the opposite pole line the high-tension wires are transposed between each substation and the telephone wires are transposed every fourth pole, or every 440 ft. The method of making the high-tension transposition is clearly shown in the engraving. The method of making right-angle turns and 45-deg. turns is shown also.

Automatic Damper Regulators II.

By W. H. Wakeman.

In a previous article dealing with this subject, a number of regulators were described. All of them except one were operated by steam pressure, and in the one either steam or water was applicable. Fig 1 illustrates a regulator that is operated by water pressure alone, although the steam pressure indicates the time when changes in its position shall take place. Boiler pressure is available in the pipe 2, but it is arranged so that it is always full of cold water, as heat is not wanted here. This pressure is always acting on the diaphragm 3, but so long as it is less than the maximum desired, the lever 4 remains in its lowest position.

The maximum working pressure is determined by the number of weights on the end of this lever, and the position of the smaller weight on it. As the boiler pressure approaches the limit it acts on the diaphragm 3 and raises the lever 4, opening the pilot valve 5. This action admits water under pressure through the pipe 6, the sediment chamber 7 and the connecting pipe to 5, and thence through another pipe to the cylinder 8, in which is a leather-packed piston. Water pressure forces this piston upward and allows a weight on the lever

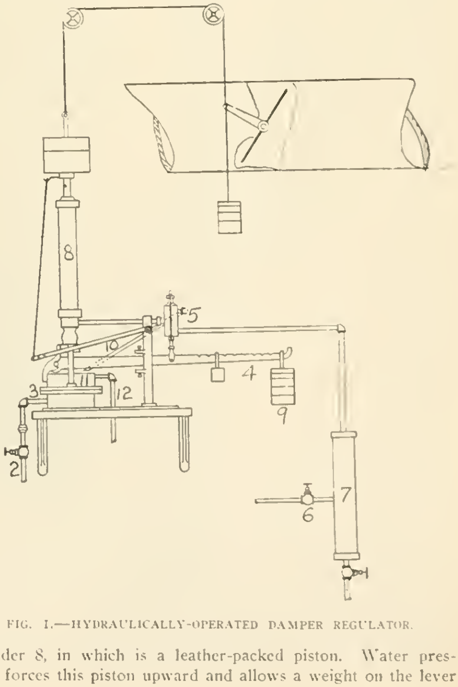


FIG. 1.—HYDRAULICALLY-OPERATED DAMPER REGULATOR.

to close the damper. When the pressure falls about 1 lb. the weights 9 force the lever 4 downward. This action closes the pilot valve 5, opens another passage to the waste pipe 10, releasing water from the cylinder 8 and allowing it to flow into 11, and thence through 12 to the sewer. As there is nothing to support the piston in the cylinder, the weights above it (also its own weight), force it downward and open the damper through the connections shown.

The stroke of the piston in 8 is more than 12 in. long, and as the water flows into it through a small pipe it closes the damper slowly. If the fire is in good order and the load is about equal to the capacity of the boiler, the piston may go up perhaps one-half of its stroke, then as the fire is checked, the pressure falls 1 lb. and this causes the piston to reverse its motion and open the damper. On the other hand, pressure may be high enough to close the damper until it falls 1 lb., then the piston begins to move downward, but before its stroke is completed the pressure may rise 1 lb. and result in closing the damper again.

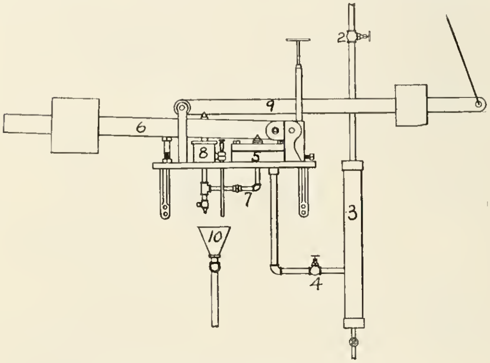


FIG. 2.—REGULATOR WITH COMPOUND LEVER DEVICE.

This plan of operation is favored by engineers who are contented with a slow fire, provided it maintains the required boiler pressure, and it certainly is a very pleasing movement. As a general rule, this regulator will open a damper wide and then close it tight before its motion is reversed, but even then it is a comparatively slow process.

One of these regulators has been in use for nearly 14 years without repairs except a new leather packing for the piston once in two or three years, costing only a few cents. It operates two large dampers for two batteries of boilers, and this calls attention to the fact that two regulators might have been installed, one for each battery, but the objection to this plan is as follows: The difficulty of adjusting two regulators to operate exactly alike and the improbability of their remaining alike in every-day practice will be apparent to all practical men; therefore when steam pressure is below the limit both will be open, but when the maximum is secured, one will close and shut off the draft from one battery, while the others remain open and causes that battery to do all of the work. The same principle causes one to open in advance of the other and force the fires to which it is connected, while the others remain dormant. Where both dampers are connected to one regulator the draft remains the same on all of them at all times so far as the dampers are concerned.

It frequently happens that one fire is in better condition than the others, hence those that need building-up ought to have more draft on than those which are clean and well ignited. On this account the idea of providing a regulator for each boiler has been advanced; but while it may not be impossible to do this, it is not practicable, because all are connected to the same steam main, hence the pressure in them will not vary with the condition of the fires. When a practical way of regulating the draft for each boiler of a battery according to the condition of the fire is found, it will be a good idea to provide a regulator for each boiler. There should always be a hand-operated damper for every boiler, thus enabling the fireman to shut off one whenever it is required.

Fig. 2 is a regulator that is fitted with a compound lever device, which is an interesting feature. Steam is admitted by the valve 2 to the condensing chamber 3, for only water under boiler pressure is wanted to operate the regulator. If it is more convenient to make a connection into the boiler at a point below the water line, the regulator will work just as well and there will be less heat to dispose of than where steam must be condensed. Pressure is communicated from 3 through 4 to the diaphragm 5. As the limit of pressure is secured, the lever 6 rises and opens a valve that admits pressure from 5 through 7 to 8 and this raises the lever 9, closing the damper until pressure falls about 1 lb., when the process is reversed so far as the levers are concerned, and the damper opens. The water used is discharged into the funnel 10 and carried to the sewer. Where it is desired to be very economical in the use of water, it can be saved and pumped into the boiler again, but the amount is so small in a case like this that it does not pay to save it.

Fig. 3 illustrates a very good regulator attached to a damper in regular service. Boiler pressure is admitted through the cock 2 and is transmitted to the diaphragm 3, and when the limit is reached it raises the weighted lever 4, at the outer end of which a small lever is attached. The other end of this lever is attached to the stationary arm 5, hence when the outer end is carried upward by the boiler pressure the valve stem 6 is raised and this admits water to the cylinder 7 from the pipe 8 through the lubricator 9 and the connecting pipe 10. As the piston in 7 is forced upward by the water pressure, which ought to be 30 lb. or more per square inch, it raises the lever 11 and this action allows the damper to close until the pressure falls about ½ lb., when the action is reversed and the damper closes.

This regulator is positive in both directions, hence if it is located so that a rigid connection can be made to the damper, weights on the damper lever are not necessary. If it is not convenient to use water at 30 lb. or more, or if it cannot be secured at this pressure from the street main, it may be taken from the boiler below the water line. In this case about 75 ft. of ¾-in. pipe ought to be used, in order to give the hot water a chance to cool before it goes into the damper cylinder, as it is designed for cold water only. When fitted in this way a man of ordinary weight, say 175 lb., can put his entire weight on the lever 11 and it will easily raise him. The lubricator is fitted with a large plug that can be taken out with a monkey wrench. The inner face of this is fitted with a receptacle for holding a piece of soap. As the water passes over this soap it is slowly dissolved and acts as a lubricant to every part with which it comes in contact. This lubricator also acts as a sediment chamber, hence it is fitted with a blow-off valve 12 at the bottom, as indicated in the engraving.

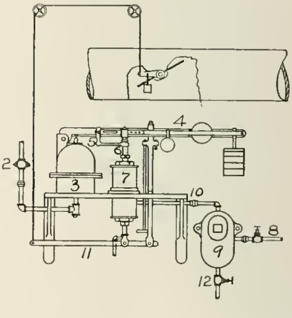


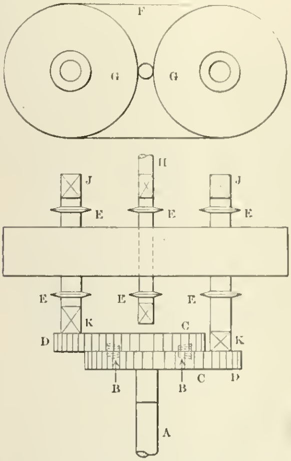
FIG. 3.—REGULATOR ATTACHED TO DAMPER.

LETTERS ON PRACTICAL SUBJECTS

HIGH-SPEED, HIGH-RATIO TRANSMISSION.

The steam turbine has led to the development of a great deal of very high-speed machinery and the experimenter is often confronted with the problem of transmitting power from high speeds to low and vice versa.

The accompanying sketch shows a simple, compact and inexpensive means of doing this with moderate powers. *A* is the slow-speed shaft which drives through the differential bevel gears *B B*, two spur gears *C C*, which should preferably be made of fiber or rawhide. Pinions *D D*, driven by *C C*, are mounted on two parallel shafts which carry friction wheels *G G* which must be well balanced and as light as possible. Aluminum is a good material for them. They should be very slightly crowned. *F* is a belt which pulls *G* and *G* together and causes friction enough to drive the high-speed shaft *H*. The bearings *K* and *K* should have ball seats and the bearings *J J* should be mounted on slides so as to be free to move toward and away from each other; but the motion will be small. Provision should be made for adjusting the distance between *K* and *K*. *E E E*, etc., are oil slingers which keep the wheels *G G* free from oil. It will be seen that shaft *H* is driven without causing any side pressures which the high-speed bearings will not be able to take care of. Of course helical gearing will do better than this arrangement, but such gearing is very expensive and there are only one or two shops that are capable of cutting them with the extreme accuracy required. The helical gearing is also very easily damaged by lack of oil.



HIGH-SPEED, HIGH-RATIO TRANSMISSION.

This apparatus is especially suitable for driving the high-frequency generator for wireless telegraphy described in the April number.

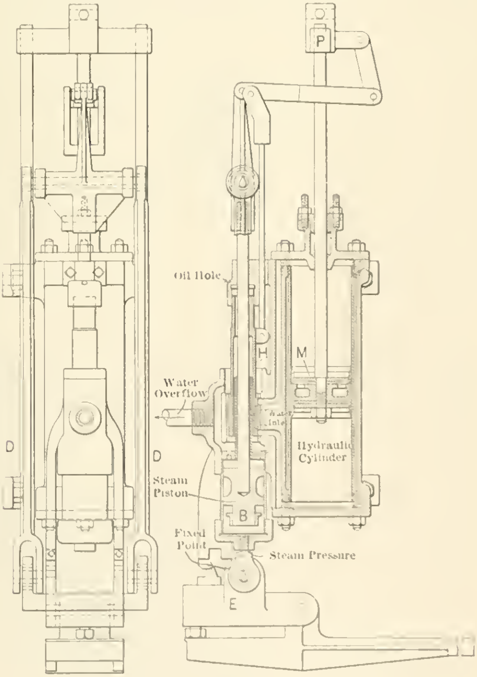
Swissvale, Pa. A. T. Kasley

AUTOMATIC DRAFT REGULATION.

The May number contains an article by Mr. Wakeman on automatic damper regulators, and inasmuch as the article is confined to that class of regulators that can be called "full throw machines," it might be well to call attention to certain phases of damper regulation in connection with automatic stokers. The wide use of automatic stokers makes the subject of automatic draft regulation of increasing importance, and from a theoretical standpoint an ideal condition can be obtained if in conjunction with the automatic feed of the furnace there could be combined the automatic control of the air supply.

An automatic stoker is primarily a continuously operating device which is set to operate at a certain speed, being driven by some form of engine or motor. This condition holds until there is some change in the steam demand, when the operating fireman throttles the engine or manipulates the speed control so as to increase or diminish the fuel fed, in accordance with requirements. The fireman is advised of the increasing steam demand by the lessening boiler pressure, as shown by the gage, and he then increases the speed of the stoker. Conversely, if some unit is cut out, the steam pressure rises, and the fireman then slows down the stoker. It follows, therefore, that regulation follows the change of requirement, and the greater the volume of water contained in the boiler, or the more sudden the fluctuation, the farther behind is the adjustment. It would appear, then, that if the fireman could make the necessary adjustment the instant the steam pressure falls ¼ lb., instead of a pound or two, which is usually the minimum amount observable on the gage, that he would be just that much farther ahead, and would catch up or slack off before the steam had varied as much as under the other conditions.

Leaving this consideration for a moment, another essential governing satisfactory draft control must be considered. When the intelligent fireman notices the steam pressure falling, he knows that it is probably due to a temporary or slight increase in the load, and would not think of putting on full power, but slightly increases the speed of the stoker and opens the damper a little, just about to compensate for this slight increase. He would not think of absolutely closing the damper if the steam should rise a little, nor would he throw it wide open if the steam should drop a little. With automatic stoking this kind of extreme fluctuation is always to be avoided, and the value of steadiness of operation is well understood by stoker firemen.



STOKER AND DAMPER REGULATOR

One can hardly conceive of any machine anticipating the requirements of the boiler and opening the dampers or closing them before the demand for harder or easier firing occurs. Eliminating this impossibility, therefore, the ideal condition is approached when a machine is obtained so sensitive that it will act upon a boiler pressure variation of a small fraction of a pound and, as the steam pressure varies, following it up closely by gradual changes in direct harmony and proportion with the requirements. This ideal draft regulation is always just enough to burn the coal required to generate a given pressure and is never more than this. A machine of this nature is shown herewith. A hydraulic cylinder has a leather-packed piston *M*, and crosshead *P*. A pilot valve *H* is attached to the crosshead by the system of levers shown. Lever *E* carries a weight which counterbalances the steam pressure on the under side of the steam piston *B*. The line connecting the center of gravity of the weight, and the fulcrum being at an angle to the horizontal, it follows that as this weight swings upward it also swings outward, increasing the leverage and compensating for the increase of steam pressure on the under side of the steam piston. An adjustment of this nature compensates for small increases of steam pressure, so that the machine operates upon a variation of pressure sufficient to overcome the internal friction. As this is very small, the machine practically operates with the slightest variation of the pressure. An increase of steam pressure raises the steam piston *B* and the counterweight. As the counterweight moves upward and outward, it reaches a state of equilibrium as soon as the increasing leverage equals the increase of steam pressure. This opens the ports admitting water from an independent source to one side of the hydraulic piston, and permitting the escape of the water on the other side. The movement of the piston being connected to the damper, and to the throttle valve of the engine controlling the speed of the stokers, increases or decreases the speed of fuel feed and the intensity of the draft correspondingly. A further slight increase or decrease of the steam pressure causes another slight motion of the hydraulic piston, which in this way very closely follows the variations of the steam pressure. The extreme travel of the piston is sufficient practically to close the damper, and slow the drive engine to a point where it just turns over, and the other extreme is sufficient to open the damper wide and run the drive engine at full speed. This machine, when once set to fit the conditions of coal and draft, will take care of the stokers without any adjustment whatever on the part of the operating fireman, and preserves the conditions of gradual changes without extreme fluctuations, which are so necessary to correct stoker operation.

Chicago, Ill. Joseph Harrington.

MAGNETIC VARIATIONS AND DEAD POINTS IN MOTORS.

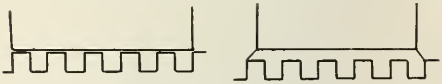
It occasionally happens in the operation of a motor that, while the machine may give satisfactory service when running, there are positions of the armature which do not give a strong starting torque and may even cause the machine to fail to start. Dead points at starting may occur with either direct or alternating-current motors and may be eliminated in both types by essentially the same method.

In the following discussion will be taken up some of the elements of design and construction which tend to cause dead points, and also the effect of these same elements on the general operation of the machine.

The general condition which may be set down as the prime cause of dead points is that of variable reluctance of the magnetic circuit with different positions of the armature. If any machine has this defect to any marked extent the armature will be held in the position of minimum reluctance by a force represented by the formula $F = \frac{(B - B')^2 A}{25.3}$, where B and B' are, respectively, the maximum and minimum values of the magnetic density, and A is the tooth area under the poles. In many cases when the unexcited armature is placed in a strongly magnetized field, the armature will resist turning by hand and when forced out of its initial position it will tend either to return to it or move to another giving the same magnetic effect.

A little consideration will make it clear that for direct-current machinery the slot-pitch and polar-arc should be so chosen that the effective arc divided by the slot-pitch will be an integer. An inspection of Fig. 1 makes evident the truth of this statement, as it shows that the number of teeth under one pole, and consequently the effective area for carrying the flux, is constant for all positions of the armature. This is on the assumption that the flux does not cover a longer arc than the pole. The condition which exists in actual practice is that the flux spreads at the pole-tips a greater or less amount, depending upon the shape of the tip, the length of the air-gap, and the slot-pitch. Under ordinary conditions the spread may be taken as about twice the air-gap, so the effective polar-arc must be considered as shown in Fig. 2. If the poles are specially shaped to give a commutating field, the maximum effective arc should be considered in determining the ratio of slot-pitch and magnetic arc.

In small motors, where the number of slots on the armature is small, the slots are sometimes cut spirally. If the pitch of the spiral is such that the slots have a lead at one end of the armature of at least one-half of the slot-pitch over the other ends, the tooth area under the effective pole will be constant whether or not the ratio of the slot-pitch to the effective polar-arc is an integer. The spiral slots may also be advantageous in making possible sparkless commutation, by providing gradual exit of the coils from the field which may not have a good commutating fringe. Shaping the pole pieces so the field gradually diminishes in intensity from the center to the edges will tend to diminish any variation in the magnetism due to changes in tooth area under the effective pole, while a design which gives a fairly uniform distribution will increase the variation.



FIGS. 1 AND 2.—RELATIONS BETWEEN POLE-PITCH AND SLOT-PITCH WITH EXTREMELY SMALL AIR-GAP AND WITH AIR-GAP OF ORDINARY PROPORTIONS.

In alternating-current motors of the induction type, the primary winding is ordinarily distributed in slots throughout the entire circumference of the core and consequently each polar-arc is broken up by the slots for coils of other phases. The polar-area is, however, the area included by one group of coils, and the polar-arc is the arc spanned by a single group of coils. In order that the magnetic reluctance shall be the same for all positions of the rotor, the effective tooth-area per pole on the stator must register with a tooth-area on the rotor, which is practically constant. One very obvious method of securing this result is to make the rotor without slots, but as this would necessitate the use of a sheet conductor and consequently an increased air-gap, it is common practice to make the number of slots on rotor prime to the number per pole or per phase on the primary. If n is the quotient obtained by dividing the primary pole-pitch by the slot-pitch and $(n + 1)$ is the quotient of the primary pole-pitch and the secondary slot-pitch, the distance which the rotor will move in passing from a position of initial reluctance to another position of equal reluctance is $\left(\frac{1}{n} - \frac{1}{n+1}\right) \times \text{pole-pitch} = \frac{1}{n(n+1)} \times \text{pole-pitch}$. If the number of slots per phase per pole is the basis taken, the distance passed over is $\frac{1}{n(n+1)} \times \frac{\text{pole pitch}}{k}$, where k is the number of phases.

The frequency of the variation of the reluctance is equal to the peripheral speed of the rotor in feet per second divided by the distance passed through in one cycle, expressed in the same units, as given above. In direct-current machines, the frequency of the magnetic variation is expressed in the same way, providing the mechanical spacing of the poles is perfect. If poles are not equally spaced, the variations will take place under different poles at different instants, which will give a higher frequency.

It is interesting to note that conditions which produce minimum magnetic changes give also minimum noise. An alternator sometimes produces a hum which indicates a frequency of vibration widely different from the frequency of the current generated, which may be due in part to air currents in ventilating ducts and in part to the magnetic variations mentioned above. In turbo-alternators the magnetic variations may be responsible for a large part of the noise, because of the fact that the magnetic fluctuations may be large on account of the comparatively large slots and also because of the high peripheral speeds which would bring the vibrations well up into the range of audible sounds.

Scranton, Pa. A. R. Dennington.

THERMIT FOR EMERGENCY REPAIRS.

Among the letters on practical subjects in your issue of May, John Jackson, of Boston, makes many inquiries regarding thermit, its practicability for small repairs on pipes, etc., its composition, reaction and finally why the electric worker is not equipped with thermit as part of his regular outfit. Perhaps I can answer many of the questions to his satisfaction, as some working experiences with thermit have posted me somewhat.

Thermit is a mixture of finely divided aluminum and iron oxide which creates a heat of 5400 deg. Fahr. in 15 seconds after being ignited, this immense heat fusing any fractured or broken parts with the added metal required and carefully prepared for welding. It requires some practice and knowledge in handling and I suspect that the cost of the prepared thermit and the special tools required for even small repairs, make against its very general use along the lines Mr. Jackson mentions.

Repairs made with thermit are possible in all the ways he mentions, but once made are certainly permanent. This would not prevent thermit being considered in repairs of pipe fittings, heaters, pumps, boilers, wheel shafts, for they can be welded without removal and are then generally stronger than before the break.

The engineer, marine, locomotive or stationary, can fully attest its value, for it has been proved in the field of each. The process in outline is briefly to file and brighten ends in butt-weld and to clean out broken and jagged surfaces by drilling and boring in repairing a break or crack. A mold is then clamped about the place to be welded, allowing room for the addition of sufficient thermit to make a button or ribbon of the mixture overlapping the weld. The part to be welded is first heated with a gasoline blow-pipe to allow for the proper fusion of the original metal to the new, the temperature of the reaction being twice that required to melt steel itself. The thermit is heated in a crucible for ordinary repairs held in tons, or for larger repairs upon a special stand, and when ignited by a charge of special ignition powder the reaction takes place almost instantly with intense heat (confined in the mold) and a blinding light. The worker and his helper should both wear blue glasses to see better and to protect the eyes.

The special outfit prepared by the manufacturers of thermit can only be purchased of them, and while the cost is not excessive for large work, it is certainly a considerable item for everyday work, and the skill and practice required, as well as the danger from neglect of precautions, will keep it out of the ordinary shop.

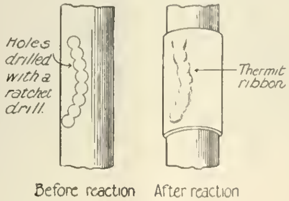


FIG. 1.—REPAIRED PIPE.

I have assisted in small repairs, pipe elbows, split joints and cracked rings where the work was to be done without displacing the broken parts in the following simple manner: The ordinary plumber's crucible and tongs were used after the former was fired out clean, to remove slag, etc. The split pipe to be repaired was drilled the entire length of the crack and then a mold made by taking old flanged pipe of larger diameter, slitting a groove around inside two halves and clamping them over the part to be repaired with long iron rods to hold them in place. This mold was set in a box of fine sand about 20 in. square, which was shoved under the mold each time a weld was to be made and drawn out after the metal cooled. A hole was drilled funnel-shape in the top of the old flanged pipe mold sufficiently large to allow of the right quantity of thermit, this being sold in measured portions according to pipe diameter, in this case 2 in. extra heavy. The clamps holding the mold to pipe are tightened as the ignition powder is added, setting off the reaction, which successfully fuses the new metal with the old into a homogeneous mass which sticks out from the pipe as a burr or ribbon and can be filed down or otherwise removed if desired. The repair is permanent to that part.

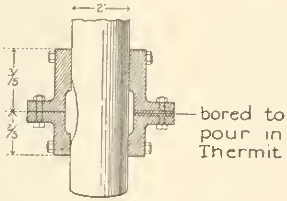


FIG. 2.—SECTION OF MOLD.

The cost of the operation is what makes it out of general reach. As figured by the thermit people, using their complete outfit as they recommend would have made our repair cost $1.56 per weld. By using our own tongs and crucible and making a pipe mold, we brought it down to about 90 cents. Even this is costly, but its use lies in larger fields and is correspondingly more costly. For all repairs over 4 in. in diameter fire clay molds must be used and the reactions double in cost and in quantities of material used. Nevertheless it is new, and as its use becomes more general and engineers recognize its undoubted utility, Mr. Jackson's engineer may then include a thermit outfit along with his indicator, his lubricator and his license.

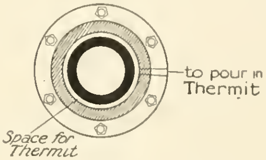


FIG. 3.—SECTION OF MOLD.

New York. F. W. Moore.

STEAM-PIPE HANGERS.

The writer was recently called in to ascertain the reason for a certain engine's frequency in breaking out the cylinder head. Four times, within six months, was the unenviable record of the engine, which had never given trouble before the date alluded to. Upon looking the engine over, it was found to be arranged with a very small home-made separator in the steam pipe, close to the throttle of the engine. The steam pipe was a long one, over 150 ft., but it was well insulated with magnesia pipe covering besides being enclosed in a box where it went out of doors from one building to another.

The engine was used for driving an electric generator in a manufacturing establishment and the breaks had occurred in two periods; two of the breaks coming within three weeks of each other in the late autumn, the other two breaks occurring this spring within a week of each other, the last break not yet having been repaired. The first apparatus examined, after looking over the engine, was the boiler, which was a fine high-pressure tubular concern, with dry pipe but no dome. Nothing wrong could be found at the boiler, or at the engine, to cause trouble, and nothing remained to be examined except the steam connection, which was 6-in., screwed-joints, black pipe, evidently of standard make. The pipe extends through two warehouses and was suspended from overhead by means of home-made hangers similar to that shown by Fig. 1, evidently forged from ½-in. iron rod by the engineer, when the plant was set up. The hangers were strong enough and there were plenty of them, the timbering of the buildings evidently causing hangers to be located at quite short intervals, say 6 ft. to 8 ft., in order to prevent unsupported pipe lengths of 14 ft. to 16 ft.

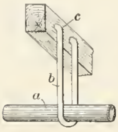


FIG. 1.—ORDINARY PIPE HANGER.

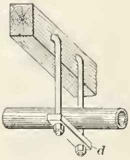


FIG. 3.—ORDINARY HANGER WITH YOKE.

Nearly all the space through which the pipe extended was dark, and the examination had to be by lantern-light. By chance, while wandering through the factory on the floor above the steam pipe, something led the writer to note that the floor was exceedingly uneven, in some places appearing several inches higher than other places only a few feet distant. A closer examination led to the discovery that some portions of the floor were heavily loaded with stock to be manufactured, and the floor had settled badly where the stock was piled the heaviest.

A question or two brought out that the stock had been in the mill only a little more than two weeks, and was put in about the time the engine broke down

The cause for the breaking of four cylinder heads by water in the cylinder was thus evident. The steam pipe had been forced down by loads of stock piled on the floor which supported the pipe. Pockets were thus formed in the steam pipe which partially filled with water when the engine was running. When an extra and sudden call for steam came on, about an hour before sundown, each time the head blew out, the increased flow of steam evidently caught up some of the water in one of the pockets near the boiler and carried that portion of water along with the steam.

Several more pockets well filled with water were in the path of the steam, and the result was that all the pockets were emptied by the rush of steam, and by the time it approached the engine, the steam pipe was almost full of water of condensation, which simply drowned out the little separator and swept down into the engine and put that machine out of business too. The trouble was all in the steam pipe, so a line was run through the dark store rooms, alongside the pipe, as shown by Fig. 2. The line was first stretched "neck and heels" from each end, then the line was straightened. The pipe is shown in its sinuous course from boiler to engine with the line *m*, *n*, *o*, stretched tight along its 150 ft. of length. The pockets at *a*, *b* and *c* will be noted. The arrow denotes the direction of flow through the pipe and the water originally picked up in pocket *a*, reinforced by the water from pockets *b* and *c*, was sufficient to flood the little separator and push out the cylinder head of the engine.

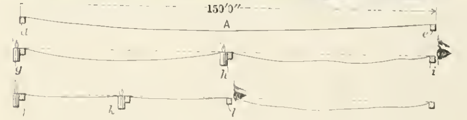


FIG. 2.—LINING A STEAM PIPE IN THE DARK.

No light was obtainable in the mill, except from petticoat lamps, lanterns and candles. Some of the latter were procured, the line stretched "neck and heels" at *f*, between targets *d* and *e*, then target *h* was put into position as shown. The candles *g* and *h* were fastened to the back of each target by three wire nails driven on an angle and the candles slipped between them. Then with the eye at *i*, target *h* was moved exactly in line with *g* and *i*, as determined partly by sighting the candles *h* and *g*, and later by sighting more closely to the illuminated edges of the targets at those lights.

After target *h* was in position and fastened, the eye was transferred to that target as shown at *l*, the candle put alongside another target at *k*, and the three points, *j*, *k* and *l* brought into line as before. It was found that the pipe originally had a pitch toward the boiler. This was changed by adding a short nipple above the boiler, giving the pipe an inclination of 4½ in. toward the engine. The writer prefers this arrangement, as then there is always a steady flow of entrained water in the direction of the steam, whereas, with the drainage toward the boiler, the flow of steam sometimes holds up the water until an extra rush of steam takes place, whereupon the water is brought over into the engine by the rush of steam. After the line had been supported and all the sag taken out of it, as shown at *n*, *m*, *o*, the condition of the pipe alignment was plainly discernible and steps were immediately taken to cure the trouble. It was not thought advisable to try to level the floor so as to bring the pipe straight. What was done consisted of placing enough posts along the line of pipe to prevent the floor from going down when loaded. Then means were taken to bring the pipe to the line and keep it there.

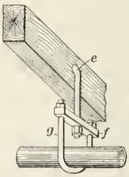


FIG. 4.—SINGLE HOOK AND YOKE HANGER.

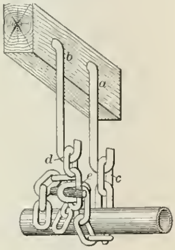


FIG. 5.—CHAIN AND HOOK PIPE HANGER.

Pieces of 2-in. by 4-in. scantling were placed underneath the pipe, one at each pipe-hanger, then wedges were driven under the scantlings until the pipe was in place. There was no means of adjusting the old pipe hangers, except by pulling them out and driving them in again at the required height. This did not work at all well. In fact, it is a mighty good job to hang pipe upon the hangers shown by Fig. 1, and to have the pipe straight when the job is done.

The hangers were so firmly driven into the timbers that they could not be removed without breaking half of the hooks and without badly distorting most of the rods in the attempt to pull the hooks out of the timbers, that it was decided to let them remain and block up between the hangers and the pipe, until the latter was brought into alignment. All sorts of schemes were proposed by the management for shortening some of the hangers so that adjustment could be made, one member proposing that the hanger be cut off below the pipe and threaded as shown by Fig. 3, a yoke applied and the hanger-rods threaded below the yoke *d*, the adjustment being made by screwing the nuts up or down. Another member of the company wanted to cut the hanger above the pipe, remove one leg and let all the weight of the pipe come upon rod *c*, which was to be connected with the pipe by means of the yoke *f* and the U-rod *g*, which was to be made from the remainder of the original hanger and threaded as shown by the engraving, Fig. 4. Still another wanted to apply an arrangement somewhat as represented by Fig. 5, in which the old hanger was cut off and the lower ends of the rods turned up as hooks, as shown at *a* and *b*. Chains were to be hung to each of the hooks, at *c* and *d*, and the ends of the chain brought around under the pipe and fastened by the old device known as the "toggle and fid." The pin doing duty as the "fid" is shown at *e*.

To secure adjustment to any height within reasonable limits it was suggested to use chains with links of different lengths, as represented by Fig. 6, at *a* and *b*, thus adjusting the height of the pipe in steps. The chain *a* has two links to 6 in., as shown, while chain *b* has a pair of links to each 6¼ in., making the links respectively 3 in. and 3⅛ in. long. Changing the length of both sides of the hanger ⅛ in. would therefore give a vertical adjustment of 1/16 in. in the height of the pipe. The writer suggested that the cost of thus changing the pipe hangers would cost much more than it would to put in entirely new hangers of an approved adjustable type similar to those shown by Figs. 7 and 8. The former shows two forms of hanger, style A being adapted to light pipes under 4 in. in diameter, while style B is fitted for heavy pipes of larger diameter.

Style *A*, Fig. 7, is made of malleable iron, the point *c* being threaded similar to a lag screw and screwing into the timber to which the pipe is to be attached; a length of small steam pipes, *b*, is cut and threaded to fit the drop of the hanger as found necessary. The screw point *a* has its lower end pipe-threaded to fit the coupling which connects the point *a* with pipe *b*. The clips *c* which encircle the pipe are usually made of malleable iron in two pieces, and they are bolted together and to the fitting into which pipe *b* is screwed. The hanger shown at *B*, Fig. 7, may be fitted either with the beam-clips *f* or the screw point *a*, as required. The vertical adjustment at *A* is made by varying the length of pipe *b* and by screwing point *a* farther into the timber. Besides the fixed adjustment in hanger *b*, by changing the lengths of rods *h* and *i* there is a turnbuckle *g* which permits the fine adjustment to be made with great exactness. The clamp clips *j* are similar to those shown at *c*, and they are attached to pipe *e* in the same manner as to pipe *d*.

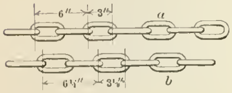


FIG. 6.—DIFFERENTIAL CHAIN ARRANGEMENT.

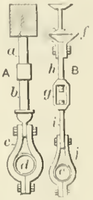


FIG. 7.—ADJUSTABLE PIPE HANGER.

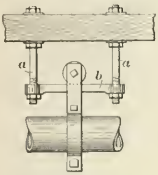


FIG. 8.—ADJUSTABLE EXPANSION HANGER.

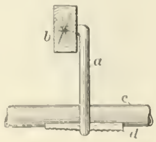


FIG. 9.—ROD AND RATCHET WEDGE HANGER.

A still better form of pipe hanger is shown by Fig. 8. This hanger is adjustable to any height or drop, by varying the length of bolts or rods *a*, *a*, which may be cut to any length and are adjustable at any time by means of the nuts supporting yoke *b*. The travel of the pipe, caused by the linear expansion, is taken care of by the little trolley wheel which runs upon yoke *b* and permits the pipe clamp to travel with the pipe instead of swinging as is necessary in all the other hangers described above, and thereby raising the pipe vertically more or less as the hangers move pendulumwise with the expansion and contraction of the steam pipe.

Thus far the owners had not succeeded in solving the problem of readjusting the old hangers to the pipe in its new position. The engineer then came forward with a sketch of a little casting, as shown at *d*, Fig. 9. This casting was made with a taper-curved cross section to fit both pipe and hanger. The little notches served to hold the ratchet wedge from moving endwise as the pipe expanded or contracted, yet it was possible to move the wedge endwise (by raising the pipe a trifle), thus securing the necessary vertical adjustment to pipe *c*, the old hanger *a* remaining unchanged as driven into beam *b*.

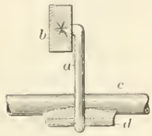


FIG. 10.—ROD AND SHOE HANGER; CEMENT ADJUSTED.

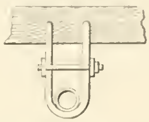


FIG. 11.—RAISING A PIPE BY CLAMPING THE HANGER.

The above noted arrangement was the most sensible one proposed, but there was just one thing in the way of adopting it, and that was: It would require considerable time to make the pattern and obtain the necessary castings, one for each of the hangers. Again, as some of them would have to be blocked up 4 in., there would be quite a bill for iron by the time the job was done. The work was finally done by wedging the pipe up as noted, and temporarily blocking it. When there was over 1 in. between the hanger and the pipe, a piece of sheet iron, ⅛ in. thick and 12 in. long, was bent in a semi-circle to fit the hanger, as at *d*, Fig. 10, and placed in position as shown. The pipe was blocked on the thick sheet-iron by means of a brickbat or two, or an old bolt nut or a piece of scrap iron as happened to fit the space. Then the space between the shoe and the pipe was filled with cement mortar, which was well pointed in, and left to set.

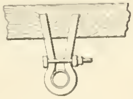


FIG. 12.—CLAMPING A PIPE HANGER.

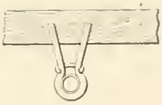


FIG. 13.—PIPE HANGER SECURED BY CLAMP-DOG.

Where there was less than 1 in. adjustment—and the pipe was so located that none of the hangers had to be lowered—a bolt and yoke clamp was put across the hanger rods above the pipe as shown by Fig. 11, and screwed up until the pipe had been raised the required distance, as shown by Fig. 12, where the rods had been pulled almost together before the pipe had been raised the necessary amount. Having raised the pipe to the desired point, measure the distance between the clamp pieces, then have a double ended hook made with just the same distance between the hooks. Screw up the clamp bolts until the double hook can be slipped over both hanger rods, then remove the bolt and yoke-clamp and drive the double hook into position as shown by Fig. 13, and the necessary adjustment is complete.

The pipe was very quickly hung up in this manner, and the cost was very slight. It is safe to say that the owners will never have another cylinder head blow out by water being stored in the steam pipe while the engine is running.

Willoughby, Ohio. James F. Hobart.

QUESTIONS AND ANSWERS

Why is it that transmission lines carrying high-tension currents are almost invariably of bare wire? D. S. S.

Because ordinarily insulation not only increases the size and weight of the wire and thus offers a greater surface for sleet, snow and wind, but the insulation is of no worth.

Is it advisable to place fairly large transformers on a pole for stepping down the potential for a commercial circuit of 200 kw? S. B.

Three single-phase transformers aggregating 200 kw can be safely erected on poles by setting two poles closely together and constructing a platform between them for holding the transformers. The platform should be placed quite low, say about 20 ft. from the ground.

How can the direction of rotation of a three-phase motor be reversed? We have tried various combinations in an effort to get the motor to operate in a reverse direction, but without success, and now the motor only runs at about one quarter of its former speed. P. S.

The direction of rotation of a three-phase induction motor may be reversed by interchanging the connections of any two of the three wires leading to the stator winding. The fact that your motor runs at a considerably reduced speed would indicate that one phase-winding is reversed. This would also result in overheating and a pronounced hum would be evident at starting.

What causes one wattmeter to run backward where two meters are used on one circuit? R. S. B.

We suppose that you refer to watt-hour meters of the motor type, used on a three-phase circuit. Either a wattmeter or a watt-hour meter will indicate a negative reading when the current in the series coil is out of time phase with the electromotive force across the shunt coil by an angle greater than 90 deg. This condition exists in a three-phase circuit when the angle of lag is greater than 60 deg., because there is an initial time-phase displacement of 30 deg. These facts were discussed fully in the September, 1907, number.

I have a four-valve engine running at 122 r.p.m. belted to a dynamo and desire to operate the set in multiple with another on an alternating-current circuit. The engine has a large flywheel and I desire to know whether there is any likelihood of trouble due to pulsations in speed from such an engine. W. J. L.

A four-valve automatic belted engine running at 122 r.p.m. should be able to drive an alternating-current generator operating in parallel with a similar generator driven by a similar engine. However, the successful operation depends as much on the characteristics of the generators as it does upon the design of the engines. The only method of determining with satisfaction just what results may be expected from the parallel operation of alternating-current generators is to submit the problem to the builder of the generator.

I would greatly appreciate your kindness if you would explain the meaning of the equation

$$\mu = 2800 - 3.2\ \frac{(7500 - B_m)^2}{10^5}$$

J. C.

It is impossible to derive any equation which will accurately determine the permeability of magnetic material under all conditions, because the permeability varies both with the mechanical composition of the material and with the mechanical treatment to which it has been subjected. The permeabilities of samples which one would expect to find absolutely identical, vary as much as 25 or 30 per cent. For most practical purposes, even an approximate estimate of the permeability is sufficient. The equation mentioned is one which fairly well represents the mean permeability of quite a large number of samples, although it is not accurate for any one single sample. The equation has no physical significance; it merely represents results as they are found to exist in nature.

To what extent should a central station company insist on the proper distribution of a customer's load across the three-wire system? E. C. S.

Obviously some attempt should be made to keep the three-wire system balanced. In New York City the requirements are quite rigid. All lighting circuits requiring over 5 amp must be equally divided and all motors having a rating over 5 hp must be connected across the outer wires, the potential between which is 240 volts. In another large city in New York State no attempt is made to balance the three-wire system, and yet it has been found that the circuits are rarely out of balance in the city referred to. Curiously enough the three-wire network which is tied together seems to have a tendency to balance itself without extra precautions being taken; an overload on one side being usually counterbalanced by an overload on the other side of the system. We know of no other city where the requirements as to balancing are as rigid as in New York.

What is the phantom circuit in telephony, and what is the function of the repeating coil used in connection with it? J. V. Q.

It is customary between telephone exchanges having considerable toll business to have order wires for the switching operations. When the distance is great, a special circuit called the phantom is sometimes used. This circuit is placed on the best lines, as the least difference in balance will cause the phantom to become noisy. Repeating coils are placed in the trunks and taps are taken out of the middle of the line side of each. These taps are connected to one-half of the secondary of a double-wound induction coil and compound receiver. A double-wound head telephone is connected so that one winding is in the phantom circuit at all times. By pressing a button at the distant station the transmitter, which is normally connected to the regular primary winding, is connected on the primary winding of the special circuit and the operator can converse over the phantom.

What part do the series resistance and reactive coil play in lightning-arrester equipments for central stations? P. L. O.

The purpose of the series resistance is to make the discharge non-oscillatory. If no series resistance or other oscillation-preventing device were incorporated in the circuit, a discharge from line to ground or vice versa will be oscillatory and may cause a low-frequency surge in the system which may be more destructive than the lightning itself. The greater the series resistance interposed, the less is the discharge ability of the arrester. The reactive coil protects the station against a high-frequency oscillation, but offers no protection against static charges of low-frequency surges, because the amount of reactance which can be introduced is limited. The reactance employed must be less than would be appreciable at the normal frequency of the system, and therefore less than would exert an appreciable effect on low-frequency surges. Its purpose is to obstruct a high-frequency oscillation, and it is not a general protective device any more than the series resistance.

In a medium size steam-driven station having a storage battery, what provision should be made for reserve equipment? F. M. C.

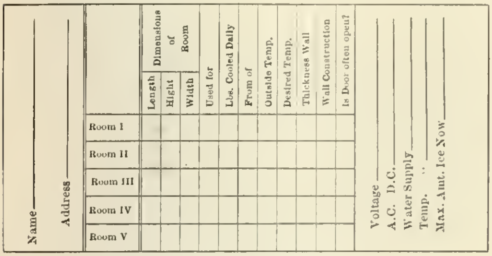
There is no definite rule which may be followed regarding the proper amount of reserve equipment to install. It is becoming quite common now to operate reciprocating engines and generators at slightly less than normal load and to depend upon their overload capacity in case one is instantly disconnected from service. During peak load all units carry approximately full load, and if one is disabled the overload capacity of the others and the battery are depended on to tide over the crisis. In case of sudden mishap the battery supplies the necessary energy until another unit can be started. Duplication in the boiler plant is avoided by arranging the steam piping so that all boilers and engines are connected to a ring main suitably divided by valves, so that any group of boilers can be used with any combination of engines. The feed-water lines are similarly arranged. In some large stations the plan followed is to make each unit virtually a separate power station in itself, means being provided for shifting the load from one set to another, and from one battery of boilers to another, so that a very flexible arrangement results. In well-managed stations the actual number of times service is interrupted, due to power house failures, is very small indeed. The majority of interruptions to the service are due to causes outside of the generating station.

Motor-Driven Refrigerating Machinery

By R. N. Dickinson.

To the wide-awake central-station manager there is a comparatively new power market opening up, that of the motor-driven refrigerating outfit. The size of this market may be imagined when one stops to consider the number of commercial enterprises using ice; for in nearly every case the ice may be displaced by the more convenient and less bulky artificial refrigeration. Markets, hotels, restaurants, dairies, chocolate factories, fish dealers and packing houses all need cooling facilities of some kind. The majority of them use from one to six tons of ice per day.

If this business can be obtained for the electrically-operated refrigerating machine, a motor of from 3 to 15 hp may be installed, according to the amount of cooling needed. The table herewith shows the average power required by the different sizes of refrigerating machines.



Name ——

Address ——

	Dimensions of Room			Used for	Lbs. Cooled Daily	From of	Outside Temp.	Desired Temp.	Thickness Wall	Wall Construction	Is Door often open?
	Length	Hight	Width								
Room I											
Room II											
Room III											
Room IV											
Room V											

Voltage ——

A.C. D.C. ——

Water Supply ——

Temp. " ——

Max. Amt. Ice Now ——

FIG. 1.—CARD FOR FILING INFORMATION.

This load will be of great assistance in straightening out the station load curve, as it will be at a maximum in the hottest weather and in the warmest part of the day, when the lighting load is off and the power load is apt to be below normal.

Tons per 24 hours	0.45	0.9	1.3	2.5	4	5	8
Horse-power required	1	2	3	5	7½	10	15

For the average requirements it will be unnecessary to operate the machine all the time, and as the minimum capacity will be required at night and in cool weather, it may be kept off the peak entirely, if desired. These conditions are favorable to a low price per kw-hour. At the present time a rate of 3 cents makes it possible for the outfit to compete very successfully with ice.

The refrigerating manufacturers are of course pushing the sale of their systems, but they do not cover the field closely enough. Each central-station man ought to get out and canvass his own town and get every possible customer connected. The central-station company doesn't care about the refrigeration end, but it most assuredly ought to be concerned about the motor load.

Before beginning the actual campaign, the various machines on the market should be examined, and one or two reliable ones determined upon to be recommended and sold to the customer In general, these outfits are made up of a compressor, condenser, liquid receiver, oil trap, expansion valve and the cooling coils. Fig. 2 is a sketch showing the relative connections of the apparatus. *A* is the compressor, driven by the motor, usually with a belt-tightener head or silent chain. (Most compressors are of the slow-speed type, running at from 100 to 200 r.p.m., according to size and make.) From the compressor the hot anhydrous ammonia gas, under pressure, passes to the condenser *C*. This condenser is built up of lengths of 1¼-in. water pipe inside 2-in. ammonia pipe, so arranged that water and gas flow in opposite directions. Here the gas is liquefied by the pressure and cooling, and drops into the liquid receiver *R*, which is simply a strong iron tank. The liquid ammonia is then forced by the pressure to the expansion valve *V*, which allows it to expand into the cooling coils *E* or the expansion coils as they are usually called. These coils are placed in the box which is to be cooled, and in them the ammonia is vaporized by the heat in the box, thus absorbing the former. As many boxes and coils may be put in series as may be desired. After being vaporized the gas is pumped through the compressor again. There are two or three completely automatic systems on the market which claim even less attention than the ordinary systems, and a somewhat better economy. However, their first cost is quite high.

As to the actual methods of getting business, the manufacturers will be found more than willing to supply literature and suggestions, and to even loan a salesman for a time. Some central stations act as regular agents, but this plan is not so good as for the company to act more in a consulting capacity, and to encourage competition between a few of the companies building the best outfit.

One of the station's regular solicitors may be used on the work after getting some pointers from the refrigerating man. But a better plan is to employ a technical graduate who has had a couple of years in a refrigerating manufacturer's shop. Several of the latter are training electrical men for this very purpose, as they can handle station business and be ready for any missionary work in the refrigerating line also.

After some judicious advertising, the manager should get a list of all the ice users in town, and find out the size of coolers, temperatures desired, amount of product cooled, etc. This information may be filed on a card, something as suggested by Fig. 1. Then the size of outfit needed can be figured and the proposition made.

Right here it might be well to say a word about figuring on the outfit needed. The expression, "pounds duty per 24 hours," means the same amount of cooling as would be given up by the same number of pounds of ice per 24 hours. There is a leakage of heat through the walls of any refrigerator. The amount of this, per 24 hours, expressed in B.t.u.'s per square foot of surface is $= (t - t)$, K, where t is the outside temperature, t the inside temperature, and K a constant depending upon the insulation of the walls. For ordinary, well-built butchers' boxes, K is about 4 to 6. So, to figure the duty of any given box, find its surface in square feet, multiply this by the difference between the inside and outside temperatures and multiply this product by K. This will give the number of B.t.u.'s leaking into the box per 24 hours. If any product (meats, etc.), are to be cooled find the product of pounds times specific heat time $(t - t)$ and add it to the duty of box. Divide the total number of B.t.u.'s by 144 and the result will be the duty in pounds per 24 hours (144 is the number of B.t.u.'s equivalent to the melting of one pound of ice).

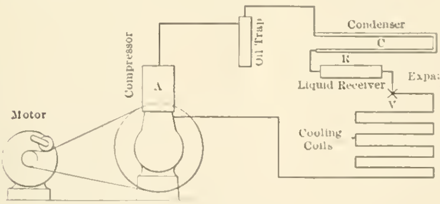


FIG. 2.—REFRIGERATING MACHINERY CONNECTIONS.

Systems are usually rated in tons duty per 24 hours. For making ice the capacity of any given outfit is one-half its capacity for refrigeration.

After calculating the duty and the contract price, which will be supplied by the manufacturer, the manager should get after the prospective customer, using the manufacturer's stock arguments—economy, saving of all the old ice bunker space, clean, dry cold, no slop or drip, no ice handling, even temperatures, very low temperatures if desired, etc.

Whether a town be large or small, some attempt should be made to introduce motor-driven refrigerating machinery, and if results are not obtained it will be the fault of the solicitor rather than of the apparatus.

Electric Drive for Machine Shops, Railroad Shops and Manufacturing Plants Using Machine Tools and Woodworking Machinery.

By Norman G. Meade.

THE commercial side of motor drive has been considered quite fully in previous articles by the writer, but the engineering features are fully as important to a new-business department and should receive proper attention. The selection of equipment for various industries requires some knowledge of the operating characteristics of each class and an intelligent comprehension of the requirements to be met by electric motors. Not alone should the motor receive attention, but the auxiliaries, including starting and controlling apparatus, panel and switchboard, wiring, etc., must be given due consideration.

It is important that every part of an electrical installation be of the highest grade, both in construction and material. The best quality of motors poorly installed may give much trouble or a poor motor used in connection with the best wiring and auxiliaries give equally poor satisfaction.

Again, if the installation is of the highest character and motors with unsuitable characteristics for the particular work they are to perform are installed, the operation of the installation will not be good. It will be seen from the foregoing remarks that the success of any plant depends upon the proper selection of motors for each specific service, therefore particular care must be exercised to analyze thoroughly the character of the machine to be operated before deciding upon the type of motor to be used.

In general, for cranes, hoists and similar applications, series-wound direct-current motors with regulating and reversing controllers should be used, although the variable-speed type of induction motor gives good satisfaction for hoist work and may be adopted if direct current is not available.

That class of machinery having a reciprocating motion and requiring excessive power at reversals should be operated with direct-current compound-wound motors. For machines that operate at various speeds a direct-current, adjustable-speed (by field weakening) motor is recommended. With adjustable-speed motors a controller should be used, as it is important that the starting and regulating resistance should be controlled by the same handle. For group drive and machines operating at constant speed, either a direct-current, shunt-wound motor or an induction motor may be used. The inherent operating characteristics of both types are similar, but the simplicity of the induction motor commends it for use where alternating current is available.

The conditions under which machine tools operate are so varied that it is impossible to make any general statement of all the possible operating conditions. The governing factors are always important, as, for instance, the character of the work machined, the kind of material cut, the speed of the cutting tool, the quality of the tool steel, the method of treating the tool steel, the stiffness of the machine tool proper, the strength of the gears, etc. All should be taken into consideration in fitting a motor to any particular machine tool.

Broadly speaking, machine tools may be divided into two classes: those with a direct rotary motion, either of work or cutter, and those with a reciprocating motion, either of work or cutter. Under the first classification come lathes, boring mills, milling machines, drill presses, etc.; the second class includes planers, shapers, slotters and machines of similar character.

In wood-working shops electric motors are particularly applicable to the operation of the machinery because of the intermittent character of the work and the high power required. A great saving is made possible by the ability to shut down any machine not in service and to operate a single machine without driving a large amount of shafting and a number of machines which are doing no work. The power required by a wood-working machine is much greater than that needed by a metal-working machine of corresponding size. The energy to be transmitted by the distribution system is, therefore, much greater and, consequently, the transmission losses are of more importance. For this reason, the saving made possible by electric transmission will be proportionately greater. Again, wood-working machines can often be more conveniently placed with regard to the work to be done if they are electrically-driven and do not need to be located with special reference to a driving line shaft.

The power required to drive wood-working machinery varies greatly according to the quality and condition of the lumber used, the speed of the feed, the depth of the cut, and more particularly the condition of their knives and cutting edges. One of the great incidental advantages of the electric driving of wood-working machinery arises from the fact that a meter may be inserted in the supply circuit of any machine, indicating the energy required by the motor. A comparison of its readings will show quite closely whether the working parts of the tool are in good order, the feed and cut of the right amount, and the cutting edges sharp. All these points will be apparent when the meter points out that the energy required for a given work on either green or dry lumber may be easily increased 300 per cent if the knives are dull, over that demanded when the knives are sharp.

As already stated, the operation of machinery by electric motors has an exceedingly wide field, but no class of establishments exemplifies the adaptability of electric drive more than wood-working shops, machine shops, railroad shops and general manufacturing plants. In machine and railroad shops the large work handled necessitates extensive buildings and the use of great lengths of line-shafting and belting, if power is transmitted from a central source. Rush repair jobs are frequent and require a great deal of overtime and Sunday work, when power requirements are small, as but sufficient machinery is operative to complete the particular work in hand. Mechanical transmission of energy under such conditions is wasteful in the extreme, owing to the surplus energy required to overcome the friction of shafting and belting throughout the shops.

There are many other considerations in connection with energy transmission, one of the most prominent being the layout of the plant, which is especially important in railroad shops, as they are generally made up of a number of separate buildings aside from the main machine and erecting shop, such as boiler shop, carpenter shop, tank shop, pipe shop, etc., which are generally scattered, widely distributing the energy requirements and necessitating the use of a number of prime movers. Where engines are used, steam is either supplied from a central source or by individual boilers forming a combination unit with the engine. The former arrangement is exceedingly poor from an economical standpoint, owing to the low efficiency resulting from the usual excessive condensation which takes place in long lengths of steam pipe. Either method involves the expense of skilled attendants, which amounts to a considerable sum annually. These conditions are, however, rapidly changing, electric motors are superseding steam equipments and have many times proved that they fulfil all requirements—reducing operating expenses, requiring a very small amount of attention, providing a power that is perfectly reliable, and reducing the time consumed by starting, stopping and changing speed to a minimum.

The increased use of electric power is directly traceable to certain decreases in the cost of production incident to its use. While some of the economies are obvious, others are more or less indirect. Increase in operating efficiency—i. e., increased production per unit of power in cases where variable-speed motors are used for driving machine tools—is an obvious reason for adopting the electric motor. While an increase in production and a decrease in operating expenses in proportion to the output are extremely desirable, it is probable that the factor which has made the electric motor a universal necessity has been the reliability and convenience of the drive obtained by its use. The word "efficiency" in connection with the operation of industrial plants must be used in its broadest sense and include not only economy in the consumption of energy, but must also recognize decreased unit cost of output, although this cost per unit usually involves increased wages to individual operatives where a personal-effort system is in vogue.

Having passed over the general advantages of electric drive, the electrical equipment next demands attention. For large shops covering considerable area and operating a good many machines that operate at constant-speed, a combination of direct- and alternating-current systems is advisable. In such cases a motor-generator set is used to obtain either direct or alternating current, depending on the central station's system. As alternating-current transmission is generally used, the suggestions for the equipment will be treated from that standpoint.

Many engineers differ as to the advisability of using both direct- and alternating-current motors, but the extreme simplicity of the induction motor and the minimum amount of attention required, unquestionably commends it for constant-speed service and, further, the standard maximum voltage for adjustable-speed type is about 220 volts, which confines the distribution system to rather narrow limits if economical distribution is taken into consideration. Another feature to be thought of is that there are generally outlying buildings located at some distance from the center of distribution where power is required for operating various classes of machinery. A familiar application in connection with railroad shops is the coal and ash conveyor at the coaling station. To reach outlying applications alternating current has an advantage over direct current, as high voltage motors may be used.

An important factor in estimating the energy required is the load factor of the plant. From tests made in machine shops the load factor has been found to vary from 25 per cent to 40 per cent, depending on the equipment. For a modern electrically-driven shop using a combination of group and individual drive a conservative load factor would be about 35 per cent. To illustrate, assume that there is a total rated motor horse-power of 100, then the required power would average 35 hp. For wood-working shops the load factor, determined by tests, varies from 30 per cent to 40 per cent, depending upon the equipment. For electric traveling cranes the power required will be approximately as follows:

When only a few cranes are used the distribution system should provide for power equal to the summation of the motor horse-power; when 10 or more cranes are used, the power will approximate 80 per cent of the above; when 20 cranes are used, the power will approximate 70 per cent of the above, and where over 30 cranes are used, 60 per cent of the total motor horse-power is a safe estimate.

From the foregoing data the power capacity required may be fairly accurately computed. It is always advisable to allow a margin for future extensions and possible overloads, so that a distribution system of somewhat larger capacity than actually needed should be installed.

For manufacturing plants or shops of considerable size, it is advisable to provide a small separate building for the transformers, motor-generator set and switchboard. The building should be located as near the center of distribution as possible.

The wiring of the plant is an important factor, as the efficiency of the entire installation may be greatly reduced by improper distribution. It is always desirable to divide it into several main circuits extending from the center of distribution so that an accident occurring to one feeder will affect the machines connected to it only. Open wiring, well supported upon approved porcelain insulators, is serviceable for overhead work.

A good plan to follow is to wire the ceiling below for the motors located on the floor above, as by this means the necessity of running wires down the side wall or posts is eliminated. For the ground floor the wiring should be placed in conduits beneath it. Motors suspended from the ceiling or suspended from the side walls may be connected to the ceiling wiring on the same floor. Good mechanical construction and the best material and workmanship should be employed.

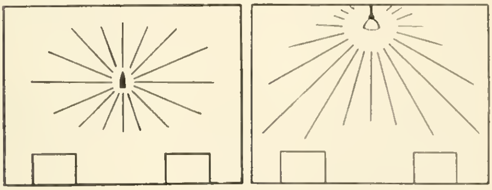
Meeting Gas and Gasoline Competition in Small Stores.

At the Nebraska Electrical Association convention, May 7, Mr. J. R. Cravath gave a talk on the above subject. The following are some of the principal points he brought out.

It seems almost unnecessary to say that good, reliable service at all hours of the day when lighting is needed and good, steady voltage to avoid fluctuation of light are essential when meeting any kind of competition; yet, as a matter of fact, poor service has no doubt been responsible for much of the gasoline competition which has sprung up. All central station men, he said, are familiar with the drawbacks of gasoline, such as the danger, heat in summer and the nuisance of taking care of the gasoline plant. The talk was, therefore, confined principally to illuminating engineering and the business policy and rates necessary to meet this competition.

As to the illuminating engineering part, he considered only the use of the tungsten lamp, because that lamp was so much more efficient than any other electric lamp suitable to store lighting. With tungsten lamps properly installed, the average illumination delivered on the plane of the counters in a store could be made double that with the best possible arrangements of enclosed arcs or Gem lamps, with a given expenditure of electrical energy. However, gasoline is such a cheap fuel that even the tungsten lamp may fail in competition if its introduction is not accompanied with proper illuminating design and with diplomatic business policy.

He then sketched on the board the light distribution of an upright gas-mantle burner or the tungsten lamp used without reflector, as compared with tungsten lamps equipped with bowl reflectors and concentrating reflectors. As gasoline lamps and gas arcs are most frequently used without reflectors, a typical distribution of light from such lamps is indicated by the sketch Fig. 1, from which it is seen that a large portion of the total light flux is given off horizontally to the sidewalks, where it is reflected back and forth with great loss before it reaches the plane of the counters. Of course, considerable light is needed on the sidewalls and ceilings, but the average gas, gasoline or tungsten lamp without reflector would waste considerably more on the sidewalls than necessary.



FIGS. 1 AND 2.—DISTRIBUTION OF LIGHT WITHOUT AND WITH REFLECTOR.

The average customer on entering a store judges the illumination largely by the comfort with which he can see the goods at or near the counter level. He is also influenced by the generally cheerful appearance of the store, but no amount of light expended on the high sidewalls can make up for poor illumination at the counter level. The study of the central-station men when installing tungsten lamps under competitive conditions should, therefore, be to direct a considerable percentage of the total light from a lamp directly to the counter level from the lamp or reflector surrounding it, instead of attempting to get so much by reflection from high sidewalls. To accomplish this, reflectors should be selected which will deliver a large percentage of the total flux of light from a lamp within an angle of about 70 deg. from the vertical, as in Fig. 2. Of the common reflectors which would accomplish this, he recommended the prismatic-bowl type and the deep concentrating prismatic types. He said that a similar distribution to that obtained from the prismatic bowl, shown in Fig. 2, was afforded by the fluted opal cone and the plain opal dome, which are staple articles of glassware for

16-cp lamps. Unfortunately, manufacturers of opal glass have not up to the present time awakened to the lamp situation, so that opal reflectors of sufficient size for tungsten lamps are not on the market, although they are much needed on account of the blinding brilliancy of the tungsten lamps, which needs a good reflector to cover it. With the prismatic bowl reflector, various tests have demonstrated that with tungsten lamps about 65 per cent of the total light generated should be obtained on the working plane of the counters, provided the lamps are not hung so that too large a proportion of the flux of light strikes dark sidewalls.

Small stores he divided into two general classes: First, those which are 15 to 20 ft. wide, with a row of electric outlets down the whole length of the middle of the store. Such a condition is frequently found where enclosed arc or Nernst lamps have previously been used. Second, those 20 or 25 ft. wide, or more, which have two or three rows of incandescent lamps suspended from drop cords. The first class, indicated by the sketch, Fig. 2, is best served by single tungsten lamps or clusters placed in bowl reflectors near the ceiling, the bowl reflector giving a distribution as roughly indicated by the lines in Fig. 2. The second class of store, where lamps are hung over each row of side counters, is best served by the use of concentrating reflectors over the tungsten lamp. In such an event it is not as necessary to place the lamps high as in the first case, but they should not be less than 8 ft. to 10 ft. from the floor. The concentrating reflector used should be deep enough to cover the lamp well.

The usual so-called concentrating reflectors over the Gem lamps do not cover the lamp as much as is desirable. The lamp filament is too much exposed to the eye, and the percentage of light directed below 70 deg. from the vertical is no greater than with the bowl-type reflector, which gives a fairly wide distribution.

Before placing an installation of tungsten lamps in a store where gasoline has been installed, it is well to talk to the prospective consumer a little as to what really constitutes satisfactory illumination for his customer. The average small merchant, when judging of the relative merits of systems of illumination, is prone to look at the light sources themselves, rather than at the general appearance of the store and of the light obtained on the goods. The merchant should be educated to judge his illumination just as would a casual customer of the store who thinks nothing about the lamps, but is simply impressed by the general effect and the comfort with which he can see what he is purchasing. If merchants would do this, there would not be so much demand for blinding, glaring lights in the ordinary line of vision.

COMPARISON OF VARIOUS GAS AND TUNGSTEN LAMPS.

Lamps and equipment.	Total lumens without reflectors.	Lumens effective on counter level.	Lumens effective on counter level.
Gas arcs, average of two kinds, with alabaster globes, 19 to 22 cu. ft. per hr.	2,514	45%	1,131
Upright gas mantle burner, clear chimney, 3.7 cu. ft. per hr.	790	45%	355
Inverted gas mantle burner, C. & L., clear globe, 3 cu. ft. per hr.	679	55%	375
Tungsten 100-watt, with clear bowl reflector	785	65%	510
Tungsten 60-watt, with clear bowl reflector	471	65%	306
Tungsten 40-watt, with clear bowl reflector	314	65%	204

With this preparation, the central-station man is ready to make tungsten installations in stores where gas or gasoline have been used, and in this connection he must know about how many tungsten lamps of a given size properly equipped must be installed to give an effective illumination equal to that previously obtained from gas burners as ordinarily used. The accompanying table was presented to show approximately the results which may be expected. For convenience in calculation, the English candle-lumen was used as the unit of comparison. One lumen is the amount of light required to illuminate a surface 1 ft. square to an intensity of 1 foot-candle. One foot-candle is the illumination on a surface 1 ft. distant from a light of 1 cp with the surface at right angles to the ray of light.

He explained that it is difficult to obtain tests on gas and gasoline mantle burners because of the exceedingly variable conditions of pressure and adjustment and variations in quality of gas which prevail in actual practice. The glassware used also has a great effect on the useful illumination. The gas-burner figures in this table were made from tests made under laboratory conditions on New York City gas by the Electrical Testing Laboratories, for use in Cravath and Lansingh's "Practical Illumination," adjustments being made by manufacturer's representatives. Probably the results were better than ordinarily existed in practice. The alabaster globes used on the gas arcs were those most commonly found on these appliances. The individual burners were tested with clear chimneys without reflectors, this being probably the nearest average condition of actual use. In the case of the gas arc and the upright gas-mantle burner, 45 per cent of the total light generated is estimated in the table as being effective on the level of the counters. The percentage of light given below 70 deg. by these upright gas burners was considerably less than 45. In fact, only 45 per cent is thrown below 90 deg., or below the horizontal, but to compensate for this the large percentage of light thrown horizontally and upward will cause a larger percentage to be reflected from walls and ceilings than if an efficient reflector were used, so that the percentage thrown below the horizontal rather than the percentage thrown below 70 deg. is taken in the case of the upright gas burners. In the case of the inverted gas burner, however, which throws a smaller percentage to high sidewalls and ceilings, no such allowance is made for reflection from walls and ceilings. It is considered on about the same basis as the tungsten lamp with bowl reflector. From the column in the table entitled "Lumens Effective on the Counter Level," the central-station man can get an idea of the number of tungsten lamps required to replace a given number of gas burners. For example, in small towns where gas service is not very good, two 100-watt tungsten lamps could safely be put up to replace a gas arc, while in cities where the gas-arc service is more closely looked after, some companies are using four 60-watt lamps to replace a gas arc. The table is intended to err on the side of safety as far as the central-station man is concerned, because usually the gas burners will not be in as good condition as the table shows. The depreciation of the candle-power of the tungsten lamp with age is not likely to be nearly as great as with gas-mantle burners.

With tungsten lamps efficiently installed, it is safe to count on obtaining an average of 4 foot-candles illumination on the plane of the counters for every 1 watt per square foot expended in electrical energy. With Gem lamps similarly equipped, an average of 4 foot-candles would be obtained with 2 watts per square foot. With common carbon lamps without reflectors, hung in rows over the counters, about 4 watts per square foot to produce an average of 4 foot-candles illumination would probably be required. The use of tungsten clusters with reflectors which allow a large amount of light to escape horizontally and which do not cover the filaments so as to protect the eye from the blinding glare, should be carefully guarded against. They are both inefficient and blinding. Such reflectors can be made unobjectionable and efficient if the manufacturers will only equip them with the proper deep reflectors.

RATES AND BUSINESS POLICY.

Much gasoline competition is due to faulty systems of rates. The man who puts in a gasoline plant or uses gas for the sake of economy is likely to be the man who is using light several hours every evening. If the system of rates is such that these long-hour consumers must pay the same rate as short-hour consumers, it is unjust either to the company or to the long-hour consumer. Assuming that the rate is correct for the short-hour consumer, it is much too high for the long-hour user, and his bills will be so high that he is tempted to put in a gasoline plant or use gas if he can get it. The system of rates should be such as to give the long-hour consumer the lower rate to which he is entitled. This does not mean that any special rates are to be made. Special rates mean discrimination and trouble for the company making them. If a company finds that conditions are such that it cannot make the proper rate on long-hour business without breaking its rate schedule, it should by all means revise its rate system at once. The rate system of a company should be sufficiently comprehensive so that it will provide for all cases which come up and give a tolerably fair rate to all classes of consumers without the necessity for any special rates. If a company's rate system does not do this, it is high time that it be revised. Among the commonest methods of charging which give the long-hour consumer the low rate to which he is entitled without making the rate too low for the short-hour consumer, there are the two-rate system and the Doherty system. Under the two-rate system the consumer is charged at a high rate for a certain number of hours' use per month of his maximum demand or connected load, while for all over that amount he pays at a very low rate. Under the Doherty readiness-to-serve system, the consumer pays a fixed flat rate of about 15 cents per 50-watt lamp connected, plus $1 meter and service charge, plus the low rate of 5 or 6 cents per kw-hour.

PLANS FOR INTRODUCTION.

When introducing tungsten lamps to supplant existing gas and gasoline installations, the easiest and best plan is to sell the consumer the lamps, reflectors and wiring outright for cash, if this can be done. There are many places where this cannot be done, however. The consumer may be skeptical as to the results he will get. He may recently have been to some expense for a gas or gasoline installation and may not wish to change. He may also be suspicious as to the life and renewal cost of the expensive tungsten lamp. To allay the customer's fears as to the renewal costs, the maintenance-insurance plan is good. Under this plan the company will either sell the consumer tungsten lamps at cost for renewal purposes, or will maintain a customer's tungsten lamp installation for 3 cents per kw-hour. In this way the consumer takes no chances on cost of lamp maintenance, unless he prefers to buy his own renewals.

There may be some customers, however, who will not even consider the initial cost of wiring and lamps, either because they cannot now afford to pay that amount of money out in a lump sum, or because of doubt as to what the installation will do. In such cases, if the consumer is a good one to obtain, both as to credit and monthly income, the company can safely put in a complete trial installation of tungsten lamps, either to be paid for in a lump sum or in monthly installments. In such cases, the company will also usually have to maintain the lamps at a fixed rate per kw-hour.

Another plan of maintenance being tried by some companies is that of having a fixed rate per month. This has the disadvantage that the number of hours the consumer uses his lamps per month cannot always be estimated in advance. Another plan being pushed actively in Chicago is to put in tungsten clusters consisting of four 60-watt lamps on a flat rate of $1.15 a month, burning from dusk until 10 p. m., five nights per week.

The company turns on and off these clusters just as it does the numerous signs which it has on flat rate, the sign patrolmen looking after the switching of the tungsten clusters. The company maintains lamps and furnishes the clusters, the contract being made for two years, so as to spread the cost of the cluster out over that period.

In conclusion it may be said that the tungsten lamp has put the central-station industry in a position where it can make rapid progress in getting business which heretofore has gone to gas or gasoline.

* * *

Tungsten Versus Gasoline at Holdredge, Neb.

Mr. F. J. Schwengel reported at the Nebraska convention that the Holdredge Lighting Company, of which he is manager, had put out 200 100-watt tungsten lamps. In the week before convention, tungsten lamp installations had replaced three gasoline-lighting outfits and there were more to come.

The Motor-Driven Centrifugal Pump as a Central-Station Load.

By E. N. Percy.

No pump is more ideally adapted to use with the electric motor than the centrifugal pump, and a proper exploitation of this kind of pump can considerably increase the motor sales and energy output of central-station companies. Since the invention and development of the multi-stage and turbine-type centrifugal pumps, there is hardly any duty or pressure to which they are not better adapted than the reciprocating pump, when electrically driven.

Where long transmission lines cross the country there is frequently opportunity to develop small irrigation projects by pumping from some lake, stream, spring, well or canal and greatly enriching the value of adjacent land, whether already farmed or not. Where the capital cannot be raised to build a proper canal scheme, irrigation can frequently be accomplished to great profit by each farmer putting in a small pump and attaining all the results desired. The writer has seen 160 acres of desert land bear four fine crops of alfalfa per year when irrigated with a 4-in. pump and 7-hp engine pumping from an alkali lake, the water being lifted about 15 ft. A 75-hp engine, driving a 12-in. pump, lifting water 15 ft. from an alkali lake, irrigated 1500 acres, upon which four crops of alfalfa were raised per year. If a transmission line had been run across this country, much of the energy could have been sold along the 30-mile length of the lake.

Other purposes to which motor pumps are applied include municipal fire and water service. In small towns the pumps run in parallel for ordinary service, but in the event of a fire are connected in series and give double the pressure. A particularly good point about these pumps is that if the discharge valve is closed, no harm results, as the pressure does not increase.

Fire pumps driven by motors have been approved by the underwriters for certain conditions, and in places where a constant pressure is to be maintained, as with properly wound motors, they run at constant speed, whether discharge valves are open or shut, and the load varies approximately according to the amount of work used. If all valves are shut, the pressure is maintained just the same.

Frequently it happens that contractors wish to keep a foundation, caisson or other piece of construction drained. A vertical centrifugal pump submerged in a sump, connected by a vertical shaft leading to the motor placed high and dry, makes a fine combination for such purposes. Also, for land drainage or reclamation on a large scale, such as marshes, lake bottoms, flooded islands, etc., the electric pump would often find a ready sale if someone were right on the spot with the electricity and motor and pushed the proposition. For instance, parts of the Sacramento River District in California, especially islands in the river, are frequently flooded. They are always reclaimed with huge steam-driven centrifugal pumps, notwithstanding the fact that the largest long-distance transmission power lines in the world run up and down and all around the river. Some of the pumps have 48-in. discharge openings and immense capacity; in addition there are hundreds of small pumps used by small farmers for draining land and gardens.

The small gardener, especially the progressive Italian, can always be shown where a small electric pump will leave him free to do other work, and cost less than a windmill or tank.

In large buildings, of late, it is a custom to put in complete plumbing for ice water, pumped from the engine room to a tap in each room. The centrifugal pump is again very suitable, because no floats, governors or other automatic apparatus are necessary. The pump maintains the circulation and supplies all water drawn, without regulation of any kind, damage to pipes or noise; nor is it necessary to have an air chamber. Needless to say, the electric motor is the ideal drive, not only because of its noiselessness, but it costs less to operate and to repair than the reciprocating type of pump.

For tank service, the motor-driven centrifugal pump is ideal, because, instead of a complicated and unreliable automatic apparatus to shut off steam or electricity when the tank is full, a plain float valve is put on the end of the discharge pipe, and when it closes, nothing happens. The pump runs right along, taking scarcely any power, until the valve opens again. If this continues for some time, it will be observed and the motor can be shut down by hand, which is usually the case anyway.

In large power plants, the centrifugal pump has a recognized place as a feed pump. A three- or four-stage pump, operated by an electric motor, will feed the boilers through any length of pipe without an air chamber, and there will be no noise, shocks, jars or other trouble incident to a high-pressure reciprocating type of pump. Any or all of the checks may be open or closed; the pump will need no attention. In the event of a sudden shut-down of the main engines, all checks may be opened wide and the boilers flooded with cold water; the pump will run just as it does under no load, and the gages show little or no variation of pressure.

Its use as a circulating water pump or as a fire pump has been well established. It is probable that future circulating pumps will, in some instances, be electrically driven and run at much higher speeds; being, in consequence, smaller. As a water service pump for tall buildings, the same advantages apply. There is, however, an additional advantage. In modern office buildings, the lower stories have a much too high pressure, in some cases 200 lb. per square inch. To offset this it has been customary to pump to a tank on the roof, and to use reducing valves for the lower stories, or to have several systems of piping running at various pressures. With the centrifugal pump an electrically-driven pump could be placed every two or three stories, maintaining a very medium pressure, and would run unattended for days at a time. In the event of their stopping, if no check valve is at the suction, no pressure could accumulate and the pipes would simply empty. A multi-stage pump could be operated in the engine room with sufficient capacity for the building. From each stage, a pipe could be taken and run as high as that number of stages was supposed to discharge, the last one taking the upper stories.

Many opportunities exist in small and large cities to solve sewage problems by the installation of an electric pump at a suitable point. It must be remembered that a comparatively small pipe can handle the contents of a large sewer, because of the much higher velocity. Often it is necessary to mix water with the sewage. This is a specialty by itself, but an electric pump, and a pipe line to some nearby river, swamp, sewage farm or sump would settle many a perplexing sewage question.

Mine drainage is one of the most profitable fields for the electrical man. If a transmission line be near by, the proposition is ideal. If not, a power plant close at hand, with electrical transmission to the pit, is an ideal and economical arrangement. No attention below ground is necessary, except occasional inspection. No matter whether a sinking pump, station pump or submerged outfit be used, the efficiency is high and no losses from condensation or other troubles due to long steam pipe line are present. In the water discharge, there is no water-hammer, noise or other trouble as with a reciprocating pump. The discharge is smooth, regular and noiseless. Mineral or gritty waters do not hurt the pump, and it will work in any position.

Deep-well pumps for irrigation, general farm supply and even water supply for large buildings are best driven by motors. Any engineer or owner can be very quickly shown how much more economical the electric centrifugal pump is than the deep-well steam pump generally in use, and the first cost is usually less. This type of centrifugal pump is fairly well developed. It is the best pump for fountain service, as many a pretty park and public square could be graced by a fountain were it not for the cost of the water, and any ordinary means of pumping the same water over and over entails an attendant with consequent expense. The little electric centrifugal will maintain this service, with a small expenditure of energy, and almost no attendance. The city of Berlin, Germany, has many such fountains. In isolated, unattended stations of all kinds, such as railroad tanks, long pipe lines, filling flumes, etc., this type of pump can be placed and left, with reasonable assurance of its continuous operation.

Electric centrifugal pumps are now being used on board ship for drainage, fire service, bilge and deck use. In addition to the advantages mentioned before, they are unaffected by dirty water, coal, ashes, waste and other débris which may gather in the bilges in time of storm, and always result in shutting down an ordinary reciprocating pump at the critical moment. Some hydraulic dredges have been built with electric motors instead of a steam plant, where electric power was especially available; and several have been built with electrically-driven auxiliaries.

Systems for handling lubricating oil for large plants can be handled with least danger to pipes and drip points with a centrifugal pump. They are found in such places as breweries for handling beer, rubber factories to pump the solutions filled with rubber lumps, chemical factories and oil refineries. In ice plants they have been used with the greatest success for brine pumps and for circulating water through ammonia condensers. The pump is well adapted to the open-air style of ammonia condenser, pumping from the pan over and over, with just enough added to make up for evaporation, as the water runs down over the pipes in the open air.

The hydraulic elevator field is one of the finest for this type of pump. Its peculiar advantages make it particularly applicable to elevator service; especially as, while electric power is usually available, many engineers prefer hydraulic elevators. With the electric centrifugal pump one has the hydraulic quietness and certainty of control, with the simplicity of the electric motor, without gears, clutches, brakes, pump plungers or other complications attendant upon either the hydraulic system with reciprocating pumps or the direct electric system. With the electric centrifugal pump system, the control is simple, while the motor is continuously running and not subject to the exigencies of indirect control. Furthermore, such starting and stopping apparatus as is necessary is under the eye of the engineer, and is very simple. This system has been worked out practically by well-known elevator firms. The wide field for the electrically-driven centrifugal pump is therefore apparent and it rests with the electric light companies whether or not full advantage will be taken of the opportunity for a motor load thus presented.

Electrical Shows.

By H. W. Hillman.

So much has been said and written about electrical shows that those associated with the electrical industry perhaps have the impression that the electrical show is now an old story. This impression may have been received because we are inclined to become so interested in our own work that we fail to weigh carefully the impressions of those associated with other industries and the people in general.

It is not true that the electrical show has become an old story. It is brand-new, and even Chicago and New York have practically just started the idea. I believe Grand Rapids is the first city as small as 100,000 population to have an electrical show. The great success from what might be called an experiment has led me to the opinion that every city and town in the country, regardless of size, should have an annual electrical show. The central station should be the leader and interest supply dealers, contractors, manufacturers and the people to support the enterprise.

Many central-station managers may think their city or town is too small to be able to follow Chicago and New York with an electrical show. For the benefit of such station managers I will offer the following suggestions, hoping that they may be of some value to them on this subject.

The size of the city or town does not interfere in the least. It simply limits the extent of the exhibition. The fact that a town is large enough to have a central station is sufficient to warrant an electrical show. Opportunity is afforded to beautifully exhibit all the various electrical devices even in a small hall. If the size of the town demands a small hall and small exhibit, the effect is to create small initial and operating expense, a feature that encourages instead of discourages the idea of the exhibition.

At Grand Rapids the two competing telephone companies exhibited with 400 sq. ft. of space for each company. Their exhibits were especially attractive to the people, and their managers have advised me since that even though they did not secure enough additional business to pay for the space and operating expenses, the educational feature was one which warranted them in exhibiting.

The electrical show differs materially from food shows and is more educational and more valuable because the devices interest men, women and children, those associated in stores, factories, libraries, offices and in all walks of life.

A prominent citizen and manufacturer advised me regarding the Grand Rapids show that he thought it was wise to charge an admission of 25 cents because the people, having paid this admission, would pay more attention to the exhibits and spend more time than they would providing the admission were free. Inasmuch as the exposition is for educational value, this point is well taken.

During the show teachers of the schools sent boys as representatives to investigate the various devices and to speak before the other scholars advising them in regard to the many attractive features. Thousands of tickets were distributed among the schools, with permission of the school board, and a large attendance of children resulted at an admission of 10 cents each.

The electrical show in Grand Rapids was particularly appropriate at this time because of the rapid development in connection with incandescent lamps. Manufacturers and supply dealers had beautiful exhibits of tungsten lamps with all kinds of shades, and their presentation of the latest methods in electrical illumination was highly educational. I know that the people appreciated such exhibits because many of our manufacturing customers advised me of their intention to test the new tungsten lamps in their factories. The manager of the city schools was particularly interested because they are considering particularly the wiring of many new buildings and the best methods of lighting schools. He is considering the use of the vacuum cleaner in the high school for an experiment. There is a feeling here in the city that schools should be cleaned oftener, that the dust from blackboards is injurious, and the adoption of the electrical vacuum cleaner or renovator is being very carefully considered for schools. This exhibit is valuable in the form of an exposition because school matters are always discussed in the newspapers, and physicians are particularly interested in sanitary features of schoolhouses. Therefore, if an appropriation is made for vacuum cleaners the people will be more likely to support the idea, having been impressed with the advantages of the device at the electrical show.

The show can be made self-sustaining if it is properly handled. An electrical show association should be formed, including the central station, the supply dealers, the contractors and any local manufacturers; or, if thought best, limited to the central station and supply dealers. The very first work in connection with exhibits requires a contract with the supply dealers to do the wiring, and then the exhibitors furnish the supply dealers work for wiring. As a result the expense for space of the supply dealers is more than returned by their contracts for wiring work. The central station secures a return of its money from the light and power meters installed in connection with the exhibits, the manufacturers are able to secure a return for their space money by watching the requirements of the central station and the dealers and contractors for materials for use in the exposition. At the Grand Rapids show a local sign manufacturer had 15 beautiful signs on exhibit, all of which had been sold and were ready for installation immediately after the show. Various orders were taken at the show for signs because of the exhibit. Therefore, the manufacturers secured a good return for the small expense involved.

Regarding charge for space, the Electrical Show Association had no difficulty whatever in securing 50 cents per square foot. The association employed an architect who presented a general design of the decorations and booths for the inspection and approval of the executive committee of the association. All aisle decorations, wooden supports, railings, arches, painting and illumination for them were handled by the association for the purpose of having uniformity in appearance. This policy offered an opportunity also to reasonably charge 50 cents per square foot for space.

A concluding point, which should strongly impress every station manager, particularly if one can assume that all station managers are desirous of increasing their business, is that in order to hold an electrical show it is necessary to have the hearty co-operation of the central-station manager, the supply dealers, the contractors, the people and the local manufacturers. They must all be pulling the same way and endeavoring to help one another, and co-operating with one another for the improvement of the local electrical business. Such a situation is cemented by the holding of an electrical show, and it is helpful throughout the remainder of the year in ways too numerous to relate. If hearty co-operation does not exist between the parties mentioned, and a station manager desires to hold an electrical show, he will find it necessary to change relations, making them pleasanter and more co-operative. Therefore, a study of the electrical show and the necessities for the success of such a show will require a change in the policy to the effect of heartily co-operating with dealers, contractors and local manufacturers, and a situation will be brought about which will not only mean success for the electrical show, but it is the keynote to the success of central-station business. I have always believed in the hearty co-operation of such parties interested in the electrical industry locally as well as the people, but the electrical show in Grand Rapids has impressed upon me more than ever the great value of co-operation.

Letters to the Editors.

Patent Office Models.

To the Editors of Electrical World:

Sirs:—The technical press of the country is the direct result of modern invention, and it should properly constitute the forum wherein the inventors may express their opinions and confer as to their needs. The need for common discussion and action on the part of the inventors was never greater than at the present time, as has been set forth by contributors to your columns.

At the present time the Patent Office has a surplus of nearly $7,000,000 to its credit, and last year its surplus amounted to over $279,000. In the face of this enormous excess it is calmly proposed in the name of economy to dispose of the patent models by public sale and removal to the National Museum, where they do not belong. These models, numbering over 157,000, constitute the greatest mechanical museum in the world, and form an integral part of the patent system of this country. According to Commissioner Moore, of the Patent Office, they are public records, and absolutely essential to the adjudication of questions of priority and invention. Commissioner Moore, in his testimony before the Senate committee, states, and every one connected with the patent business knows it to be true, that many of the old inventions were not disclosed in the original drawings, but are always disclosed in the models.

A bill has passed Congress and I am informed has been signed by the President, appointing the Secretary of the Interior, the secretary of Smithsonian Institution and the Commissioner of Patents a committee of three to determine which of the patent models the inventors need and to dispose of the remainder by sale or otherwise. The absurdity of this bill is at once evident. Who is competent to say what the inventors of to-day need? By what rule are we to measure inventive needs? Who is to formulate a philosophy by which the future course of invention, science and industry is to be determined specifically in advance? Solomon is dead and Franklin, if living, would ridicule the task; who can understandingly accept it? A running brook may suggest to the poet a rhyme; to the painter a landscape; to the engineer power; to the agriculturist irrigation; to the inventor perhaps an endless belt, perhaps a new mixer, perhaps a new drill, perhaps a new tool that bears no relation to natural scenery. By what means are we to learn the value of the patent models in suggesting new inventions; can three men who are crowded with their work competently decide the value of the 157,000 models to invention, to art, to science and to industry?

But more important than this phase of the question is the purely legal aspect of the proposed destruction of the Patent Office models, the proposed assault on the integrity of the patent system and the validity of existing patent rights. Since the Patent-Office models are vital public records of current value to the Patent Office it follows that their destruction, by removal to quarters where they will be practically inaccessible to public and official inspection, or by sale or gift, will operate to confuse the work of examination, prevent the body of inventors from learning the nature of expired patents in order that they may intelligently use or avoid them, as necessity requires, and result in endless fraud.

Little has been heard of the proposed disposal of the models, perhaps for the reason that the patent lawyers desire their disposal, and the corporations will benefit by this disposal. It practically means the records of inventors are no longer safe in the hands of the government and that it is as likely to dispose of or neglect to protect the files of the Patent Office, which constitute the greatest technical library in the world to-day, and that a large number of inventions covered by the models, and not shown in the patent drawings, will be repatented, thus contributing to the rapid demoralization of the entire patent system.

For the last 10 years we have been approaching a crisis in the patent system, and it seems that the critical period has at last arrived. In operation the patent system is becoming ever more inimical to the inventor and ever more unreliable, complicated, confused. Thought should precede discussion, discussion should precede action, and action should correspond with need.

Nothing can be done without concerted action, and this can be best accomplished by organization. Invention has organized the world, but the inventors are the most poorly organized class of citizens in the world. Every class of citizens is organized, from the chicken pickers to the philosophers, from the undertakers to the ministers, all except the most useful class, the inventors.

Invention is the product of need consciousness. Organization is the highest expression of need. Let the inventors organize! The time to begin is right now. The way to act is directly. The exact plan is immaterial. The name important, but not vital; here is one that has already done valiant work in Washington—The Society of American Patentees and Inventors.

Let the inventors of every locality confer and form temporary organizations, let them begin now to amass and develop power to influence legislation. Temporary organizations should first be formed, and then a general conference should be held of representatives of different cities and a national organization, with international branches, formed. There is work right now to be done. The integrity of the Patent Office must be maintained. The validity of patent rights must be secured. The progress of invention must be rendered more certain, and more beneficial to the inventor. The progress of society depends on the progress of invention, and the progress of invention must no longer be left completely in the hands of men who are incapable or not desirous of securing to the inventor his constitutional and social rights.

The inventors and scientists everywhere should forward an immediate protest to the President and the secretary of Smithsonian Institution against the sale, removal or disposal of the models.

These protests must be forwarded immediately, organization should proceed at once. Let every prominent inventor select a few friends and induce them to join with him in an organized effort to conserve the interests of the American inventors and patentees. The immediate aim of organization should be the preservation of the Patent Office models; the ultimate aim should be as broad as inventive need and contemplate broad reforms of an enduring character. The writer will do all in his power to co-operate in securing efficient organization of inventors and patentees.

Washington, D. C. Joseph J. O'Brien.

615 Sixth Street, N. W.

[We are thoroughly in accord with our correspondent as to the desirability of a national organization of inventors, but we believe that he overrates the value of the collection of Patent-Office models. For about a generation it has been optional with an examiner to require a model, and this option is very rarely exercised, except in cases of an application for a patent on a perpetual motion or other machine involving denial of a law of nature. The present collection, with few exceptions, thus dates back 30 years or more; and only a small portion of it is now available for inspection by inventors, the greater part being boxed and stored. Presumably the models to be preserved are those of interest in the history of the various arts involving invention, and in the selection of these the committee without doubt will have the assistance of the staff of Patent Office examiners, who are necessarily experts in the history of these arts.—Eds.]

Choice of Transformers.

To the Editors of Electrical World:

Sirs:—In his article on "The Choice of Transformers for the Central Station," in your first issue for May, Mr. L. A. Starrett assumes that 110-volt incandescent lamps may operate at from 111.65 to 111.76 volts for 4 hours out of each 24. Under ordinary lighting conditions it is not usual for all lamps to be in use when the e.m.f. has the high value indicated. In order for the life of the lamps to be decreased from 600 to 441 or 447 hours, as stated by Mr. Starrett, they must be used during their whole life at the no-load e.m.f.—which condition is an impossible one in practical service.

Moreover, the value of 18 cents for each incandescent lamp seems high, as does also the rate of 15 per cent on the investment. Furthermore, it does not seem plausible that a transformer operating at a high temperature should last as long as one operating at a lower temperature.

Follansbee, W. Va. J. G. Homan.

To the Editors of Electrical World:

Sirs:—The electromotive forces mentioned by Mr. Homan, namely, 111.65 and 111.76 volts, are the no-load values for transformers that operate at a full-load e.m.f. of 110 volts. In the latter part of my article it was stated that "not all of the lamps would be in use when the voltage was at the higher point." In any event, however, the lamps are used at e.m.f's. above the normal value.

The value of 18 cents per lamp covers not only the cost of the lamp, but also the time and expense necessary to replace it. The value of 15 per cent interest on the investment is not net but gross, and covers all points usually included in this item.

In regard to the operation of transformers at high temperature, Mr. Homan evidently overlooked the statement in my article that "the temperature rise is not a vital point because the transformers operate at full load for only a small part of the time." Naturally the 20-hour temperature of the transformer will be that due to the transformer iron loss only, and the operating temperatures of the transformers, namely the high-efficiency and low-efficiency types, when subjected to iron loss only do not differ materially. If the low-efficiency transformer were operated continuously at full load, it would naturally deteriorate more rapidly than the high-efficiency transformer.

Pittsburg, Pa. L. A. Starrett.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Voltage Regulation for Alternators.—M. SEIDNER.—Modern alternators with a voltage drop of from 15 to 25 per cent fulfill all requirements of practice, so that with such alternators there is really no necessity for employing a special method of voltage regulation. The author thinks, however, that in future the tendency will be to build alternators with from 30 to 50 per cent voltage drop because they are much cheaper, and then to employ a special method of voltage regulation. The various designs of voltage regulators which have been invented in the past are classified and briefly described. The author describes a new regulator of his own. The special feature is the use of an iron resistor, such as is used as ballast resistor with Nernst lamps. Its property is to regulate for constant current within certain limits of potential difference. By raising the potential difference at the terminals of an iron resistor the latter is brought from dark red heat up to bright red heat, and its resistance increases simultaneously in such a way that the current remains practically constant within these limits: If direct current and alternating current passes simultaneously through the iron resistor, the latter maintains the "geometrical" resultant of the two currents constant. If one current increases, the other diminishes. The principle of his voltage regulation is to pass through the iron resistor both the exciting direct current of the generator and the alternating current of the line. Any changes in the alternating current cause corresponding changes in the direct exciting current whereby the voltage variations of the generator are compensated. The first arrangement used by the author is shown in Fig. 1. *G* is the armature of the three-phase generator and *N* are the field windings which are supplied with direct current from the exciter *E*. The exciting circuit n_g contains the iron resistor r_e the terminals of which are also connected to the series transformer *St* and the shunt transformer *Sp*. Both direct current and alternating current pass, therefore, through the iron resistor r_e. Since with increasing load in the line the alternating current in r_e increases, the direct current will decrease. It is, therefore, evident that the exciter must be provided with a double winding, namely, with a magnetizing winding *n* and a demagnetizing winding n_g. The current in the latter is regulated by means of the iron resistor. Experiments has shown that such a differential excitation is unstable. The author, therefore, connects the two transformers so that their voltages are added under an angle larger than 90 deg. With increasing current the resulting voltage does not increase but decreases, which causes a decrease of the resistance of the iron resistor and results in an increase of the direct current. The iron resistor, therefore, regulates in the correct direction, with only one set of magnetizing winding. The arrangement of Fig. 1 has other disadvantages due to the fact that r_e, *E* and *N* are in parallel so that the alternating current exists not only in r_e, but also in the armature and the magnet-field coils. Similarly the direct current of the exciter enters into the secondary windings of the transformers and magnetizes them in one direction. To overcome these disadvantages the arrangement shown in Fig. 2 is now used. The rotation is the same as in Fig. 1. This method of voltage regulation is stated to be simple, cheap and absolutely safe in operation, and it can be applied to completed machines.—*Elek. Zeit.*, April 30.

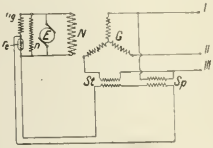


FIG. 1.—VOLTAGE REGULATION FOR ALTERNATORS.

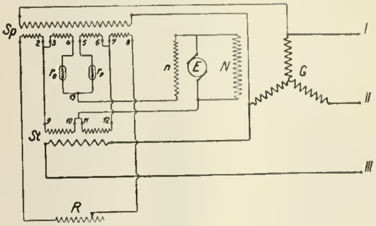


FIG. 2.—VOLTAGE REGULATION FOR ALTERNATORS.

Operation of Alternators in Parallel.—L. FLEISCHMANN.—The author criticises some objections which have been raised by Benischke against the formulas of Goerges and Rosenberg on the resonance phenomena of alternators. He also criticises a few fundamental points in Benischke's own mathematical theory. He concludes that the old theory has been found useful in so many cases that it is best under all circumstances to try to avoid any resonance which would occur according to the old theory.—*Elek. u. Masch.*, April 19. Benischke's and Fleischmann's replies in *Elek. u. Masch.*, April 26.

Parallel Connection of Alternators.—G. BENISCHKE.—While it is in general true that parallel operation of alternators, driven by reciprocating engines, is usually best accomplished by belt-driving, he describes two cases in which the belt driving rendered the parallel operation impossible. In both cases surgings occurred which were due not to oscillations of the electric machines themselves, but to impressed oscillations. In one case the lack of degree of uniformity of the rotative speed of the driving engine was too great, and the only remedy would have been to increase the weight of the fly-wheel. In the other case the trouble was due to torsion oscillations of the connecting axle. In both cases no remedy was tried and the alternators were not operated in parallel.—*Elek. u. Masch.*, May 3.

Lamps and Lighting.

Metallic-Filament Lamp.—An illustrated description of a new metallic-filament lamp of English make which, as already mentioned in the Digest, consists of a number of 20-volt to 25-volt tubular-unit lamps grouped together on one holder to form a 100-volt or 200-volt lamp. Each of the tubular lamps contains a substitutional resistor and a simple switching device, so that if one of the tubes burns out the others are not extinguished. Each of the low-voltage tubular lamp units costs about 25 cents, and, although the first cost of the whole lamp with its body is greater than that of the ordinary metallic-filament lamp, it is estimated that the cost of renewals will be far less, since these comparatively heavy flawless filaments will have a longer life and when one unit fails, only this one need to be replaced. The substitutional resistor is simply a short carbon filament within the lamp itself, as shown in Fig. 3, in which the metallic filament is marked *M* and this carbon filament *C*. The carbon filament is connected in parallel with the metallic filament through a miniature spark gap, contained in the lamp cap and consisting of two small pieces of metal, separated by two layers of an insulating material resembling tissue paper. The insulating material keeps the carbon filament out of circuit normally, but when any lamp tube burns out the potential across the spark gap rises from a value of 20 or 25 volts to the full 100 or 200, the insulation is punctured and the two pieces of metal are fused together making a circuit through the carbon filament. This latter has the same resistance as the metal filament, so that the same current as before continues through the remaining lamp tubes. The specific consumption per British candle-power is given as from 1¼ to 1½ watts. The 20-volt tubular lamp gives about 10 cp and a group of 10 on a 200-volt circuit will give 100 British cp with a consumption of from 125 to 140 watts.—Lond. *Elec. Eng'ing,* April 30.

Metallic-Filament Lamps and Central Stations.—An account of the continued discussion of Handcock and Dykes' recent paper on the effect of the new metallic-filament lamps on the business of central stations. C. P. Sparks said that the standard of illumination would be raised, and he did not think the electricity supply business would suffer severely. He expressed disapproval of the maximum-demand system and approval of the flat-rate system of charging. C. H. Stearn exhibited his new multiple-unit lamps (described in a separate abstract). P. Still preferred the flat rate of charging for lighting. L. Andrews cited instances in which the drop in revenue due to the introduction of metallic-filament lamps had been considerable. He thought the flat rate of charging inequitable, and said that good results, both as to consumption and load factor, had been obtained some years ago by charging $2.50 per lamp connected and 3 cents per kw-hour for energy. J. F. C. Snell had found that comparing incandescent gas burners with metallic-filament lamps, gas at 62 cents for 1000 cu. ft. was equivalent to energy at 7 cents per kw-hour. He believes in the flat rate of charging. R. Hammond gave figures showing the increase in kw-hours generated in London during the past few years; he is convinced that the falling off in output will be only temporary, and that the new lamps will be a magnificent thing for the industry. He approves the principle of the authors and Long's system of charging. E. T. Ruthven-Murray said that the power factor of auto-transformers used for metallic-filament lamps is as low as 0.7 on low loads, but rises to nearly unity on full load. He suggested the use of a time-limit indicator with a non-replaceable contact that could be set by the consumer. W. M. Mordey suggested the term "wire lamp" instead of metallic-filament lamp, and spoke strongly against the maximum demand system. (In letters in Lond. *Elec. Eng'ing,* May 7, it is pointed out that the term "wire lamp" is not correct, since with the exception of the tantalum filament, the filaments are not wire drawn, and the term "metal lamp" is put forward as a substitute.) In summing up the discussion, Colonel Crompton took the view that the new lamps would seriously affect some of the central stations, and that a review of the methods of charging is necessary.—Lond. *Elec. Eng'ing,* April 30.

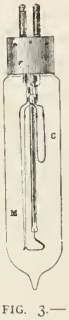


FIG. 3.—METALLIC FILAMENT LAMP.

Tungsten Lamp.—A description of a continuous method of Ruhstrat for making tungsten filaments. A continuous wire of tungsten oxide, etc., passes through an orifice in the press containing the paste and is then conducted through an electric furnace. When it leaves the furnace it is either wound on a roll or cut into predetermined lengths. The continuous speed of the moving wire is about 2 mm per second. The whole apparatus is enclosed in an air-tight vessel through which hydrogen passes.—*Zeit. f. Beleucht.,* April 30.

Graphite Filament.—A note on a method of the Anker Company for making graphite-filament lamps. Chemically pure graphite of low specific resistance is made up with concentrated nitric acid into a paste and heated in a large platinum crucible. To the residue about 10 per cent of a binding material (acetyl cellulose, solutions of pitch or thin coal tar, etc.) is added and the mixture is worked up into a uniform paste, which, by pressing through fine orifices, is formed into filaments. They are preliminarily dried, but before they have hardened completely and have become brittle, they are brought into the desired form, embedded in graphite and heated. Lamps with filaments prepared in this way are said to have a life of from 500 to 600 hours and are said to consume from 1 to 2.5 watts per hefner candle.—*Zeit. f. Beleucht.,* April 20.

Transformers for Metallic-Filament Lamps.—A. BAINVILLE.—The author refers to the design of the small transformers now on the market in England for reducing the supply voltage for use with low-voltage and low-candle-power metallic-filament lamps. He remarks that the design is very nearly the same as that of the transformers used by Weissman for his low-voltage carbon lamp system which was exhibited at the Paris Exposition in 1900. He used carbon lamps at 18 or 20 volts and from 10 to 16 cp, consuming about 2 watts per candle-power and having a useful life of 200 hours. The author thinks that the attempts to produce an efficient 16-cp, 220-volt, metallic-filament lamp will be futile and that the use of step-down transformers is preferable.—*L'Ind. Elec.,* May 10.

Small Transformers for Metallic-Filament Lamps.—An illustrated description of an "adapter transformer" which, as shown in the middle picture of Fig. 4, is connected between the lamp and the switch, so that its employment does not require any alteration of the wiring of the room. The transformer is placed in the lamp socket like any ordinary lamp, and the low-pressure lamp is placed in a socket provided at the lower end of the transformer. A single core of high-grade iron strip is insulated, and first the primary and then the secondary winding are put on. The ends of the strips are then bent round at both ends and both sides to form a closed magnetic circuit. On account of the modern methods of insulation employed in the manufacture of the "adapter transformers," a very high space factor is attained. The continuous rating of the standard type illustrated in the middle figure is somewhat over 20 watts, and the usual arrangement is to use one of these in conjunction with one 16-cp, 25-volt lamp, or two 10-cp, 25-volt lamps. The transformers can be obtained for primary e.m.f's. of from 100 to 250 volts and for a secondary e.m.f of 25 or 50 volts, and for any required frequency. Since an ordinary carbon-filament lamp consumes 3.75 watts per candle and most metallic-filament lamps consume about 1.2 watts per candle, and the efficiency of the "adapter transformer" is 85 per cent, consequently the combined transformer and lamp will consume less than 1.5 watts per candle or still less than one-half of the carbon lamp. At a slight extra cost a turn-down device can be fitted to the transformer. By twisting the lamp socket, the lamp terminals are brought in contact with stationary contacts connected to different points on the secondary winding, as shown in the right-hand diagram. There are, as shown, three positions: (1) 25 volts (full voltage), corresponding to the full candle-power, say 16 cp; (2) 20 volts, corresponding to about 10 cp, and (3) 5 volts, which gives a mere glow suitable for night light in the nursery or sick room. As the transformer is designed to work at full load, the value of the no-load pressure is of no account, and any drop can be allowed so long as the full-load terminal voltage is the proper voltage for the lamp to be used. This permits of a much more economical design, as the only factor to be considered is the heating of the iron and copper and the losses.—Lond. *Elec. Eng'ing,* May 7.

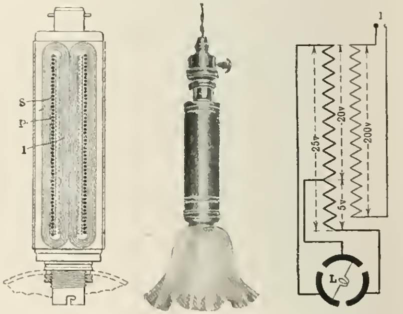


FIG. 4—TRANSFORMER FOR METALLIC-FILAMENT LAMP.

Leading-In Wires.—Descriptions of various methods for making a joint between the ends of the filament and the leading-in wires. The Allg. Elek. Ges. uses the heating effect of a high-ampere, low-voltage, alternating current, together with slight mechanical pressure. The current is applied only for from 1/10 to 1/3 second to prevent any oxidation. Kuzel joins the filament with the leading-in wires by means of a very refractory metallic carbide, for instance, manganese, chromium, tungsten, etc., carbide. If the ends of a carbon-filament are put into fused tungsten carbide made by the method of Moissan, the carbide passes into the pores of the carbon and when the filament is removed the end is covered with a layer of the carbide, which may be made of any thickness by repeating the operation. The joint between the nickel end of the leading-in wire and the end of the filament obtained by this method is strong; the same method may also be employed for metallic filaments. The tungsten carbide need not be chemically pure, but it may contain from 1 to 6 per cent of carbon, as in the case with carbide produced by Moissan's method. Other methods of making a joint between the leading-in wire and the filament are also described. —*Zeit. f. Beleucht.*, April 30.

Leading-In Wires.—B. Duschnitz.—An article discussing the production of the joint between the leading-in wire and the surrounding glass. Flint glass (containing lead) and platinum have almost exactly the same temperature coefficient of expansion. The author gives a long review of various proposals which have been made to save the expense for platinum, mainly based on patent specifications, and also discusses the use of two kinds of glass in the same globe.—*Elek. Anz.*, April 12, 16 and 19.—The same author discusses the methods of making the joint between the leading-in wires and the filament, the descriptions being based on patent specifications. Some general discussions are added.—*Elek. Anz.*, April 30; May 7-14.

Osram Lamps for Street Lighting.—Figures collected by P. T. Wilmshurst from actual operation of osram lamps in Derby show an average life of at least 1570 hours. Since a number of the lamps are still burning, their life will be longer, but no account has been taken of this fact in the above figure. The diminution of light up to the end of the life was small in each case. G. Wilkinson gives comparative figures proving that street lighting by osram lamps is much cheaper than by incandescent gas mantles. The comparative figures are as follows:

One 3-cu. ft. gas mantle costs per year for gas	$3.75
Mantle	.37
Total for 1200 hours, burning	$4.12
Electricity at 2.5 cents per kw-hour, for 33-watt osram lamp, which gives an equally good light, and often better than a gas mantle	$2.31
Renewals	.75
Total for 2100 hours, burning	$3.06

As to the life of the osram lamp, Wilkinson states that "this appears to be very satisfactory. They appear to last much longer when used without globes, probably due to the cool atmosphere around them; we have numbers of them in the town burning well on to 3000 hours, and the average is probably over 2000 hours, excepting in case of accidental breakage." —Lond. *Elec. Eng'ing*, May 7.

Nernst Lamp.—In order to avoid the use of special preheating devices for Nernst lamps, the Cons. f. Elektrochem. Ind. mixes the rare earths, etc., with tungsten, or tungsten alloys. The content of tungsten gives the filament the desired conductivity in the cold state. Filaments of this composition must be used in vacuuo or in an inert atmosphere, and the lamps can be operated only with alternating current, since with direct-current, electrolysis destroys the filaments. The lamps must be used with a ballast resistor (iron).—*Zeit. f. Beleucht.*, April 20.

Mercury-Vapor Lamp.—P. A. Huguenin.—An illustrated description of his method of starting mercury-vapor lamps. When the switch is closed, an electromagnet imparts to the tube a tipping motion, and, by means of a contact device, a portion of the electromagnet winding is caused to remain in series with the arc and to give the resistance and reactance necessary for the stability of the arc. The system is easily applicable to connection of several lamps in series. Several possibilities of improving the color of the light are also discussed.—*La Lumière Elec.*, April 18 and 25.

Polar Curves.—W. Voege.—A translation with illustrations of his recent German paper on a new method of obtaining polar curves of distribution of light or an artificial illuminant. As was noticed in the Digest, the author measures the total radiation in different directions around the lamp by means of a thermo element and reduces the results to photometrical curves by measuring the intensity of the light in one direction and assuming a constant ratio of luminous energy to total energy in all directions.—Lond. *Elec.*, May 8.

Generation, Transmission and Distribution.

Electricity in German Mines.—An article on the large increase in the use of electric motors in mines in the Rhenish Westphalian district and especially in the Ruhr coal district, where the separate steam plants are gradually being superseded by electric power. The generating plant is always located where the cost is a minimum, either at the colliery or at coke ovens where the gases are utilized. A greater distance between the different generating plants offers no difficulty for their operation in parallel and for using one or the other as reserve. The mine companies have begun to supply electric energy to towns in the neighborhood. For instance, the Hibernia Company, which had no electric installation in 1902, has gradually installed a number of generating plants which will have a rating of 20,000 hp during the middle of this year. All the mines are connected together by double cables. The total length of these cables and overhead wires is 120 km (more than 70 miles), while the cable network of the supply company which receives energy from the mining company has a length of 130 km (80 miles). Steam turbines and gas engines are used. The total number of kw-hours produced in 1906 was 13,900,000, which was increased in 1907 to 23,900,000, of which 18,500,000 were used by the mining company itself and the balance was sold to a supply company. —*Elek. Zeit.*, May 7.

Electric Hoisting.—Kammerer.—A long illustrated lecture held before the Berlin Electrical Society on the changes in the mechanical design of hoisting, etc., machines, due to the use of electric power, with special reference to elevators, cranes, winding machines for mines, etc.—*Elek. Zeit.*, April 23, 30; May 7, 14.

Slide-Rule.—An illustrated description of a new multiple slide-rule for steam-engine calculation, for instance, for finding quickly the power of an engine of given dimensions or reversely the size and the speed of an engine to develop a given power.— Lond. *Elec. Eng'ing*, April 30.

Traction.

Railway Converter Substations.—J. E. Woodbridge.—The requirements of direct-current railway substations are so similar in the majority of cases that the author argues it would be found of value to electric railway managers and engineers to co-operate in effecting a more complete standardization of substation design and railway transmission potentials. The subject is discussed in the following order: Standard transmission voltages; standard features of the apparatus; typical station designs and details. The discussion, which is based on long, practical experience, is very concise and cannot be abstracted briefly.—*Gen. Elec. Rev.*, May.

Installations, Systems and Appliances.

Resistance of Insulators.—F. Negre.—An account of results of some tests on insulators. One of the poles of a Wilmshurst machine was connected with the neck of a bell insulator, and the other through a galvanometer with the attachment. The tension was measured with an electrometer. A simple bell insulator, 8 cm in diameter, and a triple bell 11 cm in diameter, were tested at 5500 volts. In another series the e.m.f. was increased to 50,000 volts. In some cases the bells were moistened with vapor or covered with lampblack. Each insulator has a "critical tension" up to which the insulating resistance is constant. This critical tension varies with the diameter and other dimensions, and with the state of moisture and cleanliness. It was found to be 11,000 volts for a simple bell, 16,000 for a triple bell, and 32,000 for an American type designed for 50,000 volts. After the critical tension is exceeded, the resistance rapidly declines, especially if the insulator is damp or dirty, or has a small diameter. Fine water drops distributed over the surface coalesce into larger drops; these congregate on the rim and become pointed. In the dark, brush discharges are seen to start from the points of the drops. These discharges are specially marked when the potential is positive. When it is negative a faint glow takes the place of the brush discharge. —*Comptes Rendus*, April 21; abstracted in Lond. *Elec. Eng'ing*, May 7.

Regulations.—K. Wilkens.—The author criticises the police regulations on erection, operation and supervision of electric installations proposed by the Prussion government department and suggests a different set of regulations. The chief criticism made is that the government rules try to improve the quality of installation and care in maintenance by police regulations which in the opinion of the author is wrong.—*Elek. Zeit.*, May 7.

Wires, Wiring and Conduits.

Thread of Sockets.—A committee of the German Assoc. of Elec. Eng. proposes standardization of the thread of sockets, based on the Whitworth thread with a pitch of 26 threads per inch and a depth of 0.625 mm. A supplementary article of P. H. Pearls gives explanatory notes on the proposed system.—*Elek. Zeit.*, May 7.

Calculations of Coils.—An anonymous article describing a simple method of calculating the chief dimensions of a coil with tables for different kinds of wires.—*Elek. Anz.*, April 19 and 23.

Electrophysics and Magnetism.

Magnetic Alloys.—P. Asteroth.—An account of experiments on the influence of thermal and magnetic history of hysteresis and other magnetic properties of Heusler's magnetic alloys made from non-magnetic elements. Quenching of the alloys eliminates the hysteresis entirely, the "loop" being converted into a single straight line. On heating the alloys above the temperature of transformation, cooling them for three hours, and "ageing" them at a temperature of 140 deg., the hysteresis loop reappears. The coercive force becomes 18 in a casting, and the remanent magnetism 820 c.g.s. For a wrought piece the figures are 3.5 and 600 respectively. The author points out that the magnetic properties are thus largely within our control. The hysteresis has many analogies with elasticity and crystallization. It appears that quenching prevents the magnetic molecules from settling into positions in which they can obey magnetizing forces. The formation of larger aggregates encourages such mobility, but also increases the viscosity which resists the orientation. The magnetic orientation may also depend upon the rotation of electrons attached to the atoms. If this is facilitated by larger crystalline aggregations, the influence of quenching is quite clear. The elimination of hysteresis is of great theoretical interest.—*Verh. German Phys. Soc.* No. 2; abstracted in Lond. *Elec. Eng'ing*, May 7.

Radioactivity.—A paper by S. Russ discusses the distribution in electric fields of the active deposits of radium, thorium and actinium. R. D. Kleeman discusses the different kinds of gamma rays of radium and the secondary gamma rays which they produce, while W. H. Bragg and J. P. V. Matzen report on an experimental investigation of the nature of the gamma rays. The result of the latter investigation appears to be that the gamma rays are material in nature.—*Phil. Mag.*, May.

Electrochemistry and Batteries.

Copper Refinery.—F. D. Easterbrooks.—A profusely illustrated description with detailed drawings of the new electrolytic tank house of the addition of the Raritan Copper Works. There are 1188 cells, and the Walker system of tank arrangement is employed. The current density is 20 amp per square foot, the minimum current 7500 amp. The new copper furnaces and apparatus for casting wire bars are also described. There is also an editorial discussing the relative advantages of the multiple system and of the series system of copper refining.—*Electrochem. and Met. Ind.*, June.

Units, Measurements and Instruments.

Meter and Relay Connections.—H. W. Brown.—The author presents the chief principles to be observed in making connections to meters and relays, with application of these principles to questionable cases which may arise. The summary of his discussion is as follows: Alternating-current lines having series instruments may be considered positive if there is a return line that is considered negative. The direction of current is then the same as the direction of energy transmission. The direction of external current from the secondary of a shunt or series transformer is the same as if the secondary circuit were connected directly to the corresponding primary terminal. For normal action of any standard type of meter, corresponding e.m.f. and current circuits should have currents in the same direction. On standard types of meters having both series and shunt circuits, series circuits are brought out at the bottom and shunt circuits at the top, except on recording meters which have both shunt and series connections at the bottom. In the polyphase watt-hour meter, shunt circuits are above the corresponding series circuits. In power-factor meters, shunt circuits should be connected across the phase whose current passes through the series circuit on the left side as viewed from the rear.—*Elec. Jour.*, May.

Resistance Cut-Out for Electrostatic Voltmeters.—Electrostatic voltmeters are largely in use as earth detectors on high-tension circuits. According to the (Brit.) Home Office Regulations, on every completely insulated system in a coal mine an earth detector should be kept connected up continuously in circuit, so as to indicate the leakage current. As is well known, this regulation cannot be carried out, as no method is known whereby the leakage current of, for example, a 2200-volt, three-phase circuit can be continuously indicated. On such circuits, therefore, an attempt is made to comply with the spirit of the regulation by installing three electrostatic voltmeters connected between phases and ground. A British firm has brought out an instrument containing three electrostatic voltmeters in one case for this purpose. The following method of protection is provided against injury due to internal sparking: The apparatus consists of a small glass tube filled with water of a certain conductivity corresponding to the voltage of the supply. A small valve is provided in the glass tube near the bottom, consisting of a hole covered with a piece of rubber tubing. This water-tube resistor is placed in series with the electrostatic voltmeter. The current is led in at the bottom of the glass tube and taken out at the top by means of platinum wires fused into the sides of the tube. The whole is enclosed in a removable porcelain handle. The method of mounting is shown in Fig. 5. The resistance of the water tube is so adjusted that if sparking occurs, for any reason, within the voltmeter the current is limited to such an extent that only a small amount of energy is expended in the water tube. If the current continues the water is heated and boiled, and a slight jet of steam issues from the valve above referred to, interrupting the circuit. The device has been subjected to very severe tests, such as placing it directly across the terminals of a 3000-volt alternator, when the circuit was interrupted so quietly as to be scarcely perceptible.—Lond. *Elec.*, May 8.

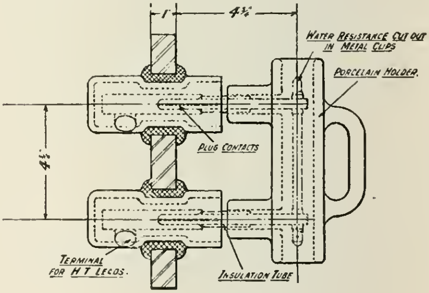


FIG. 5.—RESISTANCE CUT-OUT.

Telegraphy, Telephony and Signals.

Telegraph Cables.—E. F. Patritsch.—The Austrian telegraph department has lately used for its larger installations a new type of cable in which the insulated conductors were covered with a layer of tin-foil in order to diminish and dampen the mutual induction of the conductors in the cable. While for telephone cables this arrangement has been effective in producing a certain amount of damping, it has been denied that it would be effective for telegraph cables. The author has made an extended investigation of this problem with the aid of an oscillograph. The arrangement of the experiments is described. The paper is to be concluded.—*Elek. und Masch.*, May 10.

Slightly-Damped Oscillations.—B. Glatzel.—A description of a new method of obtaining slightly damped electric oscillations. The idea is to excite in the primary circuit an oscillation which does not run off into a damped oscillation but stops after the first quarter-period. The secondary circuit, closely coupled with the primary, then receives a single strong impulse, which produces oscillations of the proper period of the secondary circuit. If the secondary contains no spark-gap, the damping may be very slight, so that there is a way of producing very feebly damped oscillations. The coupling may be close enough to utilize the whole force of the impulse. There will be no recoil into the primary, since the latter is open. The primary impulse may be obtained by an adaptation of the Cooper Hewitt mercury arc. This has the peculiarity that as soon as the current falls below a certain value, there is not sufficient heat to evaporate the mercury, and the current is broken. This is secured by designing the apparatus in such a manner that the greatest possible amount of energy is absorbed during the first impulse. The oscillations cannot be more rapid than about 50 per second, as otherwise the current remains uninterrupted.—*Verh. German Phys. Soc.* No. 3, abstracted in Lond. *Elec. Eng'ing*, May 7.

Electrically Driven Wood-Working Plant.

The new plant of the Virginia Table Works, at Marion, Va., affords many opportunities for a study of modern wood-working plant design. This factory is completely equipped with electrically-driven wood-working machines and illustrates thoroughly the advantages of the electric drive for this class of machinery.

In deciding upon the adoption of the electric drive for this plant many factors were taken into consideration. The company desired to obtain a maximum output from a minimum operating space. It was found that with the electric drive more space could be utilized and the machines located to better advantage as regards lighting and the proper sequence of manufacturing operations. The elimination of all heavy line shafting with high friction losses and attendant annoyances from broken belts and obstructed light and the reduced fire risk were all taken into consideration.

The initial costs of the electric drive and of the mechanical drive were found to be approximately equal, but when the company learned that energy could be purchased from the local lighting company at 2 cents per kw-hour it found that with the adoption of the electric drive there would result a large saving in the cost of energy. This point has been borne out during the operation of the plant for several months.

It might be well in this connection to mention the fact that the president and general manager of the Virginia Table Works is also a manufacturer of heavy wagons. In the wagon plant, where the mechanical drive is used, the cost of energy, not including renewal of belts, amounts to more than $200 per month. When it is considered that the monthly cost of energy in the table works averages about $130 and that the number of machines in service in the two plants is about the same, it will be seen that the electric drive accomplished what is desired by every manufacturer, namely, the reduction of operating expenses.

The total rating of motors installed throughout the plant is about 175 hp. They are of the induction type manufactured by the General Electric Company. These motors have long been looked on with favor in wood-working plants on account of their simplicity and ruggedness. The absence of all moving electrical contacts in this type of motor and the consequent reduction of the fire hazard is also an important point in their favor.

The fact that the starting resistor is contained within the revolving member, thus eliminating the separate starting compensator, contributes to a wiring arrangement that is remarkably free from complication. A main switch with the necessary fuses is all that is required. The wiring throughout the plant is done in a neat and substantial manner.

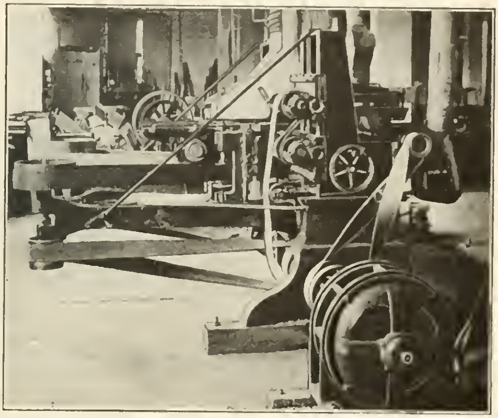


Fig. 1.—Induction Motor Direct-Connected to Tenoner Cut-off and Rounding Machine.

The electrical energy transmission throughout the mill is at 220 volts; three-phase, 60-cycle alternating-current being supplied by the local lighting plant. In this connection it is interesting to note that although the total generating rating of of this plant is only 100 kw, or about 134 hp, energy is supplied not only to the table works, but also to several small factories in the town.

With one exception the individual drive is used throughout. In many cases the motor is direct connected by means of flexible couplings either to an extension of the machine shaft or to a countershaft contained within the machine. Where this method is impracticable, the motor is either connected to a countershaft to which the machine is belted or it directly drives the machine by means of a short belt connection.

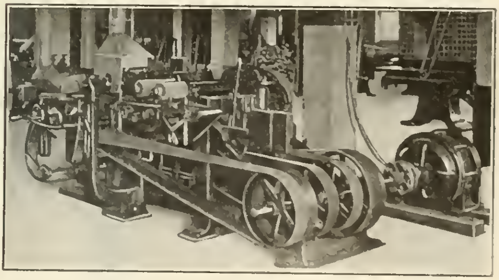


Fig. 2.—Induction Motor Direct-Connected to Countershaft of Molder.

Figs. 1 and 2 are excellent examples of the direct drive. In Fig. 1, which shows a double-end tenoner, cut-off and rounding machine, driven by a 15-hp motor, the motor is connected directly to a countershaft contained within the machine. A short belt, shown in the illustration, drives the cut-off saw attachment. In Fig. 2 a 20-hp motor is shown driving an H. B. Smith Machine Company's No. 108 9-in. molder. It will be noted that the bedplate of the machine is extended to carry the countershaft, which is direct-connected to the motor. The feed rolls and cutters are belt driven from the countershaft. This method of connection results in a compact and easily accessible unit with an abundance of head room. The absence of overhead belting contributes also to a better lighting arrangement.

A typical illustration of the belt drive without countershafts may be seen by referring to Fig. 3. A 20-hp motor is here shown driving a Merritt table-leg machine. A direct-connected motor could not be used in this case on account of the high speed of the cutter head. This same method was applied in a similar case involving the operation of a double-spindle shaper by a 4-hp motor connected to a short countershaft.

A Fay-Egan triple-drum sander is driven by a 25-hp motor. The method of connecting the motor directly to the countershaft is used throughout with the exception of one group drive. In this case a 10-hp motor drives a countershaft from which the following machines are belt driven; two hand lathes, one spindle carver, one dovetail machine, one combination saw, two emery grinders, one post borer and a belt sander. All of these machines are small, and the arrangement is compact.

All sawdust and shavings are effectually removed from the machines by an exhaust blower direct connected to a 20-hp motor. Exhaust pipes carried directly to the floor afford an easy and effective method of disposing of the sweepings. As stated before, all refuse material is carried directly to the boiler room, where it serves as fuel.

Among the motor-driven machines not mentioned are a swing cut-off saw, glue jointer, cabinet surfacer, band saw, etc.

The operation of the plant has been satisfactory in every respect and no trouble whatever has been experienced. The factory superintendent states that he finds the electric drive to be more satisfactory in every way than the mechanical drive, giving as his reasons that the machines are located to better advantage than would be possible with long-line shafting and that the flexibility of control is greater.

The president of the concern aptly expresses his views of the electric drive in the following: "We are very much pleased with the motor drive and everything is going along successfully. I do not hesitate to say that I would not change to any other drive I know of, even at much less cost." The Jas. D. Lalor Engineering Company, Washington, D. C., had charge of the design and general layout of the plant.

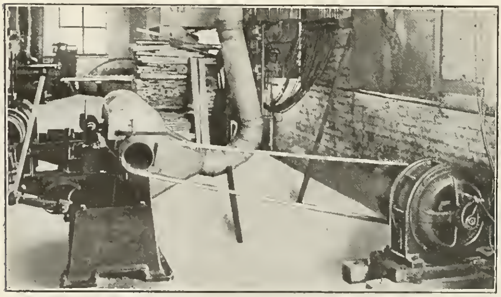
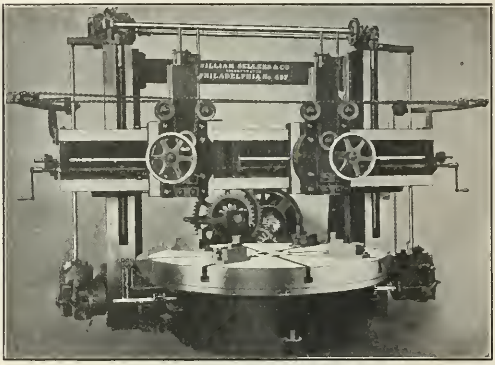


FIG. 3.—INDUCTION MOTOR BELTED TO TABLE-LEG MACHINE.

Boring and Turning Mill.

Manufacturers in this country make more extensive use of boring and turning mills than in any other country, although this useful machine tool was first developed in England. This is doubtless due to the improvements made by American machine tool builders, who have departed widely from the types manufactured by their foreign competitors. The range of use to which this machine may be put is very wide. In many shops it takes the place of a lathe, because for many classes of work it is the more economical tool, owing to the facility with which the work can be set on the face plate. In some shops it is customary to place a number of pieces of comparatively small work on the surface of the table around the edge, and thus turn almost a continuous ring. When the work permits it, both tools on the cross-head may be made to cut at the same time, one on the top of the work and the other on the side.

In order to obtain the greatest output for a tool of this nature, it is necessary to provide the greatest convenience for all the movements, horizontally, vertically, engagement and disengagement of feeds, etc., so that the machine can be kept under cut as much of the time as possible. The time which is lost in preparing work reduces the output of the machine, and it is the output that brings profit. The actual investment charge for the machine will in many cases be found to be a more important item than the labor charge and hence every increase in production is a direct saving.



BORING AND TURNING MILL.

By using a variable speed motor installed as an integral part of the boring mill, the correct speed may be obtained in the minimum amount of time, as the controlled handle is conveniently located for the operator.

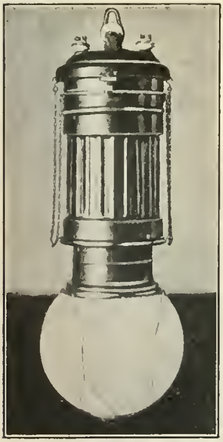
The boring mill shown in the illustration, built by Wm. Sellers & Company, Inc., of Philadelphia, is capable of taking work 84 in. in diameter. The variable speed motor, supplied by the Westinghouse Electric & Manufacturing Company, has a speed range of 2½ to 1, giving the table any speed between 1 and 23.8 r.p.m. with the exception of two small gaps. The feed may be varied from 1/32 in. to ¾ in. per revolution of the table in eight steps.

The machine is entirely self-contained and not dependent upon supplemental foundations for its rigidity, as the only portion of the machine extending below the floor line is the lever for adjusting the center step, which is accommodated by a trough 7 in. wide by 7 in. deep. The table has a flat bearing with a central spindle and adjustable step controlled by the lever mentioned above. The use of the motor permits the machine to be located where the work can be supplied to it with the least handling, thus decreasing the lost time, when the machine is not producing. The wide speed range permits work of various diameters to be turned at the maximum cutting speed.

Arc Lamps with Inclined Electrodes.

The lamp illustrated on the next page is of the inclined-electrode type with nothing below the arc to obstruct the light. Both electrodes feed by gravity simultaneously, the regulation of the arc being accomplished by the lateral movement of one electrode with reference to the other.

A serviceable reflector of refractory material surrounds the points of the electrodes just above the arc so as to prevent the "washing" of the electrode ends, and to steady the arc from the effects of air currents as far as possible. A "blow magnet" is so situated with relation to the arc that it performs the double function of keeping the arc steadily fan-shaped at the electrode tips and also totally extinguishes the arc if for any reason it approaches dangerously near to the reflector. The reflector, therefore, is well protected from burn-out and should last indefinitely. A heavy "baffle plate" of insulating material is provided just above the reflector, thereby effectually preventing any appreciable amount of the products of the arc from depositing on the parts of the mechanism. During operation the lower surface of the bottom plate of the lamp and of the reflector becomes coated with white deposit from the arc which acts as an excellent reflector for the upward light from the arc.


ARC LAMP WITH INCLINED ELECTRODES.

These lamps are designed to burn two-in-series or singly across direct- or alternating-current circuits at from 100 to 125 volts. They can be used on any frequency between 40 and 140 cycles. The lamps may be wound for either 8, 10 or 12 amp, the latter current being considered standard. All lamps are equipped with light opal globes.

The life of these lamps is stated to be about 12 hours on in door circuits and between 10 and 11 hours on outdoor circuits. The simple construction and the large volume of illumination obtained from these lamps appeal to the operators of mills, wharves, warehouses, erecting shops, foundries and other places where the quantity of light is as desirable as the quality. This lamp has just been placed on the market by the General Electric Company, Schenectady, N. Y.

New Electric Car.

For some months, Mr. Hiram Percy Maxim and Mr. T. W. Goodridge have been engaged in the production of a new electric car which was to have several entirely new features. This car has just made its appearance, and in several details it is a striking departure from the conventional electric carriage design. A worm-and-wheel drive is used in place of the customary gear and pinion and sprocket and chain. The mounting of the worm drive is very interesting, as will be seen from an inspection of Fig. 1. The electric motor has its shaft prolonged and the worm mounted directly upon it. The worm wheel is supported in a separate housing which is divided vertically, and attached directly to the end of the motor. The stub shafts of the differential project through this housing, as will be seen in Fig. 2. The drive is very simple, as the entire gear reduction of 10 to 1 is accomplished in one small housing which is virtually a part of the motor. All chains, chain housings, strut rods, adjustments, gears, pinions and gear housings are at once avoided, and the entire transmission made enclosed, self-contained and silent.

The great objection to the worm-and-wheel drive has been the question of loss, due to the working action being entirely a sliding one, instead of approximately a rolling one, as in the case of gears. The irreversible feature of the worm has been also a hindrance to its favorable consideration. The builders claim to have perfected a design whereby all of these faults are overcome. The worm and wheel run in oil and require no adjustment. The worm is made of steel and hardened, and the worm shaft and motor-armature shaft run on ball bearings.

Another feature of the car is the mounting of the motor and transmission. These are carried on the chassis frame. They hang just so that the differential stubs, already referred to, stand in approximate alignment with the centers of the rear wheel hubs. Two universal jointed driving shafts then connect the differential stubs with the rear wheel hubs. Up and down motion of the body is allowed for by the universal joints. For average loads these shafts are in a straight line, approximately, and only on jounces and recoils is there any motion in the joints. The rear axle is offset to allow for the clearing of the universal joints, and except for this offset, is an ordinary plain carriage axle. The rear wheels run on this axle, and driving dogs engage at the outer ends of the hubs in the same manner as in conventional floating axle design.

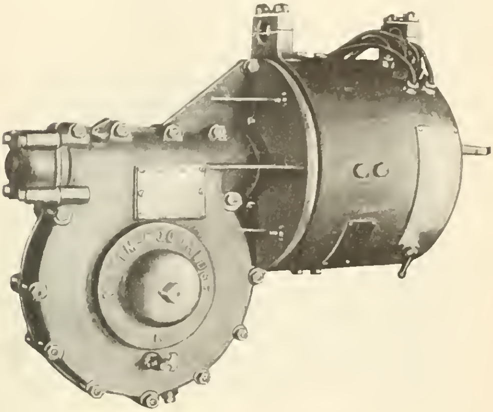


FIG. 1.—WORM-AND-WHEEL DRIVE.

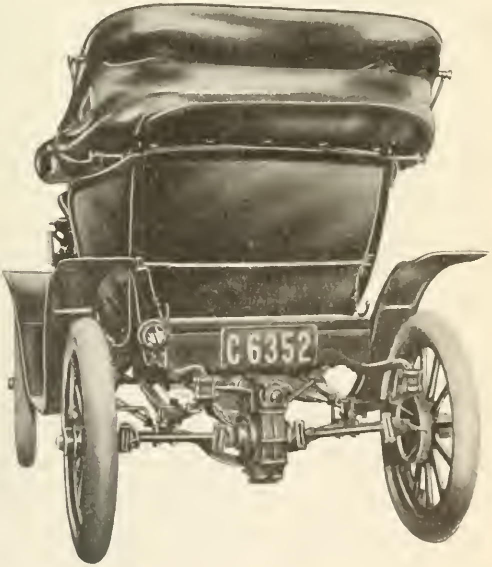


FIG. 2.—VIEW OF REAR OF VEHICLE.

This carrying of the weight on the springs, instead of carrying it rigid and "dead" upon the rear axle, makes the riding of the car very much better, and also admits of the use of solid rubber tires instead of pneumatics. This demand is one that is fast developing.

The carriage is equipped with 30 Exide cells, and all of seat and is not much greater than is the weight on the front wheels. This has an important effect in the softness of riding and materially assists the tire problem.

The control of the car is likewise original. Instead of the conventional lever projecting upward through the seat, the controller handle is mounted on the steering post just below the steering lever. There are two brakes fitted, each being a foot lever projecting upward through the floor. One brake operates on the hubs and one upon the motor shaft. The wheel base is especially long, being 84 in., which materially adds to the ease of riding. The wheel diameter is 32 in. and the tire used in both solid and pneumatic is 3½ in. The motor is of General Electric make, and the control is by means of the new style uninterrupted torque, multiple-series controller, giving five speeds ahead and three reverse. The maximum speed is 18 miles per hour. The mileage per battery charge with either solid or pneumatic tires is said to be 50 on ordinary road surfaces and much more on good city pavement. The weight of the car is 2100 lb. with the battery mentioned and correspondingly less with smaller battery and simpler body. The chassis is entirely self-contained and can be fitted with any type of body. The car is built by Maxim & Goodridge, Hartford, Conn.

New Works of Lincoln Electric Company.

Several novel features have been incorporated in the new works of the Lincoln Electric Company, East Thirty-eighth Street and Kelley Avenue, Cleveland, Ohio. The building, 120 ft. x 55 ft. ground dimensions, is of concrete block construction, well lighted and ventilated by numerous large windows on all sides. The blocks are laid up in such a manner as to provide an air space in all walls. The interior is of steel and wood treated with water paint, one of the best forms of slow-burning construction. Floors are all of 2½-in. tongue and grooved boards. Further fire protection is afforded by a composition and gravel roof and standpipes connected with the city water mains, with hose connected on each floor. Considerable attention was paid to safety features, and the architect succeeded in making the building as nearly fireproof as possible for that type of construction.

The first or basement floor contains the power and heating plants, the punching department, boring mill and storage space. The power plant consists of a Lincoln three-wire generator, giving direct current at 110 and 220 volts at one end of the machine for operating the small motors in the shops, and three-phase, 25-cycle current at the other end, which will be stepped up to 110, 220 and 440 volts for testing. For the higher voltages to be used in testing, 60-cycle current is obtained from the Cleveland Electric Illuminating Company's circuits. The equipment for these tests is located in the winding room on the third floor, and consists of a transformer with nine taps for giving from 500 to 10,000 volts in 500-volt steps. All windings are given rigorous tests before they are allowed to leave the shops.

The method of furnishing the various departments with hot water deserves mention in this connection. The water from the gas engine flows to a closed pressure tank, attached to the city water mains. This is enclosed in a sheet-metal case, with an electrically-operated fan at an opening near the bottom for cooling the water. The cooler water sinks to the bottom and is again used in the engine, while hot water is taken off through a pipe system at the top and conducted to various parts of the building. The pressure from the city mains keeps the tank filled and at the same time raises the water in the pipes to any point desired.

Another feature of the power plant is the fact that the exhaust gas is used for heating the baking room on the third floor. After leaving the engine the pipe divides, both branches going to the room mentioned. Here each one again divides, one portion extending up and the other down from the junction point. From these latter divisions 10 radiation pipes are taken off. These extend straight along the walls of the room, and those from each side enter two other larger pipes, these latter being connected by a T-section, to which the outside exhaust pipe is attached. The area of the radiation pipes is about nine times that of the pipe which carries the gas to the dividing point and each division is larger than the preceding one. By this arrangement all back-pressure is eliminated. The exhaust makes scarcely any noise because of the numerous subdivisions of the piping.

The hot gas alone is sufficient to maintain a temperature of about 175 deg. Fahr. in the room, but with the aid of an electric heater the heat is kept at 200 deg. Working under a full load the engine will probably furnish enough heat for the room without any aid from the electric heater. It is estimated that the room has the use of almost as much gas now, without additional cost, as would be required to heat it in the usual way In other words, the gas is serving two purposes, and from an economical standpoint, this is an important feature.

In the machine shop, on the second floor, belts have been done away with entirely, all the lathes having been equipped with Lincoln motors, mounted on the machines and operated with gear transmission. All motors are of the variable-speed type, and are operated at either 110 or 220 volts, according to the speed desired. This, of course, gives a ratio of 2 to 1 and the use of field resistance for the smaller steps gives a ratio of 3 to 1, so that the total range of the machines is 6 to 1. Rapid reversal is one of the main features of these motors. Going at a fairly high speed, they may be reversed within the limit of about one revolution. Reversal is secured by a reverse current sent through the armature and the speed range in both directions is the same.

A 32-in. Schumacher & Boye lathe is served by a 5-hp motor, while a New Haven 24-in. lathe has a 3-hp motor, and an 18-in. lathe a 2-hp motor. Four 14-in. lathes are operated by 1-hp motors, and the shaper and milling machine by 2-hp motors. The absence of belts on this floor makes it possible to serve all the large machines on the east side by a traveling crane with a span of 17 ft. for the whole length of the bay, 120 ft. Provision is made for a similar crane in the east bay when it is needed, but at present it is used for lighter work which may be handled in other ways. The crane was designed by the Forest City Engineering Company, which also prepared the plans for the building.

The winding department, on the third floor, is served by an overhead trolley with track extending over the benches along the east side of the room, then turning to the west over the dipping cans and into the baking room. By the use of this trolley one man is able to handle any machine produced in the shops.

As conducted in this shop, the dipping and baking process is interesting. All armature and field windings are thoroughly dried first and then dipped into a neutral varnish, in which they are allowed to remain until bubbles cease to rise to the surface. when they are removed for baking. After being dipped into an oil-proof varnish they are given the final baking. The windings are thus thoroughly impregnated with varnish and protected from dampness and injury.

In addition to what has already been said regarding the baking room on this floor, it might be mentioned that the inside walls are made of hollow tile with an air space to aid in retaining the heat. The roof is of corrugated iron, covered by about 3 in. of sand. So thorough is the protection that little heat can be noticed at any time on the outside of the walls.

All floors are reached by an electric elevator, which was made complete in the shops of the company. It will carry 5000 lb. easily and serves all the purposes of the shop. All machines are tested to 3000 volts alternating current between the winding and ground before they are allowed to leave the shop. This insures satisfactory operation when they are put into use. The company manufactures direct-current machines from 4 hp to 120 hp and alternating-current motors from 1 hp to 200 hp, as well as magnets with a lifting capacity of one ton of scrap or pig, and long-pull solenoids for lifting bridge breaks and other purposes, with a capacity up to 500 lb. through a distance of 6 in. or 7 in.

Generating Sets for Industrial Plants.

For many years the B. F. Sturtevant Company has been manufacturing generating sets of small capacities up to 150 kw. The sets with vertical engines have been designed especially for marine lighting, and have so successfully passed the rigid government specifications that large numbers furnish the light on battleships, cruisers, excursion steamers, etc. The primary features of these sets have been capacity for continuous operation without attention and are equipped with balanced piston valves for simple engines, and piston valves and balanced slide valves for the compound type.

The success of these sets has led the B. F. Sturtevant Company to build them in larger sizes—sizes which admit of high steam economy—and they are now being placed upon the market in capacities from 150 to 500 kw, the engines being of the four-valve type and equipped with gridiron valves. To get the best possible economy, each steam valve is provided with an auxiliary cutoff valve so that the cutoff may be automatically controlled by the governor and varied according to the load independently of the other events. The main steam valves and the exhaust valves, which are also of the gridiron type, are actuated by the eccentric on the shaft.

These engines are especially adapted for industrial plants where it is desired to have power at least cost and supplied continuously, and will be appreciated by those willing to pay more for first cost, and then get the benefit of continual saving. Although economy is an important feature of this type of generating set, other advantages have not been overlooked in the design. The clearances have been reduced by making the engines of the four-valve type; vibration has been eliminated by the cross-compound type and perfect balance; and the design gives every opportunity for easy repairs. The valves are placed in cylinder castings and not in the heads, so that the cylinder heads may be removed and the piston inspected or repaired without disarranging the valve gear.

To reduce the necessity of frequently adjusting the wearing parts, the engine is equipped with an automatic system of forced lubrication. A small direct-acting pump maintains, within a system of pipes and passages, a pressure of about 15 lb. per square inch. This system supplies all the wearing surfaces within the enclosing frame of the engine, and so abundant is the lubrication that the wear is almost imperceptible, and the adjustable parts need be taken up only at very long intervals.

As further protection from dust and accident, all removable parts, except some of those connected with the valve gear, are entirely enclosed by the cast-iron frame. At the top of the frame there is a watershed partition which separates the frame from the cylinder and prevents oil within the frame entering the cylinder on the piston rod, and also makes it impossible for the condensation from the stuffing box getting into the frame and mingling with the oil. The watershed partition has a further advantage in that it protects the lower cylinder head, and as the cylinder head is maintained at a comparatively low temperature, vapors do not form on it from oil and water.

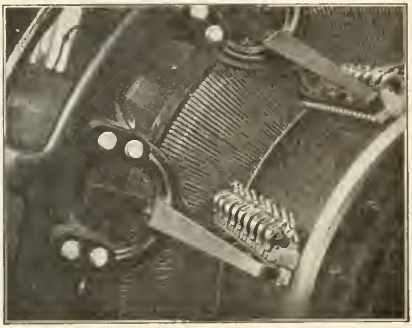


FIG. 2.—COMMUTATOR AND BRUSHES OF 10-POLE GENERATOR.

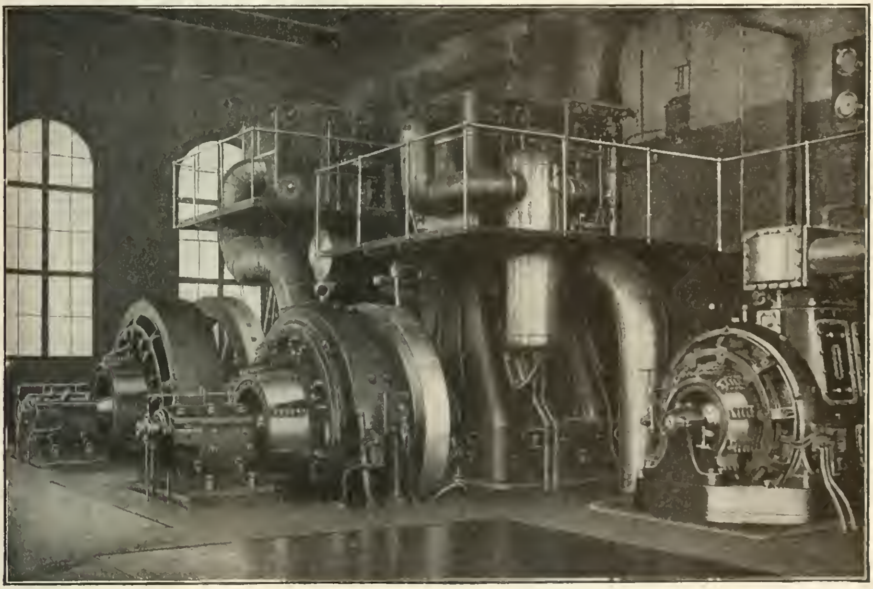


FIG. 1.—POWER HOUSE SHOWING THREE GENERATING SETS OF 100-KW, 250 KW AND 400 KW

The generators are direct-connected to the engine shafts by flange couplings. As in the case of the engine, they are especially adapted to the power plants of factories and mills, for they are designed for a wide range of load and require little or no attention. Ample cooling surfaces and abundant ventilation contribute to freedom from heating and burn-outs. These machines are capable of carrying an overload of $33\frac{1}{3}$ per cent for two hours without injurious sparking, and will carry 100 per cent momentarily without destructive sparking or heating. The insulation between the windings is given a test at alternating pressure of at least 1500 volts at 60 cycles for a period of 60 seconds. Especial attention has been given to the pole pieces so that the magnetic flux is perfectly distributed and the plane of sparkless commutation constant.

The armature is of the iron-clad, drum-wound type, the core being built up of sheet steel segments, clamped between end flanges and provided with vanes which maintain a constant blast of air over the surfaces of the winding. The armature is multiple-wound and provided with cross-connecting rings, so that all brushes of the same polarity are maintained at the same potential, a feature that insures a uniform pole strength.

The commutator (Fig. 2), mounted on an extension of the armature, is built up of drawn copper segments, which are insulated with amber mica of the best quality, of a thickness that makes impossible an accidental breakdown. So perfect is the commutation of these generators that the necessity of turning off the commutator is a very remote possibility.

Carbon brushes of a size that the current density will never exceed 30 amp per square inch, are held in the latest design of sliding-socket shunt brush holders, which are clamped on a composition frame, insulated from the brush ring itself. Each brush holder can be adjusted separately and removed for cleaning and repairs, or the entire brush ring may be rotated by a hand wheel.

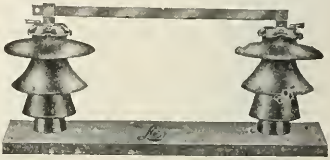
Arc Lamp Economizer.

The accompanying illustration shows a current-saving device for alternating current moving picture lamps, spot lights, search lights, photo-engraving lamps, etc., known as the "Hallberg Automatic Electric Economizer." The device has two separate windings, one primary and one secondary. The primary may be wound for any voltage from 100 to 460, and for any standard frequency. It is made in several sizes, the standard capacity for moving picture lamps being 2½ kw, with adjustments permitting 40 to 50 amp constant current at the arc. Among the claims made for the device are that it operates with a power factor of 80 per cent or more on all voltages, thus reducing the demand on the central station service to the lowest possible amount. If the arc is short circuited by over-feeding the lamp, the primary current does not increase more than 15 to 20 per cent, and the device is designed and built to stand a dead short circuit for an indefinite period without overheating. It operates without vibration, noise and heat, and the weight of the 2½-kw size is only about 100 lb. It is enclosed in a fireproof perforated brass case and may be mounted in any position on floor, ceiling or wall. When the arc is under the control of the "economizer" it cannot flame, and the carbon separation may be much less than with any other style of controller, which permits the craters of both carbon points to be focused, entirely removing the bad effects of the violet arc rays, while the intensity of the light from the craters is increased by the removal of the arc mist, which is always present when a long arc is used. The shorter arc also reduces the rate of carbon consumption and prevents breakage of the condensers in the lamp house. It saves 65 per cent on 110 volts, 83 per cent on 220 volts and over 90 per cent on 440-volt alternating-current circuits as compared with the rheostat. For moving picture lamps it is claimed to be the only device which gives perfect arc control and a steady light with large currents up to 65 amp, thus enabling the alternating-current arc to compete successfully with, and in some cases excel, the direct-current arc for the class of work referred to; and as a general rule a considerable saving on both the investment and the cost of operation can be made by using the alternating-current arc.

LAMP ECONOMIZER.

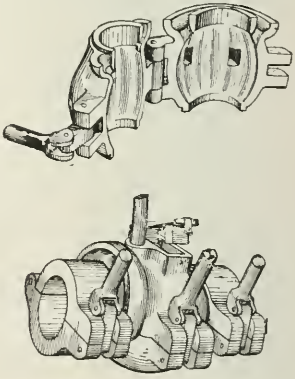
High-Potential Disconnecting Switch.

The accompanying illustration shows a high-potential switch for use with lightning arresters, for e.m.fs. of from 10,000 to 60,000 volts. It is intended for use in a case, for instance, where an arrester should prove defective or it should be desired to open the circuit for inspection. The switch is manufactured for arresters of low current but high e.m.f. The "factor of safety" is never less than 1.5 and more often is 2. The current-carrying parts are of copper, and the insulating supports of vitrified porcelain. In case of use in high-tension circuits the switch would be connected directly into the line. It is intended to be mounted above the ground or floor, away from the reach of inexperienced persons; it can be opened only by a special rod with an insulated handle having a hook on the end fitting into a hole in the blade of the switch. This switch has been placed on the market by the Lord Electric Company, 213 West Fortieth Street, New York.


HIGH-POTENTIAL DISCONNECTING SWITCH.

Device for Wiping Lead Joints.

A labor-saving device designed for wiping any kind of lead joint, whether for water connections or for electric-light and telephone cables, is shown herewith. The apparatus is known as the Corcoran wipe joint machine, and it is said will wipe branch joints as well as horizontal joints. A feature of the device is that by it a stronger and more perfect joint is possible than by the old method because a richer solder can be used. The solder is heated in an ordinary soldering pot and the machine is clamped around the parts to be joined and the solder poured in the trough, which has been previously heated by a blow-torch. The machine is moved back and forth a few times and then allowed to stand for a minute. When the excess solder in the trough has hardened it is removed and the machine unclamped. Clamps at either side of the device serve to center the machine directly over the joint to be made. No solder is wasted by the device, and it is made in various sizes to fit standard pipes and cables. The clamp is manufactured by the Wipe Joint Machine Company, of Cleveland, Ohio.


DEVICE FOR WIPING LEAD JOINTS.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Industrial and trade conditions showed improvement last week, although weather and crop reports were irregular. As a whole business was much less active than at the same time last year, and sentiment, though in the right direction, is slow. Mercantile collections were more prompt and money rates low, in spite of exports of $40,000,000 in gold and Treasury withdrawals of $45,000,000. The easy financial conditions abroad are evinced by the reduction of the official rate of discount of the Bank of England to 2½ per cent, the lowest quotation since August, 1905. Bank clearings were larger than for the same week in 1907, but this was undoubtedly due to the holiday. As a whole, crop reports were uniformly less favorable than for the previous week, due mainly to excessive rainfall in large areas. These adverse reports were of assistance to grain manipulators in squeezing out the May shorts in wheat and corn. The metal trades showed some improvement and considerable purchases of pig iron, based on the present low prices, were reported. *Bradstreet's* reports business failures for the week ended May 28 as 263, compared with 284 in the previous week, 142 in the corresponding week in 1907, 127 in 1906, 154 in 1905 and 194 in 1904. Certain electrical lines show a considerable improvement in orders booked since the beginning of the month. The wire companies report a flurry in orders for immediate delivery, which, if it proves lasting, will shortly bring the output in this line back to normal. Nearly all of the wire concerns have increased their operating forces, and in some instances full time is reported. The large electric manufacturing companies are booking good export orders, but most of the domestic business is in small contracts. The report from Chicago that the Allis-Chalmers Company had placed an order for 1500 tons of pig iron and also for a year's supply of copper is stated to be correct. The electrical output of the Allis-Chalmers Company was confined formerly to the Bullock plant at Cincinnati, but arrangements have been perfected whereby the Bullock plant will confine itself to the smaller standard electrical equipment, leaving the larger and special construction to the West Allis plant, which will develop this phase of the business to the utmost. In the last two years the West Allis plant has been practically doubled in capacity, about $5,000,000 having been devoted to that purpose. The favorable showing of the company this year was due to the fact that when the financial crisis occurred it had business booked to about $15,000,000, or a 10 months' output.

A PROTEST AGAINST SHIFTLESS AMERICAN FOREIGN TRADE PRACTICES.—The following energetic criticism of the shiftless export trade methods of some American firms is received from an Australian correspondent: There is a world-wide demand for American manufactures, but your first *campaign* should begin with our brethren at home in order to teach them a few things. In the past 12 years I have had sufficient experience with American business methods to show that the average man cannot, or will not, pay sufficient attention to details and to the requests of his customers. In many cases absolutely no attention whatever is paid to specific instructions regarding packing, shipping, and customs requirements. Instructions are evidently merely glanced over hastily, and the business done in a "slap-dash," hasty manner, and in most cases complaints are merely ignored. My American mail is just in to-day, and I have to air some of my grievances before I can rest. One of the aggravations is the constant receipt of under-paid correspondence. There is scarcely a mail comes that does not bring me a lot of letters and trade circulars on which I am required to pay from 6 to 28 cents deficient postage. The thing has got so bad that I prepared a circular, which I now send with the envelope or wrapper to everyone in the United States who forwards me anything with underpaid postage. Just to let them see how it is themselves, I put a 1d. stamp on my letter. Under date of December 23, I wrote Messrs. ——— ———, with whom we have been doing business for over 10 years, asking for some particulars and quotations upon three or four different makes of "injector" or "barometric" condensers. I sent illustrations of the various types on which I wanted quotations, and indicated just what parts were required in the following language: "The portion inside of the red line on each illustration shows the part which we require. We have relief valves and all other parts. In quoting price, please designate a code word for each condenser, so that we can cable the order in case we conclude to purchase one." Now, in quoting upon one of these condensers, they include the relief valves, etc., saying "we would not care to furnish the condenser without all the parts mentioned, as we do not believe it would perform satisfactorily without these parts;" and they entirely ignored our requests for code words to enable us to order by cable. Another experience concerns an order for some books. Under date of August 6th, 1907, I sent to ———, an order for a number of books, over 35 volumes, enclosing check on the Mechanics' National Bank to cover the cost of the books, and other charges. I was most explicit in the shipping directions, instructing specifically how the case was to be marked, and that it be forwarded through Messrs. Alfred H. Post & Co., Maritime Buildings, New York (forwarding agents who handle considerable business for Australian ports), freight prepaid and insured. I also instructed that particular care was to be taken in making out the invoice, and that no advertising matter or anything not specified on the invoice, was to be enclosed with the books. (All advertising matter imported into Australia is subject to a duty of 4 cents per lb.). After considerable delay I received the invoice, and after a much longer and unexplained delay, I received the shipping documents. The invoice was dated September 12, 1907, but shipment was not made until January 29, 1908. In the bill of lading the shipment of books is described as "One case advertising matter," the box was marked entirely incorrectly, insured and with freight to collect at this end. Can you conceive how specific shipping instructions could be so absolutely ignored? They also overcharged me on many of the books, and paid no attention whatever to my letter calling attention to this. As referred to above, bad packing is one of the common offences. Expensive machinery is merely crated, and I had a shipment of furniture which was crated in the most flimsy manner, merely as though it were to be shipped in car load lots from Grand Rapids to Chicago, and with absolute disregard to the requirements for oversea shipments. Orders that goods were to be packed in zinc-lined cases were absolutely ignored, with the result that I had a shipment which was practically ruined. As we have to "pay, pay, pay," why cannot shippers follow instructions? I had an experience in a case in which an American manufacturer of iron unloaded a lot of scrap on Australians through ———, of New York. Our complaints were merely laughed at. I do not think you could sell a ton of American iron in this vicinity at any price. You have too much "system" and too little intelligence. I get these "system" letters one after another, stacks of them, while no attention is paid to my requests for specific information. I opened up a correspondence with a firm a year or two ago, and every mail brings me one of their routine system letters. There was a question about terms of payment and some other matters. I wrote asking if the terms given in their circular were the best they had to offer, and that if so, there was no use to continue the correspondence. I never received any answer to this inquiry, but their "system" letters come by every mail. In the 12 years I have been out here I have tried in every way to increase American trade, and you know very well that I control a considerable amount of business, but I have got so disgusted that I am prepared to drop it. Unless you can succeed in working a reformation in methods over there, it is useless to exert yourself in any campaign elsewhere. Much of the American style of "stock" business correspondence and advertising does not please foreigners, the English especially. They don't appreciate American "humor." The style of many letters excites only disgust. The Englishman is a very solemn individual; he even "takes his pleasures sadly," and anything in the way of levity in business correspondence, he regards in very bad taste.

WIRE TRADE SHOWS MUCH IMPROVEMENT.—During the last week the wire trade situation has shown considerable improvement and all the large companies report increased orders over the preceding week, with a marked betterment over conditions at the beginning of the year. From a basis of 30 per cent of the normal output, on which the greater number of plants were operating last fall, the ratio has increased to at least 50 per cent. During the first three months of the current year the returns showed improvement over each preceding month, but in April the demand slackened. May returns are showing well in comparison. The Habirshaw Wire Company, which recently was operating five days a week on three-quarters time, is now running on full time again. A number of large orders have been received from the West and call for immediate delivery. An officer of one of the largest wire companies said: "The wire situation, at least as compared with many electrical lines, has shown an encouraging improvement, especially of late, but the question is, will it last? While all of us have confidence in the immediate future, yet we do not feel over optimistic about the present. We believe, however, that when the nominations are settled the revival will come with a rush. Those who have been holding back will be compelled by low stocks to come into the market. With returning confidence, first one will let go, which will influence the next one, and so on, and I venture to tempt fate by prophesying that the fall of 1908 and the spring of 1909 will prove a record year for the wire manufacturers. I am led to this belief by my observations of the low state of stocks at present. The manager of one of the railroads which ordinarily uses copper wire in its outside wiring told me that this wire in certain cases was in such bad condition that the metal showed. In one instance, where repairs were absolutely imperative, the copper wire had been replaced by iron wire, all of which will have to be torn out in time. This is a fair criterion of general conditions, and this one item alone of outside wiring will mean thousands of dollars when the demand starts again." The base price for copper wire is maintained at 14¾ cents a pound, at which level it has been holding for several months.

THE KERR TURBINE COMPANY, of Wellsville, N. Y., is busy in spite of dull times executing orders as follows: Two 60-hp Kerr steam turbines coupled to No. 8 Sturtevant gas blowers for the Economical Gas Apparatus Construction Company, at Aberdeen, Scotland; 10 single stage steam turbines with disk fans for forced draft work for the Lathrop Engineering Company, New York; one 10-kw turbine generator set, direct-current, with brake testing outfit for the Agricultural & Mechanical College of Mississippi; one 4-hp single stage turbine for driving blower for the Buffalo Forge Company, for service in Mexico; one 15-kw direct-current Kerr-Sterling generator set for C. Deuterman & Sons, White Plains, N. Y.; one 150-kw Kerr-Westinghouse direct-current unit for Janeway & Carpender, New Brunswick, N. J.; one 100 k.v.a. Kerr-Burke turbine alternator for the Warren Manufacturing Company, Milford, N. J.; one 85-hp Kerr steam turbine for the Sirocco Engineering Company, New York, to drive blowers for forced draft at the New York Edison Waterside station; four 200-hp Kerr steam turbines to drive centrifugal pumps for the Wheeler Condenser & Engineering Company, New York City; one 1200-gal. Kerr-Worthington pump unit, head 470 ft., for the Mississippi River Commission, Vicksburg, Miss.; a 1-kw headlight turbine generator unit for Chas. M. Lewis & Company, of Evansville, Ind.; one 60-hp turbine to drive centrifugal pump for the Dayton Hydraulic Machinery Company, of Dayton, Ohio. Reports from the engineering salesmen in the larger commercial centers as well as the inquiries coming direct to the home office indicate a rapid and real improvement in business conditions.

TRADE WITH GERMANY.—For the 10 months ended April, 1908, according to the report of the Bureau of Statistics of the Department of Commerce and Labor, the total of imports from Germany to the United States was $121,978,179 as compared with $134,475,801 for the similiar period in 1907 and exports from the United States to Germany totaled $250,724,722 as compared with $225,847,289 for the same time in 1907. The imports from Germany to the United States included copper bars, ingots, etc., for the 10 months under consideration to the amount of 3,537,359 lb., valued at $599,361, against 5,241,344 lb., valued at $915,116, for the same period in 1907. In 1908 crude India rubber, duty free, to the amount of 2,114,262 lb., valued at $1,561,863, was imported into the United States, as compared with 3,799,499 lb., valued at $2,781,314 during the same time in the previous year. Among the exports only 35 tons of copper ore, valued at $9,000, was shipped from the United States to Germany in the 10 months under consideration in 1908, as compared with 182 tons, valued at $48,212, for the same time in the previous year. Exports of copper ingots, bars, etc., amounted to 112,214,027 lb., valued at $16,827,888, against 71,991,834 lb., valed at $15,189,629, for the same time in 1907. Electrical appliances valued at $183,135 were exported to Germany as compared with like exports in the like period of 1907 valued at $296,503. Exports of electrical machinery totaled $86,531, against $77,144 for 1907.

TORONTO ELECTRIC COMPANY'S CONTRACT WITH THE ELECTRICAL DEVELOPMENT COMPANY—It is reported in Toronto that the price which Mr. William McKenzie, of the Electrical Development Company, asks for the release of the contract which the Toronto Electric Company has with the Electrical Development Company is $1,200,000. The Toronto Electric Company was incorporated in 1886 to supply light and power to the city of Toronto, and its franchise expires in 1919. Its contract with the Electrical Development Company provides for the distribution of Niagara electrical current in Toronto. For some time the city has been conducting negotiations with the end in view of buying the plant of the Toronto Electric Company, but the negotiations have been held up by the contract which that company has with the Electrical Development Company. The contract has 17 years to run, but it is reported that Mr. McKenzie might be induced to let the Toronto Electric Company people out for $1,000,000 cash. The city cannot take power from the Electrical Development Company, and under the contract the Toronto Electric Light Company cannot take power from any concern except the McKenzie company. Officers of the Toronto Electric Company will not confirm the report that Mr. McKenzie demanded $1,000,000 of the lighting company to allow that company to cancel its contract with the Electrical Development Company.

THE FIRE LOSS.—The National Fire Protection Association, representing all of the national institutes, societies and underwriting organizations in the United States which have thus far evidenced their interest in the protection of life and property against loss by fire through joining its efforts for the general good, had its attention called at the recent twelfth annual meeting to the diasters by fire which have occurred during the past year, involving a great sacrifice of life and an enormous fire waste, as illustrated by Collingwood School, Boyerstown Theatre, and Chelsea and Atlanta conflagrations. These, following the previous experiences at Baltimore and San Francisco, again serve to emphasize the apparent disregard on the part of the general public, resulting in the loss of hundreds of lives annually and a fire waste of almost a million dollars for every business day. It is believed that the time has properly arrived when adequate laws, federal, state and municipal, should be enacted and enforced in such a manner as will unquestionably check the enormous inroads upon the material resources of our country. The association has therefore placed itself on record as favoring new restrictive legislation or the enforcement of any existing laws that can check this awful and disgraceful waste.

WATTMETERS IN DEMAND.—An American Consul in Latin America reports that the company which is furnishing the electric light in the city where he is situated is engaged in a complete reconstruction of its plant. When the work of reconstruction is completed, current or watt meters will be installed for the use of consumers. The company has not as yet made its purchase of meters, and there is an opportunity for an American firm which manufactures such a line of goods to take prompt action in the matter. There will also be an opportunity for the sale of motors for future power installations. Further particulars can be obtained from the Bureau of Manufactures, Washington, D. C.

MICHIGAN COPPER PRODUCTION.—James L. Nankervis, Commissioner of Mineral Statistics of Michigan, gives the total copper output of that state last year as 220,217,892 lb., a decrease of 4,189,967 lb. as compared with 1906. Calumet and Hecla leads the list of mines with an output of 88,000,000 lb.; Quincy is second with 19,796,058. The other large producers in the order named are: Baltic, 16,704,868; Champion, 16,489,436; Osceola, 14,134,753; Tamarack, 11,078,604, and Mohawk, 10,107,266. In 1905 the total output for the state was 217,763,382 and in 1904 208,329,248 lb.

STATUS OF THE COPPER MARKET.—Dulness characterized the copper market during the last week, with a firmer tendency Friday. The most prominent feature of the market in refined copper was the resale of millions of pounds of Japanese copper in Europe, and the repurchase of American copper sold on Oriental account in this market. In Europe dealers have been purchasing Japanese copper at 20s to 30s below the standard market, which is equivalent to obtaining it at from 12 to 12¼ cents. This was because of the financial pressure brought to bear upon the holders of Japanese metal. Domestic consumers showed little interest in the market and continue their policy of buying supplies only for immediate needs. None of the large electrical companies has entered the market to any extent, with the exception of the Allis Chalmers Company, which has bought castings and finished copper to last until next January. Unless there is a resumption of speculative buying it is thought that in June there will be a flood of metal on the market which will send prices down to the lowest levels of the year. Monday's prices on the Metal Exchange were as follws:

Lake	12¾ @ 12⅞
Electrolytic	12½ @ 12¾
Castings	12⅜ @ 12½

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	57	12	6	57	15	0
Standard copper, futures	58	5	0	58	7	6
Market	Steady.			Quiet.		
Sales of spot				200 tons		
Sales of futures				300 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

The report of the Amalgamated Copper Company for the fiscal year ended April 30 last showed a decrease in net income of $7,473,843, but owing to the fact that dividends were reduced to a 2 per cent basis, the company was able to clear the small surplus of $525,041. The directors of the North Butte Mining Company have resumed dividend payments on the stock by the declaration of a $1 dividend, payable June 25.

FOREST PRESERVATION.—An important step in the general movement to bring many of the rich stands of timber in the South under a scientific plan of forest management is the offer made by the school of forestry of the University of Georgia at Athens, Ga., to furnish timber owners experts who will examine and report upon any of the forests in the State. The object of the offer is to collect information in regard to the forest resources of the State, to spread a knowledge of forestry and to improve forest conditions. The forest school will furnish the experts free and the only expense which will be borne by the forest owner will be for the traveling and subsistence expenses of the expert while making the examination. In cases where several owners of the same locality apply the expenses will be prorated. When applications for examinations are made, the owners have been asked to give their names and post office addresses, location of tract, area of tract, character of forest as shown by the kinds of trees growing on the land, the conditions of the forest, whether mature, original or second growth, whether the land has been burned or cut over, and the wishes of the owner regarding the use of the land.

CROCKER-WHEELER EQUIPMENTS.—The Warrenton Woolen Company, of Torrington, Conn., is equipping a new mill with electric motors furnished by the Crocker-Wheeler Electric Company, of Ampere, N. J., through its Boston office. The installation will include individually driven looms, each operated by a 1-hp, 550-volt induction motor, and other machinery to be group driven. Twenty-two motors will be installed, varying from 1 to 75 hp in size. The Boston office of the same company is supplying apparatus for an enlargement of the plant of the National India Rubber Company, of Bristol, R. I. One 40-kw and two 200-kw, three-phase, 550-volt, 60-cycle generators, 210 kw in transformers, arc lighting equipment and six 75-hp motors will be installed. Another recent contract taken by this office is an equipment for the Windham Mfg. Co., of Willimantic, Conn., F. P. Sheldon, of Providence, consulting engineer. The apparatus includes two 250-kw, three-phase, 600-volt generators, four 35-hp, three 50-hp and two 75-hp induction motors and transformers. A combination of electric and mechanical drive is being applied.

BRITISH PATENT LAW.—A special dispatch from London of May 26, says: "Representations have been made to the Foreign Office by Ambassador Reid with the view of a modification of the new patent law of Great Britain. This law was introduced by David Lloyd-George, then President of the Board of Trade, and comes into effect July 28. It provides for the revocation of all patents unless the actual process is carried on in the United Kingdom. Owners of American patents contend that this act will work a hardship on them, and as the United States respects all patents, whether American or foreign owned, they argue that Americans should receive equal treatment in Great Britain."

VANCOUVER POWER DAM.—We are advised by Mr. W. H. Hazlitt, purchasing agent of the British Columbia Electric Railway Company, Limited, of Vancouver, B. C., that the Vancouver Power Company of that city, intends to build a permenant concrete dam at the outlet of Lake Coquitlan, about eight miles from New Westminster Junction, B. C. Engineers and contractors are invited to send representatives to the site so that plans, specifications and tenders may be submitted. The dam will be approximately 200 ft. wide at the crest, 300 ft. over abutments and about 60 ft. high.

FACTORY AND WATER POWER.—It is announced that the large property at Northside, Waterford, directly opposite to the city of Cohoes, N. Y., known as the Massasoit Mills, and belonging to the estate of Edward G. Munson, deceased, including a large knitting mill, also a new wadding plant in perfect working order, together with valuable water rights, estimated at 600 hp, will be sold at public auction under foreclosure proceedings, on the premises on June 20, 1908, at 11 o'clock a. m. Mr. Jacob L. Ten Eyck is the referee.

Financial Intelligence.

THE WEEK IN WALL STREET.—The unstability of the stock market during the last week puzzled even the veteran professional element and made it impossible to predict in what direction the next movement would take its course. After a decline lasting more than eight days and averaging as much as 10 points in some of the leading issues, the market at the end of the week took up again the upward movement, under a broader buying demand than has been heretofore experienced. At the beginning of the week sentiment was considerably upset by the filing of the government suit against the New York, New Haven & Hartford Railroad Company and the fear was acute that this movement on the part of the Federal authorities was the beginning of further governmental attacks upon corporations with the evil effects that would ensue upon securities both here and abroad. A fairly reassuring statement from Washington did much to clear the situation. Those who do not take a particularly optimistic view of conditions at the present time maintain that the distribution of stocks on the recent advance was more extensive than realized by the Street as a whole, and in their opinion the large financial interests will not be disposed between now and the approaching national convention to give aggressive support to the market, though it is pointed out by others that the bond flotations in the interests of which the advance was said to have been brought about have not all made their appearance. The improving tendency of values toward the end of the week was restrained by a severe break in the securities of the Gould roads on the approach of the time for the payment of the coupons on the bonds of the Wabash-Pittsburg Terminal Company falling due June 1, and on which as early as the middle of the week it was generally believed that default would be made. A further disturbing influence in the Gould securities was the publication of the statement of earnings of the Missouri Pacific system, showing that in nine months ended March 31 the surplus available for dividends was slightly less than 3 per cent, making it practically certain that in the full year the equivalent of a 5 per cent dividend could not be earned. Among other incidents was a decline in American Smelting and Amalgamated Copper, traceable to reports about the position of some interests identified with the former property. Brooklyn Rapid Transit sold off on the announcement of its refusal to come to terms with the City of New York in regard to the use and operation of the new bridge loop, while the Interborough-Metropolitan developed some strength on the statement that an extension of its interests in Brooklyn was contemplated. In the money market the most important development of the week was the reduction in the discount rate of the Bank of England. The rate was cut on Thursday from a 3 per cent quotation to 2½ per cent, making the sixth reduction of the present year. The Bank's rate has not been as low as 2½ per cent since September, 1905. The gold movement abroad has not been the source of concern among bankers as banks are in possession of a surplus exceeded only once or twice in their history. The market on Monday displayed an extraordinary burst of activity and gains from 2 to 6 points in a score of issues were recorded. The passage of the Aldrich-Vreeland currency bill, the adjournment of Congress and the report that the Union Pacific financing would be carried out before the close of the day were the explanations given for the upward movement, but these are inadequate to explain the strength of the movement, which was plainly due to manipulation by the same interests which engineered the previous rise. Closing prices of leading electrical securities on Monday were:

NEW YORK.

	May 25.	June 1.	Shares Sold.		May 25.	June 1.	Shares Sold.
All.-Ch.	9¼*	9⅛	1,000	Int-Met., com..	12¼	12¼	17,250
All.-Ch., pfd....	24	24¾	1,700	Int.-Met., pfd...	32⅞	33	25,550
Amal. Cop.....	65¼	67¼	146,095	Mackay Cos....	66	65⅝*	900
Am. D. T......	39*	39*	—	Mackay Cos., pfd	65	65*	700
Am. Loc.......	49¼	50⅝	5,720	Met. St. Ry....	27	27*	100
Am. Loc., pfd..	103*	103*	—	N. Y. & N. J. Tel.	105*	110	—
Am. Tel. & C'bl.	60*	65	5,000	Steel, com.....	37½	38⅞	354,170
Am. T. & T....	117½	117¾	650	Steel, pfd......	101⅝	102¾	24,985
B. R. T........	51	49¼	75,120	W. U. T.......	57¼	56¾*	1,450
Gen. Elec......	133½	138	969	West'h, com....	51	51¼	5,940
Hud. R. Tel....	—	—	—	West'h, pfd	67	70½*	900

PHILADELPHIA.

	May 25.	June 1.	Shares Sold.		May 25.	June 1.	Shares Sold.
Am. Rys.......	44¼	44¼	—	Phila. Elec.....	8¼	8½	—
Elec. Co. of Am.	10	10	—	Phila. R. T.....	15¼	14¾	—
Elec. Stor. B'ty.	30	30½	—	Phila. Traction.	—	90	—
E. S. B'ty, pfd..	—	—	—				

CHICAGO.

	May 25.	June 1.	Shares Sold.		May 25.	June 1.	Shares Sold.
Chicago City Ry.	160	160	—	Met. Elev., Com.	18	18	—
Com. Edison....	94¼	94⅛	—	Met. Elev., pfd.	54	55	—
Chicago Subway.	21¾	20⅜	—	National Carbon.	63	64	—
Chicago Tel. Co.	122	123½	—	Nat. Carbon, pfd.	110	110	—

BOSTON.

	May 25.	June 1.	Shares Sold.		May 25.	June 1	Shares Sold.
Am. Tel. & Tel.	117½	117⅞	—	Mass. E. R., pfd.	—	44	—
Comb'ind Tel...	—	—	—	Mex. Tel., pfd..	—	5⅝	—
Edison El. Ill...	214	213	—	New Eng. Tel'p.	112	111½	—
Gen. Elec.......	134½	138	—	W'st Tel. & Tel.	6¼	6	—
Mass. Elec. Ry..	—	9	—	W. T. & T., pfd.	—	67	—

*Last price quoted.

Shares sold are for week May 25 to June 1.

TELEPHONE BONDS AND THE MASSACHUSETTS SAVINGS BANKS.—A bill has passed the Senate and House of the Massachusetts Legislature and will shortly be presented to the Governor for signature making legal for investment of savings banks in that State the American Telephone & Telegraph Company's collateral trust 4 per cent bonds of 1929. By the terms of the amendment the company is obliged to have a majority of its directors from Massachusetts, and the savings banks cannot invest more than 2 per cent of their deposits in telephone bonds. The text of the bill states that savings banks may invest in bonds of a telephone company of which a majority of the directors are residents of the State, provided that during each of the five fiscal years of such telephone company next preceding the date of such investment: 1. The gross income of such telephone company shall have been not less than $10,000,000 per year. 2. Such telephone company shall have paid the matured principal and interest of all its indebtedness. 3. Such telephone company shall have paid in dividends in cash an amount equal to not less than 6 per cent per annum on all its outstanding issues of capital stock. 4. The dividends paid on the capital stock shall not have been less than the total amount necessary to pay the interest upon its entire outstanding indebtedness. It is further provided that such bonds shall be secured either by a first mortgage upon at least 75 per cent of the property of such telephone company, or by the deposit with a trust company incorporated under the laws of Massachusetts of bonds and shares of stock of other telephone corporations under an indenture of trust which limits the amount of bonds so secured to 75 per cent of the value of the securities deposited as stated and determined in the indenture; and provided that during each of the five years next preceding such investment the annual interest and dividends paid in cash on the securities deposited have amounted to not less than 50 per cent in excess of the annual interest on the bonds outstanding and secured by the deposit.

REORGANIZATION COMMITTEE GRANTS THREE WEEKS EXTENSION TO WESTINGHOUSE STOCKHOLDERS.—The report of the Merchandise Creditors' Committee and the Stockholders' Committee on Tuesday, June 2, to the Reorganization Committee made such a good showing that an extension of three weeks was granted to enable the first two committees mentioned to complete their part of the reorganization plan. The Merchandise Creditors have taken $4,000,000 of the "assenting stock" in exchange for their claims and on Friday last 1700 stockholders out of a total of 3800 had been heard from and had subscribed for stock to the amount of $1,600,000. It was hoped that on the last day for subscriptions from stockholders the amount would total $1,800,000. Only about $1,500,000 is required for the successful conclusion of the plan and it is pointed out that should the stockholders yet to be heard from fail to subscribe this amount, it would pay the bondholders to make up the deficiency in order to prevent the company from being sold for the benefit of the creditors, as the rise in the price of the bonds following such action on the part of the bondholders would amount to more than the sum subscribed by them.

MACKAY COMPANY STOCK.—The Boston *Financial News* in commenting on Mackay securities says that sales of the stocks of the Mackay Companies are few and far between in the local market, but up in Montreal they take more interest in this company and the quotations are much more frequent. At the present time the shares are strong there and there is a decidedly bullish sentiment prevailing. A prominent Montreal interest, in discussing the present situation, said: "The Mackay issues hold strong, but have not yet enjoyed so full a recovery as some other issues. The four months' statement of the American Telephone Co. shows a large increase in earnings and it must be remembered that this is one of the companies in which the Mackay Companies have very large holdings. It is on increasing earnings such as these that the expectation is based that the dividend on Mackay common stock will be increased, so soon as normal commercial conditions indicate a probability of earnings continuing to permit the payment of a 5 per cent rate. The common stock of the company, therefore, carries speculative possibilities not shared with the preferred issue."

BELL TELEPHONE OF PENNA.—The report of the Bell Telephone Company of Pennsylvania and controlled companies, shows an April gross of $981,859, an increase of $88,140 over April, 1907, expenses of $620,435, an increase of $23,622 over the same month in the previous year and a net for April of $361,424, an increase of $64,518 over the net of April, 1907. Deducting charges of $84,905 left an April surplus of $276,519, an increase of $43,064. The gross for the four months was $3,870,840, an increase of $372,805 over the same period in 1907; expenses, $2,485,444, an increase of $81,252, and the net for the four months $1,385,396, an increase of $291,553. Deducting charges of $331,021, left a four months' surplus of $1,054,375, as compared with the surplus for the corresponding four months in 1907 of $838,152, an increase of $216,223.

DIVIDENDS.—The General Electric Company has declared the regular quarterly dividend of $2 a share on the capital stock, payable July 15. The Harris Trust and Savings Bank, Chicago, has been appointed local transfer agent for the Kansas City Railway & Light stock. The annual meeting of the Electrical Properties Company will take place on June 10. Books close May 26 and reopen June 11. A cash dividend of 1 per cent has been declared by the Wilkesbarre Gas & Electric Company, payable July 1. The semi-annual dividend of 1½ per cent, payable June 15, has been declared by the directors of the Northern Ohio Traction & Light Company.

KANSAS CITY RAILWAY & LIGHT CO.—The report of the Kansas City Railway & Light Company for April gives gross earnings of $492,472, an increase of $19,806 over April, 1907; expenses, $267,657, an increase of $21,937 over the same month in the preceding year and an April net of $224,815, a decrease of $2,131 from the net of April, 1907. The April surplus was $73,799, as compared with $77,120 for April, 1907, a decrease of $3,321. The 11 months surplus was $1,010,140, an increase over the similar period in 1907 of $29,425.

PRICE FOR ELECTRICITY IN BOSTON.—The Massachusetts Gas Commission has recommended that on and after July 1, 1908, the Edison Company, of Boston, reduce the price for electricity for any use to a uniform price, not to exceed 12 cents per kw hour, and that on or before October 1, 1909, the uniform price shall be further reduced as may be approved by the commission, unless the company show good cause why such further reduction should not be made.

WOONSOCKET-PAWTUCKET MERGER KILLED.—The refusal of the City Council of Woonsocket, R. I., to withdraw its opposition to the proposed $3,000,000 merger act, incorporating the Blackstone Valley Electric Light & Gas Company as a holding company for the two Woonsocket and two Pawtucket companies, practically puts an end to the efforts on the part of the backers of the plan to put the deal through. As a result of the opposition on the part of the City Council the promoters of the proposed merger say that they will not run counter to the wishes of the City Council and will make no attempt to have the matter reported from committee or passed by the General Assembly, as had been planned. The merger which would have been effected under a Maine or New Jersey charter, would have had the effect of reducing the rate of gas in Woonsocket, but as the situation stands at present the prevailing gas rate will continue. Stedman Buttrick, of Estabrook & Co., of Boston, representing the financial interests behind the plan, stated that his concern was done with the merger under the Rhode Island charter and that the action of the Woonsocket City Council had finished the matter as far as the firm he represented was concerned. Mr. Buttrick explained to the City Council why the syndicate desired the passage of the act merging the four companies into a holding company, and presented the concessions previously outlined, which would be granted in the price of gas and the improvement in lighting properties which would follow in return for the withdrawal of opposition on the part of the City Council. In explaining the proposition Mr. Buttrick said the bonds of the merger company could be sold at from 1 to 1½ per cent lower rate of interest, if guaranteed by direct mortgage, under a Rhode Island charter than would be the case if the company was compelled to go to Maine or New Jersey for a charter. In return for co-operation on the part of the City Council, he said the company would spend about $1,000,000 in Woonsocket during the next five years, and guarantee $250,000 improvements within a year. Although making no definite promises except a $1.25 rate for gas without a franchise immediately, he said the company would at once take up the franchise question with the City Council and would grant substantial reductions in rates in return for an exclusive franchise. The majority of the City Council expressed themselves as against withdrawing opposition to the merger unless the Pawtucket price of $1.10 per thousand feet, or some price approximating that figure, was guaranteed. Several of the City Councilmen spoke in favor of accepting Mr. Buttrick's promises of further concessions in price with the granting of an exclusive franchise which would guard the company from competition in Woonsocket in the matter of gas, but the majority of the members stood firm against the merger unless those behind the measure would grant the Pawtucket gas prices or prices approximating them, to the consumers in Woonsocket.

UNEARNED COPPER DIVIDENDS.—The year of 1907 was notable in respect to the large number of copper-mining companies which failed to earn the dividends chargeable against the profits of that year, according to the *Boston News Bureau.* Eight prominent instances were Anaconda, Calumet and Arizona, U. S. Smelting, Quincy, Utah Consolidated, North Butte, Mohawk, and Tamarack, which collectively paid dividends of $17,943, 580 or $7,765,621 more than net earnings. The primary cause for this condition was the unrealized expectations of copper mine managements in general that the metal market would "come back" in the latter half of the year. In the hope that copper would be saleable at somewhere near the high average of the first six months, dividends were disbursed with a free hand, but it so happened that millions of pounds of unsold copper had accumulated on Dec. 31, and, when the depreciation in stocks on hand had been charged into the year's business, the item of net profits in many instances was alarmingly small. The copper mining company which showed dividends fairly earned in the year 1907 was the exception rather than the rule. In this class, among the mines which have reported for the year, can be mentioned Osceola and Tennessee Copper, each of which show a small surplus over dividends paid. There were interests in Osceola, however, favorable to the declaration of a small dividend, for the last half of the year, but when the Calumet & Hecla people, as the owners of a controlling stock interest, were approached on the subject, they replied that "if Osceola was in our shop no dividend would be paid." No disbursement, therefore, was voted. In the case of Copper Range, it is apparent from a careful study of the annual report that only three dividends, instead of four, were charged against the year's income. The dividend ordinarily payable in December was this year made payable Jan. 1, 1908, so that it stands as a charge against 1908 income. The exclusion of this $1 dividend, which would have amounted to $384,000, together with the inclusion as earnings of $549,251 received in the Burrage settlement enabled the company to show a small surplus over dividend disbursements. In the majority of cases the well-posted copper companies knew around April 1 that there was a sudden and mysterious disappearance of copper orders, although of course deliveries were at that time being made of 25-cent copper sold in the early months of the year. In the face of a continuance of this absence of new demand throughout the balance of the year, many companies distributed earnings which could not have been fairly earned on anything less than a 20-cent copper market. The unparalleled demand which made possible 26-cent copper, it was argued, could not disappear over night, and so, as above stated, the hope of its speedy return prompted what now proves to have been a too lavish distribution to stockholders.

STONE & WEBSTER PROPERTIES.—The following are given as the gross earnings for March, 1908 of the various Stone & Webster properties, and the increase or decrease of the month, as compared with March, 1907: Houghton County Electric Company, Houghton, Mich., $18,750, Inc. $301; Whatcom County Railway & Light Company, Bellingham, Wash., $28,561, Inc. $2,005; Columbus Electric Company, Columbus, Ga., $28,700, Inc. $2,251; Dallas Electric Corporation, Dallas, Tex., $87,446, Dec. $2,046; El Paso Electric Company, El Paso, Tex., $43,640, Inc. $3,102; Northern Texas Electric Company, Fort Worth, Tex., $91,650, Dec. $105; Galveston-Houston Electric Company, Galveston and Houston, Tex., $83,530, Inc. $1,246; The Houston County St. Ry. Co., Houghton, Mich., $19,773, Dec. $642; Jacksonville Electric Company, Jacksonville, Fla., $36,965, Inc. $2,759; Savannah Electric Company, Savannah, Ga., $48,160, Inc. $994; Tampa Electric Company, Tampa, Fla., $43,121, Dec. $406; Puget Sound Electric Ry., Tacoma, Wash., $127,448, Dec. $2,165; The Seattle Electric Company, Seattle, Wash., $353,462, Inc. $34,558; Pensacola Electric Company, Pensacola, Fla., $19,205, Inc. $1,920; Brockton & Plymouth Street Railway Company, Plymouth, Mass., $7,254, Inc. $424; Edison Electric Illuminating Company of Brockton, Mass., $16,962, Inc. $2,355; The Lowell Electric Light Corporation, Lowell, Mass., $26,503, Inc. $2,316; The Minneapolis General Electric Company, Minneapolis, Minn., $83,089, Inc. $9,977; The Electric Light & Power Co., of Abington and Rockland, North Abington, Mass., $4,783, Inc. $1,080; Cape Breton Electric Company, Limited, Sydney, C. B., $17,432, Inc. $2,601; Fall River Gas Works Co., Fall River, Mass., $29,449, Inc. $1,265.

ELECTRICAL SECURITIES.—Notwithstanding the recent slump in Wall Street which brought prices down from the record levels of 1908, the leading stocks still show substantial increase over the low prices for the year. Following are given the high and low prices for 1908 of representative electrical securities, with the net change recorded on May 29 over the low for the year:

	High.	Low	May 29	Net Increase.
Allis-Chalmers, com.	9⅞	5	9	4
Allis-Chalmers, pfd.	25⅞	14	24¾	10¾
Brooklyn R. T.	54	38⅜	47¾	9⅜
Gen. Elec.	142	111	137½	26½
Int.-Met.	12⅜	6¾	12⅛	5⅜
Int.-Met., pfd.	33½	17⅛	32	14⅞
Mackay Cos.	66	52	65⅝	13⅝
Mackay Cos., pfd.	68	59⅞	65	5⅛
Westinghouse, com.	58	38	50	12
Westinghouse, pfd.	80	59½	70½	11

BUTTE ELECTRIC COMPANY BUYS OLD PARROT SMELTER.—The Butte Electric & Power Company has purchased from the Amalgamated Copper Company the smelter at the Parrot mines at Parrot, Mont., six miles north of Whitehall, and all the rights to the land and the water power controlled by the Amalgamated Company at that place. The smelter at Parrot has never been used, having been abandoned when the Amalgamated Company took over the Parrot Company in 1900. Most of the expensive machinery at that time was removed to the Washoe smelter at Anaconda. The original works at Parrot are said to have cost $1,000,000, and 160 cars of concrete were used in building the great stack of the smelter which was never used. The consideration paid for the works by the power company has not been given out, but is thought to be far below the first cost.

AN ENGLISH VIEW OF THE FINANCIAL CRISIS.—Proper curtailment in the manufacturing output and the agricultural prosperity of the country are the factors which will bring about a readjustment of the financial situation in America, and in a short while will set the country firmly on the road to its former prosperity in all lines of trade, according to Mr. Seymour Bell, the British commerial agent in the United States. In a recent report to Parliament on this subject Mr. Bell said: "The year 1907 was one of sharp contrasts in the United States. It was a year of great activity and deep depression. During the earlier months all industries were exceedingly busy and mills were working at their utmost capacity. Many unfilled orders had been carried over from the previous year and buyers were experiencing great difficulty in getting delivery of their goods. The railway lines were congested, wages were at their highest, and the high price of commodities raised the price of living to an extreme point. It was recognized by all those in a position to form an independent opinion that this tremendous industrial activity could not last; that it was merely a question of time before a reaction would set in. It became quite evident that the country was living beyond its means. Money was becoming scarce and the railways and other corporations were encountering great difficulties in obtaining the capital necessary to carry on the improvements and extensions which were in process of being carried out. Speculation in mining and real estate had been rife and personal extravagance was at its height. This all tended to place additional burdens on the money supplies which were hardly adequate to carry on the industries of the country. The panic was entirely financial. It has, it is true, brought about a widespread suspension of trade and industry throughout the country, but there has been no throwing on the market of merchandise at ruinous prices, the usual accompaniment of industrial panics. The manufacturers, on the contrary, faced the inevitable, and without delay proceeded to curtail the supply and thus reduce such chances as there might have been of glutting the market with unsalable articles. Fortunately for the country, warning of the trouble was given early, and it was possible to take steps in time to prepare for it. The cloud of uncertainty, which has been hanging over the country for so long and gradually growing more threatening, is now passing away, and it may be said that the worst of the storm has now passed. There will in all probability be mercantile disturbances for some months to come, but readjustment and recuperation are well under way, and unless labor troubles should retard the improvement or monopolies of capital interfere to keep up prices at too high a level, it is expected that before many months have passed business will be on a safer and more normal basis."

CONSOLIDATED GAS BONDS.—Pouch & Co., of 18 Wall Street, New York, in a circular inviting investment in Consolidated Gas sucurities say that controlling the entire gas and electric lighting of Manhattan Island, and interested in other nearby companies, it has an uninterrupted dividend record of 23 years, at a rate of 4 to 8 per cent. They also say: "One of the most important steps recently taken by this corporation began with the acquisition of property at Astoria, L. I., where the first unit of an enormous gas plant was built, beginning its operation in December, 1906, by making about 4,000,000 cubic feet of gas per day. The entire plant when completed will consist of 6 units and will have a capacity of 90,000,000 cubic feet per day. The completion of the additional units will enable the company to gradually transfer its operations in the manufacture of gas across the East River, which undoubtedly will so enhance its real estate holdings in New York City that they will prove, on a lease basis alone, a source of considerable annual income. In connection therewith we find that the total assessed valuation of all New York City real estate to-day as compared with 10 years ago is about 2½ times greater—suggesting future enhancement when the transfer to Astoria is completed. It has been claimed on good authority that the present 4 per cent dividend has been met entirely by the large relative profits accruing from the electric light business, which bids fair to assume enormous proportions in the near future."

GENERAL ELECTRIC CURTAILING OPERATING EXPENSES.—Preliminary reports indicate that the operating expenses of the General Electric Company will be materially reduced this year, particularly in the item of construction. For the last year $3,745,989 construction was charged to operating, but this year it is estimated that the item of construction will not be more than $1,000,000. The operating ratio of the General Electric Company runs very high. Last year it was 92.3 per cent, as compared with 88.4 per cent in 1906-7, 85.8 per cent in 1905-6 and 85.4 per cent in 1905. For the three months ended April, 1908, the company booked $10,033,173 in new orders and billed for shipment $9,208,826, equaling a rate of about 67 per cent of the business of the fiscal year ended January 31, 1908.

MANHATTAN RAILWAY COMPANY BOND ISSUE.—The matter of the application of the Manhattan Railway Company for permission to issue 4 per cent bonds to the amount of $10,818,000, under the terms and provisions of its consolidated mortgage, dated Feb. 26, 1890, and on the company's second application to issue $894,000 additional bonds of the same character and under the same conditions, was the subject of a hearing before the New York Public Service Commission of the First District last week. The two proposed bond issues will be used to take up the $10,818,000 6 per cent first mortgage bonds of the Metropolitan Elevated Railway Company, now a part of the Manhattan, which mature July 1, 1908. As the bonds to be taken up bear 6 per cent interest, and as those of the Manhattan to be issued bear interest of only 4 per cent, it is necessary to ask permission to issue the additional $894,000 bonds to provide sufficient funds with which to take care of the maturing issue. Counsel for the Manhattan company explained at the hearing that possibly it might not be necessary to use all the proceeds of the $894,000 issue to make up the amount required for taking up the Metropolitan issue. Any surplus funds under the mortgage must be used for extensions and betterments. The right to issue the $894,000 additional bonds exists in that an extension of 1.49 miles of elevated road made within the last few years has no bonds standing against it, while under the terms of the mortgage the company may issue bonds at a rate not exceeding $600,000 per mile of double-track railway and $300,000 per mile of single-track railway. It is figured that the displacement of the maturing 6 per cent bonds by new 4 per cent bonds will save the Interborough Rapid Transit Company, which leases the road and guarantees charges, in interest about $180,000 yearly. No contract for the sale of bonds has been made.

INTERBOROUGH-METROPOLITAN NOTES.—Arrangements have been concluded by the Interborough-Metropolitan Company to extend the $4,500,000 notes due May 27 by exchanging them for new notes bearing 6 per cent interest, the exchange being made dollar for dollar. All the holders except a very few agreed to the exchange and the holdings of the non-assenting are to be redeemed in cash. A year ago the Interborough-Metropolitan Company sold $8,050,000 six months 6 per cent notes, which were extended for six months more. While this amount has been reduced the collateral held for the original amount is still held as collateral.

PRESIDENT SUNNY OF THE CHICAGO TELEPHONE COMPANY.—President B. E. Sunny, of the Chicago Telephone Company, says that frankness will be the keynote of his policy in dealing with the public. He reports an increase of 100 calls daily in the last month and the total daily calls now are about 1,150,000. "Of the 23,588 telephones installed this year," he says, "16,625 were new subscribers. Half of the 5,000 telephone orders on hand are for underground conduits. The operating force was reduced from 3,900 to 3,600, but the 300 are being put back as business is improving. Expenses will be as liberal as necessary to give satisfactory service."

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY INVENTORY.—Acting Governor Draper, of Massachusetts, has signed the measure which provides that the Massachusetts Highway Commission shall cause to be made an inventory and appraisal of the property of the New England Telephone & Telegraph Company within Massachusetts, and authorizing the expenditure of $30,000 for that purpose.

UNITED RAILWAYS STOCKHOLDERS BRING SUIT.—Reports from San Francisco state that Joseph A. Sullivan, owner of stock in the United Railways Investment Company of New Jersey, has brought suit in equity to recover for the stockholders $200,000, which Patrick Calhoun, president of the United Railroads, is alleged to have paid to Abraham Ruef to influence supervisors to grant franchises to the company.

WORCESTER (MASS.) LIGHTING COMPANY.—The Worcester Gas Light Company has petitioned the Gas & Electric Light Commission for authority to issue 2000 shares of additional capital stock, the proceeds to pay for enlargement and improvement of the plant.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

ABBEVILLE, ALA.—Plans are being considered for the construction of an electric light plant, contracts for which will be placed in the near future. The cost of the plant is estimated at $12,000. P. A. McDaniel is mayor.

VALDEZ, ALASKA.—The Alaska Water, Light & Telephone Company has been granted a 25-year franchise in Valdez. The company has a hydro-electric plant at Solomon Basin, and will construct several large reservoirs during the summer to provide a supply of water for use during the low-water period during the cold weather.

HOLBROOK, ARIZ.—H. Lee Chilson, of Winslow, has been granted a franchise to construct and operate an electric railway from Holbrook to Fort Apache.

LITTLE ROCK, ARK.—Plans will be prepared by J. W. Bleidt, City Electrician, for an electric light plant with an output sufficient to supply electricity for 750 arc lamps, to cost $40,000. A 450-hp steam turbine will be installed, the cost of which is estimated at $16,000.

SAN FRANCISCO, CAL.—The power plant of the Great Western Power Company on the Feather River is nearly completed and will commence to furnish electricity in the northern part of the state in October. It is said that the entire output of this plant already has been contracted for, and announcement has been made that it has been decided that the power house would be enlarged to such a size that it will be capable of furnishing electricity throughout the state. This new investment will cost $25,000,000. The present plant cost about $12,000,000.

COLORADO SPRINGS, COL.—Plans are being made by the Colorado Springs Electric Company to install an engine, a 500-kw, three-phase generator, a motor generator, self-supporting stack and new switchboard in its plant, the cost of which is estimated at $60,000.

GRAND JUNCTION, COL.—It is understood that Morris K. Devereaux and Eugen S. Sunderlin will soon apply for a franchise to construct a street railway system in this city.

HARTFORD, CONN.—The Hartford Electric Light Company has purchased a 3500-kw, Westinghouse-Parsons, 2300-volt, three-phase turbo-generator set. This machine will be installed in the Dutch Point plant, which at present contains four turbines of the same make, aggregating 5500 kw.

DOVER, DEL.—The City Council has authorized the chief engineer of the water works system and electric light plant and the chairman of the water and light committee to make investigations preparatory to installing new engines and generators in the municipal electric light plant. A. L. Kichline is chief engineer.

KENTON, DEL.—The People's Telephone Company is erecting a telephone line between Kenton and Hartley, which later will be extended to Cheswold.

WASHINGTON, D. C.—President Roosevelt has signed the bill authorizing the Washington Railway & Electric Company and the Capitol Traction Company to extend their lines to the new terminal station temporarily.

WASHINGTON, D. C.—Bids will be received until June 18 by Bernard Green, superintendent of construction of building for National Museum, Library of Congress, Washington, D. C., for furnishing and delivering engines, including the installation of the same for the National Museum in Washington.

WASHINGTON, D. C.—Both the Senate and the House have passed over the President's veto the bill extending the time for the construction of a dam across the Rainy River in Minnesota. It was explained that the veto had been applied under a misapprehension, and that the President accordingly had withdrawn his objections.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Commissioners of District of Columbia, Washington, D. C., for furnishing and installing a 100-hp boiler and to make the necessary changes in the piping to connect up with the present plant and to furnish all necessary accessories at the power house at the Home of the Aged Infirm at Blue Plains. Specification and proposal blanks may be obtained at the above office. The commissioners are: H. B. F. Macfarland, Henry L. West and Jay J. Morrow.

KEY WEST, FLA.—The Key West Electric Light Company contemplates enlarging its power plant in this city and has secured options on the property adjoining its present power station, on which additions to the plant will be erected.

ST. ANDREWS, FLA.—The St. Andrews Light & Power Company, recently formed, will construct a plant here at a cost of about $12,000. Contracts for material have already been placed. T. J. McSween is engineer in charge.

TAMPA, FLA.—The Tampa Electric Company is contemplating an issue of $2,000,000 in bonds, the proceeds to be used to increase the equipment of its power plant and improving the electric lighting system.

MINIDOKA, IDAHO.—Specifications are on file at the office of the ELECTRICAL WORLD, 239 West Thirty-ninth Street, New York, N. Y., for electrical apparatus for the Minidoka project, Idaho, bids for which will be received until June 24 at the office of the United Reclamation Service, 777 Federal Building, Chicago, Ill.; also for turbines, pumps and accessories, bids for which will be opened at the same office on June 23. O. H. Ensign, 25 Carroll Block, Madison, Wis., is chief electrical engineer.

SANDPOINT, IDAHO.—Application has been made to the City Council for a franchise to construct an electric plant to furnish electricity for manufacturing purposes and to construct and operate an electric street railway system in this city. F. M. Molyneaux, A. Filson, V. M. McBride and Earl Farwin, of Sandpoint, and V. M. Smith, of Brooklyn, N. Y., are interested in the enterprise.

CHICAGO, ILL.—William Carroll, city electrician, according to local press reports, states that the city does not contemplate abandoning the municipal electric lighting plants, but is simply changing from steam to electrical power to drive its dynamos, and will continue to generate its own electricity.

DE KALB, ILL.—The De Kalb-Sycamore Interurban Traction Company is installing two 400-hp Wickes boilers with Murphy automatic stokers. The company is also installing the Green Fuel Economizer Company's system of exhaust draft and has placed orders with the Economical Engineering & Construction Company, of Chicago, Ill., for vacuum ash and coal handling machinery.

MANITO, ILL.—The City Council is reported to have rejected all bids for the completion of the electric light plant. New bids will be received.

FT. WAYNE, IND.—An ordinance has been introduced in the City Council providing for placing of all wires underground in the central part of the city, except trolley wires.

GARY, IND.—The Gary-Hobart Traction Company has been chartered to build street and interurban railways in and between Gary, Liverpool and Hobart. L. C. Wood and others are the directors. The capital stock of the company is placed at $10,000.

MICHIGAN CITY, IND.—It is reported that a $1,000,000 power plant will be erected in this city by the Chicago, Lake Shore & South Bend Railway. The plant will furnish electrical power to operate the cars of the South Bend and Chicago road. It is understood the company contemplates the construction of a railway to Niles along the route of the Michigan Central and eventually to Kalamazoo, Mich.

DECORAH, IA.—The Standard Telephone Company contemplates placing its wires underground in this city.

DECORAH, IA.—The Upper Iowa Power Company has awarded the contract for the construction of its dam to Rich, Carlson & Feite.

LEHIGH, IA.—It is reported that an electric light plant will be installed here. H. V. Williams is interested in the project.

INDEPENDENCE, KAN.—The Union Traction Company, which contemplates the construction of an interurban electric railway between Arkansas City and Winfield, has been voted $20,000 in bonds by Arkansas City to aid in the construction of the railway. It is reported that a similar amount will soon be voted on in Winfield. D. H. Siggins, of Coffeyville, is president and general manager.

MOUNDRIDGE, KAN.—The question of establishing an electric light plant and water works system in the town is being considered. Plans are now being prepared by Burns & McDonnell, of Kansas City, Mo.

RUSSELL, KAN.—The citizens are considering the question of establishing an electric light plant and water works system in the town, for which plans are being prepared by Burns & McDonnell, of Kansas City, Mo.

SOLOMON, KAN.—Plans are being prepared by Burns & McDonnell, of Kansas City, Mo., for the construction of an electric light plant and water works system in this place.

KNOXVILLE, KY.—It is reported that the Knoxville, Sevierville & Eastern Railway Company will commence work on the construction of its road June 14, the bonds of Sevier County to the amount of $150,000 having been declared valid. W. J. Oliver & Company will build the line.

MAYFIELD, KY.—The plant of the Mayfield Water & Light Company is reported to have been destroyed by fire on May 17.

LISBON FALLS, MAINE.—The Lisbon Falls Gas & Electric Company has purchased a 100-kw, 2300-volt, alternating-current generator and switchboard for its power plant.

PRESQUE ISLE, MAINE.—Plans are being considered to have the Maine & New Brunswick Electrical Power Company extend its service outside of the village of Fort Fairfield, the territory to be served being reached by about 14 miles of pole line which was erected for the Independent Telephone Company, the poles not having been used.

LAUREL, MD.—The citizens have voted in favor of the proposition of issuing $15,000 in bonds for the construction of a new electric light plant.

THURMONT, MD.—F. C. Perkins has been granted a franchise to erect a power plant and to furnish electricity in this city, for which preliminary surveys have been made.

BOSTON, MASS.—The bill allowing the French King Rapids Power Company to construct a dam on the Connecticut River has passed the Massachusetts Senate.

BOSTON, MASS.—The supreme judicial court of Massachusetts has decided that the New York, New Haven & Hartford Railroad Company has not the right to hold stocks of electric railways in the state of Massachusetts. It is said that the company will obey the decree of the court. C. S. Mellen, president of the company.

CLINTON, MASS.—A committee has been appointed to investigate the matter of power development at the Wachusett Dam and the question of municipal ownership of the plants of the Clinton Gas Light Company, especially as to the cost they would be to the town, and report at an adjourned town meeting to be held July 13.

CLINTON, MASS.—Plans have been completed and bids have been called for the construction of a new power house for the Bigelow Carpet Company by Charles T. Main, of Boston, mill engineer and architect, which includes power, boiler and pump houses, stack and coal pocket. The equipment will consist of 2500 hp in boiler capacity and about 1100 kw in generating units.

DRACUT, MASS.—The citizens are considering the question of establishing an electric light plant.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company is moving its substation from the Berkshire Block annex to its plant on upper Main Street.

MILLERS FALLS, MASS.—The Village Council has adopted the following schedule of rates for electricity for motors. No power rates will be given for a motor of less than 2 hp, and that a minimum charge of $2 per month be made. The rates are: For the first 100 kw-hours per month, 7 cents per kw-hour; from 100 to 200 kw-hours, 6½ cents; from 200 to 400 kw-hours, 5½ cents, and for 600 or more kw-hours, 5 cents.

PELHAM, MASS.—A franchise has been granted to the Holyoke Street Railway Company for an extension of the Amherst & Sunderland branch to Orient Springs. W. L. Loomis is president.

SHREWSBURY, MASS.—The contract for installing the municipal electric light system has been awarded to the Delta Electric Company, of Worcester, for $11,159. The contract for electrical energy for operating the system has been awarded to the Marlboro Electric Company, for a term of five years. Under the terms of the contract the Marlboro company is to deliver electricity at 6600 volts, three phase, near the town hall, and is to maintain and erect the transmission line from its plant to the substation. A 24-hour service will be furnished.

MARQUETTE, MICH.—C. Retallic, superintendent of the municipal electric light and power plant, writes that bids will be received about June 15 for the construction of a substation in connection with the present power plant, the cost of which is estimated at $12,000. C. W. Humphrey, The Rookery, Chicago, Ill., is engineer.

OWOSSO, MICH.—Plans are being formulated by the Shiawassee Light & Power Company, of Corunna, to control the supply of electricity in this district. The company is negotiating for water rights along the Shiawassee River for a distance of 35 miles. An attempt is also to be made, it is said, to secure control of the local power plant and the transmission line between the two cities. The Owosso & Corunna Electric Company, which controls the electrical plant in Corunna, is now in the hands of a receiver.

REED CITY, MICH.—The plant and holdings of the Reed City Electric Light Company have been taken over by George D. Westover, H. Millspaugh, and E. J. Haynes, of Cadillac. The new company is capitalized at $30,000 and will be known as the Osceola Light & Power Company.

CLAREMONT, MINN.—This village is considering the question of installing an electric light plant at a cost of about $6,000.

SUNBEAM, MINN.—An independent telephone company is being organized in this town for the purpose of installing a telephone system from Sunbeam through the towns of Deer Park and Kratka to High Landing.

UNDERWOOD, MINN.—Plans are being made to organize an independent telephone company for the purpose of erecting a telephone line from Underwood to Phelps.

OXFORD, MISS.—The University of Mississippi has accepted the plans prepared by Engineer Prout, of Memphis, for the light and power plant for the University. The cost of the plant is estimated at $35,000. D. M. Kimbrough is a member of the building committee.

ARCOLA, MO.—The Kansas City & Springfield Southern Railway is contemplating the construction of a power house to furnish electrical energy for its railway. C. C. McFann, of Nevada, is general manager.

LOUISIANA, MO.—Plans are being considered by the Louisiana Light, Power & Traction Company to erect an electric power house and repair shops at Louisiana. F. E. Murray is secretary.

OREGON, MO.—Bids will be received by the Oregon Interurban Railway Company until June 10, for the construction of its road from Oregon to Forest City, Mo., a distance of 4½ miles. B. F. Morgan, of Oregon, is president.

BOZEMAN, MONT.—The Gallatin Valley Electrc Railway is contemplating the construction of an electric railway from Bozeman to Salesville, a distance of 26 miles, for which preliminary surveys have been made and practically all the right of way secured. H. L. Casey is secretary, and C. N. Jacquette, of Bozeman, chief engineer.

WHITEFISH, MONT.—The Big Bend Light & Power Company has applied to the Town Council for a franchise to install an electric lighting plant in this place.

OMAHA, NEB.—The Omaha, Lincoln & Beatrice Railway Company is making arrangements to place contracts for the construction of about 1⅛ miles of track, with overhead equipment, etc.

ASHLAND, N. H.—Plans are being made by the Ashland Electric Light Company to install a new street lighting system, the equipment for which has already been ordered.

CONCORD, N. H.—The Concord Electric Company has purchased a 500-kw, 2300-volt, General Electric alternator. This machine will be installed to supplement the company's water power service.

GROVETON, N. H.—The Odell Manufacturing Company will shortly increase the equipment of its power plant by the installation of a 200-kw, General Electric, 600-volt alternator, with switchboard and several electric motors.

ASBURY, N. J.—The Atlantic Coast Electric Railway Company has applied to the City Council for a franchise to construct an electric railway from Florence Avenue to the Monmouth Beach Borough line in Long Branch.

JERSEY CITY, N. J.—The Board of Aldermen has passed an ordinance granting the Mutual Benefit Electric Light & Power Company permission to construct underground conduits in the streets of the city for the distribution of electricity for a term of 20 years.

PASSAIC, N. J.—A proposition has been submitted to the Board of Freeholders of the City of Passaic by Thomas N. McCarter, president of the Public Service Corporation, to supply electricity to light the streets of the city. The company offers to supply arc lamps during the term of the present contract, which will expire April, 1911, at the rate of $100 per lamp per year, except where lines have to be constructed to supply the lamps, when the rate will be $140 per lamp per year.

PRINCETON, N. J.—Plans are being made to enlarge the power plant at Princeton University. Two Boilers of 350 horse power, an engine and a 300-kw generator will be added. A new coal bunker will also be built. The cost of the work is estimated at $50,000.

WOODBURY, N. J.—The taxpayers have been asked to express their views at the next meeting of the Council to decide whether to enter into a five-year contract with the Public Service Corporation to light the streets of the town, instead of establishing a municipal electric light plant. The citizens favor expending $25,000, but Councilman Pearson declares, after investigation, that a plant cannot be built for that sum.

BABYLON, N. Y.—The Babylon Electric Light has filed wth the Secretary of State a notice of increase of capital stock from $15,000 to $45,000. L. H. Fishel is president of the company.

FAIRPORT, N. Y.—Plans are being made to improve the municipal electric light plant, which will include the installation of additional machinery. For further information address Dr. F. W. Clapp.

GENEVA, N. Y.—Bids will be received by Lyman P. Haviland, chairman of the building committee, State Agriculture Experiment Station, at Geneva, until June 20 for gas engine, dynamo, switchboard, motors, electric wiring, pole line and connections for the State Agriculture Experiment Station at Geneva. Drawings and specifications may be seen and blank forms of proposals obtained at the office of the director at Geneva, or at the office of the State Architect, Albany. Complete plans will be furnished to prospective bidders upon application to Franklin B. Ware, state architect, Albany, N. Y.

HUDSON, N. Y.—The City Council has awarded the contract for lighting the streets and city hall building for a term of five years to the Albany & Hudson Railroad Company, commencing Sept. 15, 1908. Under the terms of the contract the company is to furnish arc lamps of 2000 cp at the rate of $81.75 per lamp per year, and incandescent lamps of 22 cp at $22 each per year. The street lighting system consists of 117 arc lamps and 15 incandescent lamps.

NEW YORK, N. Y.—Bids will be received by J. W. Stevenson, commissioner of bridges, until June 11 for electrical equipment of the University Heights Bridge.

NEW YORK, N. Y.—The contract for installing electric equipment in new School No. 100, Borough of Manhattan, has been awarded to T. Frederick Jackson, 592 Columbus Avenue, Manhattan, for $16,600.

NEW YORK, N. Y.—Bids will be received until June 8 by C. B. J. Snyder, superintendent of school buildings, for installing electric equipment in additions to and alterations in Public School No. 64, Borough of Brooklyn.

NIAGARA FALLS, N. Y.—It is reported that the Erie Railroad will equip its road to be operated by electricity between Niagara Falls and Buffalo. W. Carl Ely, formerly of this city, is said to be forming a syndicate to take charge of the work.

VALLEY CITY, N. D.—Bids will be received by the City Council until July 6, for the sale of the municipal electric light plant. A 20-year exclusive franchise will be granted to the successful bidder. Bids for less than $40,000 will not be considered. H. F. Halverson is city auditor.

CINCINNATI, OHIO.—Plans are being considered by Dr. H. T. George, of Dayton, to establish a new traction railway to connect Cincinnati and Fort Wayne, Ind. It is proposed to use the old Gamble Road, extending from Brighton to Cheviot, as a means to enter Cincinnati.

CINCINNATI, OHIO.—Governor Harris has permitted the Hunt bill to become a law without signing it. The bill authorizes the construction of a rapid transit overhead and underground railway from Third and Walnut Streets in Cincinnati to Norwood, and, it is said, provides a means of entrance for interurban lines.

COLUMBUS, OHIO.—Plans have been approved by the State Tuberculosis Hospital Commission for a power house and several other buildings for the new hospital located near Mt. Vernon. The State Legislature made an appropriation last winter of $350,000 for extensive improvements to the hospital, including the construction of a power plant to furnish light and heat, water works, several new buildings, etc. Dr. C. D. Probst is secretary of the commission.

ELYRIA, OHIO.—The electric lighting plant of the Elyria Milling & Power Company has been completed and will soon be put in operation. The plant will furnish electricity for street lamps.

LEWISBURG, OHIO.—Bids will be received until July 1 for the construction of an electric light plant and water works system to cost $26,000. The plant will be operated by gasoline engines. Harry J. McDargh, of Dayton, is engineer.

NEW PHILADELPHIA, OHIO.—It is reported that the Columbus, Canton & Eastern Transit Company, recently incorporated, will take over the holding of the Valley Transit Light & Power Company, of New Philadelphia, and also proposes to construct an electric railway from Canton to Columbus, for which much of the right of way has been secured. W. W. Snyder, of New Uhrichsville; Michael Seibold, W. J. Wise, Frank G. Kunzl, A. W. Reiser, J. Knisely and others of New Philadelphia are interested in the project.

YOUNGSTOWN, OHIO.—The ordinance recently passed by the City Council giving the Youngstown Consolidated Gas & Electric Company permission to furnish street lighting has been reconsidered, and the proposition will be taken up in connection with the agitation for lower street railway fares.

GUTHRIE, OKLA.—An appropriation has been made by the State Legislature for the construction of a heat, light and ice plant for the Fort Supply Asylum.

EL RENO, OKLA.—E. E. Blake has filed on water rights to construct a canal for irrigation and power purposes. The cost of the work is estimated at $25,000.

SHAWNEE, OKLA.—The Chamber of Commerce and business men of Shawnee have pledged a bonus of $75,000 to any company that will build an electric railway from Shawnee to Muskogee. Okmulgee and Okemah have also pledged $25,000 each.

ALBANY, ORE.—A franchise has been granted to the Portland, Eugene & Eastern Railway Company to construct an electric railway on Ellsworth Street to connect with the Ninth Street line. A. Welch is general manager.

PANAMA.—Bids will be received until June 24 at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., for boiler room equipment, consisting of boilers, fittings and appurtenances, uptakes, breeching, duplicate induced draft fans with direct-coupled turbine and motor, feed-water heater, boiler-feed pumps, piping, valves, pipe covering, etc. Lieut. Col. H. F. Hodges is purchasing agent.

BALFOUR, PA.—An independent telephone company has been organized here to construct a telephone line from Balfour to Carlisle. L. B. Brehm is president of the company.

BIRDSBORO, PA.—The Conestoga Telephone Company contemplates the construction of a telephone line from Churchtown to Bowmanville.

DUNBAR, PA.—Plans are being considered by the Tri-State Telephone Company for the installation of a cable plant at Dunbar, the cost of which is estimated at $8,000.

HUNTINGDON, PA.—It is reported that F. M. Bollinger and M. A. Miller are planning to organize a company for the purpose of constructing a street railway system in Huntingdon and up Stone Creek, a distance of about 2½ miles, where it is proposed to establish an amusement park. It is said that a charter will be soon applied for under the name of the Brookside Electric Railway.

IRWIN, PA.—The Irwin-Herminie Electric Railway Company has been granted a franchise to operate its cars on certain streets of the borough, for the privilege of which the company is to pay the borough over $8,000. Work is to be started within 60 days and to be completed within one year.

LAVELLE, PA.—An independent telephone company has been organized in this city to construct a telephone line to connect with the independent system at Locust Dale.

MANOR, PA.—The Manor Valley Electric Railway Company has applied for a charter ond proposes to construct an electric railway from Manor to Export, a distance of seven miles. H. A. Lauffer, of Manor, is president.

SUNBURY, PA.—The Sunbury & Northumberland Electric Railway Company is in the market for overhead material and for 6000 ft. standard track. R. West is general manager.

PROVIDENCE, R. I.—The Providence Telephone Company has been granted permission to place its wires underground on certain streets in the city.

WOONSOCKET, R. I.—The City Council has voted against the approval of the proposed merger act incorporating the Blackstone Valley Electric Light & Gas Company as a holding company for the two Woonsocket and two Pawtucket lighting companies. It is stated that the merger would be effected under a New Jersey or Maine charter.

SPARTANBURG, S. C.—The Electric Power & Manufacturing Company contemplates extending its transmission lines to the surrounding mill towns. F. D. McEwen is vice-president and general manager. This company recently purchased the plant and holdings of the Spartanburg Street Railway, Gas & Electric Company.

WOODRUFF, S. C.—A movement has been started by the business men of this town to organize a public utility company for the purpose of purchasing electricity from the Electric Power & Development Company and distributing it to the citizens. The Electric Power & Development Company will extend its transmission line from Spartanburg to Woodruff.

CARTHAGE, TENN.—The citizens are considering the question of establishing an electric light plant.

PULASKI, TENN.—J. H. Ragsdale and associates are interested in a project to develop water power on the Elk River to generate electricity, which will be transmitted to Pulaski and other towns.

BRENHAM, TEX.—The County Commissioners have granted franchises to the Brenham & Long Point Telephone Company and to the Chappell Hill Telephone Company to erect telephone lines along the public highways.

FLORESVILLE, TEX.—The Cestahowa Telephone Company has been granted a franchise to erect telephone lines along certain public roads in Wilson County.

DANVILLE, VA.—The city is contemplating the construction of a new municipal electric light plant at a cost of $150,000. Frank Talbott is superintendent.

CENTRALIA, WASH.—An election will be held June 2 to vote on the proposition of issuing $45,000 in bonds, the proceeds to be used to purchase an electric light plant. The city already owns its distributing system, but has purchased electricity to operate the system, the contract for which will expire in about a year.

CHEHALIS, WASH.—A notice of appropriation of water rights on Winston Creek, near Mayfield, has been filed by E. Riggs, of the Chehalis Light & Power Company. It is proposed to develop the water power to operate the electric plant, street railway system, etc.

HUNTERS, WASH.—A. Newell and J. T. Young are developing water power at this place to furnish power to operate an electric light plant in connection with their fruit box factory.

SEATTLE, WASH.—E. B. Cox, manager of the Golden Gardens, contemplates installing electric lamps in the streets of Loyal Heights north of Ballard, and will soon apply to the County Commissioners for a franchise to erect the system.

TACOMA, WASH.—The City Council on May 15 voted to instruct the Commissioner of Public Works to advertise for bids for furnishing the city 1500 additional horse-power in connection with the municipal lighting plant for a term of 4½ years.

VASHON, WASH.—The Vashon Island Telephone Company has been granted a franchise by the County Commissioners to erect telephone lines along the county roads and to lay a cable from Fauntleroy Cove to Dolphin Point, and along the beach. A franchise was also granted to A. W. Davis to erect telephone lines over certain streets at Redondo Beach.

FAIRMONT, W. VA.—A special meeting of the stockholders of the Fairmont & Clarksburg Traction Company will be held June 10 to vote on the proposition of increasing the capital stock from $2,000,000 to $5,000,000. The company proposes to establish an interurban system connecting the important towns in eastern West Virginia. S. L. Watson is president of the company.

EAU CLAIRE, WIS.—The City Council has accepted the bid of the Chippewa Valley Railway, Light & Power Company to light the streets of the city. Under the terms of the contract the company is to furnish 140 arc lamps at a cost of $56.40 per lamp per year.

JUNEAU, WIS.—W. G. Kirchoffer, of Madison, engineer, writes that all bids received April 18 for the construction of power house, and for furnishing a 300-gal. deep well triplex pump and a 25-hp gasoline engine have been rejected, and as yet nothing further has been done.

KEWAUNEE, WIS.—The citizens have voted to issue $20,000 in bonds to establish an electric light plant.

LA CROSSE, WIS.—Plans are being considered by the La Crosse Water Power Company, which has just completed a 16,000-hp hydroelectric plant at Hatfield, for the construction of another plant below Hatfield. Orland Holway, who was the promoter of the Hatfield plant, is now engaged in the preliminary work It is proposed to construct another dam at Levis Island. It is said that a new company will be organized to build the new power plant, which will be located about two miles above the city.

NEW WESTMINSTER, B. C., CAN.—Arrangements are being made by the Canadian Pacific Railway Company to equip its road between here and Westminster Junction, to be operated by electricity, early next year. F. E. Busteed, of Vancouver, is general superintendent.

VICTORIA, B. C., CAN.—Bids will be received by W. W. Northcott, civic purchasing agent, until June 15 for two electrically driven water pumps for the civic water works system.

SYDNEY, N. S., CAN.—The City Council has decided to extend the municipal street railway system.

YARMOUTH, N. S., CAN.—Plans are being made by the Yarmouth Street Railway Company to purchase a 300-kw generator, turbines and hydraulic equipment. The company recently purchased a 150-hp Robb-Armstrong engine and a 100-kw Canadian General Electric alternator.

BELLEVILLE, ONT., CAN.—Mayor McFee has refused to sign the application made by the City Council to the Ottawa Government for the sole right to develop power on dams 3, 4 and 5 on the Trent Valley Canal.

DUNNVILLE, ONT., CAN.—The citizens have voted in favor of the by-law to purchase $30,000 of the Dunnville, Wellandport & Beamsville Railway bonds to assist in the construction of that railway.

HUNTSVILLE, ONT., CAN.—The town is considering the question of establishing a municipal electric plant and has engaged C. H. Mitchell, of Toronto, to make investigation for power development in connection with the plant.

LONDON, ONT., CAN.—The Power Committee appointed by the city to investigate the Hydro-Electric Power project, finds that under the provision of the Niagara contract the City of London would be liable for the sum of $702,658 for 30 years. The city's proportion of the cost of the transmission line, cost of operation, etc., would be $31,578, and a distributing plant would cost about $300,000, making the total cost over $1,000,000.

OAKVILLE, ONT., CAN.—Arrangements have been made by the town to install a new electric lighting plant, electrical energy for which will be supplied by the Radial Railway Company. Electricity for all purposes will be supplied on a meter basis, and meters will be supplied to all customers without charge. The company, it is said, will apply for a charter to supply electricity for motors.

PORT ARTHUR, ONT., CAN.—The civic power plant was destroyed by the bursting of the dam on Current River. J. J. Carrick is Mayor.

PORT ARTHUR, ONT., CAN.—The City Council has voted $40,000 for extensions to the municipal electric street railway system. J. J. Carrick is Mayor.

STRATFORD, ONT., CAN.—The City Council has decided to submit another by-law to the people to make a contract with the Hydro-Electric Power Commission for electrical energy.

MONTREAL, QUE., CAN.—The City Council has decided to accept the offer of the Robert Company to supply electricity in the city for lamps and motors. The new company will develop the Beauharnois Canal, and offers to furnish electrical energy at a cheaper rate than is now supplied by the Montreal Light, Heat & Power Company. E. A. Robert, E. B. Greenshields, G. G. Foster, and others are interested in the enterprise.

PRINCE ALBERT, SASK., CAN.—The City Council has decided to replace the present street lamps with arc lamps. The Council is contemplating utilizing the old electric light plant for a power house to furnish electrical energy for an electric railway system to be owned by the municipality.

SPRINGSIDE, SASK., CAN.—Plans are being made by the Yorkton Northwest Telephone Company to construct a telephone system in this city.

New Industrial Companies.

THE STOLZ ELECTROPHONE COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 by Ernest H. Stolz, Frederick K. Gustin and Albert E. Coy. The company proposes to manufacture instruments to improve the hearing.

THE FEDERAL LIGHT & SUPPLY COMPANY, of Milwaukee, Wis., has been incorporated, with a capital stock of $5,000, to deal in lighting apparatus, etc. The incorporators are: Charles F. Meinhard, Ernest Kruecke and Robert Kruecke.

THE BELMONT ELECTRIC COMPANY, of New York, N. Y., has been chartered with a capital stock of $1,000, to manufacture electrical supplies. The incorporators are: Thomas W. McKnight, John W. O'Hara and John B. Brown, of New York, N. Y.

THE GLAISTER COMPANY, of Montclair, N. J., has been incorporated with a capital stock of $20,000 to do a general electrical contracting and supply business. The incorporators are: H. M. Browne, E. J. Forhan, both of New York, N. Y., and F. W. Mills, of Hoboken, N. J.

THE MILLER-WARREN COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $5,000, and proposes to manufacture engines, boilers, machines, tools, etc. The incorporators are: William J. Schatz, Daniel Miller and Edward Warren, all of New York, N. Y.

THE MORRIS GETTER ELECTRICAL COMPANY, of New York, N. Y., has been chartered by Marcus Getter, Joseph Getter, Solomon Blaine and William Helfaud, all of New York, N. Y. The company is capitalized at $5,000 and proposes to do a general electrical supply and contracting business.

O. HUMMEL & SONS, of New York, N. Y., have filed articles of incorporation with a capital stock of $10,000, for the purpose of manufacturing machinery, engines and electrical appliances. The incorporators are: H. Leroy Bell, Robert D. Geswein, George W. Collins, all of New York, N. Y.

THE JAMES J. HAROLD MANUFACTURING COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $10,000, by James J. Harold, Emma Harold and Charles W. Harold, all of Brooklyn, N. Y. The company proposes to manufacture engines, dynamos, pumps, etc.

THE STORAGE BATTERY LIGHTING COMPANY, of Augusta, Maine, has been incorporated, with a capital stock of $1,200,000, for the purpose of manufacturing storage batteries. The officers of the company are: E. E. Newbert, of Augusta, president; J. Berry, of Augusta, treasurer, and M. H. Simmons, of Hallowell, clerk.

Company Elections.

WASHINGTON, D. C.—At a meeting of the directors of the Washington Railway & Electric Company, held May 28, the following named officers were elected: Clarence F. Norment, president; Ward Thoron, first vice-president; George H. Harries, second vice-president, and Allan L. McDermott, special counsel.

GAINESVILLE, GA.—At the annual meeting of the North Georgia Electric Company the following named officers were elected: W. A. Carlisle, of Gainesville, president; C. M. Merrick, of New Brighton, vice-president; W. H. Slack, of Gainesville, secretary and treasurer.

GAINESVILLE, GA.—At the annual meeting of the Gainesville Electric Railway Company the following named officers were elected: A. G. Sharp, of Atlanta, president; J. F. Moore, of Dahlonega, vice-president; W. H. Slack, of Gainesville, secretary and treasurer, and W. A. Carlisle, manager.

CHICAGO, ILL.—At the annual meeting of the Calumet & Chicago Railway Company the following named officers were elected: Ira M. Cobe, president; D. M. Cummings, vice-president; O. S. Gaither, secretary and treasurer.

QUINCY, ILL.—At the annual meeting of the St. Louis, Terre Haute & Quincy Interurban Railway the following named officers were elected: Edward Yates, of Pittsfield, Ill., president; W. C. Flick, of Quincy, Ill., vice-president; F. W. Knollenberg, of Quincy, Ill., secretary; S. P. Landeraft, of Quincy, Ill., treasurer. It is said that arrangements have been made for financing the project, and that work will soon commence on the construction of the road between this city and Taylorville, surveys for which have already been made.

SOUTH BEND, IND.—At the annual meeting of the stockholders of the Indiana & Michigan Electric Company the following directors were elected: Chas. A. Chapin, of Chicago, Ill.; M. L. Howell, of Cassopolis; F. A. Bryan, South Bend; A. A. Pope, of Cleveland, Ohio; E. A. Sanders, of Mishawaka; H. L. Crawford and H. H. Porter, of New York, N. Y. The directors re-elected the present officers.

IOLA, KAN.—At the annual meeting of the Crouch Electric Railway Company the following named officers were elected: F. V. Crouch, president; J. H. Osborn, vice-president; S. J. Stewart, secretary, and C. A. Bowlus, treasurer.

PAWTUCKET, R. I.—At the annual meeting of the Pawtucket Electric Company Fred W. Eaton was elected president of the company. The other officers of the company were re-elected.

New Incorporations.

CALLAHAN, CAL.—The Callahan Telephone Company has been organized for the purpose of erecting a telephone line to Gazelle, a distance of 28 miles. F. A. Grant is president of the company and F. W Armstrong, secretary.

PT. RICHMOND, CAL.—The Bay Shore Electric Light & Power Company has been incorporated, with a capital stock of $500,000, by W. H. George, of San Francisco; M. R. Jones, of Martinez; A. E. Steinberg, of Port Costa; E. M. Downer and L. E. Hart, of Pringle.

EAST ST. LOUIS, ILL.—The Duto Telephone Company has been organized with a capital stock of $10,000, by L. Beauman, W. S. Dorman, L. O. Whitnel and others.

HOPEDALE, ILL.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $20,000.

CROWNPOINT, IND.—Articles of incorporation have been filed for the Gary & Southern Traction Company by John W. Brown and others. The company is capitalized at $10,000 and proposes to build an electric railway between this city and Gary.

INDIANAPOLIS, IND.—The Indianapolis, Cloverdale & Terre Haute Traction Company has been incorporated by E. M. Bowman, H. F. Butze, Samuel T. Axtell, W. L. Cook and H. C. Sandresky. The company proposes to construct and operate a traction line connecting Indianapolis, Terre Haute and intervening cities.

POSEYVILLE, IND.—The Poseyville Light & Power Company has filed articles of incorporation for the purpose of constructing and operating an electric light plant in this place. The capital stock is placed at $10,000, and the directors are: Frank K. Seib, August Seib, Joseph F. Shaffer, Herman Stallings and Martin Dilger.

MASON CITY, IOWA.—The Idlewild Telephone Company has filed articles of incorporation with a capital stock of $10,000. The officers of the company are: W. W. Wilkinson, president; Dennis O'Donnell, vice-president; Ernest Stevens, secretary and treasurer.

ARMINTA, KY.—The Arminta Telephone Company has been organized with a capital stock of $500 by J. D. Blair, James Hall, J. H. Blair and others. J. D. Blair is manager.

HUSTONVILLE, KY.—The Hustonville Telephone Company has been organized with a capital stock of $500, by D. G. Kelly and others. The company proposes to erect telephone lines from this city to Mt. Vernon, a distance of about 40 miles.

STANFORD, KY.—The Farmers Telephone Company has been formed with a capital stock of $1,000 by A. K. Caldwell, M. F. Campbell, Tipton Simms and others.

CLARISSA, MINN.—The Eagle Valley Telephone Company has been organized for the purpose of erecting a rural telephone system. Peter Holmquist is secretary.

VICKSBURG, MISS.—Articles of incorporation have been filed for the Vicksburg Traction Company by S. S. Bullis and J. W. Cassell, of Vicksburg. The company is capitalized at $10,000 and proposes to operate an electric railway in Vicksburg.

EXCELSIOR SPRINGS, MO.—Articles of incorporation have been filed for the Excelsior Springs & Suburban Railway Company by Allen M. Bates, Hugh Wilhite and W. P. Southard, of Excelsior Springs; Henry J. Arnold, of Denver, Col., and John Lundstrain, of Colorado Springs. The company is capitalized at $50,000.

SHELBINA, MO.—Articles of incorporation have been filed for the Shelbina Telephone Company with a capital stock of $30,000, by J. H. Wood, S. A. Wood, V. E. Durham, G. C. Carnahan and W. S. Wood.

PORTALES, N. M.—The Roosevelt County Telephone Company has been incorporated with a capital stock of $25,000.

EMERADO, N. D.—The Emerado Rural Telephone Company has been chartered with a capital stock of $50,000, by J. K. Buttery, James Finnie and William Leake, all of Emerado.

LANGDON, N. D.—The Langdon Telephone Company has been incorporated with a capital stock of $25,000, by H. D. Albert, R. T. Burke, L. Allert and M. Burke, all of Langdon.

NELSONVILLE, OHIO.—Articles of incorporation have been filed for the Nelsonville & Murray Home Telephone Company with a capital stock of $50,000, by Elmer O. Pettit, J. W. Jones, J. G. Collins, John Eicker, Jr., and John A. Wellman.

SPRINGFIELD, OHIO.—The Springfield & Washington Railway Company has been incorporated to construct a railway connecting Springfield, Washington C. H. and Chillicothe. The capital stock of the company is placed at $1,000,000, and the incorporators are: George W. Baker, Hiram C. Baker, Charles Baughton, W. E. Roderick, Ulric Sloane and W. W. Keifer. The property of the Washington Traction Company was recently purchased by Mr. Baker, and the new company has been organized to complete the road according to the original plans. The company is now operating between Springfield and South Charleston.

BARNEY, OKLA.—The Barney Telephone Company has been incorporated with a capital stock of $10,000, by Harry O'Neale, O. J. Struble, H. E. Chrislet, James Llewellyn and A. V. Kelly.

CHANEY, OKLA.—The Chaney Mutual Telephone Company has been organized with a capital stock of $6,000, by J. W. Fiegel, W. S. Wood, M. A. Griffith and J. L. Leist.

CHOTEAU, OKLA.—The Choteau Telephone Company has been chartered with a capital stock of $1,500, by W. A. Crokett, C. B. Lindsey, M. E. Adkins, W. E. Grant and A. F. Hennigh.

LA CROSSE, OKLA.—Articles of incorporation have been filed for the La Crosse Telephone Company. The capital stock of the company is placed at $1,000 and the incorporators are: C. Timkin, Frank Bartell, Samuel O'Dore, of La Crosse; J. H. Connet, of Pocasset, and G. A. Smith, of Verden.

RALSTON, OKLA.—The Big Bend Rural Telephone Company has been chartered, with a capital stock of $1,300, by P. D. Gilliland, of Failfax; E. A. Williams, C. Triplett and J. B. Covert, all of Ralston.

TEXOLA, OKLA.—The Walker Telephone Company has been organized with a capital stock of $10,000, by J. E. Walker, of Texola; Rea Blossom and B. B. Walker, of Shamrock, Tex.

ALBANY, ORE.—The North Albany Telephone Company has been organized by the farmers of Benton County, and the following named officers elected: M. Gibson, president; Edward Peacock, secretary and treasurer.

TURNER, ORE.—Articles of incorporation have been filed for the Battle Creek Telephone Company by Charles H. Cannon, James R. Coleman and W. B. Clark. The company is capitalized at $2,000.

BETHEL, PA.—The Bethel & Mt. Aetna Telephone & Telegraph Company has been organized by A. A. Spannuth, Harry R. Miller, R. I. Franz and others.

AMARILLO, TEX.—Articles of incorporation have been filed for the Panhandle Telegraph & Telephone Company with a capital stock of $500,000 to construct an exchange at Amarillo, and long-distance lines into the surrounding country.

RICHMOND, VA.—The Three Springs Telephone Company, of Three Springs, Va., has been incorporated with a capital stock of $5,000. The officers of the company are as follows: W. K. Shankle, president; J. P Rumley, vice-president and secretary, and F. P. Shankle, treasurer, all of Bristol, Va.

ALEXANDER, W. VA.—The Alexander & Eastern Railway Company has been incorporated, with a capital stock of $100,000, by John B. Hart and Charles M. Hart, of Clarksburg. The company proposes to construct an electric railway from Alexander to Elkins, a distance of between 25 and 30 miles.

SISTERSVILLE, W. VA.—The Union Traction Company has been incorporated, with a capital stock of $150,000, to build an electric railway from a point near the boundary of Wetzel and Marshall Counties to New Martinsville and St. Marys and intervening cities. The incorporators are: H. W. McCoy, G. E. Work, S. G. Messer and R. Broadwater, of Sistersville; I. D. Morgan and E. L. Robinson, of New Martinsville. This company is successor to the Wetzel & Tyler Railway. E. L. Robinson is general manager

BALSAM LAKE, WIS.—The McKinley Telephone Company has been organized to construct a telephone line from McKinley to Cumberland. The officers of the company are: E. J. Pfluger, president; Israel Risberg, vice-president; Anton Lundmark, secretary and manager, and Oscar Risberg, treasurer.

LANG, SASK., CAN.—Five rural telephone companies have been organized in this city under the name of the Lang Farmers' Mutual Telephone Company, the companies being numbered from one to five. Each company will be capitalized at $1,200. The officers of the companies are as follows: No. 1—C. W. Frank, president; H. Downing, secretary and treasurer. No. 2—Wilfred Bowron, president; W. A. Bovair, secretary and treasurer. No. 3—J. M. Bradbury, president; H. M. Graham, secretary and treasurer. No. 4—Joseph Howard, president; J. J Howard, secretary and treasurer. No. 5—O. B. McCumber, president, E. S Kinter, secretary and treasurer.

LUMSDEN, SASK., CAN.—The Lumsden Radical Telephone Company has been organized to build and operate a telephone system in this city The company has applied for a 25-year franchise.

SALTCOATS, SASK., CAN.—Articles of incorporation have been filed for the Saltcoats Telephone Company with a capital stock of $25,000. About 50 miles of line will be erected. W. H. Hallett is secretary and treasurer, and Dr. Softly, manager.

YELLOW GRASS, SASK., CAN.—The Yellow Grass Telephone Company has been formed with a capital stock of $20,000.

Legal.

FRANCHISE SALE ENJOINED.—Judge Samuel B. Kirby, of the chancery court, on May 11, on application of the Kentucky Electric Company, granted a temporary injunction against the Board of Public Works, and the City of Louisville to prevent the selling of the Fetter franchise, created by a recent ordinance of the General Council. In his opinion Chancellor Kirby says: "The ordinance was never legally passed by the Board of Councilmen; it is void because it delegates to the Board of Public Works powers which can only be exercised by the General Council; it excludes bidders who, under the law, have the right to bid at the sale in violation of Section 164 of the Constitution; it is so framed that no one save the George G. Fetter Company can bid at the sale or comply with the terms of the franchise; it impairs the obligation of the contract between the Kentucky Electric Company and the City of Louisville."

CONSTRUCTION OF GRANT TO OPERATE TELEPHONE LINE.—A deed to a water company, having no right in its corporate capacity to operate a telegraph or telephone line, except as it might be incidental to the purposes of a water company, granted a right of way for the laying of water pipes, "with the right to set up, operate and maintain a telegraph or telephone line or lines thereon and with the right of ingress and egress to and from such right of way for all purposes." Afterward the water company assigned its rights to a telephone company which attempted to operate a commercial telephone line over the property It was held that the clauses relating to the telegraph or telephone lines, and to the right of ingress and egress, were consistent with and incidental to the principal object of the grant for the construction and maintenance of the water plant, and imposed upon the land in question only the burden resulting from such telegraph and telephone lines as might be reasonably adequate for the purpose of constructing and maintaining the pipe lines authorized by the grant, and hence was not broad enough to confer on a telephone company holding under an assignment from the water company the right to use such right of way for the maintenance of a commercial telephone line. The grant of the right to maintain a telephone line contemplated only such a line as was incidental to the business of the water company, and was not sufficient to permit the assignee of the water company to engage in the business of operating a telephone line with unlimited wires. Northeastern Telephone & Telegraph Co. v. Hephon, Court of Errors & Appeals of New Jersey, 69 Atl. 249.

MUNICIPAL CONSENT TO ERECTION OF TELEPHONE LINE CANNOT BE WITHDRAWN.—A domestic telephone company applied to a city for a permit to construct and operate its line in the city.

At a special meeting of the council, at which the Mayor and six of the eight Aldermen were present, an ordinance granting the permit was presented and read the first time by unanimous consent. At the next regular meeting the ordinance was adopted. It was approved by the Mayor and duly recorded and published. Immediately thereafter the company, relying on the permission, began the construction of a telephone line along the route designed by the city officials, and completed an equipment for the establishment of a telephone system. The special meeting of the council was irregular, in that notice of it had not been given to the absent Aldermen, and it was held pursuant to an ordinance relating to special meetings which had never been legally adopted. On this ground the city attempted to withdraw the consent given to the company by the ordinance. It was held that, in view of the large sums of money expended by the telephone company in erecting its lines in reliance upon the validity of the ordinance, the city was stopped from withdrawing its consent. The right of a telephone company to erect its lines anywhere in a state includes the right to enter any city with the consent of its local authorities, and when such consent has been obtained the company is subject only to such rules and regulations as the Legislature may prescribe or authorize the council to prescribe. The right thus conferred upon a telephone company by the state—its franchise—is, of course, subject to control by the Legislature, but the consent of the municipality, once given, cannot be withdrawn. Missouri River Telephone Co. v. City of Mitchell, Supreme Court of South Dakota, 116 N. W., 67.

Personal.

H. B. KIRKLAND.

MR. H. B. KIRKLAND, for many years one of the foremost men in the commercial field of electricity, has formed the H. B. Kirkland Company, which will hereafter act as selling agent for the National Metal Molding Co., with headquarters in the Postal Telegraph Building, New York City. Three generations of Kirklands have been active in the American electrical field. Mr. Kirkland's father was one of the first successful developers of nickel plate, and the formula of quadruple silver plating used by several of the largest manufacturers resulted from his experiments. Mr. Kirkland's mother's father was connected with the construction of the first telegraph line between Baltimore and Washington. He afterward had a large share in constructing and operating the Atlantic & Pacific, Continental, Bankers' & Merchants', and American Rapid Telegraph companies; and at the time of his death had in hand contracts for several important long-distance telephone lines. "Harry" Kirkland was born in Boston in 1871, and entered the service of electricity as a messenger boy for the Continental Telegraph Company of Philadelphia. He later became engaged in the construction business, spending some years with the Marr Construction Company. He engaged in the construction of various central station plants throughout the United States, and then took up inside wiring in New York City in 1888-9. In 1892 he saw the possibilities of the conduit business and took it up, and has ever since remained active in that line except for one brief season. Having a strong histrionic taste, he sought to satisfy his craving for the stage by taking charge of the mechanical department for Julia Marlowe, but was soon more than pleased to resume his connection with the interior conduit industry. Mr. Kirkland is an associate member of the American Institute of Electrical Engineers, and a member of the Engineers' Club; while he is prominent also in several engineering, commercial and social organizations. His associate, Mr. Charles F. Boynton, has served the city in the capacity of chief electrical inspector for some 10 years, and served with distinction in the Seventy-first Regiment, taking part in the battle of Santiago.

MR. N. F. BRADY.—On Wednesday evening, May 25, Mr. and Mrs. N. F. Brady gave a dinner at their home on upper Fifth Avenue to Cardinal Logue, of Ireland. Among those present on this interesting occasion were Archbishop Farley, Mr. and Mrs. A. N. Brady, Mr. and Mrs. Hugh J. Grant, Mr. and Mrs. T. E. Murray, Mr. and Mrs. J. W. Lieb, Jr., Mr. and Mrs. George J. Gillespie, Mr. and Mrs. Raymond Almirall, Mr. and Mrs. Henry J. Hemmens, Dr. and Mrs. John Jackson, Mr. and Mrs. Lyttleton Fox, Mr. John D. Crimmins, Judge Edward J. Garvan. The dinner was a purely social function, but at its close speeches were made by Cardinal Logue, Monsignor Lavelle and Father Pardow. The cardinal visited the great power house of the New York Edison Company on June 1 accompanied by Archbishop Farley, the secretary to the Cardinal, Rev. Father Quinn, and Messrs. Murray and Lieb of the Edison Company. The party was conducted through the Riverside stations by Mr. J. P. Sparrow, chief engineer, and Mr. W. H. Lawrence, electrical superintendent. The visitors were interested in many of the operating details of the plants, particularly the coal-hoisting towers. They watched with great interest the hoisting of the coal from the barges alongside the docks to the coal-hoisting towers 180 ft. above. A visit was also paid to the Twenty-seventh Street substation of the company where the party inspected the auditorium, library and reading rooms provided for the use of employees. They were greatly interested in the welfare work of the company and in the educational courses which have been instituted for the instruction of its employees.

DR. HENRY T. BOVEY, dean of the faculty of applied science at McGill University, is to deliver the commencement address at Johns Hopkins University on June 9. He will leave shortly thereafter for England to take up his new duties as rector of the Imperial College of Science and Technology, recently created in England, for post-graduate work, with headquarters at South Kensington.

MR. HERBERT LAWS WEBB has returned to London afteer a short visit to this country.

Obituary.

MR. W. A. PEARSON.—Mr. William A. Pearson, for 16 years chief architect and superintendent of buildings for the General Electric Company, at Schenectady, N. Y., died at his home in that city on May 26, after a lingering illness. He was born at Athens, Bradford County, Pa., July 29, 1855, where he received his early education. He was graduated from the Sayre, Pa., High School in 1870, and served his apprenticeship in the machinist's trade in the D., L. & W. Railroad shops in Scranton, Pa., where he was soon made foreman. He served with the Union Pacific Railroad as civil engineer for three years in Omaha, Neb., and afterward was promoted to master mechanic, with headquarters in Carson City, Nev. He then went to Virginia City, where he became superintendent of the Comstock mines, but resigned to engage in mining business with headquarters in New York. He afterward became superintendent of the marine department of the Dickson Manufacturing Company in Scranton, Pa., and later occupied a similar position with the Boies Wheel Company in the same city. His connection with the General Electric Company followed. Mr. Pearson was affiliated with the local Masonic bodies and at the time of his death was a member of St. George's Lodge, No. 6, F. and A. M.; St. George's Chapter, No. 157, R. A. M., and St. George's Commandery, No. 37, Knight Templars. He was also a member of the Royal Arcanum, and a member and officer of the First Presbyterian Church. He married in 1885 Miss Mary Burns, who died a year later, and in 1888 he married Miss Helen Franklin, who died in 1896. The interment took place at Scranton on May 28.

PROF. W. A. ANTHONY.—Prof. William Arnold Anthony, professor emeritus of physics and electrical engineering in Cooper Institute, New York, died at his home in that city, Friday, May 29, of heart disease, at the age of 73 years. Prof. Anthony was born in Coventry, R. I., Nov. 17, 1835, and was graduated from Yale. He taught physics in Iowa Agricultural College and in Cornell for 18 years, and then went into business for himself as a consulting engineer. In 1895 he became professor of physics and electrical engineering at Cooper Union, and three months ago was retired from the faculty and made professor emeritus. Prof. Anthony was a member of the American Institute of Electrical Engineers, the Franklin Institute of Philadelphia, and the American Social Science Association. He is survived by one son, Charles C. Anthony, assistant to the chief of the signal service of the Pennsylvania Railroad. He was president of the American Institute of Electrical Engineers in 1890-1 and always took a deep interest in the welfare of the organization. He was practically the first American professor of electrical engineering, his work in this direction at Cornell being altogether of a pioneer character, and having a marked influence on the trend of electrical study in this country. Prof. Anthony was a man of natural dignity and great modesty, too little self-assertive, and always interested rather in the work itself than in any credit or glory it might bring him. This year when it was proposed that he should accept the pension now available to a professor of his standing and record, he demurred very strongly, and was keenly wishful of staying in harness instead of going upon the retired list. He was the author of one or two useful technical books, and of several contributions to scientific and engineering societies.

PROF. W. A. ANTHONY.

Trade Publications.

THE SPRAGUE ELECTRIC COMPANY, New York City, is distributing a series of attractive blotters to advertise its well-known and popular electric fans. It has also issued catalogue No. 317 describing its long line of electric fans for every use, and a folder describing its new stamped-steel octagon box No. 6250. This box is a departure from former practices in the stamped steel line and undoubtedly will be welcomed by the electrical trade. Folder No. 431 tells the story concisely.

CONDULETS.—In its book of "'Condulet Suggestions," the Crouse-Hines Company, Syracuse, N. Y., shows innumerable locations where "Condulets" have been used with marked success.

WIRING CONDUITS.—The "Kalkos" wiring system, employing tinned tubes, is thoroughly illustrated and described in catalogue No. 160 of the Sun Electrical Co., Ltd., 118 Charing Cross Road, London, W. C.

ELECTRICAL SUPPLIES.—Railway material and electrical supplies are interestingly described in the May number of "Keystone Traveler," issued by the Electric Service Supplies Company, 1020 Filbert St., Philadelphia.

CONTROLLER FITTINGS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued bulletin No. 281, dealing with crane fittings and switchboards, knife-switches, circuit-breakers, grid-resistors, coil-resistors, etc.

VERTICAL STEAM ENGINES.—The American Blower Company, Detroit, Mich., has issued as sectional catalogue No. 232, a well-illustrated description and pricelist of high-speed, enclosed, self-oiling steam engines of the vertical type.

WATER-COOLING TOWERS.—Edwin Burhorn, 71 Wall Street, New York, has issued an illustrated catalogue dealing with "Burhorn" and "Acme" water-cooling towers. Much valuable information is given concerning the theory of cooling towers.

ELECTRIC HEAD-LAMP.—A complete electric lighting equipment for a steam locomotive, consisting of a self-contained steam turbo-generator and an arc lamp with reflector, is described in catalogue No. 145 of the Dayton Manufacturing Company, Dayton, Ohio.

CIGAR LIGHTER.—The F. Bissell Company, Toledo, Ohio, has issued a folder dealing with its three-in-one electric combination for use around automobiles and launches. The device consists of a cigar lighter, an electric repair lamp and an acetylene-lamp lighter.

"TRUMBULL CHEER" for June, isued by the Trumbull Electric Manufacturing Company, of Plainville, Conn., is full of bright sayings with regard to general conditions of the trade and as to its own light and power specialties in switchboard material, etc.

ELECTRICAL SUPPLIES.—The June calendar card of the F. Bissell Company, Toledo, Ohio, calls attention to the advantage to its customers of becoming friendly with the company, by writing occasionally for information concerning electrical supplies and machinery.

MAGNETO TELEPHONES.—Pamphlet No. 7 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., advocates the use of "sure-ring" condensers with magneto telephones and advertises what is claimed to be the highest grade condenser made for this purpose.

WIRING SUPPLIES.—General Catalogue No. 809 of the J. Lang Electric Company, 116 Lincoln St., Chicago, is devoted to electrical distributing apparatus, including switches, fuse-blocks, panel boards, wall and floor boxes, steel and wood cabinets, switchboard and switchboard instruments.

TELEPHONE SWITCHBOARDS.—Bulletin No. 105 of the Dean Electric Company, Elyria, Ohio, deals with common-battery switchboards in a logical and convincing manner by eliminating hackneyed phrases and including only such vital information as will enable a person to judge of the features of the apparatus.

AUTOMOBILE FACTORY EQUIPMENT.—The George N. Pierce Company, Buffalo, N. Y., has issued an elaborate description of its factory where the Great Arrow car is produced. The energy for operating the entire establishment is obtained from a central electric generating station containing direct-connected engine-driven units.

ELECTRICAL SPECIALTIES.—The detailed catalogue of the Crouse-Hinds Company, Syracuse, N. Y., is devoted to panel-boards, switchboards, knife-switches, incandescent and arc head-lamps, arc lamps, harpoon guy-anchors, Norbitt porcelain specialties, and electrical and mechanical specialties. This is a loose-leaf catalogue with an excellent thumb index.

ELECTRIC FANS.—The 1908 catalogue of electric fans issued by the Sprague Electric Company is a neatly-executed publication printed in two colors. In addition to the well-known Lundell fans, the catalogue contains illustrations and descriptions of ceiling fans, fans for telephone booths and Midget exhaust fans. It also shows a line of alternating-current fans.

MACHINE TOOL REFINEMENT.—The National Acme Mfg. Company, of Cleveland, O., is sending out, to illustrate an accompanying leaflet, a specimen of work made on its automatic multiple-spindle screw machine. This consists of a screw, thread, spindle and a cone at the end of the latter brought to a needle point, all automatically cut at one operation, the material being machine steel.

COMMUTATING POLE RAILWAY MOTORS.—Bulletin No. 4582, of the General Electric Company, Schenectady, N. Y., describes the G. E. 205 railway motor. While this motor is similar in design and construction to other standard G. E. motors, it is provided with commutating poles located between the main field poles. The commutating pole railway motor is especially adapted for use with higher operating voltages on account of the inherent good commutating and non-flashing properties, which allow for a considerably increased overload capacity. This motor is, therefore, especially adapted for operation on heavy grades or with equipments geared for high-speed work, which have also to start and stop frequently, as in city services. An extensive description of the mechanical and electrical details of the apparatus is given in the bulletin. Under the heading of "rating" several pages are devoted to the proper selection of railway motors for various services, and a table is given showing schedule speeds under different conditions. Characteristic curves of different motors and dimension diagrams are included.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

TORONTO, ONT., CAN.—Smith, Kerry & Chace, consulting and constructing engineers, have submitted a proposition to the Board of Control offering to take charge of, and carry out the detailed designs, plans and specifications and forms of bids, etc., for the construction of the city's electrical plant at a rate of 1½ per cent of the estimated cost of the construction of the plant. In case the city should construct the plant the company offers to superintend the construction work including the cost of inspection of the machinery during the process of manufacture at the factories, and also inspection of the construction of the conduit system, at a rate of 4½ per cent of the cost, to include the 1½ per cent quoted on the designs and specifications.

BRANDON, MISS.—The Planter's Gin Compress Company contemplates purchasing electrical equipment to light its warehouse by electricity. William H. Turcott is secretary.

MODESTO, CAL.—The La Grange Water & Power Company has applied to the Board of Supervisors for a franchise to erect and maintain telephone wires, cables, poles, mains, conduits and other appliances for transmitting electricity, gas, water, and for other purposes along, over and under the streets and public highways of the county.

GEORGETOWN, CAL.—Notice of appropriation of 2000 cu. in. of water in the Cosumnes River has been filed by T. C. Purcell, to be used for milling, mining, irrigating and power purposes.

ORLAND, CAL.—Plans are being made by Charles A. King to install a pumping plant and electric motor to supply water for household purposes and for irrigating his property.

CLINTON, MASS.—The Clinton Gaslight Company contemplates extending its transmission lines to the State Industrial School for Girls in Lancaster for the purpose of furnishing electricity for lighting the buildings.

GREAT BARRINGTON, MASS.—The Stockbridge Electric Company is making arrangements to erect 70 or more new electric lamps, which will be placed in the Furnace District, Stockbridge Village and Interlaken.

EUREKA, CAL.—G. M. Scott has filed a claim of 500 cu. in. of water in Old Mill Creep to be used for water supply for Trinidad and vicinity, and also for generating electricity.

LEOMINSTER, MASS.—As the special lighting committee appointed to make arrangements with the Leominster Electric Light & Power Company has been unable to make satisfactory terms with the company, the State Commissioners of Gas and Electricity have been asked to determine the price that the city should pay for electricity for lighting the streets of the city. A substantial reduction in price is also asked for the general public.

SOMERVILLE, MASS.—The American Tube Works have recently increased its electric motor power equipment by the addition of three 25-hp motors, for which the Edison Electric Illuminating Company furnishes the electrical service.

RAINER, ORE.—The Rainer Electric Company has secured a franchise to erect poles and wires and to construct underground conduits for the distribution of electricity for lamps and motors in the city.

BUCKLAND, MASS.—The Selectman and citizens have petitioned the Greenfield Electric Light & Power Company, of Greenfield, to extend its transmission lines from the Gardner Falls plant to this town for the purpose of furnishing electricity to light the streets of the town and for lamps and motors to private interests. It is claimed that the service can be secured at quite a saving from the Greenfield company over the present rates charged by the local company, which is seeking incorporation with a view to furnishing electricity for motors as well as for lamps.

TWIN BRIDGES, MONT.—It is reported that the Madison River Power Company is to erect a power plant at Parrot near the site of the Parrot smelter.

REDDING, CAL.—David E. Aldridge has filed notice of appropriation of 300 in. of water flowing in the bed of North Bear Creek to generate electricity for lamps, motors and other purposes.

FARMINGTON, MAINE.—The Franklin Power Company has commenced work on the construction of its dam on the Carrabassett River between the towns of Embden and North Anson. The dam will have a head of 25 ft. and will furnish power to generate electricity which will be distributed in the towns of New Vineyard, Farmington and Wilton for lamps and motors. A transmission line 16 miles in length is now being erected to the town of Farmington. The Farmington Power Company was formerly known as the Carratunk Power Company, chartered in 1903, and is capitalized at $100,000. S. E. Tarbox, of Farmington, is president and C. O. Sturtevant, of Winthrop, treasurer.

REDLANDS, CAL.—Articles of incorporation have been filed for the Redlands Construction company with a capital stock of $500,000 by J. M. Neeland, N. M. Newmark, A. P. Maginness, M. H. French, W. D. Larrabee, Paul Hirsch, C. S. Chesnut, W. M. Campbell and O. M. Miller, all of Los Angeles, and Redlands. The company will have charge of the construction of the Redlands and Yacaipa Railroad. The directors of the railroad company have decided to increase the capital stock of the company from $1,000,000 to $2,000,000, for which a meeting of the stockholders has been called for July 23.

CLEVELAND, OHIO.—The Cuayhoga Light, Heat & Power Company has been incorporated with a capital stock of $10,000 by Milton C. Canfield, Mortimer A. Munn, G. B. Siddall, Louis Englander and John P. Dempsey.

UPPER SANDUSKY, OHIO.—Articles of incorporation have been filed for the Columbus, Marion, Upper Sandusky & Toledo Construction Company to construct an electric railway to connect the towns named in the title. The incorporators are: J. Kent Hamilton, George A. Bassett, George P. Kirby, W. L. Rowland and W. S. Thurston, Jr., all of Toledo.

TOMAH, WIS.—The Tomah Electric Light & Power Company has filed articles of incorporation with a capital stock of $30,000. The incorporators are: Lamont Rowlands, Miles A. Goodyear and Josephine G. Rowlands.

IN RECEIVER'S HANDS.—H. H. Carr, of the Raleigh Electric Company, has been appointed receiver of the Fayetteville Gas & Electric Company, of Fayetteville, N. C., by Judge Thomas B. Purnell, of the United States district court, on application of bondholders and stockholders of the company, the American Surety & Trust Company, of New York, N. Y., taking the initiative. The Company is bonded for $50,000.

THE ROCKWELL FURNACE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000, by William F. Baxter, L. D. Rockwell, both of New York, and Walter Ackerman, Sheepshead Bay, N. Y.

THE SYNCHRONOUS MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000. The directors of the company are: Wilson W. Hoag, Miriam E. Holbrook, of New York, N. Y., and Francis D. Tandy, of Piermont, N. Y. The company proposes to manufacture electrical machines.

THE VOLKMER ELECTRICAL COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000. The directors of the company are: Edward Volkmer, Hugo Hoffstaedter, and J. B. Morris, all of New York, N. Y.

NATCHEZ, MISS.—Bids will be received at the office of George T. Eisele, city clerk, until June 17 for lighting the streets of the city for a term of five years from March 1, 1909.

ILION, N. Y.—The Board of Electric Light Commissioners is contemplating purchasing electrical power to operate the municipal electric light plant.

NEWBURGH, N. Y.—The Newburgh Electric Light, Heat & Power Company has entered into a contract with the Honks Falls Electric Power Company for electrical energy, a portion of which will be generated at its plant at Honks Falls, about 30 miles from Kingston. The Honks Falls Electric Power Company proposes to erect an additional plant at High Falls, near its present plant, which will be completed next October. A transmission line will be erected from the power house to this city during the summer. The Newburgh company now supplies electricity for lamps and motors in Milton and Marlborough, and also furnishes electrical energy for operating the system of the Cornwall Electric Lighting Company.

NIAGARA FALLS, N. Y.—Plans are being considered by the merchants of this city for extra illumination of Falls Street from Second Street to the monument. The project contemplates a series of ten or more arches carrying about 450 incandescents lamps of 16 cp. Sufficient money has been raised to erect ten arches.

Business Notes.

THE INTERNATIONAL ELECTRIC METER COMPANY'S switchboard instruments are being used in the new substation at Emerald Avenue being built by the City of Chicago.

MR. R. C. CAMPBELL, Philadelphia, district manager for the Adams-Bagnall Company, of Cleveland, sailed for Europe on May 30 for a stay of two or three months to be devoted to investigation and research in the interest of the company.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, Ill., and 136 Liberty Street, New York City, is placing on the market a new design of a sectional switch box. It is so designed that a single box can be converted into any number of gangs by releasing the clamping screws and inserting "Spacers." These gangs "hook" together, there being no screws to take out and lose; they are easily assembled and fit together snugly, making a perfect and solid gang box. With the new style sectional box only two parts—single boxes and spacers—need be carried in stock, and a gang box of any required size can be quickly assembled.

5,000,000 CIRC. MIL CABLE.—What is believed to be the largest conductor ever manufactured has recently been shipped by the Standard Underground Cable Co. to the Transit Development Co., of Brooklyn. This cable has a cross-sectional area of 5,000,000 circ. mil, made up of 427 wires arranged in 61 strands of 7 wires each. The insulation consists of a single weather-proof braid. The following figures will give some idea of the great size of this cable: Diameter of bare strand, 2 57/64 in.; diameter over insulation, 3 1/16 in.; weight of bare strand, 16.2 lb. per foot; weight of completed cable, 16.6 lb. per foot. The cable was furnished in 440 ft. lengths, each length constituting 7300 lb. of cable.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, October, 1908.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Atlantic City, N. J., June 29-July 2.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512, Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary P. W. Drew, Room 511 Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting at Toronto, June 17, 18 and 19.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind. Next meeting, Sept. 24, 1908.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary. John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., Aug. 19, 20 and 21, 1908.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich.

Minnesota Electrical Association. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

Missouri Electric Light, Gas & Street Railway Association. Secretary, C. L. Clary, Sikeston, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National Electric Light Association. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

National Electrical Trades Association. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11.

Nebraska Electrical Association. Secretary, William Bradford, Lincoln, Neb.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

[illegible] England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwestern Electrical Association. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, W. A. Rowe, Citizens' Building, Cleveland, Ohio.

Oklahoma Electric Light Railway & Gas Association. Secretary, Galen Crow, Guthrie.

Old Time Telegraphers' & Historical Association. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

Pennsylvania State Independent Telephone Association. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y. Next meeting, Detroit, Mich., June 22-27, 1908.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D.

Southwestern Electrical & Gas Association. Secretary, R. B. Stichter, Dallas, Tex.

Street Railway Accountants' Association of America. Secretary, E. M. White, Box 345, Hartford, Conn.

Street Railway Association of the State of New York. Secretary, J. H. Pardee, Canandaigua, N. Y.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, C. C. Wells, Middlebury, Vt.

Underwriters' National Electrical Association. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

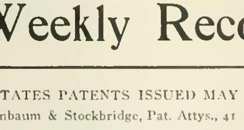
Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 26, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

888,456. DYNAMO-ELECTRIC MACHINE; John M. Barr, Pittsburg, Pa. App. filed Oct. 5, 1907. A means for effectually holding the coils of open slot machines in position against action of centrifugal, magnetic and other forces tending to displace them, and at the same time to provide the operating advantages pertaining to closed slot machines.

888,483. RAILWAY SIGNAL SYSTEM; Elihu E. Gabhart, Kingsland, Tex. App. filed Oct. 16, 1907. Railway signal system adapted for use on curves for indicating at each end when a train enters at the other end. Makes use of tappets closing circuits at the entrance to the section, and actuating signals at the other end.



888,456—Dynamo-electric Machine.

888,507. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed April 25, 1904. In telephony, means to neutralize earth currents in a line of transmission, said means comprising an inductorium, one coil connected to the line of transmission, the second coil connected to the ground; one of said coils constructed so that one part has an inducing effect opposite to the inducing effect of the second part.

888,509. CABLE TELEGRAPHIC SYSTEM; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 17, 1906. Makes use of an extremely sensitive relay in a cable system, which shall control a circuit or circuits associated with or including a second relay of less sensitiveness, the second relay serving to produce or record messages at its station as received by the extremely sensitive relay, and to repeat such messages received by the extremely sensitive relay into another line or cable.

888,510. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 9, 1906. Relates to modifications of the above.

888,511. DUPLEXING TELEGRAPH LINES; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 9, 1906. Is designed to dispense with the usual artificial cable at each station.

888,514. ARMATURE WINDING FOR ELECTRICAL MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed Aug. 17, 1904. A winding for polyphase electrical machines comprising a plurality of coils that are divided into a plurality of groups for each phase of the current, the sides of the coils of each group alternating in position with the sides of the coils of other groups.

888,517. RHEOSTAT; Seth A. Leonard, Cleveland, Ohio. App. filed June 17, 1907. Makes use of a main frame having a series of horizontal bars arranged in parallel relations at different elevations, and a series of resistance units mounted in parallel rows thereon and apart from one another, said units comprising flat plates and having helical resistance coils secured on opposite sides thereof.

888,557. SYSTEM OF ELECTRICAL CONTROL; Hermon L. Van Valkenburg, Pittsburg, Pa. App. filed Sept. 2, 1904. Provides means for effecting step by step or successive operation of the unit switches by successive operation of a manually controlled master switch. Designed for electric railway motors to simplify and lighten the apparatus.

888,602. SECONDARY BATTERY; Richard J. Feischer, Milwaukee, Wis. App. filed April 8, 1907. Comprises a partitioned bar having an upper outer flange below its rim, a cover having a continuous underside groove engaging the rim, and a groove engaging each partition.

888,610. APPARATUS FOR MANUFACTURING CARBID; Herman L. Hartenstein, Constantine, Mich. App. filed Nov. 30, 1906. Provides improved means in the manufacture of carbid, whereby the lime resulting from calcining the calcium carbonate will be discharged from the calcining furnace at substantially the hottest point thereof. Has means whereby the gas evolved in the electric furnace may be utilized for heating or burning the limestone carbonate.

888,611. SPARK COIL; John Otto Heinze, Jr., Lowell, Mass. App. filed March 6, 1908. Each coil has a metallic clip connected thereto which engages the adjacent coil, so that one cannot be removed from the box without the other.

888,613. ELECTRIC RAILWAY SIGNALING SYSTEM; Edward B. Howell, Butte, Mont. App. filed Aug. 22, 1907. Relates to a system of electric communication adapted for use in connection with railway trains where it is desired to place the engine to each train in a position to be able to transmit and receive signals to and from other trains and a station.

888,648. ELECTRICAL APPLIANCE FOR CONTROLLING AIR BRAKES; James G. Pearce and William H. Pearce, Oakland, Cal. App. filed Nov. 16, 1906. Has an electrically actuated brake controlling valve of novel construction, auxiliary to the well-known engineer's valve on the locomotive engine. Includes a system of circuit-forming conductors and contact blocks on the roadway, in combination with the track rails and with a local battery or source of current on the train.

888,674. CONNECTING CONDUCTOR FOR CABLES; Francis S. Viele, of Pittsburg, Pa. App. filed Aug. 15, 1902. A form of lead sheathing for joining cable terminals, designed to have an insulation of uniform thickness and electrical strength.

888,677. TROLLEY; Charles Myron Whitcomb, Portland, Ore. App. filed April 9, 1906. A trolley wheel of generally spherical form, having a spiral groove on each side to guide the trolley wire onto the central or normal running groove.

888,692. SELECTING DEVICE FOR ELECTRICAL SIGNALING APPARATUS; John Burry, Ridgefield Park, N. J. App. filed July 18, 1906. A circuit controller for operating a number of remote devices, such as electric bells or printing magnets, selectively.

888,748. SIGNAL APPARATUS FOR TELEPHONE SWITCHBOARDS; George H. Ryder, Somerville, Mass. App. filed May 17, 1905. A signal apparatus for telephone switchboards, having, in combination with a line relay, a line signal in circuit with the contact of the relay, a supervisory signal, and means for short-circuiting the line signal and for placing the supervisory signal under control of the same relay contacts.

888,759. AUTOMATIC MOTOR STARTER; Edwin H. Smythe, Chicago, Ill. App. filed Aug. 17, 1905. A device for gradually and safely regulating the flow of current through a motor when it is being started in motion. Comprises an electromagnet electrically operated according to the varying potentials of the motor armature to successively cut out portions of a resistance included in the armature circuit.

888,760. CIRCUIT BREAKER; Edwin H. Smythe, Chicago, Ill. App. filed Aug. 17, 1905. A circuit breaker having circuit terminals each of which is preferably composed of a pair of laminated contacts and a bridging member in two parts linked together by a toggle arrangement, so that, when the switch is being closed, the parts of the bridging member are first brought between the opposing laminae and then spread outward with great pressure to make their contacts.

888,763. LINE WIRE FASTENER; Lafayette Stanton, of Beaver River, N. Y. App. filed Aug. 1, 1907. A form of line wire fastener having a rigid loop and a pair of flexible bands co-operating therewith, to surround the insulator.

888,801. APPARATUS FOR MEASURING LIGHT; William J. Hammer, New York, N. Y. App. filed Oct. 31, 1906. In a light measuring apparatus, the combination of a source of light to be measured, means for causing the source of light to vary an ascertainable physical quantity, and means for measuring the variation.

888,802. METHOD OF MEASURING LIGHT; William J. Hammer, New York, N. Y. App. filed Oct. 31, 1906. The new art of measuring light, which consists in causing the light to be measured to vary an ascertainable physical quantity, and measuring the extent of the variation.

888,822. TELEPHONE CUT-OFF OR MUFFLER; George S. Knowles, Buffalo, Mo. App. filed Oct. 30, 1907. A telephone cut-off or muffler comprising a plate having an opening therein for the clapper of a telephone, and means on the plate adapted to prevent the clapper from striking the bells.

888,843. ELECTRIC FLAT IRON AND CONDUCTOR; Paul E. Oswald, Los Angeles, Cal. App. filed March 14, 1907. Construction of flat or sad iron having a hollow interior with a sheet-iron resistance element formed of zig-zag stampings.

888,845. ELECTRIC SIGNALING; William E. Hallett and Frank Kamerer, New York, N. Y. App. filed May 29, 1907. A burglar alarm making use of a circuit-closing button in the window sash, which is forced inward to close the circuit by an upward movement of the pane.

888,870. TELEPHONE SYSTEM; Elmer R. Corwin, Clyde, Ill. App. filed May 11, 1906. Details of complete central exchange cord and signal circuits.

888,871. TELEPHONE SYSTEM; Elmer R. Corwin, Clyde, Ill. App. filed May 11, 1906. Relates to modification of the above.

888,872. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin, Chicago, Ill. App. filed Oct. 1, 1906. Additional modification of the above.

888,873. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin, Chicago, Ill. App. filed Oct. 1, 1906. Covers further modification.

888,874. TELEPHONE-EXCHANGE SYSTEM; Elmer R. Corwin; Chicago, Ill. App. filed Oct. 1, 1906. Additional modification of 888,870.

888,877. ELECTRIC FURNACE; Léon Dion, Wilkes-Barre, Pa. App. filed April 30, 1906. A furnace adapted for fusing metals in their crude and reduced states, having various detail features to permit the fusing of the metal without escape and loss of fumes and vapors arising therefrom.

888,901. ELECTRICAL APPARATUS; Ray P. Jackson, Wilkinsburg, Pa. App. filed Sept. 3, 1907. A conical insulating body is surrounded by a bell-shaped sheathing adapted to cause a proper distribution of the potential between the support and the conductor.

888,903. CONTROL SYSTEM FOR ELECTRIC MOTORS; Henry D. James, Pittsburg, Pa. App. filed March 3, 1906. A control system for electric motors having a plurality of switches adapted to be operated in a predetermined sequence for trains, etc. Has a limiting device to retard the sequential closure of the switches under sertain circumstances.

888,904. SYSTEM OF ELECTRIC MOTOR CONTROL; Henry D. James, Pittsburg, Pa. App. filed March 3, 1906. Relates to modifications of the above.

888,912. METHOD OF OPERATING AND SYSTEM OF CONTROL FOR ELECTRICAL GENERATORS; Benjamin G. Lamme, Pittsburg, Pa. App. filed Aug. 2, 1906. The method of operating a generator having series connected field magnet and armature windings, which consists in first connecting the secondary battery in shunt relation to the field magnet winding and in then connecting the generator in a braking circuit.

888,929. AUTOMATIC ELECTRIC RAILWAY SWITCHING DEVICE; Francis M. Rise, Dows, and Arthur W. Hill, Belmond, Ia. App. filed Sept. 19, 1907. The car has two reversely moving electromagnets extending down to close proximity to the rails, means for moving them transversely to the car and for connecting them for simultaneous movement in opposite directions to successively open and close a switch tongue.

888,940. DYNAMO ELECTRIC MACHINE; Egbert M. Tingley and Joseph L. Ray, Pittsburg, Pa. App. filed March 17, 1905. A connecting means between the rotatable winding of the dynamo electric machine and the collector rings which shall be entirely unexposed and capable of resisting high centrifugal forces.

888,951. STORAGE BATTERY PLATE; Theodore A. Willard, Cleveland, Ohio. App. filed March 26, 1907. The storage battery plate is roughened with longitudinal V-shaped serrations interrupted at spaced intervals by elongated holes through the plate.

888,956. PROCESS FOR THE MANUFACTURE OF OXYCARBID OF BARIUM; Rodolfo Battistoni, Ancona, and Romolo Rotelli, Venice, Italy. App. filed Jan. 14, 1905. Comprises mixing a predetermined amount of carbon with barium carbonate, melting the mixture in a furnace, and submitting the melted mixture to the electrolytic action of an electric current.

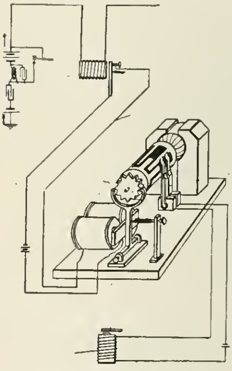
888,959. RAILWAY SIGNAL; Edgar M. Cain, of Wilmington, Del. App. filed Jan. 17, 1908. Detail features of a semaphore signal having an audible alarm whistle operated by an electromagnet, in addition to the usual semaphore.

888,980. RAIL BOND; Axel H. Englund, Philadelphia, Pa. App. filed June 16, 1904. The bond has a recess with a wall which extends entirely round the same, so that, when the bond is applied to a rail, the said recess is closed on all sides.

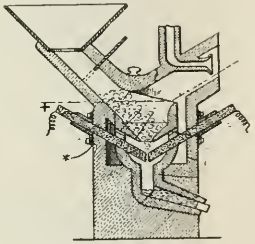
889,015. TROLLEY; Albert S. Janin, New York, N. Y. App. filed Nov. 16, 1906. A support for trolley rollers of the kind used by electric locomotives, making use of a toggle or link support depressible in a vertical direction.

889,031. WIRELESS TELEPHONE; Francis J. McCarty, San Francisco, Cal. App. filed Dec. 2, 1904. In a telephone, means introduced into the primary circuit, said means comprising a plurality of primary windings, a secondary coil which is energized thereby, a mouthpiece, a transmitting diaphragm with metallic contacts and a microphone transmitter actuated in unison, means whereby a spark is produced, and the aerial transmitting medium is affected to transmit articulate speech, and a mechanism capable of receiving transmitted speech.

889,040. ELECTRIC HEATER; Edwin F. Porter, Boston, Mass. App. filed Jan. 29, 1906. A vehicle having a seat with a heel-board and an electric heater, and means for admitting air to the back of said heater and venting heat from the front of said heater.



888,510—Telegraphy.



888,877—Electric Furnace.

889,041. CAR HEATING AND VENTILATING APPARATUS; Edwin F. Porter, Boston, Mass. App. filed Aug. 19, 1907. Relates to modifications of the above.

889,067. MERCURY VAPOR APPARATUS; Percy H. Thomas, East Orange, N. J. App. filed Jan. 6, 1904. Has a closed holder of silica and lead wires for connection with an external circuit, and a screen substantially impervious to ultra-violet rays. Designed to generate ozone in limited quantities.

889,098. PROCESS OF WINNING ALUMINUM OR OTHER METALS FROM THEIR COMPOUNDS; Henry Spencer Blackmore, Mount Vernon, N. Y. App. filed Feb. 25, 1907. Consists in liberating aluminum from its oxid by electrolysis while associated with magnesium, calcium and sodium fluorids.

889,103. HOLDER FOR ELECTROPLATING; William Y. Buck, Muncie, Ind. App. filed Sept. 25, 1907. Makes use of twisted wire having loops of a special form adapted to receive spoons and the like.

889,124. MANUFACTURE OF CARBID; Herman L. Hartenstein, Constantine, Mich. App. filed Feb. 13, 1907. A composition of matter for use in the manufacture of carbid, consisting of lime, bituminous coal, coke or charcoal, and anthracite coal.

889,126. AUTOMATIC SAFETY DEVICE FOR CRANES; Nathan S. Haseltine, Swissvale, Pa. App. filed Aug. 16, 1907. Automatically breaks the power circuit to stop the operation of the mechanism in case of accident. Has a circuit controller engaging the cable, which depends from the winding drum.

889,128. APPARATUS FOR TREATING ORES; Wilbur Alsen Hendryx, Denver, Col. App. filed Nov. 26, 1906. Makes use of a tank and means for continuously aerating the contents thereof by lifting portions and moving them in a thin sheet or film in contact with the atmosphere.

889,162. ARC LAMP; William S. Weedon, Schenectady, N. Y. App. filed May 20, 1904. A flaming arc lamp having a mechanical feed mechanism particularly adapted to metalized carbons and having means for maintaining a suitable draft through the lamp in use.

889,163. ARC LAMP; William S. Weedon, Schenectady, N. Y. App. filed May 20, 1904. Relates to modifications of the above.

12,795. ILLUMINATING DEVICE; Alfred William Beuttell, New York, N. Y. App. filed March 25, 1908. A form of support for double-ended incandescent lamps having telescoping contact members and a spring enclosed by and tending to separate said members.

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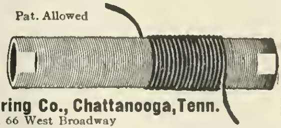

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ADVERTISE IN THE ELECTRICAL WORLD.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, JUNE 13, 1908. No. 24.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE..............................590 Old Colony Building
CLEVELAND OFFICE............................1015 Schofield Building
PHILADELPHIA OFFICE.......................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico	per year,	$3.00
Dominion of Canada		4.50
Other Foreign Countries within the Postal Union		6.00

25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,750 copies are printed.*

NEW YORK, SATURDAY, JUNE 13, 1908.

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A. I. E. E. ATLANTIC CITY CONVENTION.

The coming convention of the American Institute of Electrical Engineers, to be held at Atlantic City, June 29 to July 2, will be the twenty-fifth general convocation of that body. With on the one hand a desirable meeting place and a season of the year when the call of the seashore is persuasive, and on the other hand a program of papers covering such a wide range of subjects that few members can complain that their specialty has been neglected, the convention promises to be a successful one. Indeed, the number of papers is so large that unless parallel sessions are held there will be little time for the discussion which frequently is of higher value than the paper which draws it forth. During one session, for example, to which three hours are allotted, no less than seven papers are to be presented. Elsewhere a classified list of the papers is printed, together with brief notes indicating their character. As was to be expected in view of relatively recent developments, the subjects of high-tension transmission and electric traction dominate in the program. Electrical apparatus and engineering science are well represented, while engineering education receives the attention which it deserves, particularly at the present time, when it appears to be entering upon a new period of evolution in which professional, technical and industrial education will have distinct courses, instead, as in the past, all phases from general engineering to house wiring, figuring in the same course. To return to the subject of parallel sessions, it would appear that in view of the growing specialization in electrical engineering, it might be wise to endeavor to cover adequately at each annual convention all of the various important departments, and hold on several of the days a number of simultaneous sessions for the separate consideration of papers having a special character, such as those relating to telephony, electric traction, electric transmission, electrochemistry, wireless telegraphy, etc.; the other days being devoted to subjects appealing generally to those in attendance, such as the broader aspects of electrical engineering, principles of engineering science, etc.

THE PRESENT STATUS OF THE LIGHTNING PROBLEM.

The problem of lightning disturbance, like the problem of the poor, is always with us, and probably always will be in some degree. If it is true that discomfort loves company, then electrical engineers should be comforted by the fact that not they alone suffer by the violence of lightning. According to the statistics collected and published by the Weather Bureau for the year 1900, there were 5527 damaging lightning strokes counted in the United States in these 12 months, injuring 6256 buildings to the money value of over $3,000,000, killing 503 persons, and injuring 820 persons more, besides killing live-stock in the fields to the total number of 4250. Moreover, lightning damage has been a regular grievance among electrical engineers for more than 70 years, ever since telegraph wires were first placed overhead on poles. Year by year, poles have been destroyed, insulators broken, apparatus burned out. The only electric circuits that have been immune have been buried wires or submarine cables, and even these have naturally ceased to be proof against injury when connected to overhead wires. Electric power-transmission engineers have, however, a harder task than electric telegraph engineers when attempting to follow the example of Ajax, and defying lightning, because they carry their wires higher above ground, insulate them more elaborately, and have to protect their circuits from the dynamo arcs which follow, as well as the lightning discharges which precede. The article by Mr. Percy H. Thomas on page 1283 of this number sums up the causes and effects of lightning disturbance in electric power circuits. It covers, therefore, a wide field and offers many suggestions. As an instance, it briefly reviews the phenomena of summer lightning storms. On a hot day in summer, or on a dog-day in the language of the ancients, who attributed peculiar influence in midsummer to the then existing nocturnal prevalence of the dog-star Sirius, we are apt to predict the onset of lightning storms if the humidity is high. It is to be observed that two essential elements must concur; namely, ample sunshine and abundant moisture. When, with or without moisture, the solar heat applied to the surface is inadequate, as in our winter seasons; or, when there is abundant heat, but insufficient moisture, as over large desert plains in the tropics, there are very few thunderstorms. Where hot weather and solar evaporative power occurs, together with moisture on the surface of the earth to be evaporated, thunderstorms are frequent.

In evaporation, the molecules of water carry away small electric charges or ions, but the molecules are so minute that they fail to constitute a collective charge. By gaseous convection, the steam rises upward. A layer of steam-laden air forms, like oil as Mr. Thomas describes it, under the cooler and dryer layers of the upper atmosphere. The steam-laden air is less diathermanous than the dryer air above, or is more absorptive of radiant heat, so that, as the day advances, the blanket layer of recently evaporated moisture keeps gaining energy from the sunshine it receives, but which it only transmits on a commission basis. The hydrodynamic conditions tend, therefore, to decreasing stability. If a certain critical stage of instability is reached, the oily layer, or lower steam-laden layer, bursts through the overlying cooler and dryer layers, and ascends suddenly to a great height, with the formation of a column of cumulus cloud, due to the condensation of the steam into fog. The condensation provides nuclei for the ions in the upper air to fasten upon, not to speak of those carried up in the steam. Moreover, the potential of the charges rises very rapidly as the condensation proceeds, owing to the great increase in electric surface density as the water particles coalesce. If the electric energy released is sufficient, the electrified cloud will descend toward the earth as a thunder cloud, producing a convective disturbance that releases more of the oily layers to rush up and condense likewise. Thus a regenerative electric system is started that will go on discharging until all the available electricity is released.

Another suggestion in the article is that the voltage required to precipitate a lightning flash from cloud to ground may be less than that necessary to disrupt the entire length of the air column. We know that air, at ordinary temperatures and pressures, has a dielectric strength of about 4 kv per millimeter. At this rate, a column of air 1 km high would require an e.m.f. of 4,000,000 kv, or 4,000,000,000 of volts, to precipitate a flash, and a 1-km flash is rather a short flash from a practical standpoint. The paper points out that a much smaller voltage may suffice if the action is progressive. The fact is that air will break electrically and ionize, or conduct, as soon as the intensity of electric stress anywhere reaches the critical value. If, for instance, near to a cloud above, or near to a sharp point below, the air breaks, it immediately becomes conducting along the line of its fracture and virtually establishes a wire from the cloud downward, or from the point upward. This rupture tends steadily to increase the local intensity of electric stress in volts per centimeter at the end of the wire, which acts like a conducting wedge, and the ions rush in behind the wedge along this conductor and help to cleave the air ahead. We can sometimes see this process on a small scale in the laboratory, with the aid of photography and a revolving mirror. The disruptive spark pushes its way further and further through the air, and, after the lapse of a brief but appreciable period, bridges the entire distance. With the aid of the electric wedge, therefore, a much lower average electric stress may enable local excesses of stress to precipitate a continuous discharge. It is doubtful whether any photographs of lightning discharges actually demonstrate this progressive action, which must be exceedingly rapid; but the bifurcating and digressive forms of flash, as shown in actual photographs, certainly suggest this action; which means, to quote Mr. Dooley in regard to the action of the U. S. government on the question of the Philippine Islands, "making up its mind as it goes along," in contradistinction to predetermining the entire course beforehand.

Joint Pole Lines.

The electric lighting and telephone industries have now available a set of rules or specifications for the construction of joint electric-light and telephone-pole lines which carry the approval of enough prominent engineers in both industries to give them great weight in all cases where questions as to the form of joint pole construction arise. We refer to the rules presented by Mr. Paul Spencer at the convention of the National Electric Light Association, which have been adopted by the two dominant telephone and electric-lighting corporations in New Jersey and have also been accepted by Bell telephone companies the country over. Moreover, these rules correspond closely with those used in electric and telephone construction in other localities where the matter has been given due engineering consideration. It sometimes happens that smaller electric lighting and telephone companies find it desirable to arrange for joint pole-line construction, but the most approved methods of such construction have not always been familiar to both parties, with the result that one or the other has held out for some very undesirable design simply because it happened to be used in the nearest town. One of the most important requirements of these rules is that the electric-light wires shall be above the telephone wires. This is one of the points concerning which there is most likely to be controversy, where the question has not been studied thoroughly. The telephone man in the small town has been trained by experience to dread the house mover, who interferes with his cables. Consequently he wants to get as high above this interference as possible. Any disadvantage to the telephone man in this respect, however, is more than outweighed by the fact that the telephone lineman must pass up through the electric-light wires to work on the telephone lines and also that the telephone wires are much more likely to break and fall on the electric-light wires than are the electric-light wires to fall on the telephone wires. The chances for trouble, both in construction and operation, are multiplied many times by placing the telephone wires above. The electric-light wires are limited to No. 6 copper as the smallest size, as a precaution against breakage, while single conductor telephone wires are limited to No. 12 minimum size. Telephone and electric-light wires are not allowed on the same cross-arm, and the distance of 40 in. is required between the lighting and telephone conductors, which, of course, means considerably more than 40 in. separation between cross-arms when transformers are used. Space does not permit going into details further, but copies of these rules should be in the hands of all companies entering into joint pole-line construction for the first time. An article in our issue of May 16, on pages 1033 to 1035, gives an excellent idea of good joint pole-line construction as practised in Chicago substantially in accordance with the rules to which we have reference.

DISTRIBUTION OF ELECTROMAGNETIC WAVE ENERGY FROM A SIMPLE OSCILLATOR.

The complete invisibility of the electromagnetic waves employed in wireless telegraphy makes the study of their emission and distribution a slow and tedious process. With the visible waves of light, or electromagnetic waves a fraction of a micron in length, a few experiments give to the eye a fairly comprehensive grasp of the salient facts connected with the emission and distribution of these visually perceived waves. In fact, every person possessing normal eyesight has at least a crude appreciation of the main facts. But when we deal with electromagnetic waves many meters in length, which do not appeal directly to any human sense perception, we have to rely on the indications of apparatus for all our inferences. Since the conditions that affect the indications of such wave-recording apparatus are both complex and varied, the knowledge of how such waves are emitted and propagated comes slowly. Wireless telegraph waves emitted by a simple vertical sending mast are known to be distributed uniformly in all directions—north, south, east and west—unless there be some electrical dissymmetry in the neighborhood, such as dry land on one side and ocean on the other. In that case the waves are ordinarily transmitted over the ocean with less attenuation or enfeeblement than over the land. In upward directions, however, much less is known concerning the propagation of the waves, because receiving stations are nearly always on the surface of the land or ocean and are very rarely placed on balloons in the upper regions of the air. Although it is of little practical importance, therefore, what happens to the waves in upward directions, yet a complete comprehension of what happens to the waves near the ground level involves some knowledge of what happens to them above.

The current number of *The Physical Review* contains an account of some measurements by Messrs. C. R. Fountain and F. C. Blake on the distribution of electromagnetic energy from a little Righi oscillator, emitting waves about 8 in. long. The receiver, a small affair, some 3 in. long, was supported on a wooden arm that could be set in any desired direction from the oscillator. The distance between the oscillator and receiver was at most about five wave lengths, a condition representing about one mile on the scale of wireless telegraphy. A number of experimental difficulties enter into measurements made in such a manner, and it is pointed out in the article that the precision of the measurements is somewhat limited by such disturbing influences. Nevertheless, a rough exploration was enabled to be made of the distribution of wave energy in the space surrounding the oscillator. The measurements indicate that the electromagnetic forces surrounding an active oscillator are of two kinds, and not one only as is commonly supposed.

The first kind of forces are the electric and magnetic forces in the waves which are everywhere perpendicular to the radius carried from the center of the oscillator to the point considered. If we suppose each wave to expand from the center of the oscillator, like a soap-bubble, uniformly in all directions, then the electric forces will lie in the spherical shell of the bubble, along parallels of longitude drawn through the poles of the sphere, the said poles lying on the axis of the oscillator. The magnetic forces will everywhere lie at right angles to the electric forces, and along parallels of latitude of the expanding sphere. The force of the second kind is a radial electric force, or an electric force perpendicular to the expanding sphere. It is not accompanied by a magnetic component.

The electromagnetic energy due to the first kind of force increases inversely as the square of the radius. It also falls off with elevation of the radius, being a maximum at the equatorial plane, or what corresponds to the ground level in wireless telegraphy, and zero at the pole, or vertically over the sending mast. The electromagnetic energy due to the second kind of force, acting along the radius, is nil at the equator or ground level, but increases in upward directions, and reaches a maximum at the pole, or vertically over the sending mast. This component of energy, in any given direction, increases inversely as the fourth power of the radius from the oscillator. Consequently, although within a few wave lengths of the oscillator the energy due to the radial or second component may be more powerful than that due to the normal or first component, yet at a distance of many wave lengths from the sending oscillator the energy of the first component will far exceed that of the second, since the latter dwindles with distance so much faster. If we may apply these deductions to wireless-telegraph conditions, it would seem that at the ground or ocean level there is no radial component, and the receiving mast should be in the vertical plane for maximum effect. Up in a balloon however, and within view of the sending mast, the receiving wires should lie vertical, or in the drag rope and not inclined perpendicularly to the radius from the mast. Immediately over the mast, a horizontal receiver wire might detect no waves, whereas the vertical receiver wire in the drag rope would respond to the radial or second component.

The International Telegraph Conference in Lisbon.

The International Telegraph Quinquennial Conference, which began its sessions at Lisbon on May 4, was in session throughout the month and is expected soon to end its labors. Hon. C. P. Bryan, the United States Minister to Portugal, gave a reception to the delegates on May 17. An official banquet was given to the delegates May 4, and two days later they attended the coronation of King Manuel.

At the opening of the conference, the delegates were welcomed by an address from the Minister of Public Works, Senhor Carnet de Magalhaes, after which the conference was presided over by the principal Portugese delegate, Councillor Alfredo Pereira, Director-General of Posts and Telegraphs, and vice-president of the Portuguese Chamber of Deputies. The vice-presidents selected were: Councillor P. B. Cabral, of Portugal; M. Peter de Szalay, of Hungary, and Colonel E. Frey, director of the International Bureau, Berne, Switzerland. After the inaugural proceedings the delegates elected four committees to deal with (1) rules and regulations, chairman, M. H. Babington Smith, of England; (2) rates, chairman, M. Bordelongue, of France; (3) telephones, chairman, M. Pop, of Holland; (4) drafting, chairman, M. Banneux, of Belgium. A special committee has also been appointed to consider a number of propositions relating to the revision of the St. Petersburg convention of 1875, under which all matters relating to international telegraphy are regulated. Among those in Lisbon during the conference have been Mr. R. R. Dennis, representing the United States Department of Commerce and Labor, and Vice-President George G. Ward, of the Commercial Cable Company.

No official details of the complete conference have yet been given out, but various details are public. The Mercadier telegraph system was brought to the notice of the conference. China has filed, it is understood, a statement or protest as to the infringement of her telegraph rates in Manchuria. As to one important practical point, Sir J. Wolfe Bary said, on May 13, when presiding at the half-yearly meeting of the Eastern Extension, Australasia & China Telegraph Company: "Judging from what appeared in the newspapers a few weeks ago, considerable misapprehension appeared to have existed on the part of the Chambers of Commerce and telegraphing public generally as to the action of the government and cable companies at the conference in regard to the use of artificial words in code telegrams; but the publication of the Postmaster-General's letter to the Chambers of Commerce on the subject would have made it clear that it was not proposed to withdraw the privilege, but only to endeavor to have more clearly defined the condition as to the 'pronounceability' of artificial words. When the concession of admitting 'pronounceable' artificial words on the footing of code at 10 letters to the word was granted, it was assumed that the privilege of making up codes on this basis would be used in a reasonable manner, so that the telegraph service, whether by cable or land line, might not unduly suffer, while the public would be benefited. This expectation has not been completely fulfilled. Before the new regulations came into force the British Post Office found it necessary to issue a circular to the Chambers of Commerce, as well as to the principal code makers, directing attention to the fact that codes were being compiled of artificial groups which, in many cases, could not be regarded as 'pronounceable,' and that such words would be difficult to transmit, and would lead to errors. In many cases code makers had recognized the importance of avoiding combinations which were of doubtful pronounceability, but in some cases an unreasonable use of the concession had been shown. As an instance of this, such words as 'bujksrocty,' 'bywrgrocbx' and 'liqraqkqcr' might be mentioned as words which appeared in a code recently submitted. It would be readily understood that a telegraphist could deal more rapidly and easily with a pronounceable word, which could be more quickly grasped and remembered while it was being transmitted, as compared with an arbitrary combination of letters requiring a separate effort of attention for each letter. Thus greater speed and accuracy, which were what the public required, were obtained, and there was less need for repetition and corrections. It was desirable and to be hoped that the condition as to pronounceability would at the conference be more clearly defined, in order to put some limit for the future to the growing tendency, which, if unchecked, could not fail to produce results highly injurious to the telegraph service and consequently to the public and commerce. There was, however, no intention of adopting other than a wide and even generous interpretation which would cover the great bulk of the codes at present in use."

Temporary Shut-Down of Niagara Falls Power.

Responding to a request of the International Railway Company, the Niagara Falls Power Company will on Sunday, June 14, between the hours of 1 a. m. and 3 p. m., shut down its two big stations in Niagara Falls, thus shutting off the water from the tunnel tailrace. This will be done to afford the International Railway Company an opportunity to make a thorough inspection of the condition of the American abutment of the upper steel-arch bridge. This abutment stands close by the tunnel portal, and the outrush of water speeds by and against it with tremendous fury. It has been known for some months that the water appears to be weakening the foundation, and attempts have been made to strengthen it without success. When the water is off next Sunday, divers will go down and examine the river side and the tunnel stream side in a very thorough manner in order to obtain reliable data for guidance should repairs ever be deemed advisable.

While the power houses are closed down the factories at Niagara receiving current from them will cease operations, but the trolley lines of the Niagara-Buffalo locality will be operated by current supplied from the station of the Canadian Niagara Power Company. During the shutdown, the engineers of the Niagara Falls Power Company will make a very complete inspection of the wheelpits and of the tunnel in order to determine how they are wearing. No such inspection has been made since June 1, 1902. The tunnel has now been in use about 13 years, the first unit that discharges water into it having been started in 1895. It will be remembered that the wheelpits and tunnel are brick-lined throughout.

Trouble Over Chicago Drainage Canal Power.

A remarkable clash of arms has taken place in Chicago between two public bodies, the trustees of the sanitary district which controls the Chicago Drainage Canal and the City Council. The sanitary district trustees control the water-power plant at Lockport, which obtains power from the drainage canal. About 5000 kw is now being transmitted and sold to the city of Chicago for street lighting purposes. This is transmitted from Lockport to a substation near the city limits at a voltage of 44,000. At the substation it is stepped down to 13,000 volts and transmitted to various municipal lighting plants, as previously described in these columns. The sanitary district trustees, however, have not confined themselves to supplying power to the city of Chicago and to the park boards and other public enterprises, but have entered the commercial power field and are soliciting power business of manufacturers. The stringing of the wires of the sanitary district has been opposed in numerous cases on the grounds that frontage consents have not been obtained. Under a law passed in Illinois in 1897, a franchise cannot be granted to a person or corporation to put a pole line on a street until the consent of a majority of the property owners has been obtained for each mile of street. The contention of the sanitary district trustees is that because the sanitary district is not a corporation or person, but a public body, it is not bound by this law. There also appears to be a difference of opinion between the sanitary district trustees and the city officials as to the occupancy of city conduits and poles by wires of the sanitary district. An investigation has been started by the Citizens' Association to find out the reasons for the apparent clash between these two public bodies, both of which are supported by public taxation.

Decision of New York Public Service Commission on Consolidation.

The New York State Public Service Commission of the Second District has announced that its settled policy is not to grant permission for a foreign corporation to acquire control of any domestic corporation for the furnishing of gas or electric service in New York State, for the reason that as soon as it became a part of a foreign corporation the power of the commission to control its capitalization was lost, and this was one of the important powers which the public service commissions law took care of.

This announcement came out in connection with an application of the Twin State Gas & Electric Company and the Hoosick Falls Illuminating Company for authority for the latter company to transfer its franchises and works to the former company by merger and for the Twin State Gas & Electric Company to acquire the capital stock of the Hoosick Falls company. The Twin State company is a Connecticut corporation, which has a plant in Bennington, Vt., and it desires to acquire the Hoosick Falls plant, 12 miles distant.

Rates and Contracts of New York Electric Companies.

Public Service Commissioner Maltbie on May 20 informally discussed with the representatives of the various New York electric companies the advisability of substituting a brief form of application for the contracts which have heretofore been used by the companies, and took up in detail the provision of such an application, which had been tentatively prepared and submitted by the companies. At the following hearing, on May 27, Mr. Lieb, of the Edison company, submitted schedules bearing on arc lighting and power for public buildings, and arc and incandescent street lighting. The arrangement for arc lighting between the city and the New York electric companies are as follows:

New York Edison Company, contract for one year to Dec. 31, 1908. Annual rate of charge per lamp: 450-watt lamp, $100; two lamps of 250 watts each, $130 per post (two lamps); 325-watt lamps, $90. United Company, contract for one year to Dec. 31, 1908; 450 watts, $100. Westchester Company, no contract; 475 watts, $100. Bronx Company, contract for one year to Dec. 31, 1908; 400 watts, $105. Brooklyn Edison, contract for one year to Dec. 31, 1908; 325-watt lamp, $90; 450-watt lamp, $100; for less than 5000 lamps. Flatbush Company, contract for 15 years from May 1, 1894, and one year to Dec. 31, 1908; 350, 450, 375 watts, $97.50. New York & Queens Company, contract for one year to Dec. 31, 1908; 400 watts, $90. Queens Borough Company, contract for one year to Dec. 31, 1908; 400 watts, $90. Richmond Company, no contract; 400 watts, $100.

Mr. Arthur Williams testified that there were between 50 and 60 Edison consumers whose contracts did not correspond technically to the standard forms. Of these there are 25 who pay at the rate of 10 cents per kw-hour for the first 7 hours of daily use, and 5 cents per kw-hour for all excess over 7 hours average daily use. These contracts were made on or immediately after July 1, 1905, when the new law took effect, making the maximum price for electric current 10 cents per kw-hour. The company, Mr. Williams said, did not want to take advantage of the new law to raise the rate prevailing with those customers. The contracts mentioned are terminable at 30 days' notice on either side. Mr. Williams said these consumers were getting current at a rate slightly less than the average consumer who pays 10 cents per kw hour and that the company at one time contemplated the termination of this class of contract, but allowed it to stand in view of an opinion rendered by the counsel for the commission that the company is compelled to continue the service under the former rate. Commissioner Maltbie held the view that to continue a special contract when others in the class are paying a higher or a lower rate, was to set aside the common low rule against discrimination. Mr. Williams said that at present no special contracts of any kind are made by the company and added that the number of special contracts in existence 10 years ago was not, in his belief, larger than at the present time.

At the hearing on June 4, Mr. Williams again took the stand and said that in addition to the 52 special contracts mentioned at the previous hearing there were four special tunnel contracts at rates of 4 cents per kw-hour for current used in tunnel construction. The company, according to Mr. Williams, is willing to make such contracts with any person engaged in similar work. Breakdown service department house lighting and special forms of contracts were discussed during the remainder of the hearing. Adjournment was taken to June 5. On that date no testimony was taken and the hearing was adjourned to June 8.

Jersey City and Electric Light and Power Franchises.

A franchise was granted the Mutual Benefit Electric Light & Power Company of New Jersey to operate an electric light, heat and power business in Jersey City, N. J., by the Board of Aldermen, by a vote of 22 to 1, at their regular monthly meeting in May. The franchise went into effect immediately after the passing of the ordinance granting it. The Mutual company in its application for a franchise stated through its counsel, various benefits the city would receive if it were granted a franchise. Among its promises were that it would put all wires underground; would not sell out or merge with any other like corporation; would supply lighting service at 8 cents per kw-hour, with a 5 per cent discount for payment of bills within five days after presentation, which rate it claimed would mean a saving of nearly $170,000 per year to the present consumers. In addition to this the company agrees to give 5 per cent of its gross receipts to the city for the privilege of laying its wires underground, which is expected to reach from $10,000 to $40,000 per year. It further agrees to light the streets of the city at the rate of $65 per arc lamp per year. The officers of the company are: Mr. James E. Seymour, of Newark, N. J., president; Mr. John F. Nagle, Jersey City, treasurer; Mr. Richard S. Carrick, Jersey City, secretary.

The ordinance granting the franchise, which is for a period of 20 years, requires that all pipes or conduits shall be at least 2 ft. below the surface; that they shall not in any way unnecessarily obstruct or interfere with public or private property, and shall not be laid nearer than 3 ft. to any water or gas main, except in cases where it shall be necessary to cross or intersect the same. It shall furnish electricity for electric lights, heat and power to any and all of its customers at the maximum rate of 8 cents per kw-hour, and give 5 per cent discount on all bills paid within five days of presentation, and further, pay annually to the treasurer of the city of Jersey City 5 per cent of the gross receipts from current sold to its customers in the city of Jersey City. The company is required to construct and lay each year during the term of the franchise at least two miles of pipes and conduits and equip the same for the supply and distribution of electric light, heat and power; but is not required to lay pipes or conduits while the validity of the ordinance is under contest in the courts of the State. In case of failure to perform any of the provisions of the ordinance, the city will have the right to revoke the ordinance and thereupon all pipes and conduits laid in the streets shall become the property of the city. Upon the expiration of the term of 20 years all pipes and conduits laid in the streets hereunder shall become the property of the city, upon the payment of the value thereof, excluding franchise rights to be fixed by arbitration in case the city desires to purchase the same. Before disturbing the surface of any street for the laying of its pipes and conduits, the company is required to deposit with the city clerk the sum of 75 cents for each lineal foot of conduit to be laid therein, as security for the restoration of the street to its former condition, which sum, less the inspector's fees, shall be returned to said company in three months after the completion of said work, and the satisfactory restoration of the streets; the city shall have the right to use said deposit for the restoration of said street if the company shall fail to do the same satisfactorily.

As we go to press, announcement is made that Mayor Wittpenn has vetoed the ordinance granting a franchise to the Mutual Benefit Company on the ground that he did not feel that such franchises should be granted unless reasonable assurance is obtained that good results would follow.

Boston Edison Rate Decision by Massachusetts Commission.

The Massachusetts Gas & Electric Light Commission recommends that on and after July 1, 1908, the Boston Edison Company shall offer to sell electricity for any use at a uniform price not to exceed 12 cents per kw-hour, and that, if a customer elects to be served under the present schedules, his average price per year shall not exceed 12 cents per unit. Further reduction by Oct. 1, 1909, may be approved by the board unless the company can show good reasons to the contrary.

This decision is the outcome of a long investigation of the system of charging in use by the Boston Edison Company, extending back over a year and including 10 public hearings. The petitions asking for a reduction and change in the methods of charging was the Public Franchise League, of Boston, represented by its secretary, J. B. Eastman. The company was represented by its attorney, E. W. Burdett.

In its decision the board discusses the territory served, the distinctive characteristics of the central station as compared with the gas business, the investment in plant, the peak loads, theory of rates and resulting prices in force in the Boston district. The company uses a modification of the Wright demand system, which charges each customer substantially the cost of supplying him, including a reasonable return on the investment made in his behalf. It divides its expenses into "fixed" and "running costs," and to find the fixed cost per customer it introduces a "diversity factor," calculating that the average yearly fixed cost per kilowatt of maximum demand for its lighting customers is two-thirds and for its power customers is one-quarter the actual average yearly fixed cost per kilowatt of maximum station demand. The primary hours and rates are designed to take care of this feature of making the customer pay his proportionate share. The use of wholesale discounts relieves the larger customers of the excess costs occasioned by the smaller ones. The present rates were put in force on July 1, 1906, but the demand system of determining rates were adopted in 1898.

In the year ending June 30, 1906, the company sold 51,157,932 kw-hours, and the maximum station load was 26,311 kw. Dividing the annual expenses, including dividends, as between "fixed" and "running" costs on the basis used by the company, the fixed costs averaged $118 per kilowatt of maximum station demand and the running costs 1.25 cents per kw-hour sold. Correcting these results by the so-called "diversity factors," $80 is the average amount of fixed costs required of lighting customers and $30 of power customers per kilowatt.

Abstracts of the report here given show that the chief question was to what extent, if at all, a differential system of rates, such as the company has adopted, is unlawful because discriminating. The company contended that differential rates founded on differences in cost and condition of supply are lawful. With the change to saying that such rates are not necessarily unlawful, this contention may be conceded. It perhaps may also be conceded that competition, applying to one class or a portion of the company's business, may produce such difference in conditions of supply as to make not unlawful a difference in rate. So, too, rates established for certain classes of customers, or as they apply to certain classes, may not be unlawful even though returning less than their full proportion of profit.

The question of superior importance is whether or not the company's system of rates is on the whole consistent with those principles of sound public policy which should govern the relations of the company to the public which it serves. The purchase of suburban plants has necessarily involved a considerable abandonment of property and waste of invested capital, and the making good of this waste has borne heavily upon the earnings of the company reserved for depreciation. A larger experience than is yet available will furnish a satisfactory demonstration of its justification. This extension of the company's business may in time prove to have been in the public interest.

The expenses for generating and distributing the current made and sold are low and compare favorably with similar expenses of other large companies not only in this State, but in New York, Brooklyn and England. These facts indicate that the Boston company in this respect is skilfully and efficiently managed. On the other hand, the general expenses of the company considerably exceed all the other companies with which comparisons were made. Taxes in 1907 were over $453,000, or over 40 per cent of general expenses. This the company cannot control. The cost of obtaining new business in 1907 was $125,497.60, exclusive of the expense of quarters occupied by that department, or of the current used for demonstration, signs, etc. The figures for the year show as a result an increase in output of 20 per cent, or an increase in receipts of $261,742.74 (7 per cent), which would have been increased $200,000 more but for the reduction in rates of June 30, 1906. Judged by the immediate results obtained, this amount, and especially the expenditures for advertising in some of the Boston papers, seem excessive. The board has no criticism, but rather encouragement for the proper remuneration of an able and efficient management and for reasonable expenditures in efforts to extend and increase business.

The company seems to assume as the essential premise in its demonstration that the ratio of a customer's maximum demand to the aggregate demands of all customers, other conditions being equal, represents with reasonable accuracy his proportional share of the company's investment, and, therefore, of the fixed costs. The diversity factors adopted by the company are not based on its experience nor was it shown that they are based on the experience of others under substantially similar conditions. While the evidence tended to show some recent effects to test the accuracy of these "factors," it also tended to show that residence lighting, for example, might have a far more favorable diversity factor than the one assumed in making the present lighting rates, and this is probably because, that, unlike business lighting, the maximum demands of residence customers are not so nearly coincident. Before the diversity factors are used, the fixed costs should be divided as between lighting and power customers, which is obviously impracticable. The difficulty of finding the particular cost of an individual customer is also illustrated in the company's division of its annual expenses as between "fixed" and "running" costs.

The board is of the opinion that no differential system of rates for a public utility can be equitably and properly based solely upon the cost to the company of supplying the individual. The company has a public duty to perform and is bound to discharge it for the equal benefit of all. At best the company can assign the costs of supplying its customers only on broad lines and upon certain general assumptions and averages. There can be no more desirable requisite for a public service than that it shall be simple, definite and readily understood and applied.

On the basis of electricity sold and the maximum station demand during the year ending June 30, 1907, the company required but an average of $95 per kilowatt of maximum station demand to meet its so-called fixed costs and against $118 the preceding year. This would seem to warrant a reduction in the primary rate of 20 per cent to 12 cents. The present light rates enable the company to select desirable customers only, and tend to discourage small users from becoming customers.

In an analysis of the last year, non-contract lighting customers represented 15,000 out of 20,000, or 75 per cent. They used an average of 512 kw-hours of their aggregate maximum demands out of the 520 hours required by the company's schedule. Two years ago the company made a voluntary reduction from 18 cents to 15 cents. No recommendation was made in regard to street lighting. The present proposed reduction will probably cost the company at least $200,000.

President Edgar of the Edison Electric Illuminating Company, of Boston, has written a letter to the Massachusetts Gas and Electric Light Commission accepting the recommendation of the board in regard to rate reduction, but not admitting the incorrectness of the theory of differential prices or that the company has not proved them to be based on cost. Beginning July 1 the schedules A and A1 (15 cent primary and 12 cent secondary rate, and the church rate) will be discontinued, and a new commercial lighting rate schedule of 12 cents per kw-hour will be charged, with a minimum meter charge of $1 per month. The company feels that the board has not given sufficient importance to the state of the times and the effect of the new high-efficiency lamps upon its business.

Increase of Power Companies' Valuations.

The New York State Tax Commissioners have notified a number of corporations in Utica that there has been a large increase in the valuation for 1908 of the property of certain companies holding special franchises. Among the companies which have had their valuations increased are the following: The Utica Gas & Electric Company, whose assessment of last year of $575,000 has been raised to $700,000; the Utica Home Telephone Company, from $115,650 to $125,650; the Utica & Mohawk Valley Railroad Company, from $650,000 last year to $1,020,000. The Central New York Telephone Company, whose assessment last year was $155,000, has also had its assessment increased. The companies have the right to appeal from the valuations, and it is expected that a number of them will take advantage of this right, which will take the form of a protest to the city. Following official notice on the part of the city, a public hearing will be held, at which representatives of the companies and of the city will appear.

Hearing on the New York Central's High-Tension System.

The Public Service Commission resumed on June 4 the hearing on the question as to whether the New York Central should be permitted to maintain its high-tension overhead system. Mr. Henry Floy, consulting engineer, retained by the city, who was on the witness stand when the hearing adjourned May 22, continued his testimony. Mr. Floy gave it as his opinion that the method employed by the railroad for insuring safety for aerial wires at other crossings on its lines, namely, by furnishing an iron bridge under the wires to keep them off the road in case of an accident, was impractical at the Kingsbridge crossing of the Interborough tracks on account of the height of towers that would be required. He, therefore, expressed the opinion that the underground conduit was the safest plan that could be adopted at this crossing. He was also of the opinion that there would be little difficulty in the construction of such conduits. Mr. Floy did not believe that the expense of constructing conduits underground at this point would be excessive. He considered the New York Central's estimates of the cost of underground installation too high, and he also declared that there was plenty of room on the right-of-way for conduits. Mr. Floy's total estimate of the cost of putting the high-tension wires underground on the 10.4 miles of track in the city was $1,453,660. These figures were reached by careful inspection of the right-of-way, using the railroad's maps as a basis of measurement. Mr. Floy's figures were for 16-duct conduits. He also submitted a second estimate covering the replacement of the aerial lines on the Harlem Division as far as Woodlawn and on the Hudson Division as far as Spuyten Duyvil, which he suggested as a substitute for the larger proposition and as securing all the advantages of the latter for the construction would avoid crossing aerially all streets and highways or the necessity for placing any poles near the tracks within the city limits.

This estimate amounted to $988,324, and was based on the same premises as the first estimate, except the number of ducts was reduced from 20 to 16, as at present only 8 to 10 ducts would be required for putting the present aerial conductors under ground. Mr. Floy stated that he considered these figures, based on the unit price assumed by the New York Central's engineers, as very safe and he believed the work could be done considerably under this figure. He stated that on one inspection he had taken with him a representative of one of the largest contracting companies in the country, who made an estimate, including the wires and cables, which amounted to considerably less than $600,000.

At the hearing on June 5, Mr. Floy was cross-examined by Mr. Lyman, attorney for the railroad, without materially changing his evidence given in direct-examination. He was especially called upon to compare the aerial system of the St. Croix Power Company, of which he was chief engineer, with the system installed by the New York Central, with a view to showing the latter was as safe or safer than the former Mr. Floy was examined as to the aerial lines of the Long Island Railroad and the New York, New Haven & Hartford, Mr. Lyman's point being that the Central should not be ordered underground if these roads were permitted to use aerial lines.

In reply to a question, Mr. Floy said it was not feasible to require all electric light and traction companies to place their wires underground, as to do so would put many out of business.

Niagara Power.

The Canadian members of the joint International Water Ways Commission have submitted a report on the work of the Commission to the Canadian Parliament. It recommends that the government of the United States shall prohibit the diversion through the Chicago drainage canal of more than 10,000 cubic feet of water per second, which amount is said to be sufficient for the sanitary purposes of Chicago. It is estimated that this diversion will lower Lake Erie 5 in. The Commission recommends that no dam or dams be allowed in the Niagara River with a view to maintaining the level of Lake Erie. In regard to the use of power from Niagara Falls, the conclusions are: first, that it would be a sacrilege to destroy the scenic effect of the falls; second, that not more than 36,000 cubic feet of water per second on the Canadian side and 18,500 cubic feet per second on the United States side, should be diverted.

The Canadian members, while consenting to these conclusions, did so upon the understanding that any treaty on that basis should be limited to the term of 20 years, and should establish a principle applicable to all diversions or uses of waters adjacent to the international boundary, and of all streams which flow across the boundary. The Canadian Commission considered that it would have been wise if development had been limited to the generation of electricity for distribution in Canada. The three Canadian companies are now permitted to develop a total of 400,000 hp, and are compelled to take care of the Canadian market to the extent of at least one-half the power generated. The Commissioners say that one-half the production would undoubtedly supply all the demands from the Canadian market for many years to come, and it would not be any great hardship to compel the companies jointly or severally to build the necessary transmission lines for distribution of the power.

Electricity at the Franco-British Exhibition.

To mark the establishment of friendly relations between England and France, and to assist in strengthening the entente cordiale, the Franco-British Exhibition is now being held at Shepherd's Bush, London. The area of the exhibition site is 140 acres, or 200 acres inclusive of all the approaches. Within this space are 28 large palaces and halls, surrounded by a number of smaller buildings. Special attention has been given to the electrical equipment and illumination. Over 2000 arc lamps are installed for public lighting, and it is said that over 100,000 incandescents can be seen at one given point, illuminated at the same time. The exhibition was opened last month by the Prince of Wales, and has just been visited by the King and President Fallières of France. During the summer a great many American visitors are expected, and although the exhibits are restricted to English and French products, this will include many American articles made in one country or the other.

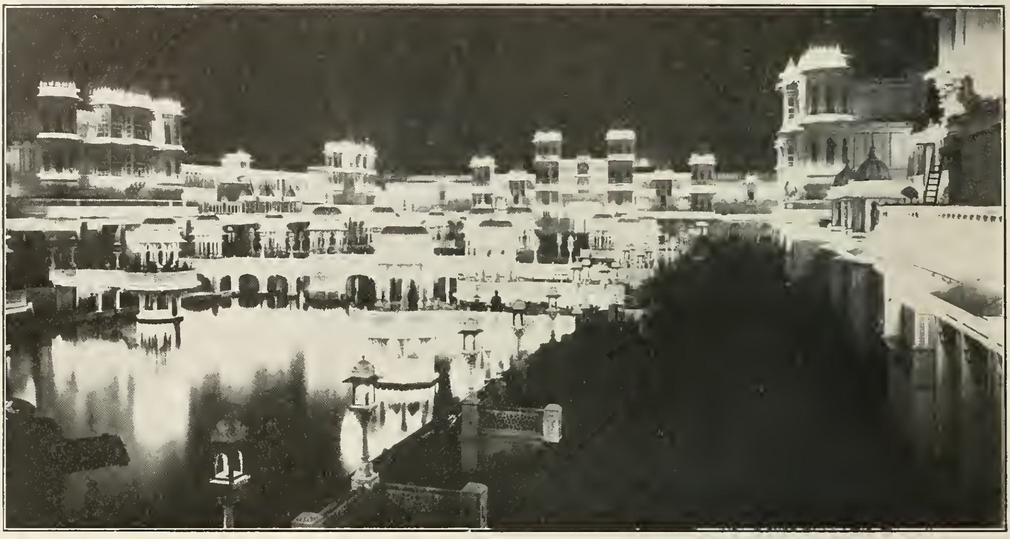


FIG. 1.—FRANCO-BRITISH EXHIBITION BY NIGHT.

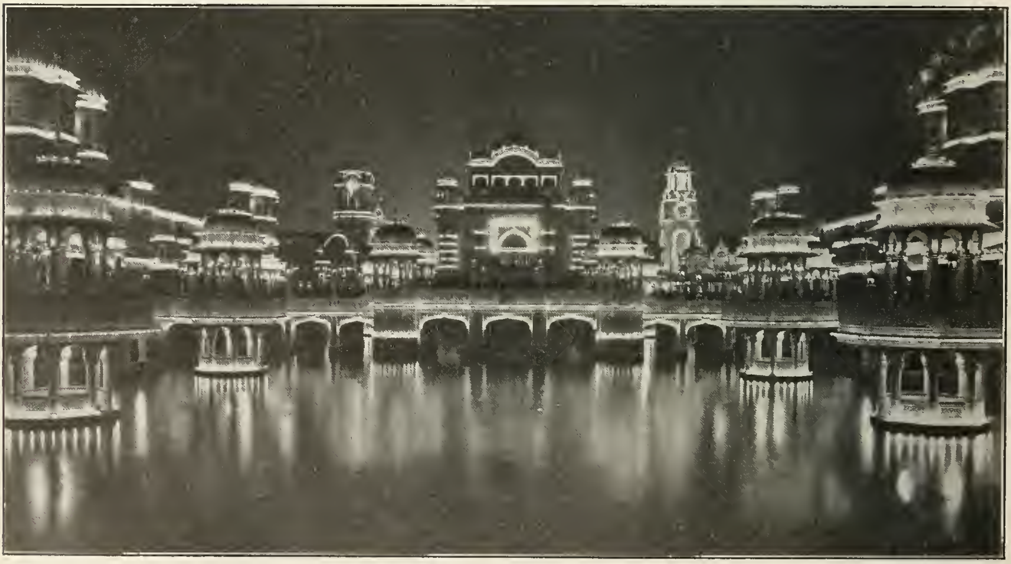


FIG. 2.—FRANCO-BRITISH EXHIBITION BY NIGHT.

Electrical energy for the exhibition is supplied by the Hammersmith Borough Council, within whose area the exhibition lies. This service is supplemented by that of the Notting Hill & Kensington Electric Supply Company, as sub-contractors. The Council charges the exhibition 2 cents per unit from sunrise to sunset and 4 cents from sunset to sunrise, with a minimum guarantee of $50,000. The sub-contract calls for current from the company delivered to the Council for 0.4 cent per unit with a guaranteed minimum of 1,000,000 watts and 0.375 cent for all units above that quantity. The Council current is single-phase, 50 cycles, at 2200 volts; the company current is three-phase, 5000 volts, and 45 to 50 cycles. Short feeders are run from the plants, consisting of concentric cables in earthenware ducts. There are two substations, each divided for single-phase and three-phase supply, respectively, and provision is made by motor-generator for direct-current supply. In the Machinery Hall have been installed generating plants, gas and steam, whose electrical energy is also availed of for use in the exhibits. There are also individual exhibits in separate buildings with their own generating plants.

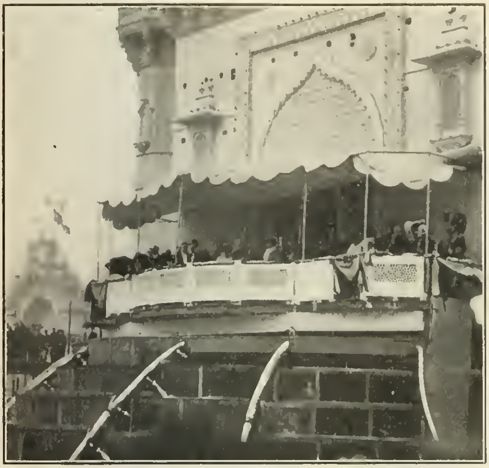


FIG. 3.—OPENING THE INDIAN COURT.

A very interesting feature of the exhibition is the display of apparatus for purely scientific methods of research. A space of 14,000 sq. ft. has been set aside for this and placed at the disposal of a number of scientific men, including Sir Norman Lockyer, Prof. John Perry and Sir Alexander Pedler. This novel department is divided into sections, each representative of a leading branch of research, such as magnetism and electricity, light and photography, chemistry, meteorology, etc.

FIG. 4.—TURNING ON WATER TO FOUNTAIN.

Our views show the lighting effects of the Court of Honor, etc., for which the "Fairyland" system has been adopted, using a special twin rubber-covered cable on the lampholders every 12 in. These lampholders are of a special watertight pattern connected without cutting the conductors, so that a bad contact affects only the particular lampholder. Some 100,000 of these lights have been placed on exteriors, in such a way that 200 lamps of 5 cp constitute a circuit on a pull-and-push switch with fuse. The lighting of the great Stadium where the Olympian games will occur is also one of the notable features, and has been done with 146 flaming arcs. The Grand Restaurant also is lighted with 5000 lamps arranged decoratively. Covered passages leading from the Uxbridge Road station to the exhibition have been lighted with no fewer than 400 flame arcs.

A good deal of extra electrical work and service are required of the transportation authorities. The Central London Railway has extended its line from the Shepherd's Bush terminus to a station at Wood Lane adjacent to the main entrance to the exhibition, and the Hammersmith & City Railway has erected a special station at the grounds. The London County Council has built an overhead trolley line in Wood Lane for the Horlesden and Harrow Road districts, and the London United Tramways has access at Uxbridge Road through the covered approach referred to above. These facilities will handle 70,000 passengers an hour, besides which there are lines of motors, omnibuses, etc.

Electrical Train Lighting Equipment on the Austrian-Hungarian Government Railroad.

A successful trial of the Rosenburg train-lighting generator equipment was made recently on the Austrian-Hungarian Government Railroad. The car used for the test contains six compartments each of which is equipped with two 16-cp tungsten lamps. The car also carries five other lamps of the same type and rating. The lamps operate at 32 volts, while the generator is designed for an e.m.f. of from 44 to 58 volts, the full load output being 30 amp. A storage battery capable of supplying energy to the lamps for six consecutive hours has been installed. Iron ballast resistors of the cartridge type are connected in series with the lamps when they receive energy from the generator. These resistors are mounted in the vestibules. In the vestibules are also mounted field rheostats which serve for adjusting the voltage of the generators when charging the storage battery, and an automatic reverse-current relay which prevents the battery from feeding energy to the generator when the speed is low. It is reported that the lamps give steady light and do not show flickering when the train is accelerating or retarding.

Electrifying German Railroads.

United States Consul Talbot J. Albert, stationed at Brunswick, Germany, reports that a beginning in electrifying some of the railroads in Prussia will soon be undertaken, the preliminary plans being as follows:

The railroad ministry will permit the first great attempts to be made with electrical power in connection with the centrals now existing in the administrative district of Magdeburg. First, the short sections Gusten-Stassfurt and Güsten-Bernburg-Köthen will be arranged for electrical operation. Later there will be a change of power on the line Magdeburg-Bitterfeld-Leipzig, and afterward on the line Halle-Leipzig. Upon these, in themselves complete lines of road, electrical power will wholly supplant steam.

The line Leipzig-Halle has been chosen for a special reason. By the electrical operation between these two points there will be a greater increase in the speed and frequency of the trains dispatched, so that in this way Leipzig will be brought into closer connection with the western main lines. The managements of two lines have been instructed by the ministry at Berlin to make a detailed inquiry how far electrical power can be economically used in comparison with the present method of operation. It is said that the preliminary work for this statistical inquiry has already been done by the ministry, so that the administration at Halle has only to verify the results already obtained.

The most favorable factor for the economical determination of the question are the bituminous deposits (Braunkohlen) between Halle and Leipzig. This kind of coal is not considered a suitable fuel for locomotives. One electrical central will suffice for the operation of both lines, and this will be built in the midst of the coal fields.

It is said the passenger traffic will be handled in the same manner as upon the road Berlin-Lichterfelde-Ost, namely, with small trains and quick service. The express and freight trains will be dispatched with electrical locomotives. The length of the two lines together amounts to 102½ miles, the line Leipzig-Magdeburg being about 80 miles and the line Leipzig-Halle 22½ miles. It is calculated that the change in the system will take two years. Current will be distributed at 10,000 volts.

Bellows Type Relays for High-Tension Switches.

Mr. R. F. Schuchardt, at a meeting of the Chicago branch of the A. I. E. E., held June 5, 1908, read a paper on "Recent Developments in Protective Features of a Large High-Tension Underground System." This took up mainly the work done by the Commonwealth Edison Company's staff in Chicago in developing the bellows type of relay for high-tension switches, some very important advances having been made. He described briefly the extensive system of stations, substations and transmission lines of the Commonwealth Edison Company. Oil switches using the simple solenoid and plunger type of overload relay and combined with a fixed time-limiting device were first used, the time limit of opening being six seconds. This proved too long and was later reduced to two seconds, but as there was considerable trouble, the time limit was abandoned temporarily, leaving only a plain relay with instantaneous action. As the system grew the necessity became more urgent for selective action of relays, so that only certain switches would open under certain conditions. Attempts to get selective action by setting relays at substations lighter than those at generating stations were not successful for heavy short-circuits, as all relays would open.

Mr. Schuchardt then described in detail the steps in the evolution of the bellows type relay in which the shortness of the time in which the relay will operate depends on the amount of current flowing. Quick recovery valves to allow the plunger to resume its normal position rapidly after opening a circuit were introduced, but turned out to be a source of trouble, as they permitted chattering, vibration and pumping to an extent which actually caused the relay to open slower on short-circuits than on overload. He exhibited curves plotted from tests of overload relays showing the time in seconds required to open with various values of current. He showed that although several relays might give the same results with a certain current, they would not necessarily give the same results with a higher or lower current value. He also showed that earlier types of bellows relay did not act with sufficient rapidity on short-circuits, although the action was sufficiently rapid on lighter currents. This difficulty has been overcome by one of the engineers of the company's testing department, who substituted for the manufacturers' air valve a simple device which is a combination of a needle valve and a pop valve. The needle valve governs the rapidity of action under overloads, while the pop valve permits quick action with heavy short circuits. Tests on oil switches show that they require from 0.2 to 0.6 second to operate after the tripping switch operated by the relay is opened. In generating stations the company uses overload relays on transmission lines only. No automatic devices are on the generator switches. In every case the switchboard operator has promptly disconnected the correct generating unit in case of trouble. Mr. Schuchardt's paper went into practical details in a very satisfactory manner and was followed by contributions from central-station electrical engineers of Milwaukee, St. Louis, New York and Boston.

Canadian Electrical Association Convention.

The convention of the Canadian Electrical Association is to be held in the Chemistry and Mining Building of the University of Toronto on June 17, 18 and 19. About 400 delegates are expected to attend.

Space has been provided in which to make exhibit of standard, special or new devices, which manufacturers and dealers may desire to bring to the notice of the electrical people in attendance. This space consists of two large rooms about 32 ft. x 50 ft., and the corridors of the basement and ground floors of the building. There are available both 220- and 110-volt direct-current circuits, as also a small capacity in 110-volt, 60-cycle alternating-current service. An efficient janitor service has been arranged to assist in unpacking and arranging exhibits. Contributors to the funds of the convention are offered one unit of exhibit space for each $25 of their contribution.

Association of Electrical Engineers of the Iron and Steel Industry.

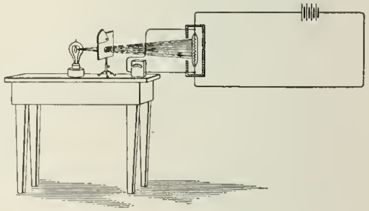
Following is a list of committees that have been appointed by the officers of the Association of Electrical Engineers of the Iron and Steel Industry:

Finance, Messrs. E. W. Yearsly, chairman; G. H. Winslow, James Farrington; papers, Messrs. E. W. Yearsly, chairman; P. D. Brown, G. W. Richardson, G. M. Sturgess; library, Messrs. G. H. Winslow, chairman; L. R. Palmer; board of examination, Messrs. B. R. Shover, chairman; J. C. Reed, L. R. Palmer; editing, Messrs. L. R. Palmer, chairman; G. H. Winslow; standardization, Messrs. F. P. Townsend, chairman; G. W. Richardson, G. M. Sturgess. Mr. G. H. Winslow, Frick Annex, Pittsburg, is secretary and treasurer.

The next meeting of the association will be held in Philadelphia June 24 and 25.

Selenium Photometer.

Mr. William J. Hammer obtained two patents on May 26 relating to the use of selenium in photometry, the claims of which seem to be very broad. The leading claim of one patent is as follows: "The new art of measuring light which consists in causing the light to be measured to vary an ascertainable physical quantity and measuring the extent of the variations." The claims of the other patent cover apparatus for applying the light-measuring method suggested.



SELENIUM PHOTOMETER.

The accompanying illustration shows diagrammatically one of the proposed arrangements of apparatus. A voltmeter indicates the change produced in the resistance of a selenium cell when the light to be measured falls upon it. The selenium is inclosed in a vacuum to exclude moisture and thereby to eliminate the polarizing e.m.f. that may be produced by electrolytic action when moisture is present. Moreover, by the use of the vacuum the deleterious effects of gases produced by heating are avoided. The tube is preferably made of quartz in order to admit certain rays that are excluded by glass.

Annual Convention of the A. I. E. E.

During the annual convention of the American Institute of Electrical Engineers, to be held at Atlantic City from Monday, June 29, to Thursday, July 2, both the headquarters of the Institute and the place of conducting the meetings will be at Hotel Traymore.

The exercises will begin with an address of welcome to be delivered on Monday morning at 11 o'clock. Following this will be the address of President H. G. Stott. The morning session will close with the presentation and discussion of a paper by Mr. C. M. Goddard on "Electricity as Viewed by the Insurance Engineer," in which the author pleads for closer co-operation between the A. I. E. E. and the National Fire Protection Association, whose interests lie in the same direction.

The program of papers will be presented at sessions on Monday afternoon, Tuesday morning, Tuesday evening, Wednesday morning, Wednesday afternoon, Thursday morning and Thursday afternoon. Unless the time consumed in presenting and discussing the papers exceeds the amount allotted to them, no session will be held on Friday, so that members will be free to make such plans as they may desire for the Fourth of July, which falls on Saturday.

The portraits on the following page are of the officers elected at the annual meeting in May, who will assume office August 1. The present officers of the Institute are as follows:

President, Mr. H. G. Stott; secretary, Mr. Ralph W. Pope; treasurer, Mr. Geo. A. Hamilton; vice-presidents, Messrs. H. H. Humphreys, A. H. Armstrong, Frank G. Baum, James G. White, W. C. L. Eglin and L. A. Ferguson; managers, Messrs. C. C. Chesney, Bancroft Gherardi, Chas. L. Edgar, Calvert Townley, John J. Carby, A. M. Schoen, Paul M. Lincoln and Paul Spencer.

H. G. STOTT,
President.

An indication of the character of the papers that will be presented at the convention is given below:

ELECTRICAL MACHINERY.

"Modern Developments in Single-Phase Generators," by Mr. W. L. Waters, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Describes the methods employed for overcoming the disadvantages of the pulsation of the armature reaction and the mechanical stresses on the end-connections of the armature coils of single-phase generators.

"A New Large Generator for Niagara Falls," by Mr. B. A. Behrend, chief electrical engineer of Allis-Chalmers Company, Milwaukee. Description of a 6500-kw generator installed in the plant of the Niagara Falls Hydraulic Power & Manufacturing Company, which is notably interesting both on account of its high e.m.f. of 12,000 volts and its high speed of 300 r.p.m.

"The Relative Proportion of Copper and Iron in Alternators," by Mr. Carl J. Fechtheimer, assistant electrical engineer, Allis-Chalmers Company, Milwaukee, Wis. A method is developed for determining what value of field flux to employ in order to obtain the cheapest machine.

"Application of Fractional-Pitch Winding to Alternating-Current Generators," by Mr. Jens Bache-Wiig, engineer, Westinghouse Electric Manufacturing Company, Pittsburg, Pa Deals briefly with the advantages of the chorded-winding for alternating-current generators from the standpoint of manufacture and design, and indicates the influence this winding has on the performance of a machine.

"Voltage Ratio of Split-Pole Converters," by Prof. Comfort A. Adams, Harvard University, Cambridge, Mass. Gives a theoretical analysis showing that the field distortion of a split-pole synchronous converter does not necessarily involve electromotive force distortion.

"Induction Motors for Multispeed Service with Particular Reference to Cascade Operation," by Mr. H. C. Specht, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Contains a mathematical treatment of the operating characteristics of two motors joined in "cascade."

ELECTRIC RAILWAY.

"The Determination of the Economic Location of Substations in Electric Railways," by Mr. Gerard B. Werner, engineer, Muralt & Co., New York. A formula is developed for determining the most advantageous location of substations so as to render the total annual charges on the installation a minimum.

"From Steam to Electricity on a Single-Track Road," by Prof. J. B. Whitehead, Johns Hopkins University, Baltimore, Md. Contains a description of the Annapolis Short Line, and an outline of the reasons for changing from steam to electricity.

"Conductor-Rail Measurement," by Mr. S. B. Fortenbaugh, engineer, General Electric Company, Schenectady, N. Y. Reports tests of the effects of reversing the polarity on "third" rails of the Underground Electric Railways Company of London.

HIGH-TENSION SYSTEMS.

"Fundamental Considerations Governing the Design of Transmission-Line Structures," by Mr. D. R. Scholes, chief engineer. Aermotor Company, Chicago, Ill. Deals with the mechanical problems involved in determining the strength of the various parts of steel towers, etc.

"Tests with Arcing Grounds and Connections," by Mr. Ernst J. Berg, engineer, General Electric Company, Schenectady, N. Y. Outlines a series of tests on a 25-cycle system at 33,000 volts, with various transformer and arrester connections.

"High Voltage Experiments at Niagara," by Mr. Ralph D Mershon, consulting engineer. Describes experiments made on the lines of the Niagara Falls Hydraulic Power & Manufacturing Company, to supplement the earlier tests at Telluride.

"Standard Tests for High-Voltage Line Insulators," by Mr. C. E. Skinner, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Records the information obtained from various sources with a view to producing a standard specification for line insulators.

"Measurements of Lightning, Aluminum Lightning-Arresters, Earth Resistances and Kindred Tests," by Prof. E. E. F. Creighton, engineer, General Electric Company, Schenectady, N. Y. Describes the instruments and methods used and the data collected during two years' study of lightning phenomena, together with a discussion of the theory and practice of lightning protection.

"Engineering Features of the Southern Power Company System," by Mr. J. W. Fraser, assistant chief engineer, Southern Power Company, Charlotte, N. C. Shows how the conditions governing the sale of energy affected the design of the system, which is described together with certain proposed extensions.

OPERATION

"The Application of Storage-Batteries to the Regulation of Alternating-Current Systems," by J. Lester Woodbridge, chief engineer, Electric Storage Battery Company, Philadelphia, Pa. Outlines the general functions of a storage battery in connection with an alternating-current system, and describes the battery booster, the carbon-regulator, the split-pole synchronous converter and a variable-voltage exciter for boosters or synchronous converters.

RALPH W. POPE, *Secretary.*
L. A. FERGUSON, *President-Elect.*
GEO. A. HAMILTON, *Treasurer.*

EXECUTIVE OFFICERS-ELECT.

"Steam Turbine Plant; Some Possibilities Resulting from Recent Engineering Developments," by J. R. Bibbins, engineer, Westinghouse Machine Company, Pittsburg, Pa. Presents in a general way some of the engineering features of the double-deck steam-turbine generating station.

C. C. CHESNEY.
B. GHERARDI
CALVERT TOWNLEY.

VICE-PRESIDENTS-ELECT.

W. G. CARLTON.
H. E. CLIFFORD.
D. B. RUSHMORE.
C. W. STONE.

MANAGERS-ELECT.

"Thirty-Day Test on Producer-Gas Plant; Discussion of Results in Relation to Cost of Energy," by Mr. J. R. Ribbins, engineer, Westinghouse Machine Company, Pittsburg, Pa. Gives data and calculations based upon actual operation of the service plant of the Richmond (Va.) works of the American Locomotive Company.

ENGINEERING PRINCIPLES.

"Three-Phase Power-Factor," by Mr. Austin Burt, superintendent, Citizens' Gas & Electric Company, Waterloo, Ia. From the various relations that exist between electromotive forces and currents in a three-phase delta-connected system, the author derives a general expression that will enable the mean power-factor to be determined when the system is unbalanced.

"Graphical Treatment of the Rotating Field," by Mr. R. E. Hellmund, engineer, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Diagrams are developed by means of which nearly all the phenomena of the rotating field may be easily studied and the various factors necessary for the calculation of fluxes, exciting current, etc., may be determined.

"The General Equation of the Electric Circuit," by Dr. C. P. Steinmetz, consulting engineer, General Electric Company, Schenectady, N. Y. Deals with a mathematical investigation of the phenomena which may occur in the most general case of an electric circuit, giving practical interpretation to the mathematical equations.

"A Minimum-Work Method for the Solution of Alternating-Current Problems," by Dr. Harold Pender, electrical engineer, New York City. Describes a method of solving alternating-current problems by the use of certain factors based on trigonometric relations rather than on physics. The treatment is mathematical but the equations are fully interpreted.

"Notes on the Electric Heating Plant of the Biltmore Estate," by Mr. Chas. E. Waddell, electrical engineer, Biltmore Estate, Biltmore, N. C. Describes the hot-water system and laundry equipment, giving data relating to operating costs.

EDUCATIONAL.

"Relation of the Manufacturing Company to the Technical Graduate," by Mr. Magnus W. Alexander, General Electric Company, Lynn, Mass. Outlines the student course given at the Lynn Works of the General Electric Company, and proposes a plan by which a student becomes an apprentice in the factory during part of each year.

"Relation of the Manufacturing Company to the Technical Graduate," by Mr. B. A. Behrend, chief electrical engineer, Allis-Chalmers Company, Milwaukee, Wis. Pleads for close co-operation between the manufacturing companies and the colleges in order to cultivate both character and intellect in the graduates.

"Relation of the Manufacturing Company to the Technical Graduate," by Mr. D. B. Rushmore, engineer, General Electric Company, Schenectady, N. Y. Points out the necessity of co-operation in modern industrial establishments and suggests more co-operation between engineering schools and the manufacturers for their mutual benefit.

MISCELLANEOUS.

"The Measurement of Rotary Speeds of Dynamo Machines by the Stroboscopic Fork," by Dr. A. E. Kennelly and Mr. S. E. Whiting, Harvard University, Cambridge, Mass. Calls attention to what has already been accomplished by others in measuring rotary speeds with the stroboscopic fork, and describes a certain modification which has been developed by the authors.

"Wireless Telephony," by Mr. R. A. Fessenden, electrical engineer, National Electric Signaling Company, Washington, D. C. Gives a brief history of the development of wireless signaling, and outlines the future possibilities of wireless telegraphy.

"A Study of Multiple-Office Automatic Switchboard Telephone Systems," by Mr. W. Lee Campbell, assistant superintendent, Automatic Electric Company, La Grange, Ill. Shows how the enormous economic waste involved in manually-operated telephone systems may be greatly reduced in systems employing automatic switchboards.

"Primary Standard of Light," by Dr. C. P. Steinmetz, consulting electrical engineer, General Electric Company, Schenectady, N. Y. Suggests a standard based upon the physiological effect.

"Water Power Development in the National Forests: A Suggested Government Policy," by Mr. F. G. Baum, consulting engineer, San Francisco, Cal. Describes a method for determining a proper and fair charge to be made by the government for water-power development based upon the cost of maintaining the area benefiting by the privilege.

"An Imperfection in the Usual Statement of the Fundamental Law of Electromagnetic Induction," by Mr. Carl Hering, consulting engineer, Philadelphia, Pa. Discusses the "looping" theory versus the "cutting" theory of the production of electromotive force by the change in the interlinkage of flux and conductors.

CURRENT NEWS AND NOTES.

NEW YORK CENTRAL ELECTRIFICATION NEARLY COMPLETED.—The New York Central and the New Haven roads have announced that the electrification of their lines within the limits of the Metropolitan district will be completed by July 1, and that after that date no steam locomotives will be run through the tunnel.

TELEGRAPH COLLEGE IN CHINA.—Further information in regard to the establishment of a postal and telegraph college in China states that the board of posts and communications has sent a memorial to the Throne, asking for an appropriation of about $46,000 gold for the maintenance of the college. The school will be under the instruction of experienced foreign and Chinese teachers, and will instruct and train young men for service in all postal and telegraph departments.

ELECTRIC MOTORS IN MINES.—In an address on "The Choice of Electric Motors for Mine Equipment" recently delivered by Mr. A. W. K. Peirce before a meeting of the South African Association of Engineers, held at Johannesburg, the most suitable induction motor for general use was stated to be one running at as high a speed as consistent with its size, at a voltage not exceeding 400 and on a circuit having a frequency of 50 cycles per second. He confined his attention to the three-phase motors of the induction type, and said that certain special applications of electric power, or the limitations imposed by the existing systems of supply, might occasionally render the employment of other types necessary, but such circumstances would only be found to be exceptional.

NATIONAL RESOURCES COMMISSION APPOINTMENTS.—President Roosevelt has appointed a National Commission to consider and advise him on questions relating to the conservation of the natural resources of this country, and to co-operate with similar bodies which may be designated by the several states. The commission is divided into four sections; namely, waters, forests, lands and minerals, each having a membership of 12, mostly members of Congress and government officials. Among the few members from civil life are President Charles Macdonald and Prof. Geo. F. Swain, of the Society of Civil Engineers, and President John Hays Hammond, of the Institute of Mining Engineers. There are no representatives of the Electrical or Mechanical engineers.

EFFECTS OF EXTERNAL FIELDS ON METERS.—A point often lost sight of in the location of meters on switchboards was brought out in the committee report on meters before the National Electric Light Association. A busbar carrying a current of 600 amp at a distance of 12 in. from a direct-current meter was found to affect the accuracy of the meter at one-tenth load over 50 per cent, the direction of the current in the busbar determining whether the meter was fast or slow. The relative position of the busbar to the meter was accountable for the error, as the same current with a busbar 2 in. from the meter had no appreciable effect. A case was cited from actual practice where a 600-amp direct-current meter in excellent condition would not register on a load of 80 amp on account of the opposing field from an adjacent conductor. In another instance a 150-amp meter registered only 90 per cent of the load passing. Meters may also be influenced by their own wiring if the service or load wires are brought around the meter, and somewhat by their proximity to each other. The middle meter of three direct-current meters placed side by side 12 in. between centers was affected from 5 per cent to 10 per cent on one-twentieth load, when the other two carried a full load. Meters should be spaced at least 15 in. centers to be free from such effects. While the instances cited are all from direct-current practice, some makes of alternating-current meters are similarly affected by external fields. Errors such as those mentioned could be avoided by a judicious location of the meters

ELECTRIC POWER FROM COAL WASTE PRODUCTS.—The town of Amherst, Nova Scotia, is supplied with electric power and light generated from the waste products of a coal mine. This accords with Mr. Edison's prophecy that the future site of electric generation would be at the pit's mouth.

PATENTS IN JAPAN.—It is stated officially that a treaty will be made and put in force between Japan and the United States, whereby American patents, trade-marks and copyrights will hereafter be given protection in Japan, so that they can no longer be appropriated by merchants and manufacturers on the spot, to the injury of those to whom the original rights belong.

PORTLAND (ORE.) LIGHTING COMPANY COURTS PUBLICITY.—The Portland (Ore.) Railway, Light & Power Company has started the publication, as advertising in local newspapers, of a series of frank statements or talks taking the public into its confidence. These publications set forth the work accomplished by the company and the advantage to the people in using its service.

PARIS TO ELECTRIFY ITS RAILROADS.—It is reported that the steam railroads entering Paris are seriously considering the proposition of electrifying their lines for some distance out from the city into the suburbs, as in the case of railroads terminating in New York City. At present there are six railroads entering Paris, one of which, the Paris-Orleans road, is already electrified.

A CANADIAN TRIP is proposed by the Iron and Steel Institute of Great Britain at the invitation of the Canadian Mining Institute. The excursion will leave Montreal on Aug. 24 and will cross the continent by Canadian Pacific to British Columbia. While in the Dominion the party will visit nickel, copper and asbestos districts. It is believed that several members of the English body will avail themselves of this excellent opportunity to study the general mining development of Canada.

INSTITUTE OF METALS.—A movement was started in England recently to form a Copper and Brass Institute, and this has now taken form in an Institute of Metals, devoted to the nonferrous metals and their alloys. A meeting to discuss the subject has been arranged to be held on June 10, at the Institute of Mechanical Engineers, Westminster, at which a number of metallurgists and manufacturers will attend, as well as representatives of the marine engineers and shipbuilding industries.

KOREAN TELEGRAPH SYSTEM.—The telegraph business of Korea is increasing, according to Consul-General Thomas Sammons, of Seoul, although the number of telegrams sent abroad, not including those to Manchuria, shows a decrease following the abnormal activity during the period immediately after the war. The telegraph lines aggregate 6772 miles. American telegraph instruments are not generally used. There were 25 post and telegraph agencies and 50 telegraph agencies, with a large number of establishments on a smaller scale calculated to facilitate communication.

ALUMINUM CONSUMPTION.—More than seventeen million pounds (17,211,000) of metallic aluminum were consumed in this country during last year, according to Mr. W. C. Phalen, of the United States Geological Survey, whose statistical report on the production of aluminum and bauxite has just been published by the Survey as an advance chapter from Mineral Resources of the United States, 1907. This is an increase of 2,301,000 lb. over the consumption in 1906, which amounted to 14,910,000 lb. The great increase in domestic production predicted in the early part of 1907 was not realized, and the failure of the predictions is attributed by Mr. Phalen, in large part at least, to the falling off in demand toward the close of the year as a result of general business depression.

ELECTRICITY FROM PEAT.—Details for establishing in Ireland an electric plant to furnish current generated from peat gas, the first plant of its kind in Great Britain, were recently reported to a committee of the British House of Commons. Consul-General Robert J. Wynne, writing from London, says that the Dublin & Central Ireland Electric Power Company is seeking a franchise to supply electricity to portions of the counties of Dublin, Kildare, Queens and Kings, and have arranged to purchase 500 acres of peat bog in the district. Heretofore one of the main objections to the use of peat as a generating power was that it contained 90 per cent of moisture and the drying expenses were too great. The promotors of the new scheme intend to use a process common in Germany by which it is advantageous to retain 50 per cent of the moisture in the peat, thereby obtaining by-products, such as sulphate of ammonia, which, it is claimed, alone pays the cost of the peat.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY DEGREES.—The faculty of the Massachusetts Institute of Technology has just conferred the degree of Master of Science on three graduate students in the electrical engineering course—Mr. R. B. Anthony, who graduated from the University of Wisconsin; Mr. E. L. Moreland, who graduated from the Johns Hopkins University, and Mr. F. W. Willey, who graduated from Purdue University. Thirty-eight students, 10 of whom are already graduates of liberal arts courses and three are graduates of the mechanical engineering course of the Institute, have been granted the degree of Bachelor of Science in the electrical engineering course. Graduate fellowships for electrical engineering study during the next year have been granted to Mr. Walter S. Rodman, now instructor in electrical engineering at the Rhode Island Agricultural College, and H. S. Osborne, who graduates from the electrical engineering course of the Institute this year. Mr. Osborne has been elected Saltonstall Fellow in recognition of his unusual attainments as an undergraduate student. Professor Laws and Professor Shaad, of the Electrical Engineering Department, each spent several days during the spring intermission studying the methods of instruction in electrical engineering and related subjects at Cornell University.

ELECTRIC STREET CARS IN WARSAW.—The first electric street-car line in Warsaw commenced operation in April. This electric line succeeds horse-drawn cars introduced in 1881 by a Belgian company, which, in 1889, sold the system to the city in consideration of an annual payment of $175,000 until the expiration of the concession in 1916. In 1907 there were 304 cars in operation and passengers were charged 7 kopecks (3.6 cents) for the first class and 5 kopecks (2.5 cents) for second class for a distance not exceeding two miles. For the year 1907 a gross revenue of $839,052 was obtained. The changing from the horse-car to the electric system will not affect the wages of employees. The daily hours are from 7 in the morning until 11.30 at night, with intervals for meals. The drivers receive 62 to 67 cents a day and conductors 62 to 83 cents. Inspectors receive $30.90 to $41.20 per month. A building company appointed by the emperor carried on the reconstruction work, the principal private contractors being German electric companies. There will be 180 motor cars, and the power house has three turbo-generators of 1800 hp each, the voltage being 600 to 650. The syndicate which will manage the system has closed a contract with the city until 1922. The syndicate agrees to pay the city an annual sum of 402,200 rubles ($207,030) and 5½ per cent on the invested capital of about 7,000,000 rubles ($3,605,000). From these receipts the city will continue to pay 350,000 rubles per annum to the Belgian company up to the year 1916; after the expiration of this liability the income passes into the city treasury. Whatever surplus net profit remains after the payment to the city of the sum agreed upon is to be divided into equal parts between the city and the syndicate.

Hydro-Electric Development in Mexico.

THE Sultepec Electric Light & Power Company was incorporated under the laws of the State of New York in February, 1906. In April, 1908, the capital stock was increased to an authorized amount of $1,000,000 and a consolidated first mortgage authorized in the same amount; the mortgage being dated May 1, 1908, and the bonds running for a period of 50 years and bearing interest at the rate of 6 per cent per annum. The company has outstanding $600,000 of its capital stock and an equal amount of its bonds and is the owner of two separate concessions in the Republic of Mexico. The newer concession was received from the Federal government and under it the company has the right to utilize a total of about 6000 hp, of which 2000 hp has been installed in the plant later described. This generating station, which is a thoroughly modern and up-to-date plant in every respect, began actual operations in December, 1907.

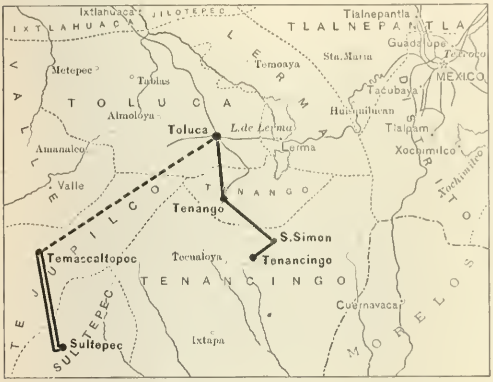
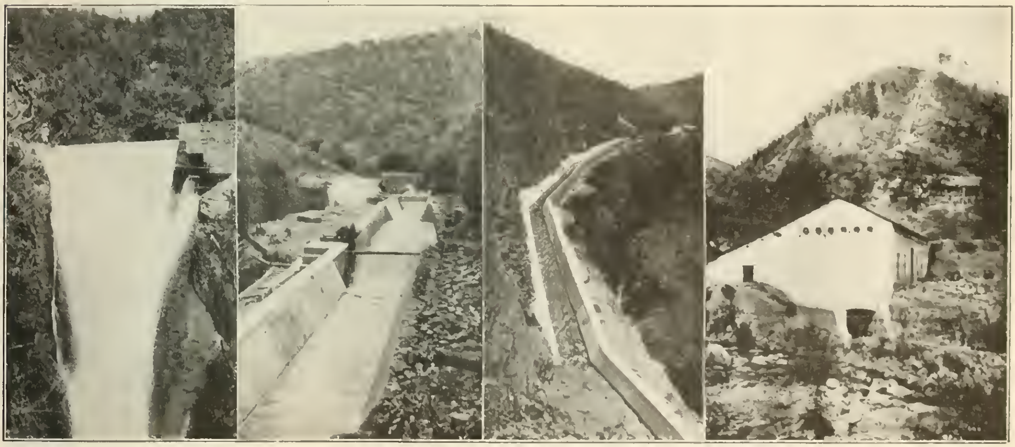


FIG. 1.—MAP OF TERRITORY SUPPLIED WITH ENERGY.

The company has also acquired by purchase the plant and property of the Toluca Electric Light & Power Company, which has been in successful operation since 1903, its total output approximating 1000 hp. A description of this plant also follows. The Sultepec Electric Light & Power Company has valuable contracts with the different municipalities through which its lines run, including a 10-year contract executed in 1907 with the city of Toluca and also contracts with local manufacturers and a number of important mines in the Sultepec district.



FIGS. 2, 3, 4 AND 5.—DAM, SAND TRAP, CANAL AND POWER HOUSE.

Some of Mexico's richest mining camps are in the State of Mexico, some 75 miles to the southwest of Mexico City, including Temascaltepec, Sultepec and Zecualpam. Much of the Montezumas' wealth came from these mines, which were among the first exploited by the Spaniards after the conquest. In recent years a large amount of American and other foreign capital has been invested in the development of the mines under modern and scientific methods, but the scarcity and high price of fuel for power purposes has become a great obstacle in the way of large development. In the neighborhood of Tamascaltepec much water is encountered in the mines and the ancient workings were abandoned when they reached a depth at which, with the crude appliances of those days, they could no longer keep them dry; one mine bears the suggestive name of Mina de Agua (Mine of Water).

THE SULTEPEC ELECTRIC LIGHT & POWER COMPANY.

Flowing by Tamascaltepec is the Rio Verde, with a minimum flow of 3 cu. m. (106 cu. ft.) of water per second and for many kilometers a fall of from 5 to 10 per cent, offering splendid opportunities for power development. This river has its source in the snow-clad ancient volcano of Xinantecatl, near Toluca; the summit of this mountain is 15,500 ft. above sea level and has a large lake in its extinct crater. The flow of water in the river is fairly constant the year around except during the rainy season, which lasts from June until November, when there are frequent floods of short duration. The Sultepec Electric Light & Power Company, of New York, has secured from the Mexican Federal government a concession for the use of this water, covering about 30 km (19 miles) in length of the river, and has just completed the installation of the first of several proposed power plants on it for furnishing energy to the mines in the above named camps. This first plant is located on the edge of the town of Temascaltepec and within a few kilometers of some of the largest of the mines, power for which is furnished directly at machine voltage without transformers. For Sultepec, 25 km southeast, and Toluca, 60 km northeast, transmission lines of 25,000 volts are established.

The river at the point where this development is made flows through a cañon eroded out of solid rock, from 10 to 30 m in depth and an average of 5 m in width. To raise the water from the river bed to the canal level, a masonry dam (Fig. 2) 17 m in height was built at a point where the cañon is from 4 to 5 m wide. The dam has a base 14 m and crest 1.86 m thick; at the bottom is a steel sluice pipe 36 in. in diameter with gate valve operated from the top of the dam. Two meters below the crest of the overflow is another sluiceway 1 m wide by 1.50 m high, controlled by a wood gate operated by rack and pinion. The crest of the overflow is 1.50 m above the floor of the canal and the entrance of the water to the canal is through a 1 by 1 m opening also controlled by a wood gate.

The dam is built of random rubble masonry, part of which is laid in cement mortar and part in hydraulic lime mortar, and is reinforced by having a large number of steel rails embedded at intervals through it. The water was diverted to one side at the bottom of the gorge, while the sluice pipe and valve were built into the other side and the water then turned through the pipe. This pipe was designed to pass about 5000 liters (175 cu. ft.) per second, while the normal flow of the river is but little over 3000 liters during the dry season. Unfortunately a number of out-of-season floods occurred while the work on the dam was yet low, sweeping out the coffer-dam and some of the permanent work each time; this caused considerable loss of time, as well as extra expense. Since its completion it has withstood some extraordinarily heavy floods.

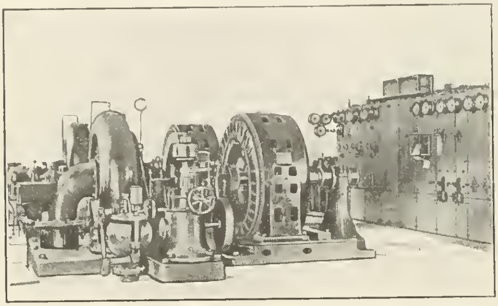


FIG. 6.—INTERIOR OF THE GENERATING STATION AT TEMASCALTEPEC.

The canal has a total length of 1170 m, of which 920 m is excavated in hard clay and 250 m is blasted out of the face of the cañon, the entire length being lined with masonry laid in hydraulic lime mortar. The cross section is a half hexagon, 1 m wide at the bottom, 2.13 m wide at the top and 1 m deep, with a slope of 1 in 300. Fifty meters below the intake is a sand trap (Fig. 3) 2 m deep, 2½ m wide by about 20 m long, discharging into the river through a sluiceway 1 m by 1 m, controlled by a wood gate.

At the lower end of the canal is a settling basin (Fig. 9) 60 m long, 20 m wide and 3 m deep, divided longitudinally into two chambers and so arranged that water may be passed through either side while the other is being cleaned or may flow through both at the same time. For the purpose of cleaning the chambers, there is a sluiceway (Fig. 9) built under them and communicating with them through openings controlled by gates. On the river side of the entrance to the basins is an overflow of sufficient capacity to discharge the full flow of water into the river in case of emergency. From the settling basin a pipe line 42 in. in diameter and 254 m in length carries the water down to the power house, the total difference of level between the surface of the water in the settling basin and surface of the tail race being 104 m (341 ft.). At the bottom the pipe expands into a 54-in. receiver (Fig. 11) from which four 20-in. branch pipes carry the water to as many turbines. There is also one 8-in. branch for the exciter unit and an 8-in. blow-off pipe. On top of the receiver are three 6-in. relief valves. The pipe is of "Lock Bar" type, manufactured by the East Jersey Pipe Company. It is made up of 25-ft. lengths, joined together with riveted flanges. The receiver is 7/16-in. thick, and the pipe is ⅜ in., 5/16 in. and ¼ in. thick, respectively, from bottom to top. An air relief is provided in the masonry at the top just below the head gate.

The power house (Fig. 5) is of masonry, with steel truss roof covered with corrugated iron. The main building is 30 m long, 9 m wide by 6 m high; a room 3 m by 9 m is partitioned off at one end for an exit for the 25,000-volt lines and for lightning arresters and high-potential cut-outs. A workshop, 8 m by 9 m, is built as an L to the main building.

In the machinery room are four Pelton-Francis turbines direct-coupled to Westinghouse 400-kw alternators, generating three-phase currents at 2200 volts and 60 cycles. These turbines are guaranteed to produce 750 hp at an efficiency of 80 per cent and 550 hp at an efficiency of 82 per cent when running at a speed of 900 r.p.m.; tests made after installing them gave somewhat better results than the guarantees. The units are controlled by oil-pressure governors with by-pass relief valves. The exciter units consist of two 40-kw, 125-volt, 690 r.p.m. generators, one Pelton impulse wheel of 90-hp capacity and a three-phase, 60-hp induction motor, so arranged that either or both generators may be operated by the waterwheel, one of them may be operated by the induction motor and the other may be belted to one of the main generators, thereby giving two separate sources of power to each exciter generator.

The switchboard consists of nine panels of Florentine marble; one panel controls the exciter machines, four are for the four generators, one is a totalizing panel, one a feeder panel with provision for four circuits at machine voltage and two are transformer panels for controlling the low-tension sides of the step-up transformers. All wires to and from the board are in lead-encased cables carried through ducts under the floor. As a good portion of the load will be taken at machine voltage, only three step-up transformers, each of 400-kw rating, are at present provided (Fig. 8); but space is provided for a fourth unit should it become necessary.

The transformers are located at one end of the main generator room; they are oil-insulated, water-cooled and step-up the voltage from 2200 to 25,000 volts and will be connected either two in V or three in delta according to the demand for power over the high-voltage lines. The high-voltage leads of the transformers are connected through circuit-breakers to busbars mounted on the wall dividing the main room from the lightning-arrester room. On the opposite side of this wall, in the lightning-arrester room, are other busbars from which the outgoing circuits are controlled by circuit-breakers. The busbars on the two sides of the wall are interconnected by wires passing through 24-in. circular openings in the wall. Westinghouse low-equivalent lightning arresters and choke coils are connected to each outgoing wire through disconnecting switches. From the lightning-arrester room the line wires pass out through 24-in. openings in the end wall of the building, being secured on the outside to heavy-strain insulators mounted on brackets.

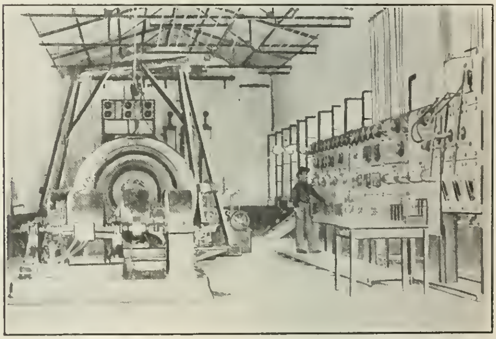


FIG. 7.—GENERATING STATION AT SAN SIMONITO.

Water for cooling the transformers is pumped from a well to a tank located just above the power house and from this tank to the transformers by gravity, or it can be taken directly from the pipe line. A 3-in. oil pipe runs from the bottom of each transformer case through the floor to a tank in the tail-race tunnel so that in case of fire in one of these transformers the oil can be quickly emptied. A 5-ton traveling crane is mounted in the main room, which can be used for handling any machine or transformer.

The transmission line to Sultepec (Fig. 12) is 24 km long. Steel poles 35 ft. in length, of the Franklin Rolling Mill Company's tripartite type, are spaced 70 m apart. The cross-arms are of native oak, dried and immersed for five minutes in hot chapapote. The three wires of each circuit are arranged in an equilateral triangle, 70 cm apart, one circuit on each side of the pole, on two cross-arms. One circuit is transposed twice between Temascaltepec and Sultepec, making a complete turn; the other circuit goes through without transposition. No. 1 Provo type glass insulators are used, mounted on locust pins which have been boiled in oil. Two meters below the transmission wires telephone wires are placed on two-pin cross arms, the wires being transposed on every fifth pole. Lightning arresters are placed on each wire entering the Sultepec substation and additional lightning protection is provided in a galvanized wire cable, ⅜-in. diameter, running along and grounded to the pole tops in those places where the line passes over high ridges, the wire being carried down each side of the ridge to where its ends can be buried in permanently wet earth.

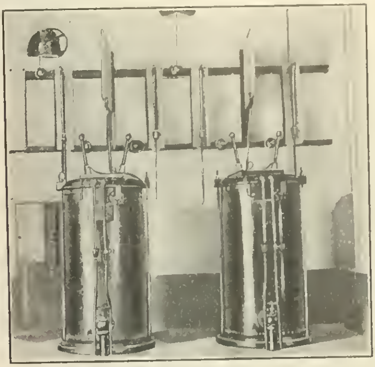


FIG. 8.—STEP-UP TRANSFORMERS AND CIRCUIT BREAKERS.

At Sultepec a substation has been erected for stepping the voltages down to 2200 volts for distribution to the mines in that vicinity. The 25,000-volt line will later be continued to Zacualpam, about 25 km from Sultepec. At present the Sultepec substation is equipped with two 200-kw step-down transformers of the same type as the 400-kw transformers at the power plant, being connected in V on the three-phase busbars which can be connected to either or both of the incoming circuits. Water for cooling these transformers is brought by gravity from a large spring nearby. Provision is made in the station for installing more transformers as the demand for electricity may require.

The machinery had to be carted over a mountain trail for a distance of 27 miles, passing over a ridge of over 11,000 ft. elevation, and from there dropping to an elevation of about 5000 ft. within 20 miles. Some of the poles had to be carried 10 to 12 miles by peons over trails impossible to carts.

A line is now under construction from Temascaltepec to Toluca, a distance of 60 km, at which place it will connect with the lines of the Toluca Electric Light & Power Company. This line will be a single three-wire circuit of No. 4 copper supported on the same kind of poles as those on the Sultepec line. On the west end of this line there are many deep but narrow barrancas which are crossed by spans of from 300 to 400 m, supported at each end on two poles placed about 3 m apart with double cross-arms between them supporting heavy strain insulators of porcelain.

The construction of the power plant was in charge of an American engineer, but the labor was practically all performed by Mexican peons, who are experts in the kind of masonry work used.

TOLUCA ELECTRIC LIGHT & POWER COMPANY'S STATION.

The Toluca Electric Light & Power Company's power plant, now owned by the Sultepec Company, is located at San Simonito, a small village 37 km southeast from Toluca. The river has its source in a large spring 6 km above the power house and is utilized by two other developments, one of 65 m and the other 105 m head, before it reaches the dam of the company. The dam is of rubble masonry laid in cement and is 3 m high, 2½ m thick at the bottom and 1½ m at the top; it rests on solid rock. The overflow sill is 18 m long. Three meters above and parallel with the dam, in front of the head gate, is a deflecting wall to protect the head and sluice gates from floods. During the rainy season, June to October, floods are of frequent occurrence, coming suddenly and with great violence, carrying an immense amount of mud, sand, boulder and trees. The canal is 1 km long, 1 m deep and 1½ m wide, with a total fall of 1 m. It is excavated in a hard, tough clay and is not masonry lined. There is a sand trap 200 m below the head gates and another 300 m below. One barranca 10 m wide and 8 m deep is crossed with a three-arch masonry flume, and another barranca, 8 m wide, is crossed with a single-arch masonry flume.

FIGS. 9 AND 10.—SETTLING TANK AND RESERVOIR AT HEAD OF PIPE LINE.

The canal discharges into a reservoir 20 m wide, 200 m long and 3 m deep, holding about a 4-hours' supply of water; it has two sluiceways for washing out the mud, which collects very rapidly in the rainy season. From the reservoir the water is conducted to the power house through a 28-in. riveted steel pipe, 675 m long, and with a total drop of 220 m (721.6 ft.). The minimum flow of water in the dry season is 750 liters per second.

The generating station (Fig. 7) is built of masonry with steel truss roof, covered with corrugated iron. It covers an area 8 m by 20 m, and is 6 m high. There are three Stanley inductor-type generators of 300-kw nominal rating, generating three-phase currents at 60 cycles and 6600 volts, the speed being 360 r.p.m. To each generator is direct coupled a Pelton impulse wheel, governed by Replogle relay governors, which deflect the water with a cut-off hood. Exciting current is supplied from a G. E. 40-kw, 56-volt generator driven by a small Pelton wheel with hand regulation, there being two such generators, each with its own wheel. The circuits are controlled from a seven-panel marble switchboard equipped with Stanley hot-wire ammeters and voltmeters, indicating wattmeters and Bristol recording voltmeter. One circuit is taken at machine voltage to Tenancingo, 5 km, where it is received by two Stanley oil-insulated, water-cooled transformers, each of 150-kw rating. These transformers were intended for three-phase to two-phase connection at 2200 volts, but because there were no two-phase motors carried in stock in Mexico, it was decided to connect them in V, giving a three-phase 2200-volt circuit. There are also two General Electric 25-light series-arc transformers for feeding the lamps which light the streets of the town.

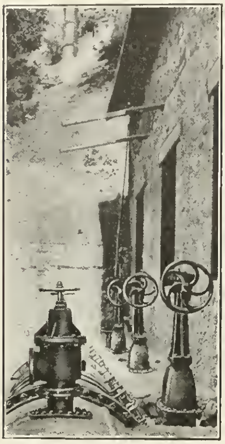


FIG. 11.—PIPE LINE IN REAR OF STATION.

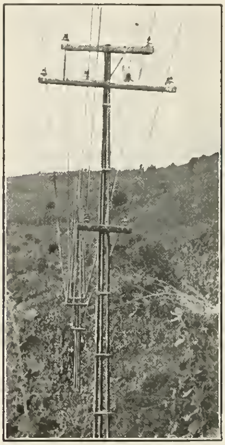


FIG. 12.—VIEW ALONG TRANSMISSION LINE.

The transmission line to Tenancingo was originally of native pine poles, but as the life of these poles is not over a year, iron tubular poles are used, one wire on top and the other two on a wood cross-arm, the side of the triangle formed by the pine being 24 in. long. For the line to Toluca three 250-kw Stanley oil-insulated, water-cooled transformers are used, stepping up the potential to 27,500 volts. This line was also originally of native pine poles, but Franklin tripartite steel poles have been substituted in their stead. One three-wire circuit of No. 6 round copper wire is used. At Tenango, half way between San Simonito and Toluca, the line passes through a substation where it can be cut by an oil-break switch for testing. At this station is a General Electric oil-cooled, three-phase, 75-kw transformer, reducing the voltage to 2300 volts for local distribution; also two General Electric 35-light series-arc transformers which furnish energy for street lighting in Tenango and Calimaya, 6 km farther along the main line. A 2300-volt circuit is also carried to Calimaya and other small towns nearby for incandescent lighting and for operating small motors.

At Toluca the lines enter a substation containing three General Electric 200-kw and three 50-kw transformers stepping down to 2300 volts. Both the primary and the secondary circuits are controlled by hand-operated, oil-break switches. There are also three General Electric 25-light series-arc transformers, two of which are for street-lamp circuits and one for lighting a brewery, which also gets its energy for motors from the company. Besides the 50 General Electric arc lamps there are 60 arc lamps of German make, operating 30 in series on a 2300-volt constant-potential circuit. Energy for motors is also furnished to a large cotton mill and numerous small industries and a 2300-volt circuit runs to several nearby towns and ranches for supplying energy to lamps and motors. Lightning protection is furnished at the power plant by a set of Westinghouse low-equivalent arresters on the 27,500-volt line, and General Electric arresters on both ends of the 6600-volt line. There are also General Electric arresters on the 27,000-volt line in the substation at Toluca and Tenango and in two intermediate arrester houses between Tenango and San Simonito.

The line to Toluca was originally equipped with porcelain insulators, but after the steel poles were erected there were frequent interruptions during the stormy season caused by punctured insulators. The porcelain insulators have now all been replaced with No. 1 Provo type glass insulators, and the interruptions from line troubles have been almost completely eliminated. The Toluca plant has now been in operation five years, and although fully loaded has a constant demand for more energy. A call from the brewery for an additional 300 hp prompted the company to build a line from its power plant at Temascaltepec to Toluca, which it is now doing, and it will install in the Toluca substation three 220-kw General Electric transformers. The circuits will be so arranged that any set of transformers may be connected to either set of high-tension wires, and the distributing circuits will have double-throw switches so that any circuit may be fed from either set of low-tension busbars.

Toluca, capital of the State of Mexico, is located on the Mexican National Railroad, 73 km west of Mexico City, at an elevation of 8700 ft. It is the central point of an immense fertile valley, which is thickly populated and highly cultivated. The climate is mild the year 'round, being somewhat cooler than that of Mexico City. It was founded in the year 1120 by the Aztecs and now has a population of about 30,000. In Toluca is one of the largest breweries of Mexico, a cotton mill, flour mill and many smaller industries, all of which are using electric energy for driving motors, and have entirely abandoned their steam plants.

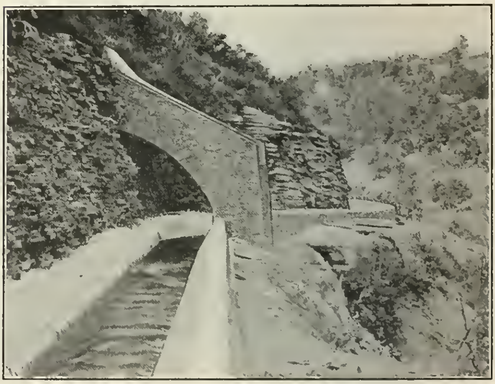


FIG. 13.—AQUEDUCT FOR PASSING SURFACE WATER OVER THE CANAL.

The officers of the company are as follows: Mr. Henry Seibert, president; Mr. Timothy S. Williams, vice-president; Mr. R. J. M. Danley, second vice-president and general manager, Toluca, Mexico; Mr. Clinton L. Rossiter, secretary and treasurer. The directorate includes Messrs. Henry Seibert, Clinton L. Rossiter, German Roth, David H. Valentine, Timothy S. Williams, John Englis, Seth L. Keeney, Frederick S. Flower and J. L. Greatsinger.

Present Status of the Lightning Problem.

By Percy H. Thomas.

Every year there is something added to the general sum of knowledge on the relation of lightning to the electric-power system. Sometimes it is a record of actual experience at a plant, sometimes a new laboratory investigation, or, occasionally, prearranged tests on a full-sized commercial system. Once in a while, once in a long while, it is a new theoretical or mathematical discussion of importance. This gradual accumulation of information has finally produced a relatively satisfactory and definite knowledge of the nature of this lightning arrester problem, although the best practical solution of a particular case is still often difficult. A periodical résumé and unification of the accumulated results is desirable. It is the purpose of the present article to make such a résumé. According to the writer's views, the ordinary action of lightning on an electric system is somewhat as follows:

For some reason, not necessary here to determine, the upper atmosphere is charged with positive electricity. This fact has been determined by actual measurement. For each element of positive electricity above in the air there is, of course, on the surface of the earth a corresponding element of negative electricity. These two attract each other as do other unlike charges of electricity and ultimately come together. These negative charges are presumably collections of ions, so much discussed at the present time in connection with radio-active substances and ionized gases. Such ions when free in the atmosphere collect about them molecules of air and dust, or, when such are available, probably accumulate as an electric charge on the small drops of water suspended in the clouds. At any rate, strong electric charges are scattered through the upper atmosphere and are constantly settling downward.

They are drawn downward in virtue of their attraction for the corresponding charges on the surface of the earth and by gravity, but are restrained by the resistance of the atmosphere. These ions are free to move about in the air, carried by whatever "aggregates" of molecules they may have collected or by drops of water in which they may have accumulated. But they move through the atmosphere only slowly, on account of its great resistance to their motion. They are also carried bodily about by the ever-present air currents.

In virtue of their mutual repulsion the ions tend further to become uniformly distributed throughout the whole space. Due to other more powerful forces, however, they become concentrated in certain regions, as they settle lower toward the earth. When the electric strain gets too great between such a region and a relatively uncharged region near by, a discharge will occur between them and a flash between clouds will be observed from the earth.

There is in addition to the two ways already mentioned by which the ions can move, namely, by passing bodily through the air or by being carried bodily with it, a third method—by a direct electrical discharge, the well-known lightning. The latter, of course, occurs only when the charges have become tremendously concentrated and relatively near the earth. Thus there exists here a novel condition of electric charge; not on a conductor and yet free to move, at least slowly, in obedience to the various forces acting upon it. This is the reason that such enormous accumulations of energy and potential may occur.

When the process of settling toward the earth and concentration of charge with its enormous resulting rise or potential has progressed for some time, there is formed a highly charged layer of water vapor at a relatively low altitude above the earth which balances a similar charge on the earth's surface. Conditions are then ready for the last stage, the lightning strokes proper. These occur, of course, when the potential between two points either in the clouds or between the cloud and earth becomes greater than the disruptive strength of the air between them can support.

In the usual case, when a storm follows a hot day, it is probable that the layer or strata of hot air formed by the rising air heated by contact with the surface of the earth, is overlaid by a heavier layer of cold air that has not been in contact with the hot earth, much in the way that a layer of oil may for the moment be made to support a layer of water on top. In this case the electric charges would be in the bottom of the cold layer. This is a condition of unstable equilibrium, as in the case of the water and the oil, and when the condition has become too topheavy, the cold air breaks through at some point and an overturn takes place. This brings the heavy charges into proximity with the earth and violent discharges of electricity suddenly occur, accompanied by the appearance of cold air and sudden gusts of wind. This overturning process once started in one place will proceed, producing like effects in other localities.

To return now to the charges which have finally worked downward into close proximity to the earth's surface. As any one highly charged region approaches near enough to the earth, a disruptive discharge passes to the nearest grounded object and neutralizes the charge on the earth's surface corresponding to the charge of this particular region. This region of air which thus discharges itself may be large or small and will produce a correspondingly large or small flow of electricity and of energy. When the region is very intensely charged, the discharge will probably spread through a much larger region of the air than when the concentration is relatively low. The discharge may even be only a brush discharge. The large discharges coming, perhaps, from regions thousands of feet or more in extent, do tremendous damage, while the smaller, relieving possibly not more than a hundred feet of air space, leave almost no trace on trees and lightning rods, the usual paths of lightning discharges. Frequently only a small strip of bark will be thrown off a tree trunk, as is often observed, as a matter of fact. In the discharge of the atmosphere by a thunder storm, there are probably very many of these small discharges for every one of the extremely heavy ones. Thus during the storm a large part of the charges of the air in a given region are gradually either discharged to earth or are swept away.

As a usual thing electric lines are not particularly exposed to the action of the descending charges and do not thus receive directly many of the discharges. These lines are lower than many trees and buildings and cover only a very small portion of the actual surface of a given region. They do, however, receive some and certain plants many more than others. The relatively extreme sensitiveness of the electric system to high-tension disturbances, however, renders the comparatively few and relatively light discharges actually received a most serious matter.

Wurts and others long ago called attention to the fact that an electric line could be disturbed without a direct discharge, through the slow accumulation of a charge on the line by leakage, in response to static induction from a charged cloud in the neighborhood and the abrupt lease of this charge by the discharge of the cloud. This action, of course, actually must take place, but it seems to the writer that it is probably not severe enough to do much damage, except perhaps in the case of a relatively small cloud very near the line. This conclusion is indicated by actual experience with transmission lines, in which, as a matter of fact, the disturbances are nearly always confined to a very definite and limited area, except, of course, for the subsequent resulting wave of charge sent along the line.

It has always been a mystery how such very long flashes of lightning as have been frequently recorded in photographs can be produced. Their length would sometimes seem to require almost unimaginable voltages, judging by the values of voltage discharge distances established in the laboratory. If the hypothesis of the accumulation of ions here put forward is correct, however, the difficulty is much reduced on account of the well-known action of the presence of ions in reducing discharge voltages in gases. It is now pretty generally agreed that current flows in an arc which has once been established, at least partly, through the agency of the ions or electrons liberated by the actual current and that the difficulty of getting the current through the air initially is due to the absence of such free electrons. Under the influence of relatively very low voltages in the arctual arc, the free electrons have the property of liberating others, and thus continuing the passage current, when once started. Now the presence of large qualities of ions in the atmosphere acts to a greater or less extent like the previous establishing of an arc and would thus greatly reduce the voltage necessary to produce a discharge; possibly to something like that ordinarily found sufficient to maintain an arc already started. On this basis 2,000,000 volts might in an extreme case start a discharge 1000 ft. long. This potential is not at all hard to accept. In bringing forward this suggestion the writer does not wish to distract attention from the generally accepted hypothesis that the length of the longest discharges is greatly extended by the step-by-step process. That is, a discharge to one region makes possible an immediate discharge to another, and so on.

To distinguish them from the induced effects, these atmospheric discharges striking a line or other object are called direct strokes. Their salient characteristic is the enormous concentration of charge they produce at a particular point of the system. Since these discharges must be from exceedingly high potential and through a path having relatively little inductance, they must be extremely sudden or abrupt; this is well known to be the actual case. It is known also both from theory and observation that such sudden discharges cannot be completely discharged through a ground connection of even a few yards in length, in view of its impedance, but the point of application must experience for an extremely brief instant of time the full strain in spite of such a ground connection. This means that absolute protection for the line itself cannot be obtained from lightning arresters unless they are placed at least every few poles, which is ordinarily out of the question. In other words, the discharge insists in taking the most direct path to earth. This much is established practically beyond controversy. This does not mean, however, that no strain at all is produced on the rest of the line, for a wave of charge is started in both directions along the line by each discharge. This wave starts at the potential reached by that point of the line where the discharge strikes. Fortunately, the wave is of much less energy than the original discharge on account of the limited static capacity of the line itself and of the limited voltage that can be withheld by the insulation of the line. These waves travel until they reach an arrester or other opportunity to discharge; their energy grows less and less as they proceed. This action may be likened to the formation of a wave in a long, narrow trough with high sides containing water and normally less than half full, by sudden flooding of the trough by a large quantity of water at some particular point; the excess water spills over and escapes from the trough at the point of the flood, but there is still a wave started in each direction as high as the sides of the trough will permit; this passes along until the end is reached or the energy of the wave is gradually dissipated. It makes no difference how much water is thrown into the trough, there can be a wave only as high as the sides will permit.

These traveling electric waves often reach a station and there will ordinarily be discharged without damage by the lightning arresters, if these are of proper design and the insulation of the apparatus is adequate. It is only in virtue of the relatively small energy of the wave, however, that the arrester, if it be a non-arcing type, can freely discharge the line. There has as yet not been produced an arrester capable of protecting apparatus against a direct stroke or a stroke in the immediate neighborhood.

The important characteristics of discharges of lightning in electric circuits are therefore as follows:

Concentration.—The discharge occurs at a very distinct location and is largely confined to the immediate neighborhood of this location, at least in the great majority of cases. Such extreme manifestations as the destruction of insulators, due to a single discharge, are rarely found over a distance greater than a mile in extent, usually much less. From this fact it may be concluded that practically no relief *for the line* is obtained from arresters at the stations.

Irresistible Character.—Many of the discharges are so severe that it is out of the question to insulate the line so heavily as to resist them. They must be expected to get to ground in the immediate neighborhood of where they strike. The higher the insulation of the line the more severe the waves that will travel along the line.

Abruptness.—The discharges are so sudden as to find a very high impedance in a short length of line and to form freely waves of static of relatively short length.

Wave Forming Power.—This has already been mentioned and is well understood.

Irregularity as to Location.—Ordinarily discharges may occur at almost any point, though they are much more frequent in some localities than in others.

From these characteristics may be drawn some inferences as to the protection of electric systems:

1. The best arresters should always be used to protect the circuits at all stations, as these circuits will be subjected to frequent waves of static from more or less distant disturbances, which waves can be handled with safety and without inconvenience by such arresters.

2. Where experience shows that particular locations are especially subject to discharges, as is often the case, unusual precautions can be taken to protect this portion of the system, as by additional arresters, overhead ground wires, etc., without entailing the prohibitive expense that would be required to protect the whole line as carefully.

3. In the protection of high-tension transmission lines, especially with the type of construction using grounded pin, the conditions are difficult. In the first place the discharges that must be expected occasionally to get to earth on account of their severity will often establish a short circuit on the system, which is much facilitated by the grounding of the pins, and either cause a shut down or great inconvenience. As the lines get longer and more widely spread, this result will occur oftener and oftener. If the strength of the insulators is made greater, then the discharge will be thrown with greater force into the traveling waves and thus be more dangerous to the stations. This latter condition of extreme wave intensity can be met by placing line arresters at points relatively close to the stations, to give a free discharge to these waves before they actually reach the station apparatus. This has not often been done, but will probably be found desirable more often in the future. One difficulty is the securing of a reliable line arrester that will discharge freely and yet cause no disturbance of the system and give no trouble when not under supervision.

Next to absolutely shielding the line from discharges altogether, the best solution, if any successful means can be found, is to permit the discharges to go to earth, wherever they may strike, but in such a manner as not to injure the insulator (that is presumably over its surface or through a separate gap) and to be so controlled as not to establish a short circuit. This would require some circuit opening apparatus for each discharge.

The method of protection of perhaps the most promise at the present time is the overhead ground wire. Of course, if a wire or wires is provided above the transmission lines which will first receive all the discharges and conduct them safely to ground, the whole problem is solved. The ground wire in its most successful form should theoretically accomplish this result. But it must not be assumed that a single wire put up in the most convenient manner and grounded here and there will accomplish this result. The matter is not so simple. The ground wire, or more probably the ground wires, must be so placed that they will receive ALL the discharges and will then conduct them to ground *without disturbing* the *lines themselves.* It must be remembered that the line voltage, as far as it is able, will tend to draw the discharge to itself away from the ground wire during negative voltage alternations, since the line potential is then added to the discharging potential. Also that the discharge from the air may come from any direction; it usually will not come straight downward, since there is almost always some horizontal motion of the air in a storm period, and this will cause the charged region to approach from the side. Thus, it is not an easy matter to make a single ground wire take discharges. A single ground wire may do much to relieve the strain, but a much more certain arrangement will be two ground wires, one on each side of the line, to catch the discharges as charged regions approach from either direction. These wires should be well spaced from the line wires, and should be earthed as often as possible. The same condition which prevents a discharged wire from being relieved by an arrester at even a little distance, will prevent a ground, wire from being effective, if the discharge has to pass more than a very short distance to reach the earth. The discharge will choose to jump to a transmission wire or to ground over some ungrounded pole, perhaps splintering it. It would seem to the writer that the only really safe plan would be to ground the wires at every pole. It is further necessary to carry the ground wires and the ground connections themselves well spaced from the transmission wires to avoid the side jumping of heavy discharges, for which there is a very strong tendency.

In cases where so elaborate a system of ground wires is not deemed warranted for the whole system, the line for a few miles from each station can be so equipped to great advantage, for thus will the station apparatus be amply protected from all discharges, even heavy ones, in its immediate neighborhood, while more distant disturbances can only send waves of static which can be handled by station arresters.

4. On low tension systems, especially distribution systems, conditions work out somewhat differently. Here the insulation of the line relatively to that of the apparatus is strong and the waves of static that are produced by discharges on the lines are, relatively, much more severe on the apparatus than in the high-tension plants. Further, the waves do not usually have so far to travel and hence do not lose so much of their energy. Thus a very good margin of insulation is required in the station apparatus, and arresters should be placed at frequent intervals and especially at all avenues of approach to any locations especially subject to lightning disturbance. Fortunately, low-tension lines are usually very much less exposed than high tension, and low-tension arresters are rather more effective.

Nothing has so far been said of the static discharges that may arise within the system itself. These are of the general order of magnitude of the waves of static produced in lines by lightning discharges, only of less severity and in a well insulated and properly laid out plant will be cared for by the station arresters.

The protection of cable systems, which form a problem of a somewhat different character, has not been here considered.

As regards the best form of protective apparatus, conditions vary greatly in different plants and no general specifications can be laid down to be followed explicitly for all cases. There will be, however, in each case where satisfactory protection has not been secured, some relatively few steps to take to strengthen the protection, in general in more or less accord with the principles here laid down. In some cases better spacing and insulating of circuits will be required, in others perhaps an insulator having a greater discharge voltage. Another case may require an arrester with a better non-arcing power, and another a freer discharge to ground. The installation of an additional ground wire may be very helpful in many cases while in others it might be of little service. Critical trouble will often be found to be due to some defect in the insulation or supervision of the protective apparatus and not to the general plan of protection. This is usually easily remedied. Usually the best guide to the proper method of strengthening of a plant's lightning protection will be through a study of its previous experience. Consequently good records of all trouble should be always kept.

The object of this short article is to summarize and co-ordinate the conclusions to be drawn from the experience of operating engineers, the experiments of investigators and the deductions of the theorists interested in the solution of the problem of the protection of electric systems from lightning disturbances and more particularly to point out the fact that there now remains comparatively little uncertainty or mystery as to the nature of the lightning problem and that engineering experience and judgment may and should be used in the laying out of protective apparatus in exactly the same way as with other engineering problems.

Standardization Rules for Stationary Direct-Current Machinery in France, Germany, Great Britain and the United States.

By A. E. Kennelly.

THERE are various sets of standardization rules relating to electrical machinery, which have been drawn up and introduced in different countries. A set of such rules was adopted in the United States, in 1899, by the American Institute of Electrical Engineers.[1] This set was revised and extended in 1902[2] and again in 1907.[3]

Another set was adopted in Germany by the Verband Deutscher Elektrotechniker at its Dresden convention in 1901, and revised in 1902 and 1903. This set has been published in book form in Germany[4] as recently as 1908, and a translation of it has been published in France.[5]

A third set was adopted in France, in 1904, by L'Association Alsacienne de Propriétaires d'Appareils à Vapeur, entitled "Regles pour les Offres, la Fourniture et les Essais des Machines Electriques et Transformateurs" prepared by the French Association of Owners of Steam Plants with Electric Service (Amiens, Lyon, Marseilles, Nancy); the Association of Manufacturing Industries of Northern France (Lille), and the Norman Association for the Prevention of Industrial Accidents[6] (Rouen). This set was revised in 1906.

A fourth set was adopted in France in 1905 by "Le Syndicat Professionel des Industries Electriques" at Paris and entitled "Instructions Générales pour la Fourniture et la Réception des Machines et Transformateurs Electriques."

A fifth set was issued in Great Britain, in 1907, by the Engineering Standards Committee, supported by the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architests, the Iron and Steel Institute and the Institution of Electrical Engineers. It is entitled "Report on British Standards for Electrical Machinery."

It was in view of the growing divergence between the standardization rules for electrical machinery in different countries that the chamber of delegates of the International Electrical Congress of St. Louis, in 1904, adopted the resolution "that steps should be taken to secure the co-operation of the technical societies of the world, by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery."[7] The International Electrotechnical Commission has since been formed, and has held its first meeting, in London, in 1906. At that meeting a preliminary organization was adopted, but no discussion of standardization rules was reached. It is hoped that this international electrotechnical commission may accomplish results that will be of benefit to the cause of international electrical engineering.

In order to compare, in outline, the provisions of the standardization rules thus far adopted in France, Germany, Great Britain and the United States, the writer has drawn up the accompanying table. In order to keep the table within reasonable compass, only stationary direct-current machines have been included. Stationary direct-current generators and motors are, perhaps, the simplest machines to compare and to bring to a common basis of standardization, if only for the reason that the difficulty of diversity in alternating-current frequencies is avoided.

Column I in the table describes the property or qualification for the machines under consideration. Column II gives an abstract of the French rule in the set adopted by the S. P. I. E.

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[1] Report of Committee on Standardization. Trans. A. I. E. E., Vol XVI, p. 255, June, 1899.
[2] Report of Committee on Standardization. Trans. A. I. E. E., Vol XIX, p. 1075, June, 1902.
[3] Report of Committee on Standardization. Trans. A. I. E. E., Vol XXVI, p. 1076, June, 1907.
[4] *Normalien fur Bewertung und Prüfung von Elektrischen Maschinen und Transformatoren. Herausgegeben vom Verband Deutscher Elektrotechniker.* J. Springer, Berlin, 1908.
[5] *Règles Normales de l'Association des Electriciens Allemands pour la Comparison et l'essai des Machines et Transformateurs Electriques,* traduit par Loppé et Thouvenot, Paris, 1906.
[6] *Eclairage Electrique.* Vol. 41, 1904, pp. 470 and 518.
[7] *Trans.* Int. Elect Congress of St. Louis, Vol. I, p. 46.

Comparative Analysis of Standardization Rules, in Different Countries, for the Rating of Stationary Direct-Current Generators and Motors.

	FRANCE (S. P. I. E.)	GERMANY (V. D. E.)	GREAT BRITAIN (E. S. C.)	UNITED STATES (A. I. E. E.)
1. Name plate on machine.	Called for, and required to state the power which the machine is to furnish, for generators in kw., for motors in hp. of 75 or poncelets of 100 kgm. per sec.	Called for, and required to state the power of the machine, the speed, current, terminal voltage and type of service.	Called for and required to state for generators. KW. output, volts, amp., r.p.m. Motors: Brake-hp. volts, amp., r.p.m.	Recommended. Should state maker's name, the voltage and the current. Where practicable, the kilowatt rating, speed, type, designation and serial number should be added.
2. Types of service recognized.	(1) Continuous. (2) Intermittent.	(1) Continuous. (2) Intermittent { For long periods. For short periods.	(1) Continuous (excluding, however, machines working from week end to week end without stop). (2) Intermittent.	Continuous.
QUALIFICATIONS UNDER RATED LOAD. 3. Commutation.	Brushes of generators should be kept in fixed positions without sparking under rated load.	Should operate for at least 24 hours without requiring treatment of the commutator.	The wearing depth of a commutator, or the radial depth by which the commutator may be reduced before requiring renewal, to be ⅜ in. for commutators up to 4 in. in diam., ½ in. for 4-6 in. diam., ⅝ in. for 6-9 in. diam., ¾ in. for 9-12 in. diam., 1 in. for 12-18 in. diam., 1¼ in. for 18-24 in. diam., 1½ in. above 24 in.	
4. Regulation of voltage in generators.		At rated load excitation and at constant speed, the terminal voltages should be observed at four equidistant loads from no load to rated load. The maximum difference between these voltages is the drop in terminal pressure, the brushes being adjusted according to need.		To be measured by the ratio of the maximum variation of terminal voltages from the normal régime between no load and rated load, to the normal rated load voltage.
5. Regulation of speed in motors.	Speed variation to be measured when passing from rated load to no load under constant terminal voltage.		Speeds required for standard motors at rated load and with 220 volts up to 2-brake-hp and 440 volts above that size Brake hp. R.p.m. | Brake hp. R.p.m. ¼ .... 1600 | 15 .... 850 ½ .... 1400 | 20 .... 800 1 .... 1400 | 30 .... 750 2 .... 1100 | 40 .... 700 3 .... 1100 | 50 .... 650 5 .... 1000 | 75 .... 600 7½ .... 1000 | 100 .... 550 10 900	To be measured by the ratio of the maximum variation in speed from the normal régime between no load and rated load, to the normal speed at rated load.
DIELECTRIC STRENGTH. 6. Test made.	Only on acceptance of machine and with the machine either hot or cold.	At factory, or, with large machines, in the plant before being placed in service, at normal temperature of operation.		With the completely assembled machine, before being put in commercial service, at temperature of normal operation.
7. Testing voltage.	Double normal pressure up to 3000 volts of normal terminal pressure; but with not less than 500 volts. Testing voltage to be alternating.	Double normal pressure up to 5000 volts of normal terminal pressure; but with not less than 100 volts. Testing voltage, direct. If the testing voltage is alternating, the maximum cyclic value is to be double the normal pressure, as above; so that the effective value of the testing voltage will be 1.41 times the normal terminal pressure of the machine under test.		Rated terminal voltage. | Rated output. | Testing a.c.-voltage effective. Not exceeding 400...... | Under 10 kw | 1000 Not exceeding 400...... | Over " | 1500 400 and over; less than 800 .... | Under 10 kw | 1500 400 and over; less than 800 .... | Any | 2000 800 and over; less than 1200 .... | Any | 3500 1200 and over; less than 2500 .... | Any | 5000
8. Points of application.	Between the windings and the frame as well as between the different windings.	Between each winding and all the others as well as the frame, successively.		Successively between each electric circuit and all other electric circuits, including the conducting material in the apparatus.
9. Time of application.	Two minutes.	Thirty minutes.		One minute
10. INSULATION RESISTANCE.		Measurement not considered as useful.		Measurement of secondary importance only. Should be such that the leakage current under rated voltage shall not exceed 1/1,000,000 of the rated load current; 1 megohm usually sufficient.
HEATING. 11. Duration of test.	kw. r.p.m. | Time in hours. 0-10 | 2 10-30 | 3 30-100 | 4 100-200 | 5 200-300 | 6 300-500 | 7 500-700 | 8 700-1000 | 9 Over 1000 | 10 For machines of intermittent service, half of the time thus specified.	For machines of brief period service, for the time stated on the name-plate. For machines of intermittent service, for one hour. For machines in continuous service, 10 hours' continuous run, except in cases of small machines, when a shorter period may suffice.	Six hours for continuous working machines. One hour for intermittent working machines.	Sufficiently long run to enable apparatus to reach practically constant temperature. This period may be reduced by commencing with overload current. For machines of intermittent service a period corresponding as nearly as possible to conditions of service.
12. Standard temperature of surrounding air.	35° C.	35° C.	Not to exceed 25° C. (77° F.) in actual service.	25° C.

13. Correction for deviation of temperature from standard.			If the air-temperature of the room in which machine is to be used be t° and may exceed 25° C., then the temperature elevations allowed are to be reduced by (t — 25°).	Observed temperature rise to be reduced by $\frac{t-25}{2}$ in per cent, if t be the actual room temperature.
14. Correction for change of temperature during test.	Mean temperature of surrounding air during last quarter of test.	Mean temperature of surrounding air during last quarter of test.		
15. Standard barometric pressure.				760 mm. of mercury.
16. Correction for deviation of pressure from standard.				Observed temperature rise to be reduced by $\frac{760-p}{10}$ in per cent, if p is a barometric pressure materially differing from 760 mm.
17. Mode of measuring temperature rise.	By thermometer on hottest parts of machine.	All parts of machines, except exciting windings carrying direct-current and stationary windings, by thermometers, allowed to reach their maxima. All direct-current exciting windings and stationary windings by increase of resistance.	Windings by resistance whenever practicable. When not practicable, by applied thermometer or thermocouple. Commutators, brushes, bearings, etc., by thermometer.	In electric conductors, by increase of resistance when possible. When a thermometer indicates a higher rise of temperature than the change of resistance, the thermometer reading is to be accepted. Parts of machines other than windings, by thermometer.
18. Temperature coefficient of resistivity in copper.		0.4 per cent per deg. C., from room temperature, when not specially determined.	0.42 per cent per degree C. from and at 0° C.	0.42 per cent per degree C. from and at 0° C.
19. Limiting permissible elevation of temperature.	Field magnet winding.............. 45°C Other direct current circuits........ 45°C Short-circuited windings .... 60°C Commutators .... 55°C Iron parts containing windings...... 60°C Bearings .... 40°C Commutating machines to operate night and day 5°C less than the above in all parts.	Rotating windings insulated with cotton .... 50°C Rotating windings insulated with paper .... 60°C Rotating windings insulated with mica 80°C Stationary windings insulated with cotton .... 60°C Stationary windings insulated with paper .... 70°C Stationary windings insulated with mica .... 90°C	For machines in which the insulating materials are of cotton, paper, linen, micanite or the like: Stationary coils, by resistance....... 60°C Moving coils, by resistance.......... 60°C Moving coils, if by thermometer or thermocouple .... 50°C For machines in which special insulating materials are used, designed to resist high temperatures, special extra temperature elevations may be allowed.	Field and armature................ 50°C Commutator and brushes, by thermometer .... 55°C Bearings and other parts of machine, by thermometer.................. 40°C Large machines with considerable overload rating, somewhat less than the above.
EFFICIENCY. 20. Methods of measurement.	By measurement of losses when measurement by input-output tests is inapplicable.	(1) Direct electric method or motor-generator input-output method. (2) Indirect electric method or motor-generator method, with measurement of losses. (3) Method of mechanical brake, applicable to small machines. (4) Method of electrical brake. (5) Method of losses without auxiliary motor. (6) Method of losses with auxiliary motor. (7) Method of engine indicator diagram for direct-coupled steam-driven generators.		(1) By input-output measurements. (2) By measurement of losses. (The former is usually applicable only to small machines.)
21. Enumeration of losses.	MECHANICAL LOSSES. (1) Bearing friction and windage. (2) Brush friction. ELECTRICAL LOSSES. (1) Hysteresis and eddy currents. (2) Joulean losses in windings. (3) Brush contact losses. The losses of auxiliary parts such as rheostat, exciter, ventilators and circulation pumps to be included. The efficiency may be determined both with and without auxiliaries.	(1) Windage. (2) Bearing friction. (3) Brush friction. (4) Hysteresis. (5) Eddy currents. (6) Copper losses. (7) Brush contact losses. Losses of power in belts to be excluded.		(1) Bearing-friction and windage. (2) Molecular magnetic friction and eddy currents. (3) Armature-resistance losses. (4) Commutator-brush friction. (5) Brush and brush-contact resistance. (6) Field excitation loss. (7) Load losses. Loss of power in belts excluded. In direct-driven generators inseparable from their prime movers the bearing friction is excluded. The loss in exciters or auxiliary machines should not be charged to the principal machine, considered separately; but should be charged to the plant consisting of principal machine, plus auxiliaries.
OVERLOAD CONDITIONS. 22. Limits of overload to be carried without injury.	In motors and generators for continuous service, 20 per cent during 1/10 of duration of heat run; 30 per cent for 5 minutes. In motors for intermittent service, 25 per cent for 15 minutes; 50 per cent for 5 minutes.	Generators and motors, 25 per cent for one-half hour. Motors, 40 per cent for 3 minutes.		In generators, 25 per cent for 2 hours. In motors, 25 per cent for 2 hours; 50 per cent for 1 minute.
23. Overload temperature elevation limits.		Temperature elevations not to exceed those stated for rated load. Overload tests not applicable after these limiting temperatures have been attained.	In all cases the temperature rise observed at the time of test must be such that the mean temperature of the machine, when in actual service, cannot exceed 85° C.	15° C. above those for rated load and after the application of rated load heat test.
24. Regulation.	Motors should be capable of sustaining 50 per cent excess in speed above normal for 5 minutes.	Generators should be capable of maintaining normal terminal voltage with 15 per cent overload.		
25. STANDARD VOLTAGES.		For generators, at terminals—115, 230, 470, 550 volts. For motors, at terminals—110, 220, 440, 500 volts.	For generators, at terminals—115, 230, 460, 525 volts. For low-voltage distribution circuits—110, 220, 440, 500 volts.	For generators, at terminals—125, 250, 550-600 volts. For low-voltage distribution circuits—110, 220 volts.

(Syndicat Professionel des Industries Electriques) already referred to. As already pointed out, there have been two sets of rules adopted in France; only one has been selected, however, in order to keep the table within reasonable limits of space. The set adopted by the Paris Syndicate has been taken in preference to the set adopted by the *Association Alsacienne*, although the latter set may be, perhaps, more generally employed. The two French sets do not, however, differ widely in their respective provisions.

Column III gives an abstract from the German rules of the V. D. E. (Verband Deutscher Electrotechniker), according to the 1908 edition above referred to.

Column IV gives a corresponding abstract from the rules in Great Britain of the E. S. C. (Engineering Standard Committee), according to the 1907 edition.

Column V gives an abstract from the corresponding rule of the United States A. I. E. E. (American Institute of Electrical Engineers), according to the 1907 edition mentioned above.

Owing to the limited space allotted to each item in the table, a rigorously correct presentation of each particular rule cannot be expected. It has, however, been endeavored to present the substance of each set in a convenient form for comparison, in order to educe their various conformities or points of difference.

It will be observed that while there are many points of difference, there are also many points of agreement and there are no differences that appear insuperable to mutual adjustment.

Erection of Transmission Line Towers in Porto Rico.

By W. R. Strickland.

It is believed that a description of the method of erection of steel transmission line towers employed by the Porto Rico Power & Light Company will prove of interest as illustrating the difficulties that must be overcome in such work.

Fig. 1 shows the style and dimensions of the regular tower; it also shows a special arrangement for crossing the La Plata River by a span of 600 ft. at about right angles to the line on each side. These towers were built to carry two three-phase 20,000-volt circuits of No. 4 hard-drawn copper wire, the insulators being triple petticoated and tested to 60,000 volts. A ground wire is placed in the center on the upright pipe for lightning protection, and two telephone wires are carried on insulators mounted within the steel pole structure. They are of structural steel heavily galvanized, and were shipped in bundles, most of which could be handled by four men. There were four similar pieces for one tower, the large cross arm and the pipe for ground wire, being very heavy, were shipped separately. The towers were assembled in the field with bolts and nuts heavily galvanized over the threads. The net weight of each standard tower is 2200 lb.

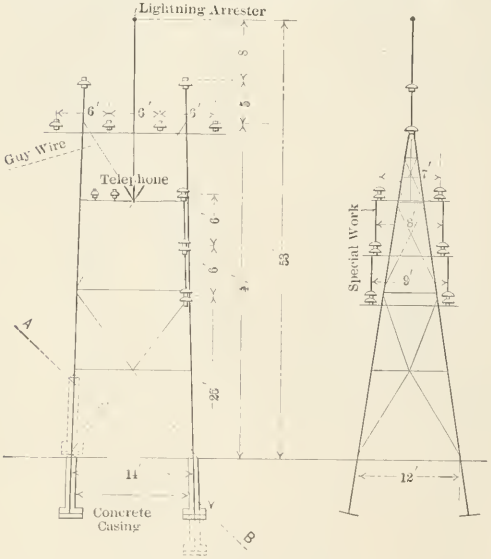


FIG. 1.—DIAGRAM OF TOWER.

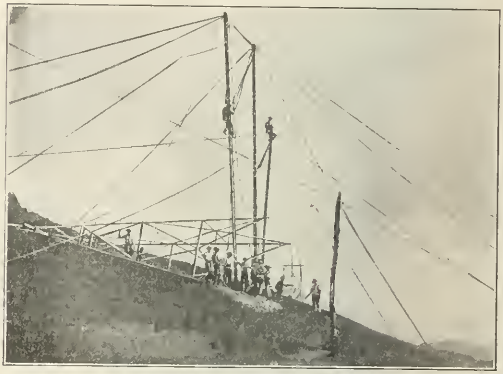


FIG. 2.—PREPARATION FOR ERECTION OF TOWER.

Several methods of erection were considered, the most popular suggestion being the movable A-frame. This method, as well as others, could not be used for several reasons. The center of gravity of the towers is very high, and the steep slopes upon which they had to be erected would have made it necessary for the A-frame to work at right angles to the line, in which case the tower would have had to be turned after erecting owing to the necessity of assembling it with the cross arm lying flat upon the ground. Some of the hills were as steep as indicated at A B in Fig. 1, so that the towers had to be cut away to fit before erection, and separate concrete anchorages were used for laterals and horizontal braces. There were few level spots such as shown in Fig. 4, where the first tower was erected. The weight of an A-frame would have been too great in one piece, as it had to be carried by hand from tower to tower, because of the broken character of the country. Moreover, the bottom legs of the tower were too flexible for the weight thrown on them sideways during erection in a manner not contemplated in the design. While the lateral braces were large enough for the tension which will come on them after erection by reason of the pull due to wind pressure, they could not carry the compression which would have come on them in resisting the stresses developed by the eccentric loading at the end of the leg during erection.

As a result of these conditions peculiar to the tower and the country, the following method was employed for application by an American general foreman, all of the rest of the labor, with one exception, being Porto Rican.

One gang in charge of a Porto Rican engineer dug the holes, put in the concrete footings, and cut off or lengthened the lower legs to correspond to the slope of the hillside. Another gang assembled the towers with the exception of the lower leg pieces, while another gang erected the small gin-pole shown on the right in Fig. 2. Then came the main erecting gang carrying large gin-poles, blocks, tackle, dead-men, tools, etc. The small gin-pole being in place, the last gang quickly erected the first large gin-pole, which in turn was used to erect the second, as shown clearly in Fig. 2.

The most difficult problem at each tower was the anchoring of the many guy lines needed. For this purpose trees were occasionally used, but in most cases steel dead-men had to be driven in the ground; in some cases the ground was so soft that two dead-men had to be used. The erecting of the main poles was in charge of a mate from a Porto Rican sailing vessel, as sub-foreman, his principal assistants being six sailors whose carefulness and good judgment were such that only twice did the gin-pole break away.

In Fig. 3 is shown a tower hoisted from the ground and being pushed into position. The lower legs are slipped into the holes and bolted to the tower, after which the tower is lowered onto the concrete footings and left for the last gang, which levels and centers the tower, placing concrete around the legs and the anchor up to about 6 in. above the ground. It will be noted from Fig. 3 that the small gin-pole has been taken down, and at the time indicated it was being erected for the next tower.

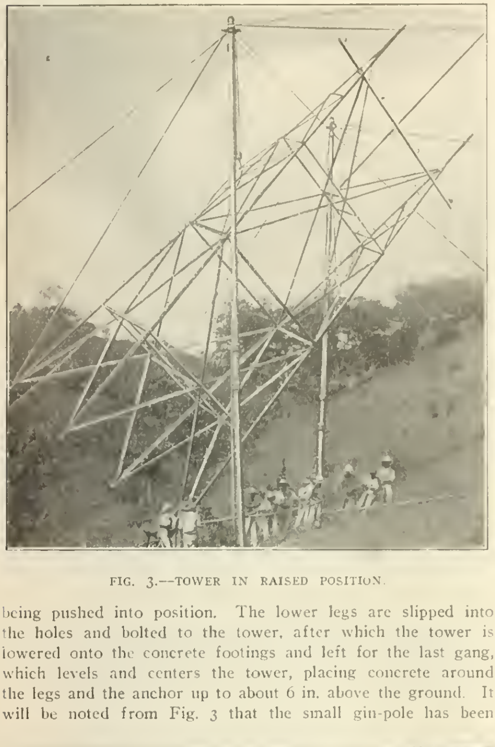


FIG. 3.—TOWER IN RAISED POSITION.

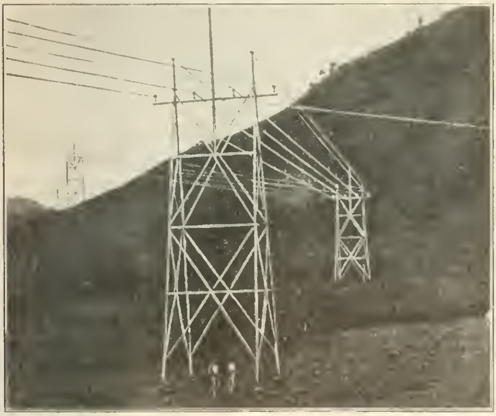


FIG. 4.—VIEW ALONG TRANSMISSION LINE.

At each angle point, the tower was set to bisect the angle in the transmission line, a supporting guy being held by concrete anchorage. Four or five towers were erected per day. After the men had gained a little experience the cost of erection, including all labor and material, sub-delivery of towers and concrete, cement at $3.50 per barrel at the tower, assembling, erecting and concrete footings and casing was brought down to from $25 to $27 per tower. Owing to special work, and some towers in exceptionally bad locations, which required more care and more concrete, and owing to delays caused by right of way fights, the average cost was considerably higher. Each common laborer was paid 75 cents per day, the sub-foreman receiving $2 or $3.

Fig. 4 shows three towers completed, and gives an idea of the character of the country. While the line for about two miles was near a wagon road, for the most part it was erected across country to San Juan, 20 miles distant, deviating from a straight route only where necessary to avoid very high mountains. The distance to the nearest wagon road was from half to a couple of miles, making it necessary, after hauling the material on an average of seven or eight miles on the road, to carry it on sleds by oxen over the hills to its location.

The spacing of the towers averaged about 440 ft. center to center, but in some cases 550-ft. or 600-ft. spans were used, the larger spans, however, occurring only where there were deep gullies or creeks to be crossed. In case of the longer spans the supporting towers were specially strengthened by guying.

Accuracy of Electric Meters.

In the report of the committee on meters before the Chicago convention of the National Electric Light Association it was pointed out that during the past year meters have been, to an especial degree, the object of legislation and that the tendency of the latter is all the time more restrictive. These facts the committee says serve to emphasize the necessity of the utmost care in the measurement of electrical energy and the folly of leaving this matter in the hands of inexperienced men. Any company would stand aghast at a 20 per cent increase in its coal costs and would probably employ high-priced experts to find out the trouble; but many of them fail to realize that a drop of 1 per cent in the accuracy of the customer's meter will affect the profits just as seriously.

In order to insure the accuracy of its meters, every company should maintain standard instruments which are accurate within a small fraction of 1 per cent. There should be a careful system of checking all working instruments with these standards and a thorough system of testing customers' meters. Careful records of meter accuracy, showing the number of meters fast or slow and the amount of these errors, should be kept. One of the members of the committee urged the importance of testing meters in position.

The trend of legislation emphasizes the fact that companies should prepare themselves for meter-regulating ordinances, and the committee recommended that companies assist in the preparation of these regulations which, while safeguarding in every way the interests of the customer, should not be unjustly oppressive on the companies. As preliminary to a general discussion of the subject, a communication from a company in New York State, whre the matter of meter regulation has gone further than anywhere else in the country, was incorporated in the report. In this communication attention was called to the advisability of operating companies inviting reasonable inspection, not only of service meters but of the standards by which they are calibrated. The following points were emphasized in the communication: The sealing of meters by a government official is a great hindrance in the way of maintaining meters accurate. Standards properly checked by official inspectors give a value to these that they ordinarily would not possess in the eyes of the community. If all meters are to be tested, the testing should be performed on the customer's premises. Systematic records of the calibration of all meters should be kept open to a representative of an authorized commission at any time. The results of meters tested on complaint should be forwarded to the commission for its approval and revision, if desired. A reasonable charge should be fixed for testing meters on complaint, and if all meters are to be tested this should be done at the expense of the government. When tests are made by an inspector on complaint, at least three points should be taken in the load curve, to be agreed upon in advance, the average of which shall be used in determining whether the meter is accurate within the provisions of the law. It was suggested that these points be 10 per cent of the meter rating, one-half load and full load. If some such arrangement is not made in advance, it will often be necessary to condemn meters which are actually measuring the energy used by the customer with reasonable accuracy.

LETTERS TO THE EDITORS.

Economics of Electric Illuminants.

To the Editors of Electrical World:

SIRS:—From the editorial with which you kindly introduced my article on the "Economical Aspect of the Various Electric Illuminants," published in your issue of May 16, and also from conversations recently with several friends, I am led to think that an impression exists that the initial cost of a lamp was not considered and included in the tables and curves of the article. This is not correct as far as the incandescent lamps are concerned; for example, the initial cost of a tungsten lamp is assumed and entered at $2. It is stated in the article to be impossible to subject the initial cost as well as depreciation and interest of the invested capital to general rules. Moreover, they do not materially influence the cost of the kilo-candle-hour since the life of the arc lamp, as a whole, as well as that of the fixtures for incandescent lamps, are so long that the factor corresponding to the cost per kilo-candle-hour of what might be called the "outfit" is infinitessimal as compared with the total cost of the kilo-candle-hour, and can be neglected. While, therefore, the factors mentioned above could have been omitted from the article without impairing its correctness, it was the intention of the writer to treat exhaustively the matter of economy of lamps and, therefore, the influence of the capital invested for outfit was not ignored, even though negligible. It is, therefore, not correct to assume that the article has reference only to an installation fully completed and with all the lamps provided and paid for. The data given apply to all economical considerations imaginable, in order that the estimating engineer may be enabled to pass judgment as to which lamp under examination is to be given the preference.

NEW YORK. ALFRED A. WOHLAUER.

Looping vs. Cutting Lines of Force.

To the Editors of Electrical World:

SIRS:—With reference to Mr. S. Sano's letter in your issue for May 30, it appears to me that under the conditions laid down by him—if such were possible—e.m.f. would not be generated by the ammeter conductors, as he assumes that the conductors lie in slots offering infinite reluctance to the magnetic lines. If, however, to modify Mr. Sano's premises, we assume that the reluctance of the slots is finite, but very great as compared with that of the teeth, we may imagine the lines being dragged by the leading tooth until the reluctance of the path through the tooth becomes greater than that through the slot; they would then cut through the slot, tending to take the low reluctance path through the tooth behind, and in so doing be cut by the conductors, thus generating an e.m.f.

In practice, of course, the process would be continuous and the e.m.f. would be proportional to the number of lines cut by the conductors; it would not be produced by the lines which were not cut by the conductors as assumed by Mr. Sano.

WEEHAWKEN, N. J. JAMES GIBBONS.

Rocky Mountain Telephone Strike.

To the Editors of Electrical World:

SIRS:—The item published in your paper of May 23, relative to the settlement of the strike of linemen and operators of this company in Montana, is erroneous in the statement of facts in most all particulars, except the one that the strike is settled. However, the only thing that interests us particularly is that a statement was made that the injunction suits were to be dismissed at our instigation. It must be evident to you that an injunction granted by a Federal court takes the matter out of the hands of the party asking for such injunction and places it exclusively within the hands of the court. Any agreement, therefore, with a labor union to dismiss an injunction brought against it by the Federal court would necessarily be in contempt of that court. We have settled the Montana strike on terms that are satisfactory to both sides, but the two injunctions granted by the Federal court necessarily stand and were not involved in the settlement.

D. S. MURRAY,
General Manager Rocky Mountain Bell Telephone Company.

[We regret the errors to which Mr. Murray alludes. The item in which they appeared was compiled from a newspaper report of the settlement of the strike.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Rotary Converters.—T. FRASER.—A note stating that the old prejudice against the rotary converter in Great Britain is dying out and that its advantages of high efficiency, great overload capacity and low voltage on the rotary element are being gradually recognized.—*Elec. Jour.*, May.

Lamps and Lighting.

Tungsten Lamps.—An account of two recent and apparently important British patents on the manufacture of tungsten lamps. According to a patent of the British Thomson-Houston Company (General Electric Company of this country), tungsten filaments which ordinarily are very brittle, become sufficiently ductile to permit of their being drawn into finer filaments which can be bent or shaped at will, if they are heated to a temperature just below red heat or below the point at which the metal oxidizes. For this purpose the tungsten filament may be wound on a heater mandrel or shaped between heated metal blocks in the open air, the temperature of the mandrel or of the blocks being such as to raise the temperature of the tungsten to a point just below visible redness. According to a patent of the Allg. Elek. Ges. it is possible to materially increase the specific resistance of tungsten by certain additions. If oxides of yttrium, ytterbium and certain other rare metallic earths having high atomic weights and high affinity for oxygen are added to the filament, the resistance is considerably increased, the vacuum is not impaired and the life of the filament is not decreased. Ytterbium is most suitable; about 20 per cent of ytterbium oxide are mixed with metallic tungsten or tungsten oxide powder and the mixture is made into a paste with a suitable binder. The filaments made from this paste are heated to a high temperature in a reducing atmosphere until the tungsten oxide is reduced, the binder vaporized and the filaments have become hard. When a filament prepared in this way is placed in an evacuated bulb and heated to a very high temperature, the bulb remains quite cold, a proof that gases are not given off by decomposition.—*Lond. Elec. Eng'ing*, May 14.

Metallic Filament Lamps.—H. PECHEUX.—The author has determined the "characteristic curves" (showing the relation between volts and amperes) for various incandescent lamps. Fig. 1 gives the same (a) for 20-cp, 125-volt carbon lamps,

(β) for 25-cp, 130-volt tantalum lamps and (γ) for 25-cp, 130-volt tungsten lamps (candle-power meaning hefner candles). The scale of this diagram is as follows: 1 mm of the axle of abscissas represents 0.01 amp; 1 mm of the ordinates 2 volts. Fig. 2 gives the characteristic curves for three tantalum lamps: *a* for 120-volt lamps, *b* for 125 volts and βc for 130 volts. The candle-power in hefner candles, as function of the voltage *E*, is given by the following expressions: $3.98 \times 10^{-14} \times E^7$ for 19-cp, 125-volt carbon lamps, $1.54 \times 10^{-7} \times E^{3.9}$ for 27-cp, 130-volt tantalum lamps, and $1.82 \times 10^{-6} \times E^{3.4}$ for 28-cp, 130-volt tungsten lamps. The constants in these expressions are valid for new lamps. In course of time they change on account of a change of the resistance of the filament.—*La Lum. Elec.*, May 16.

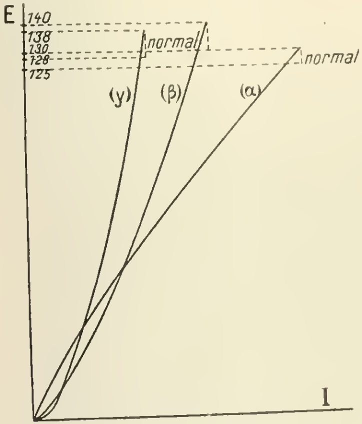


FIG. 1.—LAMP CURVES.

Bremer Arc Lamp.—Two fundamental claims in an important patent by Bremer have been declared invalid by the highest German court. The decision, which is given in full, is based on the lack of novelty in the method covered by the second claim. The first claim, which has been declared invalid, is general and refers to the regulation of an arc in such a way "that the regulating mechanism is influenced by the position of the arc, which changes with the consumption of the carbons." The second claim refers to the effect of a magnetic field on the resistance of the arc so as to draw out the arc and increase the resistance without changing the distance between the terminals of the carbons.—*Zeit. f. Beleucht.*, April 10.

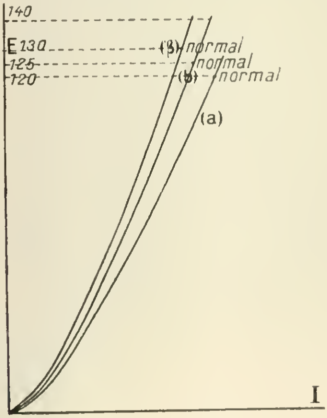


FIG. 2.—LAMP CURVES.

Metallic-Filament Lamps for Street Lighting.—An account of the results which have been obtained in various British towns with tantalum and tungsten lamps for street lighting. The results are shown to be very satisfactory; but it is strongly recommended to pair the lamps suitably when they are to be run in series. They are, therefore, tested in advance. The average life is mostly given as over 1000 hours, and in several towns most of the lamps are said to have a life of more than 2000 hours. Metallic-filament lamps are increasing in application instead of gas lamps for street lighting, and in some cases they are also replacing arc lamps. In those cities in which the lamps have been in use long enough to get accurate estimates of cost, metallic-filament lamps have been found to be a good deal cheaper than gas.—Lond. *Elec. Eng'ing*, May 14.

Generation and Transmission.

Efficiency of Heating Surfaces.—C. H. Wingfield.—A paper read before the (Brit.) Civ. and Mech. Eng. Soc'y. The author was called upon to design boilers for very different draughts. The air pressures varied from 10 in. down to 0.75 in., and there were no data. He started with Rankine's formulas as a basis, the rule-of-thumb methods of the boilermakers being useless. They left varying rate of combustion out of the reckoning. One of the greatest popular fallacies, the author considers, is the belief that the rate at which heat passes from the hot gas to the water in a boiler varies directly as the difference between temperatures. This idea does not take into account the "surface resistance." The nature and exact reason for the existence of this surface resistance are very obscure. Fletcher found that pieces of paper attached to the dry side of a furnace plate did not char. Sir John Durston proved experimentally that 90 per cent of the whole resistance exists on the dry side of the plate. The author is disposed to believe that, while some of the resistance may be due to a film of air, the greater part is an inherent quality of the plate itself. Another "popular fallacy" is that any heat absorbing surface, such as that of a water-tube, is necessarily more efficient if the flame and gas beat on it transversely than if they move longitudinally. With respect to the heat transference question, the author confirms Rankine's formula: $Q = \frac{(T-t)^2}{a}$ where Q = units of heat transmitted by 1 sq. ft. per hour, T = temperature of the gases, and t = that of the water. The denominator a is an empirical constant. The rate of transmission varies, therefore, as the square of the temperature differences. Blechynden and others have also confirmed this. One curious conclusion to which his experiments led Mr. Blechynden was that copper, after being in use for some time, transmitted less heat than steel, although the latter is comparatively a poor conductor of heat. The inference is that the surface resistance is the cause of this loss of transmissivity and that a film of copper oxide offers more resistance than a film of iron oxide. The paper concludes with an appeal for information as to just why there is such a great increase in the rate of heat transmission with the feed water at steam temperatures.—Lond. *Elec. Times*, April 9.

Calculation of Transmission Lines.—A. Blondel.—A mathematical paper illustrated by diagrams in which the author shows that the calculation of a transmission line containing inductance and capacity may be easily carried out by his former graphical method for transmission lines without capacity, some slight modifications only being necessary. Five numerical problems are given, one referring to the determination of the current at the receiving end when the voltage at the transmission end and the constants of the line are given.—*La Lumière Elec.*, May 9.

London.—A long account of the proceedings before a Parliamentary committee concerning three bills on electric energy supply in London.—Lond. *Elec.*, May 15, and *Elec. Eng'ing*, May 14.

Traction.

Electric Traction.—P. Dawson.—A continuation of his very long illustrated serial. The author now begins to discuss single-phase traction and to summarize the development of the single-phase motor from an historical point of view.—Lond *Elec.*, May 8.

Brake.—H. D. James.—An account of a series of experiments in which the author investigated the best material to use for the friction surfaces in brakes. The best combination proved to be a cast-iron shoe bearing on a cast-iron wheel. Under heavy pressure the coefficient of friction in his experiments was 0.3 and the wear on the brake wheel about one-sixteenth of the wear on the shoe. The author shows that it is possible to select the point of suspension for the brake shoe in such a way that the retarding force acts directly along the brake beam and in line with it. The pressure of the shoe against the wheel is then uniformly distributed over the brake wheel and the shoe is free to turn and find a true seat on the wheel. Long life of both the shoe and the wheel are thus insured. The clearance between the wheel and shoes may be very small, which assists in reducing the size of the magnet. The pressure between the wheel and shoes is applied by means of a helical spring located over the wheel and connecting the brake beams. In operating, the spring lifts the plunger of the magnet upward away from the stationary core. In releasing the brake, the electro-magnet draws the plunger down, the spring being stretched just enough to clean the shoes from the sheets. Tests have shown that the minimum amount of wear is obtained when the brake shoes are designed for the maximum pressure which can be used without cutting. This means that a large amount of braking force is obtained with a comparatively small wheel, but a large magnet is required to exert the pressure. By making the magnets of steel and ribbing the outside surface, very much better results can be obtained than with cast-iron magnets having a smooth surface. The magnets are entirely enclosed and all of the heat must be radiated from the external surface.—*Elec. Jour.*, May.

Installations, Systems and Appliances.

Danger of a Poor Ground Connection on the Secondary of a Transformer.—R. P. Jackson.—While it is common practice to ground the secondaries of service transformers as a protection against danger incident to break-down between the high- and low-tension windings, it may often occur that if this connection is not carefully made and is not of low resistance, it will introduce an element of danger. The arrangement of circuits and ground connections in Fig. 3 shows how actual danger to life and also a fire resulted from a poor ground, when with either a good one or none at all there would have been no trouble. In this particular case the neutral of the lighting circuit and the middle point of a two-pole lightning arrester were grounded at the same pole to two plates which had been buried in the same hole in the earth. The resistance between these two ground plates was very low, but the resistance between them and the good ground of the water-pipe system and the river was comparatively high. The 2200-volt mains were carried across the river in metallic-sheathed cable and the house wiring was placed in metal conduit connected to the water system. When by accident the cable in the river became grounded on one side of the 2200-volt circuit, a potential of 2200 volts was placed on one side of the lightning arrester. This arrester then broke down and connected the ungrounded side of the 2200-volt circuit to the lightning-arrester ground-plate, which practically meant that both ground plates were raised to a potential of nearly 2200 volts above that of the river and the water system. The resistance between the plates and the water-pipe system and river was high enough to prevent the flow of sufficient current to materially lower the potential delivered to the terminals of the transformer. The result, therefore, was that the two ground plates and the lightning circuit were at a potential of nearly 2200 volts above the water pipes and also of the conduits of the house wiring. This was the cause of the breakdown which started a persistent arc that resulted in a fire. If the earth connection of the 2200-volt circuit had been much better, or if there had been none at all, there would have been no trouble. If, however, in conjunction with this trouble there had been a breakdown between the high- and low-tension windings of the transformer, the only absolute safety would have been in a very low resistance and effective earth connections for the secondary circuit; no earth connection or ground whatever would have meant both a life and fire danger.—*Elec. Jour.*, May.

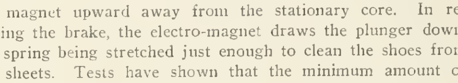


FIG. 3.—ARRANGEMENT OF CIRCUITS AND GROUND CONNECTIONS.

Direct-Current Three-Wire System with Alternating-Current Connections.—W. Fuhrmann.—In order to connect consumers at a distance with a small three-wire direct-current network the author recommends the use of a three-conductor direct-current generator, for instance, of the well-known design of Dobrowolski, in which the neutral conductor is connected to the central point of an inductance coil connected between two slip-rings. The alternating-current connections leading to a consumer at a distance are made to the two slip-rings, through the intermediary of a transformer. It is also possible to use three slip-rings with three inductance coils, the middle one being connected to the neutral wire of the direct-current three-wire system. In this case there is transmitted to the distant consumers, through the intermediary of a three-phase transformer, energy which is useful for driving of motors.—*Elek. u. Masch Bet.*, May 5.

Rectifier Station for Charging Storage Batteries.—R. Venus.—For charging the storage batteries in the telephone exchange of Rixdorf, in Germany, from a 3 x 220-volt, three-phase network, rectifier relays of the design of Koch (described in the Digest Feb. 15, 1908, page 352) are used. The German telegraph department has been using this type of rectifier with good success for changing single-phase current into direct current. In the present installation the rectifier is used for the first time with three-phase currents. Two relays are inserted in the circuit of each phase so that both half-waves of the alternating current of each phase are utilized. The arrangement is described in detail and illustrated. The results obtained are so good that it is intended to use this type of rectifier in the new Essen telegraph station.—*Elek. Zeit.*, May 14.

Lighting of Exhibition.—An illustrated description of the electrical installation of the Franco-British exhibition, now being held in London. There are about 100,000 lamps installed in the various buildings, the "fairyland" system being generally employed. In this system use is made of a special twin rubber-covered cable to which special lampholders are fixed about every 12 in. These lampholders, which are of a special water-tight pattern, are connected without cutting the conductors, so that a bad contact affects only the lampholder in question. The back of the lampholder, where the connections to the terminals are made, is sealed with a special compound so that all moisture is absolutely excluded. The lamps may be fixed vertically or in any position. No metallic parts are exposed to the atmosphere.—Lond. *Elec.*, May 15, 22.

Wires, Wiring and Conduits.

High-Tension Insulators.—C. J. Greene.—The conclusion of his article on high-tension insulators for overhead transmission lines, the first part of which was recently abstracted in the Digest. The author gives tables of the standard makes of insulators—both straight-line and shackle insulators—made in different countries. These tables give quite complete information on price, dimensions, test voltage, arcing distance, factor of safety, creeping surface, etc. With respect to factor of safety, the tables show that at high voltages in some cases it is very small, even when measured with rain falling at 45 deg., and there is no doubt but that this is due almost entirely to the difficulties in making large insulators. The design of very large insulators for the high voltages now in use seems to be governed very largely by the difficulties of manufacture, theoretical considerations of electrical and mechanical strength having to become subservient to the capabilities of porcelain. The steady rise of the factor of safety as voltages decrease is clearly indicated. As to the advisability of connecting the insulator pins to ground, there is considerable difference of opinion, but it should not be overlooked that by earthing the pins the safety of the insulator is materially decreased.—Lond. *Elec. Rev.*, May 1.

Electrophysics and Magnetism.

Resonance Spectra of Sodium Vapor.—R. W. Wood.—An account of an experimental method of analysis of the sodium spectrum which, the author thinks, may become a means of determining the exact nature of the constitution of the sodium molecule on the basis of the electronic theory. If sodium vapor is illuminated with a powerful beam of white light, it becomes strongly fluorescent, emitting a spectrum which the author believes to be the exact counterpart of the absorption spectrum. If, however, monochromatic light is thrown into the vapor instead of white light, a series of bright lines is obtained spaced at very nearly equal intervals along a normal spectrum, and separated by a distance equal to about 37 Angström units. Various series of lines with varying distribution of intensity can be brought out by changing the wave length of the exciting light. In every case, light of the same wavelength as that of the exciting light is emitted by the vapor, and, in addition, a large number of other frequencies, which bear a definite relation to each other. These spectra are called by the author resonance spectra, since they are excited by the resonance of one or more of the electrons of the system when monochromatic radiation plays upon it. The author reports the results of an extended investigation of the spectra excited by the radiations from cadmium, zinc, lithium, barium, magnesium, lead, bismuth, silver and copper arcs. *Phil. Mag.*, May

Short-Spark Phenomena.—W. Duddell.—An abstract of a (Brit.) Phy. Soc'y paper which deals with two effects which the author has observed in connection with some measurements of the current in the secondary circuit of an induction coil. The apparatus in use consisted of a "12-in." induction coil which was supplied with energy from the 200-volt direct-current mains. A resistor of large resistance was placed in series with the primary of the coil to limit the current, and the current was interrupted by means of a mercury-jet device. The secondary circuit contained a galvanometer to measure the mean current, and a thermo-ammeter to measure the effective current. When there was no spark-gap in the secondary circuit, and the coil was in action, the mean current, as read by the galvanometer, was zero and the effective current about 3.8 milliamperes. When a microscopic spark-gap, say, between two aluminum points, was introduced into the secondary circuit two curious effects took place. Firstly, the effective current enormously increased in value; and, secondly, a very large deflection was produced on the galvanometer in the direction corresponding to that due to making the primary circuit. The introduction of a spark-gap 1/10 mm long caused the effective current to rise to 38.5 milliamperes, and this continued to increase with increasing length of spark-gap until it reached a maximum with a gap of about 1.4 mm. The author thinks that this effect is due to very high-frequency oscillations set up in the wires connected to the secondary circuit of the coil when a spark-gap is introduced. He has observed the effect with brass, iron, zinc and aluminum electrodes; the latter metal is the best to use. The large deflection in the negative direction observed on the galvanometer was investigated by recording the wave forms of the potential difference and the current by means of an oscillograph.—Lond. *Eng'ing*, May 8.

Electrons.—E. A. Partridge.—A Frank. Inst. paper discussing the fundamental principles of the electron theory and its experimental foundations. The author finally refers to Planck's thermodynamic theory of radiation, and his mathematical deduction of the mass of the hydrogen atom and also of the charge called the elementary quantity of electricity. "The determination by Planck of the mass of a hydrogen atom and the charge constituting an electron is, to my mind, one of the most remarkable intellectual results ever achieved."—*Jour. Frank. Inst.*, May.

A New Radioactive Element.—B. B. Boltwood.—Uranium minerals contain a new radioactive element to which the name ionium has been given by the author. Its chemical behavior is similar to that of thorium.—*Am. Jour. of Sci.*, May.

Units, Measurements and Instruments.

Determining the Capacity of a Submarine Cable.—A. Tobler.—An illustrated description of the method of Devaux-Charbonnet for determining the capacity of a submarine cable. The principle is indicated in Fig. 4. If K_2 is pressed down and then K_1 (the switch U being connected to 2) the battery E charges the condenser C and the cable X in series. If V is the potential of the condenser plates connected to K_2 and U, the equation $C\ (E-V) = XV$ is applicable. The short-circuit switch T of the galvanometer G is then opened and K_2 is released, whereby the condenser C receives the full charge $Q_1 = CV$, the galvanometer needle being deflected by the angle δ_1. One need only determine the constant, namely the charge which the voltage E impresses on the condenser C. After connecting X to earth by means of U and releasing K_1, one presses K_1 down again for five seconds and discharges C through G, which gives $Q_2 = CE$, the deflection of the galvanometer needle being δ_2. From these three equations is obtained directly $X = \frac{C\ (Q_2 - Q_1)}{Q_1} = \frac{C\ (\delta_2 - \delta_1)}{\delta_1}$. In order to get convenient values of δ_1 and δ_2 it is necessary in certain cases to shunt the galvanometer. The instruments used in practice are described and some numerical examples are given.—*Jour. Télégraphique*, April 25.

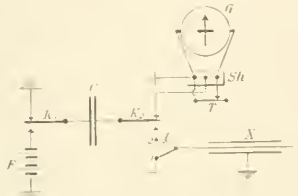


Fig. 4.—Determining Capacity of Submarine Cables.

Condensers.—G. F. Mansbridge.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. on the manufacture of electrical condensers for telegraphy and telephony. The aggregate output of the condensers in Europe and America during 1907 was 5 farads. Manufacture on a large scale and with the aid of labor-saving appliances has resulted in reducing the price to about one-tenth of the former value. The author describes in detail the method employed in condenser manufacture. In the author's process, used by the British Post-Office for manufacturing condensers for telegraph and telephone work, metallic tin, precipitated chemically or electrically from a solution of tin in nitrohydrochloric acid, is mixed with an adhesive substance and pasted on the paper; after drying, the metallized surface is burnished and forms a coherent thin metallic film The paper is then subjected to a high voltage, which fuses away the film of metal surrounding the weak spots in the dielectric. The drying, impregnation and compression of the rolled sheets are dealt with at length, particular stress being laid on the fact that too much mechanical pressure, although it increases the electrostatic capacity, considerably decreases the insulation resistance, and also the resistance to breakdown. The author recommends the use of good paraffin in preference to any other wax for condenser work In an appendix to the paper are given the Post Office and National Telephone Company's specifications for condensers for telegraphic and telephonic use.—Lond. *Elec. Eng'ing*, May 14

Condensers.—B. V. Hill.—An account of an experimental investigation of the variation of apparent capacity of a condenser with the time of discharge and the variation of capacity with frequency in alternating-current measurements. The results are given in diagrams and tables. It is shown by comparing the discharge curves of the several condensers tested with their alternating-current capacities, that the latter cannot be inferred from the former. Taking a certain commercial telephone condenser, as an example, it is shown that up to 0.01 second the capacity is only about 37 per cent of that obtained when the condenser is allowed to discharge for the whole quarter period of the galvanometer. With an alternating current, however, in which the period of charge—that is, the quarter-period of the complete oscillation—was only 0.00008 seconds, the capacity was still 80 per cent of that obtained by the ballistic method and the complete quarter-period of the galvanometer.—*Phys. Rev.*, May.

Speed and Frequency Meters.—K. Seidl.—An illustrated article on methods of measuring the speed of revolving machines from a distance. There are two different classes of instruments. In the first class a small dynamo is connected to the revolving machine so as to rotate at the same speed. If this dynamo is excited with constant current its e.m.f. is proportional to speed. The indicating instrument is therefore a simple voltmeter calibrated in revolutions per minute. In the second class of instruments a small alternator is connected to the revolving machine so as to generate alternating current of a frequency which is proportional to the speed. The indicating instrument is a frequency meter; the instruments of Frahm and of Hartmann-Kemp using a series of steel tongues tuned to different frequencies are described. Only the one tongue which is tuned to the frequency of the alternating current is set into vibration. (The construction of this instrument has been described in detail in the Digest.) The range of frequencies within which these instruments are preferably used is from 30 to 130 periods per second. The steel tongue makes a full vibration for each half wave (for each alternation) of the alternating current. In order to extend the range upward to 260 periods per second the following means is often useful: To the alternating magnetic field, produced by the alternating current, a second permanent magnetic field is added which just annihilates one-half of the alternating field so that only every second half-wave produces a vibration.—*Glückauf*, May 9.

High-Frequency Measuring Instruments.—J. Bethenod.—Indicating instruments for high-frequency circuits (for instance, hot-wire ammeters, bolometers, thermoelectric elements, etc.) always have a considerable ohmic resistance which has a damping effect on the instrument. It has been thought that the damping effect could be avoided by not inserting the instrument directly in circuit, but exciting it by induction. The present author shows, however, that this is not the case, and that with respect to the damping effect the inductive connection of the instrument is rather disadvantageous. This arrangement is useful only with very sensitive instruments and with them it has the advantage that the range of the instrument can be easily extended by varying the mutual inductance between the primary and secondary of the transformer.—*La Lumière Elec.*, May 2.

Water Recorder.—An illustrated description of a recording instrument of English make which is of general application for the measurement of water when flowing freely over weirs or through notches, but which is especially suitable for the measurement of boiler-feed water and the discharge from air-pumps. It is stated that this instrument is now used considerably in English central stations.—Lond. *Elec.*, May 8.

Working Standards of Light.—C. O. Bond.—A Franklin Inst. paper describing and discussing the following working standards of light and their use in gas photometry: British candles, the Edgerton standard, the Hefner lamp, the Elliott lamp and the pentane lamp. The author considers the latter to be best adapted for gas photometry of the accurate kind.—*Jour. Frank. Inst.*, March.

Lack of Uniformity of Revolution.—F. Loppe.—A review of the various methods which have been devised to determine the lack of uniformity of speed of revolving machinery during one revolution.—*L'Ind. Elec.*, April 25.

Telegraphy, Telephony and Signals.

Large Telephone Cables.—An illustrated description of two large telephone cables of British make. The first is an 800-pair (1600-wire) cable made of such a size that it can be drawn into a standard 3-in. pipe. The conductors weigh 10 lb. per mile. Each conductor is insulated by a single layer of manila paper, applied spirally; the longitudinal method of wrapping with a whipping of thread is employed only for wires weighing not less than 40 lb. per mile. The use of a single layer of paper on each wire, instead of the double layer formerly used, is not only cheaper, but results in a lower electrostatic capacity. The second cable described is a composite telegraph and telephone cable, considerable qualities of which are used by the British Post Office for underground work. The cable contains 15 pairs of 150-lb. twin conductors, seven quadruple pairs or "quads" of eight conductors, each weighing 100 lb. per mile, six pairs of 100-lb. conductors, 22 single "screened" conductors weighing 200 lb. per mile for telegraph purposes, and 42 single screened 70-lb conductors, 162 wires in all.—Lond. *Elec. Eng'ing*, May 7.

Telegraph Cables.—E. F. Petritsch.—The conclusion of his paper on oscillographic tests of telegraph cables with respect to mutual induction. It is shown that mutual induction between conductors in a cable of older construction is very noticeable and it is probable that the use of such cables in extended telegraph lines may lead to trouble. On the other hand, the investigation of the author shows that the new cables of the Austrian Telegraph Department (in which tinfoil is bound around the insulated cable conductors) should prove successful, at least to a certain extent. With all arrangements of the experiments the induction phenomena observed in such cables were so insignificant that they cannot lead to any troubles in telegraph transmission.—*Elek. u. Masch.* (Vienna), May 17.

Automatic Telegraphy.—P. B. Delany.—A Franklin Inst. paper describing the "electromagnetic" automatic telegraph system (the "telepost").—*Jour. Franklin Inst.*, March.

Telegraphy.—Henry.—With reference to the Bogni modification of the Morse system, the author discusses possible improvements in the telegraph system of Italy and France.—*L'Ind. Elec.*, April 25.

Automatic Telephone.—A. B. Smith.—Continuation of his long illustrated serial giving a historical sketch of the development of the automatic telephone.—*Am. Tel. Jour.*, April 18 and May 16.

Vienna.—Continuations and conclusion of the fully illustrated detailed description of the new telephone station at Vienna.—*Elek. u. Masch.*, April 5, 12, 26 and May 10.

Electric Signals.—K. Perlewitz.—An illustrated article on numerous electric devices for giving fire alarm signals or other signals (instead of the usual whistle) in factories and workshops. All these devices are based on the production of oscillations of a metallic membrane giving a sound like a trumpet. Such devices are also used on automobiles.—*Elek. Zeit.*, April 30.

Miscellaneous.

Consulting Engineers.—An editorial discussion of the question whether consulting engineers are necessary. Reference is made to the increasing tendency in England of prospective purchasers approaching manufacturers directly. This practice almost always results in asking for tenders without a sufficiently exact specification. To draw up an accurate specification, the consulting engineer is absolutely necessary.—Lond. *Elec.*, May 8. Some letters on the subject appeared in Lond. *Elec.*, May 15.

Sweden.—Statistical tables on imports and exports of electrical and other materials into and from Sweden.—Lond. *Elec. Rev.*, May 8.

Standardized Notation.—The report of the committee of the German Assoc. of Elec. Eng. proposing a uniform method of notation and diagrammatic representation of the terminals of machines, starters, regulators and transformers with supplementary explanatory notes by F. Natalis.—*Elek. Zeit.*, April 30 and May 7.

Electrical Industry in Austria.—E. Honigmann.—A review of the present condition of the electrical industry in Austria and Hungary with tables and special reference to home consumption and export.—*Elek. und Mash.*, April 26.

Lord Kelvin.—S. P. Thompson.—A long account of his first Kelvin lecture on the "Life and Work of Lord Kelvin." The lecture contains much of a personal nature which is of great interest.—Lond. *Elec.*, May 8.

BOOK REVIEWS.

Beiträge zum Kommutierungsproblem. By Karl Waldmann. Berlin: Gustav Schade. 67 pages; 54 illustrations.

The author investigates the phenomena during commutation in direct-current machines with and without commutating poles and in alternating-current series motors. The various factors affecting the commutation and the sparking limits in direct-current machines are treated in a convincing manner, but the discussion of the commutation in alternating-current motors is far from complete or satisfactory. The book is valuable in reporting the results of series of careful tests made upon direct-current machines, but it seems to contain nothing that is essentially new.

Railroad Men's Catechism. By Angus Sinclair. New York: Angus Sinclair Publishing Company. 200 pages; illustrated. Price, $1.

This little book supplements Sinclair's "Locomotive Engine Running and Management," and is intended to appeal to all railroad men "from the president to the newest brakeman." The questions are stated to be a series employed by a leading railroad system for the examination of engineers and firemen, to which have been added a score based upon the standard code of the American Railway Association. The book lacks the crude character of the usual handbook for engineers, both the questions and answers denoting that it is intended for men of some intelligence.

Die Untersuchung Elektrischer Systeme. Auf Grundlage der Superpositionspringipien. By Herbert Hausrath. Berlin: Julius Springer. 126 pages, 19 illustrations. Price, 3 marks.

A theoretical investigation of electric conducting systems including networks of conducting mains and cables carrying both direct and alternating currents. The treatise is conducted from a mathematical and physical rather than from an engineering standpoint. The final chapter deals, however, with the application of the theory to the measurement of the insulation of electric distributing systems under conditions of full operation. The book is of interest to advanced students of mathematics and physics applied to electrical engineering.

Whittaker's Arithmetic of Electrical Engineering. London: Whittaker & Company. 159 pages; illustrated. Price, 50 cents.

These 159 pages contain examples in current electricity, in electrochemistry, magnetization of iron, the construction and operation of generators and motors, all of which the student will find helpful in realizing not only the electrical phenomena, but likewise the magnitude of the quantities involved. Well-chosen examples go a good way in removing difficulties and giving clear ideas in every branch of physics. Typical examples are here worked out by way of illustrating principles and also by way of suggesting how practical problems of the laboratory and central station may be successfully attacked. There are 300 examples in the collection which junior students of electrical engineering will find very useful.

Elektrische Traktion. By G. Sattler. Hannover: Max Jaenecke. 158 pages; 123 illustrations. Price, 4.2 marks.

The characteristics of motors, the energy and power required for traction, the design of the overhead work, track circuits, and third-rail details, together with the selection of protecting and controlling devices, are fully discussed in this little volume. Although there is almost no descriptive matter relating to rolling stock or manufacturers' products, yet the method of treatment is largely descriptive. Theory has by no means been neglected, but the author has explained the theory by applying it to a practical example in each case. Not much of the material is new; in fact, some of the later developments in single-phase and direct-current motors have not been mentioned. However, the book is well filled with useful hints as to the solution of electric railway problems.

Stromverteilungssysteme und Berechnung Elektrischer Leitungen. By Phil. Hafner. Hannover: Dr. Max Janecke. 324 pages, 276 illustrations. Price, 8.60 marks.

This is an excellent practical text-book on the subject of the fall of pressure in conductors and conducting networks. It is written by an engineer for engineers and engineering students. It is abundantly illustrated by numerical examples representing fairly practical conditions. There are five chapters in the book. The first deals with current distribution in two-wire networks. The second considers the design of conductors in regard to cross-section. The third deals with feeders and feeding points. The fourth treats of multiple-wire systems. The fifth is devoted to alternating-current conductors and networks. The work will be of interest to all students of electric distribution from an engineering standpoint.

Grundzuge der Beleuchtungstechnik. By L. Bloch. Berlin: Julius Springer. 157 pages; 41 illustrations. Price, 4 marks.

This little volume is the best that we have yet seen in any language upon the particular topic with which it deals—the technology of lighting from the quantitative engineering point of view. We have many books on lamps and light sources, and also many on photometry, but the intermediate territory of room, hall and street illumination has very few books devoted to it. A notable exception is the work of which Messrs. Cravath and Lansingh are the authors.

The book is divided into six sections, dealing, respectively, with the elements of lighting technology, the measurement and computation of luminous intensity, analysis of illumination, the computation of illumination, the measurement of illumination, and indirect illumination. A copious appendix gives numerical tables for different types of polar curves. The book contains much that is of interest to the illuminating engineer.

Sommeil Electrique, Epilepsie Electrique et Electrocution. By Dr. Louise G. Robinovitch. Nantes: A. Dugas & Cie. 98 pages; 27 illustrations.

The chief value of this treatise lies in the point concerning which it differs most prominently from many of the books on the same general subject, namely, the thoroughly scientific methods used by the author in obtaining the facts upon which to base her conclusions. In fact, the book may be considered as a discussion in detail of graphical records of electrical and physiological phenomena obtained under well-defined and controllable conditions. The experiments described include applications ranging from those producing quiet sleep to electrocution. The cardiac and respiratory tracings, considered in connection with the records from the electrical instruments, furnish the substantial foundation upon which the author has built a systematic treatment of the relation between electricity and life.

Die Wissenschaftlichen Grundlagen der Elektrotechnik. By Dr. Gustave Benischke. Berlin: Julius Springer. 580 pages; 489 illustrations.

This is the second and enlarged edition of a text-book which is intermediate in character between a text-book on physics in electromagnetism and a text-book on electrical engineering. It may be described as a text-book on applied electromagnetic physics. The book is abundantly illustrated and is well adapted to the use of students of electrical engineering. The treatment of electrical measuring apparatus is particularly full and clear. There are many mathematical formulas scattered through the pages, but they contain, for the most part, only elementary algebra. The book will be of special interest to students of electrical engineering acquainted with the German language. Besides having an excellent index and table of contents, the book has the rare merit among German technical volumes of being issued with cut pages.

Erklärung der Gravitation, der Molekularkräfte, der Warme, des Lichtes, der Magnetischen und Elektrischen Erscheinungen. By Johann Sahulka. Leipzig: Carl Fromme. 175 pages; 22 illustrations. Price, 5 marks.

In this little book Dr. Sahulka attempts to give a clear explanation of the relation between electric and magnetic phenomena, heat, light, adhesion, cohesion, and gravitational action. It would probably be expected that an author who assigned to himself the above task would make free use of mathematics, both for proving the relations being discussed and for expressing the physical relations in the most condensed form. However, Dr. Sahulka has not found it necessary to rely upon mathematics, and has been able to discuss the whole subject in simple language readily understood by any one familiar with the fundamental laws of physics. Many of the statements made are given without proof, and in some respects the arguments are not convincing, but, on the whole, the treatment is good, and the book contains much entertaining reading matter.

Autogenous Welding of Metals. By L. L. Bernier. New York: The Boiler Maker. 45 pages, 32 illustrations. Price, $1.

This work is translated from reports of the National School of Arts and Trades of France, and describes the application of autogenous welding to the manufacture of tanks, boilers, piping, etc., together with its application to the manufacture of steel, brass, bars, plates, etc. The flame from the oxyacetylene blowpipe is stated to have a temperature of 6000 deg. Fahr. The metals to be welded are brought to the melting point and the hydrogen and carbon oxide generated in the flame form a reducing atmosphere which protects the melted metal so that oxidation does not take place. The ease with which oxygen and acetylene can now be made, by the addition of water to epurite for the one, and to calcium carbide for the other, has given the art of autogenous welding quite an impetus. The different welding methods are described and compared. The book lacks specific instructions on how to perform the welding operations and inasmuch as the oxyacetylene flame can be used for repairing and cutting metals, such information would be of value.

Theorie der Elektrizität. Edited by Dr. M. Abraham. Vol. I, "Einführung in die Maxwellsche Theorie der Elektrizität," by Dr. A. Föppl. Third edition, revised. 460 pages, 11 illustrations. Leipzig: B. G. Teubner. Price, 12 marks.

This first volume of a series on the "Theory of Electricity" was originally published in 1894 as a separate book with the title "Introduction to Maxwell's Theory of Electricity." Dr. Föppl, who since then has become professor of mechanics at the Technical College, in Munich, and has written the very excellent book on "Mechanics" (4 vols.), asked Dr. Abraham, as stated in the preface, to re-edit the work for the series of which he is general editor. The general appearance and character of the original book is preserved, additions being made only in order to form a connection with following volumes on the "Theory of Electromagnetic Radiation" and on the "Theory of the Elektron." The work, of course, is highly theoretical and will be appreciated only if thoroughly and exhaustively studied by an engineer of excellent mathematical training.

The first part is a special section or introduction to Hamilton's quaternions and to vector quantities. The definitions are rather brief and precise and require a certain amount of reflection and deliberation in order to be thoroughly grasped and digested. It is, however, necessary to acquire and to master this first section in order to be able to study and to understand the matter following. It is of special interest to find the author emphasizing the fact that the conception of the ether as a substance is only hypothetical; that the properties of the ether are entirely different from the properties of matter, and that the chemistry of the ether has proved so far only a word without a meaning.

Electrical Equipment of the Cargo Fleet Iron Company's Works.

The use of electric motors is becoming more and more general in industrial operations, but nowhere are they conquering ground more rapidly than in the iron and steel industries. The electric motor is peculiarly adapted for use in shops where the general conditions are such as those to be met with in iron and steel works, these conditions being the all-pervading presence of coal and other dust, work of a rough and heavy nature and unskilled labor.

One of the best examples of the large part played by electricity in modern iron and steel manufacture is that afforded by the combined iron and steel works of the Cargo Fleet Iron Company at Cargo Fleet, Middlesborough, England. For several years this company had been employed in the manufacture of pig iron only, until 1905, when a most complete remodeling of the old plant and installation of the new plant was effected in order to enable the firm to convert the whole of its output of pig iron into structural steel. This transformation was most satisfactorily accomplished, and several hundred tons of steel are now being made every week, electricity playing a very large part in its production. Blast furnace gas, steam, hydraulic, coke-oven and producer gas power are also largely used.

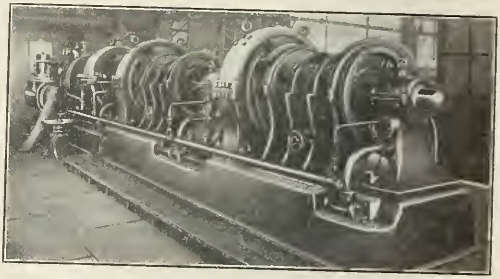


FIG. 1.—DIRECT-CURRENT STEAM TURBO-GENERATOR.

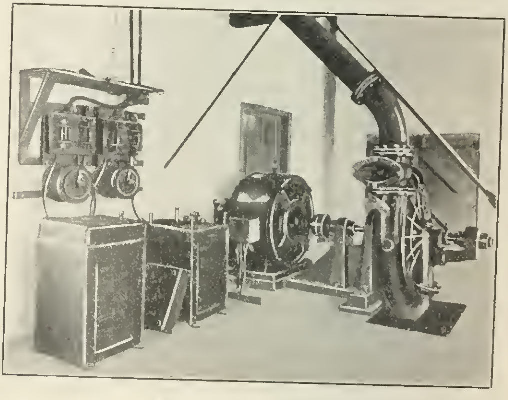


FIG. 2.—MOTOR-DRIVEN CENTRIFUGAL PUMP.

The whole equipment of the works is of the most up to date and complete nature, advantage being taken of the latest improvements in this class of machinery existing in the principal steel manufacturing countries, notably in Germany and America, the steel and iron making plant having been supplied principally by these two countries. The combination of blast furnace and steel plant on one site is probably the first in Great Britain, and has so far proved to be entirely satisfactory.

The works lie right in the heart of a big industrial district, providing a large market right at its doors for the company's products. The company is also very advantageously situated as regards transportation facilities, the works being in direct connection with the North Eastern Railway. In addition also to the splendid railway facilities possessed by the company, it has an extensive frontage on the mouth of the Tees and at present has a wharf some 300 ft. long, at which the products can be loaded into deep-sea craft for transportation to all parts of the world.

Supplies of the principal raw materials are obtained from within a radius of 20 miles, iron ore and limestone being obtained from property owned and worked by the company. The iron-stone mines are at Liverton, and the limestone quarry is at Mickleton. The supply of iron ore, it is estimated, will last for some 90 years at the present rate of consumption; that is, 7000 tons per week.

The electrical equipment of the works, which is exceedingly comprehensive, includes generating plant, of an aggregate rating of 3300 kw and a large number of motors, aggregating over 4000 hp, the large majority of which were supplied by the British Westinghouse Company.

The generating station contains a variety of prime movers, these consisting of one vertical compound steam engine, one British Westinghouse and one Richardson Westgarth steam turbine, two Premier gas engines operating on coke-oven gas, and two gas engines using blast-furnace gas. The generators consist respectively of one 350-kw, two 750 kw, two 300-kw and two 375-kw, 220-volt direct-current machines. The power house is spanned by a 40-ton traveling Broadbents crane fitted with four Westinghouse series-wound motors.

Coal is brought into the works on railway trucks, drawn by an electric haulage gear driven by a 100-hp motor up an incline onto a gantry running along the back of the furnaces, from which trucks can run on inclines to all parts of the works. The coal trucks pass from the top of this gantry to the screening and washing plants, and from the latter to the disintegrators. From the disintegrators the powdered coal is conveyed to the coke-oven coal stores by a Robin belt conveyor. These coal stores are situated in the center of two rows of Kopper coke ovens, each row containing 50 ovens. Below the coal stores is a space for receiving a Baroper coal-dust compressor, into which a certain quantity of powdered coal is run from the bins above and compressed into a block the same size as the inside of a coke oven. The block of compressed coal-dust is next carried along the front of the ovens on a pair of rails and pushed into one of the ovens by a charging apparatus running on the same pair of rails. On receiving the coal, the doors of the oven are put on and sealed up with fire-clay preparatory to the burning process. The washing, disintegrating, conveying, compressing and charging equipments are worked electrically, the coal washing plant using two motors, one of 140 hp and another of 10 hp, the washing water pump being driven by one of 80 hp. The disintegrator is operated by a 50-hp and the belt conveyor by a 25-hp motor. Each compressor box, of which there are three, is driven by a 35-hp railway-type motor, the two charging boxes being also operated by motors of the same rating.

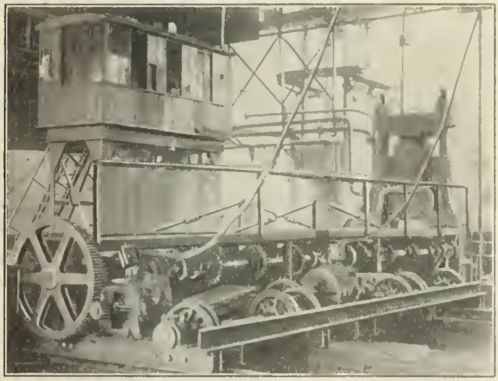


FIG. 3.—SHEAR TRANSFER TABLE OPERATED BY RAILWAY TYPE MOTORS.

The coal remains in the Kopper ovens for some 30 hours or more, and is there burned to coke by its own gas. This method is a great advance on the old method of coke making in beehive ovens as carried on in Great Britain until a few years ago, which has now been almost entirely superseded on the Continent, but which is still largely used in Great Britain. The system at Cargo Fleet is by means of air-tight ovens or retorts which yield a far greater output of coke than the old beehive type, and in addition enable many valuable chemical by-products and the gas produced during the coking operating to be saved. At the end of the burning period, the coke is pushed out at the back of the oven by an electric ram and is there cooled and broken up into convenient sizes, and afterward taken away from the bench by electrically-operated coke cars, either to the blast furnace or to the stock bins, as may be required. Each of the four coke cars is operated by a 35-hp railway-type motor, which controls all of the movements of a car.

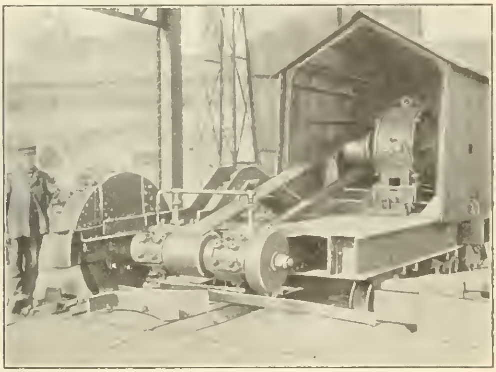


FIG. 4.—HOT SAW DRIVEN BY SHUNT-WOUND MOTOR.

The Kopper ovens give an output 10 per cent in excess of the old beehive equipment, and effect a saving by the use of the gas and the sale of by-products of about $100,000 per year. The gas is almost identical with the ordinary illuminating gas, and the by products, such as tar, sulphate of ammonia, etc., are extracted from it in the usual way, some of the purified gas, as previously mentioned, being used in the coking process, the rest being led to a holder for supplying gas to two of the engines in the power house and for various other purposes as hereafter described.

The manufacture of pig iron is carried on in two blast furnaces, located at about the center of the site. These are supplied with calcined ore, limestone and coke from two large hoppers, or bins, close at hand, which discharge into the skip of the Brown hoist charging equipment by means of endless belts, the various ingredients being automatically weighed during the passage from the bin to the blast furnace. The calcined iron and limestone are delivered to these bins by means of the gantry previously mentioned The whole process of charging the furnaces is done mechanically, no men being situated at the top of the furnaces. The original blast furnace plant consisted of five furnaces, each 75 ft. high, and with 24 ft. bosh, requiring five blowing engines, the blast being heated in 12 Cowper stoves. These furnaces have been replaced by the present pair, each of which is 90 ft high, with 11½ ft hearth, and 21 ft. bosh, designed for a maximum output of 1400 tons per week.

The blowing engines, which are a notable feature of the blast furnace plant, consist of seven Cockerill gas engines, of Messrs. Richardsons, Westgarth & Company's manufacture. Cooling water for the pistons and cylinder jackets of these gas engines is supplied from a tank which is in its turn supplied from a Morrison cooling tower, the water being pumped from the engines to the tower by means of two Gwynnes centrifugal pumps, each driven by a 70-hp motor; the cooling water is pumped through the cooling-tower and to the supply tank by four pumps, driven by 32-hp compound-wound motors; each engine is fitted with an electrically-worked "barring" arrangement operated in each case by a 10-hp series-wound motor. The engine house is spanned by an electrically-operated, 20-ton three-motor crane built by Booth Bros., of Rodley.

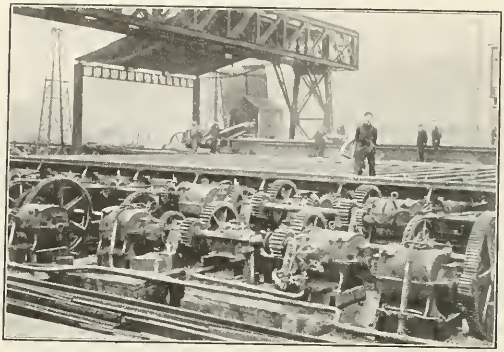


FIG. 5.—SKID AND ROLLER GEAR DRIVEN BY RAILWAY TYPE MOTOR.

The gas from the blast furnaces, which, when the latter are in full operation amounts to about 63,000 cu. ft. per minute, is used partly in the blowing engines and partly in the Cowper stoves for heating the blast; it is, however, thoroughly cleaned before being used. The latter operation is accomplished by means of ingenious arrangements of the piping, and by gas washers, the washing plant consisting of three Theisen washers, each of which is operated by a 150-hp compound-wound motor. Two of these washers are capable of dealing with all of the gas from the two furnaces, the third being installed as a standby. The gas goes into the washers at a temperature of from 300 deg. to 400 deg. Fahr., and with from 2 to 4 grammes of dust per cubic meter, and comes out at a temperature of 70 deg. with only .016 to .02 gramme per cubic meter, and is then suitable for the gas engines. This is believed to be the first instance in the history of iron making in which all of the blast furnace gas has been freed from dust before being used.

The process of making steel is a very interesting one, the plant erected for its manufacture being arranged according to the Talbot continuous process. The plant is the largest of this type yet erected in Great Britain. The continuous system of making steel by the Talbot process is as follows:

At the commencement of a run, steel scrap is put into the furnace; this is melted with the necessary re-agents, and metal from the mixer is poured into a hot-metal ladle, and carried to the ingot molds, the remainder being then over-oxidized by the addition of suitable materials and additional metal is poured in from the mixer.

The actual process at the Cargo Fleet Iron Works is as follows:

The iron from the blast furnaces is run into 20-ton and 25-ton hot-metal ladles carried on standard-gage trucks, which are then hauled by steam locomotives to the steel plant. On arriving close to the two metal mixers, each of which is capable of holding 150 tons and fired by means of gas from the coke ovens, the metal is poured into the mixer and some of the sulphur and silicon eliminated. On the charging side of the plant are two 40-ton cranes, each fitted with six series-wound motors, the total rating amounting to 175 hp per crane. From the mixers the metal is carried in a 20-ton ladle by means of one of the aforesaid cranes to the Richardsons-Westgarth Talbot furnaces, of which there are three, each being of 175 tons rating. On the pouring side of the furnaces there are two 75-ton cranes, each equipped with series motors; these cranes carry the ladles to the ingot molds, and pour the metal into molds holding from 3 to 5 tons. The ingots after being cast are taken on special cars hauled by steam locomotives to the stripping house, where the molds are stripped off and the ingots put directly into the soaking pit until required in the rolling mill. The slag from the steel furnaces is run out at the back into slag bogies, and is taken away to a special basic slag plant, which has been put down in order to crush the slag for agricultural purposes. The gas for firing the steel furnaces is made in 10 Talbot producers, from which the gas is then led to the furnaces through large regenerators in much the same manner as in a Siemens furnace.

The next process in the manufacture of the structural steel is that of cogging. This is done by a cogging mill having 40-in. centers, and 8-ft. 6-in. rolls, and driven by an 18,000-hp, three-cylinder, vertical-compound condensing engine built by Richardsons-Westgarth. The soaking pits are gas fired, surplus gas from the Talbot furnaces being used for this purpose, and are spanned by a 15-ton Broadbent crane and a mast crane of the Stuckenholtz type, the former being equipped with four electric motors. From the soaking pits, the reheated ingots are lifted by a 15-ton crane and placed on a mechanical chair for conveyance to the cogging mill. After being cogged down to the required size, the ingots are fed by further live roller gear to the bloom shears, where they are cut up into the required lengths. The live roller gear at the back and front of the mill is operated by four 55-hp railway-type motors to each set of rolls, the only persons required in the mill being a man and two boys for the control of the live roller gear, and one man for the cogging mill engine. From the bloom shears the blooms are transferred to the Collins charger by a shear transfer table and are taken by means of the Collins charger, operated by four 20-hp and one 10-hp electric motors, into either a gas-fired heating furnace, where they are reheated preparatory to the finishing rolling process, or directly to the mill, as the case may be. The cogging mill is spanned by a 40-ton crane, operated by three electric motors for the changing of rolls and other operations connected with the cogging plant.

From the reheating furnaces the blooms go to the finishing mill. This mill consists of four sets of rolls driven by a steam engine of the same size and type as that driving the cogging mill. The reheated bloom is placed on a live roller table and carried to the first pair of rolls and passed in succession through the four pairs of rolls by means of traveling tables on both sides. From the last pair the piece is carried forward by means of an extended roller rack to the hot saw or shears as may be desired. The hot saw is driven by a 100-hp shunt-wound motor; the live roller gear is also electrically operated by means of 20-hp tramway-type, series-wound motors. The finishing mill is equipped with a 60-ton electrically-operated crane, fitted with series-wound 22-hp and 20-hp motors for the main and auxiliary hoists, and 15-hp and 6-hp motors for the longitudinal and cross

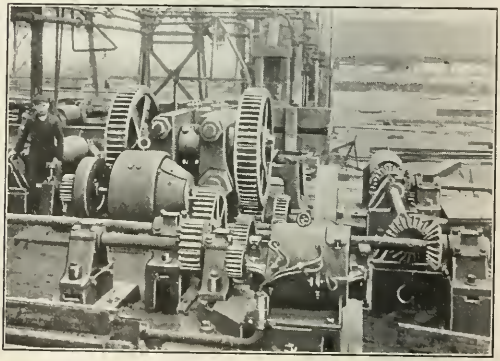


FIG. 6.—BEAM OR GIRDER STRAIGHTENING MACHINE.

traverse, respectively. Under this crane are also the roll-turning shop and the roll stores, so that when changes of rolls and repairs are necessary, they can be very easily carried out with the aid of this crane.

Beyond the finishing mill is a hot bank for cooling purposes, measuring some 100 ft. x 52 ft. From this bank the finished sections are fed by live-roller gear through the straightening machines to the shears, where they are cut into convenient and standard lengths. The hot bank is operated by eight 20-hp motors; four of these are on the live rolls and four on the skid gear. The angle and beam straightening machines are all electrically driven, the former being by means of a 55-hp motor and the latter by means of a 30-hp, shunt-wound motor. The beam or girder straightening machine is for straightening beams and girders up to 24 in. x 7.5 in., the live roller gear on either side being operated by a 20-hp series-wound motor. The head stock for straightening different sizes of beams is run in or out by means of a 5-hp series motor. The hot bank and straightening gear are spanned by two 10-ton gantry cranes, each equipped with three crane-type motors. The rail bank is equipped with two double-sided and one angle-sided electrically-driven straightener made by Messrs. Craig & Donald, the motor in the case of the first machine being rated at 20 hp and in the case of the single sided machine 15 hp, each machine being self-contained. In addition there are three ending machines and five drilling machines, all driven by electric motors.

The water for use throughout the works is obtained from the town, and a considerable quantity from the Tees, the water being pumped from the latter by means of two Mather & Platt turbine pumps operated by 70-hp motors.

Italian 12,000-hp Steam Turbo-Generator.

The accompanying illustrations give views of a 12,000-hp steam turbo-generator and auxiliary apparatus built by Franco Tosi, of Legnano, Italy, for central-station service. The turbine, which is of the Parsons type, is designed for 175-lb. steam pressure and 300 deg. C. supertemperature. It drives a Brown, Boveri & Company 25-cycle, 12,000-volt, three-phase generator at 750 r.p.m. It is stated that the steam consumption at full load is 14.1 lb. per kw-hour.

The turbine is connected to the alternator by a flexible coupling. The turbine bearings are lubricated with oil under a pressure of 22 lb. per sq. in. by means of a self-contained oil pump. Use is made of a small auxiliary steam pump to supply oil to the bearings during the starting period. The steam piping is so arranged that steam cannot be admitted initially to the turbine until the auxiliary pump has been started. Moreover, if the oil supply should fail, the turbine is brought to rest automatically.

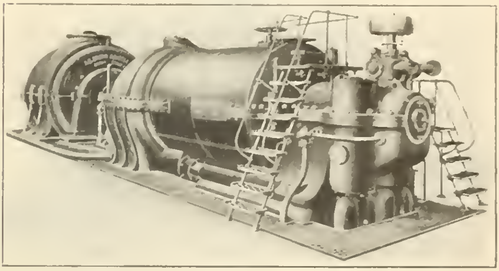
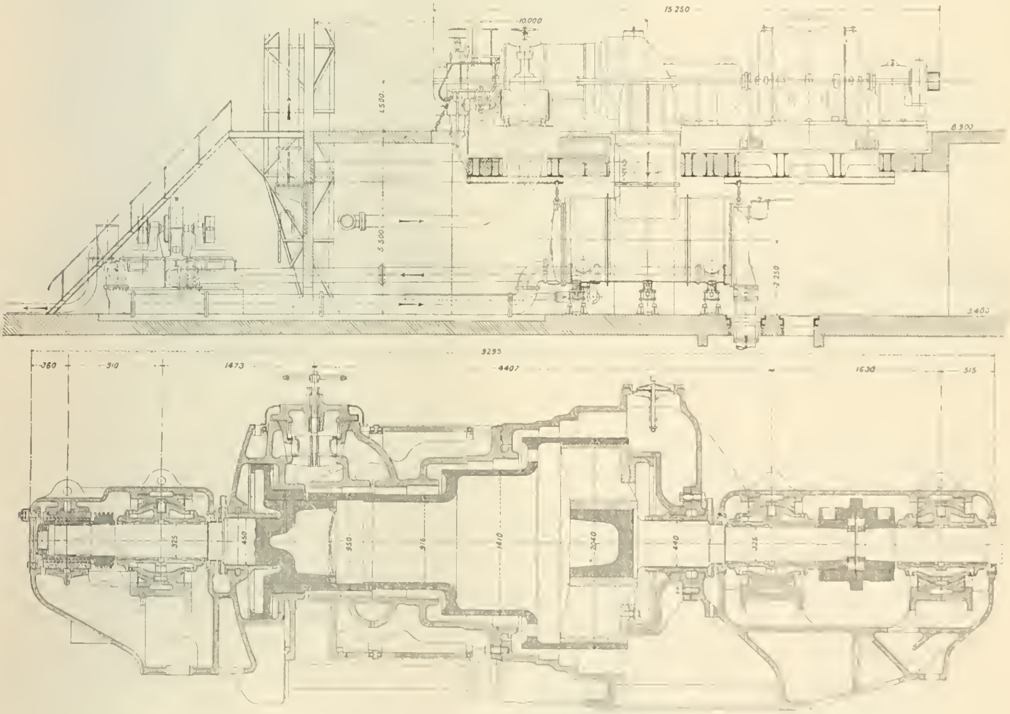


FIG. 1.—TOSI 12,000-HP TURBO-ALTERNATOR.



FIGS. 2 AND 3.—DETAIL AND SECTIONAL VIEWS OF TURBO-ALTERNATOR.

The condenser, which is of the surface type, is served by a wet air pump. This pump consists of two double-acting cylinders driven at 145 r.p.m. by an 80-hp direct-current motor. The air which accumulates in the higher parts is removed by means of a special pump. Two centrifugal pumps working in parallel serve for circulating the water; each pump is driven by a 90-hp direct-current motor. A complete syphon system is maintained in the circulation water pipes, so that the work required of the centrifugal pumps is kept at the minimum value.

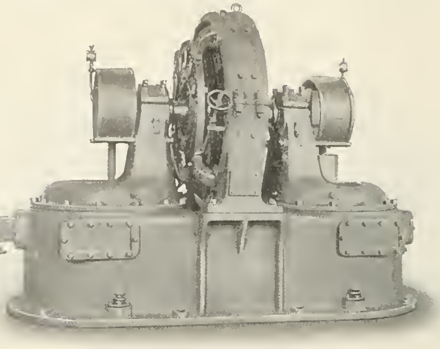
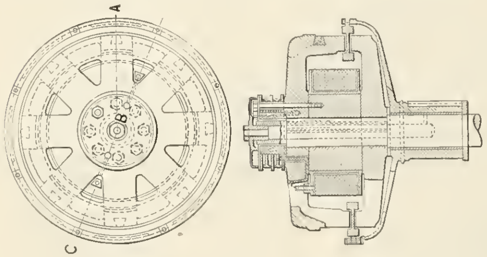


FIG. 4.—MOTOR-DRIVEN RECIPROCATING AIR PUMP.

The Induction-Type Clutch.

For many purposes it is desirable to drive heavy machinery that must be frequently and quickly started and reversed by a combination of a continuously-running motor and clutch-gearing of suitable design rather than by a reversing motor, the advantages becoming more pronounced the more frequent the reversing and the quicker the acceleration demanded. An induction clutch designed for the conditions here assumed is shown in Figs. 1 and 2.

Referring to Fig. 2, the relatively light spider, containing at its center a bearing bushing loose on the shaft and at its circumference holding a ring of copper, is the driven member of the clutch. This driven member may deliver power directly or through a pulley or pinion mounted on its hub. All other parts carried on the shaft revolve with the shaft and are parts of the continuously-running driving member. The driving member, apart from the collector rings attached to it on the left, has only three parts, namely, two steel castings and a bobbin between them holding the exciting coil. The two steel castings form a magnetic circuit, broken by the air-gap at the circumference, in which gap the copper ring is situated. The steel castings are cut away at the outside so as to concentrate the magnetic flux at eight poles, leaving between them spaces in which there are no magnetic lines except the few due to leakage. The copper ring is allowed ample running clearance between the oppositely-facing poles.



FIGS. 1 AND 2.—SECTIONAL VIEWS OF INDUCTION-TYPE CLUTCH.

When current exists in the exciting coil, and the driving member is revolving, the copper ring is dragged after the driving member by mutual attraction of the magnetic flux and the eddy currents set up in the copper, an action known as an "eddy-current drag." The action is the same as that of the induction motor except that in this case the revolving field is a field fixed relative to the driving member and revolved mechanically by revolving that member. The clutch is thrown into action by introducing current into the exciting coil through brushes which bear on the collector rings. When this circuit is broken the clutch instantly releases and no force whatever is exerted on the driven member.

The forces brought to bear on the copper ring are entirely in a tangential direction, hence there is no tendency whatever for the ring to be drawn over to the poles on either side. For this reason there is no wear at all in the clutch since there is no friction. The relations between slip and torque are substantially the same as those obtaining in the case of the induction motor, and the well-known variations in slip-torque relations that can be produced in the induction motor by varying the conductivity of the secondary circuits are here obtained by designing the ring with greater or less thickness in web or flanges, or both, or by varying the strength of the exciting current.

In rating these clutches the temperature rise is not considered as the limiting factor as is the case with dynamos and motors, because all parts are designed to withstand very high temperatures, the copper ring of itself being indestructible, and the exciting coil being wound with asbestos-covered wire. The clutches are rated at the pull which they can exert, and it is immaterial whether this pull is exerted only momentarily or continuously so far as consideration of temperature is concerned. The clutches are remarkably small as compared with the motors whose power they transmit, a clutch having an efficiency of 90 per cent weighing only one-seventh as much as the motor with which it is used.

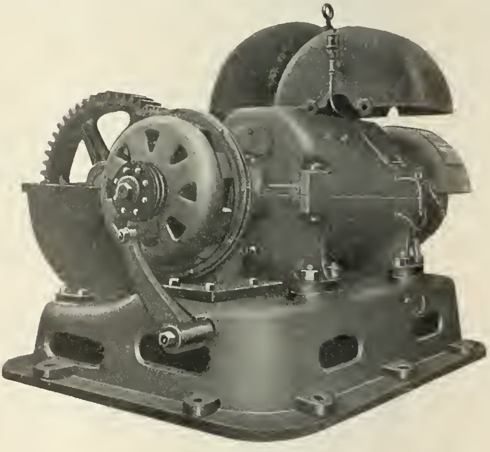


FIG. 3.—INDUCTION-TYPE CLUTCH.

Fig. 3 shows an induction clutch, such as are used in driving reversing tables and manipulators in the Bethlehem Steel Works, where 13 are installed.

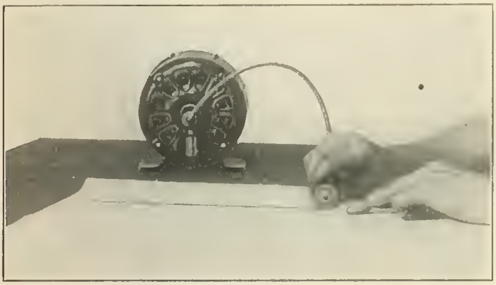
This clutch is capable of being applied in numerous connections simply as a clutch to be thrown in and out by closing or opening the exciting circuit. It has the property of positively protecting the driving and driven machinery against overload beyond the capacity of the clutch, which capacity is under control by fixing the strength of the exciting current. The clutch of itself is fool-proof against injury from overload or stalling.

In connection with reversing drives, the field in which the clutch seems best adapted is that of driving reversing rolling-mill tables, metal planers, elevators, mine hoists and reversing rolling mills, using power from either direct- or alternate-current continuously-running motors.

Exclusive rights to the manufacture and sale of the induction clutch in various forms, and of the induction drive, are held by the Wheeling Mold & Foundry Company, of Wheeling, W. Va., under patents taken out by A. P. Steckel, of Buffalo, N. Y., and F. du P. Thomson, of Wheeling, W. Va.

Motor-Driven Eraser.

In even the most careful work in engineering offices and drafting rooms mistakes will occasionally be made, and changes are frequently necessary, requiring alterations in tracings. It is well known by draftsmen that erasing with a very light fast motion will remove the lines without a scar. But most draftsmen do not have the patience to do the work without putting too great a pressure on the rubber, and the result is a marred tracing. The use of a scratcher leaves the poorest job of all. For these reasons an eraser driven by a small electric motor finds great favor among draftsmen.



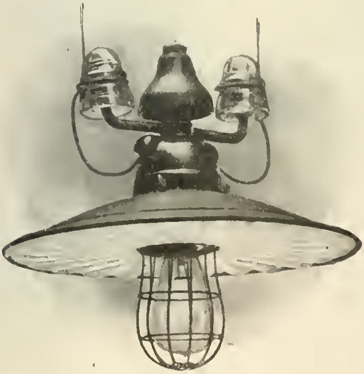
MOTOR-DRIVEN ERASER.

The eraser shown in the illustration is connected to the small Westinghouse motor by a Coates flexible shaft, allowing the motor to remain in one position near the edge of the table from which any spot in the drawing may be reached. If desired the motor may be carried from table to table, as it is light in weight. In some cases all tracings, etc., requiring correction are brought to a separate bench used for erasing.

The motor is of either the direct-current or alternating-current type rated at 1/12 or ⅛ hp. The complete outfit is supplied by the Coates Clipper Manufacturing Company, of Worcester, Mass.

Tungsten Lamp Fixture.

The growing interest in series incandescent street lighting since the introduction of the tungsten lamp has resulted in the improvement of fixtures for this purpose, and one of the latest designs of this class, made by the Wheeler Reflector Company, of Boston, is shown in the accompanying illustration.



TUNGSTEN LAMP FIXTURE.

This consists of an 18-in. porcelain enameled steel reflector, fluted to give the most effective candle-power distribution and protected by a copper or painted steel hood attached to a cast holder. The illustration shows malleable iron cross-arms supporting pony glass insulators in a vertical position, but these may be cast in one piece with the holders so that the insulators may be held at right angles to the stem. The mica insulating joint is designed for high-tension circuits and will stand a breakdown test of 34,000 volts. The important feature of this fixture, however, is the reflector, which besides being fluted and slightly convex, is adjusted at such an angle with relation to the filament and of a sufficient diameter (18 in.) to intercept the light radiated in the direction of the base. With a 40-cp lamp the light distributed shows a curve beginning at about 45 cp at the horizontal, increasing to 50 cp at nearly every angle from 20 deg. to 40 deg. below the horizontal, then gradually dropping to 40 cp at 60 deg., and 25 cp in the direction of the tip.

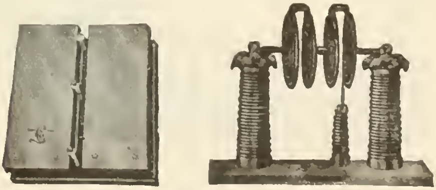
Sheet Steel Metal Locker.

METAL LOCKER.

A locker for general use, which is made entirely of sheet steel and is provided with two ventilators, one at the top and the other at the bottom, is illustrated herewith. The backs, divisions and end panels of these lockers are made of No. 24 gage sheet steel, the doors having ornamental perforations for ventilation and a lap joint to ensure a tight fit. The frames are made of steel angles and each locker is equipped with one shelf, three coat hooks, individual number plates and a special three-point locking device, which fastens the door at the top, center and bottom with a single turn of the handle. The latter is operated in connection with a dead spring bolt rim lock or brass padlock. The lockers are made in standard sizes with flat or slanting top, by Edward Darby & Sons Company, Philadelphia, Pa. These sizes, as adopted by this company, measure 12 x 12 x 60 in. high; 12 x 12 x 72 in. high, and 12 x 18 x 72 in. high. The lockers are finished in Tuscan red, olive green or black enamel, but may be finished in any other style desired.

Laminar Choke Coil.

The type of choke coil illustrated herewith is designed particularly for direct current stationary motors and for series arcs, as well as for alternating-current circuits of low frequency. It differs from the ordinary type by reason of there being alternate bands of copper and iron, the copper being entirely insulated from its magnetic neighbor by an insulating ribbon. The insulated member, which is entirely free from the circuit and acts purely as an inductive collector, traverses each of the conducting turns of the choke coil and absorbs from the current carrying strip the surplus static charge which otherwise would have leaked through the coil; and as the discharge rod is in close proximity to the upper edge of the insulated members, it readily carries away the static charge gathered on



FIGS. 1 AND 2.—LAMINAR CHOKE COIL.

their surfaces. The discharge rod is connected directly to earth through a "Par" lightning arrester. The copper ribbons, which are bare, are wound in sufficient numbers and of given size and capacity to conform to the circuit upon which it is to be placed.

An open type is also made, which is mounted on strips of marble or slate and when necessary is assembled in gangs to take care of very heavy currents. To increase its insulating properties for higher tensions it is mounted in a case surrounded by oil. All of the features of the discharge rod are retained, but the insulating properties are raised by reason of this emersion in the insulating fluid. This coil, like the other, is cut into the main circuit and acts as the choke coil to strengthen the insulation of the apparatus. Its discharge to ground is very sensitive in action by reason of the secondary ground outlet through the "Par" lightning arrester. These choke coils are made by the Lord Electric Company, of New York.

Gas-Fired Insulators for Transmission Lines.

The New Lexington High-Voltage Porcelain Company, of New Mexico, Ohio, has adopted natural gas exclusively for use in the kilns in which are fired the insulators which it manufactures for transmission line service. It is claimed that the gas-firing has two distinct advantages:

First, it eliminates from the glaze of the insulator all the impurities deposited when the insulator is burned in a coal-fired kiln. There may be a considerable amount of metallic substance in the impurities, but the principal difficulty is experienced from the sulphur in coal, which is deposited in the glaze of the insulator, which leads to arcing over under test at a lower voltage than it otherwise would. After this arcing, streaks will be found on the surface of the insulator which look somewhat like crazing; these cannot be removed and act as a sure tell-tale for sulphur in the glaze.

Second, it is naturally much easier to regulate 12 gas burners, by merely turning the valve a little one way or the other, in order to keep the temperature in all parts of the kiln the same, than it is to regulate 12 coal fires to accomplish the same result. In gas-firing, therefore, a more even temperature is obtained throughout the kiln, and when the insulators are drawn from it, they are of uniform color and vitrification, free from foreign matter, and in general have a cleaner and neater appearance than is possible with the use of coal. The above considerations indicate that an increased reliability in the service may be obtained with gas-fired insulators, accompanied with a decreased feeling of worry on account of interruptions caused by faulty insulators, on the part of the operating superintendent.

Switch for Starting Induction Motors.

The switch illustrated in Fig. 1 has been developed to eliminate the auto-transformer starter used with three-phase induction motors. By means of this switch it is possible to start a motor at what is the equivalent of 57.8 per cent of the running e.m.f. without using an auto-transformer. The phase windings of the motor are not permanently joined together, but are connected to six separate binding posts on the machine. By means of the switch, the three windings are arranged in star-connection for starting and in delta-connection for normal running. The interconnections of the six binding posts and the supply leads in the "off," "starting" and "running" positions of the switch are shown in Figs. 2, 3 and 4, respectively. It will be noted that in the "off" position all of the phase winding connections are interrupted, hence no additional main-circuit switch is required.

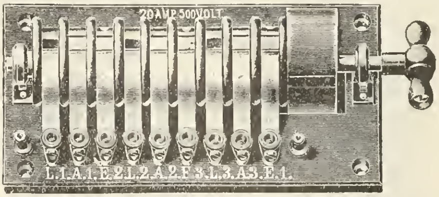
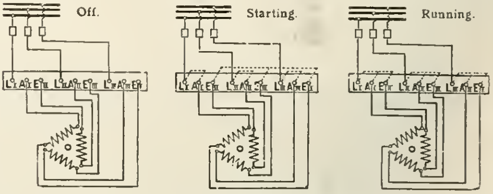


FIG. 1.—STARTING SWITCH.

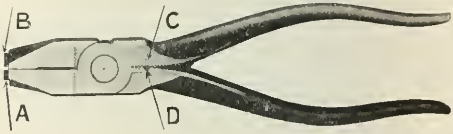


FIGS. 2, 3 AND 4.—CIRCUIT DIAGRAMS.

This switch is manufactured by the Bergmann Electrical Works, Berlin, Germany.

Safety "All-in-One" Wireman's Tool.

Wiremen usually require three different tools to cut wires, strip the insulation and make loops or eyes, viz.: side-cutting pliers, a knife and round-nose pliers. The implement illustrated herewith embodies all three of these instruments, and the three operations may be thus performed by the use of one tool. With this device insulation may be stripped from flexible cord without cutting any of the strands and without any possibility of cutting the fingers, as is common when the insulation is stripped by the use of a knife. Insulation can also be rapidly removed from the ends of rubber covered wire, and the wire can be looped into an eye to fit any size screw, without danger of scoring the wire. Where it is desired to tap a wire for connecting a rosette or a branch, a section of the insulation can be readily removed with this tool without scoring the wire.



WIREMAN'S TOOL.

Obviously this tool is a time-saving instrument, and as far as the stripping of insulation is concerned, performs this work with greater safety and speed than is possible by the old method. The looping or eye-making device consists of two round studs, *A* and *B*, on the end of the jaws. One is adapted to loop for a No. 6 screw and the other for a No. 8 screw. The wire stripper consists of a guide hole, *C*, extending nearly through the handles, ending in a thin cutter with a small wire clearance hole in the centre (*D*) with rounded edges.

The implement is 6 in. long and is used for No. 12 and No. 14 rubber covered wire, and No. 16 and No. 18 flexible cord. It is made by the Marshall Electric Company, Boston, Mass.

Field Coil Pads.

The Massachusetts Chemical Company, of Walpole, Mass., operating the Walpole Rubber Works and Varnish Works, has changed the name of one of its products, formerly known as "Field Coil Cushions," to "Field Coil Pads." These pads are used to take up all play between the field coils and adjacent parts, thereby doing away with chafing and resulting grounds through the field pieces. Formerly canvas sheets were cut to fit over the field pieces, and several such sheets were stuck together, making an unyielding washer which quickly wore out. The rubber field coil pads "give and take" sufficiently to prevent any looseness caused by expansion and contraction, and are claimed to be so easily applied as to save their cost in the time and labor saved.

New Types of Resistance Unit.

The accompanying illustrations show new types of resistance units brought out by Charles Wirt & Company, of Philadelphia. These are of the "Di-e-lite" construction and contain several novel features. Both forms illustrated are "ironclad" and are wound with zero coefficient wire. The body is of solid "Di-e-lite" (insulating stone). Fig. 1 has terminals which project through the supporting slate slab and serve for attachment, being sufficiently strong for this use. Fig. 2 has a cast-iron cradle or bracket with feet for attaching, and outwardly turned binding posts to facilitate connection in close quarters. A common size of such units is 1½ in. diameter and 7½ in. long.

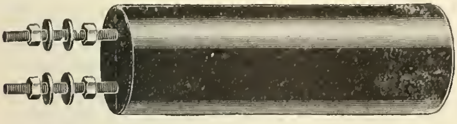


FIG. 1.—RESISTANCE UNIT.

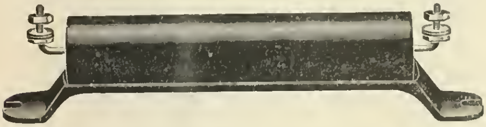
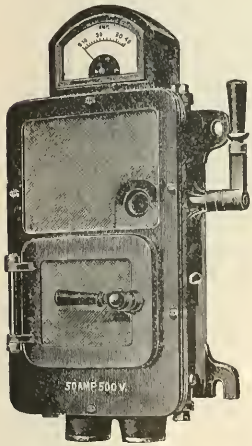


FIG. 2.—RESISTANCE UNIT.

They may be made of any size up to that of a length of stovepipe. "Di-e-lite" is claimed to possess a large heat capacity, is purely mineral and is unaffected by temperatures below red heat. When iron-clad, units of this construction have the qualities demanded by modern engineering practice—ability to stand very rough usage, mechanical and electrical.

Motor Switch Boxes for Use in Mines.

The Bergmann Electrical Works, of Berlin, Germany, have brought out a motor switch-box, as shown in the accompanying illustration, which is largely used in mines and similar places. In designing these motor switch-boxes special attention has been paid to mechanical strength, high insulation and reliability in working. The switch, fuses and ammeter are enclosed in a cast-iron case, and all joints are made completely watertight so that the switch boxes may be used in damp or wet places. The switch is of the double-break pattern for each pole and has a quick-break action. The position of the switch can be observed through a small glass window, a red indicator appearing when the switch is closed. The fuses are accessible through a door, but as the latter can only be opened when the switch is open, the fuses cannot be replaced except when the line is dead, and the switch cannot be reinserted until the fuse door is closed. Mica is used throughout for insulating all current-carrying parts, such as switch and fuses.



MOTOR SWITCH-BOX.

The terminals are arranged for cartridge fuses, but any kind of fuse can be fitted to order. Standard switch boxes are supplied with connections underneath the bottom of the box. The ammeters are of the soft-iron type fitted with air-damping arrangement. If desired, however, dead-beat, moving-coil instruments for direct current can be supplied. The ammeters have two scales: one is calibrated in amperes and the other in horse-power. Switch boxes are built for direct-, single- or three-phase current with or without an ammeter. The cable in lets can be removed and, if desired, connecting plates can be supplied suitable for conduit. The Bergmann Electrical Works are represented in Great Britain by Messrs. Marples, Leach & Company, Limited, Adnil Building, Artillery Lane, London, E. C.

Incandescent Lamp Guard.

The Underwriters require that an incandescent lamp exposed to contact with materials of an inflammable nature shall be inclosed in a wire guard so constructed that in no case can the lamp come nearer than 1 in. to such materials. In order to meet these requirements a guard must be attached rigidly to the lamp socket and the central part of the guard held at least 1 in. away from the lamp in all directions. A lamp guard which meets these requirements in every respect is shown in Figs. 1 and 2, made by W. N. Matthews & Brother, of St. Louis, and known as "The Holdfast" guard. It will be seen that the guard is clamped securely to the lamp socket and can be locked there permanently against removal by irresponsible persons. The inner spiral cushion serves to hold the lamp always in the same position with reference to the outside spreading ring, and at the same time will take up any vibration due to a sudden impact upon the outside protecting wires. These guards are made of four different weights of wire to meet all conditions of rough usage. The lightest is made of No. 18 wire and is used in places where the lamp is not normally exposed to severe blows from moving objects. Other guards are made of Nos. 14, 13 and 12 wire and are recommended for use in machine shops, in warehouses and on hand portables.

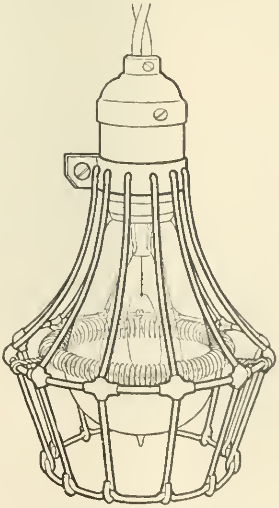


FIG. 1.—LAMP GUARD.

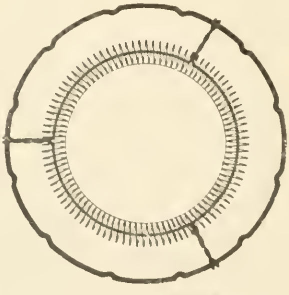


FIG. 2.—SPIRAL CUSHION.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Seasonable weather and increased manufacturing activity in the principal lines during the last week were the dominant features in the general trade situation and resulted in a continued improvement in commercial channels. Less idle machinery is reported and retail trade shows improvement as payrolls increase and as the situation strengthens on the prospect of good crops. Wholesale trade reports are also more optimistic. The slowness of collections, which are but little improved, reflect the backward position of the country as compared to a year ago. Money continues easy, but the influx from the country to the city has slackened off noticeably. Building expenditures in May were 29 per cent smaller than in April and 41 per cent less than in May, 1907. Following the rush in pig iron orders, the market was marked up and the placing of orders slackened. Reductions in certain lines of steel and iron did not bring out any amount of orders, as still lower prices are looked for. Failures for the week ended June 4 number 225, according to *Bradstreet's*, and are the smallest total reported for any week since last October. They compare with 263 in the preceding week, 155 in the like week in 1907, 162 in 1906, 194 in 1905, and 171 in 1904. Failures for the month of May numbered 1103, the largest number ever reported in that month, but slightly less than in either of the three preceding months. A somewhat better demand for electrical manufactures is reported and a number of large orders that were held up on account of the money stringency will be presently given out when the details of financing have been completed. The Westinghouse Electric & Manufacturing Company reports a better business for May than over any of the months since the beginning of the year, and Allis-Chalmers earnings for April were $250,000 in excess of the earnings reported in the preceding months. The earnings for the first seven months of the current fiscal year are understood to have exceeded all fixed charges, including interest, by $535,000. The Western Electric's domestic orders for April were 15 per cent better than the March showing, but the foreign business shows a slight decrease from March. The business of the Western Electric Company in 1906 was, in round numbers, $70,000,000. The next year it receded to about $50,000,000, and this year, it is estimated, will run between $25,000,000 and $30,000,000.

THE COPPER MARKET.

There was less activity in the copper market during the last week than during any other week since the first of the year. The only vitality shown was in the standard market, where prices are being maintained by speculation. As long as there is a profit in buying spot standard and selling future standard under the present price fluctuations, the speculative movement will be maintained, but a prevailing opinion is that according to the laws of supply and demand copper should now be selling at 12 cents or less. Although bare of stocks, the large consumers are holding off to see what the effect on the market will be from the influx from the reopened mines, which is due this month. The General Electric Company, which is reported to have cash on hand and in the banks aggregating between $15,000,000 and $18,000,000, has not entered the copper market for more than amounts required for immediate needs, and this is the attitude of practically all the large consumers. Although a large part of the heavy exports during the last six months have gone into consumption, there are still heavy supplies on hand in European warehouses, and Japanese interests are under pressure to sell spot copper in London, thus precluding the hope of unusual exports. The opening of this week showed little change in the situation, the dulness, perhaps, being a little more marked. There are those, however, who profess to take an optimistic view of the situation. The fact that several of the large selling agencies have refused to accept offers for large blocks of metal for future delivery around 13 cents a pound seems to indicate that producers, at least, feel confident of an early revival in demand. D. Houston & Company say: "There is not the slightest reason to imagine that copper will continue to suffer indefinitely under the disadvantage of a restricted demand. A tremendous expansion in the use of the metal is bound to follow the economical and conservative policy now practiced at the various melting establishments. Present prices of copper are at such a low level, and stocks in manufacturers' hands have been so much reduced, that the resumption of a brisk industrial demand ought to be hastened by sheer necessity." May exports showed a sharp decline from April exports, but a large increase over the exports for May, 1907. The decrease from April amounted to 9,113 tons, while the increase over May, 1907, which, however, marked a low record in exports for the last decade, was 16,630 tons. Monday's closing prices on the Metal Exchange were as follows:

Lake	12¾ @ 12⅞
Electrolytic	12½ @ 12¾
Castings	12⅜ @ 12½

Owing to the holiday in London, Friday's prices are quoted as follows:

	Noon.			*Close.		
	£	s	d	£	s	d
Standard copper, spot	58	2	6	..	..	.
Standard copper, futures	58	12	6	..	..	.
Market	Steady.			......		
Sales of spot				100 tons		
Sales of futures				400 tons		

*Closed until Tuesday.

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

FOX BROS. & COMPANY, 126 Lafayette Street, New York, have recently established an electrical department in connection with their railway and mill supply business. This new department will handle the line of arc lamps made by the Carbone Licht Gesellschaft of Germany, for which company they will be sole agents in the United States and Canada. This line of lamps includes the Carbone lamp, Radiante lamp, Phalanx lamp and Polar flaming arc. The Carbone lamp, which has attracted much attention since its invention several years ago, gives a fine white light and has an efficiency somewhat greater than that of the open arc. The Radiante lamp burns 40 hours on one trim and the quality of the light is particularly good for interior illumination, as in stores, offices, and in the textile industry where color values are important. The Phalanx lamp is the same lamp adapted for alternating currents. The Radiante Economy lamp takes 4 amperes and burns 32 hours on one trim. The light is white and soft and represents an efficiency nearly double that of the enclosed arc. The Polar flaming arc is made for both alternating and direct current. The large size burns 20 hours on one trim and the economy claimed is .25 watt per English candle. All of the above lamps have already passed into large use in Europe. D. D. Miller and Louis J. Auerbacher will have charge of the Fox electrical department. Mr. Miller, who was for many years in the sales department of the Westinghouse Company, will supervise the sales. Mr. Auerbacher has made a specialty from the beginning of the various recent great developments in arc lighting, and in several trips to Europe has thoroughly studied the various types of new arcs both in operation and construction, and also the processes of manufacture of the special carbons employed.

TO BOOM EXPORT TRADE.—With the purpose in view of extending American foreign trade, a committee of the directors of the Illinois Manufacturers' Association has decided to go abroad within the next six months. The committee, consisting of 200 members of the association, will visit Japan, China, Korea and the Philippines and other foreign countries. A special steamer, the first of a new line which will ply between America and the Far East, will transport the committee to Japan.

ELECTRICAL EXPORTS.—Exports of electrical appliances, including telegraph and telephone instruments, for the month of April, 1908, were valued at $586,427, an increase over the value of similar exports for the same month in 1907, which totaled $583,780. Brazil headed the list of countries importing this class of goods, with imports valued at $88,035, British North America was second with imports valued at $82,699, and Mexico third with $75,950. Exports for the 10 months ending with April, 1908, totaled $5,868,371, as compared with $6,868,071 for the same period in 1907 and $5,405,379 in 1906. Exports of electrical machinery to foreign countries valued at $566,586 for the month of April, 1908, showed a marked falling off from like exports in the same month in 1907, which were valued at $748,618. Japan headed the list of countries importing this class of electrical goods with imports valued at $187,693; the United Kingdom was second with $50,504, and Mexico third with imports valued at $48,891. For the 10 months ending April, 1908, the exports of electrical machinery from the United States totaled $7,366,634, an increase over the same period in 1907, when the exports were valued at $7,124,240. From the above it will be seen that although the exports of electrical appliances for April, 1908, increased over the exports for the same month in 1907, yet the exports of electrical machinery fell off from April, 1907, to the extent of $182,032. On the other hand, for the 10 months ending April, 1908, the exports of electrical machinery appliances, including telephone and telegraph instruments, fell off to the extent of $1,020,600 from the same period in 1907, while the exports of electrical machinery for the 10 months ending April, 1908, showed an increase of $242,394 over the corresponding period in 1907.

PLANT FOR CYANAMID.—The contract for the construction of the first cyanamid plant on this side of the water has been let by the American Cyanamid Company to Westinghouse, Church, Kerr & Company, of New York City. The contractors already have organized the work with men on the ground, and construction will be vigorously pushed in the expectation that the plant will be ready for operation in about 10 months. The plant is located at Niagara Falls on the Canadian side, and for the purposes of its present and future business the company has acquired an area of 26 acres. The initial capacity will be 7500 tons per annum, although the plans which have been prepared will permit the expansion of the industry at that point to 40,000 tons. There are 11 cyanamid plants in Europe projected, in process of construction, or in operation, and their aggregate annual capacity is 166,000 tons. Inasmuch as America supplies a considerable portion of the foodstuffs for Europe, it is thought likely that the expansion of the American plant for the purposes of agricultural fertilizer will be very rapid.

RITER-CONLEY $1,000,000 CONTRACT NEARING COMPLETION.—The contract which the Riter-Conley Company (Sharon) has with the Rio Janeiro Power Company, and involving in the neighborhood of $1,000,000, is nearing completion. The Riter-Conley Company contracted to furnish the feeder pipes, transmission line towers and structural material for the large hydro-electric plant of modern design, which the Rio Janeiro Light & Power Company is developing at Rio das Lages. The initial maximum capacity of this plant will be more than 50,000 hp, but the enormous storage capacity of the reservoir which is being constructed, and which has a capacity of 7,780,000,000 cu. ft., will enable the company to increase further the capacity of the station as business requires. It is estimated that a total capacity of at least 120,000 hp can be developed at this point if necessary. The turbines used in the work are being furnished by the Escher-Wyss Company, and the electrical apparatus is supplied by the Westinghouse Electric & Manufacturing Company.

SYNCHRONOUS MOTOR-GENERATOR IN CHLORINE PLANT.—The chlorine plant of the United States Reduction & Refining Company, at Colorado Springs, Col., has in operation an Allis-Chalmers 150-kw synchronous motor-generator set to supply electricity for the electrolytic production of chlorine used in the treatment of gold ores. MacDonald cells with carbon anodes and cast-iron tanks as cathodes and an electrolyte of salt solution are used in connection with the set. A syncronous motor-generator set was selected as best adapted for operation in connection with the cells because any serious drop in potential would cause the machine to fall out of step and release itself from the circuit. Otherwise the counter e.m.f. generated by the cells themselves would have a tendency to reverse the polarity of the generator. The set consists of a 225-hp synchronous motor coupled to a 150-kw generator. The motor is fed with three-phase, 440-volt, 60-cycle currents and the generator delivers direct-current at a potential of 150 volts.

WESTINGHOUSE BUSINESS.—In line with the report of improvement in the conditions at the works of the Westinghouse Electric & Manufacturing Company at East Pittsburg, it is said that during the month of May the shipments of finished material represented $2,250,000, or almost $700,000 more than the shipments during April. While the general business of the company still shows evidence of betterment, especially in the demand for small apparatus, it is not expected that there will be any unusual activity in the departments constructing large machines until the candidates for President have been selected. That this seems to be a fact is indicated by the many negotiations which are held in suspension for the present. Similar conditions exist at the Westinghouse Machine Company, although the latter has just secured a very important contract for gas engines and gas producers from the Duranguena Electric Company, of Durango, Mexico.

ACHESON LUBRICANTS.—Edward Goodrich Acheson has transferred to the Acheson Oildag Company his patents and trade-marks covering his latest important products, "Oildag" and "Aquadag." These patents and trade-marks cover the industrial world, 22 countries in all. Oildag has already obtained popularity as a gas-engine lubricant, the claim being made that its use makes possible a 50 per cent reduction in the oil consumption, at the same time greatly increasing the available power of the engine by decreasing the friction and increasing the compression, also quieting the engine and making it run like velvet. Oildag is also valuable in the operation of electric-light plants. It is a mixture of deflocculated, unctuous Acheson-Graphite mixed with oil, put up in tubes and cans for charging 1, 5 or 10 gal. of mineral oil. The Acheson Oildag Company has established offices and works at Niagara Falls, N. Y.

DUNCAN COMPANY TO MANUFACTURE TRANSFORMERS.—The Duncan Electric Manufacturing Company, Lafayette, Ind., has purchased the machinery, tools and business of the Lafayette Electrical Manufacturing Company, manufacturers of transformers. The transformer plant has been thoroughly rejuvenated and the most modern transformer manufacturing apparatus installed. The services of one of the most competent transformer engineers in the United States have been secured, and workmen are now engaged in installing an insulation impregnating outfit. A new departure in the testing of transformers is that of subjecting them to a higher breakdown test than has heretofore been customary, as an extra means of insuring the highest standard of dependability.

WESTINGHOUSE MOTORS FOR MEXICO.—The San Rafael Mineral Company, of Pachuca, Mexico, has placed an order with the Westinghouse Electric & Manufacturing Company for an electrical equipment for a stamp mill. The order, which came through the Westinghouse Mexican agent, includes eight motors and a switchboard. For the month of April, 1908, Mexico imported electrical machinery to the value of $48,891, and was the third largest importer of this class of machinery from the United States.

MOTOR MANUFACTURERS FORM ASSOCIATION.—A majority of the electric motor manufacturers of the country held a meeting at Hot Springs, Va., June 1, 2 and 3, at which an association was formed for the purpose of promoting better acquaintance among the manufacturers and the discussion of technical and commercial questions affecting the trade. The officers and permanent organization will be announced later.

THE BAY STATE LAMP COMPANY, of Danvers, Mass., has equipped a factory for the manufacture of "Hygrade" new lamps, which it will sell in addition to the "Bay State" lamp. The new lamp is stated to be the result of several years of experiment to meet every requirement for a high grade, uniform and lasting carbon filament lamp.

PIRELLI & COMPANY, MILAN.—Capt. G. L. Carden, special agent of the Department of Commerce and Labor, in a recent report, states that Pirelli & Company are now employing 5300 men in their works, the output of which consists of insulated wire and cables for all purposes, including the submarine telegraph, and also rubber tires.

SAN FRANCISCO TELEPHONE COMPANY ORDERS 17,000 TELEPHONES.—The Automatic Electric Company, of Chicago, has received an order from the Home Telephone & Telegraph Company of San Francisco, to ship at once 15,000 telephones for that city, and 2000 for the plant at Berkeley, Cal.

Financial Intelligence.

THE WEEK IN WALL STREET.

The most significant feature of the stock market last week was the sudden loss of interest on the part of speculators—who have constituted principally the buying element during the recent activity—as soon as the announcement was made that the Union Pacific financing plans had been consummated by the sale of first mortgage bonds to banking houses in New York and Europe. The opinion of the speculative element seems to have been that prices were simply being pushed upward by large financial interests with a view of making a basis upon which to market these bonds. This transaction having been completed the professionals naturally concluded that it was a good time to take in profits, and the pressure to sell became more acute. Thus is explained the course of the market during the week. In the earlier days the advance was resumed, and there was some activity on the buying side. With modest transactions prices were not only sustained, but were slowly pushed a little higher. On Thursday, when the Union Pacific bond transaction was announced, the buying was checked and sellers were more largely in evidence. Prices in many instances sagged, and the volume of trading was curtailed. Net changes for the week show probably as many advances as losses, but the decline from midweek to the close was practically universal, and the activity was notably less. The reduction in the price of steel bars amounting to $4 per ton, while not directly reflected in the price movements of Wall Street, was generally accepted as a move tending toward the improvement of general trade conditions and therefore resultant eventually in an improved condition of securities. Manufacturers are of necessity benefited in any cheapening of raw material. The general impression prevails that other reductions in steel products will follow, and a general feeling of hopefulness for increased orders pervades the element interested in industrial securities. Another encouraging feature pointed to by the sanguine traders in the Street is the general easier tendency in the rates for money in all the financial centers of the world. The open market discounts in London and Paris were materially easier, and the official rates quoted by the banks of Germany, Sweden and the Netherlands were reduced. This tendency was, of course, reflected in Wall Street, and is taken as an invitation to investors to buy at present price levels, awaiting the materially higher levels which are confidently promised when business again resumes normal conditions. Among the notable advances during the week ending Saturday, June 6, were: Amalgamated Copper, 2⅜; American Telegraph & Cable, 4½; Central Railroad of New Jersey, 5; Denver & Rio Grande, 6; General Electric, 3; New York, New Haven & Hartford, 4½; Southern Pacific, 3⅛, and United States Rubber, first preferred, 2¾. There was little activity shown in the market on Monday, and the fluctuations were within narrow margins. The net changes for the day were mostly records of fractional losses, and at all times the trading was extremely dull. The publication of the government crop report was a sustaining factor, but traders were apathetic. Closing prices on Monday are given in the table.

NEW YORK.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
All.-Ch.	9⅛	9⅝	1,000	Int-Met., com.	12¼	11½	6,725
All.-Ch., pfd.	24¾	27⅜	4,000	Int-Met., pfd.	33	32	13,580
Amal. Cop.	67¼	67⅛	130,000	Mackay Cos.	65⅝*	66	100
Am. D. T.	39*	39*	———	Mackay Cos., pfd	65*	65½	200
Am. Loc.	50⅝	49¾	9,200	Met. St. Ry.	27*	30	900
Am. Loc., pfd.	103*	102½	200	N. Y. & N. J. Tel.	110	109	18
Am. Tel. & Cbl.	65	65	100	Steel, com.	38⅞	37⅝	393,270
Am. T. & T.	117¾	118	1,700	Steel, pfd.	102¾	101⅛	23,773
B. R. T.	49¼	48⅝	35,300	W. U. T.	56¾*	50¼	323
Gen. Elec.	138	135½	1,126	West'h, com.	51¼	50¼	4,275
Hud. R. Tel.	—	—	———	West'h, pfd.	70½	—	400

PHILADELPHIA.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
Am. Rys.	44¼	44¼	———				
Elec. Co. of Am.	10	10	———	Phila. Elec.	8½	9½	———
Elec. Stor. B'ty.	30½	33	———	Phila. R. T.	14¾	13⅛	———
E. S. B'ty, pfd.	—	—	———	Phila. Traction	90	87	———

CHICAGO.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
Chicago City Ry.	160	165	———	Met. Elev., Com.	18	18	———
Com. Edison.	94⅛	95	———	Met. Elev., pfd.	55	53	———
Chicago Subway.	20⅜	20	———	National Carbon.	64	67	———
Chicago Tel. Co.	123½	127	———	Nat. Carbon, pfd.	110	112	———

BOSTON.

	June 1.	June 8.	Shares Sold.		June 1.	June 8.	Shares Sold.
Am. Tel. & Tel.	117⅞	117¾	———	Mass. E. R., pfd.	44	47	———
Comb'ind Tel.	—	—	———	Mex. Tel., pfd.	5⅝	—	———
Edison El. Ill.	213	211	———	New Eng. Tel'p.	111½	110¾	———
Gen. Elec.	138	135	———	W'st Tel. & Tel.	6	6	———
Mass. Elec. Ry.	9	10	———	W. T. & T., pfd.	67	—	———

*Last price quoted.
Shares sold are for week June 1-6.

NEW YORK CENTRAL'S TROLLEY HOLDINGS.—Through Mr. Horace C. Andrews, of Cleveland, head of the Andrews syndicate, the New York Central has been gradually acquiring control of New York State traction systems for several years. The full extent of these holdings has now, for the first time, been made known through the movement started by the railroad to secure the consent of the Public Service Commission of the Second District to the formation of an extensive holding company. The new company will be amenable to the public service laws, but, being totally within the state, will be entirely outside the jurisdiction of the Interstate Commerce Commission. The list of properties already acquired is as follows:

	Bonds.	Stocks.
Canandaigua Gaslight		$50,000
Eastern Monroe Electric Light & Gas	$6,000	250,000
Oneida Railway	10,000	15,000
Ontario Light & Trac		30,000
Rochester Ry. & Light	11,926,900	9,500,000
Rochester Electric Ry		200,000
Roch. & Sodus Bay Ry		1,850,000
Rochester Railway	4,557,000	6,000,000
Roch. & East Rapid Ry	1,500,000	1,500,000
Roch. & Suburban Ry	450,000	420,000
Rome City Street Ry	200,000	150,000
Syracuse Rapid T. Ry	4,149,000	4,000,000
Utica & Mo. Val. Ry	3,157,000	7,500,000
Total	$25,955,900	$31,465,000

In addition, it is understood, that options are held on these properties:

	Bonds.	Stocks.
International Traction Company of Buffalo	$18,255,000	$15,000,000
Buf., Lock. & R. Ry	4,000,000	1,760,000
Syracuse & Sub. Ry	550,000	400,000
Total	$22,805,000	$17,160,000

Connection between Rochester and Syracuse may be accomplished by the electrification of the West Shore, or by the purchase of the lines held by the Beebe syndicate, which is the more likely plan. These roads are:

	Bonds.	Stocks.
Roch., Syr. & Eastern	$7,500,000	$8,500,000
Auburn & Syracuse	1,390,000	1,950,000
Auburn & Northern	1,000,000	1,500,000
Total	$9,890,000	$11,950,000

The properties already obtained are held by the Mohawk Valley Company, a corporation with a capital stock of $20,000,000, of which the New York Central holds 60 per cent, while the balance is held by the Central Railway Syndicate, in which are represented the Andrews interests, and to which large owners of New York Central securities are subscribers. The total holding of traction securities by the railroad will, under this plan, amount to about $100,000,000.

DIVIDENDS.—The directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2¼ per cent on the capital stock, payable June 15. Directors of the Chicago City Railway Company have declared the regular quarterly dividend of 1½ per cent, payable June 30. The directors of the Lindsay Light Company, of Chicago, have decided to pass the dividend on the capital stock. Secretary C. M. Wheeler says: "The company was never in better financial condition than it is to-day, but earnings and trade conditions do not warrant the payment of dividends at this time, so the directors have deemed it prudent to defer payment temporarily." The directors of the Columbus Railway & Light Company have declared a dividend of ½ per cent on the capital stock, payable June 15 to stock of record June 1. The directors of the United Traction & Electric Company have declared the regular quarterly dividend of 1¼ per cent, payable July 1. The regular quarterly dividend of 1½ per cent on the capital stock, payable July 10, to stockholders of record June 3, has been declared by the Canadian Westinghouse, Ltd. The West End Street Railway Company, of Boston, has declared a dividend of $2 a share on its preferred stock and 3 per cent on its common stock, payable July 1. Under the terms of the lease with the Boston Elevated, the usual semi-annual dividend of 4 per cent on West End Street Railway Company preferred stock will be paid July 1. The regular quarterly dividend of 2½ per cent, payable June 30, has been declared by the directors of the Chicago Telephone Company.

ANOTHER APPEAL TO WESTINGHOUSE STOCKHOLDERS.—After the meeting of the reorganization committee on June 1, when it was decided to extend to June 22 the time for allowing the stockholders of the Westinghouse Electric & Manufacturing Company to subscribe for their share of the assenting stock, the following letter was sent out to the stockholders: "Your committee reports that the merchandise creditors' committee have succeeded in securing subscriptions to new stock of the company from the holders of all the merchandise debt excepting about $450,000. The advantage to the stockholders of this voluntary conversion into assenting stock, at par, of floating debt of such magnitude is manifest. Unfortunately, the stockholders, the real owners of the property, who have the most at stake, have not done as well as the creditors, for thus far the stockholders have sent in subscriptions for only about one-half of the $6,000,000 of stock for which they are required to subscribe in order that the merchandise creditors' plan may become operative. For the purpose of securing for the stockholders a full opportunity of availing themselves of the subscriptions of the merchandise creditors, and in view of the enormous advantage to the company and its stockholders which would result from the success of the merchandise creditors' plan, the readjustment committee have extended to June 22 the time within which the stockholders may furnish the necessary subscriptions to the new stock. Stockholders who have not yet subscribed should send in their subscriptions at once to the secretary of the committee. It is only by prompt action on the part of the stockholders in subscribing for their full quota of the new stock that a forced sale of the assets of the company and the serious sacrifice of your investment can be prevented." The merchandise creditors' committee is still at work and expect to arrange for the creditors, represented by the $450,000, to take that amount in stock in exchange for their claims before June 22, the final date. The stockholders' committee report that returns are still coming in slowly and express the belief that the necessary amount will be obtained when all the stockholders have been heard from.

DENVER GAS & ELECTRIC.—A stockholders annual meeting of the Denver Gas & Electric Company was held last month, when a report for the year was presented. The net earnings of the company, as shown by the report, were increased $136,012.32. After reading the report the stockholders instructed the directors to create a sinking fund in the general mortgage in order to retire the outstanding bonds of the company from time to time. There are four different methods of sinking fund maintenance under consideration, and one of these will be decided upon at an early date. The stockholders also made arrangements for the issuing of a number of small denomination bonds in place of some of the large denominations now outstanding. At present the smallest bond of the gas company is $1,000. It is planned to take up a number of these and issue their equivalents in denominations of from $100 to $500, in pursuance of the company's policy of interesting as large a number of people as possible in the welfare of the corporation. At present the company has $5,500,000 out in general mortgage bonds, which mature in 1949. The stockholders chose the following men to act as directors for the ensuing year: Emerson McMillan, Henry L. Doherty, Frank W. Frueauff, James B. Grant, John C. Mitchell, Fred G. Moffat, William J. Barker, Henry T. Rogers, Harry C. James, Edward W. Rollins, John T. Brady, John H. Porter, Clare N. Stannard. After the stockholders' meeting had adjourned the directors held a meeting and re-elected officers as follows: Emerson McMillan, chairman of the board of directors; H. L. Doherty, president; Frank W. Frueauff, vice-president and general manager; W. J. Barker, second vice-president and general superintendent; C. N. Stannard, secretary, and John T. Brady, treasurer.

MARCONI OFFICIAL DENIES REORGANIZATION REPORT.—Officials of the Marconi Company deny the report emanating from Washington to the effect that a reorganization of the company is under way and also that the company has given up its fight against the ratification of the Berlin Treaty by the United States. The terms of the treaty, if adopted by the United States, would oblige wireless stations and vessels at sea equipped with wireless apparatus, to communicate with each other without regard to the system used, a move which the Marconi interests have vigorously opposed on the grounds that the government, by the adoption of the treaty, would be interfering with the rights of private enterprise. A director of the company denied that there had been a reorganization. "The company has merely increased its capitalization," he said to the Electrical World, "to £750,000 by the creation of 250,000 preference shares at £1 each, conferring the right to a fixed cumulative preferential dividend (in priority to all other shares) at the rate of 7 per cent per annum on the capital. Certainly that does not constitute a reorganization. As for the Berlin Treaty, it has been buried in committee in the last session of Congress and we intend to see that it remains buried."

METROPOLITAN STREET RAILWAY CERTIFICATES SOLD.—The Central Trust Company and the banking house of William A. Read & Company bought $3,500,000 of one-year 5 per cent receivers' certificates to be dated June 15, 1908, from Adrian H. Joline and Douglas Robinson, receivers for the Metropolitan Street Railway Company and the New York City Street Railway Company. The certificates are secured by a first lien on all properties and income of these traction companies including real estate and leasehold rights, and upon all property hitherto acquired or to be acquired by the receivers from the proceeds of these certificates. Under the decree of the court no additional certificates can be issued without providing that the proceeds shall be used to take up the $3,500,000 to be issued at the present. The real estate in New York City upon which these certificates will become a first lien includes the power house at the East River and Ninety-sixth Street and other property in various parts of the city, which is assessed at the present time for more than $7,000,000.

COMMONWEALTH (MICHIGAN) POWER COMPANY.—The operating results of the Commonwealth Power Company for the first eight months of the present fiscal year ended Feb. 29, 1908, show gross earnings of $346,551, against $257,424 for the corresponding period last year. Net income, after deducting all operating expenses, taxes, insurance and maintenance charges amounted to $99,134. The 6 per cent dividends on the outstanding $1,252,000 preferred stock amounting to $50,080, leaving a surplus of $49,054 for additional improvements, etc. The company's installation records show that 4,933 motors (aggregating 10,865 hp) in various manufacturing establishments are new served with electric power, compared with 823 motors (representing 7,140 hp) connected last year. To provide for the future, in addition to its seven completed water power properties, this company has acquired many valuable power sites to be developed as needed.

DIRECTORS ELECTED AT MONTPELIER.—The annual meeting of the stockholders of the Consolidated Lighting Company, of Montpelier, Vt., took place on May 25 in New York City. The following directors were elected: Mr. W. F. Davidson, Port Huron, Mich.; Mr. J. C. Tomlinson, New York, N. Y.; Mr. Clarence Senter, Montpelier, Va.; Mr. J. E. Davidson and Mr. C. S. Davidson, both of Montpelier, and Mr. A. D. Bennett, Port Huron, Mich. The following officers were elected: Mr. James E. Davidson, president and general manager; Mr. John C. Tomlinson, vice-president; Mr. A. D. Bennett, treasurer, and Mr. C. S. Davidson, secretary. The same officers were elected for the Vermont Power and Lighting Company and the directors chosen were: Mr. John C. Tomlinson, Mr. A. D. Bennett, Mr. C. S. Davidson, Mr. George G. Moore and Mr. J. E. Davidson. The fiscal year of the two companies ended May 1 and the report of the general manager showed a successful year

CHICAGO RAILWAYS COMPANY SELLS BONDS.—The Chicago Railways Company has sold to N. W. Harris and to the National City Bank an additional $3,000,000 first mortgage 5 per cent bonds. The proceeds will be used at once in order to enable the company to take advantage of the present low prices for construction work, and the bonds will be offered to the public shortly. Following the sale of these bonds the company had placed an order for 650 cars to be delivered not later than April 30, 1909. The price paid for these cars will enable the company to save at least $1,000 on each car, in comparison with prices a year ago, making a total minimum saving of $650,000.

APPLICATION FOR CHICAGO CONSOLIDATED TRACTION RECEIVERSHIP.—In the United States District Court was filed, on Saturday last, an application by the Central Trust Company, of New York, acting as trustee under the mortgage of the Chicago Consolidated Traction Company, for a receiver for the company. The Chicago Consolidated Traction trols all the important suburban electric street railways in the Company was formed in 1809 by Charles T. Yerkes, and con- north and west divisions of Chicago. It is proposed that the receivership shall be used as a basis for reorganization of the company in order to prepare terms on which the property could be sold to the Chicago Railway Company.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

LOCKESBURG, ARK.—The Lockesburg Telephone Company is preparing to construct a telephone line to Paraclifta and Riddle.

NEWPORT, ARK.—The Newport Water, Light & Power Company, recently incorporated with a capital stock of $100,000, has purchased the plant and holdings of the Newport Water Company. The company has been granted a 30-year franchise by the city and proposes to either purchase the local electric light plant or erect a new one. The officers of the company are: A. N. Walker, of Marion, S. C., president; N. V. Walker, of Aurora, Mo., vice-president and general manager; L. Miner, of Newport, secretary and treasurer.

PINE BLUFF, ARK.—The United States Court on June 6 ordered the property of the Pine Bluff Light & Water Company to be sold on June 9 under foreclosure proceedings.

LOS ANGELES, CAL.—The contract for installing a heat and power plant in the new annex to the county jail has been awarded by the County Supervisors to Newell Brothers, of this city, for $10,744.

MONROVIA, CAL.—Application has been made to the City Trustees by H. Kirchenschlager asking for franchises to construct a street railway on the principal thoroughfares in the city, to be operated by electricity, gas or gasoline motor.

SANTA CRUZ, CAL.—The San Vincente Lumber Company contemplates establishing a power plant here. M. H. Grover is manager.

SANTA CRUZ, CAL.—Preliminary steps have been taken for bonding the city for $100,000, for extension of the electric lighting system, water supply and construction of a new bridge.

LAS ANIMAS, COL.—The Navy Department at Washington, D. C., has authorized the award of the contract for installing the electric lighting system at the New Hospital at New Fort Lyon, Las Animas, to the D'Olier Engineering Company, of Philadelphia, Pa., for $8,652.

BETHEL, CONN.—The Danbury Gas & Electric Light Company has submitted a proposition to the borough officials to light the borough with electricity, using tungsten lamps.

HARTFORD, CONN.—Arrangements are being made by the New York, New Haven & Hartford Railroad Company to commence work on the extension of the electric railway to Bloomfield. C. S. Mellen is president of the company.

WASHINGTON, D. C.—Bids will be received until June 16 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 1246—1000 dry battery cells; 12,500 ft. single conductor insulated telephone wire and 6000 ft. rubber covered copper wire; supplies for telephone and telegraph system. Boston, Mass.: Schedule 1270—Four induction motors; switchboard. Bids will also be received until June 23 as follows: Mare Island, Cal.: Schedule 1258—1450 lb. insulating tape; enclosed fuses; copper, copper rod, etc.; lighting wire. Applications for proposals should designate the schedules desired by number. E. B. Rogers, paymaster general, U. S. N.

TAMPA, FLA.—Plans are being considered by the Tampa-Sulphur Springs Traction Company to construct a ¾-mile extension to its system in Ybor City.

ATLANTA, GA.—The Atlanta, Griffin & Macon Railway Company, and the Americus & Albany Electric Railway Company have made application to the State Railroad Commission for permission to issue $5,000,000 in capital stock and $5,000,000 in bonds for each company, the proceeds to be used for the construction of an electric railway from Atlanta to Macon and Albany.

VIDALIA, GA.—The municipal electric light plant has been completed and is now furnishing electricity for lighting the city. The plant was installed by McCrary & Company, of Atlanta.

DWIGHT, ILL.—Seigert Brothers & Company are making arrangements to rebuild and enlarge their electric light plant and have placed orders for a 130-kw, 2200-volt Westinghouse alternator and a four-valve Ball engine.

JOLIET, ILL.—Plans have been completed by the Western United Gas & Electric Company for the construction of its new plant, the site for which has been purchased.

MANITO, ILL.—S. J. Marshall, clerk, writes that the contract for completion of the electric light plant has been awarded to the Ft. Wayne Electric Company for $3,000. E. E. Sayler is engineer.

STREATOR, ILL.—It is reported that the Chicago, Ottawa & Peoria Railway Company will soon commence construction work on its railway between Streator and Ottawa. H. E. Chubbuck, of Ottawa, and George Mattis, of Champaign, are among the directors.

TAYLORVILLE, ILL.—Work will soon commence on the construction of the local railway of the Taylorville Railway Light, Heat & Power Company, which will be about four miles in length. The power station will be located in Taylorville. The company will also sell electricity for lamps and motors. The company is capitalized at $150,000, and the officers are: James Forester, of Taylorville, president; Henry Cheney, of Taylorville, vice-president; James A. Adams, secretary, and W. B. Adams, general manager.

WINDSOR, ILL.—A franchise has been granted by the City Council to the Mattoon, Shelbyville, Pana & Hillsboro Traction Company to construct its railway in Windsor.

CHANDLER, IND.—The Chandler Telephone Company has been granted a franchise to erect a telephone system in this place.

CROWN POINT, IND.—A committee of business men of this place has secured the right of way from Crown Point to Gary, a distance of 11 miles, which it will donate to any company which will build an interurban railway connecting either Gary or Hammond with Crown Point before May 1, 1909. The property is held by three trustees, John Brown, W. G. Woods and W. E. Sasse, who also have a franchise over the highways in Lake County.

INDIANAPOLIS, IND.—Plans are being made by the People's Light & Heat Company to increase its capital stock from $50,000 to $1,000,000, the proceeds of which will be used to construct a large plant in Vigo County, a few miles west of Terre Haute. The company has acquired the coal mines of the Feuvre Coal Company in Vigo County, and proposes to erect its power plant near the mines and erect transmission lines through Terre Haute, Brazil, Greencastle, Danville, Plainfield and to Indianapolis. The plant will have an output of 5000 hp. Frank M. Fauvre is president of the company and Paul H. White, secretary and treasurer.

MARION, IND.—A proposition has been submitted to the City Council by the Marion Light & Heating Company for lighting the streets of the city, which it is said will be considered by the Council.

SOUTH BEND, IND.—The Indiana-Michigan Power Company contemplates rebuilding the Buchanan Dam, which was destroyed by the flood last spring. The present dam will be replaced by a concrete structure.

TERRE HAUTE, IND.—The contract for the construction of the Terre Haute & Merom Traction Company's railway through the town of Gardenville was awarded to Dunn Roberts, of Terre Haute.

MASON CITY, IA.—The name of the Mason City & Clear Lake Traction Company has been changed to the Mason City & Clear Lake Railway Company.

OSKALOOSA, IA.—Plans are being made by the Home Telephone Company to place its wires underground in the business section of the city.

SIOUX FALLS, IA.—F. W. Bisbee, of Castana, is reported to be interested in a project to construct an electric railway from Sioux City to Council Bluffs and Omaha.

SLOAN, IA.—An independent telephone company has been organized by the citizens of Sloan to install a local system. The company is capitalized at $500, and the directors are B. H. Danforth, E. A. Shea and W. B. Backer.

AUGUSTA, KAN.—A local telephone company is being formed by the farmers of Elm Creek to erect a telephone line to connect with the Haverhill Mutual Exchange in Augusta.

CARROLLTON, KY.—The contract for the construction of the new electric light plant has been awarded by the City Council to Samuel Hills, Jr., of Cincinnati, Ohio. The equipment includes a new 250-hp engine, 250-kw dynamo and the construction of a new building at a cost of $19,200.

LEXINGTON, KY.—The Lexington Railway Company has been authorized by the City Council to extend its lines. Louis Des Cognets is vice-president.

MAYFIELD, KY.—It is reported that the Mayfield Water & Light Company will rebuild its power plant which was recently destroyed by fire.

LAKE CHARLES, LA.—The Hi-Mount Land Company has placed a contract with the Lake Charles Ice, Light & Water Works Company for the installation of an electric light system and extension of water mains to Hi-Mount.

FREDERICK, MD.—The Washington, Frederick & Gettysburg Railway Company has awarded the contract for extending its railway from Lewiston to the Monocacy Valley Railroad to J. E. McDonough, of Frederick, Md. A. C. McBride is general manager.

OAKLAND, MD.—The Youghiogheny Light & Power Company contemplates the construction of an electric railway from Oakland to Swallow Falls, with branches to Uniontown, Pa., and Kingwood and another branch to connect with the railroad of the Jennings Lumber & Coal Company. The officers of the company are: A. C. Sturgis, president; Truman West, vice-president; Bowie Johnson, secretary; James D. Hamill, treasurer, and H. P. Tasker, general manager.

ADAMS, MASS.—The citizens of Adams, instead of North Adams (as reported in the issue of May 9), have voted to install an electric light plant at its town farm.

FALL RIVER, MASS.—The new American Thread Mill will be operated entirely by electricity.

LAWRENCE, MASS.—The Pacific Mills will shortly place in operation an electric plant, with an output of 3000 hp, consisting of three Allis-Chalmers turbines. The ultimate output of the plant will be 12,000 hp. The equipment of this plant cost about $69,000 and the wiring $30,000.

LOWELL, MASS.—The Tremont and Suffolk Mills have installed an electric plant, consisting of a 3000-hp Allis-Chalmers turbine, the first of six units.

SPRINGFIELD, MASS.—Plans are being considered for the consolidation of the Berkshire electric railways and the establishment of electric railway connections between Springfield and Pittsfield by connecting the Western Massachusetts and Berkshire systems. The Legislature will be asked to pass a bill giving the Berkshire company permission to construct a railway to connect the system with the summit of Greylock Mountain, extend its railway south from Great Barrington through the town of Sheffield to the Connecticut line and connect this extension with the town of Egremont. The plan involves an expenditure of $2,000,000. The financing will be done by the New York, New Haven & Hartford Railroad Company, which operates the railways.

BENTON HARBOR, MICH.—The contract for the construction of the Chicago, Benton Harbor & Grand Rapids Electric Railroad has been awarded to Charles A. Applegate, of Chicago, Ill.

KALAMAZOO, MICH.—The plant of the Commonwealth Power Company was badly damaged by fire May 28, putting the lighting and street car service in the city out of commission. Two large transformers were damaged.

PALMER, MICH.—The question of extending its system to Princeton is being considered by the Marquette County Telephone Company.

BRAINARD, MINN.—Plans and specifications have been prepared by George Cadogan Morgan, 69 Jackson Boulevard, Chicago, Ill., for the construction of an electric light plant and water works system for the city. Estimates were submitted on hydro-electric, gas, oil and steam power plants as follows: Generating plant on Crow River, pole line, pumping equipment, etc., $146,327; gas plant, etc. (complete), $65,677; American Diesel oil engine plant, etc. (complete), $69,857; steam plant, complete, $36,107. The hydro-electric plant would, with the addition of more machinery, give the city over double the amount of power available from other sources at an additional cost of $18,975. The City Council has retained Mr. Morgan as consulting engineer to have charge of the work.

MINNEAPOLIS, MINN.—The Minnesota Construction Company has been organized to build an electric railway from Minneapolis to Medicine Lake, which later will be extended to Montevideo. Right of way has been secured for the first section, which will be six miles in length. The company is capitalized at $100,000, and the officers are: John Blichfeldt, president; W. W. Wardwell, secretary and treasurer.

THIEF RIVER FALLS, MINN.—The Farmers' Telephone Company is contemplating the construction of a telephone line from Sanders to Thief River Falls in the near future.

CARROLLTON, MISS.—W. H. Hafner, mayor, writes that bids will be received until June 15 for rebuilding the electric light plant. R. C. Huston, of New Orleans, La., is engineer.

ST. LOUIS, MO.—Plans are being considered by the Affiliated Business Men's Association to erect and maintain a municipal electric lighting plant, the cost of which is estimated at $3,000,000. For further information address Leo A. Landan, chairman of the Legislative Committee.

UNIVERSITY CITY, MO.—Plans are being considered to make extensive improvements to the town, including the construction of a municipal electric light plant, city hall, park, etc., the cost of which is estimated at about $250,000. It is proposed to issue $100,000 in bonds at once to commence the work and to issue the remainder in January, 1909.

MILES CITY, MONT.—The City Council has voted to issue $10,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant.

TOWNSEND, MONT.—Plans are being made by the Delp Creek Improvement Company for the construction of an electric light plant, bids for which will probably be received about Aug. 1. The company has a 25-year franchise and proposes to build a 100-hp plant and furnish electricity for lighting the town of Townsend, and a plant of 500 hp to supply electricity for mines at Radersburn. N. S. Poole is general manager, and C. Helmick, of Helena, engineer.

PENDER, NEB.—The citizens are considering the question of holding an election to vote on the proposition of issuing bonds to establish a municipal electric light plant.

UNIVERSITY PLACE, NEB.—F. Harbican, superintendent of the municipal water and light plant, writes that the city is in the market for three electrically driven pumps. The city has entered into a contract with the Lincoln Traction Company to furnish electricity to operate the municipal electric light system and to pump the city water for a term of five years at the rate of 4 cents per kw-hour delivered at the University Place station.

ATLANTIC HIGHLANDS, N. J.—The Borough Council has granted the New Jersey Traction Company a franchise to lay its tracks through the business section of the town.

JERSEY CITY, N. J.—The Board of Aldermen on May 26 granted a franchise to the Mutual Benefit Electric Light & Power Company to construct and operate an electric light plant in this city, in return for which the company is to pay the city 5 per cent of its gross receipts. The company proposes to install a modern plant and place all its wires underground. It also agrees to furnish electricity for lamps at the rate of 8 cents per kw-hour, with a discount of 5 per cent on all bills paid within five days after presentation.

PASSAIC, N. J.—At the special election held June 2 the citizens voted in favor of installing a municipal electric light plant.

PATERSON, N. J.—Plans are being considered for the construction of an electric railway from Paterson to New Foundland.

PATERSON, N. J.—Plans are being made to incorporate the North Jersey Transit Company for the purpose of operating an electric railway between Paterson and Suffern, a distance of 15 miles. The company will be capitalized at $1,000,000

ALBUQUERQUE, N. M.—D. K. B. Sellers is reported to be interested in a project to build an electric railway on the Highlands.

ALBION, N. Y.—The A. L. Swett Electric Light & Power Company, of Medina, has applied to the Public Service Commission for permission to extend its service to this village, for which a franchise has already been granted by the town.

BINGHAMTON, N. Y.—The Binghamton Railway Company contemplates extending its railway system to Owego and Waverly.

BUFFALO, N. Y.—The Board of Aldermen has authorized the Commissioner of Public Works to secure a new contract for electricity to operate the electric pumps at the water works station. The present contract expires June 30, 1908.

MIDDLEBURGH, N. Y.—Plans are being considered by the Middleburgh Telephone Company to place cables on Main Street and Railroad Avenue in this city.

ROCKVILLE CENTER, N. Y.—The South Shore Traction Company has been granted a franchise by the Village Trustees to construct and maintain an electric railway in the town.

SYRACUSE, N. Y.—Bids will soon be asked by the Board of Contract and Supply for lighting the streets and municipal buildings of the city.

POORS KNOB, N. C.—The W. C. Meares Mill Company has secured a charter to develop water power, to generate electricity and to erect mills. The capital stock of the company is placed at $12,000. R. L. Doughton is interested in the project.

TARBORO, N. C.—The Carolina Telephone & Telegraph Company is planning extensive extensions to all of its lines in the state. The capital stock of the company was recently increased from $250,000 to $300,000.

WILSON, N. C.—The Tar River Light & Power Company has amended its charter increasing its capital stock to $100,000

CLEVELAND, OHIO.—Plans are being considered by the Cuyahoga Light, Heat & Power Company to utilize the water power of the Cuyahoga River at Cuyahoga Falls.

LOGAN, OHIO.—D. V. Thurness, mayor, writes that the village is considering the construction of a municipal electric light plant, the cost of which is estimated at about $15,000. A. G. Hall, of Logan, electrical engineer, will have charge of the work.

ARDMORE, OKLA.—J. D. Connelly, of Titusville, Pa., and E. A. Rea, of Corydon, Ia., are interested in a project to build a street railway system in Ardmore.

GUTHRIE, OKLA.—The Oklahoma Gas & Electric Company contemplates making improvements to its system, which will involve an expenditure of about $200,000.

ASTORIA, ORE.—Preliminary steps have been taken to organize the Astoria, Seaside & Tillamook Railroad Company for the purpose of building an electric railway from Astoria to Seaside and thence to Tillamook. The company will be capitalized at $2,000,000. F. L. Evans is promoter of the company.

DIXONVILLE, ORE.—Arrangements are being made by the North Deer Creek Telephone Company to erect a telephone line from Rosenburg to Dixonville. E. A. Hinkel is president of the company and Homer H. Fox, secretary.

PORTLAND, ORE.—The county court has granted to the United Railways two franchises.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has applied to the City Council for a blanket franchise granting the company permission to lay tracks on different streets of the city. The cost of the work is estimated at $250,000.

SALEM, ORE.—The Salem-Fairfield Telephone Company has been granted a franchise to erect a telephone line between Salem and Champoeg.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until June 29 for furnishing copper tubes, electrical fixtures, wire, incandescent lamps, etc. Blanks and general information relating to this circular (No. 416) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and the Chamber of Commerce, Tacoma, Wash.; also from the U. S. engineer offices in the following cities: Los Angeles, Cal.; Baltimore, Md., Philadelphia, Pa., Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio, Chicago, Ill.; St. Louis, Mo., Detroit, Mich.; Milwaukee, Wis., St. Paul, Minn.; Chattanooga, Tenn.;

Louisville, Ky., and Mobile, Ala. Lieut.-Col. H. F. Hodges is general purchasing officer.

AVOCA, PA.—The Borough of Avoca has renewed the contract for street lighting with the Standard Electric Light Company for a term of five years from June 1, 1908. Under the terms of the contract the company is to furnish arc lamps at the rate of $65 per lamp per year. Frank Howard is superintendent of the Standard Electric Light Company.

HUNTINGDON, PA.—The Juniata Water & Power Company, which is operating a power plant in Warrior Ridge Gap, is contemplating making extensive additions to its system and extending its transmission lines through the Juniata Valley. Plans have been completed for the second hydro-electric plant along the Juniata River, which will be located between Huntingdon and Lewiston. The company will soon commence work on the erection of the extension of the steel tower transmission system from the Warrior Ridge plant through Huntingdon to Lewiston. In addition to the second dam and the extensions of the transmission line, three hydro-electric plants will be erected along the Juniata River, all of which will supply electrical energy through the main transmission line. The company now furnishes electricity for lamps and motors in Huntingdon, Tyrone and Altoona. S. L. Brumbaugh is interested in the project.

JOHNSTOWN, PA.—The Johnstown Telephone Company contemplates extending its system to St. Michael.

NEW CASTLE, PA.—Plans are being considered to install a power plant in the high school to furnish electricity for lighting the building, also for heating and ventilating.

NORRISTOWN, PA.—Plans are being considered by the American Union Telephone Company to extend its service into the surrounding country.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has made arrangements with the Hamlet Textile Company for the purchase of additional power. The company is using about 75 hp furnished by the Hamlet Textile Company.

ABBEVILLE, S. C.—The citizens on June 3 voted in favor of the proposition to issue $25,000 in bonds to purchase and rebuild the electric plant of the Abbeville Light & Power Company.

FOUNTAIN INN, S. C.—Contracts have been placed by the Fountain Inn Manufacturing Company for the construction of its additional mill building, cottages, etc., at Fountain Inn. The machinery of the new mill will be operated by electricity, which will be furnished from the power plant of the Enoree Power Company, seven miles distant.

MITCHELL, S. D.—The electric light and gas plant of the Mitchell Gas Company has been purchased by the Mitchell Power Company. The new owners contemplate enlarging and improving the plant.

MEMPHIS, TENN.—Sealed proposals will be received by the Shelby County Courthouse Commissioners until July 1 for furniture and furnishing interior work, including electric and gaslight fixtures and electric time clock system for the new courthouse building for Shelby County. Plans and specifications may be seen at the office of Hale & Rogers, 11 East Twenty-fourth Street, New York, N. Y., architects, or at the office of the architects' superintendent, or at the office of the Shelby County Commissioners, Memphis, Tenn. John Colbert is secretary of the commission.

TREZEVANT, TENN.—The Trezevant Telephone Company has decided to construct a long-distance line from this city to Bradford, by the way of Holly Leaf.

AMARILLO, TEX.—The Panhandle Telegraph & Telephone Company will place its wires underground in the business portion of the city.

AUSTIN, TEX.—The Water, Light and Power Committee has engaged Walter G. Kirkpatrick, of Jackson, Miss., to prepare plans for rebuilding the Austin Dam, which was partly carried away during a flood in the Colorado River in April, 1900, and a large part of the power house and equipment was wrecked. It is proposed to rebuild the dam and equip the power house.

EL PASO, TEX.—The capital stock of the El Paso Electric Railway Company has been increased from $750,000 to $1,500,000.

FORT WORTH, TEX.—The Northern Texas Traction Company has filed amendments to its charter increasing its capital stock from $250,000 to $3,000,000.

NAVASOTA, TEX.—The Navasota Light & Power Company has been incorporated, with a capital stock of $20,000, by R. A. Horlock, W. R. Horlock and E. A. Harris.

ROCKPORT, TEX.—The Rockport Ice & Light Company has placed a contract with Turner & Prior, electrical engineers, for the installation of a new electric light plant in Rockport.

RICHMOND, VA.—The City Council has passed an ordinance providing for an issue of $350,000 in bonds, the proceeds to be used for the construction of an electric light plant on the site of the old pumping plant.

COLVILLE, WASH.—The W. H. Gerhart-Bradrick Lumber Company has received a proposition from the Northwestern Gas & Electric Company offering a special rate for electrical power for elevating lumber from the lumber company's yard to the top of thte hill, also to furnish energy to operate the new planing mill and box factory soon to be erected.

ELLENSBURG, WASH.—An independent telephone company has been organized by the farmers of the Reecer Creek District for the purpose of erecting a telephone line to connect that section of the country with the main line in Ellensburg.

NEWPORT, WASH.—R. S. Anderson, who recently purchased the local exchange of the Pacific States Telephone & Telegraph Company, has been granted a franchise in this city. The system is to be reconstructed and a telephone line built to Metaline. The cost of the work is estimated at $10,000.

NORTH YAKIMA, WASH.—The North Yakima & East Selah Irrigation Company is asking for bids for the construction of a large power canal to develop 3400 hp and to utilize the full minimum flow of the Yakima River, work on which will commence this summer. Smith & Young are the engineers.

SUMAS, WASH.—An independent telephone company has been formed by a number of residents of Upper Sumas, Abbotsford and Huntingdon for the purpose of constructing lines into the towns of Sumas and Matsqui to make connections with Chilliwack and other cities. L. G. Van Valkenburg is interested in the project.

WALLA WALLA, WASH.—The Walla Walla Valley Traction Company has applied to the County Commissioners for a franchise.

WESTON, W. VA.—J. S. Mitchell, superintendent of the Weston Electric Light, Power & Water Company, writes that the company is planning to enlarge its plant and will install a 300-hp water-tube boiler this summer and renew the pole line.

WHEELING, W. VA.—The Wheeling Traction Company is contemplating extending its railway to Moundsville this summer. As yet nothing definite has been decided upon.

APPLETON, WIS.—The Wisconsin Traction, Light, Heat & Power Company is contemplating extending the local street railway. The extension will comprise about two miles of track.

APPLETON, WIS.—The Green Bay & Mississippi Canal Company, which is constructing an electric power plant at Kaukauna, is making arrangements to build a new dam, below the plant now under construction, where a head of 27 ft. will be secured to furnish power for another large electric plant which the company will construct. It is said that the company will lease the first plant as soon as it is completed. During the summer the plant of the Appleton Paper & Pulp Company, which is owned by practically the same interests as the Green Bay & Mississippi Canal Company, will be torn down and an electric power plant erected on the site, which will be leased immediately to the local companies to furnish electrical energy for their factories.

JEFFERSON, WIS.—The citizens have voted in favor of the proposition to issue $7,500 in bonds, the proceeds to be used for improving the municipal electric light plant.

MILWAUKEE, WIS.—Plans are being considered by the committee on street lighting of the Greater Milwaukee Association and the Council committee for improving the street lighting system in the business section of the city.

SPARTA, WIS.—Work has commenced on the construction of the proposed railway of the Sparta & Melrose Electric Railway & Power Company from Sparta to Melrose, a distance of 28 miles. The officers of the company are: Charles Newland, president; James Cole, vice-president; Howard Teasdale, secretary, and W. A. Sholes, treasurer.

STEVENS POINT, WIS.—The Porter Telephone Company, which is building a telephone line through Plover and Stockton to Stevens Point, is planning to build other lines west and north of Plover.

CHEYENNE, WYO.—The City Council has passed an ordinance granting a franchise to T. H. Cosgriff and others, of this city, to construct and operate an electric street railway and to generate and distribute electricity for lamps and motors in Cheyenne.

LETHBRIDGE, ALB., CAN.—The City Council has received the report of Cecil B. Smith, power expert, which recommends the city retaining control of the power plant and also the making of several improvements.

NELSON, B. C., CAN.—The City Council has made an offer to supply electrical power free to the Nelson Tramway Company if the company will at once resume the street car service in force before the power plant was destroyed by fire.

VANCOUVER, B. C., CAN.—Plans are being made by E. K. Rogers to erect a $40,000 power plant in connection with the Hidden Creek group of mines at Goose Bay, Observatory Inlet. The plant will be installed this summer.

VICTORIA, B. C., CAN.—The Provincial Government has approved the plans of the Prince Rupert Power & Light Company, of Prince Rupert. The company is authorized to construct its system, including dam, pipe lines and power houses at or near Woodworth Lake, Shoowahtlans River, in the Skeena River mining division, and to transmit and distribute electricity to various points on the Tsimpsean Peninsula, and Kaien and Digby Islands.

HAMIOTA, MAN., CAN.—The municipality of Hamiota has decided to build a rural telephone system. For further information address Joseph Andrews.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Street Railroad Company has decided to extend its road through the municipality of St. Vital. Wilford Phillips is general manager.

WINNIPEG, MAN., CAN.—The City Council has decided to sell $600,000 in bonds for the construction of the plant now being built at Lac du Bonnet at a cost of approximately $3,000,000. Cecil B. Smith is civic power expert.

KINGSTON, ONT., CAN.—The Kingston Milling Company has secured a site about six miles east of Kingston, where it will erect a power plant and will transmit electricity to its mill, which will be enlarged.

NORTH BAY, ONT., CAN.—The Town Council has made application to the Hydro-Electric Commission to develop Smoky Falls, on the Sturgeon River, 18 miles distant, to furnish North Bay with electricity.

PORT ARTHUR, ONT., CAN.—C. B. Smith, of Toronto, consulting engineer, has been authorized to prepare plans, to be submitted to the Council, for the development of 10,000 hp at Dog Lake Falls.

PORT ARTHUR, ONT., CAN.—The Electric Railway Commissioners have been authorized to proceed with the double tracking of the Port Arthur Electric Railway system between Current River Park and the southern boundary of the city. The railway is owned and operated by the city.

PORT ARTHUR, ONT., CAN.—The City Council has decided to carry out the recommendations of Cecil B. Smith, civic power expert, in regard to the development of power along the Current River. The damage to the plant by the recent flood will also be repaired. For further information address J. J. Carrick.

PORT ARTHUR, ONT., CAN.—The recent fire at the plant of the Port Arthur Electric Light & Power Company destroyed seven dynamos, 16 transformers, tools, etc., leaving intact only the walls of the building, two steel penstocks and two water wheels, with shafting. The loss is estimated at about $35,000. New generators, shafting and other equipment were installed and a new roof put on the building and the plant put in operation and electricity furnished to the towns for lamps and motors 17 days after the fire.

TORONTO, ONT., CAN.—Bids will be received by Adam Beck, chairman of the Hydro-Electric Power Commission, Toronto, until July 15 (extension of time from June 2), for the construction of the Toronto-Niagara Falls, St. Thomas-Niagara Falls transmission line; steel transmission towers; transmission line cable, and erection complete of transmission system, according to plans and specifications to be seen at the Commission's office. Tenders will not be considered unless on form supplied by the Commission.

TORONTO, ONT., CAN.—The Board of Control has decided to construct the municipal electrical distributing plant by city labor, and to establish an electrical construction department, with a consulting board of three experts, and an engineer of construction under this board. Alexander Dow, of Detroit, Mich., was appointed one of the members of the board and has been asked to appoint the two other members. The engineer to have charge of the construction work will be appointed by the City Council.

New Industrial Companies.

THE PORTSMOUTH ELECTRICAL & PLUMBING COMPANY, of Portsmouth, Ohio, has been incorporated, with a capital stock of $12,500, by Charles Barlow, W. L. Reed, G. J. Schmidt, H. W. Hier and W. R. Sprague.

THE ELECTRICAL TRADING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $1,000, and the following directors: Edward McAviney, Jason G. Lamison and Timothy A. Leary.

THE AMERICAN INSULATING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $12,000, to manufacture insulating materials.

THE TROY TELEPHONE SPECIALTY COMPANY, of Troy, N. Y., has been incorporated, with a capital stock of $15,000, to manufacture telephone appliances and instruments. The incorporators are: Perry J. Fitzgerald, of Albany; Edward L. Granel and Joseph F. McLaughlin, of Troy.

THE PRESSED STEEL TURBINE ENGINE COMPANY OF AMERICA, of Kittery, Maine, has been incorporated, with a capital stock of $2,000,000. The officers of the company are: W. C. Cogswell, of Newton, Mass., president; C. D. Wainwright, Jr., Marblehead, Mass., treasurer, and H. Mitchell, of Marblehead, Mass., clerk.

New Incorporations.

GRIDLEY, CAL.—Plans have been completed by Ralph Beebe, engineer, for a combined municipal water and light plant.

COLORADO SPRINGS, COL.—The Kansas-Colorado Railway Company, capitalized at $5,000,000, and the Colorado Transportation Company, with a capital stock of $5,000,000, have been organized to construct an electric railway from Garden City, Kan., up the Arkansas Valley to Canon City, Colorado Springs and Denver. The companies will furnish electricity and water to towns along the route. The incorporators of both companies are: A. H. Atwater, of Canon City, Col.; J. A. Lockhart, of Rocky Ford, Col.; R. W. Paterson, of La Junta, Col., and A. H. Warner and Andrew Russell, of Garden City, Kan.

LA JUNTA, COL.—The Kansas-Colorado Electric Transmission Company has been organized, with a capital stock of $3,500,000. The company will be operated in connection with the Kansas-Colorado Railway Company, which has been incorporated with a capital stock of $5,000,000. The officers of the two companies are: S. H. Atwater, of Canon City, president; J. A. Lockhart, Rocky Ford, vice-president; Robert W. Patterson, of La Junta, second vice-president; A. H. Warner, of Garden City, secretary, and Andrew Russell, of Dodge City, Kan., treasurer.

TWIN FALLS, IDAHO.—Articles of incorporation have been filed for the Idaho & Nevada Southern Railway Company to construct an electric railway from Twin Falls and other points on the Twin Falls tract to Wells, Nev. The capital stock of the company is placed at $250,000, and the officers are: H. L. Hollister, president; I. B. Perrine, vice-president and general manager, and R. M. McCullom, secretary and treasurer.

CHARLESTOWN, ILL.—The Charlestown, Westfield, Marshall & Terre Haute Railway Company has been incorporated with a capital stock of $50,000. The officers of the company are: W. R. Patton, of Charleston, president; J. W. Dawson, of Westfield, vice-president; Seymour Hurst, of Marshall, secretary.

MILFORD, ILL.—The Milford Telephone Company has been incorporated, with a capital stock of $25,000, by C. H. Dawson, A. J. Hall, M. F. Dawson and others.

Legal.

ELECTRIC PLANT IN RECEIVERS' HANDS.—The Arcadia Electric Light Company, of Arcadia, has been placed in the hands of G. P. Wing and A. E. Shaffer, as receivers. The plant is owned by John A. Shunk, of Peru, and on account of the company's failure to pay interest on its mortgage indebteness it was placed in the hands of receivers.

FULTON POWER COMPANY CLAIMS DAMAGES.—The Folton Light, Heat & Power Company, of Fulton, N. Y., has filed in the Court of Claims a claim against the state for the appropriation of land and water power on the Oswego River at Fulton, which the company claims to own and which was taken by the state in connection with the barge canal project. The company claims damages to the amount of $5,200,000. The Court of Claims will hold a special session in New York, N. Y., June 22, to hear the testimony on the claim. The state claims to own the water and the right to take it for canal purposes without compensation

ROANOKE WATER COMPANY ENJOINED.—An injunction was granted in the corporation court in the case of the Virginian Railway Company v. the Roanoke Water Power Company, of Roanoke, Va., by which the latter is restrained from raising the dam of its electric plant 2 ft. The plant is located on the Virginian, and it is stated that a contract between the two companies specified that the dam should not be more than 45 ft. in height, otherwise a portion of the track would be flooded. The power company recently made a contract to supply the railway company with electricity for lamps and, desiring as much reserve power as possible, planned to raise the dam.

RIGHTS OF EMINENT DOMAIN DENIED BY THE COURT.—An action instituted some time ago by the Yadkin Power Company, chartered by the State Legislature to operate power plants on the Yadkin River, to secure the right to condemn the lines of the Whitney Company, has been disposed of in the state courts in favor of the Whitney Company, of Salisbury, N. C. The Yadkin company alleged that it possessed the right of eminent domain and had secured electrical rights on the river prior to the time of the establishment of the Whitney company's undertaking near Salisbury, N. C. The Yadkin Power Company has now taken an appeal to the state Superior Court.

Personal.

DR. H. T. BOVEY, Rector of the Imperial College of Science and Technology, London, will deliver the address on June 12 at the commencement of Clarkson Memorial School, Potsdam, N. Y.

MR. WILLIAM W. COLE, for many years manager of the Elmira Water, Light & Railroad Company, of Elmira, N. Y., has resigned from that company and after July 20 will be associated with the firm of Dodge & Day, modernizing engineers of Philadelphia, in which firm he has taken an interest.

MR. REGINALD PORTER, a director of the Key Engineering Company, of London, has spent the past month in this country in the study of electrical work and of large gas engines, and sailed for home on June 6 on the Cunarder *Campania*. Mr. Porter is to present a paper on the gas engine topic before one of the engineering societies in England at an early date. He attended the National Electric Light convention at Chicago, and visited Pittsburg, Milwaukee, Buffalo, Niagara, Montreal and Boston.

MR. HUGH MILLER, a prominent member of the Glasgow City Council, has been visiting this country, and making a study of lighting development, which is under his special attention in the Council. On Friday evening, June 5, Mr. Miller, who sailed the next day on the *Columbia*, was a guest at the Engineers' Club at a farewell dinner given in his honor. Those present were Commissioner Milo R. Maltbie, of the Public Service Commission, President Alex. C. Humphreys, of the Stevens Institute of Technology; Mr. H. G. Stott, President American Institute of Electrical Engineers; Messrs. J. W. Loeb, Jr., and Arthur Williams, of the New York Edison Company, Messrs. R. A. Carter and W. R. Addicks, vice-presidents, and Mr. W. H. Bradley chief engineer, Consolidated Gas Company, and Mr. T. C. Martin. After dinner a very thorough inspection was made of the Engineering Societies' Building, particularly the headquarters of the National Electric Light Association, the Gas Institute, and the Association of Edison Illuminating Companies, all of which were thrown open for the occasion and which interested Mr. Miller deeply.

MR. ALLISON J. THOMPSON, lately of Cleveland, Ohio, has joined the Excello Arc Lamp Company as secretary and general manager.

MR. THOMAS L. HARTIGAN, president of the Manila Electric Railroad & Light Company, of Manila, P. I., has returned to the United States. He will spend the summer here and return to Manila in the fall.

MR. R. L. BRITTIAN has resigned as superintendent of the Northfield Lighting & Power Company, of Northfield, Vt., to accept a position as superintendent of new electric plant owned by Moody & Almon, in Montpelier, Vt., now in process of construction. Mr. Brittian will take charge July 1.

MAJOR E. L. ZALINSKI, U. S. A., now on the retired list, has recently been installed as president of the Bureau of Illuminating Engineering, Incorporated, at 437 Fifth Avenue, New York. This bureau will consider questions involving the conditions requisite for suitable and proper illumination.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Company, sailed on the steamer *Celtic*, June 4, accompanied by Mrs. Hirschberg, for his annual visit to the works in Germany. Mr. Hirschberg will be absent about five weeks and will visit other important electrical factories in Europe.

MR. JAMES S. WATSON, manager of the drive chain department of the Link-Belt Company, has transferred his headquarters from the Philadelphia works to the company's chain manufacturing plant at Indianapolis. In his new field he will combine supervision of manufacture with direction of the selling force handling the Renold silent and roller chains.

MR. R. A. PHILLIP, of Stone & Webster, Boston, has completed a course of lectures to senior students at Massachusetts Institute of Technology on modern switching practice with high-tension circuits. Mr. A. S. Michener, comptroller of the Stone & Webster organization, lectured on the theory of accounting and the relations of the engineering, operating and executive departments to the accounting department, and Mr. Walter Goodenough of the same organization lectured on boiler-room practice.

MR. A. J. J. PFEIFFER, the general manager of the Calcutta Tramways, is in this country on a short trip, and proposes also to visit Mexico. Mr. Pfeiffer was formerly connected with the General Electric Company and went abroad in 1897 to make important railway installations for the French Thomson-Houston Company. Among the roads constructed under his direction was the Milan-Gallarate-Porte Ceresio third-rail line to the Italian lakes. In 1902 Mr. Pfeiffer became associated with Dick, Kerr & Company, of England, and soon after went to Calcutta, India, in the interests of that company to install the system of which he then became general manager.

MR. J. R. McCOLL, formerly associate professor of steam engineering at Purdue University, Lafayette, Ind., and now connected with the engineering department of the American Blower Company, Detroit, has been delivering a series of lectures before engineering classes of the technical schools in the Middle West. The subjects dealt with are the movement and heating of air for heating, ventilating and drying systems, the theory and practice of blower design and installation and kindred topics. The lectures are illustrated by means of stereopticon views and are followed by discussions on the part of the students, who invariably evince great interest in the subjects presented.

PROF. A. L. WALKER has been appointed professor of metallurgy and administrative head of the Department of Metallurgy, at Columbia University, New York City. His duties will begin on July 1 and he will take personal direction of the instruction in non-ferrous and electro-metallurgy and metallurgical design. Professor Howe will continue to deliver his lectures on iron and steel. Mr. Walker has had an exceptionally valuable practical experience in all branches of metallurgical work since his graduation from Columbia. He was born on Jan. 14, 1863, and received his preparatory school education at Charlier Institute, New York City, and Morris Academy, Morristown, N. J. He was graduated from the School of Mines of Columbia University in 1883 with the degree of E. M.

Obituary.

MR. WILLIAM HAMMOND HUBBARD, who assisted Dr. Alexander Graham Bell in the late '70s in the development of the telephone died June 1, at Lake Forest Ill. Mr. Hubbard was 50 years old.

SIR ROBERT G. REID, who died in Montreal on June 3, was an engineer of international fame. He built many of the noted railroad bridges in this country, but his most important work was the development of Newfoundland, which began in 1890. Since that time, through grants and concessions, his power on the island became enormous, and he built and controlled the railways and larger public utilities. At one time he contracted with the government to operate the whole of the telegraph lines of the island and maintain and operate an electric street railway in St. John's. These two monopolies did not meet with public approval, however, and he turned his telegraph holdings over to a company with $25,000,000 capital, and agreed to the reversion of the railroads to the government at the end of 50 years. In 1907 he was knighted for his services to Newfoundland, of which he had been called the greatest benefactor.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

WASHINGTON, IND.—The sale of the municipal water works plant by the receiver was set aside by the court on the ground of irregularity. The property will be sold at a future receiver's sale.

DELPHI, IND.—The Carroll Electric Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000. The object of the corporation is to build and operate an electric light plant for the purpose of generating electricity for light, heat and power in Delphi and other towns and villages in said county. John H. Burr, Nathaniel Moore, A. V. Smith and F. C. Smith are the directors.

WAHOO, NEB.—Bids will be received by the city until June 25 for the construction of a municipal electric light plant and water works system, the cost of which is estimated at $60,000. John Martz, of Wahoo, is engineer.

BRUCE, WIS.—Bids will be received until June 23 by the village of Bruce for the construction of an electric light plant and water works system. Oscar Claussen is consulting engineer.

LISTOWEL, ONT., CAN.—The town of Listowel will receive bids until June 18 for complete equipment for an electric lighting plant with an output of about 200 hp, consisting of gas producers and engines, boilers and steam apparatus, generators, switchboards, transmission supplies, etc. For further information apply to K. L. Aitken, 1003 Traders Bank, Toronto, consulting engineer.

HARRISBURG, PA.—Governor Stuart has approved the following extensions of electric railways: The West Penn Interurban Railway Company from near Poundstone Ferry to New Geneva, four miles; also from near Republic Works to Dearth post office and beyond, a distance of 7½ miles. The Brownsville Street Railway Company over certain highways in Bridgeport, a distance of 3½ miles.

GREEN BAY, WIS.—The Northern Hydro Electric Power Company has been incorporated for the purpose of developing the water power at High Falls and Johnson Falls to generate electricity. B. L. Parker, of Green Bay, is secretary.

EUREKA SPRINGS, ARK.—At the annual meeting of the Citizens' Electric Company the following named officers were elected: J. D. Jordan, president; M. D. Jordan, vice-president; C. C. McCarty, secretary and treasurer.

VICTOR, MONT.—J. S. Hodge has secured a site for an electric light plant and will develop a water power.

BLOOMINGTON, ILL.—The Union Gas & Electric Company has been reorganized and the following officers elected: Richard S. Storrs, president; G. Bullock, vice-president; L. B. Johns, secretary and treasurer. W. F. Clausen will be retained as superintendent, and L. B. Johns will have charge of the new business section. Extensive improvements are contemplated to the system later on.

KANSAS CITY, MO.—The Denton, Foote & Company, of Kansas City, is reported to have secured the contract for equipping what is known as the "Strang" line to be operated by electricity from the Missouri & Kansas Interurban Railway Company.

HUDSON, N. Y.—The Albany & Hudson Railroad Company has purchased what was known as the Rider electric light plant of Frank B. Erwin, of New York City, and has taken possession of the entire outfit, which includes poles and wires, engine, generator and all the machinery in the old pumping station. It is expected that the machinery, all of which is new, will be sold. The Albany & Hudson Railroad Company has made a number of improvements to its power plant at Stuyvesant Falls, including the installation of a new engine, to provide additional power to operate its system.

MALDEN, MASS.—The Street and Water Commission has recommended that it be given permission to make a three-year contract with the Malden Electric Company to light the streets of the town under the same conditions and prices as under the present contract, but to replace the present incandescent street lamps with the new tungsten lamp.

COWLEY, WYO.—B. E. Slusser is interested in a project to construct an electric plant to provide Lowell, Crowley and Byron with electricity for lamps and motors. It is proposed to erect a plant on the Shoshone River between the towns and to develop the water power of the river to operate the plant.

LA GRANDE, ORE.—The Grande Ronde Electric Company contemplates utilizing the water power of Olive Lake instead of installing a steam power plant to provide additional power for its system. The cost of the improvements contemplated is estimated at $45,000.

NIAGARA FALLS, N. Y.—The contract for the extra illumination of Falls Street has been awarded by the merchants who have subscribed to the project. The cost will be $2,500, which will provide for 1000 16 cp incandescent lamps placed on 14 arches.

WHITE RIVER JUNCTION, VT.—The Mascoma Electric Light & Gas Company is installing new machinery at its new power plant on the Glen Road in West Lebanon, N. H.

BOSTON, MASS.—Lieut.-Governor Draper has signed the bill for the incorporation of the French King Rapids Power Company with authority to construct a dam across the Connecticut River and to furnish electricity for light and power.

TAMAQUA, PA.—At a meeting of the Tamaqua Light, Heat & Power Company held on June 3, the following officers were elected: Jas. Tinley, president; George Kellner, treasurer; David Bensiger, secretary; A. C. Shuttleworth, general manager. The company also voted to issue $50,000 in capital stock the proceeds to be used for improvements and betterments to the plant. It is proposed to purchase a 500-kw Westinghouse, two-phase, 2300 volt, 60-cycle turbo-generator set and a 500-hp Babcock & Wilcox water-tube boiler. The two turbines installed some time ago were found to be defective and were returned to the builders, and the present belted unit from which all the load is supplied is overloaded. The condensing equipment installed for the first two turbines will be retained and used with the new turbine. The station is located near a small river so that condensing water is easily procurable, but inasmuch as coal costs only 70 cents per ton delivered in the bin it is doubtful if any marked financial economy will result.

Business Notes.

THE SCHUTTE & KOERTING COMPANY, of Philadelphia, Pa., manufacturer of steam and engineering specialties for power plant, chemical and other industries, has opened a branch sales office in the Keenan Building, Pittsburg, Pa., where it is represented by Mr. E. A. Knowlton.

INDIANAPOLIS BRANCH OF H. W. JOHNS-MANVILLE COMPANY.—The H. W. Johns-Manville Company, of New York, announces the opening of a branch office in Indianapolis, Ind., to take care of the local requirements of the trade in that territory. This office, which is located at 30 South Penasylvania Street, Indianapolis, will be under the management of Mr. Charles E. Wehr, who for several years has represented the company in that section.

GEARS AND PINIONS.—The R. D. Nuttall Company, of Pittsburg, announces that it has added to its already comprehensive list of gears and pinions the well-known Titan brand of manganese steel gears and pinions, having arranged with the Atha Steel Casting Company for its exclusive sale. This places the Nuttall Company in a position to furnish practically everything in the way of gears and pinions for every requirement of action and electric railway service.

THE VANDERMAN PLUMBING & HEATING COMPANY, Willimantic, Conn., has discontinued the name under which the company was organized May 1, 1892, and is now known as the Vanderman Manufacturing Company. The officers, management and line of business continue the same as under the former name, with the exception that the plumbing and heating lines of the business are discontinued. Entire attention is now given to foundry business.

THE BRILLIANT TUNGSTEN LAMP FIXTURE.—Mr. Milton Hartman, well known in incandescent lamp circles, has taken the sales management of the tungsten lamp fixture department of the Brilliant Electric Company. This is a new department being organized to push the new tungsten unit, consisting of an artistic nickel-plated fixture, equipped with Holophane reflectors and "Brilliant" tungsten lamps, which combination forms an artistic, harmonious lighting unit, and by reason of the high efficiency of tungsten lamps, the cost of operation is so low that the outfit pays for itself in a very short time. The Brilliant tungsten lamp fixture department will exploit this outfit throughout the country.

BISSELL COMPANY ESTABLISHES ILLUMINATION DEPARTMENT.—The F. Bissell Company, Toledo, Ohio, has recently installed a department of illumination, which will be in charge of R. W. Hiett, illuminating engineer. It will be the object of this department to give information as to proper distribution of lighting units so as to secure the best illumination both as to quality and cost. Anyone using light or selling electricity or doing wiring can economize for himself or for his client usually at no cost to himself by taking advantage of this department, which will give advice on plans for lighting layout or reply to requests for information of this department Both will be given free of charge unless it is something special, the layout of which would require considerable time, when a charge would necessarily have to be made.

DYNAMO BRUSHES.—The Cutler-Hammer Mfg. Company, of Milwaukee, has just issued a 16-page pamphlet descriptive of its "Wirt Type" dynamo brush, designed for use with low-tension, direct current motors and generators, alternating-current generators, plating dynamos, exciters, etc. The construction of the brush is fully described and illustrated in the pamphlet in question, which states that in designing a dynamo brush two conditions must be met in order to insure satisfactory operation. One of these is that the brush must be elastic so that it will make good contact with the commutator under slight pressure, disregard of this condition resulting in undue heating and rapid deterioration of both brush and commutator, due to friction. The second is that the brush must oppose a high resistance to the wasteful and destructive current generated when adjoining commutator bars are short circuited by the brush. The claim is made that the construction of the Wirt Type dynamo brush is such that these two necessary conditions are fully met. In addition to the purely descriptive matter and price list, the pamphlet contains information on the care of commutators and brushes, the importance of correct lap, etc.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 2, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

889,200. ELECTRICAL FUSE; Albert G. Charters and John G. Jones, Watford, England. App. filed June 21, 1907. A fuse wire is held between spring plungers, which separate with an abrupt movement when the fuse blows.

889,205. RAILWAY SIGNAL SYSTEM; Emory P. Cook, Oberlin, Pa. App. filed Aug 30, 1907. Block signal system having sectionally energized track rails and means by which circuits are completed to alarm devices on the trains through different trucks of the engine. Includes means for actuating the switch points.

889,220. TROLLEY POLE; John C. Gay, Jordanville, N. Y. App. filed Oct. 21, 1907. The trolley pole is made with parallel rods movable laterally so that the wheel is capable of yielding laterally without deflection from a vertical plane.

889,240. PROTECTIVE SETTING FOR METALLIC BODIES IN CONCRETE; Roman T. Kanski, New York, N. Y. App. filed Sept. 28, 1907. A protective setting for metallic bodies such as bridge anchors, etc., which are buried in the earth so as to prevent them from electrolytic action. Makes use of an earthernware box of special construction.

889,264. TROLLEY CATCHER AND RETRIEVER; Robert Shields, South Boston, Mass. App. filed April 22, 1907. A spring reel for a trolley cord of the type having a normally tensioned spring drum, which is held against action by a detent. An abrupt movement of the pole trips the detent and causes the rewinding spring to act.

889,266. THIRD-RAIL ATTACHMENT FOR ELECTRIC CARS; George Henry Sohn, Lincoln, Cal. App. filed Oct. 30, 1907. A conduit for street railways having a trolley wire supported by spaced saddles, which are in turn fastened to special spool-shaped insulators bolted between the guiding rails of the conduit slot.

889,277. ELECTRIC RAILWAY; Casimir Von Gizinsky and William McClure, Schenectady, N. Y. App. filed Dec. 19, 1906. Railway construction in which the third rail is forced in short sections, each of a length not exceeding the length of a motor car. The sections are brought into action by depressible tappets operating switches while the car passes.

889,305. REVERSING TIMER AND DISTRIBUTER; John Otto Heinze, Lowell, Mass. App. filed Nov. 30, 1906. Means for preventing pitting of the contacts of vibrating interrupters of induction coils. Makes use of a specially constructed circuit controller whereby there is a regular automatic reversal of the current flow through the vibrator.

889,308. PROCESS AND COMPOUND FOR TREATING MANTLES; Marcus H. Hulings, Allegheny, Pa. App. filed May 13, 1907. A compound for treating mantles to increase their life and capacity for incandescence and comprising a powder of common salt, lime, alum and borax.

889,322. LAMP RECEPTACLE; Andrew A. Moffitt, Providence, R. I. App. filed May 3, 1907. A lamp receptacle having a porcelain body adapted to receive a threaded shell and having a center contact formed of a metallic plate projecting straight in through one side wall from an exterior terminal.

889,346. EYE-MAGNET; Harold Thomassen, Dayton, Ohio. App. filed May 1, 1907. A U-shaped magnet, with converging poles of the ordinary form. Has an insulating plug attached thereto, by which the same is supported and manipulated in use.

889,355. THERMOSTAT; Peabody A. Brown, Denver, Col. App. filed Sept. 4, 1906. A means for regulating the temperature of liquids such as molten metal. Makes use of a thermostat device having circuits leading to an annunciator in the vicinity so that the temperature is indicated.

889,358. CUT-OUT MECHANISM FOR ELECTRICALLY OPERATED MACHINES; George S. Conger and Charles Pearce, New York, N. Y. App. filed Dec. 27, 1906. A cut-out for electrically operated machines designed to provide a simple and effective cut-out for stopping waste of electric current when the machine is temporarily out of use.

889,442. CABLE TERMINAL; Frank B. Cook, Chicago, Ill. App. filed Nov. 2, 1907. A cable terminal power distribution box designed to permit ready access without requiring a lineman to crawl through the drop wires when the terminal is mounted on a pole.

889,431. FURNACE FOR METALLURGICAL AND SMELTING PURPOSES; Kristian Birkeland, Lysaker, near Christiania, and Samuel Eyde, Christiania, Norway. App. filed Jan. 6, 1906. In an electric furnace, electrodes, means to produce an arc between the ends of the latter, a hearth adjacent the arc gap between the electrodes, but not immediately below the same, means to prevent material fed thereon from coming into contact with the arc ends of the electrodes and means to spread the arc over the hearth.

889,448. THIRD-RAIL ELECTRIC RAILWAY SYSTEM; John Francis Feeley, Bigtimber, Mont. App. filed July 16, 1907. Patentee has a trolley conductor supported on the inside of an overhanging insulating housing which is covered by a sheet metal coating to prevent wear.

889,463. TROLLEY WHEEL; Robert F. Heinze, Mamaroneck, N. Y. App. filed Aug. 30, 1907. The trolley harp is made very broad and the wheel pivoted between spring plungers so as to be capable of lateral movement independent of the harp.

889,469. SIGNALING SYSTEM FOR RAILWAYS; Charles H. Lay, Jersey City, N. J. App. filed Feb. 27, 1908. Overlap system for block signals adapted to provide greater flexibility than the usual danger and caution overlap system. Makes use of very short blocks and has four overlapping sections.

889,482. ELECTRIC SIGNALING SYSTEM; Francis L. O'Bryan, South Framingham, Mass. App. filed Jan. 8, 1908. Has a signal and a motor for actuating the same and a track relay for closing the motor circuit. Makes use of an electromagnet in the motor circuit having an armature adapted to break such circuit at the track relay after the signal has been actuated.

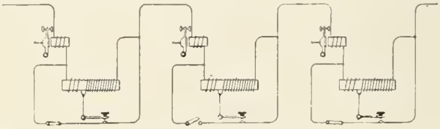
889,522. ELECTRIC INDUCTION FURNACE; Karl A. F. Hiorth, Christiania, Norway. App. filed Jan. 2, 1908. In an electric induction furnace, a spiral-like smelting channel, the ends of the windings of which are conductively connected to each other.

889,542. ELECTROMEDICAL BATTERY; Edmund T. Otto, Jersey City, N. J. App. filed Aug. 15, 1907. Complete electromedical apparatus, making use of a casing with a battery and induction coil and certain switches and parts adapted to be conveniently operated.

889,559. PROTECTOR FOR THIRD RAILS OF RAILWAY SYSTEMS; Joseph N. Tomlinson, of Vineland, N. J. App. filed Dec. 19, 1906. The third rail is made with an insulating coating, which extends over the top surface of the rail from one side so as to leave an undercut space, in which the collector shoe runs.

889,561. SIGNAL SYSTEM FOR RAILWAYS; Louis H. Thullen, Edgewood, Pa. App. filed March 3, 1906. A signal system having track rails, which are included in and form part of the return path of the conductor to the generator for the power current. Makes use of inductive bonds between the block sections.

889,566. ELECTRIC SWITCH; Alfred A. Wohlauer, New York, N. Y. App. filed June 25, 1907. An electric switch or cut-out, by which the spark of breaking contacts is confined in a vacuum tube, so that danger of fire and the wearing out of the metallic parts is prevented. Makes use of a vacuum tube partly filled with mercury and mounted to turn between contacts in the switch casing.



889,592—Telegraph System.

889,567. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph Lester Woodbridge, Philadelphia, Pa. App. filed Oct. 2, 1907. Means for controlling the transfer of current between the circuits and transforming apparatus of a system of distribution, in which alternating and direct current circuits are interconnected by motor generators.

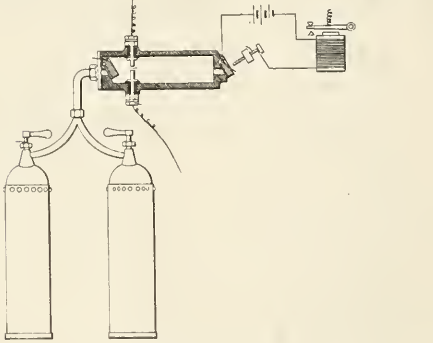
889,582. TELEPHONE SYSTEM; Henry P. Clauseum, Chicago, Ill. App. filed Nov. 15, 1908. Complete features of cord, signal and subscriber's circuits.

889,592. TELEGRAPH SYSTEM; Stephen Dudley Field, Stockbridge, Mass. App. filed Jan. 24, 1907. A means adapted for use on an ordinary telegraph line by which the usual sluggishness of the signals is overcome. Patentee makes use of a simple winding which is connected into the circuit at each station in such a way that a momentary e.m.f. is applied to the line at the beginning and termination of the signals so as to sharpen the same and therefore accelerate the transmission.

889,690. FIRE-TRUCK SIGNAL; John Kenlon, New York, N. Y. App. filed Aug. 22, 1907. A construction of fire truck signal designed to facilitate the control of the truck by the driver and tillerman. Has a signal apparatus to indicate to each party when the other is seated.

889,712. PRESSURE GOVERNOR; William McClave, Scranton, Pa. App. filed March 13, 1906. A pressure governor designed to control the condition of combustion within a furnace and govern the pressure of steam within a boiler heated by said furnace.

889,715. TROLLEY; Earl D. Peerstone, Chicago, Ill. App. filed Dec. 7, 1907. In place of the usual trolley wheel patentee has a frame with a pair of swiveled harps which are spring-connected together and which have separate trolley wheels to engage the wire.



889,789—Telegraphy.

889,744. PLATING APPARATUS; Clarence G. Backus, New York, N. Y. App. filed Aug. 15, 1907. Has an electrolytic bath and an endless member movable relatively therein and means for adjusting the tension of said endless member. Includes a receptacle adapted to be connected with said endless member and partially submerged within said bath

889,760. SWITCH BUTTON; Charles A. Clarke, Hartford, Conn. App. filed Oct. 24, 1907. A turnbutton switch so constructed that there will be practically no liability of relative rotation between the button and its contained parts arranged for attachment to a spindle of the like.

889,765. THERMAL ELECTRIC ALARM; Lloyd Currier, of Underwood, S. D. App. filed May 11, 1907. An alarm signal device of the type in which the circuit is closed by the action of a thermostat. Includes a lever having a ball at one end, engaging a socket in a heat-responsive member. The lever carries a circuit controlling device.

889,776. TROLLEY WIRE SPLICER; Harry G. Dyer, Gloucester City, N. J. App. filed Sept. 12, 1907. A quick trolley wire splicer having a sleeve with coned extremities and toothed ratchet bars, which are spring-impelled to grasp the wire within the sleeve.

889,784. TELEGRAPH SYSTEM; Charles Kinney Jones, Quincy, Ill. App. filed Sept. 12, 1907. Means for automatically cutting out any one or more of the telegraph keys in case the operator at a station forgets to close his line switch. Also sounds an alarm under these circumstances.

889,786. CONNECTOR FOR ELECTRIC WIRES; Charles J. G. Keiner, Baltimore, Md. App. filed Oct. 18, 1906. A connector for wires, making use of two interlocking members, which are bound together by a binding wire so as to avoid any possibility of the connection loosening from vibration.

889,788. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App filed Oct. 28, 1905. A line of transmission, a series of transmitting and receiving stations for said line, the line comprising two conductors twisted in intimate relation, the stations in series between one of said conductors, in combination with terminals for said line, said terminals comprising twisted wires inductively related to, but conductively independent from, each other.

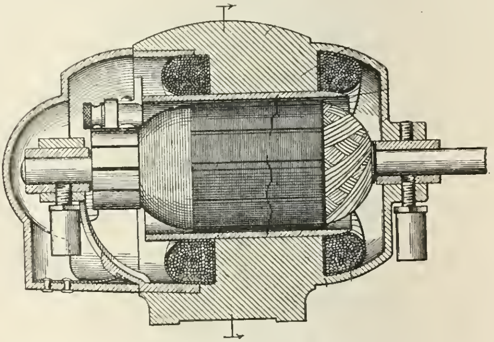
889,789. TELEGRAPH; Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 9, 1906. The invention consists in producing explosions by means of incoming telegraphic impulses and operating a translating device through such explosions.

889,790. TELEGRAPHY Isidor Kitsee, Philadelphia, Pa. App. filed Nov. 17, 1906. A telegraph receiving device having two terminals and means to alternately join and separate said terminals independent of the action of the transmission means, said terminals being surrounded by an inflammable medium.

889,791. WIRELESS TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 21, 1906. Relates to modifications of the above.

889,792. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 21, 1906. Has a detector, consisting of a series of metallic plates in loose contact with each other, part of said plates being provided with oxidized surfaces. One of the plates has a ground connection and the other has an antenna. Makes use of a recorder shunting all of said plates.

889,803. SUPPORT FOR ELECTRICAL CONDUCTORS; Francis B. H. Paine, Buffalo, N. Y. App. filed June 20, 1906. A supporting system for high potential transmission lines designed to insure the double purpose of preventing the wire from falling to the ground and also grounding the wire on a supporting pole.



889,841—Dynamo-Electric Machine.

889,812. MULTIPLE SOCKET FOR ELECTRIC LAMPS; Frank J. Russell, New York, N. Y. App. filed Dec. 18, 1907. A multiple cluster socket, making use of stiff wires, being so bent as to produce the equivalent of threaded shells and center contacts.

889,841. DYNAMO-ELECTRIC MACHINE; Vincent G. Apple, Dayton, Ohio. App. filed May 11, 1907. Makes use of field pole cores and a continuously connecting pole tube of para-magnetic material, attenuated between the pole cores.

889,852. MEANS FOR AUTOMATICALLY INDICATING CERTAIN RELATIVE POSITIONS OF GUNS OR THE LIKE TO EACH OTHER; Willie Dickson Kilroy, of Hatch End, England. App. filed March 23, 1907. Means for preventing the different guns of a battleship from being simultaneously trained so that they might injure one another.

889,857. ELECTRIC FURNACE; Albert J. Petersen, Alby, Sweden. App. filed April 13, 1906. In an electric furnace for treating gases by means of voltaic arcs, the combination of a furnace chamber, an inner central electrode, an outer electrode concentric therewith, means around the furnace for creating a magnetic field in the space within the said outer electrode, and means for moving gases through the said furnace chamber, substantially as and for the purpose set forth.

889,871. SWITCH BUTTON; Charles A. Clarke, Hartford, Conn. App. filed Feb. 15, 1908. Construction of turnbutton switch designed to obtain proper adjustment between the button of the switch, and the face-plate or cover, and the spindle.

889,883. WIND-OPERATED DYNAMO; Emil J. Johnson, Madrid, Iowa. App. filed Aug. 31, 1907. A special construction of dynamo adapted to be directly mounted on the shaft of a windmill so as to be watertight in use and be properly balanced to swing with the wheel in every direction.

889,884. INSULATOR; M. Harrison Strong, of Ozark, Mo. App. filed June 9, 1906. An insulator making use of two grooved insulating rollers, which are strapped together in a metallic frame so as to receive the wire between them.

12,805. RUHMKORFF COIL; John McIntyre, Jersey City, N. J. App. filed Feb. 21, 1908. An induction coil designed to permit continuous running of the apparatus without requiring retrueing of the contact portions. Makes use of a retaining device independent of the vibrator and adapted to engage and hold the same temporarily while adjusting the operating mechanism of the coil.

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LI. NEW YORK, SATURDAY, JUNE 20, 1908. No. 25.

PUBLISHED WEEKLY BY THE
McGraw Publishing Company
JAMES H. MCGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.
239 WEST THIRTY-NINTH STREET, NEW YORK.
TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE....................590 Old Colony Building
CLEVELAND OFFICE....................1015 Schofield Building
PHILADELPHIA OFFICE....................Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....................per year, $3.00
Dominion of Canada....................4.50
Other Foreign Countries within the Postal Union....................6.00
25 shillings 25 marks 31 francs

Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,250 copies are printed.*

NEW YORK, SATURDAY, JUNE 20, 1908.

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JOHN HAYS HAMMOND.

As we go to press, but unfortunately too late for publication, we have received a letter from Mr. L. B. Stillwell supporting strongly the candidacy of Mr. John Hays Hammond for the Republican vice-presidential nomination. This journal has no politics, but we venture to express the belief that the view taken by Mr. Stillwell as to the desirability of such a candidature will have the general approval of every engineer. There is no political office in this Republic for which a competent engineer accustomed to public life should not be willing to stand. It is to be remembered that the greatest of our presidents was a civil engineer. There are two points, however, that are incidental but important. One is the possible succession to the presidency, a place requiring the best energies of a vigorous man in the best of health. The other is the fact that the United States Senate, while one of the most notable deliberative bodies in the world, does not exact from its presiding officer the full exertion of all his powers. An engineer of the distinction and executive ability of Dr. Hammond might serve his country to better advantage in an active cabinet position.

THE WESTINGHOUSE SITUATION.

It is seriously to be regretted that the apparent apathy on the part of some of the stockholders of the Westinghouse Electric & Manufacturing Company should imperil the plan of reorganization proposed by the Merchandise Creditors' Committee and noted several times in our pages. If industrial and electrical conditions were bad without hope of improvement we could understand this seeming reluctance to give the company the capital necessary for a safe development and steady continuance of its great business; but all the signs to-day are of recovery and returning prosperity. What the Westinghouse system can do in normal times is a matter of record; while the field of electrical construction and consumption grows yearly and is rapidly reaching its old level as a new starting point. But with the Westinghouse system, like any other, reduced to a group of factory buildings—mere bricks and steel—its good-will gone, its patents invaded, and its superb organization scattered, the stockholders would receive the barest fraction of the value that now inheres in the company's assets. The situation is one that affects the electrical industry as a whole, and it is to be devoutly hoped that the stockholders, like prudent men, will unanimously decide to conserve that which is now theirs and is tangible, rather than permit it to melt away, with universal loss.

UNDERWRITERS' ELECTRICAL INSPECTION.

That the old-time prejudice against underwriters' electrical inspection has not abated in some parts of the country, is evident from a letter on the subject printed elsewhere. That underwriters' inspectors and electrical men having to do with installation work will ever become brothers in feeling is a dream that will always lack realization. Assuming that absolute perfection resided with the former, and that self-interest should impel the latter to accept the National Electrical Code as a blessing even though in disguise, a certain principle of human nature, and particularly of American human nature, would prevent close communion. That is to say, the average human being resents interference with the details of his business by any person or interest whose status in such interference is not absolutely tangible. While a certain amount of friction due to this feeling will therefore probably always affect the relations of underwriters' inspectors and those engaged in installation work, there is very little, if any, excuse for the attitude of deliberate hostility which in some quarters is yet maintained against underwriters' electrical inspection. Leaving aside the right of underwriters to protect their monetary interest by refusing insurance when a property does not conform to their ideas of a safe risk, it should always be borne in mind that the rules to which risks are required to conform are not a code in the compilation of which the electrical interests concerned have been deliberately ignored. On the contrary, the code, when put in its present form in 1897, was approved by a conference at which no less than a dozen engineering and industrial national bodies were represented, including the American Institute of Electrical Engineers, the National Electric Light Association and the National Electrical Contractors' Association. Moreover, at a similar conference held annually, proposed additions to, or amendments of, the code are submitted for discussion prior to their adoption. While there is not always unanimity in the approval of more stringent requirements added to the code, yet the representatives of the various national bodies are allowed an opportunity for their discussion, and almost invariably when criticism against a proposed rule is strong, it is either withdrawn or amended to obviate the objections offered. In view of this co-operation of electrical bodies in the formulation of the code and the part which they play in its amendment from time to time, any requirement which is thought to bear unduly against the electrical interest should rather be brought to the attention of one or more of these bodies than furnish a cause for hostility against underwriters' electrical inspection in general. We have several times recently pointed out the great benefit to the central-station industry from careful inspection of electrical installations, and shall not here dwell upon this side of the question.

Induction Coils for Gas Ignition.

The ordinary spark coil for igniting gas in the household burner, the automobile engine, or the boat engine, is one of the most generally used electrical devices. It is very simple in construction as well as reliable in action, and yet it has remained but little understood in quantitative detail by engineers, although its general principles of action were established by Faraday, Henry and many other experimentalists. The working formulas of the spark coil have been conspicuously absent in text-books of electromagnetic machinery, whereas the working formulas of its cousin, the alternating-current transformer, have long occupied niches in text-book literature. The principal reason for the scant treatment of the spark coil has been the troublesome and irregular electric resistance of the spark gap. The excellent work of Prof. F. W. Springer has recently added largely to our knowledge of the subject, and a paper by Mr. Benj. F. Bailey, in the *Physical Review*, on "Induction Coils," makes another stride toward filling the gap in our formulas. The paper by Mr. Bailey does not deal with the subject so much from a mathematical standpoint as from an experimental standpoint, by supplying records of tests made on spark-coils under fairly practical conditions. The method of observation described was virtually the potentiometer method of operating a revolving contact maker, on the shaft of a rotating circuit closer and opener. Consequently, although tedious to work with, it absorbs no appreciable energy from the coil under test.

The article brings out a number of useful facts that, if duly confirmed, cannot be too widely disseminated. In the first place, spark coils, when operated with a secondary winding, commonly develop an efficiency of 50 per cent. When operated without any secondary winding, the efficiency may go up to 80 per cent, or even more. These are surprisingly high figures for the efficiency of so misused and crudely designed instruments as spark-coils commonly are. At the same time, we must remember that the tests reported were made under laboratory conditions, and we must not be distressed if efficiencies in the every-day use of grimy and dust-laden automobile ignition instruments should be found much lower. Another interesting fact is that not only does the current strength in a coil without secondary winding rise nearly on a straight line, if the period of make is properly short, but the fall of current during breaking appears to be substantially along a straight line when plotted against time. The time of making contact may be 1/30 of a second, and the current may rise at a nearly uniform rate of over 50 amp per second during this time. The time of breaking contact, and of sparking at this contact, may last 1/300 second, and the current may fall at a nearly uniform rate of over 500 amp per second during this interval. The important point brought out is that although the resistance of the spark at the break increases with the time or with the length of the gap in a complex manner, the current through it subsides nearly according to a straight-line law. The maximum e.m.f. across the gap appears in different coils, with different speeds of breaking, to have reached maxima from 25 to 70 volts, or about the voltage of ordinary arc-lamps. The maximum external power reached from 20 to 30 watts. It is suggested in the paper that proper ignition depends more on the maximum watts in the spark than on the total energy in the spark. Here lies a good field for future investigation.

When a secondary winding is used on the induction coil, the primary spark-gap is ordinarily shunted by a condenser. This condenser plays an important part in the proceedings. It absorbs the magnetic energy in the coil as electric energy, and commonly liberates that energy in an oscillatory discharge if the secondary coil is not too heavily loaded. In such a case the coil acts as a converter from direct to alternating currents, the frequency of the alternating current being 800 cycles per second in one case analyzed. The efficiency of the coil and the magnitude of the maximum induced e.m.f. depend upon the capacity of the condenser. The best condenser for these purposes is usually not the best from the standpoint of suppressing sparking at the primary gap, so that a compromise capacity has to be adopted. With a condenser in the primary circuit, the ohmic resistance of the primary coil, if no greater than occurs in practice, has only a modifying influence. The surge-resistance $\sqrt{L/C}$ of the primary circuit is the controlling factor. The maximum voltage across the primary gap is the primary current strength at breaking, multiplied by this surge-resistance. The maximum secondary voltage on open circuit will be this voltage multiplied by the ratio of transformation. The induction coil in any form is a device for storing energy temporarily in the magnetic form, this magnetic energy disappearing from the primary electric circuit. On magnetic discharge, the magnetic energy is thrown into a spark-gap or into a secondary circuit, after paying for certain losses, namely, core-losses, copper-losses and spark-gap losses. The eddy-current losses in the core are apt to be large, owing to the high secondary frequency, unless the core be very finely divided. High induction-coil efficiency requires, therefore, a relatively large magnetic energy, and relatively small losses in storing and releasing it.

THE MISSED OPPORTUNITY.

Doubtless one of the interesting features of a transatlantic voyage is the frequent announcement of communication established with one ship or another or with a shore station. It should give one a curious sensation at first to know that 300 or 400 miles away the sounder clicks responsive to the messages shot from the ship's antennæ, but the feeling of wonder cannot but give way to a certain sense of keen regret that the tremendous possibilities of wireless are, in fact, bent, so far as general service is concerned, to relatively non-important uses. The navies of the world have probably pushed wireless telegraphy further ahead than any of the commercial operators, yet aside from this one must regretfully own that wireless service is rather trivial. One may perhaps get small personal messages, or learn from the bulletin that Snobsbury, poly-millionaire in pork, has passed to his somewhat dubious reward, and that three widows are contesting his estate. There seems as yet to have been nothing like a determined effort to work wireless for what it is worth, making it thoroughly useful to the navigator and valuable to the traveler by sea. Nobody seems to know just what the wireless situation is as regards working range of action, or if anyone does actually know he is keeping wonderfully silent about it. We have wonderful tales, doubtless quite correct, of messages steadily received over many hundred miles and even quite across the Atlantic, but we do not hear of the apparently frequent failures to span much shorter distances, and know little or nothing about the difficulties encountered and to be overcome. Syntonic sending and receiving has been promised so often that it has come to be a joke, yet every chap who tries it is more than likely to be the victim of such pranks as brought to unseemly merriment not long ago a solemn lecture by one of the distinguished founders of the art. It seems to be one of the cases where the immense possibilities of a more or less distant future have quite overshadowed a really great and immediate use for the present.

Perhaps when there is less selling of stock and more sending of messages on a purely commercial basis, one may expect a more serious and regular use of wireless for practical purposes. Even granting that sending long-distance messages over land will remain the failure that it has been thus far, there is still a very wide scope for usefulness that should not longer be neglected. The first definite thing to which steady attention should be directed is the conquest of the traveled high seas. This should be undertaken by international action, like all the large uses of wireless, since only thus can work upon the high seas be carried out upon a clear and uniform plan. The definite purpose in view should be to put the whole North Atlantic, as a start, under a wireless network capable of maintaining permanent and complete intercommunication. There are effective stations in the region now, but not enough or with sufficient power to do the full work. The stations on the Irish Coast and on Cape Race are good enough, but they need reinforcement. The Azores should be utilized for a powerful plant, backed up by another on the French coast and others on Bermuda, the Lesser Antilles, the Canaries and Madeira. Were such a chain of stations as this properly equipped there should not be a square mile of the traveled Atlantic out of their reach. Even without increase of the present radii of action, the ocean could thus be covered for sending purposes with the utmost ease, and the same stations should be able to pick up messages over almost equivalent radii. The next step would naturally be to fit out some of the big liners with extra powerful apparatus and the longest feasible antennæ to serve as temporary intermediaries pending the time when all steamers may carry equipment enough to keep continually in touch with a shore station. This done, it could be made practically certain that no steamer having a wireless installation would ever be out of touch with a station afloat or ashore. The shore stations relaying with each other could even now be sure of complete intercommunication, so that any suitably equipped ship could at all times send and receive messages from shore to shore. Even at present the big liners are now and then lucky enough to pick up one shore 'ere losing the other, but more stations are needed to make things absolutely sure.

This done, one of the first matters of importance is to establish a complete wireless weather service so that any equipped vessel might know with a reasonable degree of certainty the weather to be expected during the next day or two and make plans accordingly. As it now is, no one can predict the weather a day and, say, 500 miles ahead, but with a full series of wireless reports the conditions could be predicted with more precision than is possible ashore, since in the great level of the open sea there are fewer local disturbing factors than are found ashore. With such information at hand the transatlantic schedule could be held almost to an hour, barring failure of the machinery, and some dangers could be averted by accurate knowledge of the position of serious storm centers. This knowledge is even now almost within reach and can be attained by a little systematic extension of work at present going on. Steamers crippled and in need of assistance could make their condition known even if storm-driven far out of the usual path, whereas there is a capital chance of their being out of reach. In fact, wireless working under existing conditions just misses a magnificent chance for usefulness. Its reach is not quite long or sure enough to span the distances now necessary, and its application lacks the systematic character that can be given only by unified effort and, for that matter, unified control. It is too much of a plaything and too little of a serious reliance We mentioned some time since the plans being made for distribution of time by wireless and the important benefits that might be derived from it—important even if its full possibilities cannot yet be realized. All this is eminently proper matter for international effort, which seems in the case of wireless telegraphy to be particularly appropriate. It is perfectly safe to say that no considerable part of the possible benefits can be realized by private effort. One might as well pin one's faith to a lighthouse corporation instead of trusting such work to the government.

Appraisal of New York City Traction Properties.

The Public Service Commission for New York City has determined to definitely test the limits of its authority over the traction lines of New York City which are now in the hands of receivers. The commission has adopted a resolution ordering an appraisal of all the property of the street railway companies of Manhattan. This action is a result of the statement of the receivers of the New York City Railway Company that it could not provide what the commission ordered and defined as adequate service without defaulting on the rentals of many leased lines.

The commission takes the position that it is obligated under the law to see that an adequate service is maintained, and that if the lines cannot provide such service with their present fixed charges, a readjustment is necessary upon a basis of actual values. It is the position of the commission that the capitalization of the various surface properties in Manhattan, about $250,000,000, is excessive, and that the necessity for earning an adequate return upon this capitalization cannot, in justice, be pleaded as an excuse for not furnishing the public with sufficient service.

Chairman William R. Willcox, of the commission, made the following statement of the reasons for an appraisal:

"The directions of the commission for adequacy will be insisted upon, for it is time to have it thoroughly settled whether a mismanaged local public service corporation can escape the obligations placed on it by the laws of the State when it throws itself into the hands of receivers appointed by any court. If such action on the part of such corporation relieves it from the operation of the laws of the State and thus constitutes an immunity in so far as the operation of the statutes is concerned, the sooner it is known the better. The letters sent by the receivers to the commission seem to indicate that the first object of the receiver is to pay rentals of leased lines and other fixed charges. This idea is a mistaken one. The obligation resting upon those enjoying public franchises is primarily to give an adequate service, and it is to be regretted that the importance of serving the public is not considered at least equal with that of serving the stockholders. The commission has ordered that adequate service shall be furnished under the four orders issued. No objection has been made by the receivers to the definition of adequate service which the commission has adopted, and the only excuse that has been offered is that the fixed charges will not permit the expenditure to give an adequate service to the people, and an implication is made that if adequate service is insisted upon the system will be disintegrated and transfers from one line to another therefore refused.

"The law empowers this commission to regulate rates of fares between companies and to provide for continuous rides by transfers between two or more lines. Manifestly it cannot fix rates or take action compelling the issuance of transfers, or arrange for a joint rate, until it knows the value of the company's property."

The resolution adopted by the commission is as follows:

"Whereas, The receivers of the New York City Railway Company have stated to the commission that it is impossible for them to provide adequate service upon the street-car lines in Manhattan because there would not be sufficient funds to pay the rentals of many leased lines if the service were made adequate; and,

"Whereas, The investigation made into the books of this company and its subsidiary companies last fall indicated in certain instances that the companies were greatly overcapitalized and that the rentals being paid were out of proportion to the value of the lines; and,

"Whereas, Thousands of citizens of New York will be seriously inconvenienced by the abolition of transfers by the receivers; and,

"Whereas, It has been asserted that if a fair rental were paid to the subsidiary companies, based upon a fair value of their property, the company could give adequate service and retain a satisfactory system of transfers; and,

"Whereas, These questions raised by the action of the receivers cannot be definitely answered without a knowledge of the value of the property of each line as one factor; therefore be it

"Resolved, That the commission proceed to inventory and appraise the property, tangible and intangible, of the street-railway companies in the Borough of Manhattan and that the chairman have general direction of the work."

Mr. Willcox says that the appraisal will be made under the direction of the best experts it is possible to employ in the country.

After the decision to make an appraisal was announced, the receivers of the New York City Railway Company issued a statement in which they said:

"The action of the commission in voting to inquire into the value of the street-railway properties in Manhattan before issuing any further orders for increase of service commends itself to the judgment of the receivers. We do not wish to be understood as having any purpose to defy the commission or to enter into any controversy with that body."

The total fixed charges on which defaults have so far been made on mortgages and rentals of the Metropolitan Street Railway Company, the Third Avenue Railroad Company, the Central Crosstown Railroad Company and the Fulton Street Railroad Company is $7,751,308. Should the federal court also act favorably on the application to discontinue the operation of the Central Park, North & East River Railroad Company and the Twenty-eighth & Twenty-ninth Streets Crosstown Railroad Company, this figure will be increased to $7,988,308.

The statement includes that no more fixed charges can be eliminated without default on the interest on securities of underlying companies, which would mean the disintegration of the entire system and entail a serious curtailment in the present transfer privileges.

Hearing on New York Electric Lighting Contracts.

At the investigation of the electric light service of New York by the Public Service Commission, Mr. Arthur Williams, general inspector of the New York Edison Company, was again examined June 11. Mr. Williams said that as far as he knew the Edison Company had never had more than 75 or 80 special contracts with customers, and that all of those were inherited from other companies. Mr. Williams was then examined at length with reference to the various riders attached to special contracts, the commission seeking to know in regard to every one of them what objections, if any, there were to making public their provisions and giving every consumer an opportunity to avail himself of them. Speaking of the rider obligating the consumer to contract for a period of six years and to agree not to put in a private plant, Mr. Williams said that the private plant clause was considered important, and as it affected owners and lessees of buildings and not sub-tenants, it was to that extent a provision which could not go in the standard form of contract. The same rider which accompanied a concession in rate to from 3 to 5 cents per kw-hour was held by Mr. Williams to be impractical for small consumers in an apartment, because the company could not accept their guarantee as to the use of their proportionate share.

Mr. Williams admitted that the main considerations for making concessions were to keep out private plants, to guarantee a large consumption and to have the right to put in a small local station within the building rent free. Mr. Williams stated that a blank space was left in all wholesale contracts in which special conditions could be written to conform with the circumstances attending the contract, but said that similar conditions would apply to all consumers under similar circumstances. In reponse to Commissioner Maltbie's insistence that all possible conditions should be made known to every prospective customer, Mr. Williams said that the company considered every case individually, and he doubted if it would be practical to make in advance a statement that would cover all conditions. Mr. Williams explained that there were sometimes clauses inserted requiring weekly payments on account, which was not a special concession, but simply a matter of protection to the company where it did not care to extend its credit for a larger amount. One of the special clauses inserted in wholesale contracts provided for the purchase of incandescent lamps in use in the installation when the contract was made, at 7½ cents each, and that in consideration of supplying lamps and supplying carbons and attention for incandescent lamps, a concession of 1 cent per kw-hour would be made. After hearing Mr. Williams upon all the riders in detail, Commissioner Maltbie expressed the opinion that the company could not too speedily make public all its forms of contract, conditions of service or special riders, so that any prospective consumer would have an opportunity to take advantage of them. The hearing was adjourned until June 15.

At the hearing on June 15, Mr. Williams was again on the stand to give further information concerning the wholesale contracts of the company. He stated that when a reduced rate was granted under a 2000 kw-hour per month contract, with a two-hour daily consumption, this quantity was charged against the consumer whether he used it or not. In the matter of discounts Mr. Williams said that in these wholesale contracts, when the bill amounted to $500 per month, 5 per cent was allowed, and when it reached $1000 per month, 10 per cent was allowed. Mr. Williams added that the company will terminate all of its wholesale contracts July 1, as it contemplated furnishing only one form, which would save these complications and give all customers equal opportunities. Commissioner Maltbie announced that with the understanding that the company was at work upon a uniform contract inquiry into that subject would be discontinued.

Mr. John W. Lieb, for the Edison Company, testified as to the difference in contract rates in Manhattan and in the Bronx and explained that it was due to the different character of territory and different classes of consumers. Mr. Lieb also explained that to serve one large building as a unit was cheaper than to serve six smaller ones, even though located closely together, and consuming the same amount of electricity. The hearing was adjourned until June 17.

Inspection of Niagara Power Tunnel.

The wheelpits and tunnel tailrace of the Niagara Falls Power Company underwent a thorough inspection on Sunday, June 14, and were found in almost perfect condition. This is the first inspection made since June 1, 1902, and after this lapse of six years the great underground work of the Niagara power development appears as substantial as ever. The tunnel inspection was made possible through the fact that the International Railway Company desired to have the tunnel flow shut off long enough to inspect the north abutment of the upper steel-arch bridge on the American side of the river, this abutment having a retaining wall to protect it from the torrent that pours out of the tunnel.

The water was shut off at 1 a. m., Sunday. The gates and valves worked nicely. Before 2 a. m. engineers were in the tunnel making their examination. Every part was gone over, and with the sole exception of a few bricks out of the roof of the connecting tunnel between the wheelpits, everything was found in perfect condition. A. H. Van Cleve, consulting engineer, was in charge of the engineering inspection, while Mr. C. C. Egbert, mechanical superintendent, made a full inspection of the mechanical features of the two great installations.

The International Railway Company had a force of men, including three divers, ready to make an inspection of the abutment, and as soon as it was light enough this work began. The result was that it was found that the retaining protective wall had not protected the abutment as intended, but that the water had succeeded in washing away the shale back of it. The damage was not so great as was expected it might be, and repairs will now be made, guided by the knowledge the inspection has afforded.

In order that a Lake Survey Corps might secure data as to the normal flow of the American channel and falls during the time when no water was being diverted, the Niagara Falls Hydraulic Power & Manufacturing Company also shut down its works. Thus for a few hours no water was being diverted at Niagara Falls, N. Y., for power development. Mr. Francis C. Shenehon, of the Lake Survey Corps, had men stationed at the river's entrance, near Buffalo; at Schlosser Dock, Port Day, Willow Island and Prospect Point, Niagara Falls, who took levels during the continuance of the shutdown and after the turbines were again in operation. The conditions under which these levels were taken were understood to be very pleasing, and it is said the level at Prospect Point, the brink of the American Falls, showed an increased depth of 1 1/5 in., but this is not definite information.

Major W. C. Kutz, of the Taft Scenic Commission; Secretary W. E. Wilson, of the International Waterways Commission; Dr. E. W. Schoder, of Cornell University; Mr. A. Monro Grier, Mayor A. C. Douglass, Mr. W. S. Humbert and General Manager Philip P. Barton, of the Niagara Falls Power Company, as well as others, made a trip through the tunnel.

Convention of the National Electrical Trade Association.

The annual convention of the National Electrical Trade Association was held in Philadelphia, Thursday, June 11, at the Manufacturers' Club. Twenty-five members were in attendance and after transacting the business brought before the meeting and electing officers, the Philadelphia members entertained the visiting members by a trip to Atlantic City. The following officers were elected:

President, Mr. Charles M. Wilkins, of Partrick, Carter & Wilkins; vice-president, Mr. Norman Marshall, of the Marshall Electric Manufacturing Company; secretary-treasurer and counsel, Mr. Fredrick P. Vose, Chicago. Four delegates: Mr. Norman Marshall, representing the New England Association; Mr. Charles M. Wilkins, representing the Philadelphia Association; Mr. John H. Dale, representing the New York Society; Mr. James F. Wolff, representing the Chicago Association.

New Quarters for Chicago Engineering Meetings.

The numerous engineers in Chicago and vicinity who have been attending engineering meetings of various kinds, most of which have been held in the rooms of the Western Society of Engineers on the seventeenth floor of the Monadnock Block, are interested in the important changes which will take place the coming summer in the rooms of that society. The new quarters will occupy the entire north part of the seventeenth floor of the Monadnock Block, occupying a space 62 ft. x 61½ ft. The library, reading room, secretary's office and committee rooms occupy the outer portions of this space. The inner portion, 36 ft. x 44 ft., will be an auditorium protected by the outer offices from the noise of the street, which have been very annoying in the old quarters. This room will have a seating capacity of 162, which can be somewhat increased in emergencies. This room is 14 ft. high and is provided with a skylight and provisions for artificial ventilation. The inability to secure proper ventilation has been one of the greatest drawbacks to the old quarters, and at times has interfered seriously with the attendance and interest at meetings. It is expected that the new quarters will be ready in time for the first engineering meetings in the fall. Both the Western Society of Engineers and the Chicago branch of the American Institute of Electrical Engineers hold meetings in these quarters.

Illinois Frontage-Consent Law May Be Unconstitutional.

A decision of much interest to electric-lighting companies in the State of Illinois, and indirectly to those of other States, was given out June 9 by Master in Chancery Zeisler, in Chicago, regarding the law requiring the consent of a majority of the property holders on a street to the construction of pole lines or conduits for electric-light wires. In 1897 the State Legislature of Illinois enacted a law requiring that the majority of the property holders on any mile of street or roadway be obtained before the City Council or Board of Trustees could legally grant a franchise for the construction of a pole or conduit line for electric-light wires. In Chicago the board of trustees of the sanitary district, a public body which controls the Chicago drainage canal and the electric power generated by the canal, attempted to build pole lines in the streets of Chicago without obtaining the consent of property owners. The law specifies persons or corporations. The sanitary district trustees held that a public body created by the people would not come under a law applying to persons or corporations. The case was tried before Master in Chancery Zeisler in a suit filed before Judge Carpenter by real estate owners. The master in chancery not only held that frontage consents were unnecessary because the board already had a grant from the State of Illinois, but went further and held that the frontage-consent law was unconstitutional and void because it applies only to electric-light companies and not to other companies transmitting electricity. His decision applying to the constitutionality of the act is as follows:

"I find that whatever danger to life and property may arise from the presence of any electric wires in or under a street does not affect abutting property holders as such, but affects to an equal degree all those who have occasion to use the street; in other words, the general public. Apart from the fact that electric-light wires are thicker than telephone, telegraph and alarm signal wires, there is no material difference in the appearance or general method of construction of the different transmission lines.

"The construction or maintenance of an overhead transmission wire for lighting purposes is not more unsightly nor in other respects more burdensome to abutting property holders than that of an overhead transmission line for any other purpose.

"The legislative purpose of the frontage-consent act of 1897 manifestly was not to protect the general public against the danger arising from the presence of electric wires in or under the streets because it gives a practical veto power only to abutters, and because the same act requires frontage consent for the laying of gas pipes in the street, and there is no pretense that the construction or maintenance of a gas-pipe line endangers abutting property holders. Manifestly, therefore, the only purpose was to afford protection to abutting property holders (as distinguished from the general public) against the inconvenience arising from the tearing up of streets, the possible depreciation of their property or the offense to their aesthetic sense arising from the maintenance of pole lines in front of their property.

"The fact that lighting wires are more dangerous than other wires to those who come in contact with them bears no relation to this legislative purpose, and there is no fair reason for requiring the consent of frontage owners for their construction, which would not require with equal force the extension of this provision for the construction of transmission lines for other purposes. The frontage-consent act, so far as it applies to electrical transmission lines, violates both the State and the federal constitutions and is therefore void. The question whether it is also void so far as it applies to the laying of gas pipe in the streets, does not arise in this case, and I, therefore, express no opinion thereon."

This ruling of the master in chancery is yet to be passed upon by Judge Carpenter. This decision will help to settle the controversy between the city of Chicago and the sanitary district trustees as to the rights of the sanitary district pole lines in the streets of Chicago. The City Council of Chicago, at its meeting June 8, also passed an order that the sanitary district be allowed to run wires on poles and in conduits belonging to the city under the approval of the city electrician, with compensation to be agreed upon in each case.

Lighting Questions in New York.

On Thursday evening, June 11, the regular monthly meeting of the contract and inspection department of the New York Edison Company was held in the Edison Auditorium. Several very interesting and instructive papers were read by members of the department, including "The Public Utilities Company's Dealing with the Public," by Walter Neumuller; "Electric Signs," by E. A. Mills; "A Few Thoughts Concerning the Competition of the Local Plant," by W. H. Whitton; "Work of the District Offices," by F. H. Kinnicut; "The Tungsten Lamp," by E. F. Tweedy. At the conclusion of Mr. Tweedy's paper several lantern slides were shown giving the performance of the tungsten lamp, followed by views of lighting fixtures adapted for use with tungsten lamps, which were described by Mr. Mills.

Mr. Arthur Williams, general inspector, closed the meeting with a timely address on the activities of the department in the past and present, with suggestions for work in the future.

Investigation of Telegraph and Telephone Companies.

During the closing hours of the last session of Congress a resolution was passed by the Senate which called on the Secretary of Commerce and Labor for an investigation of telegraph and telephone companies. The resolution follows: "That the Secretary of the Department of Commerce and Labor be, and he is hereby, directed to institute an investigation into all the telegraph and telephone companies engaged in the conduct of an interstate business as to the methods used in handling the public's business, the wages paid to telegraphers, telephone operators and other employees of such companies and the working conditions of the employees thereof, together with a statement of the receipts and expenditures of such companies for a period of five years. And he is further directed to report the results of such investigation to the Senate on the first Monday in December, 1908." In compliance with this resolution Secretary Straus has instructed Commissioner Charles P. Neill, of the Bureau of Labor, to conduct the inquiry and to have his report ready before Congress convenes.

Illumination and the Eye.

Dr. Henry Gradle, of Chicago, addressed the Chicago section of the Illuminating Engineering Society, June 11, on "Illumination and the Eye." He took up mainly the effects of varying degrees of illumination on the eye and showed that what the eye considers good illumination is, within certain limits, largely a matter of comparison or contrast. The eye can work comfortably within great ranges of illumination, but after being exposed to very high illumination, such as sunlight, considerable time is required to adapt it to seeing most clearly where the illumination is less. In the discussion it was brought out that the eye normally in daylight receives a certain amount of light from every direction. If we change these conditions with artificial light, it is most trying on the eyes. For example, a person when sitting in a comparatively dark place and looking toward a place more brilliantly lighted with exposed lamps suffers great eye fatigue. A practical example of this was afforded by the accidental extinguishing of the lamps at one end of the meeting room during the meeting, thus causing considerable eye discomfort to those sitting in the dark end of the room looking toward the lighted end. In theaters the darkening of the audience room, Dr. Gradle pointed out, had the effect of making the audience perceive things on the stage more clearly than if some of the general lighting of the audience room was continued during the performance.

Progress of Denver Gas & Electric Co.

During the past year the Denver Gas & Electric Company has installed two turbo-generators of 3000-kw and 2250-kw capacity respectively, and a De Laval turbine of 225 hp. Thirty-one miles of pole line have been erected and substations have been electrically connected in a manner to make them interchangeable in case of breakdowns. The transformer capacity has been increased by 2185 kw, and 3320 electric meters were purchased. The increase in sales for the year ending May 1 was 4,559,755 kw-hours, or a gain of 21.7 per cent in quantity and 14.8 per cent in gross receipts. The lesser increase of gross receipts is due to reduction in the rates made to conform to a franchise ordinance which provides that after Jan. 1, 1908, the average of receipts from sale of current shall not exceed 7.1 cents per kw-hour. During the past year special effort has been made to secure additional local stockholders in order to increase local interest in the property. On May 1, 1907, only 81 stockholders were residents of Denver, while on May 1 of the present year this number had been increased to 295. No less than 145 employees of the company are now stockholders. The payment of dividends of one-half of one per cent on the first of each month has done much to create an interest and demand for the stock locally. The annual report of the company states that Denver now enjoys the reputation of having the best lighted business section in the country, and that with the increase in private lighting has come a demand for additional public lighting, which was shown in the recent installation of ornamental street lighting on one of the main streets, and plans for increased lighting on another important street. The city has also added to its street lights in the residential section.

Last year the number of electric consumers was 21,140, an increase of 3150; the number of 16-cp lamps connected, 360,300, an increase of 36,343; kw-hours sold for the year, 25,531,451, an increase of 4,559,755; the number of arc lamps in use, 3,193, an increase of 574; the number of electric signs connected, 291, an increase of 125; the number of 50-cp street lamps connected, 693, an increase of 137; the number of motors connected, 1913, an increase of 191; horse-power of motors connected, 11,291, an increase of 606 hp.

Commencement at Worcester Polytechnic Institute.

The thirty-eighth annual commencement exercises of the Worcester Polytechnic Institute were held on June 11 in Tuckeman Hall, Worcester. A class of 71 men were graduated, of whom 23 were electrical engineering students. Eleven graduate students and engineers received the degree of E. E. The commencement speaker was the Hon. James Logan, Mayor of Worcester, and general manager of the United States Envelope Company, his subject being "Changing Industrial Conditions."

Mayor Logan reviewed the development of modern industry since the Civil War period, stating that one result of the conflict was the speeding up of all productive machinery. Between 1836 and 1861 the Patent Office issued 32,291 patents; from 1861 to 1865, 22,667 patents, and from 1865 to 1907 there were issued 823,894 patents, or a yearly average practically as large as that of 1861-65. The expiration of fundamental patents greatly stimulated minor inventions and applications. The speaker then emphasized the importance of management, and particularly accounting in the industrial work of the times. The management of the large corporation is to do for the industry what the inventor has done with machinery; for, after all, a machine is simply organized thought, and while no patents are granted for improvements in management, there are as real inventions in that field as in the mechanic arts. We have standardized methods and machines, but we never can standardize human beings. The individual equation must always be considered, and the rank and file do not take orders as they once did.

In industry, as in war, the fighting formation has been changed. Modern methods have abolished the idea that men must be mere machines. The officers are no longer able to control their men as formerly, because the fighting formation covers so much ground, and, therefore, the men in the ranks must have a higher standard of industrial intelligence. Successful industry requires, as never before, genius in organization, and the leader must be a constructive statesman in industry, capable of formulating large and far-reaching policies. Men may criticise and abuse Rockefeller and Carnegie, but when time, the great softener, has done its beneficent work, and we can get the proper perspective, the world will note and give credit to these men for bringing the organization of business to a scientific basis. Notwithstanding its defects the modern factory system has been one of the mightiest instruments of civilization. The corporation is to be the machine for bringing in the shorter working day for the laboring man.

One of the secrets of Andrew Carnegie's success was his accounting system. The cost of running one accounting room of his Pittsburg plant was $80,000 a year, but Mr. Carnegie said it was worth all it cost, for it gave him the inside details of his business. Gov. Hughes' successful penetration to the very center of the dark continent of high finance was in considerable part due to his knowledge of accounts. More and more the accountant is to be the prime factor in the development of industrial efficiency, and the engineer should know something about accounting, since his own success or failure may be determined in the office instead of the field.

The annual engineering lecture was delivered at the institute on June 9 by Prof. George I. Rockwood, who gave an illustrated review of modern steam turbine development, with a discussion of the advantages and disadvantages of the different types.

Electrical Development at Rome, Italy.

It is proposed to make additions shortly to the electrical supply of Rome, Italy, which will aggregate an expenditure of nearly $4,000,000. These include a large steam generating power plant outside Porta S. Paolo, on the Tiber, to give an additional 30,000 kw, which, with the 15,000 kw available from the Aniene and Nera, will make the total extra supply 45,000 kw. Only the Aniene plant—giving 5,000 kw normal and 6,500 kw maximum, and a steam central station, giving 7,500 kw normal, and 10,000 kw maximum—will be built at present, the Nera hydro-electric plant and the extension of the steam central station to supply an additional 20,000 kw being left for further consideration, when the extending of the city and the rapid increase of population will make a larger supply of power necessary.

The main features of the central hydro-electric power plant on the Aniene include a canal some 8.4 miles long (including a tunnel 1.16 miles long) to carry 460 to 530 cu. ft. of water per second, and giving a fall of some 202 ft. There will be four generating sets, each consisting of one hydraulic turbine, giving 2,600 hp, normal, at a speed of 500 r.p.m., and 3,100 hp maximum direct coupled to a three-phase alternator, developing normally 1,800 kw at 6,000-6,500 volts, at a frequency of 50 periods. There will be four three-phase transformers, submerged in oil, water cooled, which will raise the voltage from 6,000 volts to 30,000 volts, the voltage on the transmitting line.

The transmitting line, 23.5 miles long from the hydraulic central to the receiving substation in Rome, will consist of two groups of three wires each, the section of the wires being such that in case of accident on the line the current may be transmitted to Rome by one group only. The wires will be supported by iron poles of the rigid type on the mountain sections and on the "Semenza" or elastic system in the plain, the two groups of wires being placed some 7 ft. apart.

The receiving substation in Rome, to be situated adjacent to the central steam station, will have four transformers, oil insulated and water cooled, reducing from 30,000-32,000 volts to 6,000-6,330 volts. The steam generating power station plans will include eight boilers of the multitubular type, with stokers, economizers, feeding pumps, etc. There will be four turbo-generating sets, each consisting of a steam turbine direct coupled to a three-phase alternator, each group to give 2,500 kw, normal, at a speed of 1,500 r.p.m.

The main distributing system will consist of eight cables, aggregating a length of 56.5 miles. The secondary distributing system will extend practically over the whole area of the town. A considerable number of Nernst lamps (1,650) and metallic filament lamps, 100 and 60 cp, will be employed for lighting streets and narrow thoroughfares.

The total cost of the plant and distributing system has been estimated at $3,706,000, of which $752,000 is allocated for the hydraulic works and central hydro-electric station on the Aniene, $144,000 for the transmitting line, $700,000 for the central steam generating power station, and $1,300,000 for the main and secondary distributing system in town.

For the further extension, which is contemplated, of the steam central station (to give an additional 20,000 kw) there are to be installed four turbo-generating sets, each of 5,000 kw. The technical part of the work is under the supervision of Signor Giorgi, municipal electrical engineer.

Industrial Uses of Ozone.

At the May meeting of the Faraday Society (London), Mr. F. Mollwo Perkin presented a paper on the industrial uses of ozone, particularly in connection with water purification. The method used by Siemens & Halske was described in detail. The apparatus consists of two concentric electrodes, the inside one being of aluminum and the outside one of glass. The aluminum one in order to keep it cool is hollow and has water circulating through it. The external one is also kept cool by water contact, and as the water is in an iron container which is earthed, this acts as a negative pole, and, of course, water is a conductor on the high tensions which are employed. Dried air is passed up the annular space between the two electrodes, and, by means of the silent electric discharge which is there taking place, is ozonized. From the ozonizer the air passes up towers which are filled with pebbles, and over which the water trickles; by this means the water is divided up into a number of small streams, and consequently a very large surface is exposed to the action of the ozone. After the water has been thus treated it is allowed to flow into the reservoir in a series of cascades. By this means it comes in contact with the air, and any excess of oxone which may be in it is removed.

It is found that the water purified in this way becomes almost absolutely sterile, and any bacteria which may happen to remain are not of a pathogenic nature, consequently the water is absolutely safe for potable purposes. Messrs. Siemens & Halske have a large installation for dealing with water at Wiesbaden and another for purifying the water supply at Paderborn. They have also erected experimental plants in several other places. The process can be very cheaply carried out, as it does not cost more than 1/5d for every cubic meter of water which is treated. A portable plant has also been devised and is of particular use in case of war; in fact, some of them were employed in the late Russo-Japanese war. They should also be of value for other purposes—if the water supply of any town were to become contaminated with typhoid, for example.

The paper discussed other uses for ozone, including the bleaching and sterilizing of flour, a process used in a very large number of mills in Great Britain. Flour so sterilized is capable of export for long distances, and may be kept for a very long time without deterioration.

In the discussion it was suggested that a simpler method of sterilizing on a large scale was to soften the water and bring down the bacteria in the precipitated chalk. It was pointed out that water from rapidly-flowing rivers needed little further purification, and reference was made to the difficulties of removing the last traces of ozone from the sterilized water. It was stated that germs that could not easily be destroyed were, as a rule, harmless. The chairman described an ozonizing plant he had lately visited in Philadelphia, where the water purified was practically diluted sewage. This plant was capable of treating water for a population of 30,000, but occupied only 30 ft. x 50 ft. of ground, as against acres required for sand filters.

Central-Station Operating Results in Massachusetts.

The recently published report of the Massachusetts Gas and Electric Light Commission for the year ending June 30, 1907, affords scope for considerable detailed analysis of the cost and revenue of the central stations in that State. In the following discussion of some of the more important results of operation in the year covered the unit method of comparison is used in preference to the totals given in the report, which makes the relations between the various quantities more readily apprehended. Table I shows the distribution of earnings for all the private companies in the State, giving the proportion of each dollar, approximately, earned by the different classes of business.

Table I.

Commercial arc light service by contract	$0.01
Commercial incandescent service by contract	0.016
Commercial arc and incandescent service metered	0.57
Public arc light service	0.152
Public incandescent service	0.047
Sale of electric power	0.163
Sale of current to other companies	0.024
Steam heating revenue	0.004
Miscellaneous rentals, approximately	0.014
Total	$1.00

The most striking feature of these figures is the very small percentage of total business due to the sale of current for power. Practically one-sixth is due to power sales, while 57 per cent constitutes the sale of commercial arc and incandescent lighting current. Allowing that many small power users are served by incandescent circuits, it is clear that the future of the central-station power business in Massachusetts offers a notable opportunity for progressive development.

The State is pre-eminently the home of manufacturers, and except in the valleys of the Connecticut and the Merrimac, water power is not to be had in any considerable volume. Since both the central station and the steam-using manufacturer depend upon coal, the two should come together even more closely than in the past. Neither the load factor nor the efficiency of the small steam engine in the manufacturing plant can, in the majority of cases, compare with the well-organized central station, and if the disposition observed in some quarters to rest satisfied with existing business should give way to an energetic power campaign, the results ought to be satisfying to both the company and the public. These are at present doing business in a territory far below the power saturation point per capita.

Considering the length of the cold season in the latitude of Massachusetts it is surprising that so little central-station heating business is done. In this respect the central stations of the South have much to tell their Northern brethren. From the table it is clear that the sale of current on the flat-rate basis has practically died out in Massachusetts, in proportion to charges by meter.

Table II.

Coal and other fuel	$0.12
Rent of real estate used for plant	0.01
Oil and waste	0.003
Water	0.005
Station wages	0.062
Station repairs	0.004
Steam plant repairs	0.013
Electric plant repairs	0.009
Apparatus and machinery	0.005
Current bought	0.025
Wages for care of lights, meters, distribution, clerical, labor, collectors	0.028
Repairs and renewals of lines	0.05
Repairs and renewals, meters, lamps, motors	0.016
Distribution tools and appliances	0.005
Carbons	0.007
Incandescent lamps	0.025
Globes and directors' allowances	0.004
Salaries of officers	0.024
General salaries	0.038
Rent of offices separate from plant	0.002
General office expenses	0.027
Taxes	0.075
Insurance	0.014
Law expenses	0.006
Claims and bad debts	0.002
Incidental expenses	0.004
Total	$0.583

Table II shows the distribution of operating expenses per dollar earned by the private companies of the State.

The importance of the fuel question is reflected by Table II, which shows that 12 cents out of every dollar earned were expended for coal or other fuel. While station economy continues to be a matter of extreme consequence, the question of taxes is of much import. The latter exceed station wages in total amount for the State. Repairs and renewals of lines call for a substantial disbursement. Reduction of taxes is a difficult matter to bring about, but when questions of rates arise it is well to call attention to figures like these, which amounted to over $736,000. It is interesting to note that steam-plant repairs figured 1.3 cents per dollar earned, against 0.9 cent in electric-plant repairs. The total cost of operation was 58.3 per cent of the earnings.

The total kw-hours generated by the private companies of the State in the year were 193,951,433. The average cost of each unit of output was 2.94 cents, including all the items shown in Table II, excluding interest, depreciation and dividends. The average income per kw-hour generated was 5 cents.

Table III shows the tributary population, the gross earnings per capita, the population per horse-power and connected motor load, the gross earnings and the operating expenses in the systems of the 12 principal urban central stations, the companies being arranged in the order of tributary population as figured in the commission's report on the basis of the State census of 1905.

TABLE III.

Name of company by city.	Tributary Population.	Gross E'n'gs per cap.	Motor (con'd) hp.	Popul'n per connected hp.	Gross Earnings.	Approx. fr. Operating Expenses.
Boston Edison	703,597	$5.72	35,096	20	$4,024,000	$2,156,000
Worcester	128,135	2.36	1,449	88.5	303,000	154,800
Lowell	110,000	2.66	5.071	21.6	292,800	183,000
Fall River	105,762	2.32	1,048	100.5	246,000	155,600
Malden	101,129	2.34	1.285	79	236,500	152,000
Cambridge	97,434	2.88	2,411	40.3	281,000	138,000
Lawrence	89,972	2.16	1,460	61.5	194,900	115,400
Lynn	89,358	3.95	2,914	30.6	352,200	202,500
Springfield	86,486	5.19	3,692	23.4	447,700	249,900
New Bedford	78,597	1.72	553	142	135,200	72,500
Brockton	57,484	3.12	1,167	49	178,500	111,400
Boston Con. Gas	56,418	4.41	475	118	248,300	106,800

It will be seen from this table that the size of the city is small indication of the capacity of the community to absorb power. It might be expected that the resources of the largest company in the State, the Boston Edison, would permit the most thorough exploitation of the power and lighting field, but the figures for Lynn show about the same relative extent of power consumption in that city, with Springfield a close third. Lynn and Cambridge also appear to have given much attention to power business in the past few years. In gross earnings per capita Springfield follows the Boston Edison Company closely, indicating a widespread demand for electric service in that city. In considering Malden and Cambridge, it should be recalled that they are very largely inhabited by Boston business men who make their homes in these suburbs, although a considerable amount of manufacturing is scattered through Malden, and even more in Cambridge. The Boston Consolidated Gas Company serves a large suburban territory, including the town of Brookline.

TABLE IV.

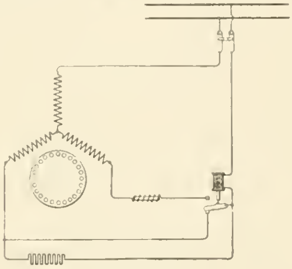
Company.	Kw-hours, generated.	Kw-hours, sold.	Per cent loss.	Op. cost per kw hour gen., cts.	Lb. coal per kw hour gen., cts.	Cost distbn kw hour sold, cts.	Tot cost per kw-hour sold, cts.
Boston	84,516,076	60,677,401	23.8	0.83	2.65	0.64	3.54
Worcester	5,108,527	3,994,583	19.7	1.22	3.46	1 16	3.88
Lowell	7,074,706	6,196,480	12.4	0.975	3.12	0.84	2.96
Fall River	3,953,851	3,310,677	16.3	1.4	4.	1.75	4.7
Malden	3,951,702	3,037,276	23.1	1.07	3.46	1.97	4.95
Cambridge	5,952,956	4,871,738	18.1	1.05	3.22	0.78	2.83
Lawrence	3,698,421	2,896,255	21.8	0.82	..	1.23	3.98
Lynn	8,216,268	7,183,497	12 5	1.2	..	0.92	2.82
Springfield	15,562,953	9,510,105	38.8	0.73	..	0.80	2.62
New Bedford	1,574,452	1,325,953	15.7	2.27	..	1.06	5.45
Brockton	2,831,445	2,190,222	22.6	1.87	5.6	1.55	5.1
Boston Con. Gas	2,785,712	2,420,852	12.8	1.77	..	1.46	4 8

Table IV shows the kw-hours generated and sold by each company, with the percentage of loss, the operating cost per kw-hour generated at the station, the pounds of fuel per kw hour generated at the station, the cost of distribution per kw-hour sold and the total cost of manufacturing and distribution per kw-hour sold.

In the foregoing table the fuel consumption per kw-hour is based on the long ton and in the cases of the Lawrence and Springfield companies water-power plants are in service to supplement the steam stations. In Lynn, New Bedford and by the Boston Consolidated Gas Companies a number of fuels were used, prohibiting any comparison. The total cost per kw-hour sold includes the operating expenses at the station, the distribution expenses, the cost of management, taxes and incidentals. Interest, dividends and depreciation are not included in the above figures. These figures show the percentage dividends paid by the purely electric companies: Boston Edison Company, 11 (7.5 and 3.5); Worcester, 8; Lowell, 8; Fall River, 8; Malden, 9; Cambridge, 10; Springfield, 8; Brockton, 5.

Self-Starting Single-Phase Induction Motor.

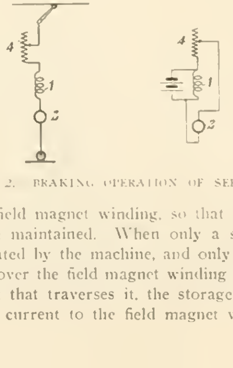
The accompanying illustration shows a scheme for rendering a three-phase induction motor self starting, as a split-phase machine receiving energy from a single-phase circuit, for which a patent was granted to Mr. A. R. Everest on May 12. The automatic switch is arranged normally to establish running connections. The magnet of the switch is so proportioned that when the current exceeds a certain value, as during the starting period, the phase-splitting devices are in circuit and an accelerating torque is produced on the shaft.



SELF STARTING SINGLE-PHASE INDUCTION MOTOR

Braking Operation of Series Motors.

A patent issued on May 26 to Mr. B. G. Lamme discloses a method for causing a series motor to operate as a braking generator under stable conditions. A storage battery is connected in shunt to the field magnet winding before the machine is connected to the braking circuit, so that it will begin operation as a separately excited generator and no severe shock will result. The storage battery remains connected in shunt to the winding during operation of the motor as a generator, and serves to cause a substantially constant amount of current to be supplied to the field magnet winding, so that stable conditions of operation are maintained. When only a small amount of current is generated by the machine, and only a small drop of potential occurs over the field magnet winding by reason of the armature current that traverses it, the storage battery will assist in supplying current to the field magnet winding and will



FIGS. 1 AND 2. BRAKING OPERATION OF SERIES MOTORS.

serve to maintain the field magnet strength at substantially its normal value. If the machine generates more than the normal amount of current, the drop of potential over the field magnet winding caused by this current will be increased above the voltage of the storage battery and the battery will be charged by the current generated in excess of the amount necessary to maintain the field magnet strength at substantially its normal value. Thus the field magnet strength is maintained substantially constant.

Society of Wireless Telegraph Engineers.

The annual meeting of the Society of Wireless Telegraph Engineers took place at 192 Bay State Road, Boston, Mass., on June 1, 1908. The secretary's report showed that the society held 10 meetings during the last year, at each of which a paper bearing upon the subject of wireless telegraphy was presented. Among the papers presented were the following: "On the 'Skin Effect' in Oscillation Circuits," by John Stone Stone; "On Tubular Condensers," by O. C. Roos; "On the Field for Wireless Telegraphy in the Philippine Archipelago," by C. E. Russell; "On An Experimental Verification of Oliver Heaviside's Theory of the Induction of Currents in Cores," by Dr. Roy T. Wells; "On Experimental Observations on the Audion," by Sewall Cabot; "On Experimental Observations on the Loss of Energy in the Dielectrics of Coils in Oscillation Circuits," by E. R. Cram.

It was decided at the annual meeting to make such changes in the constitution of the society as would enable it to increase considerably its membership. The following officers were elected for the ensuing year: President, Mr. John Stone Stone; vice-president, Mr. E. R. Cram; secretary, Mr. C. E. Russell; treasurer, Dr. Roy T. Wells. The following gentlemen are on the board of managers: Messrs. F. A. Kolster, A. P. Browne, C. C. Kolster.

CURRENT NEWS AND NOTES.

OPAL REFLECTORS FOR TUNGSTEN LAMPS.—Several manufacturers of opal glassware have recently taken up the manufacture of opal reflectors of proper size and shape to cover tungsten lamps and give good illuminating results.

OLD-TIME TELEGRAPHERS.—The Old-Time Telegraphers and the United States Military Telegraph Corps will hold their annual convention at the Cataract and International Hotel, Niagara Falls, N. Y., on Sept. 16, 17 and 18, when an attractive program of entertainment has been provided.

NEW YORK CENTRAL HEARING CONCLUDED.—At a brief hearing on June 15, by the Public Service Commission in New York City, the investigation into the aerial high-tension system in operation on the New York Central Railroad was concluded. The testimony was gone over and errors in the record corrected and the commission then set July 16, at 2 p. m., as the time for hearing arguments.

NEW YORK TELEPHONE AND TELEGRAPH REGULATION BILL IS NOT PASSED.—The Legislature at Albany adjourned June 11 after refusing to take up the bill recommended by Governor Hughes, extending the jurisdiction of the Public Service Commission to telephone and telegraph companies. The Senate bill embodying these recommendations was passed, but a similar bill introduced in the House was defeated by a vote of 55 to 36.

MOHAWK RIVER ELECTRIC POWER PROJECT.—Two companies were incorporated June 15 for the purpose of utilizing the undeveloped water power of the Mohawk River for the generation of electrical energy. The interests behind the Hudson River Electric Power Company are said to be the promoters of the two new corporations, one of which is the Mohawk Power Company, of Glens Falls, and the other the Public Securities Company, of Albany. The former apparently will be the operating concern, while the latter will look out for the financial side.

MACKAY SCHOOL OF MINES.—Telegrams from Reno, Nev., of June 10, state that by act of the Legislature the day had been celebrated as a State holiday on account of the dedication of the Mackay School of Mines and the Borglum statue of John W. Mackay, both presented by Clarence H. Mackay and his mother. As an additional evidence of the appreciation of the State, Governor Dickerson extended to Mr. Mackay and guests the freedom of the State, an unprecedented compliment. The decree of Doctor of Laws was conferred upon Col. George Harvey, who made the dedicatory address, and the degree of Master of Arts upon Katherine Mackay in recognition of her educational work. The services in front of the beautiful building, the last designed by Stanford White, were impressive.

TWO-CENT CABLE RATE PROPOSED.—John Henniker Heaton, a member of the British Parliament, who was a leader in the movement to secure a two-cent postage rate between England and America, announces that he will now devote his energies to securing a two-cent cable rate. Mr. Heaton suggested that the British and American governments should jointly acquire the property and rights of the existing cable companies at a fair valuation, establishing a common state of monopoly in cable communication. The Atlantic cables as they exist have a carrying capacity of 300,000,000 words per annum. At the present prohibitive rate of 1s., or 25 cents a word, only 25,000,000 are sent. If they were used to their full carrying capacity, Mr. Heaton has no doubt that the rate of 1d., or 2 cents, per word would be remunerative.

RURAL TELEPHONES FOR NEW ENGLAND.—The New England Telephone & Telegraph Company has proposed a new plan for rural telephone service whereby districts with a population of 20,000 or less can have telephone connections with the general New England system at a moderate cost. The idea is to reach the owners of detached farms, the country homes of business people from the cities, clubs, camps, stores, etc. The principal feature is the construction of private lines by the subscribers themselves, which will be connected with the nearest central office of the New England Telephone & Telegraph Company. The company charges 55 cents a month for residences and 70 cents a month for places of business to cover operating costs. The subscribers get not only unlimited communications with all the subscribers of the exchange, but access to the toll lines covering all New England and the eastern part of the United States.

CO-OPERATION DISCUSSED AT ELECTRIC CLUB, CHICAGO.—Mr. C. A. S. Howlett addressed the Electric Club, Chicago, at its noon meeting for lunch, June 10, on the far-reaching effects to be obtained by co-operation of all electrical men to secure the introduction of electrical appliances. He showed how every electrical appliance introduced meant more business for some one in the electrical field. Members of the club, he said, were all dependent upon the electrical business for a livelihood, and it was to their interest to have more co-operation in advancing electrical business in general. He also suggested that the club might well take a more active interest in civic problems involving electrical matters. Such civic problems had recently come up for discussion and were being handled by organizations whose members had but a small fraction of the knowledge of electrical affairs which the members of the Electric Club had. Among the civic matters which are up for discussion in Chicago at the present time in which members of the Electric Club are better posted than any other body of men, he referred to the electrification of steam railroads and the settlement of the controversy between the city and the sanitary district trustees as to the distribution of electric power from the drainage canal in the city of Chicago.

Turbo-Generator Station in Seattle, Wash.

An 11,000-kw turbo-generator station has recently been placed in service in connection with the general energy-supply system of the Stone & Webster interests in Seattle, Wash., and vicinity. Energy is delivered from this system to operate the street railways, and for lighting and commercial purposes in Seattle. The chief source of supply for the system is a 15,000-kw hydro-electric station on the Puyallup River at Electron, 60 miles from Seattle. Owing to conditions favorable to the utilization of additional waterfalls in the vicinity, the bulk of the energy generated will also be obtained in the future from hydro-electric stations. The new steam station has therefore been designed as a relay to the present hydro-electric equipment and to such other installations as may be made. An existing 3500-kw steam-driven station in Seattle is also operated in connection with the general supply system.

The new turbo-generator station is on the right bank of the Duwamish River at Georgetown, four miles south of the business section of Seattle, and close to the transmission line from the Electron station, at a point where fresh water for condensing purposes could be obtained. The present station is the first one of six sections which are proposed to be built in conjunction on the same site. This section is entirely independent of the future additions, however, although the arrangement of its generator room is such that the latter will become a part of one main generator room as the other sections are built. The station building is a monolithic reinforced-concrete structure, 80 ft. x 218 ft. in plan, and with a height of 68.25 ft. from the ground line to the top of the roof.

The building is divided by a transverse 6-in. reinforced-concrete wall into a boiler room and a generator room, the former being 153 ft. 10 in. long, and the latter occupying the remainder of the building.

The original plans for this section of the station contemplated that two turbo-generator units, one of 3000 kw and one of 5000-kw rating, would be installed. Soon after the smaller unit had been erected, however, the decision was made to install a unit of 8000-kw rating instead of the proposed 5000-kw one, on account of increased demands on the system. Otherwise, the arrangement of the station was carried out as originally proposed. The two units are placed at the same floor level, with one unit on each side of the longitudinal center line of the building. Steam to operate each unit is normally supplied with steam by the row of boilers on the corresponding side of the boiler room, although both units can obtain steam from either side.

The boiler room contains 14 466-hp Stirling water-tube boilers, set in batteries of two with three batteries in a row on the 3000-kw turbine side, and four batteries in a row on the 8000-kw turbine side of the longitudinal firing-room floor. These boilers are at present fired with fuel oil. Since oil may eventually be superseded as fuel by coal, the storage bunkers for the latter were built over the firing floor and provisions were made in the construction of the building to permit coal-conveying apparatus to be installed.

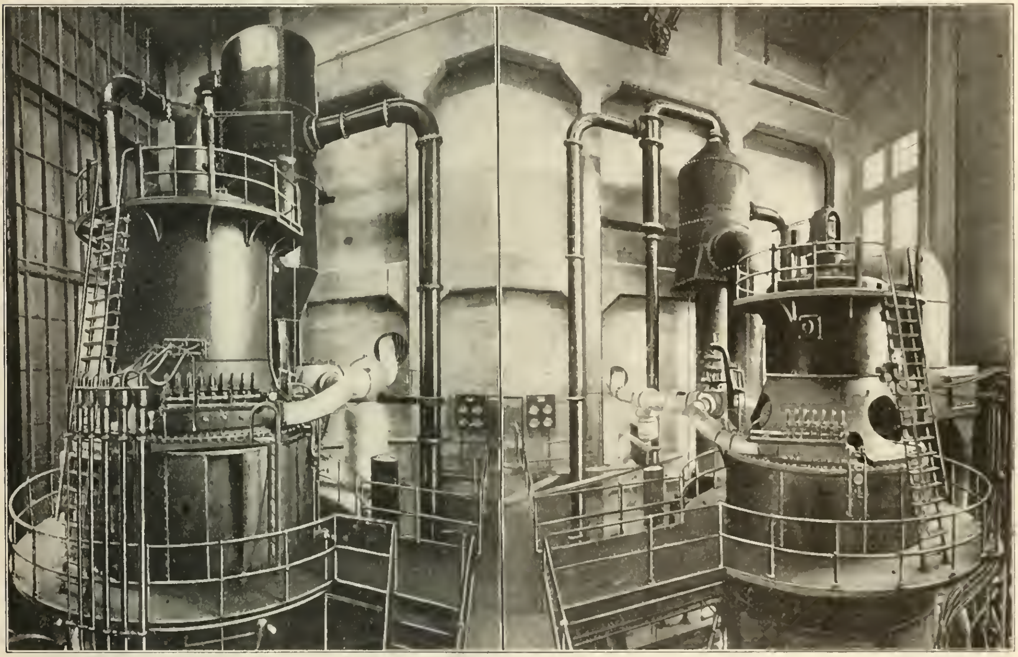


FIG. 1. THE TWO MAIN UNITS IN THE GENERATOR ROOM

A very complete storage and delivery system has been installed to handle the fuel-oil supply. The oil is delivered in tank cars on a switch extending around the downstream corner of the end of the boiler room next to the river. Three 8 ft. x 32 ft. circular steel tanks are placed side by side in the same horizontal plane under the track where oil can be delivered directly into them from the tank cars. A single-acting reciprocating oil pump, in a house at one side of this track, is also arranged to take oil from the tank cars through a 5-in. flexible suction hose and to deliver it through a 6-in. connection to a 150,000-gal. steel storage tank 30 ft. in diameter and 30 ft. high. This tank is placed with its center 83.5 ft. from the adjacent corner of the building and is surrounded by a pit large enough to hold the contents of the tank in case the latter should break. The exhaust pipe from the oil pump is connected to a steam coil in the bottom of the oil tank in order to supply the heat necessary at times to thin the oil so that it will flow readily. A live-steam pipe is also connected to this coil as an auxiliary.

The section and discharge connections of the oil pump are joined with a by-pass pipe. This pipe and the suction and discharge connections are fitted with valves that enable the pump to be used in various ways. The oil can be taken from tank cars through the 5-in. flexible suction hose and delivered to the large storage tank through a 6-in. connecting pipe, or from that tank to the cars. Oil in the large tank will flow by gravity into the three underground tanks through the same 6-in. pipe to which the discharge pipe from the pump is connected, until the level in the large tank is reduced nearly to the bottom of the latter; after that the pump can be used to deliver the oil below that level. The pump can also deliver oil from the tank cars directly to the underground steel tanks.

Each of the three underground steel tanks is fitted with a live steam coil for heating the oil, these coils draining to the river. The 6-in. pipe into which both the discharge and the suction pipes of the pump are connected, and through which oil is supplied to or drawn from the large storage tank, passes around in front of the three small ones and thence into the station building. In the building this pipe is connected to a header from which two 10-in. x 6-in. x 10-in. Wagener steam-driven pumps receive oil. These pumps are arranged together in a pair, with two 2-ft. x 7-ft. circular oil-heaters between them. Each tank is supplied with exhaust steam for heating, and is operated similarly to a surface condenser, the steam taking the place of the cooling water. Each tank contains 87 ft. of 2-in. pipe, through which the oil is pumped under a pressure of about 40 lb. per square inch, which is maintained by an automatic pump governor. After passing the heater, the oil is delivered through filters to the burners under the boilers. Instead of an intermediate pressure-tank being placed in this supply system, the discharge pipe from each pump is fitted with a relief valve, the oil from which is carried back to one of the underground tanks by an overflow pipe.

A 2½-in. oil supply line is carried from the pumps along in front of both rows of boilers. This line is paralleled by a 2-in. pipe connected to the superheated steam main and also to a saturated steam main. At each boiler a connection is made to both supply pipes to deliver steam and oil to the burners under the boilers.

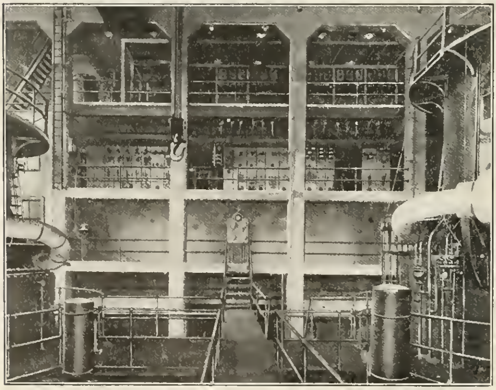


FIG. 2.—WIRING AND SWITCHBOARD GALLERIES.

The boilers are of the standard Stirling water-tube type with the steam and water drums arranged parallel to the front surface and with a superheater in the rear pass.

GENERATOR ROOM.

One of the most significant features of the generator room is the fact that the generating equipment, with a normal rating of 11,000 kw and a guaranteed 50 per cent overload rating, or a total of 16,500 kw, is placed in a floor area 65.25 ft. x 73 ft. This area also includes the various auxiliary apparatus for the two units, including the condensers, exciters and the equipment of a substation installed in connection with the station.

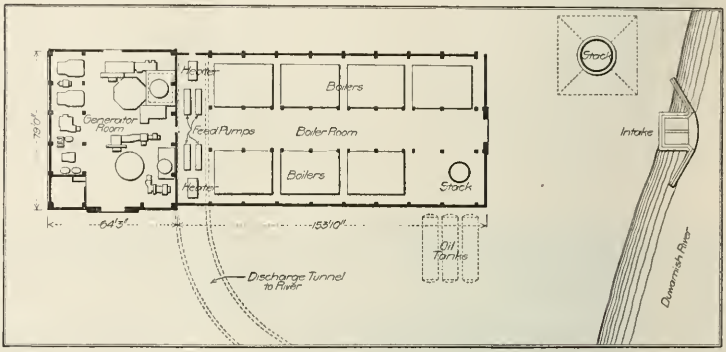


FIG. 3.—GENERAL PLAN OF STATION.

The two main units are General Electric Curtis turbo-alternators with three-phase, 60-cycle, 10-pole, separately-excited, revolving-field generators, designed to deliver energy at 13,800 volts and to operate at a normal speed of 720 r.p.m. The speed of the units is controlled by the standard turbine governor built by the General Electric Company, which is arranged so that it can be operated from the switchboard. The turbines operate on a normal steam pressure of 175 lb., with 110 deg. of supertemperature.

The turbine of each unit is served by a Weiss counter-current barometric condenser. The cooling water for the 3000-kw unit is delivered into the condenser by a 12-in. horizontal centrifugal pump, directly connected to a 10-in. x 12-in. high-speed Porter-Allen engine. This pump draws water through a 16-in. pipe extending from the intake at the river, where the 10-in. boiler-feed supply pipe starts in the underground trench to the pump. The water passing through the main barometric tube is discharged against the pressure of the atmosphere into a hot well. A secondary barometric tube with a foot-valve is provided to remove any moisture that might otherwise be carried into the dry-air pump. The latter is of the horizontal tandem Weiss crank and fly-wheel type, with a 34-in. air cylinder and a 12-in. steam cylinder. The speed of this pump is controlled by a throttling governor arranged for variable speeds.

The condenser of the 8000-kw unit is supplied with 1500 gal. of cooling water per minute by an 18-in. horizontal centrifugal pump driven by a 11-in. x 14-in. Porter-Allen high-speed engine. It has a Weiss dry-air pump with a 48-in. air cylinder, an 18-in. steam cylinder and a 30-in. stroke. The water from this condenser is also discharged into a hot well. The sizes of the condenser for the large unit are quite unusual, as may be seen from the following: The exhaust connection of the turbine to the condenser chamber is 78-in. in diameter and rises to a height of 41 ft. above the floor of the generator room; the main shell of the condenser, with a diameter of 9 ft., has its top 54.5 ft. above the generator room floor and the condenser receives 30,000 lb. of steam per hour when the unit is operating at the normal full load. The condenser equipment was furnished by the Southwark Foundry & Machine Company.

The overflow water from the hot wells, to which it is discharged from the condensers, passes into a tunnel, 8 ft. x 12.5 ft. in cross-section, which extends transversely under the end of the basement of the boiler room, close to the partition wall between that room and the generator room. This tunnel is lined with concrete and extends for about 300 ft. across the land adjacent to the building to an outlet in the river, more than 200 ft. down-stream from the intakes of the pipes through which cooling water is supplied to the condensers. The cross-section of the tunnel is of sufficient size to permit the tunnel to be extended into the additional section of the ultimate station as these sections are built.

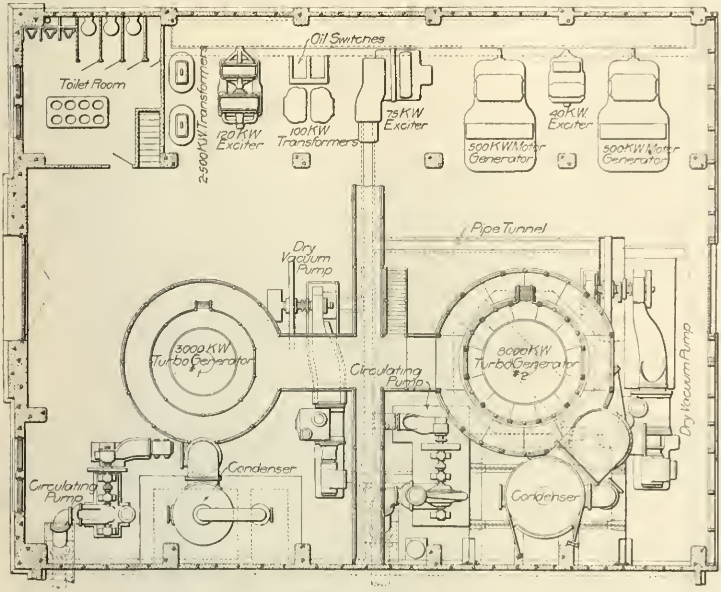
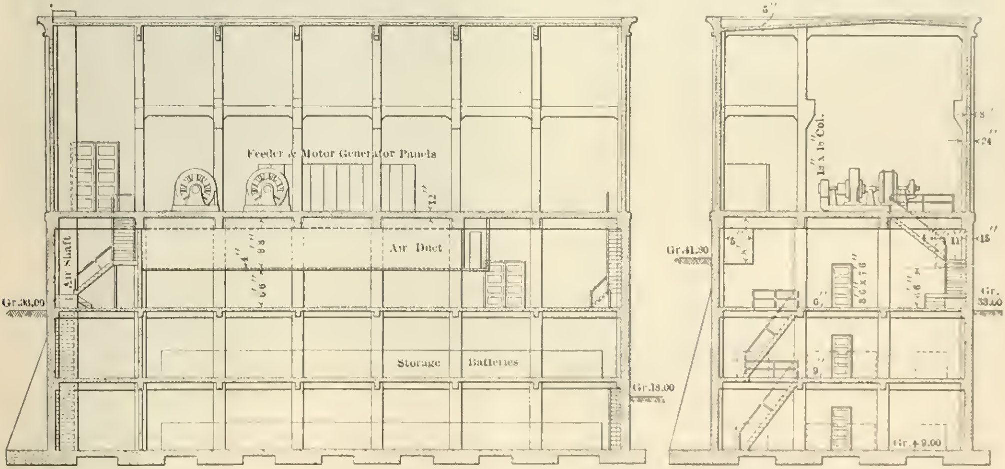


FIG. 4.—PLAN OF GENERATOR ROOM.



FIGS. 5 AND 6.—LONGITUDINAL AND CROSS-SECTIONAL ELEVATIONS OF UNION STREET SUBSTATION.

The step-bearings of the two main units are supplied with oil from a common high-pressure system. Two 7½-in. x 2⅛-in. x 18-in. duplex high-pressure Worthington pumps are installed in the basement of the boiler room to furnish pressure to this system. These pumps are in duplicate, and either of them is sufficient for the service required. The pumps deliver oil at a pressure of about 1300 lb. per square inch into duplicate mains leading to the two units. A 3-in. x 5-ft. hydraulic accumulator is placed in this delivery system to maintain a uniform pressure in the latter. The step-bearing of the 8000-kw unit is lubricated with oil at a pressure of 1000 lb. per square inch, and the step-bearing of the 3000-kw unit at a pressure of 460 lb. The pressure in the mains is reduced to that required in each case by a baffler in the supply pipes, close to the bearings. The overflow oil from the step bearings is returned to either or both of two Turner receiving and filtering tanks. One of the latter holds 450 gal. and can filter at the rate of 20 gal. per minute; the other holds 400 gal. and can filter at the rate of 12 gal. per minute. The two high-pressure pumps have a suction connection with the storage tank of both of the filters.

The intermediate bearings on the two main units are supplied with oil under a pressure of 120 lb. by two 9 and 3.5 x 10-in. cross-compound Worthington pumps, installed in duplicate. These two pumps also take suction from the storage tanks of the two filters. A 3-ft. x 6-ft. air tank is placed at each unit on the delivery pipe from these pumps to maintain a uniform pressure at the units. An emergency connection is also made between the delivery pipe of these pumps and the high-pressure oil main, in order that the one of the two pumps of the intermediate system which is not supplying oil to the steady bearings may deliver to those mains in an emergency.

The equipment of the entire station is supplied with lubricating oil from a complete separate system. This system is served by two oil pumps, in duplicate, with a 400-gal. oil tank in the monitor of the boiler room connected directly to the delivery system. A connection is made from the latter to the high-point of each unit, and branches are extended from this connection. The waste oil from the units is carried by gravity back to a sump tank under the floor of the boiler-room basement. The oil is blown from this tank under air pressure, which is supplied by compressors in the basement, to a separate Turner oil filter from which the station oil pumps take oil by suction.

Two compressors are installed in the basement of the boiler room to supply air under pressure for various purposes about the station. These compressors deliver to a tank from which connections are made to all parts of the station.

Two direct-current generators, one a 40-kw motor-driven unit and the other a 75-kw engine-driven set, were installed to furnish excitation current for the 3000-kw main unit. A 120-kw motor-driven exciter was added when the 8000-kw main unit was installed. All of these exciters are placed on the first gallery floor, which is at the same level as the operating floor around the main units. On this floor are also mounted two 500-kw motor-generator sets for supplying direct-current at 600 volts locally to the street railway system. Two 100-kw transformers are placed on this floor to supply current at 2300 volts for lighting and to drive small motors in the station. A local brewery is also supplied with 2300-volt current directly from the station, two 500-kw water-cooled transformers on the first floor of the gallery being used for this service.

The second gallery floor is a separate room for wiring connections, except for an office at one end. The third floor contains the switchboards from which the operation of the various equipment in the generator room is controlled. Motor-operated oil switches on the high-pressure connections of the station are placed on the fourth gallery floor. The top floor is given over to lightning arresters, static dischargers and outgoing transmission-line connections.

The main units are arranged for remote control from a switchboard on the third floor of the operating galleries. A cable from each phase of both main generators is carried from the latter in brass pipes leading to conduits under the floor of the generator room. These conduits extend to the end wall of the building at the rear of the galleries and the cables are carried up a 12-in. space between this wall and the gallery floors to motor-driven oil switches on the fourth floor of the gallery. The second floor of the latter is utilized exclusively for wiring connections. This floor is separated from the generator room by a light concrete partition, with access to this wiring room from only the end of the gallery by means of concrete stairways. The remainder of the gallery floors, which are entirely of reinforced concrete, are reached by stairways of concrete, so that the gallery structure is fully fireproof.

The operation of the main generators and their exciters is controlled from a 10-panel switchboard on the third floor of the gallery. The panels of this switchboard are of blue Vermont marble equipped with standard G. E. switches and recording and indicating instruments. The operation of the equipment of the substation is controlled by a separate eight-panel switchboard on the same floor. A third two-panel switchboard is installed on this floor to control the operation of connection to the transformers installed on the first floor of the gallery to supply energy to a local brewery.

The 13,800-volt energy delivered by the main generators is carried out of the station at that voltage to either of two substations near the business section of the city, descriptions of which are given below. The e.m.f. is decreased to 2300 volts in these substations for local distribution. Transformers in the generating station are therefore not necessary.

UNION STREET SUBSTATION.

This substation, four-sevenths of which has been completed, is located on the south side of Union Street between First and Western Avenues, on the steep hill running from the water front. It was designed as a combined three-wire direct-current lighting and transformer station. The ultimate equipment will consist of 5000 kw in motor-generators made up for four 1000-kw, three-phase, 13,200-volt, 50 cycle, 125- and 250-volt direct-current lighting motor-generators and two 500-kw, two-phase, 2200-volt, 60-cycle, 720 r.p.m., 125- and 250-volt, direct-current, interpole lighting motor-generators, these latter machines representing the present equipment. In addition to the generator equipment, three 2000-kw banks of 13,200-volt, three-phase to 2200-volt, two-phase transformers are to be installed together with two lighting storage batteries, each of 5440 amp-hour rating. Ultimately there will be four lines entering the station, two two-phase 2200-volt and two three-phase 13,200-volt. As the two two-phase and two three-phase lines are brought to the station from different parts of the company's system, it will readily be seen that a number of relay combinations are possible.

The switchboard is located on the main floor of the substation. The present board consists of two 2200-volt motor panels,

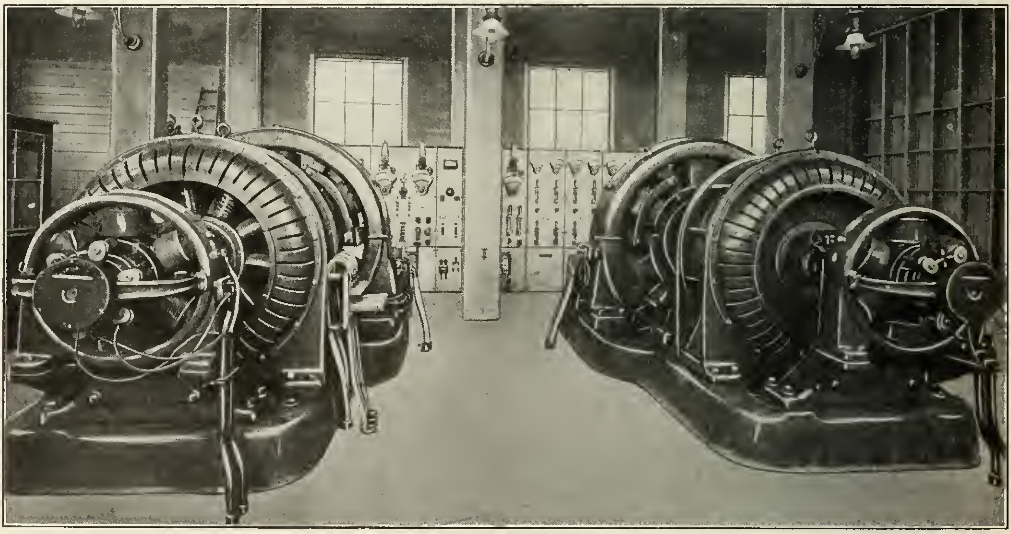


FIG. 7.—MOTOR-GENERATOR SETS AND SWITCHBOARD IN UNION STREET SUBSTATION.

two 250-volt three-wire generator panels, six 1500-amp three-wire feeder panels and a pressure panel, the latter containing direct-current voltmeters for obtaining the voltage of the generator, buses and feeder distribution centers. A swinging bracket contains an alternating-current voltmeter and synchronoscope. Each motor panel has remote-controlled oil switches operated by 125-volt direct-current solenoids. Two control-switches are used on each panel, one for the starting compensator oil switches and the other for the main switch between the motor and the bus. The main and compensator oil switches for each motor are electrically interlocked so that it is impossible to close either switch until the other has been opened.

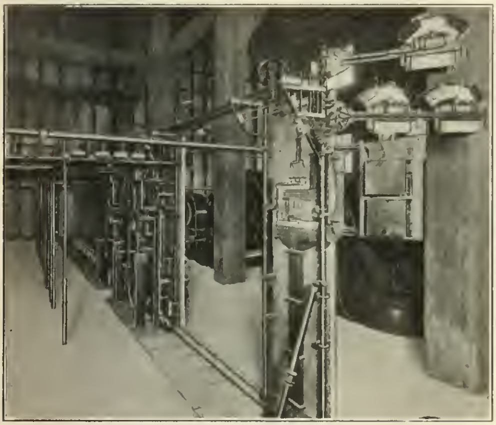


FIG. 8.—REAR OF SWITCHBOARD IN UNION STREET SUBSTATION.

Each motor panel contains an overload time-limit relay. Each direct-current generator panel contains two ammeters, two single pole automatic circuit breakers with speed-limit trip, two single-throw, 3000-amp switches for high bus, two double-throw, single-pole, 3000-amp switches for low bus and a future battery charging bus, a direct-current starting switch, two double-throw, single-pole field circuit transfer switches, one double-pole field circuit switch, field rheostat mechanism and a three-wire watt-hour meter. Each feeder panel contains four single-pole 1500-amp switches for high and low bus, and two ammeters.

Subsequently there will be added nine direct-current feeder panels, two battery panels, one booster panel, four 1000-kw generator panels, four motor panels, three transformer panels and four incoming and outgoing line panels; the total length of switchboard will be about 80 ft.

Below the generator room is the switch and high-tension bus room. At present there are installed six 2200-volt oil switches, each consisting of four single-pole switches mounted in concrete cells and electrically operated from the switchboard. The compensators for obtaining the neutral for the three-wire system are also on this floor, the disconnecting switches for use with these compensators being mounted on the side of the machines and the neutrals connected together. The future arrangement in this room calls for five additional two-phase switches, three for transformers and two for lines. The bus as extended will be double, and bus selector-switches are provided for at the end of the present generator bus.

The 13,200-volt three-phase arrangement will consist of a double 13,200-volt bus and a 6900-volt starting compensator bus. With the latter bus, two compensators will be used for the four 1000-kw motor-generators, each relaying the other, it being possible to start any machine from the starting bus. The operating switches will be interlocked in a manner similar to those of the 2200-volt machines described above. All of the oil switches will be of the cell type, each pole being in a separate concrete compartment. There will be three transformer switches, two line switches and 12 motor-generator and starting-compensator switches.

The direct-current cables and bare copper bars leaving the switchboard above also pass through this room, the cables leading to the street and the copper bars to the battery and end cell rooms below. It has been arranged to use bare copper bars for leads from the direct-current side of the four 1000-kw generators to station buses and in order to keep these latter bars as near as practicable to the ceiling of the switch room; the beams being very deep, suitable holes were left in the concrete beams for inserting soapstone insulation. All of the wire and cable used larger than No. 6 will be insulated with varnished cambric and covered with a white flameproof braid. All auxiliary wiring is installed in iron conduit buried in the concrete, and conduit has been installed for future apparatus. The bends were made of especially large radius in order to facilitate pulling in the cables. A considerable amount of labor was saved by inserting all bolts for support of bus framework, copper and cable in the forms before concreting.

NORTH SEATTLE SUBSTATION.

This station is located to the rear of the new North Seattle concrete car barns of the Seattle Electric Company, on the north side of Republican Street between Sixth and Taylor Avenues. At the southwest corner a wire-tower was erected as a part of the building for 13,200-volt incoming lines, outgoing 2200-volt lines and a number of 600-volt feeders. The tower begins in the basement of the building and projects above the roof. Entrance may be had to it either from the switch room floor or from the generator room, where a concrete platform was constructed from which the line disconnecting switches are operated. The lower, or switch-room, floor contains all of the 13,200-volt line and generator oil-switches, starting auto-transformers and switches for the latter with provisions for all future 2200-volt lighting and industrial switches and potential regulators.

The generator room, at present, contains one 1000-kw, 514 r.p.m., 13,200-volt, 60-cycle railway motor-generator set delivering direct-current at 600 volts to the trolley system. The switchboard on the north side controls all of the oil switches in the basement, as well as the 600-volt feeder system.

The station was designed as a combined direct-current railway and alternating-current lighting and power substation. The final equipment will consist of three 1000-kw, 13,200-volt, 60-cycle, three-phase motor-generators, three 2000-kw banks of 13,200-volt, three-phase to 2200-volt, two-phase transformers similar to those in the company's Union Street substation, and two motor-driven blower sets.

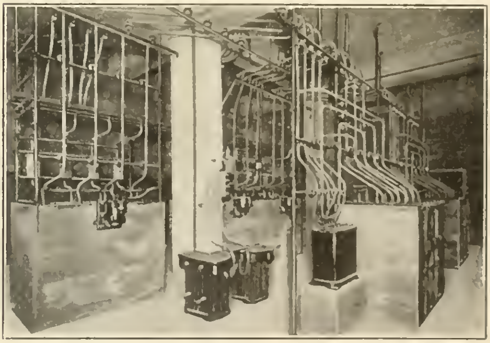


FIG. 9.—WIRING CONNECTIONS IN SWITCH ROOM OF UNION STREET SUBSTATION.

The switchboard is located near the north wall on the same floor with the generators and transformers. The present installation consists of one direct-current railway generator panel containing one single-pole automatic overload circuit breaker with speed-limit trip, ammeters, negative main switch, starting switch, single-pole field switch, watt-hour meter, rheostat mechanism and the usual plugs and receptacles, one alternating-current motor panel containing an ammeter, motor-field switch, rheostat mechanism time-limit overload relay, and two auxiliary switches electrically interlocked for operating the oil switches, one for the starting compensator and the other for the main bus, and six standard 1200-amp railway panels, each containing one single-pole, single-throw switch and circuit breaker and an ammeter.

Subsequently there will be added two 1000-kw direct-current generator panels, two motor panels, two 13,200-volt line, three transformer, one 2300-volt two-phase industrial and six 2300-volt single-phase lighting panels.

Below the generator room is the switch and bus room. At present there are installed three three-phase, 13,200-volt oil switches in concrete cells, operated from the switchboard above. The main bus is double with selector disconnecting-switches. An auto-transformer starting bus is used. The ultimate number of three-phase oil switches will be 12, and on the north side of the room provision has been made for one two-phase industrial, three transformer and six single-phase, 2200-volt lighting switches and induction voltage regulators. All oil switches will be of the remote-controlled cell type.

A channel iron cable rack passes along the north and west walls of the switch room to the wire-tower in the southwest corner of the building. At present only one 13,200-volt incoming line is installed. It enters the building from the west side of the tower down which it runs to the switch room. Choke coils are mounted on the inside wall of the tower, but the lightning arresters are placed on the generator room side of the wall in plain sight of the operator.

All cable and wire used are insulated with varnish cambric as at the Union Street substation, and covered with a white flame-proof braid. The 13,200-volt buses are of No. 40 solid copper mounted on line insulators. The distribution of all small leads, exciter and field wiring, from the switchboard is by means of iron conduit buried in the concrete; all hanger and cell supporting bolts were fastened to the forms before the concreting was done.

The above described station and substation were designed by the Boston office of the Stone & Webster Engineering Corporation. The construction of the buildings and the erection of the mechanical equipment were carried on under the direction of the Seattle office of that corporation, of which Mr. M. J. Whitson is superintendent. Mr. H. H. Barter was engineer in charge of the installation of the equipment. The electrical equipment was furnished by the General Electric Company.

Meter Laboratory of the Birmingham Railway, Light & Power Company.

The meter laboratory of the Birmingham (Ala.) Railway, Light & Power Company is one of the most complete for its size in the South. It is located on the third floor of the company's office building at the corner of First Avenue and Twenty-first Street, and occupies a main testing section 31 ft. long by 20 ft. Being located on the southwest side of the building, with four windows opening on the street, the laboratory is at all times amply supplied with natural light for the accurate work demanded. Fig. 1 shows a general view of the laboratory.

About 7400 electric meters are in service on the company's circuits and the principal work of the laboratory is the maintenance of these with tests of various kinds on meters or lamps, adjustments for better accuracy and any special investigations that may be needed from time to time by any department of the company. Five men are constantly at work inside or outside the laboratory making meter or other tests. The laboratory supplies the standards by which all portable checking instruments are tested, and the secondary standards used in meter testing are frequently compared with the company's most accurate instruments.

Two permanently-wired switchboards are installed in the laboratory. These are arranged so that meters can be connected to the testing circuit with minimum loss of time. Both boards are shown in the accompanying illustrations and are designated as "A" and "B" for convenience. Board "A" (Fig. 2) is mainly used for testing larger meters, from 50 to 600 amp rating, single-phase, polyphase and direct current. The smaller meters are tested, as a rule, on board "B" (Fig. 3). The wiring of each board, however, is flexible enough to permit a number of other tests to be made without disturbing the connections. Both switchboards have white marble panels, and are provided with instruments, plugs and controlling switches, mentioned later.

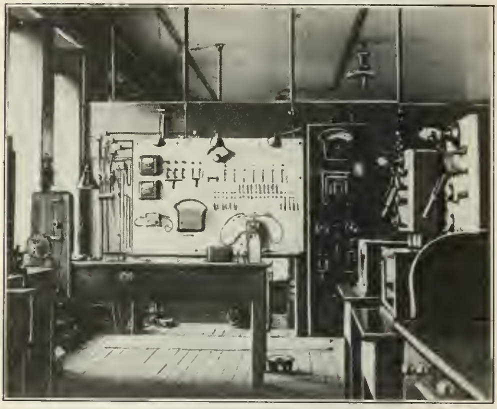


FIG. 1.—GENERAL VIEW OF LABORATORY.

In front of one of the windows is installed a speed lathe driven by a ½-hp, 230-volt motor, whose speed is 1400 r.p.m. The motor is set upon the window sill and a short countershaft is mounted in the upper part of the window for the driving adjustment. The starting box is located beneath the window casing conveniently for the lathe user. This lathe is used in polishing pivots, winding resistance tubes and coils, straightening shafts and other light work. A table for general instrument repairs is provided, and there are two vertical panels adjacent to it for the checking of test instruments. The table and panels are shown at the right in the general view of the laboratory. Mounted near the panels and connected with them are two standard indicating wattmeters, one scaled 0 to 1500 and one 0 to 3500 watts. The equipment also included a testing transformer of 115 volts primary and 10,000 volts secondary potential. This transformer is for use in making insulation tests, also in testing line transformers. A small motor with grinding and buffing attachments is mounted on one of the

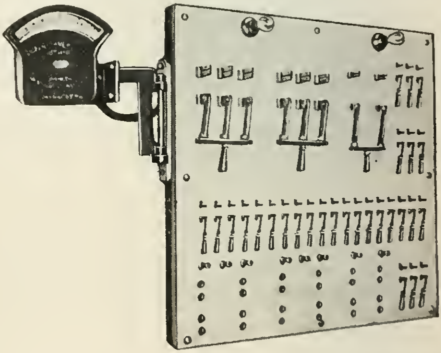


FIG. 2.—BOARD A.

work benches and has proved one of the most convenient tools in the laboratory. To enable a steady current to be available when needed for testing, there is installed on another part of the floor a 4.5-kw motor-generator set which consists of a 220-volt motor direct-connected to a 110-volt generator, the set having a normal speed of 1800 r.p.m. The current from this set is brought to the laboratory and is controlled by a Tirrill regulator on a special panel, shown at the right of switchboard "B" in the general view of the laboratory. This current is used for excitation purpose at both switchboards and is kept quite constant by the regulator.

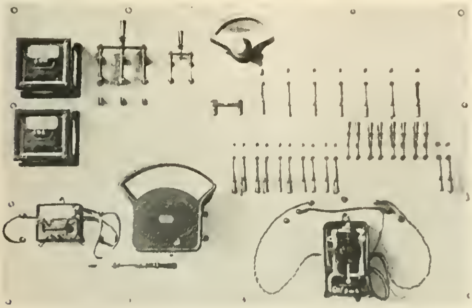


FIG. 3.—BOARD "B."

The general wiring arrangement of the board "A" is shown in Fig. 4. This panel is about 4 ft. square, and contains at the top service switches supplying 110-, 220- and 550-volt direct current and 110- and 220-volt alternating current. The terminals of these switches are connected on the back of the board to busbars. By means of plugs and flexible cables instruments can be connected in various ways between the busbars and supplied with the requisite current for testing. At the left of the panel, on a bracket, is mounted a 1000-amp meter of the station type, with 10-, 100- and 1000-amp shunts. According to the load upon the tested instrument the proper ammeter shunt can be connected in at once without the trouble of making wiring changes. The load for the instruments is provided by a bank of fuse resistance coils mounted in a truncated box in front of one of the laboratory windows, the scheme of connections being shown in the drawing. This resistance is cut in or out by 30 single-pole knife switches connected to the coils on one side and to the positive busbar on the other. One side of the resistance coil is connected to the negative bus. The coils are attached to insulators so as to run up and down, vertically, and the heat given off is drawn out of the room and discharged out of doors by a 16-in. exhaust fan located at the mouth of the funnel, which is formed by the truncated box. In this way the apparatus can be operated on the warmest days without discomfort to the laboratory staff, and the danger of fire from overheated coils is reduced to a minimum. The fan is controlled from the switchboard and the box is lined with asbestos. The resistance gives a range of current adjustment of from ½ to 80 amp per switch, and is capable of consuming about 600 amp with all coils in use.

Bord "B" contains a 25-amp General Electric watt-hour meter which is checked against the company's primary standards every few days, and also a 5-amp watt-hour meter. This board is supplied with 110- and 220-volt currents, and the load is secured by resistance coils mounted on the wall behind the panel An ammeter and voltmeter are also provided for use on direct-current tests. The resistance wires are of German silver and are mounted on insulators supported on an asbestos backing. To provide for the expansion of the wires, each wire is supported at its middle point by a pin block and small spiral spring which enables the slack to be automatically taken up and permits the necessary increase in length as the wire heats up. The wiring in the laboratory is for the most part run behind the baseboard of the wall with a false molding that can be swung up out of place whenever any repairs or circuit changes are needed.

The method of meter testing employed is largely by the use of rotating standards. It is thought best to use this method in preference to the indicating instrument method, because it simplifies the work, enables more meters to be tested and reduces the chance of error.

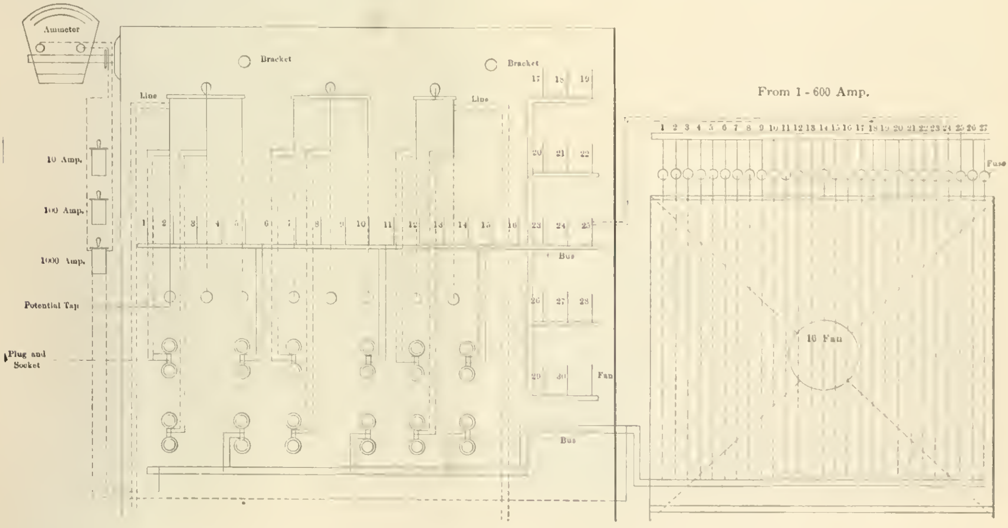


FIG. 4.—CONNECTION DIAGRAM BOARD "A," BIRMINGHAM CENTRAL STATION LABORATORY.

The rotating standards are, of course, frequently checked against the primary standards, which are indicating instruments of laboratory type. Besides the rotating standards there are very many voltmeters, ammeters, millivoltmeters and wattmeters for use in the various tests. The laboratory of the Birmingham Railway, Light & Power Company is in charge of Mr. F. M. Underwood.

Electrical Engineering Equipment at Clemson College, South Carolina.

Engineering courses are now available in a large number of Southern colleges and universities, and in some of these institutions the equipment and instruction offered to the undergraduate student are thoroughly representative of the best accepted methods of technical education. In the field of electrical and mechanical engineering one of the most highly developed courses in the South is that of Clemson College, South Carolina, and this institution so well typifies the best progress in undergraduate instruction in applied electricity that its facilities have been thought worthy of description.

Clemson College is one of the youngest institutions in the South, having been opened in July, 1893. It is located on the old Fort Hill homestead of that well-known statesman, John C. Calhoun, about one mile from the Calhoun station of the Southern Railway, and at an elevation of 800 ft. in the picturesque foothills of the Blue Ridge Mountains. The homestead and study of Mr. Calhoun are preserved on the campus. The first step toward the establishment of the college was made by the Hon. Thos. G. Clemson, son-in-law of Mr. Calhoun, who in 1888 bequeathed to the State the Calhoun homestead, with other securities for the establishment of an agricultural college. Instruction in the sciences rather than the classics has been the object of the institution, which is one of the few purely technical colleges in the South. Courses are offered in agriculture, chemistry, animal industry, geology, civil engineering, textile industry, mechanical and electrical engineering. The students are under military discipline, the Commandant of Cadets being an officer of the U. S. Army. Each course leads to the degree of B. S.

The mechanical and electrical courses are combined at Clemson in a single curriculum, and aim to lay a solid scientific foundation by both theoretical and practical instruction upon which the student may build rapidly after graduation. Thorough work is given in English, and as far as time permits, civics, economics, geology and botany are taught in the course as well as the partly technical sciences of mathematics, physics and chemistry. Within the department are taught physics, mechanics and mechanical engineering. Along with the theoretical instruction, practice is given in the laboratories and in the extensive shops which form an important part of the equipment. A strong course in drawing is one of the prominent features.

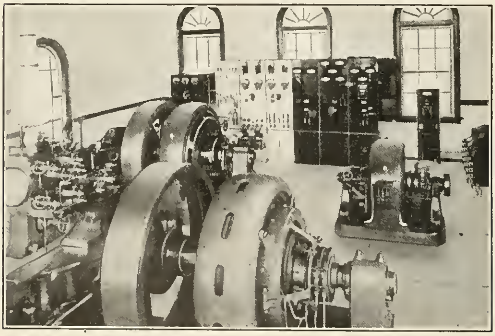


FIG. 1.—VIEW OF GENERATING STATION.

All the college buildings are supplied with heat, and electricity from a new central power plant conveniently located on the campus. This plant was designed with the idea of utilizing it for instruction as well as for the service of the buildings. The power house is a single-story structure 84.5 ft. long by 40 ft. wide, built of 8-in. cement granite-faced blocks, backed up with 4 in. of red brick. The roof is of truss construction with Cortright metal shingles and Dixie ventilators. The plant has a 46 ft. x 38 ft. boiler room, a 27 ft. x 38 ft. engine room, and three smaller rooms, one for oil, one for pumps, heaters, etc., and the other for toilet and bath. A tiled floor is provided in the engine room, and the cost of the building was about $4,500.

The boiler equipment consists of one battery of two 150-hp Stirling units and two 100-hp Lombard return tubular units. The Stirling battery cost about $4,000. The horizontal tubular boilers are the only apparatus from the old plant used in the new station. The products of combustion are delivered into the stack by a 3 ft. x 7 ft. breeching. The new boilers are normally operated at 130 lb. pressure, but the old units, used only in steam heating, carry 80 lb. The stack was built by the Alphons-Custodis Company at a cost of about $2,200. It is 100 ft. high above the foundation and 60 in. inside diameter, being large enough for 700 boiler horse-power, if that output is later needed.

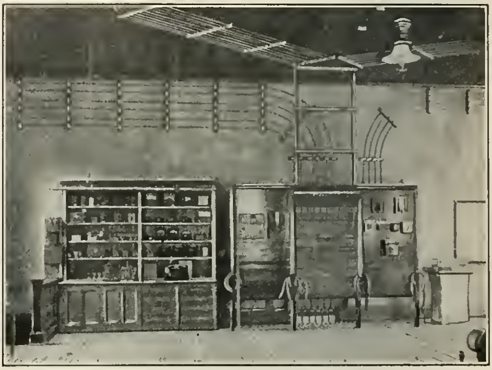


FIG. 2.—PLUG SWITCHBOARD, SENIOR ELECTRICAL LABORATORY.

The steam heating of the mechanical, chemical and electrical buildings, and the old and new barracks, is effected by the Webster vacuum return system. The mechanical and textile buildings are also provided with steam at 130 lb. for engines and heaters. The installation was planned to heat the barracks by the exhaust steam from the engines in the plant.

The engine room equipment consists of two units. One is a 13½ in. x 12 in. four-valve Harrisburg engine, directly connected to a 75-kw General Electric three-wire direct-current generator. This unit operates at 225 r.p.m., 125 and 250 volts, and has 5 per cent overcompounding. This four-valve engine is probably the most efficient simple high-speed engine built, its steam consumption being 24.5 lb. per hp-hour at half load and 25 per cent overload, and 23 lb. and 23.5 lb. at three-quarters and full load, respectively. The generator has a full-load efficiency of 91 per cent, and a half-load efficiency of 89.5 per cent. The other generating unit is a 13 in. x 13 in. piston slide-valve engine of the Harrisburg make, directly connected to a 70-kw, three-phase, 2300-volt revolving-field alternator. The engine shaft carries a 6-kw exciter for this set. The range of steam consumption of this engine is from 29 lb. per hp-hour at half load to 27.2 lb. at full output. The current is of 60 cycles frequency. The efficiency of the alternator varies from 83 per cent at half load to 89 per cent at full load, and it has a voltage regulation of 8 per cent. In addition to the generators, the engine room contains a 75-kw rotary converter that can be operated from either end. It is connected to the alternator through three 25-kw, 2300 to 185-volt, single-phase, oil-cooled transformers, with half-voltage taps for starting. On the alternating-current side are reactances for 5 per cent over-compounding on the direct-current side. The rotary has a compound field winding, and gives 250 volts at the brushes, the neutral on the three-wire system being joined to the central point of the transformers on the alternating-current side. The speed of the rotary is 1200 r.p.m. A compound field winding is used when running from the alternating-current end, but when running inverted, the series turns are short-circuited.

The switchboard equipment consists of six panels, three alternating-current and three direct-current. The alternating-current panels are of black enameled slate, and consist of the rotary panel, the three-phase generator panel, and a three-phase feeder panel. The direct-current panels are of blue Vermont marble, and are assigned to the three-wire generator, to the direct-current side of the rotary, and to direct-current feeders. The rotary panel contains the starting devices used in running the rotary inverted. There is also one starting panel for operating the rotary from the alternating-current side.

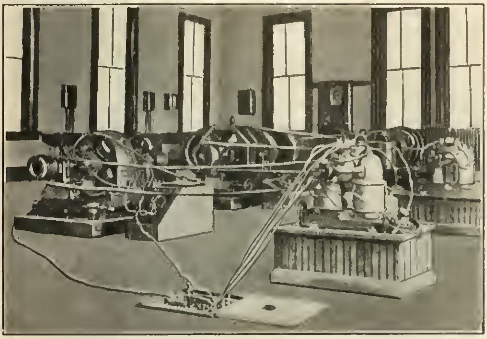


FIG. 3.—VIEW OF FLOOR BOX AND BOX FOR MAKING CONNECTIONS WITH SWITCHBOARD.

With this equipment, the station can furnish its entire output either in alternating or direct current, or half of each kind. Either unit can be substituted for the other, and if necessary in the future, the direct-current generator and the rotary can be put in series to give 500 volts for operating an electric railway line to Calhoun. Usually, during the heating season, when economy in steam consumption is not an important item, to run the alternating-current unit alone is run, direct current being obtained from the rotary for the Edison three-wire system of lamps and motors, and alternating current is supplied directly for operating a water pumping station and for the laboratory. By the installation of a synchronous motor in the electrical laboratory building, a prime mover can be had whose speed regulation depends only upon the speed of the engine which drives the alternator. If it is desired to have alternating current without operating the engine, the rotary can be run inverted to supply energy for the pumping station. The cost of the electrical equipment was about $7,000, and the cost of the engines, with foundations, was about $3,000.

The principal buildings concerned with the electrical and mechanical course are the dynamo laboratory, the electrical instrument laboratory and the mechanical laboratory. The dynamo laboratory is a modern brick structure, 80 ft. by 37 ft.; besides containing machinery for instructional use, it includes the electrical engineering lecture room. A dark room for photometric work and supply rooms are located in this building. The lecture room has elevated seats and is equipped with a complete line of illustration models, apparatus and instruments. It contains an electromagnet having a lifting force of two tons. In this room there is a counter strong enough to support any of the smaller machines used in testing. The counter rests on a solid clay foundation. It has a slate top 2.5 in. thick, and is served by a crane of 1000 lb. capacity. Binding posts on the back of the counter are connected through fused knife-switches to mains having their plug terminals on the laboratory switchboard.

The dynamo laboratory contains, in addition to speed counters, rheostats, switches and other small apparatus, a full equipment of generators of varied sizes, motors, instruments, transformers, arc and incandescent lamps, fuse-testing equipment and lightning arresters. The dark room contains a complete outfit for high-potential, high-frequency and X-ray work, and a central-station photometer, with rotating stand, for lamp testing.

The laboratory wiring is carried out on the principle of saving time in making connections that are not instructive in any particular experiment that is to be made, but of leaving to the student all connections that are intimately concerned with the educational value of his work. Heavy mains from the power house make connections to triple plugs on the switchboard. Under the floor are run six heavy circuits. From these, laterals are run to floor boxes furnished with fused knife switches and binding posts. The boards are of slate, let in below the floor level, and covered when not in use by slate slabs. From four binding posts in the floor boxes other laterals are run, conecting to small switchboards on the side walls. These in turn have binding posts and plugs by means of which connection may be made to an overhead system of comparatively small mains run on the ceiling. These overhead mains are joined at intervals to plug boards, reached in making connections by long-handled plug rods.

The main distributing switchboard consists of a slate panel, equipped with ⅝-in. plug contacts. These contacts are about 3 in. long with three splits about two-thirds of the way down, and are soldered into heavy brass terminal blocks secured into the back of the board. Flexible cable soldered into ⅝-in. tapered tubing is used to make the connection. Multiple plug contacts are employed on lines likely to be used at the same time by different experimenters. The small overhead lines are protected by plug fuses, and the larger ones by link fuses on the back of the board. Any line may be plugged through the circuit breakers placed on the side panels of the switchboard.

The electrical instrument laboratory is in a separate building designed specially for the more delicate experiments, built of brick, no iron, steel or other magnetic substance having been used in its permanent construction. It contains, besides elementary apparatus, Kelvin, Queen, Carhart, Wheatstone, Willyoung, Becker, D'Arsonval, Nalder, Rowland and Elliott measuring instruments. All instrument supports are piers specially designed to prevent vibration. A local switchboard is provided to facilitate the making of connections.

The mechanical laboratory is in a substantial brick structure containing about 30,000 sq. ft. of floor space. On the first floor are the mechanical laboratory section, machine shop, forge shop and foundry. The original power plant was located in this department, and the engine units and the generators are still available for service in the instruction work. The alternator used in this plant has six poles and 36 coils connected in sets of six. The terminals of these sets are brought to binding posts on top of the machine. From these may be had single, two, three or six-phase currents, with the choice of delta or star

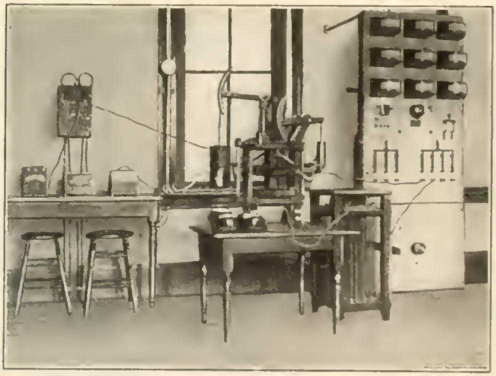


FIG. 4.—TEST OF CONSTANT CURRENT TRANSFORMER.

connections. In order to make the connections more conveniently, the alternator is equipped with plug terminals and flexible plugs, by means of which phase interconnection may easily be obtained. Accompanying this machine is a set of edgewise indicating instruments arranged to measure two or three-phase power. The equipment of the mechanical division is very complete for the study and testing of engines, boilers, fans, machine tools, forges, condensing apparatus, calorimeters, air compressors, dynamometers, testing machines, injectors, indicators and other equipment most frequently met by the mechanical and electrical engineer industrial establishments. A completely equipped foundry, accommodating 20 students, is in regular service. The tool arrangement and variety in the machine shop are unusually convenient and complete. On the second floor of the mechanical building is a woodworking shop. About 20 electric motors are in service about the college buildings, driving equipment in the different departments.

On the second floor of the mechanical building are offices and recitation rooms, including the study of Prof. Walter Merritt Riggs, E.M.E., director of the department of mechanical and electrical engineering. The top floor of the building is used as a drawing room. About 200 men have been graduated from the mechanical and electrical department since the college began work. Thorough instruction in fundamental principles, with supplementary shop and laboratory practice, has been the policy. The thesis work thus far carried out has consisted mainly of designing in the senior year. In the four years available for undergraduate study it is not expected that any special research can be undertaken, under present-day conditions. The president of the college is Patrick Hues Mell, M.E., Ph.D. The following men are in charge of the divisions indicated: Prof. W. M. Riggs, electrical engineering; Prof. S. B. Earle, mechanical engineering; Prof. T. G. Poats, physics; Prof. R. E. Lee, drawing and designing; Prof. S. T. Howard, machine shop; Assistant Prof. J. H. Hook, wood shop; Assistant Prof. J. W. Gantt, forge and foundry.

General Inspection and Repairing of Service Meters.

By Joseph B. Baker.

In an article which appeared in the May 30 number, the writer described the various preliminary tests made on customers' premises on unsealed commutator-type and induction-type meters with indicating instruments; a tester and helper being employed in making the tests. By this means the general behavior of the meter is ascertained. The instrument should then be given a general overhauling and any conspicuous troubles that may have shown up during the test should be corrected preliminary to and in connection with the recalibration. However, some of the things mentioned below do not have to be done at every "regular inspection." Thus in many companies it is considered that the jewel bearing need not be cleaned (and oiled, if oiling is the custom) oftener than once a year for meters that are operating under normal conditions and that show up well on test.

The following electrical troubles of commutator meters, and their remedies, may be referred to:

If a meter will not run at all, the cause is usually to be found in an open-circuited resistance card or shunt field; in a high-resistance brush contact, or a broken wire leading from the resistance card; or again, in rare cases, an open circuit at the soldered contact at one of the two commutator segments upon which the brushes are found to be resting. These troubles can usually be repaired on the spot. If the break is in one of the sections of the armature winding, the meter will run, even on light load, but will register low through the entire range, because current can pass through only one-half of the armature. Such a break cannot, as a rule, be located and repaired on the consumer's premises, but must have attention at the laboratory.

If a meter runs slowly or unsteadily, or both, on both light load and full load, the trouble may consist of a defective armature winding (open-circuited, short-circuited or grounded) or of a short-circuited pair of commutator segments, and may be located by using a special test lead in circuit with a lamp. This arrangement consists of a convenient length of lamp cord with a lamp connected in on one side, and is to be used by connecting one pair of ends across the voltage leads and exploring the armature with the free ends—which should be terminated in substantial points for the purpose—by touching these ends on one pair of adjacent segments after another, working entirely around the commutator in such a way as to test every armature coil. The shunt field coil should be disconnected from the brush during this test. The free ends of the test lead should be touched on at the points where the leads from the armature coils are soldered to the commutator segments, but not on to the surface of the commutator itself. If all of the segments and armature coils are faultless the lamp will light at equally reduced candle-power at every test around the commutator, owing to the resistance of the armature windings between segments. If, however, the lamp lights up to full candle-power on touching any pair of segments, a short-circuit exists between the two segments on which contact is being made; and this short-circuit, which may be due to a particle of foreign matter lodged between the segments or to a burr projecting from one segment to the other, should be cleaned out with a wood pick or burned out electrically. If the short-circuit is in the winding, the trouble will probably have to be cleared at the laboratory. If the lamp does not light at all, it shows an open coil in the armature, requiring the armature to be rewound at the laboratory; or an open circuit in one of the leads from segment to armature or in the soldered contact at one of the segments, either of which troubles may be cleared on the spot.

If the shaft is observed to be bent, it will usually have to be removed to the laboratory to be straightened.

A bend in the shaft, due to a blow or stress from any accidental cause, will usually be in one of two places: at the top where the shaft terminates in a journal of small diameter running in the upper bearing, or at the shoulder where the shaft is turned down to fit the hub of the disk. A bend at the top, which might cause friction or jamming between the worm and worm wheel, may be detected by lifting the top bearing until it encloses the extreme upper end of the shaft. Upon twirling the shaft, a bend at the shoulder between the journal and the shaft, even if very slight, will cause a noticeable wobbling of the shaft. A bend at the shoulder above the disk hub will be revealed by the running of the disk "out of true."

The tester should remove and examine the jewel, clean it out thoroughly—a pointed stick covered with clean chamois answers well as a cleaner—and test it by passing a sharp steel point over its bearing surface (the "needle test," as used in the inspection of meter jewels in the process of manufacture), taking care not to bear on too heavily, as by so doing the jewel may be scratched, especially if it be a sapphire. Too many jewels should not be tested with the same needle, as the latter may become blunted in contact with the hard jewel surface, so that minute imperfections cannot be detected with it. If the jewel shows any sign of being cracked, or roughened, it should be replaced by a new one, the pivot being changed at the same time (in meters having a renewable pivot). Damaged meter jewels may be replaced by sapphire jewels of the original design, or (in pivot-and-jewel meters) by diamond jewels. The replacing of a sapphire by a diamond jewel, or the inspection of a diamond jewel already installed, involves the taking of special notes for the record of the test, to afford the central-station company data on the behavior of diamond jewels in service.

The shaft-end should be examined with a magnifying glass. In meters in which the shaft-end is not removable, if the shaft-end is scratched the shaft must be replaced at the laboratory. In order to avoid rusting or scratching of the shaft-end or pivot, it should not be touched or handled with the fingers, but only with clean chamois or soft wood. In removing a pivot, after removing the jewel screw (or post) from the meter, start the pivot with a solid wrench and remove it with a spring wrench; and in replacing the pivot, or putting in a new one, use these tools in reverse order. In this way any risk of dropping the pivot will be avoided. Immediately upon removing the pivot with the spring wrench, it is a good plan to screw it into the end of an old meter shaft, so that it may be examined without handling. In inserting the new pivot or removing the old one care must be exercised not to spring either the shaft or the disk.

In the practice of many companies, if the meter is in a damp location the jewel and pivot are oiled, using only a very little watch oil of the best quality, to lubricate the jewel bearing and prevent the pivot from rusting. A mere trace of oil is sufficient—all surplus should be wiped off. An excessive amount of oil is likely to produce a clogging effect by collecting dust, or thickening, and should be avoided.

After the jewel is put back in place, the tester should see that the worm is opposite the center of the register worm wheel with which it meshes; loosening the lock-nut on the jewel screw (or bushing) and raising or lowering the shaft to bring it so, if necessary, in meters designed with the worm on the meter shaft. Before loosening the lock-nut, however, the jewel should be screwed up tight, as otherwise it will be likely to turn in the bushing and give rise to much trouble. When the worm and worm wheel are properly meshed, the top bearing should be cleaned and adjusted if necessary so that it is at the right height and free from binding.

The top bearing may be cleaned by inserting a small stick of soft wood and twisting it about in the hole. The hole should fit the shaft—neither so worn as to permit the worm and worm wheel to jam, nor so small as to cause friction. After cleaning, blow through the hole with the air syringe. The top bearing should be set to enclose about one-half of the length of the small-diameter upper end of the shaft. After this adjustment is made, the shaft should be pushed downward against the jewel spring to make sure that the end does not come out of the top bearing when the jewel spring is fully compressed. In adjusting the height of the bearing, if a set screw is used it should be loosened, thus leaving the stud free.

Opinions differ as to the advisability of oiling the top bearing. Some meters are made with a top bearing consisting of a fixed journal, running in a hole in the top of the shaft and designed to be lubricated from a minute oil well. In other meters the top bearing plug constitutes a chamber, air-tight at the top, which may be filled with oil, the latter forming a cushion around the top of the shaft, which prevents rattling at this point (as in alternating-current meters) and also prevents rusting of the top of the shaft. Care should be taken not to use too much oil—especially in the top bearings of commutator meters—as any more than will be held in the bearing by capillary attraction is liable to creep down the shaft in time and cause trouble.

If in making adjustments the disk is displaced from its proper position midway between the magnet poles, it should be brought back to this position by shifting it up or down on the shaft.

The register, cursorily examined at the beginning of the inspection of the meter, may now be overhauled thoroughly. The friction in the train may be enormously increased by dust, dirt or verdigris, by bent wheels or teeth, or by burrs on the teeth, due to rough usage. Special attention should be given to the worm and worm wheel, to see that they are clean, and that they mesh properly and run without bending or undue friction. The amount of play between the worm and worm wheel and between the other wheels of the train may be determined by testing with the finger. Each wheel and pointer should be examined separately, and known to be clean, true, uninjured and fast on its shaft. The pointers should be ascertained to be standing in their proper relative positions on the dials by spinning the train so as to bring the pointers to a simple (easily deciphered) dial reading.

The importance of keeping the register free from troubles that mean friction may be realized by bearing in mind that the aggregate gear and bearing friction of the trains of wheels may easily become very high compared to the total friction of the moving element of the meter. A bent wheel tooth or a clogged bearing, especially on one of the low reading dials, may result in slowing down or actually stopping the meter. The entire register, including the dials, should be cleaned with benzine if necessary, or removed for cleaning at the laboratory if verdigris is present. Whether the bearings should be oiled is a matter on which opinions differ. In any event, only a trace of oil should be used. The worm may be cleaned with a tooth brush, or by twirling the shaft while pressing the sharpened edge of a piece of soft wood against the worm—not too hard for fear of bending the shaft—allowing the convolutions of the worm to cut into the wood, with the grain.

In the inspection of commutator meters, the handling of the commutator and brushes is a matter which should be approached with the greatest caution, as it is easy to ruin the accuracy of the meter by ill-advised tinkering.

In commutator meters the commutator is considered by many meter experts to be the weakest point, and the one feature above all others which has been the cause of most inaccuracy in operation. It should be borne in mind that while a carefully designed and constructed modern watt-hour meter possesses the same inherent accuracy for the measurement of power that the electro-dynamometer possesses for the measurement of work—being, in fact, a rotating electro-dynamometer in which the directions of the fields of the fixed and moving coils are maintained in the position for constant (maximum) torque by means of sliding contacts at the commutator and brushes—this accuracy is subject to serious disturbance in practice by variable electrical and frictional resistances at the commutator and brushes. The commutator, in which the electric meter departs most from the laboratory standard of precision, is at the same time the very part which can least afford, so to speak, to be carelessly or negligently handled. When it is considered that under the exigencies of commercial meter work the commutator must be allowed to go for long periods exposed to variable and abnormally severe conditions, from a laboratory point of view, and without any attention, it is readily seen that without the utmost care and skill in maintaining this vulnerable point of the electric watt-hour meter, it is as unreasonable to expect ac rate results from the meter as it would be to expect accurate indications from an electro-dynamometer the moving coil of which had a loose contact of varying electrical resistance and bearing supports of varying friction. Moreover, this inherent weakness of the watt-hour meter is made more serious by the fact that the meter is not a deflecting instrument, merely giving instantaneous values, but a rotating instrument, giving integrated values; so that the error due to functional disorder at the commutator is cumulative in effect.

Many meter experts agree that under no circumstances should the commutator be cleaned unless it is very rough, and sparking too badly to be stopped by pressing the brushes lightly on the segments while revolving the shaft or by very slightly increasing the tension; or unless it is tarnished so badly as to be inoperative. When the meter is first installed, the tension should be adjusted for the local conditions and should not be changed thereafter, unless the conditions change; as by so doing the small grooves which wear into the brushes would be slightly moved from their seat on the commutator, thereby setting up sparking, and this sparking once started would tend to increase by the burning and roughening of the commutator.

Examination and handling of the brushes are facilitated by the special brush tool which comes with the meter-tester's kit, and by holding a piece of white paper or a lamp back of the commutator. A good test of the brush tension under ordinary conditions is to spring the end of the brush away from the commutator about ⅜ in.—using a knifeblade or small screwdriver so as to bear on the brush fingers evenly—and then allow the brush to fly back against the commutator. If the tension is right, the brush will neither slam down hard on the commutator, which would indicate too heavy a tension, nor jingle against it, which would indicate that the tension was too light. If the brush tension needs to be increased, a good way to do so is to place the special brush tool against the brush at the point where it is coiled around the stud and press it in far enough to give it the right amount of "permanent set." In adjusting the tension, the pressure should not be applied at the free end of the brush, as doing so is liable to bend the brush or the individual fingers out of the vertical plane. The fingers should lie naturally in the same vertical plane—i. e., when the brush is lifted from the commutator by outward pressure at a point near the stud—so as to bear on the same element of the commutator for the full width of the fingers. The brush tool can be used to correct the alignment of the fingers, whether they are twisted out of the vertical or bear on different elements of the commutator.

A moderate tension of the brushes—neither so heavy as to bear on the commutator with excessive friction, which would not only introduce friction error, but bring on sparking and its attendant troubles, nor so light as to risk springing away from the commutator under vibration, which would also cause sparking—will usually give the best satisfaction in the long run. The tension should be kept as nearly equal on both brushes as possible, so that the wear will be reduced to a minimum. If the meter is supplied with a sufficiently powerful adjustable shunt-field coil, by which to compensate for increasing resistance of the armature circuit due to tarnishing of the commutator and consequent lowering of speed, the brush tension will have to be changed only in very rare cases. Less trouble will be experienced with light-load readings if, in testing the tension, the brushes are handled very gingerly, so as to avoid disturbing their seat upon the commutator.

In cleaning the commutator and brushes it is generally agreed that nothing which is more abrasive than partly worn crocus cloth should ordinarily be used.

It was formerly thought necessary to give the commutator and brushes a thorough cleaning at every inspection, but it is now believed by many experts that such frequent cleaning is a mistake, and that the commutator and brushes should be interfered with as little as possible, after having once been properly adjusted at the time the meter was installed. The subject is intimately connected with the proposition that a meter after being carefully calibrated under the special facilities of the test room should have its final adjustment and calibration done at its place of installation, so as to start right under the local conditions of vibration, dust, moisture, temperature variations, etc. In a meter which has been properly adjusted on the consumer's premises, and which is carefully and systematically inspected—the commutator ascertained to be true, smooth and clean, and the brush tension skilfully adjusted to the local conditions of vibration—the commutator and brushes will ordinarily give little trouble. The commutator will tarnish (more or less rapidly, according to local conditions) so as to require occasional readjustment of the shunt-field coil to compensate for the increased resistance between brushes and commutator, but will develop a smooth surface which will gradually reach a permanent state, if left undisturbed, not unlike the permanent oxidized glaze which is acquired by the commutator of a well-cared-for generator or motor. Sparking will be unknown, since the meter is kept free from dust, and since the brushes, having been properly adjusted at the start, never either cut into the commutator on the one hand, or, on the other hand, spring away from it under the vibrations to which the meter is subjected.

Crocus cloth should only be used in extreme cases, when excessive sparking due to unusual vibration which had not been allowed for in the original adjustment at the time of the installation of the meter, or excessive tarnishing due to severe conditions of moisture, temperature, etc., are found, requiring thorough dressing down of the surfaces of the commutator and brushes and the readjustment of the brush tension and of the shunt-field coil, i. e., the beginning of an entirely new chapter in the service history of the meter.

When the condition of the commutator or brushes, or both, is such that cleaning is seen to be necessary, a piece of cotton tape or webbing (an ordinary corset string answers nicely) should be used before resorting to anything which could be called an "abrasive." A shoestring, sometimes used, is not as good for the purpose, as it contains sizing and dye, which are liable to cause trouble. Whatever is used should also be free from lint, which may catch between the segments. The contact surface of each brush may be gone over with the tape stretched over a thin, flat stick—rubbing lengthwise of the brush, and taking care to avoid bending the brush. The commutator may be given the same treatment by passing the piece of tape around it and then pulling or "sawing" the tape back and forth so as to twirl the meter shaft, thereby polishing the commutator in the bight of the tape, taking care to pull gently so as to avoid any risk of bending the shaft or injuring the jewel by too strong a side-pull on the shaft. In cleaning the commutator, care should be taken to avoid turning it out of its original position on the shaft. The angular position of the segments with relation to the sections of the armature winding to which they are connected should remain unaltered, as any shifting will shift correspondingly the point of commutation of the meter and thus alter the calibration. The air syringe may be used to remove all dust or other particles that might cause trouble. If the condition of commutator and brushes is so bad, through excessive tarnishing or roughening, as to require the use of an actual abrasive to put them into shape, a piece of worn crocus cloth may be substituted and used in the same way as the tape. Brushes which are in very bad shape may be smoothed with a fine file (taking care not to touch the commutator), followed by the crocus cloth. Carborundum cloth may also be used.

After going over the commutator and brushes as much as may seem necessary, and adjusting the alignment and tension of the brushes, the seat of the brushes on the commutator may be tested by pinching the pair of brushes very lightly between the thumb and forefinger of one hand and twirling the meter shaft between the thumb and forefinger of the other hand. In doing so, any roughness of the commutator, whether due to roughness of the surface, high segments or foreign particles, will be felt through the brushes. If there is not room to get at the brushes with the fingers as described, the inequalities may be felt almost as well by bearing lightly on one brush with the finger or with a thin implement held in the fingers. This operation not only detects inequalities in the commutator, but helps to establish a permanent seat between the newly cleaned and adjusted commutator and brushes by dislodging foreign particles and wearing an incipient groove in each brush, with a corresponding path, or contact zone, around the commutator.

Very many of the troubles experienced in adjusting the brushes have been lessened or eliminated by the gravity-control brush arrangement with which commutator meters of the most recent type have been equipped. The great advantage of the new arrangement is that no tinkering of the brushes is required, and that the adjustment, once made, by a simple thumb-nut arrangement, need not be disturbed. It should be stated, however, that gravity-control brushes are susceptible to vibration troubles, causing sparking at the commutator, for vibrations of certain frequencies in unison with the natural period of the brush rig.

The general caution in regard to the maintenance of the commutator and brushes may be summed up by saying that it is rarely necessary to clean the commutator unless it is very rough or very dirty, or blackened, due to sparking or oxidation; and rarely necessary to clean the brushes if there is no sparking, as it is inadvisable to disturb the contact surfaces of commutator and brushes. There should be no current on the potential circuit during the work on the commutator or brushes, as sparking and consequent damage to the contact surfaces are apt to result.

The entire meter should then be given a general inspection, cleaning the disk, magnets, register, dials, etc, if necessary, and ascertaining that the binding posts are well set up.

It should be noted whether the series field coils show any signs of overheating by short-circuit, or overload, such as blistering or discoloration of the shellac. If any such evidences are found, special attention should be given to the damping magnets, in connection with the calibration of the meter, to ascertain whether they have become weakened or demagnetized by the stray field due to the short-circuit or overload; and the consumer's load should be investigated to see whether it does not exceed the capacity of the meter.

If the meter is of an old-style commutator type without adjustable shunt-field coil, such a coil should be put on.

In installing adjustable shunt-field coils on an old meter, remove the old stationary shunt-field coil carefully, leaving the inside of the series-field coil thoroughly cleaned of any projecting "fins" of the old shellac and mica or other insulating substances with which it may be coated. Place the adjustable coil in the meter and connect it up, making sure that it is connected with the right polarity by moving it near enough to the armature, temporarily, to make the latter rotate on no-load. The shunt should be connected for about five minutes in order to attain its normal running temperature in the meter, before calibrating the meter on light load.

A trouble sometimes found in induction meters, of minor importance, yet often annoying to the consumer, especially in residence installations, is a humming or rattling sound in the meter—sometimes both sounds—due to vibration set up by the alternating current. The former sound is made by loose laminations in the iron core and can be remedied by tightening up the laminations. The rattling is usually caused by lateral movement of the top of the meter shaft in its bearing, and may be overcome by the oiling of the bearing referred to above, or by substituting a wooden or fiber bushing for the brass top bearing (bushing or shaft-end) with which the meter is equipped at the factory.

New Telephone Patents.

SWITCHBOARD APPARATUS.

It has been universally recognized that the switchboard cord is about the most vulnerable part of a manual switchboard, and it is also known that the weakest part of the switchboard cord is at the base of the plug, where it is subjected to abrupt bends and twists. In order to overcome this difficulty, E. L. Smith, of Oak Cliff, Tex., has invented a plug with a ball and socket joint at its base, one member of this joint being the plug body proper and the other member being the cord terminals. The idea is well given in Fig. 1, which shows a plug and cord in section.

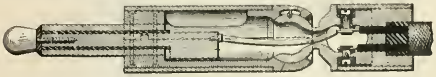


FIG. 1.—SMITH PLUG.

It is now common practice to furnish all telephone exchanges of considerable size with various interrupted currents to provide audible signals for the operators, in order that they may distinguish between different lines, tests, etc. Where there is a ringing generator used these interrupters are commonly mounted so as to be driven by it, but C. J. Erickson, of Chicago, Ill., has now patented an interrupter device of the vibrator type. The vibrators of these interrupters are tuned to different periods, so as to furnish with one a high pitched tone and with the others slow interruptions to differentiate between the various signals. The whole apparatus is designed to run automatically and furnish the signaling currents continuously.

IMPROVEMENTS IN DESK STANDS.

H. L. Knight, of Cleveland, Ohio, has obtained a patent for a desk stand set in which the switch springs are placed vertically within the body tube and the plunger is operated by a substantial vertical rod, secured at one end to the switch lever and guided at the other end by an insulated plug. This rod is surrounded by a spiral spring which operates the lever upon the removal of the receiver. This design affords a very compact arrangement of the parts.

TELEPHONE SYSTEM FOR FIRE HOSE.

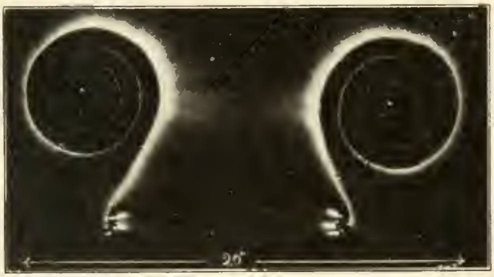
It has been many times suggested that a distinct advantage might be obtained in the fighting of fires, especially in providing for greater safety of the firemen, if some method of extending a telephone line could be devised so that wherever the firemen went with the hose it would be possible to communicate with them. To this end, H. Groswith, of Philadelphia, Pa., has patented the means of carrying forward such a circuit. He imbeds within the body of the hose the telephone wires and at each hose coupling provides registering contact plates so that the telephone circuit is automatically extended as lengths of hose are attached or detached. It seems probable that with such a system perfected many lives might be saved at fires by warning firemen of conditions which they cannot see when within burning buildings, but which are evident to those outside.

LETTERS TO THE EDITORS.

High-Frequency Discharges.

To the Editors of Electrical World:

Sirs:—It is believed that the discharge represented in the accompanying illustration should prove of interest as showing the effects of employing a frequency estimated as 10,000,000 cycles per second—a value greater than appears to have been used previously. Use was made of an induction coil, differing only slightly from the ordinary kind, having a 1.5-cm spark-gap and a 0.009-mf condenser in its secondary. The secondary coil, which is a modified Tesla, excited a tertiary, across the terminal of which the discharge formed.



HIGH-FREQUENCY DISCHARGE.

It is probable that the discharge was not due to secondary emission or condensation because the "brush" did not change its form when a plate glass 2.5 cm in thickness was placed between the terminals in the path of the discharge. All of the coils and apparatus were designed by the writer and made on the premises. It would be interesting to learn if any other worker has employed a tertiary for the purpose indicated.

Rutherford, N. J. Leo Daft.

Underwriters' Inspection.

To the Editors of Electrical World:

Sirs:—I have read with much interest the editorial on "Electrical Inspections" in the issue of May 30. The important point brought out, it seems to me, is the value of electrical inspection to the small central station.

During five years' experience as an underwriters' electrical inspector in the Northwest, I have, almost without exception, found the larger central-stations in favor of inspection, while those not openly supporting it have in no way opposed it. On the other hand, the small central-stations have almost invariably opposed inspection, some managers doing everything possible to discredit inspection with consumers.

This opposition is generally based on the idea that enforcement of National Electrical Code requirements retards the growth of business. I do not believe that such a conclusion is justifiable. Good service is just as essential to the success of lighting companies in small towns as it is in the cities, and anything that tends to improve the service cannot be otherwise than beneficial to the central-station, be it large or small.

Poor wiring, aside from the fire hazard involved, generally means poor service to the consumer. If the lighting in a store be shut off by the blowing of a fuse, it is just as annoying to the owner of that store as though the entire stations were shut down for the time being. The consumer, not being familiar with causes and effects in electric current supply, usually does not recognize the cause to be his own poor wiring, for which the lighting company may in no way be responsible, considers only the effect, and charges it to "poor service."

It is to be regretted that more managers of small central-stations do not realize the importance of good interior wiring and the beneficial results of electrical inspection based on enforcement of National Electrical Code requirements.

BUTTE, MONT. W. T. JACKSON.

The Single-Phase Commutator-Type Motor.

To the Editors of Electrical World:

SIRS:—I have read with great interest the paper presented by Mr. B. G. Lamme presented before the Philadelphia section of the American Institute of Electrical Engineers at its February meeting, entitled "The Single-Phase Commutator-Type Motor."

Without any doubt Mr. Lamme was the first to appear as sponsor of the single-phase commutator motor for traction. However, it is worth noting that quite a development of this type of motor was proceeding at the same time, and altogether independent, of Mr. Lamme's work.

In this connection I beg to be permitted to point out the main points in the active work of the writer in the development in order to avoid the possible repetition in future of a publication similar to the one referred to above in which the data concerning the pioneer work done in this field are altogether incomplete.

At the present time three types of single phase commutator motors are on the market; namely, repulsion motors (compensated or not), series motors and series-repulsion motors.

Repulsion Motors.—It is to-day admitted that the writer was the first to point out the automatic development of a rotary field in the plain repulsion motor, and the good commutation which is the result thereof. (See *Electrotechnische Zeitschrift*, June, 1903.) I was thus the first to point out the special points which will decide the future of the repulsion motor. As regards the compensation of repulsion motors, it is also recognized that I was the first to discover the property of short-circuited brushes in suppressing the self-induction of a rotor having a commutator fed by single-phase current. (See *Industrie Electrique*, May 10, 1902.) Further, I communicated to the General Electric Company, before a patent was applied for in any country, the series connection of the compensated-repulsion motor.

Series Motor.—Contrary to what Mr. Lamme appears to think, it was not the Siemens-Schuckert Werke which first had the idea of employing auxiliary poles excited by a lagging current. The chronological order of the patents regarding this question are herewith tabulated and given below as follows:

German Patent of Behn-Eschenburg (Oerlikon)	March, 1904
French Patent of Latour	April, 1904
British Patent of Milch	May, 1904
German Patent application of Richter (Siemens-Schuckert Werke)	July, 1904

Series-Repulsion Motor.—It is sufficient for the writer to call attention to his U. S. Patent No. 841,257, assigned to the General Electric Company, relating to the general form of this motor, as well as to an article which appeared in the *Electrotechnische Zeitschrift* of Feb. 1, 1906, which gives a full account of its detailed theory. It will be seen, therefore, that the writer's name is intimately connected with the development of this motor.

PARIS, FRANCE. MARIUS LATOUR.

Insulating Couplings.

To the Editors of Electrical World:

SIRS:—In your issue of May 23, on page 1113, is an article describing a form of insulating coupling. Possibly there are many readers who have never seen, or even heard of, such a device, and it may be of interest to them to know that a coupling of this description was designed and adopted as a standard by the British Thomson-Houston Company, of Rugby, England, about four or five years ago, the only difference being in the ring used to hold the rubber buffers in place. The diagram shows this to be apparently bent up from square rod, whereas the ring used in the Rugby design is cut from sheet steel.

If my memory serves me correctly, the coupling was originally designed as a flexible device in addition to having insulating properties, but practice ultimately proved that unless the two shafts were lined up with but a very small percentage of deflection, there was an excessive amount of vibration, which, in addition to having a detrimental effect upon the machine, was a source of annoyance to the buyer.

In all other respects the results have proved entirely satisfactory, and a large number are now being used and have been in operation for a sufficient length of time to prove their efficiency, on three-phase, high-tension motors, of from 60 to 250 hp in cotton mills and places of a similar nature situated throughout the northern counties of England.

It was the rapid growth of the use of a supply of 500 volts and over that gave rise to the need for such a coupling, and consequently the supply was not long in following the demand. There is one potential point that should always be borne in mind by the man responsible for machines to which these couplings are attached, and that is, to keep all trace of oil away from the rubber buffers; otherwise the results will be those that usually accrue when these two antagonists are brought into contact with each other, necessitating an unnecessary expense for renewals.

SOUTH BOSTON, MASS. FRED'K C. HERLAN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Temperature Ratings.—P. M. LINCOLN.—With reference to the standardization rules of different countries (see ELECTRICAL WORLD, June 13, page 1285), the author remarks that the difficulty in the temperature ratings of American and German machinery is even greater than indicated by the comparative tables, for the reason that the overload capacities demanded by the American purchasing public are considerably in excess of those necessary to conform to the standardization rules of the Am. Inst. Elec. Eng. For instance, the institute rules call for 25 per cent overload for two hours on generators, and at this increased load allow 15 deg. C. temperature rise in excess of that allowed at full load. On the other hand, American manufacturers have, in the past, been producing, and the purchasing public demanding, generators designed to meet specifications calling for 25 per cent overload continuously with 10 deg. C.

temperature rise in excess of the full-load temperature and 50 per cent overload for one or two hours with 20 deg. C. rise in excess of that at full load. This latter condition may be compared directly with the German 40 per cent overload for 3 minutes without any temperature guarantee. This practice of the American public is rather illogical. The American institute requirements are much more logical in this respect. The 15-deg. excess temperature rise allowed for a two-hour 25 per cent overload is, within limits, what may be expected in practice with a logically rated machine. It is urged that the American public should be educated to accept the reasonable method of rating generators laid down by the standardization rules of the Am. Ins. Elec. Eng.—*Elec. Jour.*, June.

Lamps and Lighting.

Twisted Filaments.—A note on a recent British patent of A. G. Bloxam (Siemens & Halske Company). The manufacture of metallic-filament lamps of various candle-powers may be facilitated by the employment of two or more filaments twisted together to form one filament of lower resistance and higher candle-power. Standard bulbs and supporting frames may be used for lamps of various candle-powers. A twisted filament has more surface than a single filament of equal section, and is thus shorter for a given candle-power. The twisted filament may be embedded in a ductile metal, and drawn out, if necessary, the outer metal being afterward removed chemically or by fusion. With thick filaments, excessive heating of the supporting hooks is liable to occur. With twisted filaments, however, this can be avoided, as only one strand of the twisted filament need be passed over the hook.—Lond. *Elec. Eng'ing*, May 14.

Leading-In Wires.—A note on a British patent of Bastian, Calvert & Sanders. As a substitute for platinum for the leading-in wires use is made of a pure copper conductor in the form of a very thin ribbon (0.004 in.). This ribbon is provided with a surrounding tube of enamel, glass or soft white "platinum flux" glass, which is fused round that portion of the conductor which is to be fused on to the ribbon by the action of two oppositely directed blow-pipe flames. Not only are all gases excluded from the film between the coper and the soft glass covering, but oxidation of the metal is prevented, and a gas-tight seal is obtained.—Lond. *Elec. Eng'ing*, May 14.

Generation and Transmission.

Electric Motors in Mines.—Electric motors are now introduced extensively in collieries in the northeast of England. The Tribley installation is described. It consists at present of a winding gear receiving energy through an Ilgner converter set; a surface haulage gear for transporting tubs of coal from the new pit head to the old colliery; an electrically-driven fan for providing ventilation in the mine, and a certain number of lamps on the surface and in the workings. Moreover, there is in working order an underground haulage system along one of the main roads, although in two or three directions the work of bringing the coal tubs to the pit shaft is accomplished by means of gravity owing to the natural dip of the seam. The Ilgner converter set consists of a 440-volt, three-phase motor running at 1200 r.p.m. and a direct-current generator of interpole design capable of giving any e.m.f. between zero and 300 volts and a current of 167 amp. At the outer end of the shaft is mounted the exciter for the direct-current machine, and the whole of the control of the winding motor is regulated by varying the field excitation of the dynamo of the Ilgner set. The fly-wheel weighs 900 kg and has a diameter of 4 ft. 11 in. When revolving at 4300 r.p.m., considerable energy is stored in it. The winding gear consists of a single-drum winder, 8 ft. in diameter, geared to a direct-current shunt-wound motor designed to carry 167 amp at an e.m.f. of from zero to 300 volts. It is a 12-pole, shunt-wound machine, with field coils specially arranged in sections so as to give large heat radiating area; when taking full current it develops 60 hp. There is no regulating rheostat in the field circuit of this motor, and the Ilgner set, generator and this motor are connected up solidly together by means of cable with only an overload circuit-breaker in series. The duty of the winder is to lift 800 tons of coal per shift of eight hours, or rather, it has to draw that amount of coal in seven hours, one hour being required for changing men. The tractive effort has a very slight effect on the energy supply system. The method by which this closeness of regulation is obtained is by means of a slip regulator placed in series with the primary of the motor of the Ilgner set. This slip regulator consists of a liquid resistor in each phase lead of the supply system, the position of whose movable plates is determined by the balance of what is virtually a torque dynamometer. The dynamometer consists of a squirrel-cage induction motor, giving a torque of 1.4-kg-meters when taking 3.8 amp and 190 volts, whose spindle is attached to an arm on which depends the gear holding the movable electrodes of the liquid resistor. Adjustment is made by means of counterweights. Should the current through the primary of the squirrel-cage motor exceed a specified value, it operates against the weight of the electrodes and raises them, thereby inserting resistance in the stator circuit of the motor. The current in the squirrel-cage dynamometer is at all times proportional to the power in the motor of the Ilgner set. It follows, therefore, that when the demand on this motor becomes excessive its speed and output are dropped by the insertion of resistance in the primary and an opportunity is given to the fly-wheel to take up the work by giving out its stored energy. In this way a consistent balance is kept up between the demand of the winder motor, the stored energy of the fly-wheel and the demand on the mains.—Lond. *Elec.*, May 15.

Steam Turbines.—J. M. Bailey.—An illustrated article discussing the possibilities of further improvements in steam turbines in the following directions: First, reduced specific steam consumption; second, increased peripheral speed; third, simplicity of design with minimum number of moving parts. From a practical standpoint the following points are considered: Accuracy of workmanship and mechanical designs arranged so that expansion and contraction under all conditions of load and steam pressure are provided for in such a manner as not to interfere with safe operation. There are now used in the United States more than 2,000,000 hp in steam turbines for driving direct-connected generators.—*Elec. Jour.*, June.

Motors for Steel Mills.—M. A. Whiting.—The author summarizes the very severe conditions to which electric motors are subjected in steel plants, and describes the characteristics of the design and construction of the various types of direct-current and alternating-current motors developed for this purpose by the General Electric Company.—*Gen. Elec. Rev.*, June.

Traction.

Single-Phase Railway.—An illustrated article on the single-phase railway from Rome to Civita-Castellana, which is the first single-phase road installed by the Westinghouse interests in Europe. The section between Rome and the power house is operated at 600 volts, the remaining section at 6600 volts. The whole line has been in operation since December, 1906. The traffic has increased steadily, and the road is to be extended 24 miles. At the point where the line e.m.f. changes from 600 to 6600 volts, a dead section, 4 m long, is inserted. At the middle point of this section and in line with the other poles, there is placed a pole carrying a porcelain arm which throws the change-over switch on the car as it passes. This switch, which is placed on the roof of the car, is of the two-way type, having one terminal connected to the base of the pantograph and the other two connected to the 6600-volt and 600 volt terminals, respectively, of the auto-transformer. In passing over this section it is not necessary to lower the trolley, as no current is on the car when the switch is thrown. Since the catenary construction is not employed, the government insisted that a sure means of protection against the live end of a broken wire be found. To meet this requirement, a small wire was connected to the trolley wire at the end of the line in Civita-Castellana and brought back on the pole line to the power house. Here it was connected to one terminal of the primary of a shunt transformer, the other terminal being earthed. The secondary is connected to an electromagnet mounted on an oil switch, which is in the circuit of the wire connecting the power house to the trolley line. To put current on the line, the switch is closed by hand; it is then held in by the electromagnet. To test the operation of this apparatus, a knife switch was put in the circuit; when this switch was opened, the oil switch dropped out immediately, with no perceptible interval of time. In case of a short-circuit on the line, the switch will open on account of the drop in voltage.—Lond. *Elec. Rev.*, May 15.

London.—An illustrated description of recent extensions of the generating station of the Central London Railway. This railway is worked by direct current supplied from a number of substations along the route, which receive energy from the generating station at Shepherd's Bush in the form of three-phase alternating current at 5000 volts and at a frequency of 25 cycles per second. The rating of the former equipment of the generating station amounted to 5100 kw in six 850-kw units. An additional 2000-kw generating set has now been installed. The cost of operation on this road in 1907 was as follows: The total cost of operation was 13.7 cents per train-mile (of which 58.28 per cent was generating station costs, 6.01 substation costs, 32.13 locomotion and 3.58 superintendence). The total cost of running the line was 69 cents per train-mile, so that the total cost of operation was 20.1 per cent of the total cost.—Lond. *Elec. Eng'ing*, May 14.

Installations, Systems and Appliances.

Automatic Protection of High-Tension Circuits.—An illustrated description of the protective system of C. H. Merz and B. Price, which is already employed on about 70 feeder cables, covering a route length of about 200 miles, working at 6000, 12,000 and 20,000 volts, together with 50 substations with an aggregate rating of 50,000 kw of installed plant. It has been found that under ordinary working conditions a shock on the system at the moment of breakdown has been scarcely noticeable at the power station, and in no case has the synchronous apparatus in the substation been upset. The general principles of the system is that a balance is created under normal conditions between the power which is flowing at the points of entry to and exit from the cable or apparatus to be protected, and means are taken whereby this balance is disturbed only when leaking takes place between the points of entry and exit, due to breakdown. One way in which this system of balance is employed to control the relays may be seen by the aid of Fig. 1, which is a diagram of connections for a simple case of a three-phase feeder cable. A three-core, low-tension pilot cable is laid in the same trough and is connected up at each end to three-phase relays or to three single-phase relays and to the secondary windings of series transformers, the primaries of which are in series with the cores of the main feeder cable. These relays are of the simplest possible character. They act only as contact-makers, and are designed not only to close the local battery circuit instantaneously, but also to release a falling weight, which in turn short-circuits the contact just made. Since the current at both ends of the main cable (neglecting the inappreciable capacity current) must be the same at every instant, it will be evident that unless there is a leakage between the two sets of series transformers the inductive effects which this current will produce in the pilot-wire circuits will be equal and opposite, so that no appreciable current will be produced in the relays. As soon as there is a leakage, however, the balance will be upset, and a current capable of operating the relays will follow. In Fig. 2 is shown the method of protection of branched feeders by means of e.m.f. balancing with an open reverse-delta-connected series transformer. The protection of a transformer by means of magnetic balancing is shown in Fig. 3. As under normal conditions the m.m.fs. in the magnetic balance cores are equal and opposite, the flux is practically zero and the windings, therefore, are practically non-inductive; measuring instruments may be connected as shown.—Lond. *Elec. Eng'ing*, May 21.

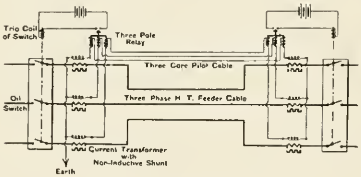

Trip Coil of Switch
Three Pole Relay
Three Core Pilot Cable
Oil Switch
Three Phase H. T. Feeder Cable
Current Transformer with Non-Inductive Shunt
Earth

FIG. 1.—DIAGRAM OF CONNECTIONS.

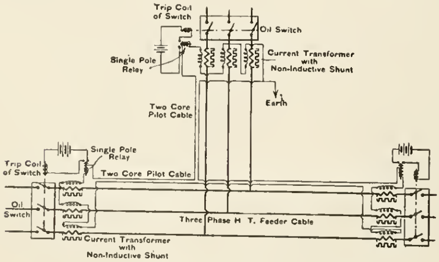


FIG. 2.—PROTECTION OF BRANCHED FEEDERS.

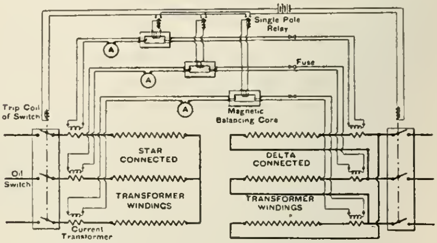


FIG. 3.—PROTECTION OF A TRANSFORMER.

Switch-Gear Relays.—C. C. Garrard.—A paper read before the (Brit.) Inst. Elec. Eng., in which the author reviewed critically some principles applied in systems of switch-gear control apparatus and relays for alternating-current circuits. In speaking of polyphase relays he said that they should never be used, but always single-phase relays connected separately on two or three of the phase leads on three-wire or four-wire systems, respectively. Concerning solenoid relays, he remarked that the dashpot solenoid type of maximum relay is not to be relied upon for dealing with intermittent overloads or short-circuits. Fuse-shunted trip coils are cheap, but changing the thickness of the wire not only alters the current at which the combination works, but also affects the time lag enormously. Thus, independent adjustments of the time and the current calibrations are not feasible—at least, if fuse wires of constant length and of the same material are used. The fuse-shunted trip coil may, however, find useful application on motor-control panels where ordinary fuses are not desired, and where a discriminating action, apart from the prevention of the machine being cut off due to every temporary overload, is not wanted. As to maximum relays connected on the "resultant principle," the author stated that the only safe arrangement is to have the same number of relays as there are series transformers. If the circuit be a four-wire one, then three relays are necessary; if three-wire, then only two relays are essential. As to reverse-power relays on generators, the author pointed out that the most suitable value to which a generator reverse-power relay should be set is such that it will operate, after the requisite time lag, with a power reversal of 10 per cent of the full rating of the machine. With this setting, the current which can be produced in the generator windings is never very excessive. At the ends of feeders a reverse-power relay should be set proportionately higher than on the generator; probably if it were set to operate at 25 per cent of the normal full-load rating of the feeder the most suitable arrangement would be obtained. The author then discusses the protection of interconnector cables (for the connecting of one substation with another). The Merz and Price system is briefly described, and the author then deals with the protection of interconnector cables by means of electrically-interlocking reverse-power relays. As the criterion of failure of an interconnector is simultaneous flow of energy into it at either end, such a circuit can be protected by the installation of reverse power relays at both ends, both relays being connected in a common tripping circuit arranged so that only when energy is flowing into the cable at both ends is the trip-coil circuit closed at both relays and the main switches caused to open the circuit (see Fig. 4). Normally, the trip circuit is broken at one relay and made at the other, or vice versa, according to the direction of flow of energy in the circuit. The relays close the circuit with a slight time lag, so that, on the flow of energy reversing, one of the contacts is opened at the one relay before the other one is closed. *A* and A_1 are pairs of contacts which are closed automatically when the main circuit-breaker at the corresponding ends opens. Thus, if the switch at the left end of the interconnector opened slightly before the one at the right-hand end, the trip-coil circuit would be closed at *A* by the relay of the right-hand end. Thus the circuit-breaker at the right-hand end would also operate. The object of this arrangement is to ensure that both ends of the interconnector will be disconnected, even if the two switches do not quite act simultaneously. Each trip coil is also arranged so that it is cut out of circuit when its main switch has opened the circuit, after, however, *A* (or A_1) has been closed. The trip coils, therefore, are not subjected to danger of burning out. The state of affairs might, however, arise that the left-hand switch was opened and the right-hand switch was closed, there being a short-circuit or earth connection on the interconnector. By the act of closing the right-hand switch the trip coil of this switch will be put into circuit ready for operation, and the circuit through it will be complete through the right-hand relay, which operates due to the flow of energy into the fault, through *A*. Thus the right-hand circuit-breaker will open, at the same time cutting out its own trip coil. Thus it is impossible to connect up the interconnector at either end while there is a fault. The arrangement as set forth above, of course, necessitates that there should be some voltage in order to operate the relays. If the voltage absolutely disappears, the reverse-power relay will not work, and it may be thought that in the case of a very bad short-circuit this will happen. Considerable experience has shown, however, that even under the worst conditions the voltage does not entirely disappear, and that if the calibration of the apparatus is unaffected by fall of potential down to 10 per cent of the normal working voltage, all working conditions will be met. As the pilot wire carries only the tripping current, it will be seen that only one pilot is necessary whether the relays are single-, two-, or three-pole. On a three-phase system the relays will be two- or three-pole, according as to whether the system be three-wire or four-wire. An account of the extended discussion which followed is also given.—Lond. *Elec. Eng'ing*, May 21.

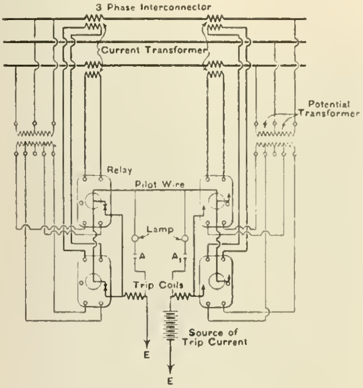


FIG. 4.—SWITCH GEAR RELAY.

Tirrill Regulator.—A. Schwaiger.—While the Tirrill voltage regulator is being used considerably in practice, theories of it have been developed which often do not agree with the practical results. The author deals with the principles of rapid regulation and first gives a "static theory" of the Tirrill regulator. It is shown that the regulator can be in equilibrium in any position. Nevertheless, it might be possible that when the regulator moves from one position to another position it might not come to rest in its new position. The static theory must, therefore, to be supplemented by the dynamic theory, giving the conditions under which oscillations of the regulator around the position of equilibrium will diminish in time. It is shown that by selecting a proper method of damping it is possible to produce stability in any case.—*Elek. u. Masch.* (Vienna), May 17.

Switzerland.—A. Weber.—Some statistical notes on the central stations of Switzerland in 1907. There were 539 stations, of which 171 were primary generating stations with a maximum rating of 168,920 kw. As to the capital invested in the hydroelectric stations utilizing waterfalls of different heights, the following figures are given: The average cost per horse-power. including the network, is $174 for waterfalls less than 12 m in height; $196 for from 20 to 100 m; $150 for from 101 to 500 m; $110 for from 501 to 1000 m. Of the 171 generating stations, 56 supply direct current, 18 single-phase current, 35 three-phase current, 33 single-phase and three-phase currents, and 17 direct current and three-phase currents.—*La Lumière Elec.*, May 16.

Switchboard.—An illustrated description of a high-tension switchboard of German make, the special feature of which is the use of removable switch carriages so as to permit easy tests, repairs, etc.—Lond. *Elec.*, May 15.

Relays.—M. C. Rypinski.—A continuation of his illustrated serial on protective relays. The present instalment deals with alternating-current overload and reverse-power single-phase relays, operating on inverse-time-element action.—*Elec. Jour.*, May.

Earth Resistance.—R. Haas.—In Germany the lawn on terraces is often held together by means of a ribbon of sheet iron and this ribbon is said to be very suitable for earth connections, especially since the lawn is always kept wet.—*Elek. Zeit.*, May 14.

Circuit-Breakers.—H. G. MacDonald.—A continuation of his long illustrated serial on circuit-interrupting devices. The author discusses the general features and designs of oil circuit-breakers.—*Elec. Jour.*, May.

Wires, Wiring and Conduits.

Porcelain Insulators.—C. C. Garrard.—It is almost universal practice at the present day to use corrugated porcelain insulators for the bushes of transformers, switches and the like. It has been the fashion to specify that these should have certain minimum leakage distances from live metal to earth. In order to conform to the specifications it has often been found necessary to employ very deep corrugations, which increase the cost and make cleaning difficult. These deeply corrugated insulators have been evolved from the ordinary petticoat insulators for outdoor service. In order to find whether these corrugations are really necessary, the author has experimented with the two insulators shown in Fig. 5. A corrugated and a plain insulator having about equal exterior diameters were tested for equal direct distances; that is to say, the direct jumping distance through air, not following the surface of the corrugations, was the same in both cases (about $8\frac{1}{2}$ in.). The two insulators were tested in parallel, and with the corrugated insulator the spark jumped across first, at 80,000 volts (effective). The distance on the plain insulator was then slightly shortened (to about 8 in.) and it was found that this insulator sparked across

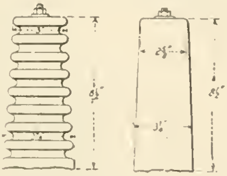


FIG. 5.—CORRUGATED AND PLAIN BUSH.

first. The conclusion which was drawn was that for insulators of about the same outside diameter the corrugations are of no value, and might well be left off, as the determining factor of the breakdown point is the length of the shortest air path. Of course, this conclusion applies only to indoor insulators. Porcelain insulators tend to keep themselves dry and to maintain their insulation, for as moisture is deposited the discharge dries it off. Corrugated insulators have the great disadvantage that it is difficult to clean them and the author concludes that it will be preferable to do away with the usual corrugated insulators on indoor switches, transformers and the like and replace them with simple cylindrical plain ones, designed to have as long a direct air jump as possible. This will result in an appreciable saving in cost. As, however, the corrugated insulator has become a standardized article, an interchange of opinion on this question might be desired before making the change.—Lond *Elec.*, May 15.

Joints.—F. Loppe.—An illustrated description of joints for wires and cables, devised by E. Begot and specially suitable for aluminum. A joint for two wires is illustrated in Fig. 6.

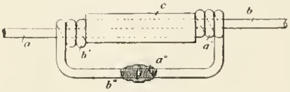


FIG. 6.—TWO-WIRE JOINT.

The two wires *a* and *b* are laid side by side for some distance and enclosed in a sleeve *c*, and the end of each wire is then wound in a few turns *a'* and *b'* around the other wire and the two terminals *a''* *b''* are finally soldered together in some way. The resulting joint is mechanically and electrically strong. A joint for a cable is shown in Fig. 7. The two ends of the cable *d* and *e* are provided with end pieces *f* in such a way that when the nut *g* is turned the two end pieces are brought nearer together. Each of the cable ends is opened out and a double cone *h* is placed in the center. By turning the nut *g* the different wires of the cable are pressed between the double cone piece *h* and the inner surface of the end pieces *f*. Fig. 8 shows a joint for aluminum bars, such as are used with electric furnaces. The ends of the two bars *a* and *b* are threaded, and between the two ends the sphere *e* is inserted. By turning the nut *d* the two ends of the bars and the sphere *e* are strongly pressed together.—*L'Ind. Elec.*, April 25.

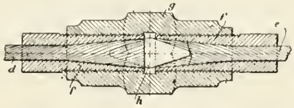


FIG. 7.—CABLE JOINT.

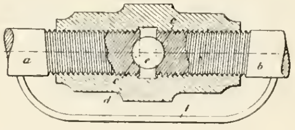


FIG. 8.—JOINT FOR ALUMINUM BARS.

Graded Cables.—C. S. Whitehead.—A note on a (Brit.) Phys. Soc'y paper in which the author examines the formulas given by O'Gorman and by Russell for the "grading" of cables; that is to say, for the required adjusting of the electrical constants of the different layers so that the electric intensity radial to the axis may be constant throughout the covering. The object of the paper was, in fact, to corroborate the formulas arrived at by approximate methods by the authors named, by the rigorous use of Maxwell's general equations. The result is to confirm the approximate formulas, provided that the electrical waves propagated along the cable are not short-waves.—Lond. *Elec. Eng'ing*, May 14.

Suspension of Trolley and Transmission Wires.—R. N. Tweedy.—A paper read before the Dublin section of the (Brit.) Inst. Elec. Eng. on Pringle's tangential system of suspending overhead trolley and transmission wires. The chief features of the system are: 1, the use of two or more non-fouling ears soldered to circular wire at each point of suspension; 2, the attachment of these ears to a bracket arm or span wire by a length or lengths of flexible steel stranded wire; 3, the use throughout of one-piece porcelain insulators. The advantages of the system are pointed out, and tables are given showing the results of tests.—Lond. *Elec.*, May 15.

Electrophysics and Magnetism.

Electronic Theory of Gravitation.—C. V. Burton.—A note on a (Brit.) Phys. Soc'y paper in which an attempt is made to adapt the ether of the electromagnetic theory so as to account for gravitation. Hicks and other writers have supposed that ordinary matter is a modified portion of ether possessing as one of its properties a perpetual pulsatory motion in respect of its volume. It is well known that any such pulsatory objects, placed in a fluid, will exhibit attractions toward one another. The chief outstanding difficulty has been in providing for that agreement in phase which must be assumed to subsist among the centers of pulsatory disturbance. "This difficulty is avoided by the author by supposing all of the pulsations to be caused by primary waves of the compressional-rarefactional type propagated through the ether with a velocity enormously transcending that of light. These primary waves may be traveling in directions indifferently distributed, or predominantly in one direction; but an essential point is that all effective wave-lengths should be very great, measured even by astronomical standards. Taking Lodge's estimate for the density of ether (10^{12} grams per cc), and for the constitutive energy of the ether (10^{33} ergs per cc), the author finds as mathematically reasonable figures the following: Velocity of the compressional waves of the ether $= 7.3 \times 10^{16}$ times the velocity of light; wave-length $=$ 1.5×10^{17} cm; rate at which energy is being propagated through each square centimeter of surface taken parallel to the wave fronts $= 3.4 \times 10^{11}$ kw."—Lond. *Elec. Eng'ing*, May 14.

Contact E.M.F. and Cohesion.—F. Sanford.—An abstract of a Phys. Soc'y paper. In the consideration of the phenomenon of contact e.m.f. in metals, the writer has been led to the conclusion that it is definitely related to the specific inductive capacity, so that a metal having a higher specific inductive capacity will become positively electrified when in contact with a metal having a lower specific inductive capacity. It also seems probable that cohesion, like chemical affinity, is due to electric attractions, and since the electric attraction between two charged bodies is inversely as the specific inductive capacity of the intervening medium, the attractions between the molecules of bodies should vary according to the same law. The above assumptions lead to the conclusion that the voltaic series should be inversely as the cohesion series. Lacking direct data on the cohesion of metals, the author has attempted to test the above hypothesis by relating the voltaic series to the melting points, the expansion coefficients and the hardness of the metals. Apparent exceptions from the rule are discussed.—*Phys. Rev.*, May.

Units, Measurements and Instruments.

Induction Coils.—B. F. Bailey.—The author first considers theoretically and experimentally primary or single-circuit coils without or with an iron core. It is shown that for the highest efficiency the battery should have a rather high e.m.f. and the time of contact should be short, so that the current rises to only a small fraction of the value it would attain if given unlimited time. The break should be reasonably short, but not too brief, especially with a coil having wire of a large diameter in the core, and the core should be made of the wire having the smallest possible hysteretic coefficient. For the sake of first cost, the coil could be made much smaller than those usually employed. The author then discusses the secondary coil, dealing especially with the effect of capacity upon the secondary e.m.f. and with effect of current in the secondary. Finally the efficiency of the secondary coil is investigated.—*Phys. Rev.*, May.

Thermomagnetic Effect.—L. L. Campbell.—An abstract of a Phys. Soc'y paper on the variation of the thermomagnetic effect in soft iron with the strength of the magnetic field and with the temperature gradient. The transversal thermomagnetic effect was first determined in soft iron under a constant gradient of temperature and a varying strength of magnetic field. The temperature gradient was about 18 deg. C. per centimeter, and the magnetic field varied from about 6000 to 12,000 maxwells. The effect increased with, but was not a linear function of, the field strength. The thermomagnetic rotation coefficient Q increased with the field for awhile, and then gradually decreased. For one iron plate, Q had an initial value of 0.00147, a maximum of 0.00150, and a final value of 0.00148. At the higher limit of the field strength, the effect did not seem to approach a saturation value. A second set of measurements was made with constant field strength = 9000 maxwells, while the temperature gradient varied from 15 deg. C. to 65 deg. C. per centimeter. The effect here also increased with the gradient, without being a linear function of it. For the same iron plate, as above, Q increased from 0.00146 to 0.00161, and then fell off to 0.00134. At the highest gradient employed, the effect seemed to approach a saturation value. In the light of the above determinations, it would seem well, in quoting values of the coefficient Q for metals, always to state definitely the field strength and temperature gradient under which the determinations were made.—*Phys. Rev.*, May.

Induction Experiments.—R. T. Wells.—An account of experiments in which the primary circuit consisted of a uniformly-wound coil with straight axis and circular cross-section and the secondary was a metallic cylinder inside of the coil. The reactions of the core-currents change the effective resistance, inductance and impedance of the coil. The author discusses theoretically and experimentally the effect of such reactions.—*Phys. Rev.*, May.

Telegraphy, Telephony and Signals.

Long-Distance Telephony.—At a recent Royal Society soiree in London, S. G. Brown showed some experiments which may possibly have a most important bearing on the future of long-distance telephony. Current from a high-frequency alternator was passed through a resonating circuit, containing capacity and inductance in series, so that a considerable oscillating current was obtained. Near the inductance was a coil, forming part of another circuit, containing an electrolytic interrupter and a galvanometer. Across the poles of the interrupter was connected a 4-volt battery. Normally the interrupter, which consisted of platinum electrodes dipping in strong sulphuric acid, would at once polarize, but the high-frequency current produced when the circuits were in tune broke down its resistance entirely and allowed the battery current to flow. The tuning of the circuits was so sharp that the approach of a minute piece of iron to the inductance coil of the first made a most extraordinary variation in the inductance in the second, and therefore in the battery current that could flow. The feeblest vibration of a telephone diaphragm would have the same effect, and thus if a receiver were speaking in the field of the inductance coil, another receiver in the battery circuit would reproduce the speech with all the power of the battery behind it. "Thus a simple telephone relay can be constructed and the distance of the transmission of speech increased indefinitely." The alternator used for the high-frequency current gave an output of up to 100 watts with a periodicity of 12,000 cycles per second when running at 6000 r.p.m. "It was of the inductor type, and pleasing both mechanically and electrically."—Lond. *Eng'ing*, May 15.

Wireless Telephony.—A note on a patent of A. Steinacker and A. Plisnier describing some improvements in wireless telephony. It is stated that good results have been obtained by substituting a mercury-vapor lamp for the copper-carbon arc in the oscillating circuit.—Lond. *Elec. Eng'ing*, April 9.

Miscellaneous.

Electrical Power in Iron and Steel Works.—W. E. Reed.—A long paper discussing successively the electric driving of auxiliary apparatus, of main rolls, the methods of equalizing reversing mills, with illustrated description of various recent installations. A full account is also given of the extended discussion which followed the reading of the paper.—*Proc. Eng. Soc'y of Western Pa.*, April.

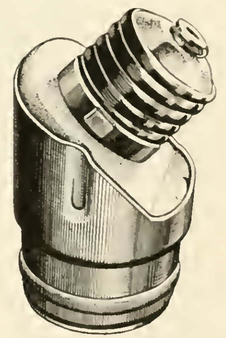
Evening Schools.—W. J. Crawford.—Some notes on the teaching of evening students in engineering. The author discusses at some length the necessary qualifications of the teacher and refers briefly to some subjects to be taught. Other things being equal, the success from teaching engineering subjects will vary directly with the success of the mathematical teaching. "Practical mathematics" (giving the practice of mathematics without the theory) is a "laudable subject," but "it is being shockingly overdone." Teaching in contracted methods in multiplication and division is useless since the slide rule should be in general use. Squared paper work is important, but the proper place for it is after a working knowledge of the simple equation has been acquired.—Lond. *Elec. Rev.*, May 15.

Mechanical Stokers.—J. E. Barnes.—A paper read before the (Brit.) Inst. Mech. Eng. on mechanical stokers as a means of reducing the fuel bill. The author discusses types of stokers, methods of driving, the kinds of coal used, the use of forced draught, operation and upkeep, and gives a description of various commercial makes of stokers.—Lond. *Elec. Eng.*, May 1.

Purchase of Coal.—J. B. C. Kershaw.—The author criticizes severely the usual methods of selecting coal and of checking the quality of the deliveries under a contract. The only satisfactory way is by means of chemical laboratory tests carried out by chemists who have had experience in this class of work.—*Cassier's Mag.*, May.

Tungsten Lamp Adapter.

The Dale Company, of Ninth Avenue and Thirteenth Street, New York City, has brought out the lamp adapter shown herewith for use on electroliers with sockets set at an angle or with any other angle fixtures. The adapter is intended for use with tungsten lamps, which at the present time are intended to hang vertically, and by its use the ordinary electroliers are serviceable for these high-efficiency lamps. In order that the plug of the adapter may make contact with the socket of the electrolier and at the same time have its own socket vertical, an adjustable strip of copper is provided as shown, and this may be extended or compressed in making the center connection. Aside from the angular feature, the device follows standard plug and socket construction.


Tungsten Lamp Adapter.

General Electric Company's Engineering Convention.

For nine days ending June 9 the engineers of the General Electric Company were gathered together at their annual meeting for discussing the past year's development in the art and considering plans for the future. Engineers from the local offices of the General Electric Company throughout the country and Mexico were in attendance, as well as representatives of all branches of the engineering department of the company. Every phase of the company's engineering work was considered in detail. The engineers of the various departments presented interesting papers on a great variety of important subjects.

The meeting was opened at the principal works at Schenectady, N. Y., by Mr. E. W. Rice, Jr., vice-president. After spending five days at Schenectady the meeting was adjourned to Pittsfield, where Mr. C. C. Chesney, manager of the Pittsfield Works, opened the meeting and introduced the engineers at that factory. The meeting was continued at Lynn, where the engineers were welcomed by Mr. W. C. Fish, manager of the Lynn Works. The company's incandescent lamp works are located at Harrison, N. J., and when the convention assembled at this place Mr. G. F. Morrison, manager, outlined the remarkable development in incandescent lamp engineering during the last year.

Among the engineers from the field present at this meeting were: Messrs. J. Lyman, Chicago; J. L. Monges, San Francisco; W. F. Wright, Denver; H. H. Barnes, New York; C. T. Mosman, Boston; W. S. Culver, Cincinnati; L. F. Deming, Philadelphia; H. E. Bussey, Atlanta; W. H. Hand, St. Louis; C. A. Chase, Mexico.

The Circuit Breaker as Power-Plant Insurance

Some time ago a 500-hp, 230-volt, direct-current inter-pole motor was installed in a textile mill on the first floor, and so connected with rope drives as to transmit power to the second, third and fourth floors of the building. The problem of starting this heavy machine direct connected to a shafting friction load of 20 per cent of normal was taken care of by the use of a specially designed multiple switch starter.

The next problem, that of protecting the motor from excessive overload and stopping it instantly from any of the floors driven by it, was then taken up, and after careful consideration it was decided to use a 2000-amp "LL" type Cutter breaker with overload and shunt trip coil features combined. Lead wires from the tripping coil were run in conduit up through the building with a suitable push-button arrangement in an easily accessible place on each floor, from which the motor may be quickly shut down without any destructive arcing whatever of switch mechanism.

This simple solution of what at first appeared a difficult problem from both a practical and financial point of view, possesses a number of advantages. In this particular case, where there are a large number of machines driving belts and ropes with which employees are liable to come in contact, an instant stop of power from the point where an accident occurs is essential, and is easily accomplished by the use of the trip coil and push-button arrangement. To obtain remote control of heavy current apparatus at a minimum first cost, the use of the breaker with a tripping device was selected after careful consideration.

As the tripping device contains no mechanical features to become disarranged, its positive operation is continued indefinitely. The coil being an auxiliary using but little current, it is not possible for it to destroy itself in any way. As is well known, accidents to driving belts and ropes of a trifling nature are frequently happening in a mill of the character described, which if not immediately checked by stopping operation for a few moments and repairing, develop to serious proportions which require a day or so for repairs. The accessibility of the shunt trip control makes the serious accident next to impossible, as power is shut off immediately at the first sign of trouble, from the room wherein it develops. Quick repairs may then be made and the machines resume operations.

Gas Engine Ignition System.

The distinguishing feature of the ignition system illustrated herewith resides in the use of only one vibrator for any number of spark coils. The coils for automobile engine ignition are placed in a cylindrical, heat-resisting insulating tube which is mounted directly over the engine cylinders. By this construc- the high-tension leads are very short, and the danger of poor insulation between the leads and the engine frame is eliminated. The arrangement of coils and circuits for a four-cylinder engine is shown in Fig. 1.

Although only one vibrator is used at a time, two vibrators are provided. One vibrator is adjusted to produce a heavy spark suitable for starting the engine most readily, and the other for a light spark suitable for running the engine when fully warmed up. To prevent uneven wear and pitting of the platinum points of the vibrators, a polarity-changing switch is provided in the battery circuit. It is claimed that by the reversals of current the platinum points wear evenly and when once adjusted require no further attention. The two vibrators, together with condensers, the polarity-changing switch, battery switch and vibrator-switch are assembled in a box which is mounted on the dashboard of the automobile.

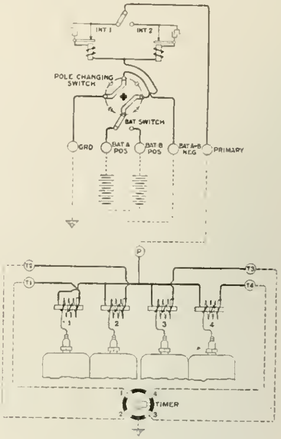


FIG. 1.—CIRCUIT DIAGRAM OF IGNITION SYSTEM.

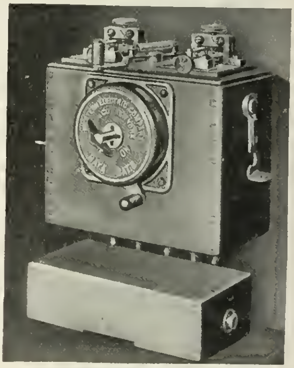


FIG. 2.—VIBRATOR BOX WITH COVER REMOVED.

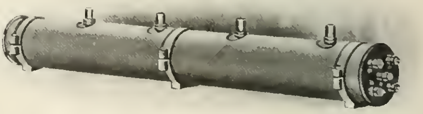
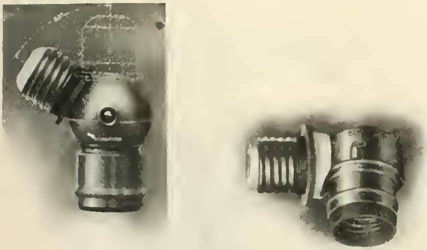


FIG. 3.—FOUR-CYLINDER TUBE.

This system has been developed and the equipment has been placed on the market by the Western Electric Company, Chicago, Ill.

New Adapter for Tungsten Lamps.

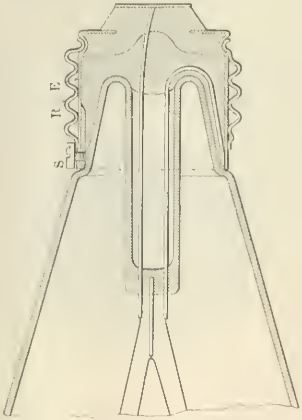
The Benjamin Electric Manufacturing Company, of Chicago, is placing on the market a new device in the form of an adjustable plug socket, the principal use of which is that of an adapter for tungsten lamps. The device is provided with a rotating sleeve which permits a complete revolution of the socket, together with a hinge joint by means of which almost any angle of adjustment desired can be secured. The position of the lamps in a fixture or bracket may thus be changed to the vertical. This device is shown in Fig. 1. Where it is desired to have lamps burn at right angles, that is, with a horizontal socket or receptacle, a second device is furnished. This is illustrated in Fig. 2.



FIGS. 1 AND 2.—ADAPTERS FOR TUNGSTEN LAMPS.

Locking Lamp Base.

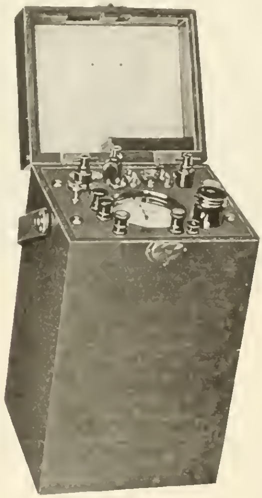
With the advent of expensive lamps like the tantalum and tungsten, the necessity of fixing lamps in public places so that they cannot be stolen from the sockets, is being more urgently felt. Even with the comparatively cheap carbon-filament lamp, some concerns lose many lamps by theft yearly. Several socket devices have been brought out to prevent lamp stealing, but the problem has been attacked in a new way in a patent recently applied for by William I. Weber and Walter R. Bonham, 1113 Monadnock Block, Chicago. Messrs. Weber and Bonham propose to use a lamp base such as shown in section in the accompanying drawing. This lamp base has the brass shell *R* which carries the screw threads mounted so that it can revolve freely on inner brass shell *E*, this inner brass shell being cemented to the lamp base in the usual manner. A small set screw *S* is provided, which is screwed down tight, to hold the shell *R* so that the lamp can be screwed into the socket. After the lamp is in the socket, the set screw *S* is removed and the lamp will then revolve freely without unscrewing. To remove the lamp the set screw *S* must be put back. This screw is provided with a left-handed thread. While this is not an absolute preventive of lamp stealing, it is believed that the ordinary lamp thief will not be provided with a screwdriver and left-handed screw of the proper size. Like many other locks, it is easy for an expert to beat, but in a small matter of this kind comparatively few are likely to become experts.



LOCKING LAMP BASE.

Watt-Hour Meter Tester.

Periodical watt-hour meter calibration is of vital importance to every central station or isolated plant, on account of the fact that the revenue received from the sale of electrical energy is dependent on the accuracy of the meters in use. Although the customary method of testing with indicating instruments is quite accurate, the rapid growth of the central station industry has produced a demand for a meter with which these tests can be made more quickly and still retain the same high degree of accuracy. The accompanying illustration shows a meter which has been developed for meeting the demand for a tester for meters on direct-current circuits.



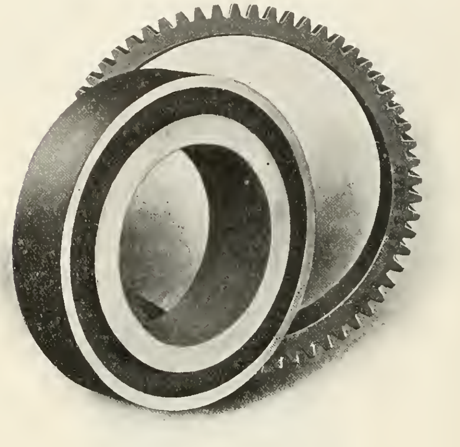
WATT-HOUR METER TESTER.

The meter is provided with a register of the three-pointer type. The disk revolutions are indicated directly by the largest pointer on the dial, which can be read to hundredths of a revolution. The two smaller pointers make one revolution, respectively, for each 10 or 100 revolutions of the large pointer. It is, therefore, a simple matter to ascertain the number of the revolutions of the disk by noting the positions of the three pointers at the start and at the finish of each test.

A valuable feature of the meter is the arrangement of the windings by which the torque on the shaft is the same for all combinations provided that in each case the meter operates at the same per cent of its rated full-load. The meter is now offered in two distinct 1-2 10-20-40 amperes or 5-10-50-100 amperes, each with single 110-volt or double 110-220-volt shunt windings, as may be desired. The 1-2-10-20-40 ampere meter has two series windings, one of which is divided into two sections and the other into four. By means of plugs and connection straps these windings may be joined in series or in parallel, thereby affording the five different current ratings indicated. A similar method gives four current ratings to the other meter. It is claimed that the testing meters give commercially accurate registration from a load as small as one-tenth of the smallest full-load rating to full load of the largest rating. This watt-hour meter tester has been developed by the General Electric Company, Schenectady, N. Y.

Removable Rolled Rim Gear.

The illustration shows a new gear for high-speed and heavy-haulage trolley service, now being placed upon the market by the R. D. Nuttall Company, Pittsburg. In conformity with the well-established principle of this company the gear, known as the Nuttall removable rolled rim, was first put to severe tests in actual service. In all of these tests the performance proved exceptionally satisfactory. The rim is made of a special grade of rolled steel of high tensile strength, and is shrunk on a cast-steel center. Thus the two members become practically a single piece. When worn, however, the rim can be easily removed and replaced at nominal cost so as to make a practically new gear. The rim can be attached to any style of center or spider. It is not limited to trolley service, but can be applied to any service where the diameter does not exceed 10 ft.

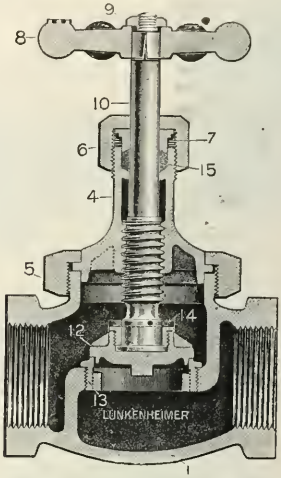

REMOVABLE ROLLED RIM GEAR.

Renewable Seat Regrinding Valve.

The Lunkenheimer Company, Cincinnati, Ohio., has designed the valve shown in sectional view herewith for the benefit of those who prefer a renewable seat regrinding valve. This valve differs from the Lunkenheimer regrinding valve only in the construction of the disk and seat. The disk 12 is provided with a projecting ring, which enters the valve-seat ring 13. Its principal function is the preservation of the seat, which is accomplished in a two-fold manner. First, as it enters the cylindrical part of the seat it deflects the current of steam from the seat-ring face, preventing the wire-drawing which would otherwise occur. This feature is especially important should the valve be left partly open for any length of time. Secondly, the seating surface is kept free from scale and grit by the action of the thin current of steam discharged over it as the disk is brought home. Another function of this ring is the prevention of water-hammer caused by the sudden admission of steam, for it will readily be seen that no matter how quickly the hand-wheel may be operated, the flange will only permit the steam to enter gradually.

The seat 13 is renewable and can be removed from the valve body by using a flat bar to engage the lugs on the inside of the ring.

The seat may be reground a number of times before it is necessary to renew it. Not only is the seat renewable, but all of the other wearing parts, including the disk, can be renewed if necessary. The hub is securely held to the body by means of a union ring, which makes it impossible for the hub and the body to become corroded together, as the thread which holds the union to the body is protected at all times from the action of the steam, the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body, and tends to strengthen the valve. The stuffing-box can be reached under pressure when the valve is wide open, as a shoulder on the steam, directly above the threads, forms a seat beneath the stuffing box. All valves above the ½-in. size have a gland follower in the stuffing-box. The valves are made to withstand a working pressure of 200 lb. They have either screw or flange ends.



RENEWABLE SEAT REGRINDING VALVE.

To regrind the valve the union ring 5 is unscrewed, the trimmings taken from the body. Then a little powered sand or glass and soap or oil is placed on the disk, and a wire or pin inserted through the slot in the disk locknut and hole in the stem. The trimmings are then replaced in the valve body and the valve reground, leaving the ring unscrewed so that the hub may rotate in the body and act as a guide for the stem while regrinding.

Octagon Outlet Box.

The Sprague Electric Company has recently put upon the market an improved stamped steel outlet box, which is known as Octagon Box No. 6250. This box, which is a departure from former practices in the stamped steel line, overcomes the defects of partial contacts between bushings or locknuts and curved surfaces of round boxes, since the flat sides give full contact, while the round corners save space. The box is smaller than a round box of the same diameter or a square box of the same width. A full line of standard covers are furnished in galvanized or black enamel finish, and covers can be had in old brass, oxidized copper, polished copper and nickel finish. The covers are interchangeable with standard ¾-in. round boxes.

OCTAGON OUTLET BOX, WITH RECEPTACLE COVER.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Irregularity in weather conditions in the principal crop growing sections of the country prevented any marked development in trade during the past week. It was too wet and too cool for satisfactory crop maturing in the Southwest and Northwest, and in the former section heavy rains seriously interfered with the progress of harvesting. This interference was of moment to the grain trade, and resulted in a firmer tone to quotations, in spite of the weakening influence of the very favorable government crop report, which was published June 9. In wholesale lines there are some evidences of fall buying, but purchasers are generally cautious, and sales for immediate shipment are confined to orders filling positive requirements. Uncertainties as to crops and the general disturbance due to the political situation will apparently restrain distant purchases for some time to come. Iron buying is rather better in some grades, and agricultural implement manufacturers have bought more freely of this material and of bars, but the cuts in general steel prices have brought out little new business, the feeling seeming to prevail in many quarters that further concessions are necessary, and that they will probably be made. Building expenditures still run well below a year ago, and lumber and kindred lines are quiet. Collections are still backward as a whole. Money is easy and demand for mercantile paper is in excess of the supply. Gross railway earnings for May are 23.8 per cent below the same month a year ago, the heaviest ratio of decrease shown on the present movement. The movement of commodity prices in May was downward, the decline in the general level being 3 per cent, and the decrease from the high point of last year is 15 per cent. Weekly clearings are 8.3 per cent below last week. Speculation is much quieter, and 13.6 per cent below last year. According to *Bradstreet's*, failures for the week ending June 11 were 253, which compares with 225 the preceding week, 161 in the like week of 1907, 170 in 1906, 175 in 1905, and 181 in 1904. In electrical trades business is reported to be somewhat better in tone, although actual transactions are still limited. Export trade is particularly quiet. Several good orders were reported, and inquiries for small business were more numerous. The General Electric Company reports some improvement, and in one of its important plants it is reported that full time will be resumed instead of the four-day schedule which has prevailed for several months.

THE COPPER MARKET.

The copper market was not distinguished during the last week by any marked improvement. In some quarters there was a hopeful sentiment, and speculative manipulation succeeded in raising prices fractionally higher than at the close of the previous week, but actual purchases of copper showed little improvement, and the relation between supply and demand could not be read otherwise than as tending to lower figures. Domestic consumers bought little metal during the week, and in Europe melters are taking smaller quantities, except when price concessions are made. At times during the week producers' agents in Europe sold copper at several shillings below the standard quotations, which had the effect of increasing the exports from this country. The shipments from Atlantic ports during the week ended June 13 amounted to 7,400 tons, and for June 15 to 1,314 tons, bringing the total shipments for June to 12,183 tons. The production of copper continues liberal in spite of the restricted demand, but is, of course, still materially below that of a year ago. During May there was an increase of about 3,500,000 lb. produced, as compared with April, but the total output was about 8,000,000 lb. below that of May, last year. Figures for the production of the United States, Canada and Mexico, for the first five months of 1908, with comparisons, are as follows:

	1908	1907	1906
January	65,900,000	84,035,143	97,296,400
February	65,036,750	85,278,160	89,205,800
March	79,105,704	102,405,230	96,480,081
April	87,582,805	96,567,700	98,044,400
May	90,880,300	98,500,000	103,800,000
Total	388,505,559	467,776,233	484,826,681

At present the output in Arizona is practically up to the capacity of the properties, the Copper Queen Company being the only large producer in the territory which is not running full time. In California the Mammoth Company smelter is running at capacity, and the British Columbia and Dominion copper smelters in the boundary district have resumed operations, and will add over 1,000,000 lb. per month to the Canadian output. The Butte properties, as indicated by their annual reports to the state tax department on June 1, show enormous decreases, the total net earnings being only $4,648,261, as compared with $20,263,291 in the previous year. The decrease was due to the complete shut down during three months and the operation at only 30 per cent capacity during four months. The net earnings by companies are:

	1908	1907
Boston & Montana Company	$1,561,065	$7,049,988
Anaconda	1,132,875	5,819,185
North Butte	1,113,648	3,271,214
Butte Coalition	71,811	1,432,761
Butte & Boston	295,605	1,249,467
Trenton	67,259	481,624
Parrot	....	141,731
Washoe	246,096	....
Original	159,902	663,259

Closing quotations on the Metal Exchange, New York, on June 15, were:

Lake	12¾ @ 12⅞
Electrolytic	12½ @ 12¾
Castings	12⅜ @ 12½

The London market was as follows:

	Noon. £	s	d	Close £	s	d
Standard copper, spot	58	7	6	58	5	0
Standard copper, futures	58	17	6	58	15	0
Market	Firm.			Easy.		
Sales of spot				450 tons		
Sales of futures				800 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

BIG ELECTRIFICATION PLANS.—A representative of one of the leading electrical engineering firms of the United States is quoted as follows: "We figure that there is $100,000,000 of electrical equipment for steam roads under consideration in this country, including work planned by the New Haven, New York Central, Pennsylvania, Harriman lines and others. One of the Eastern trunk lines is planning an expenditure of $35,000,000 in electrification. The New Haven Railroad electrification will be extended to New Haven, Conn., and work upon this section will soon be started. Plans are also prepared for electrical installation on the New Haven road between Providence and Boston. The New York Central will likewise extend its system running out of New York, and has plans in embryo for the electrification of the Boston & Albany out of Boston. As between the New York Central and New Haven systems, it is claimed that the New Haven is showing the greatest economies in operation, but the New York Central has $2,500,000 tied up in its Yonkers power plant, which it is not using at present and from which it is getting no returns. Its Port Morris power plant is able to furnish the necessary power requirements. The electrification of steam roads is fast assuming shape, and is unquestionably the next big move in the electrical world."

BEAUTIFYING FACTORY GROUNDS.—As part of its constant effort to beautify the factory grounds at Ampere, N. J., the Crocker-Wheeler Company has moved several large trees and replanted them in different locations on the property. On June 11 an oak tree, 60 ft. high, was lifted by means of the Crocker-Wheeler locomotive crane, carried about 200 ft. and replanted near the new postoffice which is being built on the company's property. The handling of this large tree and the ball of earth in which the roots were embedded involved a nice calculation as to the center of gravity of the tree. The work was accomplished, however, without mishap.

MORE DEMAND FOR HOUSEHOLD APPLIANCES.—A much better demand is reported for electric household appliances. A representative of the General Electric Company, in speaking of this development to a representative of the Electrical World, said: "We are beginning to realize upon our investment in advertising electric flatirons and other domestic conveniences. The campaign to introduce these lines has been persistent and energetic and, while the growth in popularity of these conveniences has been slow, I believe it will be permanent. People are gradually learning that they can use these appliances inexpensively. We find that where a householder can be induced to try an electric iron she almost always becomes a permanent customer and generally one that will readily begin the use of other similar conveniences. There is a steady growth in demand for these goods and retailers all over the country are beginning to realize that they must be prepared to meet inquiries."

THE HADAWAY ELECTRIC HEATING & ENGINEERING COMPANY, which was some time since acquired by the Westinghouse Electric & Manufacturing Company, has had its office and works removed from 238 West Broadway, New York, to the works of the Westinghouse Company at East Pittsburg. This change will permit the business to be carried on upon a much larger scale than formerly, and all the standard appliances for hatters, confectioners, printers and other manufacturers will be turned out in larger quantities. Special attention is to be given to the manufacture of the sadirons, gluepots and similar appliances that have recently become so popular. A New York office will be maintained on the twenty-second floor of the City Investing Building, 165 Broadway.

RUMORED INSULATED WIRE CONSOLIDATION.—It is reported that the Teter-Heany insulated wire manufacturing business will be absorbed by the Habirshaw Wire Company, of Yonkers, N. Y. It is understood that the controlling financial interest in the latter company is also a large stockholder in the York concern. No confirmation or denial of this report could be obtained at the New York office of the Habirshaw Company.

LARGE ORDER FOR INCANDESCENT LAMPS.—The Central Electric Company, Chicago, Ill., has secured an order for 180,000 Columbia incandescent lamps from the city of Seattle, Wash., shipments being made at the rate of 15,000 per month. This contract is one of the several recently secured, and was handled through the Central Electric Company's Seattle representatives, Mr. Burton R. Stare and Mr. J. A. Savage.

COMMONWEALTH EDISON COMPANY OF CHICAGO.—It is reported that the Commonwealth Edison Company has closed a contract with the Chicago City Railway to furnish power. The contract, it is said, runs 10 years and involves a payment of about $1,200,000 per year. Negotiations for a similar contract are said to be pending between the Commonwealth company and the Chicago Railways Company.

THE F. J. ROONEY LAMP COMPANY, Weehawken, N. J., has equipped a model incandescent lamp factory and is now placing on the market a complete line of standard, miniature, candelabra and ball type lamps. Mr. Rooney's long experience in lamp making augurs well for the success of the product of this company.

STANLEY PLANT OF GENERAL ELECTRIC COMPANY.—The Stanley plant of the General Electric Company at Pittsfield, Mass., is said to have resumed operations on full time in all departments. The plant employs normally about 2200 people, but since the depression in business began some of the departments have been operated on part time.

Financial Intelligence.

THE WEEK IN WALL STREET.

As transactions in stocks have fallen to new low records, and prices have shown a decided tendency to sag, it would be natural to suppose that Wall Street was without speculative developments. Such was not the case. The general cut in steel products, coming after many protestations that prices would be maintained, the unusually encouraging government crop report, and the general acceptance of a settlement, in advance of the conventions of the two presidential nominations, were conditions which in more active times would have caused interest either among buyers or sellers. Each of these conditions might have been taken reasonably, especially by those of sanguine temperament, to presage better times, but no hardening tendency developed. Instead of either the public or speculative interests having the courage to invest, transactions steadily diminished, and the dullest week in the recent history of the Exchange was recorded. Among the more notable losses during the week ended June 13, were Union Pacific, 4⅛; New York, New Haven & Hartford, 3¼; Erie, 4⅛; Illinois Central, 3; Chicago, St. Paul, Minneapolis & Omaha, 4; Cleveland, Cincinnati, Chicago & St. Louis, 3, and Pittsburg, Cincinnati, Chicago & St. Louis preferred, 7. Electric securities were not violent in their changes, but the tendency was generally downward. Allis-Chalmers preferred advanced 3¾ points, Brooklyn Rapid Transit declined 2 points, General Electric declined 3, Mackay Companies advanced 1, and Westinghouse common recorded a loss of 3½. There was little activity in any of the shares. Money conditions continued more favorable to the buying side throughout the week in this country and Europe, and rates were generally easier, with the demand for both call and time accommodations restricted. The export movement of gold dropped to low figures compared with recent engagements, and Paris seems to be the only European center desirous of increasing its stock. On June 15 the conditions which prevailed during the previous week were again in evidence, and the near approach of the convention in Chicago seemed to be sufficient excuse for traders to defer their customary business to some more convenient season. Price changes for the day were mostly fractional. Closing prices for June 15 are quoted in the table:

NEW YORK.

	June 8.	June 15.	Shares Sold.		June 8.	June 15.	Shares Sold.
All.-Ch.	9⅝	10	6,800	Int.-Met., com..	11½	10⅜*	9,200
All.-Ch., pfd....	27⅜	29¼	5,900	Int.-Met., pfd...	32	28½	14,450
Amal. Cop.....	67⅛	67⅛	96,650	Mackay Cos....	66	66*	200
Am. D. T......	39*	39*	——	Mackay Cos., pfd	65½	64*	400
Am. Loc.......	49¾	48¾	2,500	Met. St. Ry....	30	23*	50
Am. Loc., pfd..	102½	102	550	N. Y. & N. J. Tel.	109	109	60
Am. Tel. & Cbl.	65	65	100	Steel, com.....	37⅝	37¼	150,105
Am. T. & T....	118	118½	3,025	Steel, pfd......	101⅛	101⅝	5,935
B. R. T........	48⅝	47⅛	22,335	W. U. T.......	50¼	—	400
Gen. Elec......	135½	133¾	1,500	West'h, com....	50¼	44¾	6,710
Hud. R. Tel....	—	—	——	West'h, pfd.....	—	71*	——

PHILADELPHIA.

	June 8.	June 15.	Shares Sold.		June 8.	June 15.	Shares Sold.
Am. Rys.......	44¼	44¼	——	Phila. Elec.....	9½	9½	——
Elec. Co. of Am.	10	10⅛	——	Phila. R. T.....	13⅛	13½	——
Elec. Stor. B'ty.	33	30	——	Phila. Traction..	87	87¾	——
E. S. B'ty, pfd..	—	49*	——				

CHICAGO.

	June 8.	June 15.	Shares Sold.		June 8.	June 15.	Shares Sold.
Chicago City Ry.	165	190	——	Met. Elev., com.	18	17½	——
Com. Edison....	95	97½	——	Met. Elev., pfd.	53	53	——
Chicago Subway.	20	19½*	——	National Carbon.	67	67	——
Chicago Tel. Co.	127	130⅜	——	Nat. Carbon, pfd.	112	112	——

BOSTON.

	June 8.	June 15.	Sold. Shares		June 8.	June 15.	Sold. Shares
Am. Tel & Tel.	117¾	118¼	——	Mass. E. R., pfd.	47	46	——
Comb'ind Tel...	—	—	——	Mex. Tel., pfd..	—	—	——
Edison El. Ill...	211	209	——	New Eng. Tel'p.	110¾	111	——
Gen. Elec.......	135	134½	——	W'st Tel. & Tel.	6	6*	——
Mass. Elec. Ry..	10	9½	——	W. T. & T., pfd.	—	65	——

*Last price quoted.
Shares sold are for week June 8 to June 15.

DIVIDENDS.

Electric Boat Company, New York, quarterly 2 per cent, preferred stock, payable July 3.

Louisville (Ky.) Traction Company, quarterly, 1 per cent, common stock, payable July 1.

Mexican Light & Power Company, Mexico, common stock, 1 per cent, payable June 15.

Westinghouse Air Brake Company, Pittsburg, quarterly, 2½ per cent, payable July 10.

MICHIGAN LAKE SUPERIOR POWER COMPANY.—A complete reorganization of the Michigan Lake Superior Power Company has been recommended by the first-mortgage bondholders committee, which is headed by John Pitcairn. The report proposes the deposit of the $3,500,000 trust mortgage 5 per cent bonds with the Commercial Trust Company, of Philadelphia, and the Guaranty Trust Company, of New York, for the protection of the holders. In addition to the first mortgage bonds, there are outstanding $2,400,000 second mortgage bonds with accumulated interest from January 1, 1903, and $500,000 capital stock. There are also unsecured debts of $1,200,000 and claims of $130,000. It is estimated that it will take $1,775,000 to remedy the defects in the power house and dam at Sault Ste. Marie. At present the plant is shut down to about one-eighth its capacity.

WESTERN UNION COMPANY PAYS CASH DIVIDEND.—Directors of the Western Union Telegraph Company, at their quarterly meeting on June 10, declared a cash dividend of one-half of 1 per cent, placing the stock on a 2 per cent annual basis. The statements for the quarter ended March 31 and partly estimated for the quarter ending June 30 show increases in net earnings over the last quarter of 1907, and the estimated net earnings of the current quarter are slightly in excess of those for the first quarter of 1908. The estimated net earnings for the present quarter are $1,400,000, as compared with $1,330,886 in the preceding quarter and $1,537,201 for the corresponding period of last year. Bond interest was $433,062 and the dividend amounts to $497,550, leaving $469,388 to be added to surplus. This is the first quarter for more than a year showing an increase in surplus, and the gain is, of course, the direct result of the reduction in the dividend rate. The extent of the decrease in net revenue during the year ended June 30, 1908, is indicated by the following comparative statement, the last quarter of 1908 being partly estimated:

Year ended June 30:	1908.	1907.	1906.
Net revenue	$3,223,335	$6,324,210	$7,070,582
Bond interest	1,732,848	1,420,061	1,327,975
Balance	$1,490,487	$4,904,149	$5,742,607
Dividends	4,161,675	4,868,096	4,868,089
Deficit	$2,671,188	*$36,053	*$874,518
Total surplus	$14,213,593	$16,884,781	$16,848,728

*Surplus.

The increase in net earnings in each of the first two quarters of 1908 over the last quarter of 1907 was due to a reduction in operating expenses, not to improvement in business. An official of the company said that the increase in business in recent months had not been sufficient to cause much encouragement. The condition of the company had been improved, he said, by rigid economies in the use of labor and the purchase of supplies. At present, he said, a trifle more activity is apparent, but the business of the company is still far below normal. The economical policy of the company, he declared, was shown in the reduction of dividends to meet the changed conditions.

EDISON COMPANY OF BOSTON.—It is estimated that the earnings of the Boston Edison Company for the year ending June 30 will show an increase of about 5½ per cent in the gross and about 7½ in the net. The estimated earnings of the company for the year just ending compare with the actual figures of the previous year as follows:

	1908.	1907.	1906.	1905.
Gross earnings	$4,241,754	$4,020,620	$3,780,911	$3,346,027
Expens., includ. tax.	2,681,754	2,569,657	2,410,485	2,143,106
Net	$1,560,000	$1,450,963	$1,370,426	$1,202,921
Miscellaneous profits.	40,000	41,340	49,256	33,286
Total net*	$1,600,000	$1,492,302	$1,419,682	$1,236,206
Interest and div'd	1,325,000	1,406,700	1,227,776	1,164,790
Surplus	$275,000	$85,602	$191,907	$71,415

*Equivalent to a trifle over $12.50 a share on its 126,387 outstanding shares.

The new business secured by the company is comparatively light owing to the general stagnation of business, but the large development of new business during the first six months of the fiscal year will bring the total beyond the largest in the company's history. The recent introduction of the high economy lamp is estimated by the management as already showing the result of customers securing the same amount of candle power from the company for about 7 per cent less money. The incandescent lamps, arc lamps and horse-power connected April 30, 1908, compare with connections on June 30 in the years 1907, 1906 and 1905 as follows:

	April 30, 1908.	June 30 1907.	1906.	1905.
Incandescent lamps	939,534	863,313	788,560	708,384
Arc lamps	10,068	10,330	10,534	10,102
Horse-power	38,922	35,096	30,432	26,416

The total connections on April 30 aggregated 1,635,160 cp equivalents, compared with 1,503,478 on June 30, 1907.

GENERAL ELECTRIC-WESTINGHOUSE MERGER RUMOR REVIVED.—The report that the General Electric Company and the Westinghouse Electric & Manufacturing Company are to be merged has made its appearance again in the following statement published in a daily newspaper: "It was said that negotiations for a merger of the Westinghouse and General Electric companies had progressed so far that those who labored to bring about such a consummation were about to take a long vacation, regarding the arrangements as successfully concluded. According to the story current the success of the plan of the merchandise creditors for the adjustment of the affairs of the Westinghouse Company was an essential preliminary to the merger, but it was said there was every reason to believe that no hitch would occur on that account." As on previous occasions when similar reports have been current, the officers of both companies denied the rumor emphatically. "I don't see how such stories arise," an officer of the Westinghouse Company said; "there is absolutely nothing to justify them. It has been pointed out time and again that a merger has not been under consideration and that a consolidation would be highly impractical."

AMERICAN TELEPHONE COMPANY'S EARNINGS.—The report of the American Telephone & Telegraph Company to the New York Stock Exchange for the three months ended March 31, 1908, shows the following: Dividends received, $3,403,567; rental of instruments, $1,348,803; telephone traffic, $2,262,338; real estate, $22,737; interest, $1,285,338; miscellaneous, $8,989; total, $8,331,772. The disbursements were: Expenses of administration, $466,188; interest, $1,928,580; taxes. $60,000; telephone traffic, $1,218,935; dividends (payable April 15, 1908), $3,050,561; total, $6.724,264. The balance was $1,607,508. The balance sheet as of March 31, 1908, showed total assets of $404,771,009, as compared with $359,129,713 on June 30, 1907, and $353,801,015 on Dec. 31. 1906.

HARRIMAN QUITS UTAH LIGHT & RAILWAY COMPANY.—E. H. Harriman has disposed of his interests in the Utah Light & Railway Company, of Salt Lake City, which have been taken over by the Utah Gas & Coke Company. The Utah Light & Railway Company will continue its more important branches, the furnishing of electric light and power and the operating of the local street railway system. The street railway system is being rapidly rehabilitated to a thoroughly up-to-date system. The lines are being reconstructed, and Mr. Harriman recently authorized the immediate construction of shops and barns to cost $350,000.

PUBLIC SERVICE COMMISSION AUTHORIZES MANHATTAN RAILWAY BOND ISSUE.—The Public Service Commission, First District, adopted on June 11 the report of the chairman, William R. Willcox, who recommended that the petition of the Manhattan Railway Company to be allowed to issue bonds in the amounts of $10,818,000 and $894,000, respectively, be approved. Immediately following this authorization the entire block of bonds was sold to the banking house of Redmond & Co., of New York City, and will, by that firm, be offered to the public.

NORFOLK & PORTSMOUTH TRACTION COMPANY.—The report of the Norfolk & Portsmouth Traction Company for the four months ending April 30 shows a slight decline in both gross and net earnings as compared with recent years. The comparisons are:

	1908.	1907	1906.
Four months gross	$558,917	$629,014	$405,379
Expenses	358,650	411,163	321,499
Four months net	$200,267	$217,851	$173,880

ASSOCIATED BELL TELEPHONE OPERATING COMPANIES.—The report of the Associated Bell Telephone Operating Companies for April, not including the American Telephone & Telegraph Company, shows total net earnings of $3,138,500, an increase of $216,400 over April, 1907. The balance for dividends after fixed charges is $2,496,700, an increase of $138,600. The balance available for dividends in the first four months of the year is $9,173,500, an increase over the corresponding period of last year of $779,500.

NEW VICE-PRESIDENT FOR CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.—W. Emlin Roosevelt has been elected vice-president of the Central & South American Telegraph Company, not of the Mexican Telegraph Company, as was first reported. Mr. Roosevelt was chosen vice-president to succeed Mr. Charles Lanier, resigned, several months ago, so that no change was actually made when the election was held recently.

PHILADELPHIA RAPID TRANSIT COMPANY.—Consent of the Philadelphia Council has been asked by the Philadelphia Rapid Transit Company to an issue of $5,000,000 new bonds. Not more than half of the new bonds are to be issued at once, and the remainder will be disposed of as the company needs the proceeds. The matter was referred to a committee by the Council.

APPEAL TO WESTINGHOUSE SHAREHOLDERS.—Following the action of the readjustment committee of the Westinghouse Electric & Manufacturing Company, extending to June 22 the time allowed stockholders of the company to subscribe to their portion of the assenting stock, George Westinghouse has issued, under date of June 10, an urgent appeal to shareholders, calling attention to the necessity of prompt action on their part. Mr. Westinghouse encloses a copy of an opinion from the counsel of the company showing what would happen if the merchandise creditors' plan is not accepted. Mr. Westinghouse in his letter says: "About one-half of the shareholders have made their subscriptions, while the merchandise creditors have practically rounded out their obligations to take $4,000,000 of assenting stock in exchange for merchandise debt. In again asking you to respond promptly to the circular of the stockholders' committee, I do so because I know of the substantial character of your enterprise, the strong position in which it will be put by carrying out the merchandise creditors' plan, and because I believe that the shares you now hold, as well as the shares newly subscribed for, will be fully worth their face value. The risks to all stockholders who are unwisely (perhaps unfairly) relying upon the efforts of those who subscribe are altogether out of proportion to any possible benefit of such a course, since no substantial risk is incurred in making the subscription to assenting shares, in view of the fact that the payments are conditioned upon the success of the plan of the merchandise creditors' committee. It is suggested to those who, because of lack of means to pay the first installment, have not subscribed for their proportion, that it will be better to sell a portion of their present holdings. say, an eighth, to meet the first payment of such subscription and to rely on much better terms for selling enough to meet the balance when due, rather than to incur a further risk of losing the entire investment. The opinion by the counsel of the company, sets forth in clear terms the inevitable procedure, should the readjustment committee undertake, under the provisions of the readjustment agreement of Jan. 20 last, to effect a sale of the property in the interest of creditors. No stockholder can read this opinion without a realization of his sense of obligation to himself and to his fellow stockholders." The opinion of the counsel, Cravath, Henderson & de Gersdorff, states in part: "The procedure in winding up a manufacturing company like yours and the transfer of its property to a new corporation would be radically different from the familiar procedure in the case of railroad corporations where, as a rule, reorganization is accomplished by the foreclosure of a mortgage which covers practically all of the property of the railroad company. None of the debt of your company is secured by mortgage, so that there could be no sale of its property in the interest of creditors except pursuant to a decree in a creditors' suit to wind up the corporation, or under judgments obtained by creditors upon their claims. In either case the factories and the tangible personal property at the factories would probably have to be sold at public auction, and there would have to be separate sales of the stocks and bonds and other so-called 'investment assets' which are not appurtenant to the manufacturing plants. The holders of the two issues of collateral notes would be entitled to compel a sale of the collateral pledged as security for their notes and would have a claim rating equally with the claims of other creditors for such part of their notes as remained unpaid after the application of the proceeds of the sale of their collateral. The receivers would be compelled to collect the accounts and bills receivable in so far as they are readily collectible and only the slow and uncollectible accounts and bills receivable would be sold at public auction. There could be no final distribution of the proceeds of the sale of the various assets and of the cash in the hands of the receivers until all the claims against the company had been filed with a special master and had been approved after a final adjudication of such contests respecting claims as might develop. Ending the decision of such contests, there could be partial distributions, the amounts of which would, of course, depend upon the magnitude of the undetermined questions. Experience has shown that winding up a large manufacturing corporation and the transfer of its business and assets to a new company are attended with much litigation and delay, except in the rare cases where there is a substantially complete unity of action on the part of creditors and stockholders. We believe it would take at least a year to consummate a reorganization of the affairs of your company by means of a forced sale of its assets and their transfer to a new corporation. How much longer the process would take, and the extent to which the business and the organization of the company would be demoralized would, of course, depend upon the extent and character of the litigation which would develop." Accompanying these circulars was a statement of the condition of the company on April 30, 1908, as compared with the report of Oct. 23, 1907. It shows that if the stockholders subscribe to the $6,000,000 assenting stock the company will have available cash assets, including accounts and notes receivable, of $20,304,014. The current indebtedness of the company will also be reduced $4,000,000 by the subscriptions of the merchandise creditors already assured. Following the above circulars, George W. Gutherie, of the stockholders' committee, and Joseph W. Marsh, chairman of the merchandise creditors' committee, issued a joint appeal to the stockholders, urging immediate action, and calling attention to the serious danger of the abandonment of the merchandise creditors' plan. This circular declares that the whole rehabilitation plan is "in imminent danger of failing because of the refusal or inability of stockholders to subscribe for the necessary $6,000,000 of new stock." It is stated that only a little more than $3,000,000 of this sum has been subscribed, and that the limit of the time allowed is only a few days away. The circular continues: "The far-reaching and disastrous effect of such failure can be best appreciated by the banking interests, but it will certainly mean the forced liquidation of the company's property, the loss of a large portion of the merchandise creditors' claims, the entire loss of the stockholders' investment, the probable loss of this great industry, and the direct loss of a very large sum of money, in the aggregate, by this community, besides seriously affecting its general business interests. The critical character of the situation is our excuse for presenting these suggestions to you, and we trust that you will co-operate heartily and quickly in the manner outlined, since but one week remains in which to accomplish the desired results." The employees of the Westinghouse plants at Pittsburg have subscribed for 2,000 shares of the new stock in order to help along the merchandise plan, and it is understood they are ready to take 3,000 additional shares. These shares are taken at par, and the amount of money involved is $250,000.

THIRD AVENUE RAILROAD EARNINGS.—The report of the committee representing 4 per cent consolidated mortgage bonds of the Third Avenue Railroad Company, New York, shows gross earnings for the year ended June 30, 1907, of $6,261,162 and operating expenses of $4,399,898. After provision for interest on the first mortgage bonds and bonds of subsidiary companies, taxes, other than the special franchise tax, and interest on floating debt of subsidiary roads, the balance was $1,033,594, which was not sufficient to meet the charges on the $37,560,000 of first consolidated mortgage 4 per cent bonds. The operating expenses did not include an allowance for depreciation.

NEW HAVEN TROLLEY MERGER BILL KILLED.—The House of Representatives of the Massachusetts Legislature has defeated the bill which proposed to authorize the Berkshire Street Railway Company to purchase the stock of the Bennington & North Adams Street Railway. The opponents of the bill asserted that the Berkshire company was controlled by the New York, New Haven & Hartford Railroad and that the passage of the bill would legalize the holding of street railway stock by the railroad and would, therefore, be contrary to recent court rulings.

ALBANY & HUDSON RAILROAD BUYS LIGHTING PLANT.—The Albany & Hudson Railroad, Hudson, N. Y., has purchased the Rider electric plant at Hudson and has taken possession of the entire equipment, including wires and poles, engine, generator and other machinery in the old pumping station. The machinery will probably be sold, but the poles and wires will be retained. When necessary changes have been made, the old line in Warren Street will be taken down, probably during the summer. The Albany & Hudson road spent recently a large sum on its power plant at Stuyvesant Falls. A new engine was installed and the old machinery thoroughly overhauled. Extra trains have been added in preparation of the opening of the season at Electric Park.

PROVIDENCE (R. I.) TELEPHONE COMPANY.—The Providence Telephone Company will ask its stockholders in September for authority to increase the capital of the company from $2,500,000 to $3,000,000. The company has declared a dividend of $1 per share, payable July 1.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has purchased a site in Jonesville, on which it will construct a new power house. The cost of the power plant is estimated at $1,500,000.

RUSSELLVILLE, ALA.—The citizens have voted to issue $24,000 in bonds for the construction of an electric light plant and water works system.

YUMA, ARIZ.—The contract for furnishing the controlling apparatus for the operation of sluice gates in Laguna Dam, Yuma irrigation project, California-Arizona, has been awarded to the Northern Electrical Manufacturing Company, of Madison, Wis., for $4,628.

BAIRD, CAL.—William Ellery, of Redding, has filed on 124,000 cu. inches of water in the McCloud River, near this place, for the purpose of generating electrical power.

BAKERSFIELD, CAL.—The Edison Electric Company, of Los Angeles, is now supplying all the electrical power which it is using in the southern part of the state from its Kern River plant, its other hydroelectric plants being shut down. The reason given is one of economy. Sufficient power can be generated by the Kern plant so long as the present flow of water continues, and it is generated at minimum cost. So far the power plant has not used anywhere near all the water available, and it is now generating 40-000 hp.

GRIDLEY, CAL.—The City Council is considering plans for the construction of an electric lighting system to cost $3,000.

LOS ANGELES, CAL.—The Los Angeles Railway Company contemplates purchasing in the near future two 100-kw motor generators, one 600-kw motor generator and nine transformers.

MARYSVILLE, CAL.—It is reported that the Great Western Power Company is taking preliminary steps toward the installation of a reserve electrical power plant in Yuba County hills. It is proposed to take water from the Yuba River near Goodyear Bar in a ditch for a distance of 25 miles to Pittsburg Hill, where the power house will be located.

MODESTO. CAL.—A complaint filed in the superior court recently for condemnation of right-of-way shows that the Tuolumne Water Power Company, which filed articles of incorporation in this county on April 14. has already begun work on the construction of its tranmission line across Stanislaus County. The company is generating electrical power on the Upper Stanislaus, and will construct a transmission line to a point south of the bay, and from there into San Francisco.

OROVILLE, CAL.—The Great Western Power Company has commenced the work of building a large diverting dam at the intake to its power tunnel. It will be 125 feet high and will turn the river through the tunnel, conveying the water to the electric plant at the lower end.

OROVILE, CAL.—J. W. Goodwin, president of the Oroville Water, Light & Power Company, states that the company contemplates expending about $50,000 on improvements in Oroville. It is further stated that the company contemplates reducing the price of electricity for motors.

RED BLUFF, CAL.—W. J. O'Connor, of Chico, has filed a notice of appropriation of 8000 cu. in. of water to be taken from Deer Creek and carried to the power plant. A second application has been made by J. T. Boyles, of Chico, for 8000 cu. in. of water from the same creek to be used for the same purpose.

SAN FRANCISCO, CAL.—It is reported that the United Railroads is negotiating with the Great Western Power Company to furnish electrical power for operating the street car system, for which between 20,000 and 30,000 kw will be required. It is also said that the Great Western Power Company may make arrangements to supply the Oakland Traction Company and the Key Route system with electricity to operate the Alameda car lines.

STOCKTON, CAL.—The Central California Traction Company has applied for a franchise to operate an electric railway in Stockton.

GOLDEN, COL.—Final surveys are being made for an electric railway from Golden to the top of Mount Lookout. Rees C. Vidler and others are interested in the project.

WESTPORT, CONN.—The Westport Water Company is contemplating increasing the equipment of its electric light plant and extending its transmission lines. F. B. Hubbell is manager.

SMYRNA, DEL.—Plans are being considered for the organization of an independent telephone company to construct two telephone lines from Smyrna to Fleming's Landing and toward Woodland Beach.

WASHINGTON, D. C.—Bids will be received until June 30 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal.: Schedule 1279—Electric traveling crane. Portsmouth, N. H.: Schedule 1294—Two motor-driven, dry-grinder, wood-turning lathes; 12-in. wood-turning speed lathe: mechanical wood-working machine; motor-driven sensitive drills, etc. Applications for proposals should designate the schedule desired by number. E. B. Rogers is paymaster general, U. S. N.

JACKSONVILLE, FLA.—The Board of Trustees on June 3 adopted the recommendation of the electric committee that an electrical engineer be engaged to make an investigation of the municipal electric light plant and water works system to see what is required in the way of improvements and extensions to meet future demands.

ATHENS, GA.—The Athens Electric Railway Company will install another 1000-kw steam turbo-generator unit.

ATLANTA, GA.—Plans are being contemplated by the Georgia Railway & Electric Company to build a three-mile extension of its railway.

MACON, GA.—Orders have been placed for electrical machinery for the large shops of the Central of Georgia Railway Company, which are now under construction.

TROY, IDAHO.—The Inter-State Telephone Company contemplates erecting a telephone line from Troy to Dreary.

CENTRALIA, ILL.—The Centralia Gas & Electric Company has sold its local plant to H. G. Higgins. It is said that improvements will be made to the system.

CHICAGO, ILL.—It is reported that the Chicago City Railway Company has made arrangements to secure all of its electrical energy for operating its system from the Commonwealth Edison Company, at a cost of about $1,000,000 per year. It is expected that the Chicago Railways Company will also purchase electricity from the Commonwealth Edison Company.

CHICAGO, ILL.—The City Council has granted the Sanitary District of Chicago permission to use city poles and conduits wherever possible for the use of the distribution of electricity in the city, and in cases where the Sanitary District wishes to erect its own poles and build conduits permission will have to be granted by the Department of Public Works. R. R. McCormick is president Trustees of the Sanitary District of Chicago.

CHICAGO, ILL.—The Calumet & South Chicago Railway Company, which acquired the Calumet Electric Street Railway and the South Chicago City Railway, has filed a mortgage covering the entire rights and property of the combined companies to secure an issue of $5,000,000 in bonds, the proceeds to be used for rehabilitation work. The First Trust & Savings Bank, of Chicago, is trustee of the mortgage.

KANSAS, ILL.—The Village Trustees have sold the municipal electric light plant to S. J. Blatchford, for $4,000. It is said that the new owner will install new machinery to furnish electricity for street lamps and for commercial purposes.

MARSEILLES, ILL.—The Marseilles Land & Water Company, which has recently completed a transmission line on reinforced poles to Morris and Seneca, expects to build a transmission line west to Ottawa during the coming year.

DANVILLE, IND.—The Danville Light, Heat & Power Company has been granted a franchise to furnish electricity to other towns in Hendricks County.

EVANSVILLE, IND.—The Board of County Commissioners is considering the question of installing electric lighting systems in both the white and colored orphan asylums.

GARRETT, IND.—William Watson, city clerk, writes that the city is contemplating making improvements to the municipal electric lighting plant, the cost of which is estimated at $15,000. R. S. Ashe, of Richmond, Ind., is engineer.

HARTFORD CITY, IND.—The Hartford City Light Company is planning to install new dynamos in its plant

NOBLESVILLE, IND.—The contract for the construction of the hydroelectric plant on the White River has been awarded to J. C. Dumont of Detroit, Mich. The output of the plant will be about 800 kw, and will be transmitted to and distributed in Noblesville. H. von Schon, of Detroit, Mich., is chief engineer.

TERRE HAUTE, IND.—Application has been made to the County Commissioners for a franchise to construct an interurban railway from Terre Haute to Linton, via Dugger and Riley, Ind.

ATLANTIC, IA.—Plans are being prepared by J. L. Darnell, Kansas City, Mo., for a power house for the municipal electric light plant.

HARTLEY, IA.—Contracts for the construction of the municipal electric light plant will be let about July 1.

MARSHALLTOWN, IA.—The Marshalltown Telephone Company and the Iowa Telephone Company have been consolidated and it is proposed to enlarge and modernize the system, which will require an outlay of $30,000.

MOUNT VERNON, IA.—It is reported that the power house of the electric light plant and the city pumping station were destroyed by a tornado on June 8.

BARBOURVILLE, KY.—The Camp Ground Telephone Company is making arrangements to erect new telephone lines to Corwin, a distance of 12 miles.

FRANKFORT, KY.—The Capitol Commission has adopted the plans and specifications prepared by Frank M. Andrews, of Cincinnati, Ohio, for the power house and electric light plant for the new capitol building, for which, it is said, bids for construction will be called at once. The cost of the work is estimated at $75,000.

HAZARD, KY.—The Perry County Telephone Company is planning to extend its lines throughout Perry County.

LANCASTER, KY.—The Bastin Telephone Company will commence at once work on the erection of its lines to Sedalia and Richmond, a distance of about 20 miles. Other extensions are also planned.

MT. STERLING, KY.—Plans are being made by the Kentucky Telephone Company to erect about 50 miles of telephone line to connect Clay City, Stanton and other towns. The company will be in the market for wire and other materials.

NEWPORT, KY.—Bids will be received until July 22 by John W. Davis, city clerk, for a franchise to furnish a telephone and telegraph service in the city of Newport.

PADUCAH, KY.—Contracts have been awarded for the construction of the proposed electric railway of the Ohio River Improvement Railroad Company between Paducah and East Cairo, Ill. The car equipment will be furnished by the General Electric Company. The road will be 38 miles in length. Charles P. Crump, of Columbus, Ohio, is president of the company.

SUTTON, KY.—Plans are being made by the Sutton Telephone Company to erect a telephone line from Sutton to Ash Camp, a distance of 10 miles.

SOUTH PARIS, MAINE.—The electric power station has been put out of commission owing to the high water in the river.

FROSTBURG, MD.—The Frostburg Illuminating & Manufacturing Company has secured a renewal of the contract for furnishing electricity for street lamps.

OAKLAND, MD.—H. P. Tasker, general manager of the Youghiogheny Light & Power Company in a letter addressed to the Mayor and Town Council, states that the company has completed arrangements for financing its project of erecting a hydro-electric plant near Swallow Falls, and asks for a franchise granting it permission to use the streets of the town for a term of 40 years for its proposed electric railway from Swallow Falls to Deer Park.

CHICOPEE, MASS.—The Springfield Street Railway Company has been granted a franchise to construct a street railway in Chicopee.

COLRAIN, MASS.—The Gas and Electric Light Commissioners have authorized the Colrain Electric Light & Power Company to issue $2,500 in capital stock for the purpose of taking over the plant of the partnership now operating under the same name. J. W. Cram is president of the company.

FITCHBURG, MASS.—The joint special committee of the City Council on street lighting contract will recommend acceptance of the Fitchburg Gas & Electric Light Company's offer for a new contract for street lighting at $95 per lamp per year for arc lamps and $20 each per year for incandescent lamps of 30 cp. Under the present contract the city pays $100 and $30 respectively for 324 arc lamps and 93 incandescent lamps.

HANCOCK, MASS.—The Selectmen have granted the Pittsfield Street Railway Company a franchise to construct and operate a street railway in the town of Hancock. The railway will be extended from the present terminus of the West Pittsfield line.

LENOXDALE, MASS.—The citizens are considering the question of installing an electric lighting system. A committee has been appointed to make arrangements with the Lee Electric Light Company to extend its transmission lines to the town to furnish electricity for lamps.

MARION, MASS.—The Marion Gas Company has applied to the Board of Gas and Electric Light Commissioners for an approval of an increase in capital stock of $15,000, the proceeds to be used for improvements to its electric plant.

SPRINGFIELD, MASS.—Permission has been granted to the Springfield Street Railway Company to lay double tracks on Sumner Avenue and Long Hill Street.

STOCKBRIDGE, MASS.—The contract between the town and the Stockbridge Electric Company for lighting the streets of the town has been completed and provides for 85 incandescent lamps of 32 cp, to be installed in Stockbridge, Glendale and Furnace District. Lamps served with overhead wires to cost $15 per lamp per year; and lamps with wires in conduits at $27 each per year. The contract is to run 20 years; the town has the privilege of purchasing the fixtures at the end of that time. The cost of installing the system is estimated between $7,000 and $10,000. It is expected to have the street lighting system ready by July 1.

WELLFLEET, MASS.—The contract for the construction of a dike on Herring River has been awarded to Thomas & Connor, of Middleboro, Mass., for $16,240. The dike will be used for power purposes.

WINCHENDON, MASS.—The Connecticut River Power Company is making surveys around Lake and has located a site for its power house.

CADILLAC, MICH.—The Village Council is contemplating replacing the dam on Cedar Creek, which was recently destroyed, to furnish power to operate the municipal electric light plant.

DETROIT, MICH.—Bids will be received until July 8 by the Public Lighting Commission for installing an electric generating unit in the municipal electric light plant. F. T. Bowler is secretary of the commission.

MONROE, MICH.—The Toledo, Ottawa Beach & Northern Railway Company has applied for a franchise to build an electric railway through the streets of the city. The company proposes to extend the railway from Toledo Beach to Detroit.

MORLEY, MICH.—E. A. Bending and Joseph Bicknell, of Muskegon, are interested in a project to erect a large power plant in Morley. It is proposed to develop power from the Little Muskegon River by a series of dams near Morley and near Howard City.

NEGAUNEE, MICH.—The Marquette County Telephone Company contemplates extending its lines from this city to the Swanzey Range, via Palmer. An exchange will be established at Gwinn.

ALBERT LEA, MINN.—The City Council has directed the Albert Lea Light & Power Company to extend its light and power service.

BRAINERD, MINN.—An election will be held June 23 to vote on the proposition to issue $120,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. George Cadogan Morgan, Chicago, Ill., is consulting engineer.

UNIVERSITY, MISS.—Bids will be received until July 1 for the construction of a steam power plant for the University of Mississippi, which will include dynamos, overhead wire, underground conduits, and other machinery. The cost of the plant is estimated at $35,000. D. M. Kimbrough is chairman of the building committee, and F. G. Prout, of Memphis, Tenn., is engineer.

EXCELSIOR SPRINGS, MO.—The Excelsior Springs & Suburban Railway Company is constructing an electric railway from the Chicago, Milwaukee & St. Paul Railroad depot, near Excelsior Springs, to the central portion of the town, a distance of about 2½ miles. The company proposes to install the overhead trolley system, and build a power plant in Excelsior to furnish electricity to operate the system. The company is capitalized at $50,000, and the officers are: W. A. Bell, of Excelsior Springs, president; W. A. J. Bell, of Excelsior Springs, vice-president; J. E. Lundstrom, of Colorado Springs, Col., secretary and treasurer, and W. P. Southard, Excelsior Springs, superintendent and electrical engineer.

KANSAS CITY, MO.—The Kansas City, Ozark & Southern Railway Company is planning to commence construction work on its proposed railway from Ava to Mansfield, a distance of 15 miles. The company also contemplates constructing a hydro-electric plant on Bryant River, 20 miles Southeast of Ava. A. B. Quigley is chief engineer.

MOUNT VERNON, MO.—Bids will be received until June 13, by Dr. J. L. Eaton, president Missouri State Sanatorium for equipment of power plant, electric lighting, heating, etc.

SEDALIA, MO.—The capital stock of the Economy Steam Heating & Electric Company has been increased from $50,000 to $125,000.

BUTTE, MONT.—The electric lighting system was put out of service June 4, caused by the bursting of White's Dam, below the city and the flooding of the power house.

FREMONT, NEB.—The City Council is considering the question of replacing the present street lamps with alternating-current enclosed arc lamps. The Fort Wayne Electric Company, of Fort Wayne, Ind., recently submitted a proposition to the Council offering to make the change for $1,600.

HOOPER, NEB.—Plans are being made by the Hooper Telephone Company to construct new lines west of this city.

PENDER, NEB.—R. P. Mason, village clerk, writes that an election will be held to vote on the proposition to issue $7,000 in bonds to install an electric light plant.

SEWARD, NEB.—Contracts for furnishing material and equipment for the addition to the municipal electric light system have been awarded to Filer & Stowell Company, of Milwaukee, Wis., and the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. J. Martz is engineer.

RENO, NEV.—Plans are being contemplated by E. J. Baldwin for the construction of an electric railway from the terminal of the Lake Tahoe Railroad & Transportation Company's line to his hotel on Lake Tahoe, and may be extended to circle the lake to include Tallac.

BRIDGETON, N. J.—The Bridgton & Millville Traction Company is contemplating the construction of a spur from its railway near Cedarville to Fortescue.

AUBURN, N. Y.—Plans are being made by the Auburn & Cortland Electric Railroad Company to commence work on the Cortland end of the road in the near future. It is proposed to complete the construction of 36 miles of tracks within two years.

BABYLON, N. Y.—A franchise has been granted to the South Shore Traction Company to construct a street railway on certain streets of the town.

BISMARCK, N. Y.—The Tri-State Telephone Company is planning to erect a telephone line between this city and Napoleon.

BROADALBIN, N. Y.—The Broadalbin Electric Light & Power Company has applied to the Public Service Commission for permission to issue $42,500 in capital stock and $18,000 in bonds; also for authority to construct a dam and generate electricity in Broadalbin under a franchise received from the Town Board.

BUFFALO, N. Y.—The Board of Aldermen has voted to appropriate $5,000, or half of the expense, for an investigation of the prices charged for electricity for lamps and motors in this city before the Public Service Commission. The manufacturers and others using electricity will pay the other half.

DUNKIRK, N. Y.—Plans are being made to begin work on the construction of the new power house at the plant of the Brooks Locomotive Works. When the power house is completed additional machinery will be installed.

LAKE PLACID, N. Y.—The Mountain Home Telephone Company has been granted a franchise at Lake Placid.

MUNNSVILLE, N. Y.—It is stated that an electric light plant will soon be established in this city. W. R. Paul is interested in the enterprise.

NEW YORK, N. Y.—Bids will be received until June 22 by C. B. J. Snyder, superintendent of school buildings for alterations and additions to the electric equipment in Public Schools 2, 22, 23, 28, 88, 92, 105, 131, 140, 161 and 174, Borough of Manhattan. Bids will also be received on the same date for alterations and additions to the electric bell and electric light systems in Public Schools 46, 157, 159, 184, and 186, Borough of Manhattan.

PERRY, N. Y.—Lightning struck the plant of the Perry Electric Company June 9, destroying the dynamo.

WARSAW, N. Y.—It is reported that the Rochester, Scottsville & Caledonia Electric Railway Company has secured all rights of way and franchises required for the road from Rochester to Portage, and that the contract for a considerable part of the construction work will be let in the near future.

NORTH WILKESBORO, N. C.—Work will commence by the Horton Telephone Company on the installation of its system, which will include the erection of about 100 miles of toll lines. Ralph Duncan is engineer of the company.

WILLISTON, N. D.—The city is planning to increase the output of the municipal electric light plant and will install a 150-kw, three-phase, generator, a 200-hp engine and 12 additional arc lamps. C. C. Mackenroth is superintendent.

AKRON, OHIO.—The Big Cuyahoga Light, Heat & Power Company, incorporated recently, is seeking to secure control of the Cuyahoga River from the Portage County line to the confluence of the Big and Little Cuyahoga Rivers by condemnation proceedings in order to secure water power for the operation of electric plants. A large part of the land sought is owned by the Northern Ohio Traction & Light Company and a hard fight will probably result, as the new company will be a direct competitor if it secures the power from the river. This is said to be a revival of a plan conceived by Dr. Eliakim Crosby years ago, when $90,000 was spent in building a dam and a hydraulic canal along the bank of the river.

FREMONT, OHIO.—The hydro-electric development at Fremont, which was deferred last year on account of the financial depression, has been revived. The properties have been taken over by a Columbus, Ohio, syndicate, which has engaged H. von Schon, of Detroit, Mich., consulting engineer, to prepare plans and specifications.

FREMONT, OHIO.—Application has been made by the Fremont Power & Light Company for a franchise to erect lines for the purpose of furnishing electricity for light and power to the citizens of this place. The company proposes to dam the Sandusky River above this city for the purpose of securing water power for the operation of the plant. Chicago, Detroit and Fremont capitalists are interested in the project.

HAMILTON, OHIO.—The City Council has authorized an issue of $64,000 in bonds, of which $25,000 will be used to continue the municipal electric service to the territory recently annexed to Hamilton.

LIMA, OHIO.—Permission has been granted to W. Kesley Schoepf to submit a proposition to furnish rates for electricity for city and commercial lighting to the City Council. The Council has already passed an ordinance and will open bids for a bond issue June 28, the proceeds to be used for the construction of a municipal electric light plant. Mr. Schoepf is seeking a renewal of his 10-year municipal contract.

MARYSVILLE, OHIO.—The Union County Telephone Company intends to make extensive improvements to its system, including the building of lines. R. H. Mathew is manager.

PLYMOUTH, OHIO.—The Board of Public Affairs is considering the question of installing another 75-hp gas engine in the municipal electric light plant. A. T. Ramsey is superintendent.

TOLEDO, OHIO.—Henry A. Everett has been granted a franchise through Ash Township, Mich., on condition that the Toledo, Ottawa Beach & Northern Railway Company, for which the franchise was received, shall construct a spur to Carleton, a distance of three miles.

FAIRVIEW, OKLA.—Arrangements are being made to install an electric light system in Fairview, for which bonds will soon be issued.

STILLWATER, OKLA.—The city of Stillwater will, in the near future, expend $7,000 for improvements to the municipal electric light system.

BAKER CITY, ORE.—The Grande Ronde Electric Company will construct a 33-mile transmission line this summer from Union to connect with the Rock Creek line in Baker County, at a cost of about $50,000. The line will connect with the lines of the Fremont Power Company at the Red Boy mine to the south of Sumpter.

MEDFORD, ORE.—Preliminary arrangements are being made to double the output of the Rogue River Electric Company.

PORTLAND, ORE.—The directors of the Portland Railway, Light & Power Company and the Oregon Electric Railway Company, of Portland, Ore., have authorized the expenditure of $1,199,500 and $300,000, respectively, during the current year for improvements and extensions to the Portland electric traction lines, both city and interurban systems, and the city lighting and power systems. The appropriation will be divided between the different departments of the Portland Railway, Light & Power Company as follows: Portland Railway division, $417,500; Oregon Water Power division, $218,500; Portland General Electric division, $445,000; Salem division, $58,500. The $300,000 authorized by the Oregon Electric Railway Company will be used for improvements to the Portland-Salem railway and for new rolling stock.

STAYTON, ORE.—A. Welch, of Portland, Ore., offers to construct the Salem-Stayton electric railway and give a two-hour service, providing the people along the line of the railway will subscribe for $50,000 in bonds and the people in Salem to another $50,000 in bonds.

TYGH VALLEY, ORE.—The Poe Telephone & Telegraph Company is planning to erect another line between Tygh Valley and Dalles.

CLEARFIELD, PA.—The Cresson & Clearfield Coal & Coke Company is planning to equip one of its mines with electrical machinery. The mine has an output of 1000 tons of coal a day.

HUNTINGDON, PA.—W. M. Hendeson, counsel for the Brookside Electric Railway company, has applied to the Town Council for a franchise to construct an electric railway in the east end of the town to extend up Stone Creek.

HUNTINGDON, PA.—The Brookside Electric Railway Company will apply for a charter to construct and operate an electric railway in the Borough of Huntingdon and the town of Oneida. John M. Laird, F. M. Bollinger, O. C. Breneman, M. A. Miller and Nevin Peightal are interested in the enterprise.

JOHNSTOWN, PA.—Extensive improvements are contemplated by the Johnstown Passenger Railway Company, which will include the construction of the Morrellville extension, renewal of tracks along the Valley Pike in the Eighth Ward, and minor improvements on the Dale line.

McKEANSBURG, PA.—The McKeansburg Rural Telephone Company contemplates the construction of a telephone line to various places. The company is now building a line to Harrisburg.

PHOENIXVILLE, PA.—The Town Council has passed an ordinance permitting the Montgomery & Chester Electric Company to extend its system to the borough line on South Main Street.

PITTSBURG, PA.—The contract for the electrical wiring of the Carnegie Technical Schools has been awarded to the W. H. Ochiltree Company, of this city.

TIDAL, PA.—The Madison Telephone Company will build additional telephone lines to Rimer Hill and Posytown.

LAURENS, S. C.—The Boyd mill power plant, situated on Reedy River, 11 miles west of Laurens, is nearing completion and will soon be put into operation. The plant will have an output of 2000 hp and will furnish electricity in Laurens and throughout the county. N. B. Dise is president of the company.

SPARTANBURG, S. C.—The Spartanburg Railway, Gas & Electric Company is making preliminary surveys for the extension of the street railway line from this city to the fair grounds. F. H. Knox is engineer.

RIPLEY, TENN.—The Nanipoo & Edith Telephone Company is making arrangements to erect a telephone line from this city to Edith. The company recently increased its capital stock from $1,500 to $4,000.

HOUSTON, TEX. Plans are being made by the Houston Electric Company to commence work on the Harrisburg railway extension. The company is also planning other extensions, which will require an expenditure of about $149,000. David Daly is local manager.

McKINNEY, TEX The City Council contemplates issuing $8,000 in bonds, the proceeds to be used for extensions to the electric light plant.

MINERAL WELLS, TEX.—The local electric light plant has been purchased by R. B. Pace, of Shreveport, La.

UVALDE, TEX.—A franchise has been granted to M. M. McFarland, of Austin, to construct and operate an electric railway through the streets of Uvalde.

WHITESBORO, TEX.—John Marshall, mayor, writes that there is an excellent opening for an electric light plant in Whitesboro, which has a population of 2500.

MOAB, UTAH.—Application has been made to the state engineer at Salt Lake City, by Henry Grimm, of Moab, for permission to use the water of Green River to generate electricity for lamps and motors. It is proposed to construct a canal from Green River to Moab.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company is making arrangements to install a new 1500-kw. Allis-Chalmers synchronous motor-generator set with switchboard and other apparatus in the West Temple substation at Salt Lake City.

SWANTON, VT.—The Village Trustees have purchased a new 300-kw Fort Wayne alternating-current generator to be installed in the municipal electric plant located at Highgate, to replace a smaller one at the power house. E. A. Burnett, P. J. Farrell and E. M. Prouty are the trustees.

RICHMOND, VA.—The sub-committee of the Committee on Light has recommended the installation of 103 arc lamps to be placed in the annexed territory. The contract with the Virginia Passenger & Power Company for lighting the streets of the city expires July 1, the city having the option of extending it for one year. A special meeting of the committee will be held soon to consider the matter.

BREMERTON, WASH.—Bids will be received by R. C. Hollyday, chief of Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 8, for constructing a structural steel frame for the central power station, building No. 106, U. S. Navy Yard, Puget Sound.

CHEHALIS, WASH.—The Chehalis Light & Power Company has been incorporated, with a capital stock of $50,000, by C. L. McKenzie and E. Riggs, the present owners of the electric light system. The company is planning to provide for a day service.

EPHRATA, WASH.—The erection of a new telephone line between Ephrata and Soap Lake is contemplated by the Farmers' Mutual Telephone Company.

LITTLE FALLS, WASH.—Work has commenced on the construction of the large power plant of the Washington Water Power Company at Little Falls on the Spokane River, near Reardan. A head of 68 ft. will be secured and 30,000 hp will be developed. When completed this will give the company a total of 61,000 hp at its three hydro-electric plants, besides a steam plant of 20,000 hp reserved for emergency. The cost of the plant is estimated at from $500,000 to $1,000,000.

SEATTLE, WASH.—Charles W. Kimball, secretary and manager of the Seattle, Snohomish & Everett Railway Company, writes that surveys for its proposed electric railway to connect Seattle, Bothwell, Snohomish and Everett have been completed and work on construction, of the road will commence as soon as the route has been established. The overhead trolley system will be installed. The company proposes to secure electrical energy to operate the road from the Seattle Electric Company.

TACOMA, WASH.—The Pacific Traction Company is making surveys for a railway to extend from the terminus of the company's line at American Lake to Olympia. E. J. Felt, of Tacoma, is vice-president.

TACOMA, WASH.—The Current Power Company will make a proposition to the City Council to install a power plant in the Narrows, similar to the one at Strumpfs Rapids, only on a larger scale. Secretary J. H. Boothroyd says that the plant will furnish 10,000 hp and can be installed for $250,000.

TACOMA, WASH.—J. D. Farrell and Samuel Hill are reported to have taken an option on the controlling interest of the power and irrigation project of the Hanford Irrigation & Power Company at Priest Rapids, on the Columbia River, 30 miles northwest of Pasco. By building a canal a mile long parelleling the river 10,000 hp has been developed, and it is said that 20,000 hp more can be developed. It is proposed to organize a company and construct about 100 miles of electric railway. Messrs. Farrell, Hill, Judge Hanford and W. R. Rust, of Tacoma, are interested in the enterprise.

WALLA WALLA, WASH.—The Walla Walla Traction Company has applied for a franchise over the county roads from the south limits of Walla Walla to the north side of Rensom Clark donation claim.

ASHLAND, WIS.—The new management of the Ashland Light, Power & Street Railway Company on June 8 voted to issue $450,000 in bonds, the proceeds to be used to extend the street car lines through the residence portion of the city, to build a new gas plant, to purchase new cars, and to secure a water power and power plant. The line will be extended to Washburn, also to Odanah, and the Copper Falls water power, 18 miles from Ashland, will be developed.

LANCASTER, WIS.—The City Council is considering the question of a new electric lighting contract for the city. The street lighting system consists of 45 arc lamps for which the city pays $50 per lamp per year. Owing to the increase in the cost of fuel and labor the price asked for in the new contract is $65 per lamp. The present service for street lighting is until 12:30 a. m., and from 5 o'clock until daylight during the winter months.

VANCOUVER, B. C., CAN.—F. R. Glover, acting general manager, of the British Columbia Electric Railway Company, writes that the company is planning to build an electric railway from Westminster to Cloverdale, a distance of 12 miles, and next year from Cloverdale to Chilliwack, a distance of 44 miles. Extensions will be made in the city of Vancouver. The company expects to commence the electrification of the Westminster-Eburne road in about a month. Orders have been placed for one 2000 rotary converter for the Vancouver substation; one storage battery of 275 cells, for the Victoria plant; three 500 kw step-down transformers together with extension to switchboards in Vancouver, New Westminster, Burnaby and Lulu Island substations.

PORTAGE LA PRAIRIE, MAN., CAN.—Investigations are being made by Engineer Skinner with a view to improving the lighting system of the city.

HAMILTON, ONT., CAN.—The City Council has decided to submit the offer of the Cataract Power Company and the proposition of the Hydro-Electric Power Commission to the ratepayers for them to choose between the two propositions.

HAMILTON, ONT., CAN.—Engineer Sothman, of the Hydro-Electric Power Commission, announces that it has been definitely decided to build the transmission line along the top of the mountain, and locate the transformer station near Dundas, whether Hamilton enters into the scheme or not. It was originally intended to build the line along the Beach, but it was found it would be much cheaper to put it on top of the mountain.

NIAGARA FALLS, ONT., CAN.—The Ontario Distributing Company has applied to the Lincoln County Council for a franchise to construct a transmission line from St. David's along the Queenstown and Grimsby Stone Road.

OAKVILLE, ONT., CAN.—Sealed tenders will be received until June 23 by A. S. Chisholm, chairman of the Board of Water and Light Commissioners for the construction of water works system and electric light plant, etc. Willis Chapman, Toronto, is chief engineer.

WOLSELEY, SASK., CAN.—The Central Light & Power Company contemplates installing a 150-hp gas engine and a 90-kw generator in its plant. Lee Boyer is manager.

New Industrial Companies.

THE UNION ELECTRICAL MANUFACTURING COMPANY, San Francisco, Cal., has been incorporated, with a capital stock of $50,000, by A. A. Cluc, L. G. Copeman, G. M. Fisk, P. A. Clifford and F. J. McNulty.

THE IDEAL STEAM TURBINE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000, and the following directors: Francis S. Palmieri, Alfred Bonom and Augustus M. Brown, of New York, N. Y.

THE INDUSTRIAL ENGINEERING COMPANY, of Camden, N. J., has been incorporated, with a capital stock of $10,000, by J. F. McLaughlin, J. English and B. L. Myrtetus. The company proposes to do a general engineering business.

THE STAVE ELECTRICAL COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000. The incorporators are: Theodore Stave, Alexander Watson and Richard H. Smith, of New York, N. Y.

THE EDWARD G. SAWYER COMPANY, of Boston, Mass., has been incorporated with a capital stock of $5,000, by Elisha B. Sawyer, Robert J. Macdonald and Ara E. Barnes. The company proposes to deal in electrical and lighting supplies.

THE VULCAN STORAGE BATTERY COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $25,000. The directors are: Franz Sigel, Charles Lansing, of New York, N. Y., and William Knobloch, of Williamsbridge, N. Y.

THE H. G. TROUT COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $60,000, for the purpose of manufacturing machinery, engines, tools, etc. The incorporators are: H. G. Trout, W. B. Trout and H. G. Walker, all of Buffalo, N. Y.

THE GILLETTE SEPARATOR COMPANY, of Phillipsburg, N. J., has been incorporated, with a capital stock of $100,000, by Burroughs C. Gillette, of New York, N. Y.; Martin L. Dreisbach, George C. Mason, Jr., of Easton, Pa., and Clarence Walters, of Phillipsburg, N. J.

THE WILKIRK ELECTRIC COMPANY, of Camden, N. J., has been incorporated by F. R. Hansell, George H. B. Martin and John A. MacPeak, of Camden, N. J. The company is capitalized at $5,000, and proposes to manufacture machinery, engines, motors, dynamos, etc.

THE HARRISON PERCENTER LEVEL COMPANY, of New York, N. Y., has filed articles of incorporation. The company is capitalized at $100,000 and the incorporators are: A. W. Britton, J. D. Baker and B. F. Russell, of New York, N. Y. The company proposes to manufacture mechanical and electrical devices, machinery, etc.

New Incorporations.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs & Memphis Long Distance Telephone Company has been incorporated, with a capital stock of $3,000. The officers of the company are: W. B. Pace, president; E. C. Bellamy, vice-president; L. M. Hynson, secretary and general manager, and C. W. Dixon, treasurer.

CHICAGO, ILL.—Articles of incorporation have been filed for the Northeastern Electric Railway Company. The company is capitalized at $50,000, and proposes to construct an electric railway from Woodbury to DeKalb, Ill. The incorporators are: Clinton G. Lumley, E. C. Spinney, Irving D. Stevens, E. B. Harang, F. H. Rhodes, William L. Abbott, George W. Lyndon and others.

OLNEY, ILL.—Articles of incorporation have been filed for the American Lockout Telephone Company, with a capital stock of $5,000, by Guy E. Terhune, W. B. Huston, Alfred H. Poe and others.

FARMERSBURG, IND.—Articles of incorporation have been filed by the Farmersburg Telephone Company, and the following directors elected: Ameridath J. Aikers, James Brancon, Thomas H. Kendall, Arthur Hook, George Bennett, Harvey Lewis and James H. Forbes. It has an authorized capital stock of $10,000, and proposes to build and equip a new exchange and telephone system in Farmersburg.

MONROE CITY, IND.—The Vincennes & Washington Transit Company has been organized to build an electric railway from Vincennes to Washington via Monroe City, and thence to Bloomington. The interurban railway from Vincennes to Washington, a distance of 21 miles, will be built first. Work is now under way between Monroe City and Wheatland. The road will be built under the direction of Burns & Company, of Chicago, Ill., who will purchase all the supplies and materials and award all contracts.

POSEYVILLE, IND.—The Poseyville Light & Power Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are: Frank W. Seib, August Seib and others.

TERRE HAUTE, IND.—Articles of incorporation have been filed for the Terre Haute & Northern Traction Company, with a capital stock of $100,000, by W. A. Philips, A. J. Stein, D. Russ Woods and S. C. McKeen. The company proposes to construct and operate street railroads in the city of Terre Haute and the towns and villages of Markle, Burnet, Fontenet, Coal Bluff, Perth, Diamond and Bridgeton and to operate an interurban railway connecting Terre Haute with the above new towns. The company also proposes to furnish electricity for heat, lamps and motors.

KEOKUK, IA.—Articles of incorporation have been filed for the Keokuk & Columbus Junction Transit Company with a capital stock of $10,000 to construct an electric railway to connect Keokuk and Columbus Junction and intervening towns. The railway will be about 75 miles in length. The officers of the company are: J. E. Peterson, of New London, president; D. B. Hamill, of Keokuk, vice-president; T. A. Craig, of Keokuk, secretary, and Ira W. Mills, treasurer.

PIERSON, IA.—The Farmers' Mutual Telephone Company has been incorporated, with a capital stock of $50,000, by O. L. Cole, A. C. Fowler, E. J. Raw, O. S. Pixler, F. F. Nicholls and H. DeLambert.

PORTLAND, IA.—The Averydale Telephone Company has been organizer, with a capital stock of $9,990, and proposes to install a telephone system in this city.

SIDNEY, IA.—The Sidney Electric Light, Heat & Power Company has been organized by the purpose of establishing an electric light plant in Sidney. The company is capitalized at $15,000, and Harry Day, of New Madrid, Mo., is manager.

BAVARIA, KAN.—The Citizens' Mutual Telephone Company has been chartered with a capital stock of $10,000.

SHARP, KY.—The Sharp Home Telephone Company has been organized to erect a local telephone system and contemplates extending the system throughout the surrounding country. The company will soon commence work on a line to Little Cypress.

SUTTON, KY.—The Sutton-Hellier Telephone Company has been formed, with a capital stock of $3,000, to erect a telephone line from Sutton to Wright, 15 miles distant, with several short-line branches. John P. Blanton is general manager.

TADELLA, KY.—The Tadella Telephone Company has been formed, with a capital stock of $2,000, to construct a telephone line 12 miles in length connecting Tadella and White Post. J. W. Smith is general manager.

WATERVILLE, MAINE.—Articles of incorporation have been filed for the Vassalborough Electric Light & Power Company with a capital stock of $50,000. The officers of the company are: Edward Chase, president and treasurer, and D. P. Foster, clerk, both of Winslow.

MILFORD, MICH.—Articles of incorporation have been filed for the Milford Home Telephone Company by John N. Weaver, Mark B. Liddell, John C. Black, Charles E. Lovejoy and Milton C. Williams and others. The capital stock of the company is placed at $15,000.

FLOODWOOD, MINN.—The Floodwood Telephone Company has been chartered, with a capital stock of $1,500, by M. A. Schussler, W. A. Baune, C. D. Rutherford, M. L. Freedy and M. W. Johnson.

MARINE MILLS, MINN.—The Scandia & Marine Mutual Telephone Company has been organized. A. Hawkinson is secretary.

ROSEAU, MINN.—The Roseau Telephone Company has been incorporated, with a capital stock of $10,000, by C. A. Peterson, Olaf Holdahl, of Roseau, and others.

PHILADELPHIA, MISS.—Articles of incorporation have been filed for the Philadelphia Electric Company by M. A. Cramer, H. A. Cramer, and A. Cramer.

GREENFIELD, MO.—The Greenfield Electric Light Company has been incorporated with a capital stock of $3,000 by Leroy Lansing, Fred Shafer and E. A. Lansing.

LARUSSELL, MO.—The Spring River Independent Telephone Company has been formed. A. W. Goff, J. T. Burks, L. D. Meador, W. M. Gaff and others are interested in the enterprise.

ST. LOUIS, MO.—The West End Light & Power Company has filed articles of incorporation, with a capital stock of $50,000. The incorporators are: Arthur D. Kloos, J. D. Dana and S. L. Swarts. The company has purchased from Browning, King & Company the latter's electric light franchise rights, granted by the city of St. Louis in 1882, and will erect a plant in the West End soon. Arthur D. Kloos, manager of Browning, King & Company; J. D. Dana, president of the Revere Realty Company, and S. L. Swarts are interested in the company. The new company is planning to erect a plant and generate electricity for lamps and motors. The new concern will be a competitor of the Union Electric & Power Company.

MILES CITY, MONT.—Articles of incorporation have been filed for the Miles City Home Telephone Company, with a capital stock of $60,000, by C. B. Towers and others.

GENEVA, NEB.—The Iowa Central Telephone Company has been organized, with a capital stock of $150,000. The officers of the company are: W. C. Shipley, president, and H. G. Conger, secretary.

STORY, NEB.—Articles of incorporation have been filed for the Story Telephone Company, with a capital stock of $300, by W. B. Donaldson, of Story, and others.

NEWARK, N. J.—The Billings & Eastern Montana Power Company has been chartered, with a capital stock of $1,000,000, to operate street railway and interurban railways, to be operated by electrical or other power. The incorporators are: P. E. Bisland, of Bronxville; C. R. Ganter, of New York City, and F. Randell, of Brooklyn.

CASCADE VALLEY, N. Y.—The Cascade Valley Telephone Company has been incorporated, with a capital stock of $500. The directors are F. O. Taylor, William Bice, Willis Comstock, of Cascade Valley; M. K. Whipple, Thomas Bosket, Charles Ostrander and Edward Seward, of Damascus.

PENN YAN, N. Y.—Articles of incorporation have been filed for the Benton Telephone Company, and the following directors elected: J. K. Turner, William E. Beattie, I. W. Comstock, George L. Turner, Walter Lebbon and Edward Hurrin, all of Gage. The company is capitalized at $1,000.

NORTH WILKESBORO, N. C.—The Horton Telephone Company has been incorporated, with a capital stock of $5,000, by W. W. Horton, J. B. Horton, W. P. Horton and Ralph Duncan.

PISEK, N. D.—The Star Telephone Company has been chartered, with a capital stock of $3,000, by J. F. Spale, of Vesleyville; Frank J. Kouba and Joseph V. Kouba, of Pisek.

BROOKVILLE, OHIO.—The Brookville Electric Company has been incorporated with a capital stock of $20,000 by John W. Brockman, A. Bassert, M. P. Hubbard and others.

CYNTHIANA, OHIO.—Articles of incorporation have been filed for the Hillsboro, Cynthiana & Bainbridge Traction Company by Oliver E. Eylar and others.

KIRKSVILLE, MO.—Articles of incorporation have been filed for the Kirksville Light, Power & Ice Company by Warren Hamilton, C. V. Miller, John C. Mills and others.

MARYSVILLE, OHIO.—The Union County Farmers' Telephone Company has been incorporated, with a capital stock of $24,000, to construct and operate a telephone system in Marysville and Richwood and adjacent territory.

WILLSHIRE, OHIO.—Articles of incorporation have been filed for the Home Telephone Company, with a capital stock of $15,000, by J. E. Snyder, S. L. Evans, A. M. Foreman, S. E. Hurless, W. G. Hoffer and others.

COALGATE, OKLA.—Articles of incorporation have been filed for the Chuka Telephone Company by S. W. Lane, of Coalgate; S. J. Murrow, of Unchuka, and F. P. Reinking, of Wardville, and others.

GUTHRIE, OKLA.—The Pleasant Ridge Rural Telephone Company, of Pleasant Ridge, has been incorporated with a capital stock of $1,500. The directors are: R. P. Knight, D. W. Cunningham and R. C. Barker, all of Frederick.

GUTHRIE, OKLA.—Articles of incorporation have been filed for the Guthrie & Interurban Railway Company by C. R. Renfro, F. E. Houghton, G. Crow, and R. E. Overton, of Guthrie, and E. C. Brown, of St. Louis, Mo. The company is capitalized at $100,000, and proposes to construct an electric interurban railway from Guthrie to a point on the Cimarron River, five miles distant.

GLEN ROCK, PA.—Articles of incorporation have been filed for the Glen Rock Electric Light & Power Company, with a capital stock of $20,000, by C. B. Seitz and others.

MECHANICSBURG, PA.—The Upper Allan Telephone Company has been organized for the purpose of constructing a telephone line between Mechanicsville and Bowmansdale, and will connect with the lines of the American Union Telephone Company.

MILLS, PA.—Articles of incorporation have been filed for the Mills & Ulysses Telephone Company with a capital stock of $5,000, by J. Y. Hoffman and others.

SPRING CITY, PA.—The Locust Grove Telephone Company has been organized by the citizens of East Vincent Township to build a telephone line to connect with the local exchange at Spring City or that of Phœnixville. The officers of the company are: Horace Latshaw, president; Samuel Bertoley, vice-president; Jacob Finkinbinder, secretary, and Amos Kolb, treasurer.

ALAMO, TENN.—The Alamo Home Telephone Company has been chartered, with a capital stock of $5,000, by Charles T. Love, R. L. Conyers, C. A. Foster, T. H. Durham, J. O. Smotherman, H. B. Nance and R. R. Thompson.

NEWMARKET, VA.—Articles of incorporation have been filed for the Newmarket Telephone Company, with a capital stock of $5,000, and the following officers have been elected: J. H. Garber, of Newmarket, president; C. E. Neff, of Quicksburg, secretary and treasurer, and A. M. Neff, of Newmarket, manager.

SEATTLE, WASH.—Articles of incorporation have been filed for the Northern Light, Mining & Development Company by C. T. Sylliaasen, A. H. Dahl and Thomas L. Nyman. The capital stock is placed at $1,000,000.

VANCOUVER, WASH.—The Vancouver Traction Company has been incorporated by E. M. Rands, of Vancouver, W. J. Patterson, of Baker City, and A. Welch, of Portland. This company will take over the property and holdings of the Washington Railway & Power Company formed by W. H. Moore and associates.

MONTREAL, QUE., CAN.—The Saguenay-Quebec Telephone Company has filed articles of incorporation. The company is capitalized at $140,000 and the directors are: J. E. A. Dubuc, J. E. Cloutier, E. G. Gosselin, all of Chicoutimi.

WALLA WALLA, WASH.—Articles of incorporation have been filed for the Walla Walla & Eureka Flat Telephone Company to build a telephone line from Walla Walla to Eureka Junction, and thence through Eureka Flat to Pleasant View. It is estimated that the entire system will cover a distance of about 150 miles.

WASHOUGAL, WASH.—The Sunset View Telephone Company has been organized and the following-named officers elected: Robert Bedell, president; C. C. Buslach, treasurer.

CHIPPEWA FALLS, WIS.—The Bateman Telephone Company has been organized in this city to construct a telephone line from Chippewa Falls to Bateman.

CLYDE, WIS.—The Clyde Telephone Company has been incorporated with a capital stock of $300, by S. J. Gill, Frank Flumery and Dr. Sheldon.

GREEN BAY, WIS.—The Northern Hydro-Electric Company has been incorporated to develop the water power at High Falls and Johnson Falls to be used to generate electricity. B. L. Parker, of Green Bay, is secretary.

Personal.

W. W. COLE.

MR. W. W. COLE, the general manager of the Elmira, N. Y., Water, Light & Railway Company, has taken an interest in the firm of Dodge & Day, of Philadelphia, Pa. He will be in full charge of the operating department for public utilities, and will also look after all expert and consulting work in connection with public service corporations. He will also take charge of financing new engineering projects such as power plants, electric railways and hydroelectric developments. Mr. Cole has long been prominent in the field of electric lighting and traction, and has been in Elmira for many years past, going there nearly two decades ago when he built and put into operation the old West side system. It was under his advice that the public utilities of Elmira were consolidated in the hands of one large holding company and under his management the allied properties are in a prosperous condition. The electric lighting service has been developed, the street railways have been greatly improved, the Seneca Lake line has been bought and rebuilt, and the water system and filter plant are in a high state of perfection. At one time there was considerable prejudice in Elmira against the public utilities, and it is largely due to the work and diplomacy of Mr. Cole that that feeling has been entirely dissipated. Mr. Cole has been active in the affairs of the Empire State Gas & Electric Association, of which he has held the presidency. His resignation at Elmira takes effect July 20, when he will immediately assume his new duties, with headquarters in New York City.

MR. F. G. DANFORTH has been elected president of the Skowhegan Electric Light Company, of Skowhegan, Maine, taking the vacancy caused by the death of Mr. William Doran.

MR. CLEMENT C. SMITH, president of the Columbia Construction Company, of Milwaukee, Wis., has been appointed president of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis.

PROF. FRANK M. DENTON, of the Carnegie Technical Schools, Pittsburg, has sailed for Europe, where he will visit the more important technical schools of Great Britain and the Continent in order to make a study of their methods.

MR. R. T. GUNN, superintendent of transportation of the Fort Wayne & Wabash Valley Traction Company, of Fort Wayne, Ind., has been appointed general manager of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis.

MR. G. F. MAUSBRIDGE, of London, is on a visit to this country. Mr. Mausbridge is the inventor of a new type of electrical condenser, which formed the subject of a paper recently read before the British Institution of Electrical Engineers.

MR. I. W. PHILLIPS, who has been with the North Mountain Power Co., of Eureka, Cal., for the past three years, has resigned his position with that company and, after a short trip East, will take up the development of a water power proposition in Oregon.

MR. DAVID SARSFIELD has severed his connection with the Berwick & Salmon Falls Electric Company, of South Berwick, Maine, and the office of superintendent has been discontinued. Mr. Charles F. Warren and son will have charge of the station and lines.

MR. E. R. WEEKS, of Kansas City, Mo., visited Columbia, Mo., recently and addressed the general assembly of the State University, the teachers' and the women's clubs, on the subject of humane work in Missouri. He also lectured before the university school of engineering on the value of technical education.

MR. N. C. DRAPER, vice-president and general manager of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis., has resigned to become district manager of the Ohio Electric Railway, with headquarters at Zanesville, Ohio. Mr. Draper was formerly with the Westinghouse Electric & Manufacturing Company at Cleveland, Ohio.

DR. ANGUS SINCLAIR.—At the commencement exercises at Purdue University, Mr. Angus Sinclair, editor and publisher of *Railway and Locomotive Engineering*, was made a doctor of engineering, a degree given rarely and only by technological colleges of the first rank. Dr. Sinclair is a native of Scotland, and has long been one of the foremost authorities in the world on locomotive design and practice.

MR. JOHN I. BEGGS has been tendered a vote of thanks by the Milwaukee General Committee on River Front Improvement, in recognition of his unsolicited aid in carrying out one of the objects of the committee, by beautifying the grounds of the Niagara Street power station. A lawn has been laid out between the station and edge of the water, flowers and vines planted, and on all window ledges of the station boxes of flowers and plants have been placed.

MR. R. H. WATSON, formerly of the Gould Storage Battery Company, Chicago office, has purchased the interest of Mr. James R. Deane in the Northwestern Electric Company, of Chicago, and succeeds Mr. Deane as secretary and treasurer of that company. Mr. Deane has become identified with the Guarantee Electric Company in a selling capacity. The Northwestern Electric Company handles mainly second-hand electrical apparatus, in which line of business Mr. Watson has had ample experience, having been for a number of years with the Gregory Electric Company, of Chicago.

MR. W. J. A. LONDON has recently accepted the position of chief engineer of the Terry Steam Turbine Company, Hartford, Conn., succeeding Mr. C. E. Terry, recently deceased. Mr. London's experience in the turbine industry has been extensive, dating from his early connection with the C. A. Parsons Company, Newcastle, England, and about 15 years later with Brown-Boveri Company, Baden, Germany, and the British and American Westinghouse Companies. His work has taken him into the field not only of land turbines, turbo-generators and condensers, but also that of marine propulsion.

MR. EDWARD H. JOHNSON, who went abroad after the development of the Edison lighting and Sprague motor systems, has just returned to this country to stay, after an absence of nearly 10 years, during which his visits have been few and far between. He has spent the interval largely in the development and exploitation of the "regenerative" method of railway motor operation, and has worked out with the aid of other inventors, notable improvements in this direction. He will give his attention to this line of work, but has already been invited to take up several other novelties and systems by those familiar with his many successes and his tireless energy. For the summer Mr. Johnson will make his headquarters while in New York at the Union League Club, but he and Mrs. Johnson have a large amount of visiting to do around the country before they settle down.

Legal.

IN RECEIVER'S HANDS.—J. L. Waddell, of Somerset, Ky., formerly superintendent of the water works, has been appointed receiver of the Somerset Water, Light & Traction Company, of Somerset, Ky., by Judge Jarvis. Application for the appointment of receiver was made by the Louisville Trust Company.

ELECTRIC LIGHT COMPANY ENTITLED TO REASONABLE OPPORTUNITY TO LOCATE DANGEROUS LEAKAGE.—An action was brought against an electric light company to secure damages for the death of a person by coming in contact with a broken telephone wire, hanging down in the street, which in turn was in contact with one of the defendant's electric light wires, the insulation on which had been broken. A line of poles set near the east line of the street where the accident occurred served the double purpose of carrying wires which supported the trolley wire for a street railroad and two telephone wires which were set about 2 ft. apart and about 25 ft. above the sidewalk. During the night preceding the accident a fire had occurred in the top of defendant's pole at the place where the crossarm was attached; the insulation had been burned from the light wires, and the crossarm had been burned in two. This had caused the light wires to drop down to the telephone wires, with the result that one of the latter wires had been burned until it had parted and had fallen to the street, and one of the light wires rested on the other telephone wire, with no insulation between them at the point of contact. The south end of the broken telephone wire remained attached to the pole. A judgment against the company was reversed because it did not appear that the company had had reasonable time to discover and remedy the trouble. In the performance of its duty to exercise the highest degree of care an electric light company is entitled to a reasonable opportunity to ascertain and locate trouble upon its lines and must then be allowed a reasonable time, while exercising greatest diligence, to put its lines in order. Brown v. Consolidated Light, Power & Ice Company, Kansas City Court of Appeals, 109 S. W., 1032.

COLD GALVANIZING LITIGATION.—A decision in equity, on final hearing, has been rendered by Judge Cross, of the Circuit Court of the United States, District of New Jersey, in favor of the Hanson & Van Winkle Company, of Newark, N. J., and Chicago, Ill., and against the United States Electro-Galvanizing Co., of Brooklyn, N. Y., the decision clearing the electro-galvanizing process of the former from the charge of infringement. By this decision certain salts and processes are authoritatively declared to be free and clear of existing patents which have heretofore been asserted to be all controlling. Electro-galvanizing of certain kinds of work is now specified by the Governments of Great Britain and Germany, and the United States Government has installed at its various ship yards complete equipment for the purpose of treating articles by the electrical method. A large number of manufacturers find this process useful, particularly those who desire to galvanize work of high temper or small cross section which is liable to lose temper or to become warped or distorted owing to the high temperature of the hot bath.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

SPRINGFIELD, OHIO.—The City Council has directed the lighting committee to investigate the question of erecting a municipal electric light plant and secure data pertaining to the cost of the plant and operation of the same. President C. W. Rich, president of the Board of Public Service, is in favor of erecting the plant, to be erected on the old pumping station grounds.

JOPLIN, MO.—The Joplin Light, Power & Water Company has applied to the City Council for a franchise for a term of 20 years. The Joplin & Eastern Kansas Railway has also petitioned the Council for a franchise to construct its proposed railway in Joplin.

KNOXVILLE, TENN.—The Acme Electric Company, of Knoxville, Tenn., has been awarded the contract for the construction of an electric plant at Montvale Springs.

MANCHESTER, CONN.—The Manchester Electric Company has increased the voltage on its entire system from 3300 to 6600 and is now furnishing a day service throughout.

HARTFORD, CONN.—The Hartford Electric Light Company has increased its capital stock from $2,100,000 to $2,400,000, the proceeds of which will be used for improvements to its plant.

BEAUFORT, S. C.—An election will be held June 29 to vote on the proposition of issuing $43,000 in bonds, the proceeds to be used to buy the present or erect a water works system, to install an electric light plant and to build a new town hall.

MADISON, WIS.—The contract for furnishing two general service pumps and a battery of electric fire pumps for the heating and power plant of the new capitol was awarded June 11 to the Fred M. Prescott Company, of Milwaukee, Wis., for $6,960, by the State Capitol Commission.

HAMILTON, ONT., CAN.—The special sub-committee, having charge of the street lighting matter, has approved of the plans drawn up by Engineer Sothman, of the Hydro-Electric Power Commission. Tenders for a plant with an output sufficient for 625 arc lamps will be received until August 3.

LAFAYETTE, GA.—The supreme court has reversed the election held here some time ago, at which bonds were voted for the establishment of an electric light plant and water works system. It is not probable that an election will be held for some time, as it is doubtful if bonds would be voted at this time.

GUADALAJARA, MEX.—McKeever Brothers, who are operating the El Favor mines, near Guadalajara, Mex., have placed a contract for the construction of a power plant at the dam to furnish power to operate their stamp mill.

WESTERLY, R. I.—At the annual meeting of the Westerly Light & Power Company the following officers were elected: William Clark, president; W. L. Mauran, vice-president; T. E. Steere, secretary and treasurer, and Herbert B. Rust, general manager.

LEICESTER, MASS.—The Selectmen have been authorized to draw up a new contract for lighting the streets. The present contract with the Worcester Electric Light Company expires July 1.

TEKONSHA, MICH.—At a special election held June 9 the citizens voted against the proposition to issue $12,000 in bonds to establish a municipal electric light plant.

LISBON, IA.—The electric light and water plant is reported to have been wrecked on June 8 by a tornado.

GLENS FALLS, N. Y.—Articles of incorporation have been filed for the Mohawk Power Company with a capital stock of $100,000. The company proposes to generate electricity and gas for light, heat and power purposes, and to construct dams across the Mohawk River in the counties of Schenectady, Albany, Saratoga, Montgomery, and Herkimer. The directors are: Eugene L. Ashley, Elmer J. West, of Glens Falls, and Byron E. Morow, of Schenectady.

MAYFIELD, KY.—The electric plant of the Mayfield Water & Light Company was put out of commission again June 11 by lightning. The plant had resumed operation June 9 after having been shut down three weeks following a fire. It will take several weeks to repair the damage, and the whole town at present is without artificial light.

KENNETT, CAL.—The owners of the Gladstone Mine, of French Gulch, are planning to increase the output of the mine, and will install a larger hoisting plant and double the output of the power plant on Crystal Creek.

Business Notes.

ALLIS-CHALMERS BIRMINGHAM OFFICE.—The Allis-Chalmers Company has opened an office at Birmingham, Ala., in charge of Mr. Seldon Jones, as district manager, in rooms 319-320, First National Bank Building.

THE BUFFALO FOUNDRY & MACHINE CO., Buffalo, N. Y., which besides making exceptionally large castings, builds a number of lines of machinery, including pumps and condensers, has recently established a New York office at 143 Liberty Street, in charge of Mr. H. E. Jacoby as resident engineer and manager.

THE CAMPBELL-STAGG COMPANY, 220 Broadway, New York City, representing manufacturers, has been incorporated. The Eastern business of the Steel City Electric Company, of Pittsburg, Pa. (Fullman "Star" bushings and floor outlets), at present handled by William G. Campbell, will be taken care of by the new company. It is the intention of the company to promote the use of floor boxes generally.

I. P. FRINK, of New York City, has equipped all the show windows and showcases in the new store of Messrs. Rogers, Peet & Co., at the northeast corner of Thirty-fourth Street and Broadway, with reflectors. This store is one of the largest and most modern men's apparel shops in the country, and the Frink patent window reflectors serve to illuminate properly the attractive window displays.

MR. JOHN RICHMOND, of the Mechanical Appliance Company, Milwaukee, who was in New York on a business trip last week, stated that his company is at present doing very interesting work in the application of its motors to industrial machines. The variety of these motor-driven appliances is increasing continually, and every line of business is learning the convenience and economy of substituting electricity for hand power in many ways.

INTERLOCKING RUBBER TILING.—Andrew Dall & Son, of Cleveland, Ohio, have recently placed an order with the New York Belting & Packing Company, Ltd., for the installation of interlocking rubber tiling in the Cuyahoga County Court House, Cleveland, Ohio, for which Lehman & Schmit are the architects, amounting to $125,000. This is believed to be the largest order for rubber tiling ever placed. The tiling will be laid in the large court rooms, corridors, judges' chambers, ante-rooms, etc., in different designs.

TRANSFORMERS FOR FOREST PARK, CHICAGO, ILL.—The Central Electric Company, of Chicago, has completed delivery on approximately 2000 kw capacity of transformers for furnishing light and power to the latest pleasure resort of Chicago. The current is taken from the 12,000-volt transmission lines of the Sanitary District, being transformed at 2300 volts and distributed around the park. By means of transformers located in individual tranformer houses, the 2300-volt is again stepped down to 110-220 or 440 volts as desired for operating lamps and motors. The installation of this equipment was completed in a remarkably short time after the contract was placed, this being necessary in order to open the park at the specified time.

ELECTRIC GOODS MFG. COMPANY.—The expansion of the electric specialty business of the Electric Goods Mfg. Company, of Boston, which necessitated the removal last summer of its plant from Boston to its present commodious factory in Canton, Mass., has led to giving up its jobbing electric light supply branch, which has just been sold to the Western Electric Company. The company on June 1 moved its main office to 144 Pearl Street, corner of Purchase, Boston, where it will continue to handle its extensive lines of interior telephones, telephone switchboards, annunciators, gas and acetylene apparatus, Samson batteries, etc., which have made the firm so widely known during a quarter century.

WHITE STAR FILTERS AND OILING SYSTEMS.—The Pittsburg Gage & Supply Company, Pittsburg, Pa., report a decided increase in the sales of its White Star oil filters and continuous oiling systems. A number of oiling systems have been installed in the various plants of the Carnegie Steel Company in the past, and two more installations have just been completed at its Carrie Furnace, Rankin, Pa. The following is a partial list of other sales and recent installations: Republic Iron & Steel Company., Raimond, Ala.; American Iron & Steel Company, Lebanon, Pa.; Shawinigan Water & Power Company, Montreal, Canada; Memphis Cold Storage & Warehouse Company, Memphis, Tenn.; P. & R. Ry. Company, Rutherford, Pa.; Monongahela River Consolidated Coal & Coke Company, Pittsburg, Pa.; New River Collieries Company, Thurmond, W. Va.; Liberty Mills, Nashville, Tenn.; General Fire Extinguisher Company, Warren, Ohio; Austin Biscuit Company, Boston, Mass.

THE CONSOLIDATED SUPPLY COMPANY.—The Consolidated Supply Co., Chicago, which has just been incorporated, will make a specialty in handling general steam and electric railway, mill and mining supplies, with headquarters at 321 Dearborn Street. The office and store occupy the ground floor in the Manhattan Building, the storeroom extending through and fronting on 60 Plymouth Place. The location is ideal, as the office, with a frontage on Dearborn Street as well as the storeroom on Plymouth Place, has large display windows. The incorporators are: L. C. Hopkins, John P. Mahoney and J. L. Benedict. Mr. Hopkins has had some eight years' experience in the railroad and supply business. For the past year he was connected with the sales department of the Chicago Pneumatic Tool Company, and previous to that was four years with Fairbanks, Morse & Company. Mr. Mahoney was formerly chief clerk to the purchasing agent of the T. St L. & W. Ry. Mr. Benedict was in the railroad business 10 years and for the past five or six years was connected with the Chicago Pneumatic Tool Company, as manager of its Chicago office and on the road.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 9, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

889,891. METHOD OF PREPARING CARBON ARTICLES; Peter McN. Bennie. Niagara Falls, N. Y. App. filed July 11, 1907. The method of shaping hard carbon articles, which consists in locally softening or graphitizing the parts of the article which it is desired to remove.

889,907. SYSTEM OF ELECTRIC MOTOR CONTROL; William Cooper, Pittsburg, Pa. App. filed Sept. 3, 1907. Comprises a time-limiting device in connection with a device which is dependent upon the current traversing the motor circuits for effecting an automatic acceleration of the motors.

889,908. REGENERATIVE SYSTEM OF CONTROL; William Cooper, Pittsburg, Pa. App. filed Sept. 3, 1907. A system of control for alternating-current railway motors of the commutator type, by which they may be caused to operate as generators and supply a constant current to the distributing circuit regardless of their speed.

889,911. SYSTEM OF DISTRIBUTION FOR DIRECT CURRENT: Frederick Darlington, Pittsburg, Pa. App. filed June 25, 1906. The combination with two or more dynamo-electric machines mechanically coupled together and electrically connected in series relation, of a translating device connected between terminals of one or more of the machines, and means for insulating one or more of the machines from the others and also from the ground.

889,929. ELECTROLYTIC METER; George Hookham and Sydney Holmwood Holden, of Birmingham, Eng. App. filed Nov. 20, 1905. Has a cell provided with a graduated tube of small bore, in which gas produced by electrolysis is measured at a pressure independent of barometric pressure.

889,931. ELECTRICAL TRANSFORMER; Svend E. Johannesen, Pittsburg, Pa. App. filed March 3, 1906. An arrangement of circuits and parts of an auto-transformer employed in voltage regulation and so adjusted that the variations in the reactance therewith with variations in the voltage adjustments may be confined within very narrow limits.

889,937. ELECTRODE FOR ARC LAMPS; George M. Little, Pittsburg, Pa. App. filed May 10, 1906. An arc lamp electrode comprising a plurality of layers composed alternately of iron and copper.

889,956. INSULATOR; John P. Nikonow, Pittsburg, Pa. App. filed May 11, 1906. The insulator has a conical central pin which depends from a conical sleeve within a housing which is designed to be perfectly watertight, so that leakage currents cannot pass through the interior of the ribbed porcelain body.

889,963. MERCURY SWITCH FOR RAILWAYS AND THE LIKE; Robert Pfeil, of Grunewald, near Berlin, Germany. App. filed Jan. 6, 1908. A means for enabling a traveling train to act on fixed working devices. Makes use of switch elements wholly enclosed in a casing having a mercury bath.

889,989. TRANSFORMER REGULATOR; Wilbur H. Thompson, Wilkinsburg, Pa. App. filed June 25, 1906. In a regulating transformer the combination with a stationary hollow cylinder and magnetizable core, of a plurality of symmetrically disposed coils which are mounted to revolve around the axis of the core and each of which surrounds the core wall.

890,001. ELECTRIC SAFETY AND ALARM SYSTEM FOR RAILROADS; Herbert D. Williams and Marcus Leonard, Vermillion, Kan. App. filed April 18, 1907. Railroad signal system making use of spaced contact rails connected with semaphore signals and designed to establish alarm signals on the trains through depending contact shoes.

890,030. ELECTRIC RAILWAY BOND; John Dolan, Dayton, Ohio. App. filed June 15, 1906. Form of rail bond, making use of laminated ribbons with soldered ends, having rivets and surfaces adapted to be soldered to the rail.

890,042. AUTOMATIC TELEGRAPHIC TRANSMISSION INSTRUMENT; John Gell, of London, England. App. filed Aug. 12, 1907. Automatic telegraph transmitter of the type adapted to send dots or dashes continuously by alternate movements of the operating key. Relates to details of the T-shaped operating lever, having specially constructed contacts.

890,049. ELECTRIC SIGNAL FOR RAILWAYS; Joseph H. Gunn, Cortland, N. Y. App. filed Oct. 31, 1907. A railway signal system particularly adapted for trolley roads. The patentee makes use of specially constructed semaphores which depend directly in the path of the train so as to insure their observance.

890,053. ELECTRICAL INSTANTANEOUS WATER HEATER; Louis C. Henriksen, Los Angeles, Cal. App. filed April 10, 1907. Comprises a casing having a plurality of coils to carry the water and an electrical conductor, comprising resistance elements arranged in juxtaposition to the water-carrying coils.

890,058. TROLLEY; Samuel D. Hunt, Youngstown, Ohio. App. filed Oct. 9, 1907. A trolley system having a main feed wire and auxiliary side wires. The harp carries special trolley wheels to engage all the trolley wires so as to maintain an effective contact at viaducts and the like.

890,084. PROCESS FOR THE PRODUCTION OF ALUMINUM OXID; Frank W. Morris, Victoria, British Columbia, Canada. App. filed March 13, 1907. A means for producing aluminum oxid from any clay by electrolytic action.

890,094. RAILWAY SIGNAL APPARATUS; Charles A. Pitts, Callahan, Cal. App. filed Aug. 19, 1907. Has a trip alongside of the rail and designed to be operated by a projecting tappet on the locomotive. The trip has mechanical and electrical connections for operating signals.

890,125. CABLE CLIP; Stewart H. Crampton, New York, N. Y. App. filed Oct. 30, 1907. A strap for suspending a cable from a messenger in making use of sheet metal stamping with one notched end, which co-operates with a perforation in the other end.

890,144. AUTOMATICALLY CONTROLLING ELECTRIC MOTORS; Harry W. Leonard, Bronxville, N. Y. App. filed Jan. 5, 1903. The combination with a main source of electric energy, a motor to be controlled, a dynamo electric machine supplying energy to said motor, a second motor operated by energy from the main source for driving said dynamo, and means controlled by the amount of energy taken by said second motor from the main source for changing the resistance in one element of said dynamo electric machine.

890,183. MAGNETIC CIRCUIT BREAKER; Ralph Scott, New Brunswick, N. J. App. filed Jan. 17, 1906. A magnetic circuit breaker of such form as to be capable of use on a panel board in place of the usual enclosed fuses. The patentee has a structure which secures a separation of the circuit-breaking contacts with great suddenness and under circumstances which produce a magnetic blow-out of the arc and the formation of gases to destroy the same.

890,198. ELECTRIC RAILWAY; Louis H. Thullen, of Edgewood, Pa. App. filed March 2, 1906. Means for indicating to a motorman whether or not there is sufficient potential in the sectional conductor which he is approaching to operate his car or train, or whether it is excessive.

890,200. ELECTRIC CUT-OUT; William C. Tregoning, Cleveland, Ohio. App. filed April 8, 1907. Electric cut-out of the type having two blocks with under-cut metallic ledges, which can be engaged by a bayonet joint movement, making an electrical and mechanical connection.

890,201. TROLLEY REPLACER; John Trout, Philadelphia, Pa. App. filed July 11, 1907. The patentee has flaring arms pivoted outside the trolley harp, which are raised to guide the wheel on the wire by a tension on the operating cord.

890,220. ELECTROMAGNETIC SIGNAL CONTROLLING DEVICE; Henry M. Crane, New York, N. Y. App. filed Jan. 29, 1906. An electromagnetic signal controlling device adapted to effect the sequential operation of electrical devices, especially in connection with telephone exchange service for use as a combined line and cut-off relay.

890,249. PROCESS OF OBTAINING PURE TIN FROM CRUDE TIN OR TIN ALLOYS ELECTROLYTICALLY; Otto Steiner, Crefeld, Germany. App. filed Aug. 10, 1907. The method of obtaining pure tin, which consists in electrolytically dissolving crude tin in a solution of an alkali sulfid and simultaneously plating out the tin upon a cathode of pure tin and maintaining an electrical tension of less than 0.2 volt between the electrodes.

890,255. INCLOSED FUSE; Frederick H. Weston, Jr., and Frank C. De Reamer, Schenectady, N. Y. App. filed Dec. 6, 1904. The patentee has a pair of flat fuse strips of reduced section at their middle portions and enclosed in a tube containing insulating refractory substance.

890,285. CONDUIT COVER; Hubert Krantz, New York, N. Y. App. filed Oct. 18, 1907. A form of staple or latch for the interior surfaces of conduit box covers, having lugs for guiding the action of the device and all formed of integral sheet metal.

890,299. AUTOMATIC REGULATION FOR DYNAMO ELECTRIC MACHINES; Ferdinand Porsche, Vienna, Austria-Hungary. App. filed April 4, 1903. A dynamo electric machine for motor vehicles, designed to furnish current for driving the machine. The dynamo is specially constructed and arranged on the usual transmission shaft.

890,349. ALARM SIGNAL MECHANISM; Ellsworth E. Flora and Robert J. Zorge, Chicago, Ill. App. filed June 19, 1907. A means for placing torpedoes on track rails in advance of a train, under the influence of signal mechanism.

890,367. RAIL BOND; George A. Mead and Charles R. Sturdevant, Mansfield, Ohio. App. filed Nov. 25, 1904. The rail bond has a terminal provided with a raised rib extending adjacent the ends thereof and along the lower edge to form a recess or seat which, when the terminal is applied to the surface of a rail or other part to be bonded, is closed along the lower edge thereof and open along the upper edge thereof to receive solder.

890,374. CABLE SWITCH; Edward H. Pryor, Medina, N. Y. App. filed July 16, 1907. A form of cable switch having a pair of arms converging in one direction, one of said arms being adapted to lie against and engage a supporting cable and the other being adapted for the attachment of a guiding cable and presenting an inclined and laterally extending guide to direct the supporting hooks of a conducting cable from the guiding cable on to the supporting cable.

890,421. TROLLEY WHEEL SUPPORT; John H. Gross, of Norwalk, Ohio. App. filed Oct. 10, 1906. In place of the usual pole, the patentee has a system of parallel rods, which maintains the usual harp and wheel in a predetermined angular relation to the wire under all circumstances.

890,451. GENERATOR OF ELECTRIC OSCILLATIONS; Valdemar Poulsen, Copenhagen, Denmark. App. filed Feb. 1, 1908. In an apparatus for generating electric oscillations by means of an electric arc or the like, a circuit, including inductance and capacity; an electrode in said circuit, an electrode having a thin coating forming the actual electrode substance and means for continuously renewing said coating.

890,453. APPARATUS FOR ALIGNING CONDUIT SECTIONS; Joseph T. Rice and Coleman King, West Hoboken, N. J. App. filed Feb. 23, 1907. An expansible plug designed to be pushed into a conduit between the sections to be aligned and expanded by wedge action while the sections are being soldered together.

890,458. SYSTEM OF MOTOR CONTROL; George B. Schley, Norwood, Ohio. App. filed March 29, 1907. A system of train control in which only a single train wire is used. Has main controllers on the different cars, which are caused to move into any operative position for either forward or backward movement by operating any one of a number of master controllers throughout the train.

890,496. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; Herbert W. Cheney, Norwood, Ohio. App. filed April 29, 1907. Provides a protective device in conjunction with a starting controller which shall properly protect a motor or other translating device at both starting and during normal operation, while also allowing the heavy current necessary for starting.

890,539. FIELD COIL SUPPORT; Emmett W. Stull, Norwood, Ohio. App. filed March 9, 1905. A coil support, consisting of a plate of spring metal having a central opening to receive a pole piece, said plate having tabs punched therefrom; said tabs being bent out of the plane of said plate alternately in opposite directions.

890,577. VENTILATED LAMINATED CORE FOR DYNAMO-ELECTRIC MACHINES; Walter J. Richards, Norwood, Ohio. App. filed Oct. 31, 1906. A core for dynamo electric machines, comprising a plurality of main laminæ and groups of special laminæ arranged at intervals, forming ventilating passageways, the special laminæ having overlapping openings adjacent, respectively, the outer and inner peripheries of the core.

Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. LI. NEW YORK, SATURDAY, JUNE 27, 1908. No. 26.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

James H. McGraw, President.
J. M. Wakeman, 1st Vice-President. A. E. Clifford, 2d Vice-President.
Curtis E. Whittlesey, Secretary and Treasurer.

239 West Thirty-ninth Street, New York.

Telephone Call: 4700 Bryant. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office....................590 Old Colony Building
Cleveland Office....................1015 Schofield Building
Philadelphia Office....................Real Estate Trust Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico....................	per year, $3.00
Dominion of Canada....................	4.50
Other Foreign Countries within the Postal Union....................	6.00

25 shillings 25 marks 31 francs
may be sent to our European office.

Foreign subscriptions should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue 15,000 copies are printed.*

NEW YORK, SATURDAY, JUNE 27, 1908.

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Discretion in Business Building.

At the National Electric Light convention last May a number of speakers dwelt on the importance of using some common sense in soliciting different classes of central-station business and putting the greatest effort on those which bring the greatest net returns. In the past three years of great activity in the building up of central-station load and the training of new soliciting forces, there has sometimes been too much emphasis placed on the gross amount of load connected without regard to how profitable it is, and how much investment is required to take care of it. The investment charges are such a large percentage of a central-station's cost to serve that it is important to concentrate effort on such kinds of business as yield a high gross revenue per dollar invested as that also means a high net revenue. It is especially desirable at times when financial conditions prevent expenditures in extensions, that effort be devoted to securing more income from existing lines and from existing customers.

Simply to increase a central-station company's connected load without in any way changing the character of that load may result in an increase in net earnings where a plant has been previously underloaded, and where the increase in load has meant nothing but an increase in fuel expense. An increase in the company's load without any change in the character of the load curve and without increasing the average with reference to the peak load means in the long run simply an increase of investment with no decided change in earning capacity. Of course, as a company grows it usually installs more economical machinery and in general has more economical methods of doing business, which tend to increase the net revenue per dollar invested. On the other hand, the larger the company the more expensive is the distributing system and the larger the investment per kilowatt of equipment. As a general proposition, therefore, it may be safely stated that if a plant wishes to make a steady improvement in its net earnings, it must also make a steady improvement in its load factor; that is, in the ratio of the average to the maximum load for the year. Although there is no business taken by a central station company which does not call for some increase of investment, yet there is a great difference in the amount of increase called for by different classes. At the same time, there should not be too much conservatism about taking on business which calls for increased investment; otherwise a central station's territory would not be properly developed and competition would be invited; but once an investment has been made in an extension or in any part of the central-station system, the manager should not rest until business has been built up to utilize that investment to the fullest extent. This usually means that a greater amount of effort than formerly should be devoted to the building up of business which is on at other times than simply during the period of the maximum peak load.

Central Stations and Contractors.

Electric light convention discussions recently have brought out the fact that we are now entering on a new era of co-operation between central-station companies and electrical contractors. That there has not been enough co-operation between these parties in the past is evident to anyone who has been familiar with general conditions. For this lack of co-operation both central stations and contractors are to blame. Two or three years ago, when central-station companies began to awake generally to the necessity of more active efforts to take on additional business, one could hear it frequently said by the central-station man that the electrical contractor had not sufficiently pushed business or that his work was not satisfactory, and for these and other reasons the central-station company was taking this business into its own hands. There are many places where central-station companies are contracting for wiring and keeping supplies mainly because there is no satisfactory independent concern doing that kind of business in the town. If the central-station company has the right to complain that the contractor has not been as active in getting after new business, or as faithful in properly fulfilling his contracts as he should have been, the contractor, on the other hand, frequently has to urge against the central station that it has not given the attention which it should to the business brought in by the contractor.

The fact is, as long as central stations and contractors fail to pull together, just so long will the business lack the rapid development which it should have. The central station should encourage and help the contractor in every way possible. There have been times when central-station companies have thought it advisable to sell electric irons and some other devices at about cost, thus shutting the contractor out of this class of business. It is entirely true that if left to the contractors alone, much of this business would never have been developed. The contractor and dealer cannot afford to spend as much money on such sales as the central station. Nevertheless, the contractor adds another business-getting factor in a town, and if his efforts are properly encouraged by the central station, he can do the company a world of good, besides relieving it of considerable detail work. We have in mind one small town where the central-station company and contractor are planning a campaign together for the introduction of different devices, and are working as harmoniously as if they belonged to one organization. The company has even gone so far as to help the contractor financially by taking the commercial responsibility for large orders of different devices which the contractor would not dare assume alone. This the company is in a position to do because it has a fully mapped-out policy that calls for the introduction of a certain number of appliances in a certain time, but it will take no active part in their introduction if the contractor demonstrates his ability to place them along with his other work. In the case of winning over gas customers to tungsten lamps and installations of that kind, it is the understanding that the contractor shall exert his best endeavors to put in a tungsten lamp installation before the company takes a hand in the game. It is true that the contractor makes a certain amount of profit on these things which the company, with an equal amount of effort, might otherwise make; but given an energetic contractor and a company which has its hands full of other matters, the chances are that the company would not, after all, make much, and that the central station business will grow faster by virtue of having a live contractor looking after one end of it than if the company were handling the whole thing. Of course, conditions vary in different towns. The conditions just described do not exist in every town. Nevertheless, there is a decided movement among both large and small companies toward better co-operation between the contractor and central station. The dinner given to the contractors by the central station at Brooklyn recently, in which the plans of the company were explained and the co-operation of the contractors enlisted, is an illustration of this.

The Faulting of Tantalum Lamps.

We present on page 1374 some interesting pictures reproduced from microscopic observations of tantalum filaments taken from incandescent lamps at different stages of service with different types of current supply. It is well known that tantalum filaments last much longer on direct-current circuits than on alternating-current circuits, and a tantalum filament that commences by looking like a polished walking stick under the microscope, soon becomes rocky on alternating-current supply, and resembles a basaltic column badly broken up, like the pillars of Fingal's cavern. The pictures presented show the effect very well, but no one has yet suggested any theory of the action. It would be very interesting to know whether the result is purely thermal, due to rhythmic heating, or whether it is electrical in some degree.

Uniform Illumination.

An article by Mr. Alfred A. Wohlauer on page 1376 of this issue gives some convenient constants for use in determining the proper number and distribution of certain lighting units to obtain a desired illumination effect. The author demonstrates by well-known photometric relations that the number of lamps required varies directly with the product of the area to be illuminated with the strength of the illumination desired, and inversely with the effective lighting power of each lamp, and is independent of the height of suspension. The equation used for expressing this relation contains a certain factor a, the value of which depends upon the lighting units employed. The exact conclusions of the author are based on the use of lamps equipped with certain types of reflectors in order to obtain uniformity of illumination. The table giving values of the factor a should prove serviceable in the solution of practical problems in illuminating engineering.

It is interesting to note that the actual value of the factor a for any chosen lighting unit affords an excellent indication of the efficacy of the reflector in turning the light rays from the lamp into the desired direction. The values reported by Mr. Wolhauer are evidently those obtained from photometric observations of the rays sent immediately from the lamp or reflector in the desired directions. Thus the light which may reach the illuminated plane by reflection from the ceiling has been neglected, and the values represent results that would be obtained with black ceiling and side walls. Tests of actual installation of lamps equipped with reflectors that absorb very little light would show that the effective illumination of a room with white walls and ceiling depends more upon the total candle-power of the lamps than upon the exact shape of the light-distribution curve of each lamp and its reflector. It would seem, therefore, that with the factor a there should be used an additional factor whose value depends upon the light reflected from the ceiling.

What Is Light?

This question has been asked in a great variety of different meanings, and has likewise been answered, at least in attempt, in an equally great variety of significances. The naive reply of the schoolboy to this question, in an elementary examination on physics, ought not to be omitted. It ran thus: "Light, as I understand it, is very little understood." The particular inquiry which we contemplate on this occasion, however, is directed to a scientifically accurate yet practically manageable definition of that commodity which is produced, either naturally by the heavenly bodies, or artificially by lamps, in order to enable us to use our eyes. The definition is specifically directed to the relation between this commodity and the radiant energy upon which it depends. Light is obtained from radiant energy; that is, electromagnetic-wave energy of certain kinds. The wave energy must be rhythmically sustained, like a steady organ tone, as distinguished from a random succession of noisy and irregular impulses. The wave energy must also reach the retina within certain limits of vibration-frequency, or of wave-length. In other words, it must lie within the visible spectrum. Suppose that we know the amount of such electromagnetic power falling on the eye, and also the relative distribution of this power with respect to frequency or wave length. Will the sensation of light corresponding thereto be proportional to this power, or how will it vary with the amount, or with the spectrum distribution?

These are very important questions from the scientific side, full of interest to the physicist, the biologist, the physiologist, the oculist and the optician. They are also very important questions from the practical side, to the above named specialists, as well as to the illuminating engineer, the lamp manufacturer, the electrical engineer and the central-station manager. All of these are virtually interested in the production, utilization and sale of the commodity light. How to give satisfactory physiological light-sensation from electric energy in kilowatt-hours, is a problem that is of the greatest commercial importance, however complex and many-sided it may be. The problem is so large that the central station confines itself ordinarily to the generation of electric energy, except in contracts for street lighting. The illuminating engineer shoulders the next stage of the task, in undertaking to provide adequate and æsthetic illumination, measured in foot-candles, or meter-candles, with due regard to economy, from electric power. These specifications are sufficient for the existing industrial conditions. But the specific problem of supplying adequate and pleasing luminous sensation has had to be deferred because we do not yet grasp it properly, or understand its relations.

The article by Mr. P. G. Nutting, on page 1371 of this number, is addressed to a preliminary outline of these conditions which define light sensation in terms of radiation-power. It is shown that three factors are involved, namely, first the relative distribution of the power in the visible spectrum; second, a sensibility-factor of the eye which must be applied to the incident power, in order to arrive at the total retinal stimulus; and third, a sensation-factor which must be applied to the above product in order to determine the total luminous sensation which the stimulus produces. Both the sensibility-factor and the sensation-factor may vary among different individuals—notably, in color-blind persons. Taking average values, however, to represent average individuals, the sensibility factor will vary with the spectrum distribution, while the sensation-factor will vary with the stimulus. If we double the visual stimulus on the retina, we do not double the visual sensation. According to the views given in the article, which are generally accepted, we have two kinds of instruments in our retina for perceiving light. These are respectively the rods, and the cones, which lie distributed over the retinal surface in great numbers, each being said to have an independent nervelet connection in the great optic nerve connecting the retina with the brain. The rods appear to be mainly distributed over outlying areas of the retina, and are supposed not to be capable of conveying color sensation. The cones are most numerously distributed in and near to the yellow-spot, the center of visual perception, and are supposed to be differentiated with respect to color impressions. It would seem that the rods are vestiges of the visual implements used by our remote ancestors in the order of evolution; while the cones are of more recent development. This idea receives support from the fact that the rods are relied upon for very feeble visual sensations, or illuminations on the eye of 0.1 foot-candle or less—that is, in illumination too feeble to read by; whereas, for illuminations above this value, and particularly above 1 foot-candle, the cones become actively engaged. This accounts for the fact that colors disappear at dusk. A Whistlerian night-picture gives us hardly any suggestion of color values; we see only muddy murkiness of varying depths. In such feeble lights, the cones are sound asleep. In dull light we do not spare the rod but spare the cones.

It is a very remarkable fact, as pointed out in the article, that in very feeble light, i. e., rod-light, the sensitiveness of the eye is a maximum at a color that seems to vary slightly among different individuals but averages 0.51 μ, or a little over half a micron. This is in the green, and toward the blue side thereof. On each side of this green color the sensitiveness of the eye diminishes according to a curve that resembles the probability curve. Perhaps it should be a probability curve, because we are dealing with the behavior of a very great number of different rods of the same general type. It is interesting to remember that water, and especially sea-water, is much more transparent to green and blue light than to yellow and red light, so that fishes, a few meters below the surface, have to get along with vestiges of greenish blue light. Possibly we owe our retinal rods to fishy ancestors who developed them in many generations of feeble greenish blue light. When we bring our retinal cones into action, however, that is, when we work in regular daylight values of illumination, amounting to several or many foot-candles, the article shows that the maximum sensibility of the retina is no longer at 0.51μ, but at nearly 0.57μ, or in the yellow. It has been shown, in fact, that the maximum sensitiveness of the cone-using eye corresponds in spectrum position, at least approximately, with the maximum power of sunlight. Possibly then rod perception is adjusted, by long-distance inheritance, to the best daylight illumination under the surface of the sea; while certainly cone perception is adjusted to the best daylight illumination above that surface. The Purkinje effect is the result of this variation of retinal sensibility to different colors as we reduce from strong to very weak illuminations.

Chicago Railway Power Contract.

The Commonwealth Edison Company, in Chicago, is closing up the details of a contract with the Chicago City Railway Company which is practically an extension of the arrangement already in force, whereby most of the power for the Chicago City Railway system is supplied by the Commonwealth Edison Company, as extensively commented upon in our article in the May 16 issue on the Commonwealth Edison system. Besides this, negotiations are under way with the Chicago Railways Company operating the surface lines on the north and west sides for an extension and enlargement of its contracts. Both surface and elevated railroad lines of Chicago, with the exception of the South Side Elevated Railroad, have depended mainly on the Commonwealth Edison Company for power to take care of all the increase of business for a number of years past.

Educational Plans of Boston Edison Company

The Edison Illuminating Company, of Boston, has completed arrangements with Prof. Sydney Whitmore Ashe to carry on next winter a comprehensive scheme of educational work for its employees. The course, which will be given beginning Jan. 1, will be along lines somewhat similar to the educational courses carried on in the past two years by the New York Edison Company and the Brooklyn Edison Company. The number of lectures to be given will be limited to 20, sessions being held both afternoon and evening, thus affording all employees an equal opportunity to attend. The course will be given directly under the supervision of the Edison Club, a special lecture committee being appointed for the purpose. Mr. Herbert W. Moses, president of the club, will be chairman of the committee. The lectures will be one and one-half hours in length, and will be both theoretical and practical, everything being demonstrated in an experimental manner.

Process for Making Incandescent Lamp Filaments.

A patent issued June 16 to Werner von Bolton, of Berlin, Germany, describes a process for making tantalum-lamp filaments. The application, dated Feb. 4, 1906, is a division of an application filed Dec. 28, 1905.

As tantalum metal exists in the form of an amorphous powder, to obtain a coherent metallic mass, the powder may be mixed with a binder, such as paraffin, or preferably subjected to high pressure. In either case the resulting mass is heated by means of an electric current in the absence of air *in vacuo* or in an atmosphere of a gas, or surrounded by an indifferent substance having no action upon tantalum. Under the influence of the heat produced by the electric current finally a welded or molten homogeneous metallic body is obtained which can be hammered or forged or rolled or drawn to wire or treated in any known mechanical way. The inventor prefers to reduce the homogeneous metallic body obtained in the above-described manner to rods or the like of suitable cross-section by pressing, rolling or a similar treatment, and then to draw filaments from the rods.

Boston Finance Commission and Street Lighting.

The Finance Commission of Boston has decided in sub-committee not to submit any report at present on the street lighting situation. In an interview with a representative of this journal recently, Mr. George U. Crocker, a member of the committee, stated that although he had made a casual study of several European systems on a recent trip abroad, nothing would probably be done until experts of the Edison Company and the Boston Consolidated Gas Company, who are now abroad, return with data secured in a thorough study of street lighting conditions there. Mr. Crocker was much impressed with the Welsbach street lighting as practised in Berlin, but did not imply that electricity could not meet the situation under Boston conditions.

Among the subjects taken up by the commission early in its work was the cost of street lighting, and in harmony with its policy of pointing out all possible economies, the commission has taken a special interest in this matter. Only a few weeks ago the Edison Company took over the public building lighting of the city on its regular basis of rates, thereby saving the city about $1,000 per month. The recent reduction recommended by the Gas and Electric Light Commission from 15 to 12 cents per kilowatt-hour will tend to benefit the whole city. The Edison Company has always shown a disposition to go more than half way in the supplying of information to bodies of this kind, even when considerable cost is involved for clerical labor and expert analysis. When all the data desired by the commission are in, it will render a report to the City Council and Mayor Hibbard.

Electricity in a Modern Hotel.

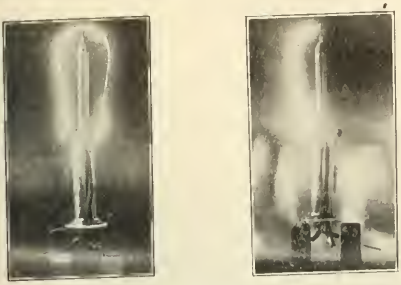
At a meeting of the New York Electrical Society, held at the Hotel Astor, on June 17, Mr. Frederick A. Muschenheim gave an interesting illustrated talk on the electrical equipment of the hotel, where about 900 motors are in use, and many ingenious electrical devices have been introduced for the convenience of the guests. A description of the isolated generating station and of many of the motor installations of the hotel appeared in our issue of Feb. 11, 1905. Since that time the motor applications have been greatly extended and many new uses have been found for electricity. It is noteworthy, however, that the load on the generating apparatus has not only increased, but has actually decreased, due to the introduction of improved lighting units, the high-efficiency tungsten lamps being much in evidence at the present time.

Among the devices that require almost no electrical energy, but prove of great benefit in facilitating the smooth running of the hotel, the most prominent is the telautograph, which is used for recording all orders given by the guests and transmitting them simultaneously to the employee who is to execute the order and to the chief of employees in order to insure their prompt execution. An order telephoned from the guest's room is immediately recorded in writing by the girl at the telephone central, which is also the "central" for the telautographic system. Simultaneously the order appears on the record sheet at the desk of the chief of employees and at the "substation" of the employee who must attend to the order, the exact time being recorded on each sheet. When the order has been filled the employee records this fact, together with the exact time on his sheet at his substation and simultaneously the chief of employees is notified of the act. This system of recording and transmitting eliminates the errors that accompany verbal orders, minimizes the time consumed in satisfying the wants of the guests, overcomes the disadvantageous crowding of the office, halls and elevators with employees, insures the maximum attention to duty on the part of each employee, and reduces the expenses to a minimum. A description of the telautograph was given in our issue for Dec. 8, 1900.

An equipment that has proved of great convenience is a system of miniature lamps of the telephone-switchboard type for indicating to the chief of employees at each instant the exact position in the hotel where each chambermaid may be found and for showing to each guest the room in which the particular maid in charge of his floor is working.

Each maid is provided with a key which serves as a switch handle for lighting a small lamp at the door as she enters a room and simultaneously lighting the indicating lamp at the desk of the chief of employees.

By means of an illuminated sign in the room of each guest he is notified immediately when mail matter reaches the office for him. The placing of a letter in the post-office box correwith the filaments of other recently developed lamps, is that the cost of the Helion filament is stated to be little more than that of the ordinary carbon lamp. Thus, while the lamp is claimed to have a higher efficiency than that of other lamps recently placed on the market, its cost is very much less. It is also claimed that a high vacuum is not necessary, so that the slight increase in cost due to the filament itself is partially offset by the saving due to a lower vacuum.



FIGS. 2 AND 3.—HELION LAMP FILAMENTS BURNING IN AIR.

Fig. 1 is a photograph of two Helion lamps burning in air in the laboratory of the inventors. Fig. 2 shows multiple filaments for 110-volt or 220-volt circuits, or both, and Fig. 3 shows the multiple filament, one-half of which is burning. Both views show the filament in air and give an excellent idea of its size.

Device for Solving Alternating-Current Problems.

Mechanical calculating devices have two distinct advantages over the long-hand method: They save time and they cannot make a mistake. The slide rule, which has become an indispensable part of every engineer's equipment, cannot be used in operations where addition or subtraction is involved, and, therefore, is of little use in the solution of the equation $A = \sqrt{B^2 \pm C^2}$, which is so often encountered in alternating-current work. Moreover, the solution of trigonometric problems by the slide rule is somewhat tedious. The device described below is especially adapted to the solution of these very problems, and should therefore be heartily welcomed by all who have occasion to deal with vector quantities.

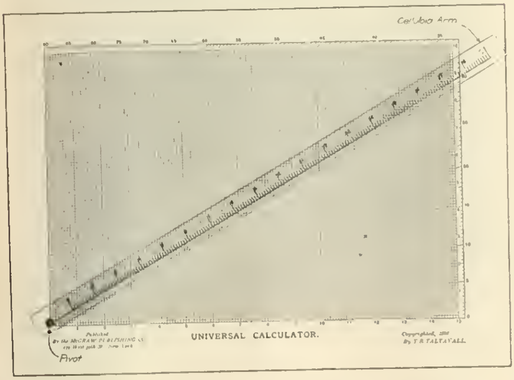

Celluloid Arm
UNIVERSAL CALCULATOR.
Published By the McGRAW PUBLISHING Co
Copyrighted, By T. R. TALTAVALL.
Pivot

FIG. 1.—CALCULATING CHART.

The Universal Calculator, as it is called, is the invention of Mr. Thomas R. Taltavall. It consists of a heavy piece of cardboard (7 in. x 9 in.), on one side of which is printed a chart, which is nothing other than cross-section lines divided up according to the decimal system. A transparent celluloid arm is pivoted in the lower left-hand corner. This arm is provided with a linear scale exactly similar to the linear scale on the chart. This scale is printed on the lower side of the celluloid so as to avoid errors due to parallax. In addition to the two linear decimal scales, the upper and right hand edges of the chart are provided with an angular scale, which gives the angles included by the arm and the lower side.

Although the Universal Calculator can be used for all kinds of calculations involving multiplication, division, etc., it is especially suited to calculations involving the use of trigonometry. It is immediately apparent from Fig. 1 that the arm can be placed so as to construct any given right-triangle, and that the hypothenuse, the sides, and the included angle can be read off directly from the various scales. In cases where the triangle is not a right-triangle, it must be divided into two right-triangles, and each one solved separately; therefore, two settings of the arm are necessary in this case.

Fig. 2 shows the so-called trigonometric lines. O corresponds to the pivot of the arm; $O\ S$ to the arm, D to the point 10 on the arm, $A\ T$ to the heavy scale line passing through 10 on the horizontal scale, and the $B\ S$ to the top line of the chart. Now it is well known that if the angle $S\ O\ A = \theta$, $O\ C = \cos\theta$, $C\ D = \sin\theta$, $T\ A = \tan\theta$, $B\ S = \cot\theta$, $O\ T = \sec\theta$, and $O\ S = \csc\theta$.

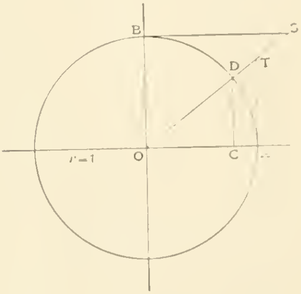


FIG. 2.—TRIGONOMETRIC LINES.

Referring to Fig. 1, the arm is placed at 30 deg. Reading to the right from the point 10 on the arm, sin 30 deg. is found to be 0.5; reading down from the same point, cos 30 deg. is found to be 0.866, and then reading to the right from the intersection of the heavy line (10) with the arm scale line tan 30 deg. is found to be 0.578.

In alternating-current work the problems involving quadrature vectors are solved with the greatest ease, and the power-factor, as well as the angle of phase displacement, may be read off at once. For instance, assuming the setting given in Fig. 1, if the resistance were 13 ohms, the reactance would be 7.5 ohms, the impedance 15.1 ohms, the power factor 0.866, and the phase angle 30 deg. The chart is well adapted to the solution of complex alternating-current problems involving series reactance and resistance, and shunted conductance and susceptance; impedance and its two vector components can readily be converted into the equivalent admittance and its two vector components.

Another important application of this device is in the solution of problems involving a straight-line ratio. For instance, if it is desired to convert meters to inches, set the arm so that it will intersect the upper border line of the chart at 39.4 units from the left-hand edge; then if the horizontal scale is considered to represent inches and the vertical scale meters, any number of meters can at once be changed to inches, or *vice versa*, by starting on one scale following the scale line to its intersection of the arm, and then proceeding from that point to the other scale where the corresponding number of the other kind of units will be found

Hearing on Light and Power Contracts.

At the hearing June 17 before Commissioner Milo R. Maltbie, of the Public Service Commission of New York City, into the contracts of the local electric-light and power companies Mr. Frank W. Smith, secretary of the United Electric Light & Power Company, was the principal witness. Mr. Smith said that his company had 83 special contracts in which retail customers were allowed 10 per cent discount in consideration of making lamp renewals, and 14 old customers who received service at the old rates prevailing before the advance of July, 1905, was made. Mr. Smith said that the company no longer made contracts allowing discounts for lamp renewals because it wanted to discourage customers from making their own renewals. He admitted that it was more profitable to the company to make its own renewals than to allow the discount.

Mr. Smith filed with the commission a full copy of all the riders and special clauses which his company places in its wholesale contracts. The breakdown clause which covers the installation of auxiliary service to private plants does little more than provide a minimum yearly consumption and a recompense for putting in the service. The same provisions as used by the New York Edison Company were presented to the customer who accepted the 120,000 kw-hour contract. The consumption of tenants is allowed to count on the total of the landlord. All of the contracts contained the 30-day cancellation notice. In the case of new buildings, the minimum guarantee is waived for six months, the 120,000 kw-hour clause dating from six months after the contract actually begins, but in that time the 5-cent rate applies. The contract also stipulates that the customer can change to a standard form of contract at any time he desires. Mr. Smith testified that the reason for giving the 5-cent rate to landlords or lessees was to get the guarantee of 120,000 kw-hours' consumption, and also to secure a six-year contract. He also said that the rent-free space in large buildings for transformers was a very valuable consideration and that his company always availed itself of the privilege. He said that the discontinuance clause was no serious disadvantage to this class of contract because the experience of the company was that once the service was begun it generally continued. This was especially true, the witness said, because his company used the alternating current, and its apparatus was not suitable for any other service.

In answer to the commissioner's direct question, Mr. Smith said he saw no objection to making all the various forms of contract and rates offered by his company public and of offering the same privileges to all consumers. He said that his company was preparing a pamphlet embodying all of these riders and provisions. The commissioner asked the witness to produce the company's books at the next hearing, June 22, so that an estimate could be made of how much the company profited by the guarantees of quantity of consumption and hours of service.

At the hearing on June 22 Mr. W. W. Freeman, general manager of the Brooklyn Edison Company, was recalled for further examination as to the special contracts of his company. Mr. Freeman said that one special contract with a large consumer was for a term of six years without limitation clause and that the consumer guaranteed to use $10,000 worth of current per year. Under this contract he paid 3⅓ cents per kw-hour for the first 525,000 kw-hours and 3 cents for all above that amount. Mr. Freeman said that the company had prepared recently a standard wholesale power contract running for five years under which the rates varied from 5 cents to 3.05 cents per kw-hour, according to quantity of current consumed. He admitted that with very large consumption the special contract cited would average a higher rate than the new contract. The witness told of one special contract, for four years, at a rate of 2¾ cents per kw-hour, with a guarantee of $10,000 yearly, and another with the same guarantee running for 10 years, the terms of which were 3¼ cents per kw-hour for the first 250,000 kw-hours, 2¾ cents for the second 250,000, and 2½ cents for all over 500,000. Other special contracts were shown at varying rates, one a two-year contract with a guarantee of $15,000 per year, the rate ranging from 2½ to 2 cents per kw-hour. Many of these special contracts, Mr. Freeman said, were experimental and made by the company to fit especial cases. Mr. Freeman said that the company was always willing to give a new customer all the benefits bestowed upon an old customer similarly situated. He admitted, however, that the terms of these special contracts were not made public, and a prospective customer would have to know of them from private sources.

Canadian Electrical Association Convention.

The eighteenth annual convention of the Canadian Electrical Association was held June 17-19 in Toronto, which city, owing to the large number of conventions meeting within it, has acquired the name "Convention City of the Dominion of Canada." About 200 delegates were in attendance from all parts of the Dominion, together with a number of visitors from the United States. The majority of those present were central-station men and engineers, but the supply houses were also largely in evidence. Among those noted as being present from the United States were: Messrs. C. R. McKay, Toledo Railways & Light Company, Toledo, Ohio; Philip H. Hoover, N. Y. Insulated Wire Company, Herman P. Kimball, Standard Underground Cable Company, and Geo. Williams, all of New York.

The managing committee, to whom is due the success of the convention, was composed of Messrs. R. G. Black, A. A. Dion, B. F. Reesor, C. B. Hunt, J. M. Robertson, J. J. Wright, W. Williams, H. O. Fisk, J. W. Purcell and J. G. Glassco. These gentlemen, with the assistance of the president and secretary, did everything in their power to provide entertainment for the delegates and visitors.

On Thursday afternoon at the close of the session the election of officers took place and resulted as follows: President, Mr. W. N. Ryerson, general superintendent, Ontario Power Company, Niagara Falls, Ont.; first vice-president, Mr. R. M. Wilson, general superintendent, Montreal Light, Heat & Power Company, Montreal; second vice-president, Mr. P. S. Coate, Chatham Gas Company, Chatham, Ont.; secretary-treasurer, Mr. T. S. Young, Toronto. Managing committee: Messrs. R. G. Black, Toronto; A. A. Dion, Ottawa; B. F. Reesor, Lindsay; Chas. B. Hunt, London; J. J. Wright, Toronto; W. Williams, Sarnia; H. O. Fisk, Peterboro; J. W. Purcell, Walkerville; W. A. Pearson, Niagara Falls, and R. S. Kelsch, Montreal.

The chair was occupied by the president, Mr. R. S. Kelsch, consulting engineer of the Montreal Light, Heat & Power Company, Montreal. Addresses of welcome were given at the opening session by Alderman Graham on behalf of the corporation of the city, and by President Faulkner and Professor Galbraith, on behalf of the University of Toronto, it being due to the kindness of these gentlemen that the convention was permitted to be held in the Chemistry and Mining Building of the University. President Faulkner during the course of his address stated he recognized that the relations between the Canadian Electrical Association and the University should be close, and that the work of electrical engineers would contribute very largely to the practical efficiency of the industrial life of the community in Canada as a whole.

The secretary-treasurer, Mr. T. S. Young, presented his annual report, in which he stated that a special effort which had been made to interest a large number of private light and power companies in the association had resulted in 92 of such companies joining. A deputation, he said, had waited on the Dominion Government on Feb. 12, 1908, and in consequence the registration fee for inspecting gas and electric meters had been abolished, effecting a saving of $6,000 to the lighting companies.

President Kelsch in his address referred to the severe and trying time due to the financial panic which had occurred since the last meeting; but after traveling over some 4000 miles of Canadian territory he was of the opinion that Canada was on the upgrade. A comparison of steam and electric roads showed that the electric roads had stood the test better than the steam roads. Referring to the tungsten lamp, he thought it would be a benefit to both the lighting stations and to the consumer, and the decrease in revenue due to its use would be more than offset by its high efficiency and increased sale.

During the morning and afternoon sessions on Wednesday the following papers were read and discussed: "Power Rates and Factors Which Influence Them," by Mr. W. N. Ryerson, general superintendent of the Ontario Power Company, Niagara Falls, Ont.; "How to Increase the Station Load," accompanied by lantern slides, by Mr. Geo. Williams, New York City; "Lost and Unaccounted for Current," by Mr. C. R. McKay, Toledo Railways & Light Company, Toledo, Ohio; and "Various Electrical Power Plants by European Designers," by Mr. C. H. Mitchell, consulting engineer, Toronto.

In the first-mentioned paper Mr. Ryerson stated that the factors which have the greatest influence upon rates to be charged were, first, the distance of the customer from the source of supply; second, the amount of power the customer desires to use; third, the character of the customer's load. The first two factors were well understood and required little comment. The question of the third factor, however, was by far the most important element entering into the cost of supplying power. The three principal methods used in charging for power are, the flat rate, the meter rate and the sliding scale. A fourth method, which had only a limited application, is what has been termed "Second Class Power." The meter rate was the most universally used and best understood method of charging for power. However, the writer of the paper, while he held no brief for any particular method of charging, preferred what he had described as the "Sliding Scale" method, especially where power is derived from waterfalls, on the ground that it offered greater inducements to raising the load factor. In conclusion he said that fortunately there has, so far, been no legislation in the Dominion of Canada regarding rates for electric light or power, and it would seem that the various members of the association should be on the alert to forestall and prevent such legislation, by so adjusting their rates of charging that no inequality or unfairness could be claimed. Such a course would in a large measure forestall any legislation, which was almost certain to be detrimental to power companies.

Mr. Dion, of Ottawa, in discussing this paper stated that taking everything into consideration he thought for the sale of small units the meter rate, together with a flat rate based on the total installation and the size of the motor, were the nearest to meeting properly the conditions without running into complications.

Mr. Williams in presenting his paper gave point to his arguments by a series of lantern slides showing the large and ever increasing revenue which was being obtained from illuminative sign lighting, decorative lighting and outline lighting, which line of business was rapidly developing in the large towns and cities of the United States.

The paper by Mr. Mitchell on "Power Plants by European Designers" was devoted largely to the hydraulic side of the question, and was historical and descriptive of the different types in use in southern France, Italy, Switzerland and the Austrian Tyrol. In connection with his description Mr. Mitchell threw on the screen upward of 100 views taken by him with his camera while on a trip through the different countries mentioned.

On Thursday the papers presented were as follows: "Modern Street Lighting," by Mr. A. E. Fleming, Canadian Westinghouse Company, Ltd., Nernst Lamp Department, Hamilton, Ont.; "Electrical Franchises: Their Legal Status and Basis of Valuation," by Mr. Jas. Bicknell, King's Counsel, one of the leading members of the bar of Ontario; "Contracts," by Mr. Robert McKay, King's Counsel, of the well known law firm of Messrs. Johnston, McKay & Company, of Toronto; and "Electrical Plant Earnings Per Capita," by Mr. W. A. Bucke.

Considerable discussion took place during the reading of Mr. Fleming's paper on the respective merits of the tungsten lamp, the Nernst lamp, the flaming arc lamp, and other forms of open and enclosed arc lamps, during which Mr. Fleming pointed out that the cost of maintenance had to be considered more than the cost of furnishing.

Mr. Bicknell's paper dealt with the subject of electrical franchises in a very comprehensive manner under the following heads: Who had the right to grant franchises; conflict of franchises; stringing wires over private lands; sale of franchises on execution; revocation or alteration of franchises; taxation of franchises; expropriation; municipal competition with electrical companies; nuisances; and basis of valuation of franchises. Mr. Bicknell at the close of his paper answered many questions put to him by the delegates.

Mr. McKay's paper on contracts emphasized one point in particular, namely, that when you come to draw a contract which will be satisfactory or proper, whether a business man or a lawyer is doing it, the first thing is to sit down and think out and know precisely what you want and all that you want; and when you have got that far you have taken the longest possible step in getting your contract ready.

A paper on "Regulation of Electric Currents or Circuits" was to have been read by Mr. W. G. Chace, of Toronto, but owing to his unavoidable absence from the city the main features were dealt with by Mr. R. G. Black, of Toronto, and in doing so, he illustrated by the use of slides the principal forms of regulators in use at the present time.

On Friday papers were read as follows: "Grounding of Transformer Secondaries," by Mr. W. L. Macfarlane; "The National Electric Code," by Mr. H. F. Strickland; and "The Oscillograph," illustrated with slides and instruments, by Mr. H. W. Price, consulting engineer, Toronto.

The subject of the grounding of transformer secondaries was one which caused considerable discussion. The president stated that it was a subject of great interest to all central-station men; a great deal had been said lately upon the subject; some of the companies having adopted one method and some another; some had criticised the pipe ground and on the other hand some of the best engineers said the pipe ground was all right. He further stated that he had learned a short time ago that the Boston Edison Company had made a rule that it would not connect up to a new customer unless the wiring in the house was provided with a permanent ground installed by the firm which did the wiring. In Montreal during the past two years approximately 40 per cent of the lighting transformers have been grounded, but the question of grounding 550-volt motor systems has not yet been decided. Water pipes are not used for grounds, but this matter is being taken up with the authorities with a view to using the water pipes for this purpose. Present practice in Montreal is to ground the neutral of pole transformers by means of No. 4 copper wire stapled to pole and soldered to a galvanized iron rod driven 8 ft. into the ground. A piece of pipe is used to protect the ground wire for a distance of 8 ft.

The exhibition of the oscillograph by Mr. Price closed the convention proper, after which the members took luncheon together and were then treated to an illustrated lecture on the large power plants of America, by Mr. R. J. Clark, of the Toronto Railway Company, describing some of the most difficult power house work that has ever been done in America, notably in Sao Paulo, Mexico, Niagara Falls and Winnipeg.

SOCIAL FEATURES.

The social features of the convention consisted of the following: A moonlight excursion on Lake Ontario, the opening of the University Science Buildings for inspection, a demonstration of electro-metallurgical apparatus by Mr. Saul Dushman, a special trip by street railway to Scarboro Beach Park, an afternoon tea for the ladies at the Royal Canadian Yacht Club, Centre Island; a drive around the city and a baseball match between representatives of the manufacturers and operating companies at Maple Leaf Park, Hanlan's Point.

By courtesy of the management of the various companies arrangements were made whereby all persons wearing the association badge were permitted to visit the power plants and distributing stations in the city at any time, a map being provided showing the location of these different stations. The Toronto Railway Company very generously gave free transportation during the convention to all wearing the association badge. The Bell Telephone Company also provided a service in the convention building specially for the accommodation of members.

CURRENT NEWS AND NOTES.

MICHIGAN ELECTRICAL ASSOCIATION.—The next annual meeting of the Michigan Electrical Association will be held at Grand Rapids, Mich., Aug. 18-21. Mr. A. C. Marshall, Port Huron, Mich., is secretary.

RICHMOND ELECTRICAL SHOW.—The Richmond Passenger & Power Company is arranging for an electrical show to be held in Richmond, Va., in the near future. The educational part of the exposition will be in charge of Mr. John W. Foster, of New York.

WIRELESS ON THE LAKES.—The Detroit & Cleveland Navigation Company has wireless telegraph stations at Buffalo, Cleveland, Detroit and Port Huron, and will establish another station in Toledo. All the steamers of the company are now equipped with Clark wireless telegraph apparatus.

HUDSON TUNNEL EXTENSION OPENED.—Beginning Monday, June 15, regular service was established in the McAdoo tunnel between Hoboken and New York City as far north as Twenty-third Street and Sixth Avenue, New York.

ABUSE OF LEASED TELEGRAPH WIRES.—It is announced that the Western Union and Postal Telegraph companies will abolish their leased wire service to brokers, on the ground that undue advantage has been taken of the leases by brokers diverting business away from the telegraph companies. It is stated that some brokers have even solicited outside commercial business at one-half the usual rate.

ELECTRICAL SHOW IN WORCESTER, MASS.—The Worcester County Mechanics' Association has decided to hold an electrical and mechanical exhibition in Worcester next February. The arrangements for this have been placed in charge of a committee composed of President Daniel E. Denney, of the association, and Messrs. Julian F. Bigelow and Charles H. Norton.

SOUTHWESTERN ASSOCIATION QUESTION BOX.—Mr. Samuel Kahn, of the San Antonio Gas & Electric Company, editor of the question box of the Southwestern Electrical and Gas Association, has published the question box this year in book form. The matter takes up 167 pages and covers practically all departments of electric and gas business. Both questions and answers are well selected, and the result as a whole reflects credit on the association and its editor.

COLUMBIA UNIVERSITY SUMMER COURSE IN ELECTRICAL ENGINEERING.—One of the summer courses in engineering that will be given at Columbia University, July 7 to Aug. 14, will be in electrical engineering. This will consist of lectures six hours per week by Prof. C. O. Mailloux on electric train movement. Prof. C. E. Lucke will be in charge of a course having gas engines as its subject, consisting of six hours of lectures and the same number of hours of laboratory work weekly.

GOVERNMENT EXAMINATIONS FOR ELECTRICAL ENGINEER.—The United States Civil Service Commission will hold examinations in various parts of the country on July 22-24 to secure eligibles for one or more vacancies in the position of electrical engineer and mechanical draftsman in the Reclamation Service. The entrance salary is $100 to $200 per month, and eligibles may be appointed as electrical engineers or assistants for the design, installation or operation of hydro-electric and steam-power plants in the West, or as mechanical draftsmen for office work and drafting in connection with the preparation of plans.

NEW TELLURIDE POWER PLANT.—Preliminary tests have been completed on the first 20,000-hp unit of the new power plant of the Telluride Power Company, at Grace, Idaho. The power for this plant is furnished by the natural flow of the Bear River, and the water stored in Bear and North Lakes, which have been converted into natural reservoirs. The station building is designed for an ultimate capacity of 80,000 hp. The pipe line is 8 ft. in diameter and six miles long, the net head being 540 ft. This is the sixth plant added to the system of the Telluride Power Company in territory tributary in Salt Lake City.

CONVENTION TELEGRAPHIC SERVICE.—It is estimated that during the meeting in Chicago of the Republican convention no less than 5,500,000 words were sent by telegraph. The two telegraph companies and the several press associations had prepared to handle 1,200,000 words a day from the convention hall, and large corps of bicycle messengers were organized to take overflow matter to the main city offices. The Western Union Company had 110 circuits from Chicago to New York City, and 150 expert operators were on duty, in addition to those detailed from the Chicago staff. The Postal Telegraph Company had 135 extra operators on duty.

ANNUAL MEETING OF N. Y. E. S.—At the annual meeting of the New York Electrical Society, held in the Hotel Astor on June 17, the following officers were elected: Messrs. Henry A. Lardner, president; W. Noble Dickinson, Jr., J. C. Forsyth and S. D. Sprong, vice-presidents; George H. Guy, secretary, and H. A. Sinclair, treasurer. The secretary's report showed that the society now has a total membership of 880, an increase of 49 over the number last year. Mr. Frederick A. Muschenheim delivered an address on "Electricity in the Modern Hotel," an abstract of which is published elsewhere in this issue. After the address the electrical equipment of the hotel was thoroughly inspected.

UNIVERSITY OF MINNESOTA ENGINEERING COURSES.—The University of Minnesota will increase the length of its engineering courses from four to five years, and at the same time has arranged to increase to a small extent the amount of technical work. The increase is, however, intended principally to enable students to take up more general culture studies than in the past, as it is believed that this will result in turning out a better grade of engineer. The added work consists of additional requirements in modern languages, economics and political science. The first year is uniform for all engineering courses. As the first four years provide a good general education, the degree of bachelor of science will be given at the end of the fourth year. Most of the purely technical work will go in the fifth year, upon the completion of which the student is eligible to the degree of electrical engineer.

LEMOINE, DIAMOND-MAKER.—Last week the sealed envelope containing Lemoine's formula for the manufacture of diamonds was opened in a French court, and several gentlemen eminent as financiers and engineers learned definitely how badly they had been duped. These instructions specified the placing of carbon and sugar in a crucible, passing through the same an electric current of a certain quantity and voltage, and then subjecting the crucible to pressure, whereupon diamonds would be formed. Lemoine, who was out of prison on bail, disappeared the day before the envelope was opened. On the strength of his claims Lemoine obtained from Sir Julius Wernher, the South African "diamond king," $320,000. Part of the arrangement was that the secret for making the diamonds was to be written out and enclosed in an envelope which was to remain unopened until the death of Lemoine and then to become the property of Sir Julius. In order to have the sealed envelope produced in court, long legal proceedings, both in London and Paris, were necessary.

Electrical Equipment of the Forrest Theater, Philadelphia, Pa.

THE Forrest Theater is the latest Philadelphia playhouse. It is located on Sansom Street, near Broad Street, and it is so laid out that it has its main entrance on the latter street, while there is a stage entrance and ample exits on Sansom Street. The theater, which is of elaborate modern design, has a seating capacity of 2000 persons, of which nearly 700 are accommodated on the main-floor level and over 600 in each of the galleries. The building is of unusual design, being built of reinforced concrete and having in its main and side entrances a novel arrangement of corridor inclines, permitting entrance direct to either main floor or balcony without the use of stairs. By this means it is possible to dismiss the audience in a minimum of time and with a minimum of risk in case of a panic. Mechanically and electrically the building fulfills all the requirements of the fire underwriters.

All of the electrical energy used in the building for lamps and motors is supplied from the mains of the Philadelphia Electric Company. Three 100,000-circ. mil cables tap the electric-light company's service mains on Walnut Street and three cables of the same size are brought in from Broad Street. These two services are fed from different substations and the different centers of distribution are connected so as to distribute the load between the two services. By this means the theater is not dependent upon one substation for its energy, and while normally both sources of supply are utilized, connections are provided for receiving the supply from one service should the other service be interrupted. The energy is bought at the rate of 6 cents per kw-hour and the average cost for eight performances per week is $150, or $18.75 a performance.

The mains and sub-mains for lamp circuits are installed on the three-wire system, and the distributing circuits and cut-outs are arranged on the two-wire system. The motor circuits are connected across the outer wires of the three wire system. The wiring throughout is run in iron conduit. The necessary mains for the various circuits are brought to a distributing center located in the basement. From this center feeders run to the various cut out centers on each floor. The Philadelphia Electric Company's mains are brought to this service board as shown in Fig. 4, and the circuits are arranged so that the lamps in the theater, the lamps in the offices and the motor circuits can be controlled separately. There are seven meters installed: two for stage-lighting circuits, two for the house-lighting circuits, one for arc-lamp circuits, one for the electric signs, and one for the motor circuits. It will be noticed that the three mains of one service are brought to the front of the meter panels, while the three mains of the other service are brought to the rear of the meter panels. The cut-out for each stage- and house-lighting meter is connected to the service mains so that one is fed from the Walnut Street service and the other from the Broad Street service. The cut-outs for the other meters are arranged so that the load can be supplied from either service.

FIG. 1.—SANSOM STREET LOBBY.

FIG. 2.—VIEW OF AUDITORIUM FROM STAGE

The stage switchboard is shown in Fig. 5. Return mains are brought back from this switchboard to supply all lamps in the auditorium, etc., which are required to be dimmed or controlled from the stage switches. A distributing center for the theater lighting is provided in the front of the house at a point convenient of access from the main foyer. This distribution center contains the switches for controlling exit lamps, stairway lamps, lamps in the lobby, passages, gradients, etc., and these lamps are independent of all control from the stage switchboard. The circuits controlling the inside and outside exit, stair and passage lamps have the switches controlling them equipped with a locking device arranged with a key lock. The stage switch

FIG. 3.—BROAD STREET LOBBY

board is located in a fireproof compartment equipped with an iron roller shutter.

The orchestra pit is wired for 30 one-lamp outlets distributed along the front and back rails, with receptacle sockets for cord extensions. These outlets are controlled from the stage. The receptacle sockets for the footlights are set in a sheet-metal case on the inside of a metal trough. There are 120 32-cp outlets provided and these are arranged in four circuits for colored lamps alternating throughout the length of the footlight trough. Each circuit is controlled by a separate switch on the stage switchboard. The lamps are apportioned as follows: 48 white, 24 red, 24 blue and 24 amber. There are five sets of border lamps, each arranged on a strip 38 ft. long, and one set arranged on a strip 25 ft. long. The lamps are wired on four circuits; three circuits containing 24 lamps and one circuit containing 48 lamps. The lamps are all rated at 32 cp. The border-lamp circuits are connected to iron outlet boxes located over the center of the border strips by a flexible cable of sufficient length to permit the border strips to be lowered to the stage floor without disconnecting the cable. For the proscenium there are two strips 18 ft. long situated one on each side of the proscenium opening. Each strip contains 60 32-cp lamps protected by a heavy wire screen.

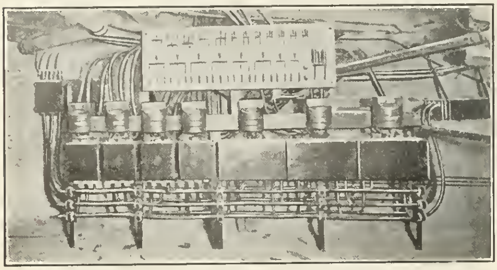


FIG. 4.—SERVICE CONNECTIONS AND METERS.

On each side of the stage, outside of the sink line, five stage pockets are provided, and two pockets are provided in the rear of the sink line. Each pocket is equipped with three receptacles; two of each are for bunch-lamp circuits and the other for an arc-lamp circuit. Each receptacle is provided with a slip plug and the arc-lamp circuit receptacles are all arranged for like polarity, the plug fitting one way only. A circuit runs from the stage switchboard to arc-lamp outlets in fly-galleries, stage pockets and proscenium bridges. This circuit is rated at 300 amp and is divided into four branch circuits as follows: One circuit feeding six pockets on the right-hand side and rear of the stage; one similar circuit for the left-hand side and rear of the stage; one circuit to feed proscenium bridge outlets, and one for fly-floor outlets on the right-hand side of the stage. The two proscenium bridge outlets are rated at 50 amp each, and the three fly-floor outlets are rated at 75 amp each. In the gallery rail and in the balcony rail at the foot of the center aisle are placed iron junction boxes. Each of these boxes is wired for 100 amp, and three outlets are provided from the box in the gallery and two outlets from the box in the balcony. The lamps in the rigging loft are controlled by two three-point switches; one in the loft and the other near the stage switchboard. In the center of the rigging loft is placed an outlet for a stage chandelier. The bunch lamps are placed in a rectangular wood box covered with a sheet-iron reflector and provided with a telescopic iron stanchion. Each bunch light, of which there are four in use, is wired for 12 lamps. There are also in use 12 strip lights with receptacles spaced 1 ft. apart. Four of these strips are 12 ft. long, four are 8 ft. long, two are 6 ft. long and two are 4 ft. long.

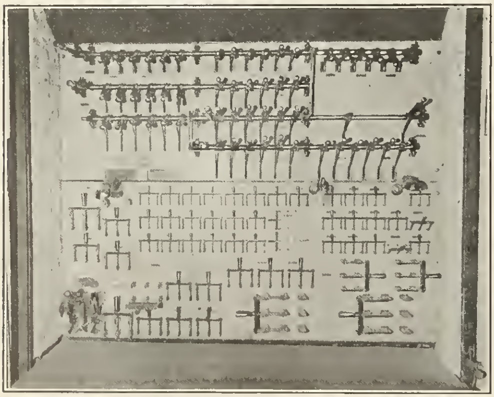


FIG. 5.—STAGE SWITCHBOARD WITH SLIDING METAL DOORS.

In the front of the house there are a number of extra outlets provided. For cleaners' lamps, four outlets are provided on each floor, and there are six portable stands, each fitted with a key socket and a plug for insertion in the receptacles. Twenty outlets are installed for use in connection with electric fans in the auditorium and 16 outlets are provided in dressing rooms for the same purpose. From the cut-out center controlling all the outside lamp circuits, four circuits of three No. 6 wires are run to three signs, one circuit not being connected at present.

FIG. 6.—PROMENADE IN REAR OF PARQUET CHAIRS.

Back of the stage switchboard in a fireproof compartment the dimmers for controlling all the lamps on the stage and in the auditorium are installed. The dimmers for controlling the house lamps are operated by a single lever and are rated for 400 16-cp lamps. For controlling the lamps on the stage, the following dimmers are installed: Eight dimmers for controlling the footlights; eight dimmers for controlling the border lamps; eight dimmers for the lamps in the proscenium, and two dimmers for the bunch lights. The levers for controlling the dimmers are placed in four rows, arranged to interlock in such a manner that any or all of them may be controlled by a master lever.

The bracket lamps around the main auditorium walls on the first floor, balcony and gallery are wired so that in addition to the control from the switchboard they may be controlled from the box office on Broad Street. One leg of the circuit connecting all emergency lamps is connected to both sets of buses and the other leg of the circuit is connected to a tap on a common wire to the emergency switch and back to the neutral of the three-wire system, thus completing the circuit.

Fig. 2 is a view of the auditorium from the stage and shows the method of illuminating the various parts of the theater. The center chandelier is equipped with 96 outlets for lamps, and around the front of the balcony and the gallery are 18 and 20 two-lamp fixtures, respectively. The greater part of the illumination is received from two-lamp ceiling and bracket fixtures. The foyer is lighted by six-lamp ceiling fixtures, as shown in Fig. 6, and by a number of three-lamp bracket fixtures on the columns. The chandeliers in the lobby have 10 lamps each, and each of the arches is equipped with 12 lamps. The ornate pedestals shown along the railing of the incline are topped with one lamp in a round globe. The chandelier in the Sansom Street lobby is equipped with 12 lamps. The large electric sign on Broad Street with the name of the theater contains over 300 lamps.

The ventilation of the theater is accomplished by means of electrically-driven fans. The exhaust ventilation of the auditorium is taken care of by three disk exhaust fans, each with duct connections to vent registers at different ceiling levels, as owing to the extreme slope of the balcony and gallery floors, it was found desirable to exhaust the air from the ceiling spaces of each level. For simplicity, the three systems are operated independently, the air in the ceiling space under the balcony being exhausted by a 30-in. fan, that under the gallery by a 36-in. fan, and the air in the main ceiling space of the auditorium being exhausted at the rear by a 42-in. disk fan. These fans are located in wall openings into the open court on the stage-entrance side of the building. The fans are all of the multivane disk type, with special spider mountings for direct-motor drive. The fans were built by the American Blower Company, of Detroit, and are equipped with 1, 1½ and 2 hp Diehl direct-current motors, respectively. The motors are enclosed in substantial iron box enclosures, which are connected between the fan frame and the exhaust ducts to facilitate access to the motors. Located upon an enclosed steel platform over the stage entrance in an open court space is a 50-in. full-housed, steel-plate bower with a 30-in. wheel for supplying fresh air to the dressing rooms having no outside window openings. This fan is driven by a 3-hp motor. The toilet rooms are connected to an exhaust-air system equipped with 12- and 24-in. Blackman disk exhaust fans.

The feed pump for the boiler used for supplying steam to the heating system is driven by a 1-hp motor. In the basement are also installed a motor-driven vacuum cleaner, a motor driven fire pump and motor-driven sewage ejectors. The various dressing rooms are also equipped with electric curling-iron heaters. The theater is the first to be built in Philadelphia under the new rules of the fire underwriters. The architects of the building were Marshall & Fox, of Chicago, Ill., and the electrical equipment was installed by the Malcolm W. Hill Company, of Philadelphia, Pa.

Wireless Telegraphy and Telephony.

At a recent Royal Society soiree in London, L. H. Walter exhibited a tantalum wire point dipping into mercury in a small bottle, as a good detector for wireless telegraphy and telephony and as particularly useful for the latter purpose. In reality Mr. Walter has found that this detector gives louder sounds than an electrolytic detector, which it emulates in other respects, at distances of 450 miles when less than 2 kw was being used. He also exhibited an electrolytic signaling key. It is an instrument for giving Morse signals on circuits using 2 kw or more without any sparking in the air, the current being broken under a solution of ammonium borate in an aluminum valve cell. There are two aluminum disk electrodes facing one another, and separated by a small gap; when the key is depressed, the two electrodes are pressed against one another, so that the current interruption following the next moment takes place across the gas film settling on the aluminum.

What Is Light?

By P. G. Nutting.

The numerous recent modifications and improvements in sources of illumination are bringing into prominence the theoretical problem of the physical definition of light itself. Radiation is not light, nor is any selected portion of radiation even proportional to light, yet radiation is the only measurable objective factor in light. The question of how much light will be given by a source emitting a known amount of radiation of a given quality must be examined with great care.

Light has yet to be defined in precise mathematical terms. The word is applied both to the subjective sensation and to the objective stimulus, causing or capable of causing the sensation. Let us see how precisely and rationally each may be related to spectral energy in watts per unit wave length. We shall find that by far the simplest procedure is to treat the eye as a physical instrument of known sensibilities, seeking a relation between scale reading and the intensity and quality of the operative stimulus. As an instrument the eye is not unlike an alternating current ammeter whose sensibility passes through a pronounced maximum at a certain frequency, but of vastly greater range than any instrument ever devised.

Mention must be made of something that light is *not*, for the error is widely extended and firmly rooted. Twenty years ago, when spectral energy curves were first being studied, Langley divided the spectrum at wave length 0.70μ in order to obtain a purely numerical rough measure of luminous efficiency. He took as light that portion of the enclosed area on the short wave length side of the ordinate at 0.70μ. Langley's idea appears to have been that the amount of light lopped off beyond that wave length would about balance the defect due to loss of sensibility from 0.70μ in to the maximum, which is not far from correct for the intense flame source he used, but subsequent workers have erroneously taken the limiting ordinate as though it were the dividing line between visible and invisible radiation and have pushed it out to 0.76 or even 1.20μ.

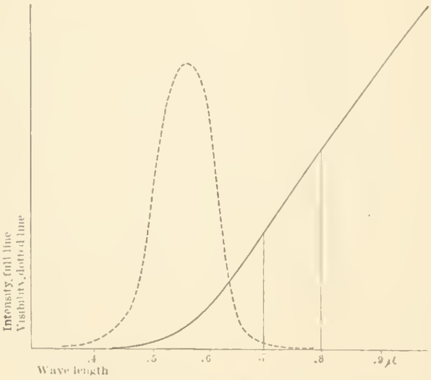


FIG. I.—RADIATION AND VISUAL SENSIBILITY CURVES

How serious an error this assumption may lead to may be seen best perhaps from the curves in Fig. 1. The full curve represents the radiation from an ordinary carbon filament lamp at normal voltage, according to recent data supplied by Dr. Coblentz. Ordinates are drawn at 0.70μ and 0.80μ. It makes a difference of about 100 per cent in the area to the left, if we choose the latter in place of the former as limiting ordinate. The actual effect on the light of lopping off that part of the spectrum between 0.70μ and 0.80μ would, however, be hardly 1 per cent or 2 per cent at most. The dotted curve represents relative visual sensibility at an intensity of about 40 meter candles. Obviously the area is not even proportional to the actual light represented and can by no means be taken as a proper measure of the light. A better procedure would be to give to each ordinate a weight according to the corresponding visibility of radiation.

Historically there is but little to be said. No one appears to have directly attacked the general problem. Goldhammer[1] has developed an expression for the relative chromatic sensibility of individual eyes which we shall mention later. Hertzsprung[2] has set up an approximate formula for intensity sensibility and made some ingenious applications of it. The writer gave a brief general outline of the problem in the *Physical Review* (February, 1907).

In order to express light (integral or spectral) in terms of radiation, we must know (1) the average relative sensibility of the human eye for the same amount of radiant energy at each wave length of the visible spectrum, and (2) the variation of sensibility with intensity at constant wave length. Then spectral energy multiplied by (1) is luminosity or objective light and this product operated on as indicated by (2), will give the subjective light.

Sufficient data is available for at least roughing out the solution and for directing the more precise determination of the essential constants. A pitiful amount of data is valueless because of failure either to record the spectral energy of the source used or else because two variations were covered at once. A long series of investigations by A. König, in conjunction with Brodhun, Dieterici and others, are free from these defects and his results are in such form that they may be easily recomputed for our purposes. The writer has determined experimentally some of the constants of the fundamental equations.

VISIBILITY AND OPTICAL INTENSITY.

Vision is apparently accomplished by the retinal rods alone from the threshold value (roughly 0.0003 m-c) up to about 0.1 m-c. From that intensity up to about 100 m-c, cone vision appears to play an increasing part in vision and above 100 m-c it is the chief factor.

For visibility at low intensity there are considerable data in fairly close agreement. The best is that of A. König[3] on nine different subjects given in the table below.

VISIBILITY AT LOW INTENSITY (ROD VISION.)

Wave length.	A. B.	E. H.	F. D.	R. R.	E. B.	A. K.	A. H.	E. K.	F. H.	X. P.
.430	.015	.10	.038	.062	.064	.059	.047	.069	.31	.089
.450	.074	.30	.14	.25	.21	.21	.23	.23	.47	.01
.470	.27	.64	.31	.50	.47	.49	.50	.49	.74	.58
.490	.57	.90	.58	.74	.80	.60	.86	.69	.96	.84
.505	..	1.00	.85	1.00	1.00	1.00	1.00	1.00	1.00	.99
.520	1.00	.96	1.00	.85	.98	.99	.98	.87	.90	1.00
.535	.78	.77	.85	.64	.74	.77	.75	.66	.71	.81
.555	.45	.47	.49	.33	.41	.42	.36	.38	.44	.47
.575	.20	.20	.25	.12	.17	.17	.12	.14	.21	.13
.590	.085	.076	.15	.051	.067	.061	.045	.071	.10	..
.605	.035	..	.09	.022	.026	.022	.015	.024	.048	..
λ max	.518	.507	.521	.504	.512	.511	.511	.506	.502	.514

This data plotted to maximum ordinate unity gave for the wave length of the maxima the data of the last line. Other data by Pflüger (nine subjects) and Langley (four subjects), not produced here, give as a mean wave length of maximum sensibility 0.5097, which we shall take as 0.510 even.

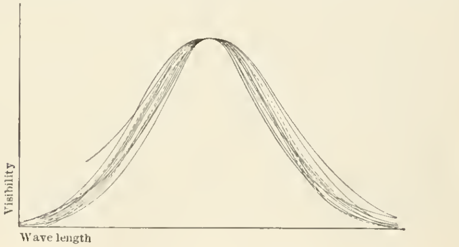


FIG. 2.—CURVES OF VISIBILITY AND OPTICAL INTENSITIES.

Shifting the curves of König's data to 0.510 as maximum ordinate, the curves reproduced in Fig. 2 are obtained. They form a fairly symmetrical galaxy, so narrow that a mean curve may be drawn with some certainty. The well-known probability curve is of this form. To represent these visibility curves it may be written

$$V = V_0 e^{-\kappa(\lambda - \lambda_m)^2}$$

where $\lambda_m \doteq 0.510$ and $\kappa = 530$ (computed mean).

Goldhammer (l. c.) used the function

$$\left(\frac{\lambda_m}{\lambda} e^{1 - \frac{\lambda_m}{\lambda}}\right)^n$$

to represent some of König's data, n varying from 150 to 300 with different individuals. This curve is always steeper on the blue side and represents the data scarcely as well as the simpler probability curve, but has the advantage of being integrable and of the same form as the Wien-Paschen emission function.

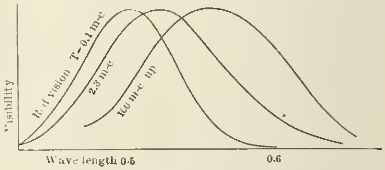


FIG. 3.—VARIATION OF VISIBILITY WITH INTENSITY.

Numerical values are given below:

Wave Length.	Mean Observed.	Probability, $\kappa = 430$.	Goldhammer $n = 235$.
.410	.03	.02	.01
.430	06	.07	.03
.450	.23	.22	.16
.470	.49	.51	.46
.490	.81	.84	.83
.510	1.00	1.00	1.00
.530	.81	.84	.86
.550	.49	.51	.54
.570	.22	.22	.27
.590	.08	.07	.11
.610	.03	.02	.03

The computed probability curve for $\kappa = 430$ lies nearer the mean observed curve than do most of the individual curves.

For moderate and high intensities the only data available are those of A. König on his own eye, but his eye was very near the average in sensibility and the work was carefully done. His method was to find by measuring slit widths the relative amounts of energy necessary to produce a constant illumination throughout the spectrum of a gas flame. The writer has taken König's equivalent slit widths, corrected them for the spectral energy of the source (which König fortunately determined) and plotted the reciprocals to maximum ordinate unity. The final corrected data is given in the following table and accompanying curves (Fig. 3 and 4):

ROD AND CONE VISION.

VISIBILITY AT VARIOUS INTENSITIES.

Intensities.	.00024	.00225	.036	.575	2.30	9.22	36.9	147.6	590.4 m-c
Ratio to Proceeding.		9.38	16	16	4	4	4	4	4
λ = .430	.047	.057	.076	.060	.063	.057	...	....	....
.450	.23	.21	.21	.20	.14	.10	.085	....	....
.470	.50	.46	.42	.42	.36	.19	.16	.13	....
.490	.85	.78	.75	.70	.63	.40	.28	.25	.24
.505	.99	.99	.98	.94	.88	.63	.50	.45	.40
.520	.97	.96	.94	.99	.97	.85	.72	.69	.67
.535	.75	.76	.76	.83	.98	.98	.91	.88	.87
.555	.36	.42	.47	.54	.83	.97	.99	.99	.99
.575	.12	.17	.20	.26	.58	.85	.97	.98	.98
.590	.045	.059	.095	.15	.42	.71	.88	.92	.92
.605	.015	.022	.044	.10	.28	.54	.71	.079	.79
.625	...	...	.022	.05	.17	.05	.42	.52	.54
.650	...	...	...	...	.057	.11	.15	.18	.23
.670	...	...	...	...	...	.038	.050	.055	.058
λ max	.511	.511	.511	.515	.529	.545	.560	.565	.565
Constant κ	461.	466.	445.	395.	254.	221.	214.	198.	197.
$V_0/13$ =	1.08	1.16	.94	.74	.31	.48	1.07	1.00	1.00

There is some doubt as to the exact value of König's light unit, but it was approximately one meter-candle (between 0.3 and 1.5 m-c). At the foot of the table are given the wave lengths (λ max.) of maximum sensibility at each intensity determined graphically, the mean computed value of the constant κ and the value of V_0 under the assumption that objective light and radiation are proportional.

In Fig. 3 are reproduced three of these curves exhibiting the variation of visibility with intensity. The one to the left is places have slipped so that only a small area is in contact. Small crests and hollows, as shown at *e*, *e*, appear on portions of the filament; color very glossy black. The filament in all cases when supplied with alternating current, even on short service, became very brittle and its strength so affected as to render it subject to injury from slight jars or shocks.

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[1] D. A. Goldhammer, *Ann. d. Ph.*, 16, 621-652, 1905.

[2] Ejnar Hertzsprung, *Zeit. Wiss. Phot.*, 3, 468-472 and 4, 43-54, 1906.

[3] Helmholtz Festgruss, 309-388 (1891).

In the test with intermittent direct current, the current used, with the exception of *F*, was delivered from a commutating device which produced equal periods of on and off circuit, and the frequency was so adjusted that only a slight flicker was noticeable in the lamps. The voltage was regulated to give the same luminosity as when on alternating or direct current. Except for the absence of the crests or hollows observed in the alternating-current experiments, intermittent direct current produced results similar to the former. At *F* is shown the results of an intermittent service produced by a "skedoodle" socket. The faulting did not appear uniform throughout the length of the filament, as shown by the long segment on the right of *F*. Some portions showed an even greater length apparently not broken up, but by close inspection fine lines were noticeable running across the filament in a transverse direction, which indicated the beginning of a joint. The color was dull black.

Calibration of Watt-Hour Meters.

By Joseph B. Baker.

In the previous articles by the writer (May 30 and June 20) the various tests and examinations leading up to the actual recalibration of meters have been described in detail. The tests are made on the customer's premises with the meter in service. If a thorough overhauling shows that the meter will not have to be returned to the shop for repairs, the meter should be calibrated on both light-load and full-load, the necessary adjustments being made by the helper under the supervision of the tester.

In calibrating a commutator or induction meter the speed at full-load should be adjusted first, by shifting the position of the braking magnets toward or away from the shaft—toward the shaft to increase the speed, and away from it to decrease the speed.

In shifting the position of the magnets, as a rule it is only necessary to loosen one of the magnet screws, and the magnet can then be pried either way by wedging a strong screwdriver between the magnet and the meter frame, care being exercised not to press on the disk, as doing so would be apt to bend the disk or shaft, or damage the jewel bearing. The magnets should be kept as nearly as possible the same distance from the center of the disk, and should not be moved so as to lap more than ⅛ in. beyond the edge of the disk. Moving the magnets further would mean excessive leakage of lines of force, around the edge of the disk, which should pass through the disk. It is better to keep the magnets well within the edge of the disk; and if moving them out to the extreme limit mentioned is not sufficient to bring down the speed, stronger magnets must be installed, as it is probable that the magnets with which the meter is equipped have become weakened or demagnetized.

The speed at light load should then be adjusted; in commutator meters by shifting the position of the shunt field coil—toward the armature to increase the speed, and away from the armature to decrease the speed; and in induction meters by shifting the copper "shading strip" or "light load adjustment" one way or the other.

In making this adjustment time must be taken to note the tendency of continuous or intermittent vibration to start creeping in the meter or the effect of the friction of the moving system of the meter is diminished by vibration. On the other hand, it is desirable to watch the performance of a direct-current meter on light load for a period, after a thorough overhauling of commutator and brushes; i. e., during the time required for the commutator and brushes to attain their permanent condition of oxidation and wear—and follow up and compensate for any increased friction and resistance at the commutator by new adjustments of the shunt field coil.

The register is, of course, to be left on the meter, with the worm and worm wheel properly meshed, during the calibration. If after making the full-load adjustments it is found necessary to alter the light load adjustment to any marked degree either way, the full-load speed should be checked again, and the magnets readjusted if necessary; bearing in mind that an adjustment of 10 per cent on light load—with the shunt field coil, or the "shading strip," as the case may be—affects the full load calibration about 1 per cent, while the magnet adjustment affects both the light-load and full-load calibrations equally; so that the general calibration of the meter for accuracy on both light load and full load may have to be effected by a process of approximation, as indicated.

The object of the various adjustments constituting the calibration of the meter is to attain 100 per cent of the accuracy of the indicating instruments taken as standard. Accordingly, the adjustments should be manipulated to make the meter accurate, on both loads, by comparison with the instrument readings; and they may then be altered further to leave the meter running a little fast (not over 2 per cent), as the tendency, especially in commutator meters, is always to run slow in time.

Tendency to creep should also be observed while the meter is being calibrated, thereby saving time, otherwise the meter may need to be recalibrated, owing to the adjustments made for creeping. Creeping may be obviated in commutator meters by attaching a small piece of iron to the moving system of the meter in such a position that the attraction exerted upon it by one of the brake magnets will check the motion of the disk on no load, when the piece of iron "comes around opposite the magnet," thus preventing the meter from creeping more than one revolution. A tiny staple-shaped piece of iron wire, such as an ordinary paper clip, which may be slipped on the edge of the disk, answers nicely. The adjustment is effected by cutting down the clip until the magnet which is nearest the edge of the disk will hold the disk from rotating on no load under the conditions of vibration to which the meter is ordinarily subjected. The piece of wire should clamp the edge of the disk firmly with no possibility of slipping. A fine adjustment may be obtained by cutting one end of the clip shorter than the other—keeping the longer end on the top of the disk. Another method is to solder to the shaft a short piece of iron wire, which may be bent out, away from the shaft, until it is sufficiently attracted by the nearest brake magnet.

This arrangement is considered by some meter men to be better than a clip on the edge of the disk, for the reason that it may be adjusted through a wide range, whereas the clip referred to tends to prevent the disk from starting on extremely light loads. Some meters have been put out by their makers with their shafts equipped with a piece of nickel wire, to prevent creeping, instead of iron wire. Either of these devices may be used with induction meters also, but in some modern induction meters creeping is prevented by making the disk with two holes diametrically opposite each other. The iron creep retarder of whatever kind should be so adjusted that the nearest magnet will just barely hold it when the meter is tapped lightly with the fingers (to simulate heavy vibration to which the meter might be exposed) and yet not prevent the meter from starting readily when a very light load—not exceeding one-twentieth of full load—is put on. If it is necessary to install a creep retarder and it is found that the magnets would have to be shifted so near the edge of the disk, in order to prevent creeping, that their jaws actually enclose the creep retarder clamped on the edge, the magnets should be replaced by stronger ones. Some companies make it a rule not to install creep retarders unless absolutely necessary.

If the meter creeps due to vibration, even with the friction compensating device moved into its least effective position—as it may be very apt to do just after being cleaned up or after having its jewel and pivot replaced—soft rubber washers may be interposed between the meter and the wall or other support on which it is mounted, using two washers at each of the screws which secure the meter to the wall—one under the head of the screw and one between the lug of the meter and the wall. If the use of the rubber washers does not suffice, a creep retarder may have to be put in; or in case of very heavy vibration the meter should be placed in a more favorable location. Sometimes heavy vibration may be absorbed by placing the meter on a small shelf with three pieces of sponge rubber on the shelf under the meter, instead of screwing the meter to the wall.

Excessive vibration is a cause of serious trouble to commutator and brushes and to jewel bearings. It may be so intermittent as to escape observation and remedy by the meter inspector, and thereby become, unawares and between inspections, a cause of gross inaccuracy of the meter. Thus, it may start creeping, which will mean high meter readings; or it may roughen the jewel and pivot by the continual hammering action, or set up sparking at the commutator, either of which will mean low meter readings. Vibration is therefore one of the most unfavorable conditions of installation, and as such is to be avoided with the utmost care. When the local conditions are such that excessive vibration of the meter cannot be avoided, the tension of the brushes must be increased sufficiently to avoid all danger of sparking, and the condition of the jewel, the pivot or shaft-end and of the top bearing should be watched with care.

If a short circuit is made through the field coils of the meter after it has been calibrated, the meter should be tested once again, as these short circuits are apt to weaken the damping magnets in any event, and are practically certain to do so when the magnets are mounted parallel to the axis of the field coils as in the old-style meters. Even when the magnets are mounted at right angles to the axis of the field coils—the position in which they are least susceptible to demagnetization by strong stray fields—heavy short circuits will sometimes weaken them enough to make the meter run 50 per cent fast.

The resetting of the magnets of old-style meters by turning them through a right angle, so as to place the magnets across instead of parallel to the field flux, is a piece of work which usually requires the removal of the meter to the laboratory. However, when there are a large number of central-station meters installed, the resetting of the magnets at right angles may be done on the consumers' premises by removing the magnets and providing them with special bases, made up in the repair shops and drilled so as to support the magnets in the new position.

Before leaving the premises the tester should give the meter another general look-over to see that it is properly connected and that everything is shipshape before the cover is replaced and the meter sealed. Thus, the cover should be examined, and any foreign particles—scraps of insulation, wire, etc.—that may have been caught in the cover during the time it has been removed should be cleaned out before it is replaced on the meter.

After the meter has been made accurate in every respect, the tester should complete the filling out of the test card and disconnect and pack up the instruments.

The helper in the meantime can remove the temporary wires from the meter and put back the permanent wires belonging to the installation, making sure before leaving the premises that the consumer's circuit is alive. He must then turn the register back until the dials show the same reading as they did before the test—unless the consumer has been using energy during the test. In turning back the register it is not necessary to take it entirely off the frame; by simply loosening one of the screws, one end of the register may be pried away from the frame until the worm wheel comes clear of the worm, and then the register can be turned back to the original dial reading in a few seconds. After setting the register screws up tight again, the shaft should be given a spin to make sure that the worm meshes properly with the worm wheel on the register.

Metal meter covers should be examined for dents or for any deformation of the edge or gasket that will prevent them from fitting properly over the meter and closely enough around the base to be insect-, dirt- and moisture-proof. The glass windows should be well cleaned and secure in their fastenings, with no cracks or crevices in the putty between the glass and cover to admit moisture, dirt and insects. If a new glass has to be put in, all of the old putty should be removed and a tight joint made with fresh putty between the glass and the cover. It is well to wipe the cover carefully, inside and out, just before replacing it on the meter, and it should be held up to the light to see if any holes have been made in it through which wires, etc., may be inserted with malicious or fraudulent intent to interfere with the working of the meter.

Glass meter covers should be cleaned and polished inside and out, and examined for continuity and "life" of the sealing gasket.

If the magnets have been shifted in calibrating the meter, the helper should putty up the magnet screw holes again. Anything else that can be done to improve the general appearance of the meter and its surroundings should be done before the inspector leaves the premises. All remaining entries should be made on the test card, including the time of leaving the premises.

The Number of Lamps for Uniform Illumination.

By Alfred A. Wohlauer.

The area which can be uniformly illuminated by a single source of light of a given mean spherical candle-power depends only on the light emitted and on the illumination required. If

L_s = mean spherical candle-power of lamp,

I_0 = the intensity or uniform illumination in foot-candles,

then the diameter of the circular area illuminated, in feet, is

$$d = 4\sqrt{\frac{L_s}{I_0}} \qquad (1)$$

the light absorption by the reflector being temporarily neglected. Equation (1) could be considered as recognizing the absorption by the reflector if L_s is allowed to represent the mean spherical candle-power of the flux actually emitted by the reflector.

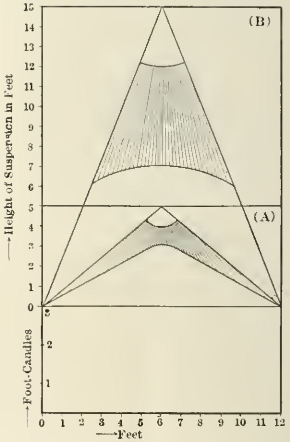

FIG. 1.—POLAR CANDLE-POWER CURVES FOR UNIFORM ILLUMINATION OF 3 FOOT-CANDLES BY SINGLE LAMP AT DIFFERENT HEIGHTS OF SUSPENSION.

Equation (1), which does not contain the height of suspension, shows that the area which can be uniformly illuminated with a certain intensity by a single illuminant of a given mean spherical candle-power does not depend on the height of suspension. By using a proper reflector for each height the light of the illuminant is distributed so that at different heights of suspension the same area is always uniformly illuminated with the same intensity. This relation is illustrated in Fig. 1, where a lamp of a given mean spherical candle-power ($L_s = 25$ candles) is suspended in one case (A) 5 ft. above the illuminated plane and in another (B) 15 ft., and a uniform illumination of an intensity of $I_o = 3$ foot-candles is desired. The reflectors used in the two cases differ, so that in each case the same circular area, 12 ft. in diameter, is uniformly illuminated.

There are, of course, certain practical limits reached in the design of concentrating as well as diffusing reflectors. For instance, it would not be practicable so to concentrate the light from an incandescent lamp that the latter could be placed on the top of a steeple in order to illuminate a certain area on the ground floor. Moreover, it is impossible so to diffuse the light that the lamp can be suspended only 1 in. above the plane which is to be illuminated. Without counting such extreme cases, the above equation gives the correct value for the diameter of a circular area uniformly illuminated by a single lamp equipped with proper reflector.

Larger areas necessitate a multitude of lamps, and the question arises as to the number of lamps required to illuminate a given area. Theoretically, the number of lamps depends only on the light emitted by each lamp, the intensity of illumination required and the area to be illuminated. If it were possible so to utilize the total flux of a certain number of lamps as to obtain ideal uniform illumination, no restriction would be necessary in practice. However, a single lamp, for instance, will always illuminate only a circular area, and a multitude of lamps, even when skilfully combined, will never lead to an absolutely uniform illumination. This effect can only be approached with more or less accuracy by the various methods of light distribution. Incidentally, the more the illumination approaches the ideal case of uniformity, the better the agreement with the theoretical number of lamps, as indicated below.

It would be possible, for instance, to place lamp units such as discussed above and illustrated by Fig. 1 at an equal height, at a distance D between each other ($D = d =$ diameter of the circular area which can be uniformly illuminated by a single lamp). They would uniformly illuminate tangent circular areas as indicated in Fig. 2. In this case uniform illumination would be obtained along the lines *ab*, *ae*, *cf*, etc., which connect the points of the plane just underneath the centers of the lamp. On the diagonals *af*, *eb*, etc., however, dark stretches occur, as no light is thrown on the shaded spaces of Fig. 2, which lie outside the boundaries of the uniformly illuminated areas. Such uniform illumination, with intermediate dark spots, would be permissible in places where (as in restaurants and the like) the tables or the objects to be illuminated could be so located as to be just within the limits of uniform illumination, while the dark spots fall in places which do not require the full share of illumination. For office buildings, auditoriums, department stores and the like, such an illumination would not be satisfactory, as it is not possible to predetermine the exact position of the objects to be illuminated, and non-illuminated spaces might prove very annoying.

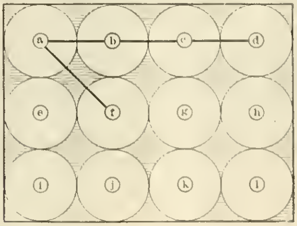

FIG. 2.—SPORADICAL UNIFORM ILLUMINATION.

If the light distribution of the lamps be so changed that the corresponding illumination curves are inclining and overlap each other, as suggested in former articles,* no dark spaces will be encountered and the unevenness will be kept down to a minimum. There will be points of maximum illumination; the non-uniformity, however, will be very slight and can be neglected in practice or overcome by certain modifications in the light distribution. (See Fig. 4.)

The distance between the lamps could then be calculated from the formula

$$D = K \sqrt{\frac{L_v}{I_o}} \tag{2}$$

where

$$K = \frac{D}{H}$$

$L_v =$ candle power of the lamp vertically, downward,

$I_0 =$ intensity of illumination in foot-candles,

$H =$ minimum height of suspension, in feet.

Equation (2), which is generally applicable in all cases, could be used also instead of equation (1), as can readily be recognized and demonstrated. There is a certain relation between L_v, K and L_s, the latter being the mean spherical candle-power of a lamp, as stated above, which can be expressed by the equation

$$K = \sqrt{\frac{a\,L_s}{L_v}} \tag{4}$$

where a is a constant factor which depends on the method of light distribution and varies from 8 to 16, according to the shape of the polar candle-power curve of each lamp and to the location of the lamps. For instance, $K = \sqrt{\frac{16\,L_s}{L_v}}$ for the method of illumination discussed at the beginning of this article and represented by Figs. (1) and (2), and $K = \sqrt{\frac{8L_s}{L_v}}$ for the method illustrated by Fig. (3), and $K = \sqrt{\frac{9.7\,L_s}{L_v}}$ for the modification corresponding to the polar candle-power curve, as indicated by Fig. 4.

It is possible, however, to start directly from an equation for

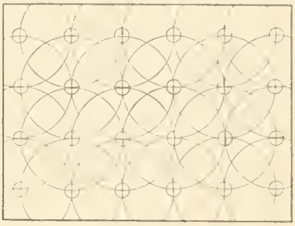

FIG. 3.—UNIFORM ILLUMINATION BY OVERLAPPING STRAIGHT ILLUMINATION CURVES.

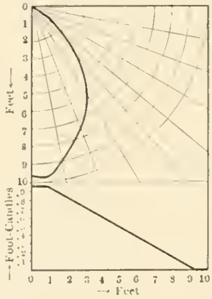

FIG. 4.—MODIFICATION OF ILLUMINATION CURVES.

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*Electrical World, Dec. 21, 1907. March 21, 1908.

the distance between the lamps, which would have the general form,

$$D = \sqrt{\frac{a L_s}{I_o}} \qquad (5)$$

wherein a has the same values as mentioned above. Equation (5) leads to the formulas $D = \sqrt{\frac{16 L_s}{I_o}}$ for "horizontal" illumination curves, $D = \sqrt{\frac{8 L_s}{I_o}}$ for "straight inclining" illumination curves and $D = \sqrt{\frac{9.7 L_s}{I_o}}$ for the modification.

Having determined the distance between the lamps, one can find the number of lamps required for the illumination of a certain area, S. Since $N = \frac{S}{D^2}$ the general form of the equation for deteming the number of lamps will be,

$$N = \frac{S I_o}{a L_s} \qquad (6)$$

Equation (6) enables one to ascertain the number of lamps of a certain mean spherical candle-power to illuminate a certain area with a chosen intensity of illumination. It will be recognized as a fundamental formula which can be used by the illuminating engineer in numerous cases.

It is obvious that, if there is no light absorption and the illumination is uniform, the number of lamps required would be

$$N = \frac{S I_o}{4 \pi L_s} \qquad (7)$$

which shows that the comparison of a with 4π, is a criterion for the uniformity of illumination as well as for the "efficiency" of the reflector. It is seen, furthermore, that if a equal 16, the uniform illumination cannot be complete, a conclusion indicating the dark spots discussed above and illustrated in Fig. 2. It is also evident that for a value of a of 9.7 corresponding to the modification illustrated in Fig. 4, the uniformity of illumination is much better.

VALUES OF THE CONSTANT *a* FOR VARIOUS REFLECTORS AND LAMP DISTRIBUTIONS.

Reflector or lamp distribution.	Constant *a*.
Holophane reflector. Form C	4.3
Holophane reflector. Form D or S	5.
Holophane Pagoda reflector. No. 2510	8.
"Straight inclining" illumination curves	8.
Holophane bowl reflector. Form B	9.
Modification of "straight lines" illumination	9.7
National X-Ray reflector. No. 700	10.
Ideal uniform illumination. (4π)	12.5
"Sporadical" uniform illumination	16.

For practical calculations the factor a, which might be termed "constant of the reflector," must depend upon the loss of light due to the absorption in the reflector, a consideration which will modify the above theoretical values of a according to the "efficiency" of the reflector.

Equation (6) is correct only for methods of light distribution as discussed above, which are theoretical, at least up to the present time. However, it has a practical value in connection with existing reflectors and methods of light distribution if the proper value of a is introduced into the calculations. This value can be determined either experimentally or mathematically. The writer has attempted to ascertain the value of a for the various commercial reflectors utilizing data gathered together from trade publications. The results given in the accompanying table may convey a fair idea of the constants of the various reflectors. Additional practical investigations are necessary, however, to verify or correct them.

It should be stated that in the case of the practical and commercial reflectors, the values of a given in the table are fully correct only when the number of lamps utilized for illumination is rather high, so that all of the lamps participate in the illumination of the various points of the plane. For a very small number of lamps, the above values of a will not lead to such correct results, although the deviations are not very great. If, however, the polar candle-power curves of the lamps have the theoretical shape assumed above, so that one lamp does not throw its light beyond the foot of the next lamp, a much greater accuracy will be obtained.

New Telephone Patents.

TELEPHONE INSTRUMENTS AND ATTACHMENTS.

A telephone transmitter forms the subject of a patent granted to E. C. Corwin, of Clyde, Ill., this patent being assigned to the Corwin Telephone Manufacturing Company. The instrument follows in general design the standard solid back, but the mica auxiliary diaphragm has been replaced by a metal diaphragm and, therefore, the front electrode is in metallic contact with the frame of the instrument. On the other hand, the back electrode is insulated from the frame, as its adjusting stud slides within a collar, which is mounted upon the bridge in such a manner as to be entirely insulated from the latter.

Mr. W. W. Dean, of Elyria, Ohio, has patented a combined call register and transmitter. This is shown in Fig. 1. The transmitter casing is extended in a manner to cover the mechanism of a counter, which counter is mounted upon a base plate, secured in turn to the rear of the face plate of the transmitter. The advantage of this type of construction is that it is not evident to the user as to how the counter may be removed without dismantling the telephone to such an extent as to destroy its service. Furthermore, the mounting of the counter is such that the operator should hear the signal read with maximum facility. Mr. Dean has assigned his patent to the Dean Electric Company.

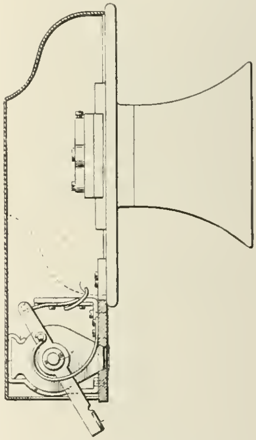


FIG. 1.—DEAN COMBINED REGISTER AND TRANSMITTER.

Hard rubber, or imitations of it, have almost universally been used as the casing for telephone receivers and these materials have been found to have excellent qualities for this purpose. It has now been suggested, however, that glass or other vitreous material be used for the receiver casing, and W. Gibson, of Danbury, Conn., has patented a telephone receiver shell of this sort. He finds that, because of the difficulty in forming threads in vitreous material, it is advisable to form the receiver cap and the receiver shell, respectively, with metal rings at their contacting points. These rings are secured in position during manufacture and carry the threads by which the two parts are secured together.

Under the name of "Voice-Screen" there has been patented by R. H. Ralston, of Denver, an attachment for the mouthpiece of a transmitter adapted to so screen the mouthpiece that there is no escape of the voice to the surrounding air. This attachment is a sort of an oblong funnel-shaped affair, the front edge being curved so as to fit reasonably to the face of the user about the mouth. The small end of the funnel fits over the transmitter mouthpiece, carrying a soft gasket, which lies against the edge of the transmitter mouthpiece. An annular nut holds the funnel in place by being slipped over the small end of the mouthpiece and drawn up until it comes in contact with the flare.

An antiseptic lining for telephone mouthpieces has been patented by H. Jankelowitz, of Germany. This lining is of the paper type, a pad of paper being formed up to fit the mouthpiece, this pad consisting of many layers and so perforated that the user can, at will, pull off the foremost, or outside, layer, exposing a fresh layer for his own use. The paper is so padded that a tab is exposed from each sheet so that this tab serves as a means of detaching the top layer.

RINGING KEY.

Fig. 2 shows a gang ringing key, patented by R. H. Manson, the patent being assigned to the Dean Electric Company. With all ringing keys it is necessary to perform two functions—first, to break the circuit toward the operator; and, second, to connect the ringing current. This gang ringing key is adapted to connect in one of four different kinds of ringing current and it is, therefore, provided with four plungers, each of which connects with its own kind of current. A single key, responsive to all plungers and located at the left hand end of the group, as shown in the figure, serves to perform the cutting-off function. It will be seen that as any plunger is depressed the lower pin in that plunger passes into a recess in the control plate, a portion of which latter is shown broken away. As the plunger is further depressed a second pin, the upper one in the plunger, presses against the slanting surface of the control plate and rocks this upon its pivots in a manner to operate the cut-off key. This occurs just before the roller of the particular plunger closes the contact of the ringing-circuit key. It will be seen that when the plunger is released, while both keys are restored, the plunger does not return to its normal position, because its lower pin locks in the recess of the control plate. This will indicate to the operator which key was pressed last. When it becomes necessary to depress a second plunger the rocking of the control plate releases the first plunger and permits its restoration to normal position.

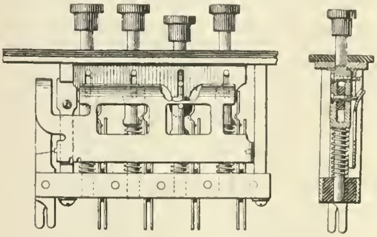


FIG. 2.—MANSON RINGING KEY.

MEASURED-SERVICE SYSTEM.

Mr. J. Harrison, of St. Louis, has obtained a patent for a system of call registering, the service meters being located at the subscribers' premises. The service meter is under the control of an electromagnet, which is included in the hook-switch circuits of the stations, so that it is impossible to operate any meter unless the hook-switch is raised—that is, in the position for conversation. The operator registers a count by applying to the line a special high-potential current by means of a key. A register signal is provided in the shape of a third lamp signal for each cord pair. This lamp signal glows only after the response of the called party, and it is permanently extinguished upon the pressing of the registering key. It seems probable at first sight that as the registering current can only be applied while the subscriber is talking, this considerable current impulse will produce disagreeable effects in his receiver in the form of a click.

ARRESTER.

William Kaisling, of Chicago, has patented an arrester unit for use with protector frames. He assembles his springs complete, adapted to hold both heat coil and carbon plates. These units may then be mounted on any desired framework without taking them apart. Mr. Kaisling has assigned his patent to F. V. Cook.

SWITCHBOARD-CIRCUIT SYSTEM.

A switchboard-circuit system of the two-wire common-battery type has been invented and patented by Mr. W. W. Dean, this patent being assigned to the Kellogg Switchboard & Supply Company. Two batteries are used—a calling and called-party battery—and the system requires a double-wound line relay and a cut-off relay. For the calling operation a current passes through the contacts of the cut-off relay, through one winding of the line relay (that associated with the tip side of the line) and then through the line and instrument, and to ground through the second winding of the line relay. This causes the line lamp to glow. When the operator responds the current flows through the tip and sleeve circuits of the jack in parallel. The current from the sleeve strand passes through the cut-off relay winding and through one winding of the line relay to ground. The tip-strand current supplies the instrument. The cut-off relay cuts from the circuit the line lamp to extinguish this, and, at the same time, opens the circuit of the tip side of the line relay

TRANSMISSION CIRCUIT.

It has been generally recognized that with the ordinary telephone circuit one of the chief causes of attenuation of telephone currents is the shunting leakage between the two limbs of the line, due to mutual electrostatic capacity. Of recent years, however, a number of attempts have been made to use this leakage circuit as the direct transmission circuit. When such is the case one limb of the line is connected at the near end to the telephone set and is left open at the far end; similarly, the other end is connected at the far end with the distant telephone set and left open at the near end. The other side of the circuit is made up of ground or of a similar open limb. It will be seen that each wire serves as one plate of a condenser, the associated wire serving as the second plate of the condenser, with the result that the transmission circuit is akin to a condenser between the two telephones. It has been suggested that the longer the line and the higher the mutual capacity the better will be the transmission efficiency of the circuit.

With a view to improving this class of transmitting circuit by increasing the mutual capacity, Mr. F. Sindingchristensen, of New York City, has added condensers bridged between two associated limbs of a circuit. These condensers are placed at regular intervals and by their assistance, the mutual capacity may be increased to any desired amount.

PARTY LINE SYSTEM.

There has been patented by T. L. Willson, of Ottawa, Canada, a party line system, which requires several additional signal wires between the stations. The talking and selective ringing circuits are kept entirely distinct.

A selective lock-out step-by-step party line system forms the subject of a patent granted jointly to F. E. Mayberry, of West Medford, and N. H. Holland, of Brookline, Mass. In this system the ordinary ringing magnets serve, not only to operate the ringer, but also to control the step-by-step mechanism. A self-restoring ratchet is provided, which, except in the selective position, locks the switch-hook in a depressed position and also locks the ringing armature. In the selective position the stops are removed from the switch-hook and a nick in the ratchet disk registers with the ringer armature lug so that the latter may vibrate. Impulses of current of considerable duration operate the driving pawl, which rotates the ratchet disk at all stations, one step for each impulse. A retaining pawl holds the disk until a reversed impulse throws it out. A stop linkage is provided between the operating and retaining pawls so that when the alternating ringing current is applied to operate the ringer at the released station the operating pawl will respond in a manner to hold the retaining pawl against release.

For multi-party lines all sorts of devices and schemes have been developed to prevent the listening-in, and prevent the ringing of the bells, of non-wanted stations. These systems have, in general, been of two classes—the step-by-step, in which there is located at each station a selective switching mechanism operated under the control of the exchange; and the selective, in which some special application of current selects immediately the desired station from all others.

In this latter class is the system patented by H. D. Williams, of Vermillion, Kan. His is what might be called a "limit system," for at each station are placed two control relays. One of these fails on too weak a current and the other operates on too strong a current. Either action cuts the station, both as to its signaling and talking circuits, from the line. The right current for any station operates the first relay and permits the second relay to fail. The currents applied by the operator are direct and the voltages are varied by considerable steps, so as to give as much margin to the relays as possible.

DESK STAND.

In Fig. 3 is shown an adjustable desk stand set, invented by W. B. Oliver, of Collingswood, N. J. The cut is almost self-explanatory. The stand is capable of horizontal rotation about a joint immediately above the base, while it is adjustable vertically through the parallel motion indicated by the dotted lines. A counter-balance spring is contained within the larger tube, so adjusted that the stand will remain in any position.

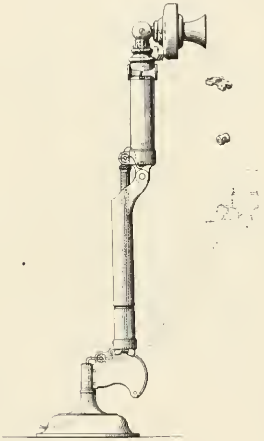


FIG. 3.—OLIVER ADJUSTABLE DESK STAND SET.

TRUNK CIRCUIT.

C. W. Sharer, of Philadelphia, has patented a trunk circuit which is designed to facilitate quick clearing of the called subscriber. A called subscriber's clearing-out signal and a guard signal enable the B, or trunk operator, to clear on the clearing-out signal, and the guard signal then warns the B operator against reassigning the trunk line until the calling end has been cleared. The circuits are adapted to the Dunbar type of two-wire switchboard. These patents have been assigned to the Keystone Telephone Company, of Philadelphia.

LETTER TO THE EDITORS.

Testing Watt-Hour Meters.

To the Editors of Electrical World:

SIRS:—On page 1145 of your issue of May 30 there appears in an article by J. B. Baker on the "Preliminary Inspection and Testing of Watt-Hour Meters" the following paragraph: "Polyphase watt-hour meters are most conveniently tested as single-phase watt-hour meters by connecting the potential coils in multiple and the current coils in series, and dividing the calibrating constant by two. Either side of the meter may be tested separately, however, by connecting one potential coil only at a time and using the actual calibrating constant."

To the second sentence of this statement I would take exception, at least as applied to polyphase watt-hour meters of Westinghouse make. The calibration of these should always be made with both potential coils in parallel on the single-phase circuit on which the meter is being tested. It makes no difference whether one or both current elements are calibrated, but, in any event, the shunt coils should both be in circuit.

This matter was investigated in a recent test at the Newark works of the Westinghouse company in the presence of representatives of the company and of the electrical engineering department of Columbia University. The registration of a 200-amp polyphase watt-hour meter in percentage of true watts was found to vary as follows:

Both current coils and both potential coils in, 101.8; either current coil and both potential coils in, 101.8; upper current and upper potential coils only, 106.8; lower current and lower potential coils only, 104.0, thus indicating a tendency to increase the registration of the meter by an average of 3.6 per cent because of the absence of one of the two potential fluxes.

A. E. SEELIG,
Test Officer, Electrical Engineering Department.
COLUMBIA UNIVERSITY, NEW YORK.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Generators, Motors and Transformers.

Single-Phase Motors.—P. DAWSON.—Continuations of his very long illustrated serial on electric traction on railways. The author discusses the series motors of the Oerlikon Company, the Siemens-Schuckert Company and the General Electric Company, and the compensated-repulsion motor of Eichberg.—Lond. *Elec.*, May 22 and June 5.

Commutation.—The conclusion of the long polemic discussion between C. L. R. E. Menges and R. Goldschmidt concerning the fundamental principles of commutation in dynamo-electric machinery and the effects produced by the covering of armature slots.—Lond. *Elec.*, May 22.

Lamps and Lighting.

Tungsten Lamps.—H. HIRST.—A paper read before the (Brit.) Inst. Elec. Eng. on tungsten lamps. The author describes the two chief methods of making tungsten filaments, developed by the Welsbach Company and by Just and Hanaman, namely, the paste process and the coating process. Of all metals which have been experimented with up to the present, only pure tungsten has a life as high as 1000 hours when operated at about one watt per hefner candle-power. The following figures give a comparison between the electrical power taken and the light radiated from the surfaces of osram and carbon filaments. One sq. mm. surface of osram filament gives 0.5 cp, and consumes 0.55 watt; 1 sq. mm. surface of carbon filament gives 0.182 cp and consumes 0.63 watt. The osram filament consumes only 80 per cent of the power taken by an equal surface of the carbon filament, but gives 275 per cent of the light given by the carbon filament. "If the kind of radiation were the same in both cases, the carbon filament ought to get hotter than the osram filament by about 60 deg. C., because of the higher total radiation consumption per unit of surface. On the other hand, considering the greater light emanating from the osram filament, its temperature ought to exceed that of the carbon filament by about 200 deg. C. These contradictory conclusions show clearly how different is the radiating power of the osram filament as compared with the carbon filament. The latter behaves much more like the 'black body' of the radiation theory." From approximate calculations the temperature of an osram filament consuming 1.1 watts per candle-power is about 250 deg. C. higher than that of a carbon filament using 3.5 watts per candle-power. "If a carbon filament were to be overrun to such an extent as to consume only 1.1 watts per candle-power, its temperature would then have to be raised by 360 deg. C. The favorable radiating properties of the osram filament, therefore, mean that its temperature is 100 deg. lower than that of a carbon filament of the same specific consumption. If it were not possessed of this radiating property it would have to be operated at a consumption of 1.5 to 1.6 watts per candle-power, in order that it might have the same life it actually possesses at 1.1 watts per candle-power." If one takes the resistance of carbon, tantalum, osmium and tungsten filaments at ordinary temperatures, the resistances at those temperatures which, in a vacuum, correspond to 1.5 watts per candle, will be as follows: For a carbon filament, 0.55 times of the original; for tantalum, 5.70 times; for osmium, 8.50 times; for tungsten, 11.00 times. Near the normal conditions the light of a carbon-filament lamp rises and falls with the 6.3 power, that of a tungsten filament lamp with the 3.6 power, of the voltage. The author then discusses the use of tungsten lamps in series; for instance, pairs of 110-volt lamps on a 220-volt circuit. For testing tungsten lamps to be used for such purposes elaborate arrangements have been made. The lamps are tested to one-hundredth of an ampere, and sorted out in from five to seven series numbers according to the type of lamp and carefully marked, and the reference numbers (ranging from, say, 28 to 38, which are marked on the caps of all lamps, singled out for series burning) practically mean that the consumption of current is 0.28, 0.29, 0.30, 0.31, etc., ampere. Considerable data in form of tables and curves are given on life tests. Data are also given on the losses in transformers supplying energy to 25-volt metallic-filament lamps. Finally, a comparison of the cost of tungsten lamps and carbon lamps is given. The author considers the annual costs of an installation of 16-cp, 25-volt lamps, of which 19 are lighted at one time; the price of energy being assumed to be 8 cents per kw-hour. The adjoining table gives the cost of 16-watt osram lamps versus 60-watt carbon lamps:

Number of hours per year of load.	Osram lamps.		Carbon lamps.		Total.		Saving with Osram lamps.	
	Energy.	Lamp renewals.	Energy.	Lamp renewals.	Osram lamps.	Carbon lamps.	Total.	Per cent.
300......	$10.95	$7.30	$27.74	$1.72	$18.25	$29.46	$11.21	38
400......	13.44	9.73	36.99	2.31	23.17	39.30	16.13	41
500......	15.88	12.16	46.23	2.88	28.04	49.11	21.07	43
600......	18.30	14.60	55.49	3.22	32.90	58.71	25.81	44
700......	20.80	17.03	64.72	4.03	37.83	68.75	30.92	45
800......	23.24	19.47	73.97	4.62	42.71	78.59	35.88	45½

In the discussion which followed, H. Harrison said that incandescent gas mantles decrease 20 per cent in candle-power after 100 hours' burning, and 40 to 50 per cent after 500 hours, whereas tungsten lamps decrease only 10 per cent in candle-power after 1000 hours. He also pointed out that enclosed arc lamps consume nearer 2 than 1 watt per candle, and are, therefore, less economical than osram lamps, and that street lighting with osram lamps may be even cheaper than with open arc lamps, if the cost of carbons be taken into account. Drake mentioned the breakage trouble, to which, he said, tantalum lamps are less subject. Dr. Louis Bell said that the shorter life of the tantalum lamp on alternating-current circuits is due to the frequency of heating and cooling. In America, tungsten lamps are largely replacing enclosed arc lamps. The American standard ratings are now 100, 60 and 40 watt. Handcock pointed to the higher ratio of the mean horizontal to the mean spherical candle-power in the case of metal-filament lamps, and thought that comparisons on the basis of horizontal candle-power are, therefore, rather unfair to the carbon lamps in which the ratio is less. C. C. Paterson said that he did not understand why the new lamps should not be standardized in candle-power instead of in watts. His experience with the gas mantle differed from that of Harrison; he found that the candle-power rises largely during the first 100 hours or so and then drops. He does not attach importance to the difference between the ratios of mean horizontal and mean spherical candle-power in the carbon and metallic-filament lamps. It amounts to no more than 5 or 6 per cent; the reduction factor is 0.85 or 0.86 on the one hand against 0.7 to 0.8 on the other. T. H. Lowden said that the British Westinghouse Company is now selling a 220-volt, 32-cp lamp.—Hirst's paper in Lond. *Elec.*, May 22, 29, and in Lond. *Elec. Eng'ing*, May 28; an account of the discussion which followed in Lond. *Elec. Eng'ing*, May 28, and in Lond. *Elec.*, June 5.

Street Lighting in London.—A. A. VOYSEY.—A report on the best method of lighting the main streets of London, with diagrams showing the results of tests made in various streets. The illumination on a horizontal surface 4 ft. from the ground is assumed to be a sufficient indication of the useful light in a street, and the minimum value of such illumination is thought to be the most important factor in good lighting; this minimum should not be less than one-tenth of one foot-candle. According to the tests of the author such an illumination can be approximately obtained by 11-amp flame arc lamps with yellow-flame electrodes, spaced approximately, either on posts at the side at 20½ ft., or centrally hung, at 28 ft. from the ground. A more even distribution of light and a more economical result can be secured by the centrally-suspended lamp at 28 ft. than by the lamp at 20½ ft. on a post at the side. Economy requires the treatment of main streets and side streets together. It is recommended that demonstration should be made in the side streets of centrally-hung arc lamps as soon as possible The author concludes that about $30,000 a year may be saved and a doubling of the average illumination throughout the city streets effected by using flame-arc lamps, assisted by a few metallic filament lamps at places where arc lamps have not a sufficient area for economical lighting. Flame arc lamps are cheaper than high-pressure gas lamps. Where central suspension is used, it should be without lowering gear in broad streets, and with lowering gear in narrow streets. Any new standards which may be required should be designed according to the advice of some reliable guide. Finally, it is suggested that the question of reducing the lighting in the main streets after midnight should be taken into consideration.—Lond. *Elec.*, June 5; *Elec. Eng'ing*, June 4.

Metallic-Filament Lamps for Street Lighting in England.—Notes on results obtained in various English towns with osram lamps for street lighting. In Croydon 82 posts are equipped with osram lamps. Each post has two 104-volt, 35-watt lamps in series on the 200 to 208-volt alternating-current circuit. The average number of burning hours obtained per pair of osram lamps has been nearly 1300, but this is without taking account of lamps still running, which may bring the average well over 1500. There is no appreciable diminution of candle-power throughout the life of these lamps. The running cost with one pair of 35-watt lamps per post is as follows:

70 watts, 3,800 hours, 270 kw-hours at 2½ cents per kw-hour.....	$6.85
Lamp renewals (average 1500 hours per pair), 2½ pairs per annum	2.31
	$9.16

In Exeter (which was the first English city to use osram lamps for street lighting, the beginning being made in 1906) there are now about 500 lamps in all, of which 135 are 110-watt lamps, mostly on trolley standards, and the rest 55-watt lamps on brackets on the old gas-lamp posts. Some of the lamps have shown exceedingly long life, ranging to above 4000 hours, but the average of some 1400 of them so far is about 1200 hours. A good deal depends on insuring that the e.m.f. is not too high.—Lond. *Elec. Eng'ing*, May 21

Incandescent Lamps.—Continuations of the long illustrated serial on recent improvements in construction of incandescent lamps. An account is given of the proposal of Bastian and Calvert to use copper ribbon instead of platinum for leading-in wires. Then the methods of supporting the long metallic filaments are discussed to prevent the different loops from touching each other or the glass walls Metallic supports cannot be used directly, since the process of exhaustion according to Malignani with phosphorus vapor would result in the formation of phosphides with a low melting point so that the supports would soon be destroyed. They are therefore now made of metals covered with a film of a very refractory oxide. Several methods of applying this oxide layer are described. The author then passes to a description of the different forms of frames for supporting and holding the filament in position.—*Zeit. f. Beleucht.*, May 20 and 30.

Arc and Brush Discharge.—M. Toepler.—In the fixation of atmospheric nitrogen use is made of arcs several centimeters in length with a relative low current, and arrangements are made by which the gas is constantly renewed. In this way an accumulation of vapor emitted from the electrodes is avoided. In such experiments it is found that the middle part of the arc, which is free from the vapors of the electrodes, has an appearance very similar to a brush discharge. The author thinks that a long arc consists of two different parts, first, the zones near the electrodes filled with vapors from the electrodes, and second, the part removed from the electrodes, free from vapors and with a discharge of the character of the brush. Grau recently determined the relation between voltage, ampere and arc lengths for long direct-current arcs between artificially-cooled electrodes. The author shows that these measurements may be approximately represented by the formula characteristic for the brush discharge.—*Phys. Zeit.*, June 1.

Generation, Transmission and Distribution.

Overload of Generating Sets.—An account of a discussion on this subject held at the Newcastle section of the (Brit.) Inst. Elec. Eng. C. Turnbull thinks that "full-load might be defined as the point where the most economical load is exceeded by, say, 10 per cent. Overload is beyond this. Combined plant must give at least the specified power." "The maximum overload of the plant should be the maximum overload of the engine, the generator being made to suit. The generator should also be capable of running continuously at any load which the engine would carry economically." G. G. Stoney in criticising these recommendations referred to the different behavior of reciprocating and turbine sets, with reference to Fig. 9, where *I* is the curve for the reciprocating engine and *II* the curve for the turbine. According to Turnbull's definition, full load is located at point *R* 10 per cent beyond point *A*, the most economical point on the curve *XAR* for the reciprocating engine. In the turbine set nominal full load is usually taken at point *F* on the curve XAR^1, the 1¼ load being located at the point *A*, and the 1½ load at the point R^1. In a reciprocating engine, the consumption rapidly ascends again after it has reached its lowest point, while in the turbine the curve continues practically horizontal. Moreover, the turbine, if it runs five minutes under overload, will run equally well for 500 hours. The point can be put this way: "An alternator has a time-limit but not a load-limit, while the turbine has a load-limit but not a time-limit, and the proper combination of a turbo-alternator depends on the balancing of these relations." The best specification is generally one which requires a 5 per cent voltage regulation at full load, and an overload of 25 per cent, to the point where bypassing becomes necessary, with ability for 50 per cent overload when the bypass is opened. Reference was also made in the discussion to the importance of designing the switchboard so as to be capable of handling an overload.—Lond. *Elec. Eng'ing.*

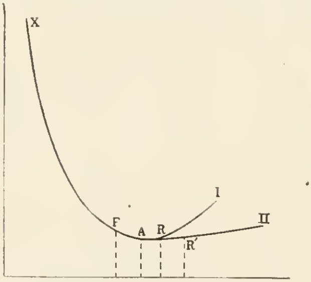


FIG. 1.—OVERLOAD OF GENERATING SETS.

Traction.

Electric Traction in Bavaria.—An article illustrated by diagrams and tables on the projected electrification of the state railways of Bavaria, water power to be utilized for the generation of the electrical energy. The average daily consumption when all lines are worked by electric traction would be 1,435,000 kw-hours, while, taking into consideration the various losses, the equivalent hp-hours at the turbines would be 3,400,000 and the mean daily load 142,000 hp. Moreover, it is estimated that the mean load due to the railways in 1920 will be 202,000 hp and the maximum load 606,000 hp. The minimum power available from water in Bavaria at any time is 300,000 hp, but with the aid of storage arrangements the falls are sufficient to supply all the energy required for traction. It is concluded that traction with motor cars or with heavy locomotives will be technically possible. Under present conditions the single-phase system is considered to best fulfill all requirements. Electric traction offers distinct advantages under all circumstances, namely, increased speed and avoidance of smoke nuisance. The additional question, whether the adoption of electric traction offers advantages over steam working, both in technical and financial directions, is answered by the fact that electric traction is financially on equal terms if (a) the cost of electrical energy does not exceed a certain limit, and (b) there is a certain density of traffic. These conditions are better fulfilled by the lines in southern than by those in northern Bavaria, as in the south coal is dearer, and electrical energy cheaper, on account of the available waterfalls power, than in the north. It is thought that the adoption of electric traction on the lines Salzburg-Bad Reichenhall-Berchtesgaden and from Garmisch-Partenkirchen to Scharnitz will be very advantageous financially. For the former railway it is estimated that steam traction and electric traction will be financially on equal terms if the cost of the kw-hour is 1 cent. The following procedure should be followed on all sections, except the first experimental lines: Lines or groups of lines should first be selected which, owing to their proximity to waterfalls and to their traffic requirements are especially suitable for electric traction. On the remaining lines electrical traction will, according to circumstances, not be adopted for some considerable time, as certain waterfalls may be more advantageously put to other uses, though their possible eventual employment for railway work will not be lost sight of.—Lond. *Elec.*, May 29.

Electric Railway for Postal Work.—The German postoffice authorities are considering the question of connecting the general postoffice in Berlin with the various stations by means of a special underground railway. A short experimental length of track from the postoffice to a railway station will first be built. The tunnels, which will be built directly under the road surface, will be 6 ft. wide by 2½ ft. high. The railway will be double-track throughout, and will have a gage of 1 ft. 4 in. Between the tracks a pit will be provided, allowing an inspection of the track to be made and repairs to be carried out. The "driverless" trains will consist of an electric locomotive drawing four cars, each containing a large sack of letters. The running speed will be 25 miles per hour, and will be independent of load, curves and gradients. The headway will be 90 seconds. Above each track will be placed two "third-rails," which will be about 1 ft. 6 in. from the track in the tunnels and 6 ft. 6 in. in the postal buildings, the trolleys being 6 ft. 9 in. long. The locomotives and cars are of the two-axle type, the former being equipped with two motors. For working this railway low-tension three-phase currents will be used.—From *Blätter f. Post u. Tel.*, abstracted in Lond. *Elec.*, May 22.

Installations, Systems and Appliances.

Losses in Alternating-Current Systems.—An illustrated description of the Berry "series systems," the object of which is to reduce the light-load losses in an alternating-current network, to only a small fraction of their former value. The fundamental principle is the use in each substation of a small auxiliary transformer, arranged with its primary and secondary windings in series with the corresponding windings of the main transformer or bank of transformers, and connected with an automatic switch of special design, so that the small auxiliary transformer is short-circuited whenever the load rises above a predetermined limit corresponding to full load on the small transformer. Similarly the switch is arranged to remove the short-circuit and place the auxiliary transformer in circuit again as soon as the load falls once more below the fixed limit. Whenever the transformers are connected in series, nearly full pressure will exist across the ends of the windings of the small transformer owing to its impedance, while the large transformer will be practically idle, so that the light-load losses will be practically only those of the small transformer. Thus, if a 10-kw transformer is placed in series with a 100-kw transformer across 2000-volt mains, the small transformer absorbs about 1900 volts, giving, say, 190 volts at its secondary terminals, while the large one absorbs the remaining 100 volts and gives 10 volts on its low-tension side. That is to say, the total losses with no load on the secondary side will be practically only one-tenth of those which would result from placing the 100-kw transformer directly across the 2000-volt mains. The diagram, Fig. 2, shows in a simplified form the arrangement of transformers and automatic switch for such a 2000-200-volt single-phase system. A 10-kw transformer, T_1, is shown in series with one for 100 kw, T_2, the switches S_p and S_s serving to short-circuit the former whenever the load rises above 10 kw. With the switches open, as in the illustration, the windings K_1 and K_2 of the switch will carry no current. On the load increasing above 10 kw the relay A, which is shown on both the primary and secondary sides, slowly pulls over the winding K_1 of the switch. This winding serves to lift up the plunger P, thus closing switches S_p and S_s, at the same time, by means of a rocking lever, breaking the circuit of K_1 at contact D_1 and closing contact D_2, so that, as soon as the circuit in the relay A decreases again, contacts $C_2C'_2$ are closed, current passes through coil K_2 and switches S_p and S_s are opened. Further advantages of the system are as follows: Considerably improved voltage regulation can be obtained, since, as the loads on the various substations increase, the larger transformers with higher voltages at their terminals come into operation. In this way the pressure is maintained at its correct value at different parts of the network which may be unequally loaded. A more important point, however, is in connection with the design of the large transformers. These, owing to the smaller importance of the iron losses, can be designed to have small copper losses, which are thus at times of heavy load less serious than is usually the case, with consequently improved voltage regulation, also aided by the fact that the main transformer will be practically cool when coming into operation. That is to say, a transformer intended to be operated on the series system would be designed with larger iron losses than usual, although its efficiency at full load would be the same on account of the smaller copper losses. Also as these latter increase as the square of the current, it is obvious that the efficiency of such a transformer would differ at other loads from one of the usual design where the copper and iron losses are made about equal at three-quarter full load. Fig. 3 shows the results of an actual test on a 450-kw Berry transformer. It will be seen that, even with full load maintained continuously, the transformer requires about 48 hours to attain a steady temperature. But since the main transformers are practically out of operation for the greater part of every 24 hours, it is best to build them much smaller than is usually the case, probably to the extent of 25 per cent. Further, as a transformer cools down every day it is always in its most efficient condition when it comes into operation. The advantages claimed for the system are summed up as follows: "The light load iron losses of transformers connected may be reduced by from 70 to 90 per cent. The transformer copper losses at full load may be reduced by nearly 40 per cent. The pressure regulation at consumers' terminals is improved, with consequently increased energy sold. The life is increased and the rate of depreciation is diminished, since the main transformers are relieved of pressure for the greater portion of every 24 hours. It is possible, owing to reduction of light-load output, to use a motor-generator in connection with a battery, and so improve the load factor on the supply-station plant. The capital outlay on transformers is smaller.—Lond. *Elec.*, May 29.

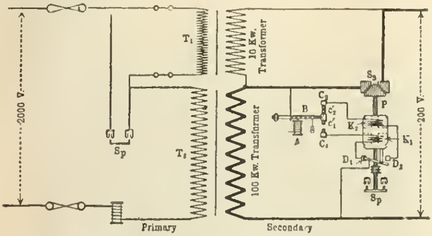


FIG. 2.—DIAGRAM OF SWITCH CONNECTIONS.

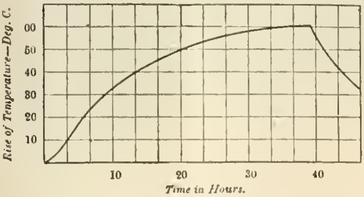


FIG. 3.—TEST OF 450-KW TRANSFORMER.

Lightning Protection.—C. P. STEINMETZ.—The principal difference between lightning, in its broadest sense, and the normal flow of energy in an electric circuit is, that lightning is the phenomenon of electric energy when beyond control. This may mean either excessive currents or excessive voltages. Excessive currents are dangerous only when lasting for some time and can generally be taken care of by circuit-breakers, automatic cut-outs, etc. Excessive voltages on the other hand are practically instantaneous in their action. Dangerously high pressures may enter the electric circuit from the outside, due to atmospheric disturbances, such as lightning, or they may originate in the circuit. Atmospheric disturbances give either single or multiple strokes, and are sufficiently well taken care of by the modern multi-gap lightning arrester. Continuous discharges, or recurrent surges, that is, lightning lasting continuously for long periods of time, with thousands of high-voltage peaks per second, mainly originate in the circuits due to an arcing ground, spark discharges over broken insulators, faults in cables, etc. They require a lightning arrester which can discharge continuously without self-destruction, at least for a considerable time. The only lightning arrester which is capable of doing this is the electrolytic aluminum arrester.—The same issue contains a note by V. E. Goodwin on the care and inspection of lightning arresters.—*Gen. Elec. Rev.*, June.

British Central Station.—An abstract of last year's financial report of the Leeds municipal electric station. The number of kw-hours sold was 12,412,861. The working expenses per kw-hour sold were 1.34 cents; the total cost, including capital charges, 4.12 cents. The average price obtained per kw-hour was 4.38 cents. An interesting item in the costs is "wages incurred on extensions, but not chargeable to capital account, being paid to corporation's permanent workmen, 0.04 cent per kw-hour." A 3000-kw steam turbo-alternator has been installed at the generating station during the year, and the present rating of the plant is 12,740 kw. An additional turbine set rated at 3000 kw is on order, and expected to be available for use before next winter. The maximum load upon the plant has been 8300 kw, compared with 7470 kw in the preceding year.—Lond. *Elec. Eng'ing*, May 21.

Storage-Battery Installations.—An account of some changes in recent German practice with storage-battery installations in central stations. Boosters are now used exclusively for charging. While balancers had been erected in some of the larger stations in the nineties, they were hardly ever used, but they are now coming into use extensively. Automatic operation of cell switches also meets with constantly increasing favor. Auxiliary cells are also made use of. Finally it is recommended to cover the cells during their use with glass plates in order to prevent evaporation and keep the obnoxious vapors out of the room.—*Elck. Zeit.*, May 21.

Protective Relays.—M. C. Rypinski.—In the conclusion of his long illustrated serial on protective relays he discusses several types of auxiliary relays. The first relay described may be used where a definite time-element action has not been provided for. It is adjustable only as to time-element and serves as an auxiliary relay to close the tripping circuit a definite length of time after its own actuating circuit has closed. It is chiefly used in connection with an instantaneous overload-relay. Another auxiliary type described is a bell relay which serves to indicate when a circuit breaker has operated by energizing a gong circuit and maintaining this circuit until it is opened by the switchboard attendant.—*Elec. Jour.*, June.

Circuit-Breakers.—H. G. MacDonald.—A continuation of his long illustrated article on circuit-interrupting devices, describing detail features of oil circuit-breakers, and especially the construction of the contacts, insulation and the operating mechanism, by means of which the contacts are opened and closed.—*Elec. Jour.*, June.

Station Connections.—R. E. Argersinger.—A discussion of some factors affecting station connections and switching arrangements. The author discusses single and multiple-bus arrangements and emphasizes that as any double bus is expensive, the actual need of it should be carefully considered before it is installed. The character of the automatic control is also an important feature which should be carefully considered.—*Gen. Elec. Rev.*, June.

Wires, Wiring and Conduits.

Submarine Cable.—An illustrated note on a large submarine cable to be used as a feeder on the Sydney trolley system and to be laid across Sydney Harbor. It is an "extra-high-tension" cable, and each core has a section of 0.062 sq. in. The cores are insulated with paper and covered with lead in the usual way. Above the lead is a layer of jute to serve as a bedding for the armoring, which consists of two layers of No. 10 S. W. G. galvanized iron wire. Over the armoring is a protective layer of jute. The heavy armoring is to prevent damage by ships' anchors and from other causes. To obviate the necessity of making joints in the cable, it has been supplied in one length of 2400 ft.; it weighs no less than 15 tons.—Lond. *Elec. Eng'ing*, May 21.

Electrophysics and Magnetism.

Electric Conductivity in Solids.—J. Koenigsberger and K. Schilling.—The author has determined the change of electric conductivity of silicon, titanium and zirconium between — 180 deg. C. and + 200 deg. C. It was found that Ohm's law is fulfilled and no polarization (at least above 0.0001 volt) could be found; in other words, these elements are metallic conductors. According to the electronic theory these elements should therefore show a change of sign in the temperature coefficient of the conductivity at a certain temperature, and a minimum value of the resistivity. This minimum value was found to exist at — 100 deg. C. for zirconium, at + 150 deg. C. for titanium, at + 800 deg. C. for silicon and at + 1800 deg. for graphite. Experiments were also made with magnetite which was also shown to be a metallic conductor, and to have a minimum point of resistivity. On the other hand, barium sulphate crystals were found to show a constant polarization of 1.49 volts against gold electrodes, so that they must be assumed to be electrolytic conductors.—*Phys. Zeit.*, May 15.

Photo-Electric Effect.—At a recent Royal Society soiree in London, Prof. J. A. Fleming demonstrated the well-known photo-electric effect (discovered by Elster and Geitel), shown by alkali metals, and particularly by the liquid potassium-sodium alloy, when sealed in vacuum tubes; they permit the escape of negative, but not of positive, electricity when illuminated by an arc lamp. The light was so directed that it fell on the surface of the alloy, a piece of platinum foil, the other electrode being fixed about a centimeter above the alloy; an e.m.f. of 0.8 volt was set up. When the illuminated alloy was joined to the negative pole of a battery, negative electricity leaked away, and this leak, it was shown by the interposition of colored screens, was produced chiefly by the most refrangible rays of the blue end of the spectrum; the magnitude of the effect further changed with the plane of polarization. Professor Fleming also demonstrated an observation, first made by him in 1904, that the carbon filament of a glow-lamp, having an insulated metal cylinder surrounding the filament, emits negative electricity, and can serve as a delicate long-distance receiver in wireless telegraphy. These oscillation receivers have been used in transatlantic telegraphy and also in radiotelephony.—Lond. *Eng'ing*, May 15.

Theory of Magnetism.—Pierre Weiss.—The author refers to Langevin's kinetic theory of paramagnetism and diamagnetism. It is assumed that the magnetic moments of the molecules are the resultants of the magnetic moments of the circular paths of all electrons in the atom. Two cases must be distinguished. In the first case the resulting moment is zero on account of the symmetric structure of the atom. In this case the only effect of an external magnetic field is a small deformation of the paths of the electrodes, which causes diamagnetism. In the second case the resulting magnetic moment is different from zero and the external field produces a torque on the molecules. On this basis, together with the kinetic theory of heat, it is possible to formulate a fundamental law for paramagnetism. Magnetization is the result of a static equilibrium between the external magnetic field and the thermal vibrations in the molecules. In order to give to paramagnetic substances, magnetic field intensities of the order of magnitude of ferromagnetic metals, flux densities of the order of 10^7 gauss would be required, which we are unable to produce. Langevin thinks that only the mutual action between the molecules is able to produce such high densities. The present author shows that by means of a simple hypothesis concerning the mutual action between the molecules Langevin's theory can be extended to the phenomena of ferromagnetism. He assumes that each molecule is acted upon by the other molecules in the neighborhood with a force equal to that of a homogeneous field proportional to and equally directed with the magnetic field density. Various conclusions drawn on this assumption are shown to correspond with the facts.—*Phys. Zeit.*, June 1.

Potential Variation in Atmosphere.—D. Smirnow.—A discussion of the different factors which influence the daily variation of the potential gradient in the atmosphere. There are three chief factors. First, during the night the atmosphere next to the earth is cooled and the diminution of its electric conductance causes an accumulation of positive charges on the earth's surface, therefore a decrease of the field above. In the morning when the earth's surface gets warmer the field intensity assumes again its former value. Secondly, in summer days the rising currents of air carry positive charges upward and leave an excess of negative charges (dust) behind so that the field intensity decreases in the lower layers of the atmosphere. The immediate action of the radiation from the sun is the production of negative charges in the highest layers of the atmosphere; a diminution of the positive charges in the middle layers of the atmosphere, and a diminution of the potential gradient near the earth's surface. This last factor is not clearly manifest in the daily variation, but manifests itself strongly in the yearly variation.—*Phys. Zeit.*, May 15.

Atmospheric Radio-Activity.—H. M. Dadourian.—An account of an investigation on the radio-active constituents in atmospheric air. The quantity of radium emanation in atmospheric air at New Haven, Conn., is from 30,000 to 50,000 times the quantity of thorium emanation; in Rome, Italy, the radium emanation is from 20,000 to 30,000 times the thorium emanation.—*Phys. Zeit.*, May 15.

Electrochemistry and Batteries.

Electric Steel.—R. H. Wolff.—A communication giving in a table the composition of steel made in regular commercial operation during one month in the Héroult furnace in a French works. The various possibilities of electric steel refining under the present condition of the steel industry are pointed out, with special reference to steel castings. It is thought that the equipment of modern iron and steel works with gas engines will result in such cheap energy that the electric furnace will become an auxiliary apparatus in most steel works.—*Elec. and Met. Ind.*, June.

Copper Refining.—J. B. C. Kershaw.—A review of the present condition of the copper refining industry. It is estimated that $75,000,000 are invested in this industry. There are 36 refineries in the world and three in course of erection. In the American refineries 86 per cent of the total output of the electrolytically refined copper is produced. Some notes are given on new plants in Australia and Russia.—Lond. *Elec.*, June 5.

Carbon Cells.—A note on a recent patent of Jungner for a gas cell in which the caloric energy of the reaction $SO_4 + O + H_2O = H_2SO_4$ is converted into electrical energy. If the sulphuric acid obtained by the above reaction is changed back into sulphurous acid by means of carbon, the whole result of the process is the oxidation of carbon to carbon dioxide. The various attempts which have been made to devise a carbon cell or to utilize in some other way the energy of oxidation of carbon to a greater extent than by burning carbon are reviewed in an editorial.—*Elec. and Met. Ind.*, June.

Units, Measurements and Instruments.

Voltameter.—R. A. Lehfeldt.—An account of his attempts to design a gas "coulometer." The usual trouble with gas voltameters is that they cannot be used accurately with high-current densities. In the instrument described by the present author the two electrodes are held in a cork, which can be inserted into a sort of inverted test-tube. The test-tube has a side limb for pouring in electrolyte till the platinum electrodes are well covered, and a small-bore gas tube runs from the top of the test-tube to a manometer and a gas-measuring apparatus. The manometer is a U-tube containing olive oil, one limb being open to the atmosphere. The gas-measuring apparatus is a vessel out of which mercury can be run from a tap at the bottom. In making a measurement of a quantity of electricity, the mercury was adjusted till the oil manometer showed that atmospheric pressure existed inside the apparatus, the circuit was closed, and mercury was run out to keep the oil manometer level. By weighing the mercury the volume of gas evolved could be estimated accurately. The temperature was kept as steady as possible by a water-jacket. The author used currents of about 0.6 amp and passed quantities of the order of a thousand coulombs through the apparatus. The mercury that was run out during an experiment averaged between two and three thousand grams. The author tried a great many electrolytes at this current density, using a potentiometer and standard-cell method of measuring the current. He found that many electrolytes give volumes of gas varying from 33 per cent to 99 per cent of the theoretical yield; but if solutions of sodium sulphate, of a concentration of 10 to 30 per cent, or solutions of potassium bichromate, of a concentration of 5 to 10 per cent, be electrolyzed, almost theoretical yields are obtained. With these solutions the apparatus is reliable and rapid, the error being within one-tenth per cent.—*Phil. Mag.*, May; abstracted in Lond. *Elec. Eng'ing*, May 21.

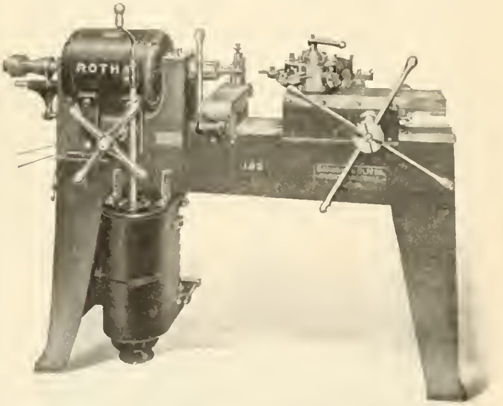
Hand Chain Hoist.

Climax Hoist Company, Philadelphia, Pa., is placing on the market a new spur-gear chain block designed by Mr. Burr, engineer of the company, which is particularly applicable for use in power houses for the handling of heavy weights. In the new hoist the load is carried on hardened and ground steel rollers. All gears are enclosed in a dustproof case and run in oil. The retaining brake is of the company's own design, and is noiseless in operation and positive in action. All parts are jig-made to standard sizes and are interchangeable. The load chain runs in a sprocket keyed to a long hub supported in a housing cast in one piece with an internal load gear. This gear is driven by a one-piece spur pinion carried on a stud with an internal gear driven in turn by a spur pinion carried on the hand-chain wheel shaft. The hand-chain wheel shaft is passed through the hub of the load gear to the opposite end of the block where the hand-chain wheel is located. Hoisting is accomplished by pulling on the right-hand side of the hand chain and lowered by pulling on the left-hand side, which releases the friction brake.

Motor-Driven Lathe for Brass Work.

The accompanying illustration shows a Bardon & Oliver motor-driven brass-finishing lathe in which the motor is mounted directly on the spindle and takes the place of the cone pulley. The armature is mounted on a sleeve into which the regular spindle of the lathe is pressed. The frame is supported on substantial brackets. The lathe bearing, hollow spindle and all other operative features of the lathe are maintained, the motor not interfering in any way with the regular performance. The rating of the motor in this case is 2½ hp, with overload capacity of 7½ hp. The speed is varied in 20 steps by means of the controller, from 300 to 1400 r.p.m. in either direction of rotation. The controller, which is of the reversible drum type with dynamic brake and mechanical dash-pot, is mounted as shown below the bed of the lathe at the head stock and where it is out of the way. The shaft is extended to take a crank located conveniently for the operator.

A feature of this outfit is that various speeds in either direction of rotation can be obtained instantly. It is claimed that the controller handle can be thrown to any position or fully reversed as quickly as the handle can be removed without causing excessive rushes of current or sparking. The maximum current taken when the motor is thrown from highest speed in one direction to highest speed in the other is said to be 60 per cent in excess of the full-load current. The dynamic brake is a valuable feature in that the lathe is stopped instantly when the controller is moved to the off position, thus saving a great deal of the time normally required to bring the spindle to rest. To facilitate truing the work up in chucking, dead points are provided on each side of the dynamic brake. With the controller in this position the spindle runs freely.

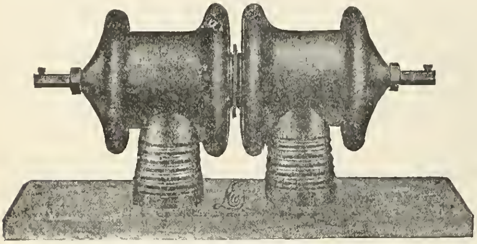


MOTOR-DRIVEN BRASS-FINISHING LATHE

The superiority of the method of mounting the motor directly on the lathe spindle is due to the rapidity with which the motor is able to respond to the action of the controller. The absence of gearing, belting, etc., makes the outfit noiseless. The amount of energy consumed is claimed to be almost exactly proportioned to the work, there being no extra bearings, gears, belts or other machinery to operate. The motors are manufactured by Roth Brothers & Company, of Chicago, and may be fitted to either new or old lathes of standard makes.

Abnormal Potential and Static Discharge Protector.

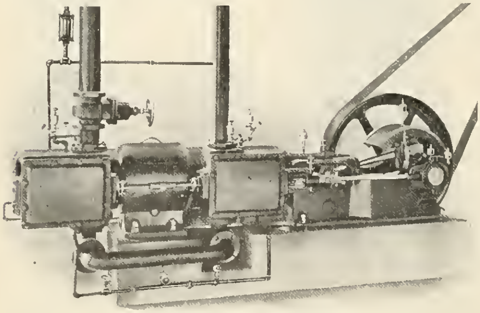
The device shown herewith, made by the Lord Electric Company, New York, has been designed to protect dynamos, motors, regulators and other similar apparatus from static discharges. It is connected to the terminals of the various machines or devices and offers a path over or around the machine by which a discharge may be delivered to any one of the grounded lightning arresters and there be dissipated to earth. It is a great protection to weak insulation, relieving the windings of transformers, regulators, motors, etc., from excessive stress. When used in connection with lightning arresters it is of inestimable value. Used in substations, power houses and transformer houses it gives excellent results. It is of the general Shaw design, but involves other principles not employed in the regular standard lightning arrester.



HIGH-POTENTIAL DISCHARGE PROTECTOR.

Belt-Driven Pump for Obtaining High Vacua.

The accompanying illustration shows a belt-driven vacuum pump which is especially designed for laboratory use in the manufacture of incandescent lamps, etc. The illustration was made from a photograph taken of such a pump located in the plant of the Westinghouse Electric Lamp Company at Watsessing, N. J. The pump, which is of the two-stage pattern, arranged with two 12-in. diameter vacuum cylinders, 12-in. stroke, and is designed for a speed of 100 r.p.m., will, it is claimed, produce a vacuum of within 0.02 in. of the barometric height as registered by the mercury gage. The suction is connected to a closed receiver which is piped off to the stands containing the incandescent lamps to be exhausted. The pump works strictly on the dry system and is adapted for all usages where high vacuum is desirable, as in connection with the evaporative processes of sugar refineries, distilling plants, chemical and dye works, glue works, salt works, soap works, the manufacture of prepared foods, medicines, essence, glycerine, etc., preserving processes, the production of high vacuum in central steam condensing systems and steam turbine work. The pumps are also built with steam cylinders for direct steam drive, or are arranged with extended bases and gearing for electric motor. The vacuum cylinders are water jacketed and the valves are mechanically operated by eccentrics keyed to the main shaft. Experience with work where a vacuum is required has shown that better results are obtained by means of two air cylinders; that is, in two stages, one cylinder discharging into the other. This machine is manufactured in various sizes by the Blake & Knowles Steam Pump Works, 115 Broadway, New York.



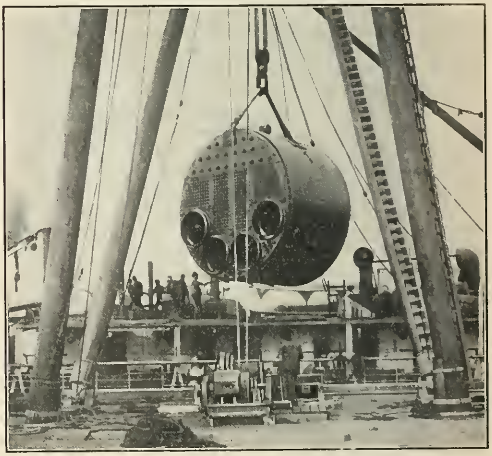
BELT-DRIVEN VACUUM PUMP.

Electric Dock Hoist.

A striking example of time saving through the use of a modern electric hoist comes from the Pacific Coast, where in the yards of the Commercial Boiler Works, at Seattle, a 65-ton boiler was raised from the dock and placed in position in the hold of the steamship *Pennsylvania* in the short space of 20 minutes. The illustration shows the boiler about to be placed in the hold.

The plant of the Commercial Boiler Works, engaged in the manufacture of marine boilers and in handling ship repairs, has its machines equipped with individual motor drive, and to facilitate the loading of heavy materials it was found necessary to install electricity in the yards as well. The hoist used was supplied by the Lambert Hoisting Engine Company and is driven by a 40-hp Westinghouse direct-current motor, the speed of which is regulated by a drum-type controller, affording nine forward and nine reverse speeds. From the drums of the hoist a ¾-in. steel cable runs to the top of the shear legs, where it reeves through a set of blocks capable of lifting from 75 to 90 tons.

The boiler, which was lifted and placed in position in 20 minutes, was one of the largest ever built in Seattle. The worm-gear hoist which was previously used would have required three hours' time to raise the same load. A 15-ton boiler was recently loaded by the Lambert hoist in 4½ minutes.



ELECTRIC DOCK HOIST.

The energy which drives the hoist and the motors in the shop as well is purchased from the Seattle-Tacoma Power Company, being transmitted by a two-phase line at 2300 volts. It is utilized on the dock as direct current and in the shops as alternating current for two 50-hp motors driving heavy rolls, one 50-hp motor driving an air compressor and various small motors, all of standard Westinghouse manufacture. A motor-generator set is installed in the shop, to supply the necessary direct current for the hoist.

Exhibits at Convention of Canadian Electrical Association.

Owing to the fact that it was not until a late hour that the management committee was able to secure the use of the University Chemistry and Mining Building, the exhibitors at the Canadian Electrical Convention, held at Toronto, June 17 19, were somewhat militated against. There was no large hall available, and the exhibits had to be separated. Thus the spectacular effects, which are always a feature of electrical displays, were lacking, and a comparison of the various arc and flame lamps shown in working competition was impossible. Some of the exhibits were in the hall and others in separate rooms down stairs, but in spite of these drawbacks the various firms made a creditable showing, and they were rendered every possible assistance by the University authorities, who placed all their electrical apparatus at their disposal.

The Canadian General Electric Company, of Toronto and Peterboro, whose stand was in charge of Mr. H. O. Edwards, was the largest exhibitor. Varied applications of electricity in many fields were shown, and particularly those calculated to interest small users of power. The domestic line was well covered, and included cooking utensils of every description, fireplaces, ovens, heating pads, pressing irons and water diffusers. Motors of small size were very much in evidence. One, a three-phase motor on a single-phase current, drove a little portable twist drill, and another a breast drill, while nearby stood a sewing machine with a motor attached. For owners of automobiles and motor boats there was a large choice of ignition apparatus, various lines of batteries and accumulators, as well as types of searchlights. For the benefit of the automobilist, living at a distance from a garage, there was exhibited a mercury-arc rectifier, for the transformation of alternating into direct current. A two-ton Sprague electric hoist occupied one corner of the room, and an electric saddle horse, full of surprises for the most accomplished rider, stood in another corner. The company showed a flaming arc lamp stripped to exhibit the working apparatus, and various meters, including a curve-drawing voltmeter, wattmeter for home use, and a prepayment meter, which is a new thing in Canada. The whole display was beautifully illuminated by tungsten lamps.

The Gas & Electric Power Company, of Toronto, exhibited a large line of switches, meters and lamps. Its switches struck the observer as being of liberal proportions in the way of contact, area and brake. These features were embodied in the current and potential transformers for instrument use. The firm also showed some high-tension oil switches, with automatic release; meter transformers for use in conjunction with trip coils of oil switch; and alternating and direct-current meters fitted with cyclometer dials. The meters are for very low starting current, and the firm claims for them great accuracy, independent of wave form, periodicity and voltage variation. The company also exhibited a "Midget" arc lamp 15 in. x 4 in. A flame arc lamp was also shown of simple and durable mechanism, using either white, yellow or red carbons. Messrs. H. F. Dodd, D. O. Hills and J. C. Monahan were in charge.

The Canadian Westinghouse Company, of Hamilton, devoted the principal part of its exhibit to the lighting interests, and showed a very complete line of lamps in operation. Included were the new tungsten lamps, standard incandescents of various candle-power, Cooper Hewitt lamps, alternating series lamps and a new metallic flame arc lamp. There were various small transformers for small central stations, a number of small power motors and a washing machine operated by a motor. The firm showed an electrolytic lightning arrester outfit, with all accessories, oil switches and a number of direct and alternating-current wattmeters, both single-phase and polyphase. precision wattmeters and portable wattmeters. An exhibit of the Nernst lamp was in charge of A. E. Fleming and M. H. Smith, while the other exhibits were under the superintendence of W. H. Eisenbeis, W. W. Lovell and H. T. Gibbs.

Joyner-Green, a new firm in the Canadian electrical field. which covers central station and power electrical equipment and electrical contractors' supplies, had an interesting exhibit. Mr. A. H. W. Joyner, who was electrical engineer for the Boston Edison Company, and afterward with Stone & Webster, had charge of the first department, while Mr. E. A. Greene, who obtained experience in the contracting and supply line in the West, looked after the second department. Their exhibit included the Helios arc lamp, twin carbon, 220 volts, and a Helios "Continental" arc lamp using 97 volts at the arc on a 110-volt circuit. They also showed Standard direct and alternating-current arc lamps, which are claimed to be absolutely noiseless, a "Dim-A-Lite" lamp, three voltages, new to Canada, and a miniature 3½-amp lamp burning 50 hours. Two other exhibits which attracted attention were an Anderson time switch with a specially-made clock, which is claimed to regulate the appliance to a second; and a cartridge coil, which can be taken to pieces, for portable engines. In the railway material line the firm showed strong, and also in some side lines. The exhibit was illuminated by a nightmare twirler flashing red and green lights alternately.

J. F. B. Vandeleur, of the Dineen Building, Toronto, was in charge of an exhibit entirely British, which showed the characteristic of plain, thorough workmanship, compactness and strength. The Evershed & Vignole's "Meggers" for measuring insulation came in for much attention. Those shown were the variable-pressure "Megger" and the constant-pressure "Megger." In the former the generator is driven by a winch-handle and the volts at its terminal vary with the speed at which the handle is turned. In the constant-pressure type the generator is driven by a centrifugal friction clutch which secures the result that when the handle is turned over the slipping speed, the speed of the generator and the terminal pressure remain constant. A "Bridgeman Megger" to measure both conductor and insulator resistance was also shown. Other exhibits were a portable voltmeter and ammeter, and a 1000-amp shunt which was compactness itself, being only 5 in. x 4 in. x 2 in. There was a Gilbert constant-current transformer in which the working current is altered or adjusted by changing the position of the transformer. The current can be changed from 5 to 20 amp, and the instrument can be used in connection with street lighting, and may be placed in any chamber or substation. Near the transformer stood Gilbert arc lamps, both flame and enclosed, with covers specially designed against snow; and a 6-ft. carbon lamp designed to run from 50 to 70 hours. Another lighting device was a short lantern to be used in stoke-holes on board ship. In connection with navy yard work was exhibited one of Berry's patent switch and fuse gears, claimed to be capable of standing a dead short circuit simultaneously across both poles at 550 volts pressure without arcing. Another noteworthy marine device shown was an Evershed & Vignole's stoking indicator in use on many of the British warships. One indicator is placed in each stoke-hold and indicates at regular intervals, by numbers, which furnace requires fuel. Other naval exhibits were, a fire-control apparatus which transmits orders from the conning tower to the guns in each position. The signals include the range and the deflection "right" or "left"; a danger indicator shows when guns in different positions are bearing upon each other, so that one may shoot away the other's muzzle for example; a helm indicator automatically indicating the position of the rudder in a battleship. These last three instruments are in use in both British and Japanese navies. Mr. Vandeleur also exhibited Morgan's pneumatic brush gear, and Morganite brushes. These are constructed in layers rendering the resistance across the brush seven to eight times greater than in the other direction, while the highest conductivity line is into the external circuit, and the highest resistance is offered to currents in the short-circuited coil. A sample of enameled insulated wire lay near the brushes.

The Canadian Fairbanks-Morse Company exhibited several types of its smaller motors and exhaust fans.

Other exhibitors were the Electrical Specialties Limited, showing dry-cell batteries; the Philip Carey Manufacturing Company, asbestos materials, in charge of H. W. Cook, and the Oneida Community, Niagara Falls, manufacturers of galvanized chains for arc lamp suspension.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

As far as general trade conditions are concerned, the convention at Chicago had no apparent effect. This was not because the nomination for the Presidency had been discounted, but because, with the present volume of business, trading is not disturbed much by political activity. During the week there was a continuance of the better feeling as to the future and some further enlargement of industrial operations was reported, especially in textile lines. Actual business was quiet, as it normally would be at this season, but not more inactive than might be expected in view of the existing circumstances. The weather reports showed a continuance of reports of excessive moisture in sections where wheat is being harvested and where corn is being cultivated. This has curtailed trade and collections Northwest and Southwest, while floods in rivers and bottom lands have checked transportation of commodities to market and added an element of doubt as to the ultimate crop outcome. East of the Mississippi River the weather has been more seasonable and a larger distribution is noted at retail on account of the additional stimulus of price reductions at many cities. It is generally agreed by retailers that stocks are not large. Fall buying has been a trifle more active in the New York market. Railroad earnings continue to show decreases. Gross earnings of a group of important roads decreased in April $28,924,865 from the corresponding month of last year, or 18 per cent. Net earnings decreased 19.8 per cent. For the four months ended with April the decreases were 13.9 per cent in gross and 21.4 per cent in net. The leather market shows a more cheerful tone. Manufacturers seem to be coming into the market and show some disposition to purchase material in anticipation of more active operations in the fall. Electrical manufacturers report a continuance of about the same volume of business as in other recent weeks. Bank clearings for the week were smaller than for the week previous and also smaller than for the corresponding week of 1907. Business failures for the week ended June 18, according to *Bradstreet's*, number 254, which compares with 253 in the previous week, and 165 in the corresponding week of 1907.

THE COPPER MARKET.

The copper market during the week ended June 22 was one of small business and firm prices. The inquiry for metal was a little better than during the weeks immediately preceding, and it was the consensus of opinion that important sales could have been made at slight price concessions. These concessions, however, so far as has been made public, were not forthcoming. It was reported that the United Metals Selling Company had refused to sell 10,000,000 lb. of copper at 12.90 cents per lb. There were many rumors of pending negotiations for large orders but their consummation was not announced. The large copper consuming concerns in this country are still admittedly short of stocks and their financial condition shows, almost without exception, sufficient ready cash to tempt even conservative managements to purchase at bargain prices. There are many indications that the domestic demand for copper will increase materially before it shows any further decline, and in Boston well informed and optimistic dealers assert with positiveness that copper is on the verge of an advance to 14 cents or perhaps 15 cents per pound in the near future. The output of copper in June in the Butte district will show, it is expected, a considerable decrease, owing to the enforced closing of the Great Falls smelter, and the paralyzed condition of the railroads, due to the great flood in the Missouri River. Any material decline in the Butte output would tend to produce better prices, because the supply and demand have been nicely adjusted by the great producers, and any unexpected falling off would disarrange the status. Daniel Guggenheim, who has returned from a three months' visit to England, France and Germany, has discussed the copper situation abroad. "Metal conditions abroad," he says, "are improving slowly but surely, especially copper. The electric copper consuming concerns appear to be in good shape. In my judgment, there is only a normal supply of metal stocks on hand. Europe is watching America keenly and is decidedly confident of our future." Exports since June 1 have been 18,449 tons, and for the week ended June 22 were 6266 tons. The total exports for June will probably be about 25,000 tons. With the light melting in this country, these exports will not prevent the accumulation of stocks. The total imports since June 1 are 3635 tons of refined, 780 tons of matte and 4180 tons of ores. It is generally believed that the stocks of copper in Europe are unusually large, especially those which yet remain in American hands. Reports from manufacturers abroad show that there is no improvement in the demand for finished material and, as manufacturers are fairly well loaded with metal, further purchases cannot be expected at this time. Little business was transacted on June 22, although there was some buying for July-August delivery. Closing quotations on the Metal Exchange, New York, on June 22, were:

Lake	12⅞ @ 13
Electrolytic	12⅝ @ 12⅞
Castings	12½ @ 12⅝

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	58	2	6	58	2	6
Standard copper, futures	58	16	3	58	15	0
Market	Easy.			Steady.		
Sales of spot				250 tons		
Sales of futures				500 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	10	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	5	0

BROWN, BOVERI & CO.—In a report to the Department of Commerce and Labor on the plant of Brown, Boveri & Co., of Baden, Zurich, Special Agent Captain Godfrey L. Cardin writes in high terms of the shop organization and technical administration. The workmen, he says, do not seem to be different in type from those found in Zurich, and the high state of efficiency at Baden is more than ever a case of administrative methods and supervision. The firm is constructing practically every standard form of electrical apparatus, and also builds steam turbines of the Brown-Boveri-Parsons type. The high character of the work turned out, both in electrical apparatus and turbines, may be better understood when it is known that Brown, Boveri & Co. have installed in Germany, the home of the largest and most advanced electrical manufacturers in Europe, almost as many modern alternating current central stations as have the Germans themselves. Brown, Boveri & Co. undertook, at their own risk and expense, the electrification of the Simplon tunnel, and it was not until after the great work of electrifying the traffic over the Simplon road was made a perfect success that the whole equipment was taken over by the Federal railways of Switzerland.

CONTRACTS LET FOR NEW CORN PRODUCTS PLANT.—The Allis-Chalmers Company has secured contracts for the installation of machinery at the new plant of the Corn Products Company at Argo, Ill., which will be the largest glucose plant in the world. Argo is a new town, near Summit, Ill., on the Chicago drainage canal. The machinery to be furnished by the Allis-Chalmers Company includes one 1500-kw, 480-volt, three-phase, 25-cycle alternator, and one 600-kw generator of the same type. These will be driven by a horizontal, cross-compound, heavy duty, non-condensing Allis-Chalmers Corliss engine. In addition there are in the contract two high-duty pumps and an equipment of individual induction motors. Of the latter about 300 will be required. The Allis-Chalmers Company has already supplied motors of similar types for the Corn Products Company at Davenport, Iowa, Waukegan, Ill., Oswego, N. Y., and Edgewater, N. J. The contract just let for Argo, Ill., will involve, it is announced, almost $150,000. The same company has furnished the motor equipment for the Chalmette refinery of the American Sugar Refining Company, aggregating about 400 25-cycle induction motors.

WESTERN ELECTRIC COMPANY IN MINNEAPOLIS.—The Western Electric Company is establishing a Northwestern headquarters in Minneapolis, where it has begun the construction of a building which it expects to occupy in October.

RECENT SALES OF ALLIS-CHALMERS APPARATUS.—Judging from the number of contracts closed by the Allis-Chalmers Company for electrical apparatus during the month of May, it would appear that the demand for more power facilities is making headway in the face of panic-bred conservatism. The City of Lawrenceburg, Tenn., is a recent purchaser of a 250-kw water-wheel type alternator and exciter. The Washburn Crosby Company, of Minneapolis, Minn., has added a 200-hp induction motor to its power equipment. The Natural Food Company, of Buffalo, N. Y., will install a 150-hp induction motor. The Pratt Light & Ice Company, of Pratt, Kan., is a recent purchaser of a 100-kw and a 50-kw generator with exciters and a 50-hp motor. The New Jersey Consolidated Water & Light Company, of Elberon, N. J., has ordered a 175-kw belted alternator. The Standard Hosiery Company, of Philadelphia, Pa., will install 28 induction motors, ranging in rating from 2 hp to 50 hp. The Great Western Portland Cement Company has purchased an 800-kw generator for installation in its plant at Mildred, Kan. A 1500-kw turbo-alternator will be installed in the Dan River Cotton Mill, Danville, Va., and the Citizens' Electric Company, of Williamsport, Pa., will install a 300-kw engine-type generator unit. The Pend d'Oreille Electric Company, of Sand Point, Idaho, recently placed an order for a 225-kw engine-driven set with exciter and switchboard, and the Northampton (Mass.) Electric Light Company for a 250-kw, three-phase, 60-cycle alternator. The John Williams Manufacturing Company, of Philadelphia, has purchased two 150-kw engine-driven generator sets. Libby, McNeil & Libby Company, of Chicago, has ordered a line of induction motors in units of from 10 hp to 40 hp. The Schlitz Brewing Company, Milwaukee, has purchased 20 induction motors, ranging in size from 3 hp to 40 hp, for installation in a new malt house. The Cudahy Packing Company at Cudahy, Wis., will install, in addition to its present large line, nine new induction motors in the sausage-room, ranging in rating from 10 hp to 40 hp. The Benito Juarez Mines Company, Salinas, Mex., has ordered a full equipment of generators and motors, the latter ranging from ½ hp to 50 hp, for operating a new gold stamp mill.

Financial Intelligence.

THE WEEK IN WALL STREET.

The Wall Street market shows a distinct improvement since the nomination of Mr. Taft at Chicago, although it is a betterment that is not chronicled so much in net gains as in general tone and awakening interest. The nomination of Mr. Taft removes one element of uncertainty, which is always a desirable change when conditions are unsettled, as at the present time. The volume of trading was larger last week and the conditions of good crop prospects and cheap money, which usually mean better business and prices, are favorable. The market has not been without disturbing features, however, which are responsible for the main declines for the week. The funding of the Erie coupons and the passing of dividends by the Lake Erie & Western Railroad and the Cleveland, Cincinnati, Chicago & St. Louis Railway, and the reduction in dividend by the Louisville & Nashville Railroad, were depressing factors. The action taken by the two latter roads was considered the exercise of such economy as conservative business management would dictate. While the reduction in steel prices has not been productive of the new business that was anticipated, it was announced that the Carnegie Steel Company had been booking sufficient new business to enable it to put back at work a number of men who had been laid off. The estimated earnings of the Steel corporation, which were placed at about $36,500,000 for the quarter, were far below those of the corresponding quarter last year, but it was pointed out that this was almost $4,000,000 ahead of the low-water mark during 1904. The market on June 22 was weak and at the close showed a decided tendency to decline, especially in many of the railroad issues. This movement was attributed to liquidation in Rock Island issues. The pressure to sell these securities was not satisfactorily explained in the street, but from authoritative and official quarters it was directly asserted that nothing in the affairs of the properties warranted a marked decline. It was said that floods in the Southwest had interfered with traffic. Baltimore & Ohio, Chesapeake & Ohio, Reading and Union Pacific stocks were especially weak in the railway list, while among the industrials, American Locomotive, Amalgamated Copper, American Sugar Refining and Western Union headed the downward movement. Westinghouse common was exceptionally strong and recorded an advance on June 22 of 4½ points. The table quotes the prices at the close on June 22:

NEW YORK.

	June 15.	June 22.	Shares Sold.		June 15.	June 22.	Shares Sold.
All-Ch.	10	11	4,950	Int.-Met., com..	10⅜*	10¾	2,250
All.-Ch., pfd....	29¼	33	4,300	Int.-Met., pfd...	28½	27⅜	2,980
Amal. Cop.....	67⅛*	66¼	81,920	Mackay Cos....	66*	65⅜*	200
Am. D. T......	39*	39*	——	Mackay Cos., pfd	64*	65¾*	200
Am. Loc.......	48¾	41¼	11,374	Met. St. Ry....	23*	25*	——
Am. Loc., pfd..102		101½*	600	N. Y. & N. J. Tel.109		109*	10
Am. Tel & Cbl. 65		65*	——	Steel, com.....	37¼	36½	133,770
Am. T. & T....118½		117⅝	3,305	Steel, pfd......101⅝		100⅞	9,130
B. R. T........	47⅛	45¾	12,625	W. U. T.......	—	53½	350
Gen. Elec......133¾		130⅞	1,658	West'h, com....	44¾	54½	7,140
Hud. R. Tel....	—	—	——	West'h, pfd.....	71*	70	953

PHILADELPHIA.

	June 15.	June 22.	Shares Sold.		June 15.	June 22.	Shares Sold.
Am. Rys.......	44¼	44⅝	——	Phila. Elec......	9½	9⅜	——
Elec. Co. of Am.	10⅛	11	——	Phila. R. T.....	13½	13⅞	——
Elec. Stor. B'ty.	30	32	——	Phila. Traction..	87¾	87	——
E. S. B'ty, pfd..	49*	49*	——				

CHICAGO.

	June 15.	June 22.	Shares Sold.		June 15.	June 22.	Shares Sold.
Chicago City Ry.190		96½	——	Met. Elev., com.	17½	17*	——
Com. Edison....	97½	96½	——	Met. Elev., pfd.	53	50*	——
Chicago Subway.	19½	19⅛	——	National Carbon.	67	69½*	——
Chicago Tel. Co.130⅜		130	——	Nat. Carbon, pfd.112		112*	——

BOSTON.

	June 15.	June 22.	Shares Sold.		June 15.	June 22.	Shares Sold.
Am. Tel. & Tel.118¼		117¾	——	Mass. E. R., pfd.	46	47	——
Comb'ind Tel...	—	—	——	Mex. Tel., pfd..	—	—	——
Edison El. Ill...209		208	——	New Eng. Tel'p.111		111½	——
Gen. Elec.......134½		131	——	W'st Tel. & Tel.	6*	6*	——
Mass. Elec. Ry..	9½	10½	——	W. T. & T., pfd.	65	65¼*	——

*Last price quoted.
Shares sold are for week June 15 to June 22.

DIVIDENDS.

Cumberland Telephone & Telegraph Company, Nashville, Tenn., quarterly, 1¾ per cent, payable on July 1.

El Paso (Tex.) Electric Company, preferred, 3 per cent, payable on July 13.

American Cities Railway & Light Company, New York, quarterly, 1½ per cent, payable on July 1.

Seattle (Wash.) Electric Company, common, 2¾ per cent, payable on July 15.

Union Switch & Signal Company of Pittsburg, common and preferred, 3 per cent, payable on July 10.

Utah Consolidated Copper Company, quarterly, 10 per cent, payable on July 15.

National Carbon Company, Cleveland Ohio, preferred, quarterly, 1¾ per cent, payable on July 1.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable on July 15.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable on July 15 .

Tri-City Railway & Light Company, Davenport, Ia., quarterly, 1½ per cent, payable on July 1.

Cleveland (Ohio) Railway, quarterly, 1½ per cent, payable on July 1.

Washington Water Power Company, Spokane, Wash., quarterly, 1¾ per cent, payable on July 1.

Manila Electric Railroad & Lighting Company, quarterly, 1 per cent, payable on July 1.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable on July 1.

Stark Electric Company, Canton, Ohio, quarterly, ¾ of 1 per cent, payable on July 1.

Cumberland Telephone & Telegraph Company, Nashville, Tenn., quarterly, 1¾ per cent, payable on July 2.

NEW YORK & PORT CHESTER RAILROAD.—The Public Service Commission of the First District of New York will investigate the New York & Port Chester Railroad and especially its relations with the New York, Westchester & Boston Railway and the manner of acquisition of control of both companies by the New York, New Haven & Hartford Railroad. On May 5 the Board of Aldermen of New York City, reciting the terms of the franchise granted to the New York & Port Chester road on May 31, 1906, one of which was that $800,000 should be spent in construction within the city limits within two years, asked the Public Service Commission to request the company to state what had been done to comply with these conditions. The Public Service Commission issued an order to the railroad company instructing it to explain its failure to comply with the terms, limiting the time for a response to June 12.

On June 15, attorneys for the road wrote to the commission that the Board of Estimate had extended the time for compliance with the conditions of the franchise to June 26. This response the Public Service Commission did not consider satisfactory, and therefore an investigation was ordered.

PUBLIC SALES FOR UTILITY SECURITIES IN NEW YORK.—The Public Service Commission of the First District of New York determined some time ago, it is now announced, that all bonds issued by public utility corporations must be sold at public auction or in some equivalent manner. The announcement of this determination, it is said, has been withheld pending the issue of the Manhattan Railway Company's $11,712,000 refunding bonds. On account of the protest of officers of this company the matter was delayed, and it was in the nature of a compromise that a proviso was inserted in the permit for the issue of these securities that, if disposed of at private sale, they must bring a price of 91 or over. The announcement regarding the method of public sale reads: "Unless the said bonds shall be sold at private sale on a basis of not exceeding 4 4/10 per cent and accrued interest, the treasurer of the company shall invite proposals for the purchase of said bonds to be publicly advertised daily for not less than six days in at least four daily newspapers published in the city of New York, to the end that the time and place of the sale shall be generally known; and the treasurer shall award the said bonds to the highest bidder or bidders therefor. Said proposals shall only be opened publicly by the treasurer of the company and in the presence of all the Public Service Commissioners for the First District, or of such of them as shall attend at the time and place specified in said public advertisement." It is held by the Public Service Commissioners that issues authorized by them carry practically a guarantee from the State that the securities are what they are represented to be, and that under these circumstances such issues will have as staple a market as municipal bonds. Commissioner Bassett said: "The purpose of this move is to guard against watering of public utilities securities. That is the most important question with which the Public Service Commission has to deal at the present time. The matter of overcapitalization is at the root of the defects of the public utilities companies, and the commission intends to do everything in its power to eradicate this evil." The applications for security issues now pending before the Public Service Commission include those of the following companies: Brooklyn Union Gas Company, Kings County Electric Light & Power Company, Coney Island & Brooklyn Railroad and Long Acre Electric Light Company.

WESTINGHOUSE REORGANIZATION PLAN ASSURED.—At the expiration, on June 22, of the time allowance granted stockholders of the Westinghouse Electric & Manufacturing Company to subscribe to the new stock proposed under the merchandise creditors' plan, it was agreed that the success of the plan was assured. While the various sub-committees, receiving the subscriptions of the stockholders, had not fully tabulated their returns up to the hour at which this report is closed, it was said by a member of the committee that fully 80 per cent of the $6,000,000 new stock allotted to the old shareholders under the plan had been subscribed and that practically all of the $4,000,000 allotted to the merchandise creditors had been taken. This assurance was given by a representative of the creditors' committee. Mr. A. W. Krech, chairman of the stockholders' committee, could not give out definite figures until all of the late returns were counted, but he was confident that in the neighborhood of $5,000,000 stock had been taken by the stockholders. An official of the Westinghouse company said that, while no official statement could be made in advance of the meeting of the reorganization committees and the receipt of their reports, the management was assured that the reorganization plan was a practical success and that, either by a short extension of the time allowed for stockholders to subscribe or by some other means to be suggested by the reorganization committee, the details would be completed. This official said that as approximately 90 per cent of the new stock had been subscribed it was assured that the property would not be allowed to go to sale, at least not until every resource had been exhausted to secure the remaining subscriptions necessary to raise the total to the $10,000,000 required. Mr. George Westinghouse, who was in New York when the reports of the committees were being prepared, expressed great confidence in the success of the plan and was sure that any plan involving a foreclosure had been forestalled. A report was in circulation in financial circles that Mr. H. C. Phipps, of Pittsburg, had agreed, before his departure for Europe, to make good any shortage in the stockholders' subscription, but Mr. Westinghouse said he had never heard of such an offer.

LARGE CONTRACT AWARDED BY PUBLIC SERVICE CORPORATION.—The General Electric Company has concluded an important contract with the Public Service Corporation of New Jersey for new equipment, the amount involved being more than $300,000. The principal items in the contract are for the Marion station and consist of a 9000-kw Curtis turbo-generator and 150-kw turbine exciter. A switchboard and other necessary appliances will also be installed. This machinery is to increase the railway equipment of the corporation. At the Cranford station a 1500-kw horizontal turbo-generator and a 35-kw turbine exciter will be installed. This is one of the new model horizontal turbine units which the General Electric Company now manufactures. For the Lakeside Avenue substation at Orange a 1000-kw rotary converter will be installed for service on the railway. In the Englewood and Hudson substations transformers for lighting service have been ordered. At the City Dock station, Newark, a 3000-kw frequency changer and switchboard are to be installed, and at Camden, N. J., a complete equipment for 250 magnetite arc lamps, including regulation switchboard, etc., will be added. All the material will be installed ready for service in the fall.

AMSTERDAM CORPORATION FORMED BY W. J. WILGUS.—The Amsterdam Corporation has opened offices at 165 Broadway, New York. William J. Wilgus is president and Henry J. Pierce, vice-president. The corporation was formed for the purpose of acting as engineer on special railroad problems. These problems are specified as electrification of steam lines, subaqueous tunnels, construction and equipment of urban and interurban lines, preparation of plans for passenger and freight terminals and furnishing analyses of operating contracts. While the principal work of the company is to give advice regarding these matters, it is prepared to act as agent for a company in supervising and directing new construction. It is stated that no alliance or connection will be made with any manufacturing or supply company. Mr. Wilgus was formerly vice-president of the New York Central Railroad. Mr. Pierce is president of the International Railway Company, of Buffalo, and also president of the Netherlands Tramway Corporation. The Amsterdam Corporation was incorporated in Connecticut in September, 1905. Mr. Wilgus states that it is a close corporation, all of the shares of which are held by three individuals, who constitute the board of directors. These are Messrs. Wilgus, Pierce and J. A. Byrne, a lawyer connected with the firm of Parker, Hatch & Sheehan.

TO ATTACK NEW YORK TRANSFER DECISION.—Public Service Commissioner John E. Eustis, of the First District of New York, declared in an address before the North Side Board of Trade at Yonkers that the commissioners were determined to preserve to the people of Westchester County the privileges they now enjoy in transfers to the lines of New York City. F. W. Whitridge, receiver of the Third Avenue Railroad and the Union Railway, has been empowered by Judge Lacombe, of the United States Circuit Court, to discontinue the transfers within 30 days. Mr. Eustis said that the commission possesses jurisdiction over the questions of rates and transfers, and after considering carefully the monthly earnings of the roads, will find some way of compelling the receiver to respect the orders of the commission.

SUIT TO LEGALIZE ISSUES OF NEW HAVEN SECURITIES.—A suit has been brought by security holders of the New York, New Haven & Hartford Railroad, through Mackay & Company, of New York, which seeks, through the Connecticut Supreme Court of Errors at New Haven, to obtain a decision sustaining the company's right to issue its securities and those of subsidiary corporations under authority of the Connecticut Legislature without obtaining permission of the Massachusetts Legislature. This suit is brought, it is said, because of attacks made upon the securities of the New Haven company during discussion of the various bills bearing upon the proposed merger of the New Haven and the Boston & Maine systems.

PACIFIC GAS & ELECTRIC COMPANY.—Justice Greenbaum, of the Supreme Court of New York City, has refused to continue the injunction obtained by the Industrial General Trust Company, of London, England, representing holders of $240,000 of 6 per cent debenture bonds of the Pacific Gas &

Electric Company, of San Francisco, which restrained that corporation from carrying into effect the plan by which the holders of $3,529,000 of these bonds were permitted to exchange them for an equal amount of debenture mortgage bonds of the company. The court held that the new plan does not violate the agreement of the original issue. The complainants took an appeal to the Appellate Division, and argument was heard on June 19. No decision has been rendered.

TRACTION EARNINGS NOT SERIOUSLY DECREASED.—While gross earnings of some of the traction companies are still showing decreases, revenues of such properties are, as usual in a period of this character, holding up much better than those of steam roads and many classes of industrials. The following figures show the earnings of traction companies operating in widely separated sections. The gross earnings are tabulated for the latest reported periods in 1908, together with the comparative increase or decrease from the corresponding periods in 1907:

Gross earnings.	May, 1908.	Decrease under May, 1907.	5 mos. ended May 31, 1908.	Decrease under 5 mos. enu May 31, 1907.
United Railways of St. Louis...	$920,765	$26,573	$4,248,216	$78,207
American Railways Co..........	246,897	2,271	1,070,789	32,295
Twin City Rapid Tr............	‡404,785	*22,808	‡2,424,761	*109,348
Syracuse Rapid Transit........	108,280	*6,391	517,203	*26,623
Toledo Rys. & Light...........	40,893	805	554,157	36,383
North. Ohio Tr. & Light.......	†129,804	3,040	†504,889	3,838
Detroit United Railway........	363,900	3,900	2,415,075	18,849
East St. Louis & Sub..........	159,882	19,723	811,267	8,724
Utd. RR's of San Francisco....	†564,673	*21,117	†1,559,687	29,366

*Increase. †Period of April and 4 months to April 30. ‡Period of 3 weeks of May and Jan. 1 to that date.

AMERICAN LOCOMOTIVE COMPANY.—Directors of the American Locomotive Company are expected at their forthcoming meeting to declare the regular quarterly dividend of 1¾ per cent on the preferred stock, but it is reported that the quarterly dividend of 1¼ per cent on the common stock, which has been paid regularly since August, 1906, will be cut or passed. During the year to end June 30, 1908, the earnings naturally will be reduced from the preceding year because of the depression of the last few months, but will be enough to justify the continuance of the common dividend for a period if the directors see fit to declare it. Collections in the last four or five months have been satisfactory and the company has the necessary funds with which to meet the dividend.

HUDSON RIVER ELECTRIC POWER COMPANY.—The Hudson River Electric Power Company, which owns the large dam across the Hudson River at Spier Falls, has made an application to the Public Service Commission at Albany for an order cancelling a former order of the commission authorizing an issue of $3,000,000 refunding and consolidated mortgage bonds. It had been intended to use the proceeds of this issue in the construction of a large dam on the Sacandaga River at West Falls. Since the State Water Supply Commission has reported in favor of creating a storage reservoir on this river, the power company declares that its new dam will not be needed. The Public Service Commission has taken the application under consideration.

REPORT OF ELECTRIC PROPERTIES COMPANY.—The report of the Electric Properties Company for the fiscal year ended April 30, 1908, as compared with the 11 months ended April 30, 1907, shows the following: Interest and dividends received, $280,671, a decrease of $117,577; expenses, $85,630, a decrease of $19,114; balance, $195,041, a decrease of $98,463; preferred dividends, $179,344, an increase of $51,287. No dividends were declared on the common stock in the year just ended, but in the 11 months ended April 30, 1907, there was disbursed for this purpose $120,000. The surplus at the end of the last fiscal year was $14,126, which, with the previous surplus of $35,447, makes a total of $49,573.

NOTES ISSUED BY HUDSON COMPANIES.—The Hudson companies, controlling the various tunnels under the Hudson River, which have been built by William G. McAdoo and his associates, has arranged to issue $5,000,000 of 1-year 6 per cent notes secured by a deposit of $10,000,000 of 4½ per cent bonds. In February the company disposed of $15,000,000 similar notes, secured by bonds. These notes mature on August 1, 1910. The company will not place its bonds on the market until the tunnels are completed and earning capacity can be measured. It is stated that the sale of the new notes provides the company with sufficient funds to complete the work projected at this time.

BUTTE (MONT.) ELECTRIC & POWER COMPANY.—It is expected that the directors of the Butte Electric & Power Company will declare, at a meeting to be held within a few days, a quarterly dividend of 1¼ per cent. This was the rate of dividend until payments were discontinued six months ago. Earnings of the company are said to be higher than during last year, and the management believe it will be able now to market $1,000,000 of the $5,000,000 6 per cent bonds authorized last year. The bonds are a mortgage on properties of the Butte Electric & Power Company, the Madison River Power Company, and the Billings & Eastern Montana Power Company.

MONTREAL LIGHT, HEAT & POWER COMPANY.—The annual report for the year ended April 30, 1908, of the Montreal Light, Heat & Power Company gives gross earnings of $3,792,218, as compared with $3,453,490 in 1907. Expenses were $1,651,656, against $1,529,270 in 1907, and the net $2,140,562, as compared with $1,924,220 for the previous year. Deducting interest charges of $493,095 gives a surplus of $1,647,467, equal to 9.69 per cent earned on the $17,000,000 capital stock. Dividends of $1,020,000 were declared making a surplus for the year of $627,467, as compared with the surplus of 1907 of $590,582.

BONDS OF TAMPA (FLA.) ELECTRIC COMPANY SOLD.—The $600,000 first mortgage 5 per cent bonds issued by the Tampa Electric Company have been sold to a syndicate composed of Redmond & Company, of New York, and Warner, Tucker & Company, of Boston. The bonds mature June 1, 1933, and are offered for sale at 93¼ by the syndicate and by Stone & Webster, general managers of the property. The Tampa Electric Company operates 41 miles of track.

MONTREAL STREET RAILWAY COMPANY.—The report of the Montreal Street Railway Company for May and the eight months ended May 31 shows increases in gross and net earnings and the surplus. Gross earnings for May were $313,678, as compared with $295,951 in May, 1907, while for the eight months ended May 31 shows increases in gross and 635 for the corresponding period of last year. The surplus increased from $425,240 in the 1907 period to $470,140 in 1908.

PHILADELPHIA RAPID TRANSIT SUBSIDIARY PROSPERS.—The Thirteenth & Fifteenth Streets Passenger Railway, a subsidiary of the Philadelphia Rapid Transit Company, and leased to it for 999 years for an annual rental of $12 per share on the stock, will pay an extra dividend amounting to $20,000, or $1 per share, July 1, from a surplus of $27,000 which has accumulated in the treasury.

BOSTON & REVERE ELECTRIC STREET RAILWAY COMPANY.—The Railroad Commission has been asked by the Boston & Revere Electric Railway Company to approve an issue of $50,000 of 20-year 5 per cent bonds, subject to call at $105. This issue is to provide funds for repaying the Boston & Northern Street Railway, lessee, sums advanced for the redemption of an issue of bonds.

MASSACHUSETTS ELECTRIC COMPANIES MAKE A GOOD SHOWING FOR MAY.—The gross earnings of the Massachusetts Electric lines show for May an increase over the same month of 1907 of 7 per cent. The April earnings showed a 6 per cent increase, while March gross was 3 per cent behind the 1907 results.

PINE BLUFF LIGHT & WATER COMPANY.—A decree of foreclosure was entered in the United States Court at Little Rock, on June 6, in the case of the New York Trust Company, of New York, against the Pine Bluff Light & Water Company, for $525,000. The property was ordered to be sold on June 9.

SHAWINIGAN POWER COMPANY INCREASES EARNINGS.—The report of the Shawinigan Power Company for the first quarter of 1908 showed earnings of $222,020, compared with $167,920 in the same period in 1907, an increase of $54,100.

CHICAGO RAILWAYS BONDS SOLD.—N. W. Harris & Company, of New York, and the other bankers that participated in the purchase, have disposed of $3,000,000 Chicago Railways Company first mortgage 5 per cent bonds.

SEATTLE ELECTRIC COMPANY.—The Seattle (Wash.) Electric Company has declared an initial dividend of 2¾ per cent on its common stock, payable on July 15.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

BESSEMER, ALA.—Plans are being considered by the People's Telephone Company for establishing an entirely new telephone system in Bessemer. New telephone lines will be erected to Norwood, East Birmingham and Kingston.

TUSCALOOSA, ALA.—The Birmingham Gulf Railway & Navigation Company has increased its capital stock to $10,000,000. The company proposes to construct an electric railway from Gadsden to Tuscaloosa, and from there to operate a barge line to Mobile and New Orleans.

PRESCOTT, ARIZ.—The Arizona Power Company, which is erecting a power plant 20 miles from Camp Verde, contemplates having its transmission lines extended to every section of territory within a radius of 50 miles of its power plant within a year, and expects to have its transmission lines completed and in operation in Jerome and Prescott early in 1909.

EUREKA, CAL.—E. C. Sharpe, of San Francisco, has applied for a franchise to install a telephone system in Eureka.

SAN FRANCISCO, CAL.—The Great Western Power Company has awarded the contract for the construction of its substation in East Oakland, Cal., to the Globe Construction Company. The company has also secured a site in Oakland, on which it will erect a steam power station where 25,000 hp will be developed. The cost of the plant is estimated at $500,000. Edwin Hawley, vice-president of the Western Pacific Railroad, is president of the Great Western Power Company.

SANTA MARIA, CAL.—The Board of Supervisors of Monterey County has granted a franchise to C. P. Baird and W. L. Lierly, of Santa Maria, to furnish electricity for light and power and water privileges.

VENTURA, CAL.—Julian P. Jones and Frank M. Packard, who have the franchise for an electric railway between Ventura and Ojai and the Matilija, are making arrangements to commence work on the construction of the road.

COLORADO, COL.—It is reported that work will be resumed on the construction of the plant of the Eastern Colorado Power Company's plant near Boulder.

EAST NORWALK, CONN.—The municipal electric light plant at East Norwalk will be completed and put in operation about August 1. Electrical energy for operating the system will be supplied from the municipal electric plant at South Norwalk. One hundred and fifty tungsten lamps of 32 cp will be used for street lighting. John W. Olmstead is manager.

WASHINGTON, D. C.—The Washington, Alexandria & Mt. Vernon Railway Company contemplates installing an additional steam turbine in its power station at Pennsylvania Avenue and Twelfth Street.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Washington, D. C., until June 29, to furnish at the navy yard, New York, N. Y., a quantity of naval supplies as follows: Schedule 1327—Testing generator, conduit fittings, etc. Applications for proposals should designate the schedules desired by number. Blank proposals will be furnished upon application to the navy pay office, New York, N. Y., or to the above bureau. E. B. Rogers is paymaster general, U. S. N.

WASHINGTON, GA.— Plans are being made by the Anthony Shoals Power Company to commence work on the development of its property on the Broad River in the northern part of Wilkes County in the near future. The company proposes to erect transmission lines and distribute electricity in Washington, Augusta and Elberton for commercial purposes. T. M. Patrick, of Washington, Ga., is interested in the enterprise.

ASHTON, IDAHO.—The Fremont Independent Telephone Company contemplates the erection of a number of new telephone lines into the surrounding country, and extending its lines throughout the city.

GRACE, IDAHO.—Preliminary tests have been completed of the first unit of the large power plant of the Telluride Power Company at Grace. The plant utilizes the natural flow of the Bear River. The power station is designed for 80,000 hp; the first installation furnishes 20,000 hp. The cost of the plant thus far is estimated at $2,400,000; when completed the system will cost $7,000,000. The transmission line from the Grace plant connects with the Utah system of the Telluride Company at Grace Logan. Besides furnishing electricity to the mines of Utah, Idaho and Colorado, the company furnishes electrical energy for lighting in Provo, Logan, Bingham, Eureka, Mercur, Silver City, Robinson and many other towns and mining cities. It also furnishes electricity for the Salt Lake City (Utah) light and power system.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company's dam located on the south fork of the Clearwater River was carried away by the flood.

IDAHO FALLS, IDAHO.—Plans are being made by the Idaho Power & Transportation Company to extend its transmission lines from Rigby to St. Anthony. A. W. Scott is president of the company.

NEZ PERCE, IDAHO.—Arrangements have been completed for the construction of an electric railway from Nez Percé to connect with the Northern Pacific Culdesac-Grangeville road in the vicinity of Vollmer. The proposition accepted by the citizens of Nez Percé provides for a bonus of $50,000 to be paid when the road is completed. The cost is estimated at $150,000. The road will be 11 miles long and will be in operation by Nov. 1. Z. A. Johnson will construct the railway.

ALEDO, ILL.—Plans are being made by the People's Telephone Company for improvements and extensions to its plant in Aledo, and also the construction of telephone lines to Viola and New Windsor.

BELLEVILLE, ILL.—The Southern Traction Company has filed a notice of increase of its capital stock from $2,500 to $1,500,000. The company is constructing an electric railway from East St. Louis to Belleville and is planning to extend the Belleville car line to Cario, Ill.

CHICAGO, ILL.—Sealed proposals will be received at the office of William Carroll, city electrician, until July 1, for furnishing the Department of Electricity, city of Chicago, Ill., with tubular steel poles, malleable iron cross arms and wrought-iron brackets, in accordance with plans and specifications on file at the above office. Proposals will also be received until July 2 for furnishing electric light and fire alarm cables as follows: 150,000 ft. No. 6 B. & S. G. rubber-covered, lead-incased electric light cable; 18,000 ft., 50 pair, No. 19 B. & S. G. solid filled core, paper insulated, lead-incased fire alarm cable; 18,000 ft., 30 pair, No. 19 B. & S. G. solid filled core, paper insulated, lead-incased fire alarm cable; 35,000 ft., 15 pair, No. 19 B. & S. G. solid filled core, paper insulated, lead-incased fire alarm cable; 25,000 ft., 5 pair, No. 19 B. & S. G. solid filled core, paper insulated, lead-incased fire alarm cable. Proposals must be made out on blanks furnished by the city electrician.

FLANAGAN, ILL.—The Pontiac Automatic Telephone Company has applied to the Village Board for permission to install a telephone system in Flanagan.

FORT WAYNE, IND.—The Fort Wayne & Springfield Railway Company is planning to extend its railway from Decatur, Ind., to Lima, Ohio, a distance of 50 miles.

HARTFORD CITY, IND.—The officials of the Hartford City Electric Light Company have decided to make additional improvements to the local plant, including the installation of new boilers, new electrical machinery and other equipment, which will involve an expenditure of about $4,000.

MADISON, IND.—Bids will be received by the City Council for lighting the streets, alleys and public places by electricity, and for furnishing electricity for commercial lighting and for motors; also for the maintenance and operation of an electric railway in the city for a term of 10 years. Bids will be received jointly or separately. F. M. Harper is chairman of the utilities committee.

KIRWIN, KAN.—The Enterprise Telephone Company contemplates placing all its wires underground in the business section of the city.

ST MARY'S, KAN.—Plans and specifications are being prepared for an electric light plant in St. Mary's, by Burns & McDonnell, of Kansas City, Mo.

STOCKTON, KAN.—Application has been made to the City Council by H. L. Ream, of Beloit, Kan., and J. W. Harris, of Lincoln, Neb., for a franchise to construct an electric light plant in Stockton.

FRANKFORT, KY.—Bids will be received until July 10 for the construction of the new power house in connection with the new capitol.

LOUISVILLE, KY.—The franchise granted by the Council to the George G. Fetter Company, which has been declared valid by the court of appeals, will be sold. The Kentucky Electric Company has been fighting to prevent the sale of the franchise.

FRANKLINTON, LA.—The City Electric Company contemplates installing an electric light plant, the equipment of which will consist of a 15-kw, 220-volt, direct-current dynamo, a 30-hp engine and a boiler of 35 hp. W. A. Erwin is interested in the enterprise. Mr. Erwin also wants prices on a small dynamo to furnish electricity for about 20 lamps of 16 cp and two street lamps.

BLANFORD, MASS.—The Farmers' Telephone Company is contemplating the extension of its system from Blanford to Chester.

CLINTON, MASS.—The contract for the construction of the power house for the Bigelow Carpet Company has been awarded to J. W. Bishop Company, of Worcester. The cost of the building is estimated at $140,000, and with equipment the plant will cost about $500,000.

DANVERS, MASS.—The Electric Light Commissioners have decided to increase the price of electricity for incandescent lamps from 10 cents to 11 cents per kw-hour, the new rate to take effect July 1 and to remain in force until July 1, 1909. This increase, it is said, was made necessary owing to the extra expense this year caused by the accident at the power station last fall. The department contemplates putting all contracts for electricity for motors on a meter basis after May 1, 1909. A rearrangement of rates will also be made for power service at that time.

LEE, MASS.—The Lee Electric Light Company has submitted a proposition to the citizens' committee of Lenoxdale to build a transmission line to Lenoxdale and furnish electricity in that village. Under the present plans the Lee Electric Light Company will furnish the electrical energy, which will be distributed by the Lenoxdale company. Work will commence on the project as soon as arrangements have been completed.

MALDEN, MASS.—The Council has authorized the Street and Water Commission to make a contract with the Malden Electric Company for lighting the streets of the city for a term of three years, at an annual cost of $32,529.

ROCKLAND, MASS.—The Electric Light & Power Company, of Abington and Rockland, has extended its service to Hanover Four Corners, and is now making plans to extend its transmission lines into Norwell. It is planned to convert the local plant into a substation and secure electricity for operating the system from the East Bridgewater plant.

LUDINGTON, MICH.—Extensive improvements are being considered by the Michigan State Telephone Company in Ludington, which will involve the entire reconstruction of the local system and the erection of several telephone lines into the surrounding country, at an expenditure of about $50,000.

DULUTH, MINN.—At the annual meeting of the Duluth-Edison Electric Company called for July 4, the stockholders will be asked to authorize an increase of capital stock from $2,000,000 to $2,250,000, which is to be issued in lieu of bonds for construction work.

DULUTH, MINN.—The City Council has authorized City Attorney Wilson to make an investigation as to whether the Great Northern Power Company can be compelled to furnish electrical energy to operate the municipal electric light plant should the city decide to install one. The contract with the Duluth Edison Electric Company for lighting the city expires two years from next July, but it may be terminated by notice within one year from next July.

MANKATO, MINN.—Plans are being considered by the Mankato Electric Traction Company to construct an electric street railway in Kesota, Minn. H. E. Hance is superintendent.

BURLINGTON JUNCTION, MO.—The capital stock of the Burlington Junction Electric Light & Power Company has been increased from $6,000 to $7,000.

COLUMBIA, MO.—A mutual telephone company is being formed in Columbia, and an application for a franchise has been made to the City Council by Attorneys Harris and Carter, who are interested in the company.

CASSVILLE, MO.—The Cassville & Western Railway Company is making arrangements to electrify its road, which now connects Exeter and Cassville, Mo., a distance of five miles. The road, it is said, will be extended. S. M. Mitchell is president and general manager.

EXCELSIOR SPRINGS, MO.—The Clay County Telephone Company has been granted a 20-year franchise to install a telephone system in Excelsior Springs.

KANSAS CITY, MO.—The Missouri & Kansas Interurban Railway Company is considering the question of changing the motive power of its system from gasoline to electricity. The company operates a car line from Kansas City, Mo., to Olathe, Kan.

KIRKSVILE, MO.—The Kirksville Light, Power & Ice Company, recently incorporated, contemplates the construction of an electric light and power plant, also an ice plant in Kirksville. J. H. Moore is engineer in charge.

OREGON, MO.—The contract for constructing the proposed electric railway from Oregon to Forest City, a distance of four and one-half miles, has been awarded to M. A. Wogan, of Kansas City, Mo., by the Oregon Interurban Railway Company. The cost of the road is estimated at $40,000, which does not include equipment. L. I. Moore is secretary and treasurer.

ST. LOUIS, MO.—The West End Light & Power Company has petitioned the Board of Public Improvement for authority to erect transmission lines for the distribution of electricity in the district embraced within Duncan and Lindell Avenues, Newstead Avenue and King's Highway. Jesse D. Dana is president.

BILLINGS, MONT.—Preliminary surveys are being made by the Stillwater Power & Railway Company for a proposed electric railway from Columbus to Cooke City, Mont. Power for operating the road will be developed from two falls on the Stillwater River. Willard Bennett, of Helena, is president.

FAIRBURY, NEB.—The Independent Telephone Company, of Fairbury, is planning to construct two copper metallic circuits between Fairbury and Dewitt.

TALMAGE, NEB.—The citizens are considering the question of installing an electric lighting plant.

NEWARK, N. J.—Work has commenced on the third section of the power plant of the Public Service Corporation in the Marion section of Jersey City. The contract for the electrical equipment, which includes a 9000-kw turbo-generator, has been awarded to the General Electric Company, of Schenectady, N. Y. Dudley Farrand is general manager.

NEWARK, N. J.—Steps have been taken by the lighting committee of the Common Council for the establishment of a municipal electric lighting plant. A sub-committee was appointed to ask for an appropriation of $10,000 with which to secure the services of an engineer and prepare plans for the plant. It is said that under the agreement between the city and the New York & New Jersey Telephone Company the company would be obliged to furnish space in its underground for the wires used in connection with the municipal lighting plant.

NEW PROVIDENCE, N. J.—The Township Committee has decided to extend the street lighting system to Berkeley Heights, N. J. The service will be furnished by the Commonwealth Water & Light Company, of Summit, N. J. It is proposed to install 50 incandescent lamps at an estimated cost of $750 per year. H. M. Whitehead is manager of the Commonwealth Water & Light Company.

NEWTON, N. J.—An independent telephone company has been organized in Newton, for the purpose of giving long-distance service to the Great Meadow District in Warren County.

PATERSON, N. J.—Mayor McBride has recommended the Board of Public Works to take steps to have all telephone and electric wires placed in underground conduits at once.

AMSTERDAM, N. Y. Plans are being made by the Automatic Telephone Company to extend its lines to Tribes Hill and Fort Hunter.

BATAVIA, N. Y.—The Batavia Light & Power Company has decided to go out of business permanently, and has notified its customers that it will not furnish either gas or electric service after July 16.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company has submitted a proposition to the Board of Contract and Supply offering to furnish electricity for lighting the streets of the city as follows: On a one-year or two-year contract for 420 arc lamps or more the company will furnish lamps at $84 per lamp per year; on a three-year contract, $84 per lamp per year to and including 400 lamps; all lamps in excess of 400 lamps at the rate of $80 per lamp; for 480 incandescent street lamps on a one, two or three year contract, $21.50 per lamp per year; for a three-year contract, $21.50 per year per lamp, to and including 500 lamps; all lamps in excess of 500 at the rate of $21 per lamp per year. The company will furnish on a three-year contract for both arc and incandescent street lamps to provide for 420 arc lamps or more, and 480 incandescent lamps as follows: Arc lamps, $80 each for first year; second year, $75 each, and the third year, $70 each; incandescent lamps, at the rate of $20 each per year for the three years. The company also offers to furnish electricity for lighting the city hall and other public buildings, including the free renewals of standard 4, 8, 16 and 32 cp incandescent lamps, at 6 cents per kw-hour. The action on the bids was postponed until the next meeting of the board.

BREWSTER, N. Y.—The Hudson River Telephone Company contemplates the construction of a telephone line from Brewster to the Connecticut state line, where connections will be made with the Southern New England Telephone Company's telephone lines.

BUFFALO, N. Y.—The Laws and Legislation Committee of the county has decided to report in favor of rejecting the proposal of the General Electric Company for furnishing electricity for lamps for the Seventy-fourth Regiment at six cents per kw-hour, and instead a recommendation will be made to advertise for bids for furnishing the county with an engine and generator.

GLENS FALLS, N. Y.—The Hudson River Electric Power Company has applied to the Public Service Commission for an order cancelling the former orders of the commission given in December, 1907, authorizing an issue of $3,000,000 in bonds. The company had planned to use the proceeds of the bonds for the construction of an additional large dam on the Sacandaga River at West Falls.

LIMA, N. Y.—The Lime-Honeoye Electric Light & Railroad Company is making surveys for an extension north to Rochester and south to Atlanta and Wayland, a distance of 69 miles. C. A. Watkins is chief engineer.

MONROE, N. Y.—The property holders between Monroe and Walton Lake are considering a project to have the electric lighting service extended to Walton Lake. They have decided to subscribe to sufficient stock of the Orange & Rockland Electric Company to pay for the construction of the transmission line, the cost of which is estimated from $1,800 to $2,000.

NEW YORK, N. Y.—Plans for enlarging and remodeling the power station of the United Electric Light & Power Company on 146th Street west of Amsterdam Avenue has been filed. The cost of the improvements is estimated at $18,000. W. E. McCoy is electrical engineer.

NEW YORK, N. Y.—Bids will be received until June 29 by C. B. J. Snyder, superintendent school buildings, for installing electric equipment in new Public School No. 93, Borough of Brooklyn, and for alterations and additions to the electric equipment in Public Schools Nos. 32, 48, 49, 73, 87, 93, 168, 171, Borough of Manhattan.

NIAGARA FALLS, N. Y.—Permission has been granted by the Board of Public Works for the illumination of Falls Streets on application of John C. Level, chairman of the merchants' committee. The installation of the system will incur no expense to the city. The new system will extend from First Street to Riverway, the cost of which is estimated at $2,500.

SYRACUSE, N. Y.—The Public Service Commission has granted the amended petition of the Syracuse & South Bay Railroad Company for the construction of its transmission line from the line of the Niagara, Lockport & Ontario Power Company to its property in Syracuse.

WHITE PLAINS, N. Y.—Proposals will be received at the office of the Board of Supervisors until July 3 for electric equipment of the central power plant; electric fixtures for new supreme court and hall of records buildings; vacuum cleaner, etc. Separate bids are to be received on all items. Plans and specifications can be seen at the office of Lord & Hewlett, architects, 345 Fifth Avenue, New York, N. Y. Farrington M. Thompson is secretary of committee.

BREVARD, N. C.—Rapid progress is being made on the construction of the buildings of the Transylvania Cotton Mills Company in Brevard. The first installation will be 4000 spindles, and both steam and electrical power will be used to operate the mills. J. W. McMinn is president.

WEAVERVILLE, N. C.—An independent telephone company has been organized in this city for the purpose of constructing a local system.

EDGELEY, N. D.—Plans are being made to erect a municipal electric light plant, which will be operated by natural gas.

GRAND FORKS, N. D.—E. J. Landers and others have made application for a franchise to construct a street railway system in Grand Forks.

MINTO, N. D.—The North Dakota Independent Telephone Company is planning to construct a telephone line from Minto to extend through Voss, Vesslyville and Pisek, and will also erect rural telephone lines to Ardock.

CLEVELAND, OHIO.—The Cuyahoga Light Company is contemplating extending its underground system. John C. Keys is president and manager.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway Company is planning to extend its system from Bowling Green to Tontogany, a distance of six miles. E. H. McKnight is general manager of the company.

LIMA, OHIO.—W. Kesley Schoepf, president of the Ohio Electric Railway Company, has submitted a proposition to furnish electricity for lighting the city and a general reduction in commercial rates. The company offers a reduction from $85 per arc lamp per year to $57.50 for a new ten-year contract. An effort is being made to prevent the erection of a municipal electric plant, for which bonds will be sold the latter part of this month.

PAINESVILLE, OHIO.—The City Council has adopted a resolution authorizing the treasurer to issue $6,500 in bonds for enlarging the municipal electric light plant.

SPRINGFIELD, OHIO.—The City Council is considering the question of establishing a municipal electric light plant.

WEST MILTON, OHIO.—Work has commenced on the construction of the hydro-electric plant and electric light system in West Milton. L. A. Pearson is interested in the project.

TOLEDO, OHIO.—The City Council has granted a franchise to the Toledo, Fostoria & Findlay Interurban Railway Company to enter the city, in return for which the company is to pay $1,000.

BRISTOW, OKLA.—An election will be held July 6 to vote on the proposition of issuing $35,000 in bonds for the purpose of installing a municipal electric light plant.

LINDSAY, OKLA.—This town has decided to construct an electric light plant and water works system. M. A. Earl & Company are the engineers. Otis Snow is town clerk.

WETUMKA, OKLA.—The citizens have voted to issue $25,000 in bonds, the proceeds to be used to install a municipal electric light plant.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until July 6, for furnishing electric fuses, connecting wire, insulating tape, insulating paint, etc. Blanks and general information pertaining to this circular (No. 450) may be obtained at the above office, or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Custom House, New Orleans, La.; 1086 North Point Street, San Francisco, Cal., and Chamber of Commerce Building, Tacoma, Wash.; also from the U. S. engineer offices in the following cities: Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky., and Mobile, Ala. Lieut.-Col. H. F. Hodges is general purchasing officer.

BROWNSVILLE, PA.—The Brownsville, Masontown & Smithfield Street Railway Company has awarded the contract for the construction of its proposed railway running from Brownsville to Masontown, to the Pennsylvania Railway Construction Company, of Pittsburg. The road when completed will connect Morgantown, W. Va., with Pittsburg. The power plant will be located at Masontown, on the Monongahela River, about 1½ miles west of Masontown. E. C. McCollough, of Uniontown, Pa., is the engineer.

FRANKLIN, PA.—The local electric light plant is reported to have been purchased by Jacob Cauffiel, who it is said will organize a company and apply for a franchise to furnish electricity in Johnston and surrounding country. It is proposed to enlarge the electric plant in Franklin.

GIRARDVILLE, PA.—The Schuylkill Railway Company proposes to build an electric railway over the summit of the Broad Mountain, eight miles in length, which will connect Pottsville with Ashland, Mahanoy City, Shenandoah, Mt. Carmel and Shamokin. The cost of the railway is estimated at $3,000,000.

HICKORY GROVE, PA.—A new telephone company has been organized in Hickory Grove.

JOHNSTOWN, PA.—The Southern Cambria Railway Company is planning to extend its road to Hastings.

MEADVILLE, PA.—Contracts have been awarded by the water and light committee for the construction of a new electric light plant to be in operation in September: To the Riverside Engine Company, of Oil City, Pa., for gas engine, at $4,450; for a 150-hp steam engine to the Phoenix Iron Works Company, of Reading, Pa., for $1,400; the General Electric Company, of Schenectady, N. Y., was awarded the contract for the complete electrical equipment, including generators, switchboards, lamps, etc., for $13,025. Harry Ellsworth is superintendent.

MONTOURSVILLE, PA.—The Montoursville Passenger Railway Company has filed a mortgage at the recorder's office for $150,000 to the New York Trust Company, trustee, to secure an issue of bonds. The proceeds will be used to refund the indebtedness of the company and for improvements.

PITTSBURG, PA.—The contract for the complete electrical installation in the main building, power house and tunnel in the Convent of Mercy has been awarded to the W. H. Olchiltree Company, of Pittsburg, Pa.

POTTSTOWN, PA.—The Pottstown & West Chester Electric Railway Company, it is said, will build the proposed electric railway at once if the property owners along the route will give the right of way. C. W. Talbot is president.

SUMMERHILL, PA.—The Borough Council has granted to the Summerhill Electric Light, Heat, Power and Manufacturing Company a franchise. J. T. Long is interested in the enterprise.

WILKES-BARRE, PA.—Bids will be received by Fred. H. Gates, city clerk, until July 23 for furnishing electricity for lighting certain streets for a term of three, five and seven years, beginning July 1, 1909.

YORK, PA.—The York Railways Company contemplates making extensive improvements to its railway, extending from York to Dallastown, Red Lion and Windsor, which will involve an expenditure of about $100,000.

CHATTANOOGA, TENN.—Plans are being considered by the Chattanooga Railways Company for the construction of an extension from Main Street to Rossville. D. J. Duncan is general manager.

NASHVILE, TENN.—Plans are being made by the Nashville Interurban Railway to complete the railway from Nashville to Franklin, Tenn., by Sept. 30. Contracts for rails, cars and for construction of substations will soon be awarded. Plans have been prepared by E. A. Proctor, chief engineer for the electric equipment, for which the contract will soon be let. After the car line to Franklin is completed the company proposes to build the railway to Mount Pleasant and Columbia, Tenn. H. H. Mayberry, of Nashville, is president.

GEORGETOWN, TEX.—Plans are being considered by the Georgetown Water & Light Company for improvements to its system, including the installation of an additional generator in the electric light plant. The cost of the work is estimated at $25,000.

HEREFORD, TEX.—W. F. West & Company have secured the contract for the construction of the power house for the new electric light plant.

RISING STAR, TEX.—The citizens have voted to issue bonds for the construction of water works system and an electric light plant.

TYLER, TEX.—The Tyler Electric Company, recently incorporated, has been reorganized under the name of the Tyler Electric Light & Power Company. A. E. Judge is president.

SALT LAKE CITY, UTAH.—Plans are being prepared by the Utah Light & Railway Company for the construction of a power plant in the Weber Canyon. The power house will be located about two miles from Devil's Gate, to which the water will be conveyed by a pipe line. The plant will develop about 3000 hp, and will cost about $200,000. Electricity will be distributed in Ogden and Salt Lake City.

ST. ALBANS, VT.—The substation of the St. Albans Electric Light & Power Company in St. Albans was destroyed by lightning June 14, leaving the city without electric light or street car service. The substation, including four transformers and two switchboards, was burned, and it will be probably a week or ten days before the service is resumed.

CHRISTIANSBURG, VA.—A new franchise has been granted the Virginia-Tennessee Telephone Company in this city. The company plans to install an entire new system, the cost of which is estimated at $12,000.

PULASKI, VA.—An election will be held July 10 to vote on the proposition to issue $75,000 in bonds for the construction of a hydroelectric plant. Edgar C. Wiley, of Lynchburg, is engineer.

RICHMOND, VA.—The Mayor has vetoed the ordinance authorizing an issue of $350,000 in bonds for the establishment of an electric light plant at the old pumping house and for increasing the pumping facilities of the water works. This is the second time that the provision for the construction of an electric light plant has been vetoed by the Mayor.

SEATTLE, WASH.—The contract for the power plant of the State University has been awarded to the Hallidie Machinery Company, of Seattle, Wash., for $76,605, and the contract for the construction of the power house to H. Chase & Company, of Seattle, for $16,677. Howard & Galloway are the architects and engineers.

TACOMA, WASH.—The City Council has authorized the Commissioner of Public Works to advertise for bids for the construction of a water power plant with an output of 10,000 hp, which can be further developed to at least 20,000 hp.

WENATCHEE, WASH.—Plans are being considered for the construction of an electric railway from Lucerne to the Molybdoni Mines on Railroad Creek. Surveys are now being made by the engineers of the Warren-Littleton Company, of Wenatchee.

MORGANTOWN, W. VA.—The South Morgantown Traction Company has awarded the contract for the construction of the extension to the poorhouse farm, a distance of two miles, to Frank Alfiery. The extension will cost approximately $60,000.

WHEELING, W. VA.—The contract for installing a new electric plant in the laundry building of the Home of the Sisters of the Good Shepherd has been awarded to the American Electric Company, of Wheeling. The equipment will consist of a 75-kw direct-connected generator.

CUMBERLAND, WIS.—An election will be held July 3 to vote on the proposition of rebuilding and improving the municipal electric light plant. The cost of the work is estimated at $15,000.

MILTON, WIS.—Arrangements are being made by the Milton & Milton Junction Telephone Company to construct a new telephone line between Milton and Milton Junction. Other extensions are also being considered.

MILWAUKEE, WIS.—The Milwaukee Light, Heat & Traction Company has received permission from the Wisconsin Railroad Commission to issue $2,500,000 refunding and extension mortgage, to secure funds for extensions and improvements as needed.

PESHTIGO, WIS.—The Northern Hydro-Electric Power Company, of Green Bay, Wis., is planning to erect a 10,000-hp power plant at Peshtigo, which will include the construction of a 400-ft. dam and power house. The cost of the plant is estimated at from $500,000 to $600,000. D. Mead, of Madison, Wis., is the architect and engineer.

CRESTON, B. C., CAN.—The Creston Electric Light & Telephone Company has engaged C. H. Mitchell, consulting engineer, to prepare plans for an electric plant to be operated by power from the Goat River Falls. George M. Benny is president.

MONCTON, N. B., CAN.—The Westmoreland Power Company has applied to the New Brunswick Legislature for an act to incorporate under the above title. Among the privileges asked for is the right to construct and operate electric railways in the city of Moncton and through the counties of Westmoreland, Kent and Albert.

SYDNEY, N. S., CAN.—A special committee has been appointed to consider the proposition to erect an electric light station in Sydney.

BRANTFORD, ONT., CAN.—The Brantford Street Railway Company will extend its street car line from Mohawk to Cainsville, and make extensive improvements to its system in Brantford.

FORT WILLIAM, ONT., CAN.—The Mount McKay & Kakabeka Falls Railway Company, which proposes to build an electric railway from Fort William to Kakabeka Falls, a distance of 15 miles, will purchase electrical energy for operating its system from the Kaministikwia Power Company, of Fort William, at 2200 volts, three-phase, 60 cycles, and transformed in the substation by motor-generator sets to 600 volts direct-current. G. R. Duncan is engineer.

GODERICH, ONT., CAN.—Plans are being made by the Ontario West Shore Electric Railway Company to build the section from Goderich immediately, the contract for which has been let to the Huron Construction Company. The parties who control the charter of this company are also interested in the Maitland River Power Company, which proposes to construct a power plant at Black Hole, about three miles distant from Goderich. The power company will furnish electricity to operate the electric railway.

LONDON, ONT., CAN.—The City Council has decided to accept the proposition submitted by the Hydro-Electric Power Commission, and has instructed the Mayor to sign the contract calling for 5000 hp.

MONTREAL, QUE., CAN.—The City Council has granted the Southern Counties Railway Company permission to enter the city with its proposed electric railway.

MONTREAL, QUE, CAN.—Plans are being prepared by Charles Brandeis, of Montreal, for a new steam power plant of 2,000 hp for the Saraguay Electric & Water Company. Proposals for the equipment of the plant will be called for in the near future.

MORRISBURG, ONT., CAN.—The Morrisburg Electric Railway Company will apply to the Provincial Legislature for a charter to construct an electric railway from Morrisburg to Russell, with a branch line to Winchester.

New Industrial Companies.

THE STANDARD ELECTRIC APPLIANCE COMPANY, of Lancaster, Pa., has been organized, and proposes to manufacture electrical specialities and supplies. M. S. Graves is treasurer and general manager.

THE GORE ARC LAMP COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $50,000, by G. I. Wooley, H. T. Berry, and H. T. Asbury, of Brooklyn. The company proposes to manufacture electric arc lamps.

THE CONSTRUCTION & ENGINEERING COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $100,000, by H. S. Collette, of New York, N. Y.; W. L. Ransom, of Brooklyn, and G. W. Bunnell, of Plainfield, N. J.

THE F. L. O'BRYAN COMPANY, of Framingham, Mass., has filed articles of incorporation with a capital stock of $50,000. The purpose of the company is to manufacture electrical devices. The incorporators are: Francis L. O'Bryan and others.

THE POPULAR ELECTRICITY PUBLISHING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000, by Foree Bain, George T. May and M. F. Allen. The company proposes to carry on a printing and publishing business.

THE NATIONAL IGNITION COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $150,000, by F. C. Ederlin, A. Williams, and G. W. Flaacke, of Jersey City. The purpose of the company is to manufacture electric appliances and devices.

THE UNITED MOTORS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000, by Henry E. Tobey, Curtis R. Hathaway, Chester W. Cuthill, all of New York, N. Y., and others. The company proposes to manufacture motors, engines, machines, cars, etc.

THE IDEAL STEAM TURBINE COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 by Francis S. Palmiero, Alfred Bonom, and Augustus M. Brown, all of New York, N. Y., and others. The company proposes to manufacture steam turbines, engines, boilers, etc.

E. CHOISTENSEN, of New York, N. Y., has been incorporated to manufacture chandeliers, fixtures, lamps, globes, etc ; also to do general electrical work. The company is capitalized at $10,000, and the incorporators are Albert R. Palmer, Frank R. Searles and Charles F. Kern, all of New York, N. Y.

THE GAS POWER MACHINERY COMPANY, of Cleveland, Ohio, has been incorporated and the following officers elected: James Z. George, president; C. E. Linsell, vice-president, and B. J. Guthery, secretary and treasurer. The company will handle the gas engine manufactured by the Lazier Gas Engine Company, of Buffalo, N. Y., and also expects to deal in everything pertaining to the gas engine industry.

New Incorporations.

PHOENIX, ARIZ.—Articles of incorporation have been filed for the International Traction & Power Company by J. A. Pfouts, Carl M. Gage, Thomas F. Durham and Thomas F. Deegan. The capital stock of the company is $50,000.

SOLOMONVILLE, ARIZ.—The Independent Commercial Telephone & Telegraph Company has been incorporated with a capital stock of $25,000. The officers of the company are: I. E. Solomon, president; H. W. Bishop, vice-president; Frank Richardson, secretary and treasurer, and Luther Green, general manager.

BUFFALO CENTER, IA.—The Buffalo Center Telephone & Exchange Company has been organized and the following named officers elected: J. G. Daum, president; F. T. Sparks, vice-president; J. J. Guyer, secretary, and T. E. Isaacson, treasurer.

TOWANDA, KAN.—The Augusta & Towanda Mutual Telephone Company is being organized by the citizens of Towanda and Augusta, for the purpose of establishing a local system and to extend into the surrounding country.

SAYLOR, KY.—The Middle Fork Telephone Company has been organized with a capital stock of $1,000 by F. Day, Harrison Williams and others. The company proposes to construct a telephone line from Saylor to Cutshin, a distance of 14 miles, and to Dayshore, a distance of 36 miles.

CANNON FALLS, MINN.—The Cannon Falls Electric Service Company has been incorporated with a capital stock of $25,000.

WAITE PARK, MINN.—The Le Sauk Rural Telephone Company has been organized by Peter Lahr, Clarke Waite, John H. Feddema and Alfred Iten. The company will install a telephone system to extend from Waite Park to Five Points.

HOLDEN, MO.—The Holden Telephone Company has been incorporated with a capital stock of $50,000 by C. Bothwell, W. B. Wallace, C. E. Starkey, Joseph Greaves, C. L. Hobart and others.

SHERIDAN, MO.—Articles of incorporation have been filed for the Sheridan Farmers Telephone Company, with a capital stock of $3,000, by J. C. White, J. C. Merckling, S W. Herndon, I. S. Tucker, John C. Harris and others.

STEVENSVILLE, MONT.—The Rural Telephone Company has been formed to install a telephone system in Stevensville, and is now in the market for material and equipment.

BOVINA CENTER, N. Y.—Articles of incorporation have been filed for the Bovina Center Telephone Company by John M. Miller, William T. Ward, Arthur D. Hoy, of Bovina Center, and others. The capital stock is placed at $3,000.

CLEMMONS, N. C.—The Muddy Creek Telephone Company has been incorporated with a capital stock of $10,000 by J. S. Hege, J. W. Hampton, J. D. Hill and others.

ROCKINGHAM, N. C.—The Richmond County Transit Company has been incorporated with a capital stock of $5,000 by T L. Covington, W. R. Rand and A. S. Dockery.

CUYAHOGA FALLS, OHIO.—The Falls Heat, Light & Power Company has been incorporated with a capital stock of $10,000 by W. A.

Searl, S. D. Tifft, W. B. Middleton, C. A. Davis and C. K. Fowler. The company will operate under a franchise granted C. M. Walsh last fall.

McMINNVILLE, ORE.—The McMinnville Local Long-Distance Telephone Company has been organized by John Wortman, Leroy Lewis, George E. Wagoner, A. M. Peery, W. T. Macy and W. S. Houck. The company is capitalized at $20,000, and plans to erect a long-distance telephone line from McMinnville to Portville.

McVEYTOWN, PA.—The Ferguson Valley Telephone Company has been organized and the following named officers elected: John C. Shehan, president; L. H. Ruble, vice-president; Fred Swigart, secretary, and Charles Kauffman, treasurer.

ROMNEY, W. VA.—The Romney Telephone Company has been incorporated by C. P. Miller, D. A. Daugherty and others.

OSHKOSH, WIS.—The Oshkosh, Winneconne & Waupaca Railroad Company has filed articles of incorporation, with a capital stock of $100,000. The company proposes to build an electric railway from Oshkosh to Waupaca, a distance of 50 miles. The incorporators are William M. Bray, E. H. Steiger, Elmer Leach, Edward W. Murphy and L. J. Monahan, all of Oshkosh.

WAUPUN, WIS.—The Eastern Alto Telephone Company, of Alto, has been incorporated with a capital stock of $1,400. Following are the officers: D. V. W. Straks, president; John Freriks, vice-president; William Meenk, secretary, and Rudolph Kastein, treasurer.

BELLA COLLA, B. C., CAN.—The Bella Colla Telephone, Light & Power Company has been incorporated with a capital stock of $25,000.

COBURG, ONT., CAN.—The Alnwick Independent Rural Telephone Company has been organized in Alnwick Township. The officers of the company are: E. W. Hayden, of Roseneath, president; R. Campbell, vice-president; F. A. Aylesworth, secretary-treasurer.

CARNDUFF, SASK., CAN.—The Carnduff Telephone & Electric Company has been organized for the purpose of constructing a telephone system. The company is capitalized at $10,000, and the following directors have been elected: Dr. Lockhart, J. H. Elliott, E. J. Campbell, J. B. Preston and J. H. Taylor.

Legal.

NOT COMPELLED TO PURCHASE PLANT OR RENEW CONTRACT.—A decision handed down by Judge Graves in the Supreme Court at Topeka, Kan., on June 6, holds that the city of Clay Center, Kan., is not compelled to either buy the plant of the Clay Center Light & Power Company, or renew the franchise with the concern, according to the terms made by the City Council in 1886. The decision is a reversal of that of Judge Kimball, of the District Court.

ELECTRIC LIGHT COMPANY MUST EXERCISE HIGH DEGREE OF CARE AGAINST UNFORESEEN ACCIDENTS.—When on the public streets in a proper place one is injured, without fault on his part, by improper insulation or derangement of its appliances, a presumption of negligence arises which casts the burden on the defendant of showing that it exercised due care. In a recent action it appeared that, at the time of the injury, the plaintiff was a child of about 11 years of age. While on an errand it was necessary for her to pass one of the defendant company's poles, to which was affixed a guy wire and iron rod attachment, situated near a footpath at the edge of the place in the street where the sidewalk is usually placed. It had rained the night previous, the ground was muddy, and as she approached the guy wire and iron rod attachment her foot slipped on the soft ground, bringing her in contact with them. She immediately fell insensible to the ground, the guy wire being charged to a dangerous voltage, and on being rescued it was found that she had sustained permanent and lasting injuries, leaving her a helpless cripple. The company was held liable in damages. Shawnee Light & Power Company v. Sears, Supreme Court of Oklahoma, 95 Pac., 449.

FRANCHISE CANNOT BE OVER-RIDDEN BY ORDIANCE RAISING COMPENSATION.—At Memphis, Tenn., Chancellor Heiskell has dismissed the bill of the city of Memphis against the Cumberland Telephone & Telegraph Company, on the ground that the company had a valid contract with the city under which both had been reaping benefits for many years. The proceeding was an effort to collect $60,570, alleged to be due for pole rental. The city contended that the company owed pole rentals at the rate of $3 per annum for each pole in use in the city since 1902, basing its suit upon a recent decision of the United States Court of Civil Appeals. This decision held that the city had a right to charge pole rental, revising the decision of the federal court at Memphis, which held the rental to be uncollectible. The chancellor did not go into the reasonableness of the rental asked. The city had contended that no contract existed. The contract which is thus upheld was made in 1879. It gives the company the right to use the streets for planting poles on condition that the topmost cross-arm on each pole be kept in repair and held for the exclusive use of the city in operating its fire and police alarm system. The chancellor said that "the city of Memphis has been using this top cross-arm since the Carnes contract was made. While, as the city contends in this suit, the rights given the defendant under that contract have increased and become vastly more valuable than when given, it is also equally true that the city's consideration has also become more valuable, as its fire and police alarm system has been increased in proportion to the growth of the telephone company's business."

DUTY OF ELECTRIC COMPANY TO INSPECT BELTING.—It has been held that, while it is not the duty of an electric company to repair defects arising in the daily use of appliances, of a temporary character, not requiring the help of skilled mechanics where proper and suitable materials are supplied for repairs which may be easily made by the workmen, when a belt moving at the rate of 5000 ft. per minute passes within a half inch of a beam and girder, and the company employs a servant whose sole duty is to inspect the belts every morning and repair defects, and the others had nothing to do with the inspection, the company owes the duty of inspection and is liable for negligence of the servant selected to perform that duty. Where the facts show that, in the understanding of both parties, a class of ordinary repairs are to be made by the servants with materials furnished by the master for that express purpose; that they and he regard it as a detail of their own work; that it is something entirely within their capacity and not dependent upon the skill of a special expert, and that the necessity springs from their daily use of the appliance, occurs at different and unknown periods in their service and is open to their observation in the absence of the master, the inference is inevitable that the contract relation between the parties makes it a duty of the servants and a detail of their work to correct the defect when it arises with the materials furnished. It was held that the present case did not fall within the exception, and a judgment in favor of the plaintiff was reversed on appeal. Dittman v. Edison Electric Illuminating Co., New York Supreme Court, Appellate Division, 110 N. Y. Supp., 87.

Obituary.

MR. W. H. YOUNG.—William Hamilton Young, of Washington, D. C., one of the most widely known telegraphers in the country, died suddenly at the home of his son Frank, in Chicago, June 19. Mr. Young, who was night manager of the Western Union Telegraph Company's Washington office for 30 years, had gone to Chicago to take charge of the press matter of the Washington correspondents during the Republican national convention last week, and while on duty at the Coliseum was overcome by the heat. Mr. Young was 73 years old. He became a telegraph operator at the age of 20 and in the Civil War was employed by the government at Washington, where part of his duties was to censor press despatches. In addition to his work as night manager, he had charge of the Western Union's press telegraphis service at the Capitol during the sessions of Congress for the last 25 years. His mildness of manner and courtesy made him extremely popular among newspaper men and senators and congressmen in Washington. Among his friends he was familiarly known as "Ham" Young, and he was highly esteemed by telegraphers throughout the country. At the time of his death he was vice-president of the Telegraphers' Mutual Benefit Association, which office he had held for many years; and two years ago he was president of the Old Time Telegraphers' Association.

Personal.

MR. EMERSON McMILLAN, of New York City, has been elected trustee of Cornell University.

PROF. V. KARAPETOFF, who has been assistant professor of electrical engineering at Cornell University, has been promoted to a full professorship.

MR. T. F. SALTER, who has made a specialty of that branch of engineering dealing with hoisting and conveying apparatus, has been appointed chief engineer of the Standard Roller Bearing Company of Philadelphia.

MR. RICHARD M. JACKEL, formerly employed at the Ft. Wayne Electric Works, Fort Wayne, Ind., has recently been appointed superintendent of the Reynolds Electric Flasher & Manufacturing Company, of Chicago, Ill.

MR. G. W. HART, of the Hart Manufacturing Company, Hartford, Conn., manufacturer of "Diamond H" switches, sailed for Europe on the *Adriatic* June 17, to be absent until September. He was accompanied by Mrs. Hart and Master George Hart.

MR. L. A. FERGUSON, vice-president of the Commonwealth Edison Company, Chicago, addressed the Chicago Electric Club at its noonday meeting June 17 on "The Relationship Between the Engineering and Commercial Departments of Electrical Undertakings." His address was along the line of that given at the recent N. E. L. A. convention.

MR. JOHN S. BARTLETT, formerly vice-president of the Lynn Gas & Electric Company, of Lynn, Mass., has been appointed president of the company to succeed the late Mr. Charles H. Newhall. Mr. Eugene B. Fraser, treasurer, has been elected to the vacancy on the board of directors. Mr. Charles H. Pritchard, vice-president, will also assume the duties of general manager of the company.

MR. LEWIS M. McBRIDE, who has been connected with the electrical industry in various branches and as electrical engineer for several concerns, and Mr. Robert B. Bonney, who has been engaged in technical telephone and electrical work for the past twelve years, have entered the electrical engineering field under the firm name of McBride & Bonney, with offices in the Jackson Block, Denver; Col., and will undertake the complete installation of lighting and power plants and electrical and telephone equipment.

MR. RAYMOND LESTER BROWN, of Campville, Conn., received upon graduation the prize for excellence in electrical engineering, which is annually awarded by the Sheffield Scientific School, of Yale University.

MR. E. M. GREEN has been appointed superintendent of the Blue Ridge Light, Power & Railway Company, of Staunton, Va.

MR. WILLIAM HAND BROWNE, JR., formerly of Baltimore, Md., and a graduate of Johns Hopkins University, has been appointed professor of electrical engineering in the North Carolina Agricultural and Mechanical College, at Raleigh, N. C. Mr. Browne for some years has been technical editor of *Electrical Review.*

MR. GEORGE WILLIAMS, commercial engineer for H. L. Doherty & Company, was married on June 20, to Miss Christine Dahl, of Christiana, Norway. The ceremony was performed in Scranton, Pa., and the couple left immediately for Buffalo and Cleveland. Mr. and Mrs. Williams will take up a permanent residence in New York City.

Trade Publications.

HAND TOOLS, including screw-drivers and drills are well discussed in an illustrated booklet issued by the North Bros. Mfg. Co., Philadelphia, Pa.

ELECTRIC SPECIALTIES.—The Gillette-Vibber Company, New London, Conn., has issued a bulletin descriptive of its molding boxes and cable caps.

LIGHTING SPECIALTIES.—Bulletin No. 54, of the H. T. Paiste Company, Philadelphia, Pa., deals with ground-clamps, entrance-switches, tablets and receptacles.

AIR PUMPS driven by direct-current on alternating-current motors are described in Bulletin No. 3803 of the Emerson Electric Manufacturing Company, St. Louis, Mo.

FIRE EXTINGUISHERS of the chemical type are briefly described and illustrated in a folder issued by the H. W. Johns-Manville Co., 100 William Street, New York.

STEAM SPECIALTIES, including gage cocks, water gages, gate valves, bronze and brass fittings are described in catalogue F of the Ohio Brass Co., Mansfield, Ohio.

STORAGE BATTERIES for telephone service are thoroughly treated in an instructive manner in Bulletin No. 103 of the Electric Storage Battery Company, Philadelphia, Pa.

STORAGE BATTERIES, which are claimed to be "fool-proof," are described in a catalogue issued by the Haschke Storage Battery Company, 271 Michigan Avenue, Chicago, Ill.

COMPOUND ENGINES.—The American Engine Company, Bound Brook, N. J., has issued bulletin No. 14, dealing with compound engines for direct-connected and belted services.

ELECTRICAL SPECIALTIES, including plugs, rosette cleats and receptacles are listed and described in a catalogue issued by the Tregoning Electric Mfg. Company, Cleveland, Ohio.

DIRECT-CURRENT MOTORS rated at from 0.25 hp to 0.50 hp are illustrated and described in Bulletin No. 3212 of the Emerson Electric Manufacturing Company, St. Louis, Mo.

RAILWAY GENERATORS of the direct-current type rated at from 125-kw to 1000-kw, are fully described in bulletin No. 104 of the Crocker-Wheeler Company, Ampere, N. J.

LIGHTNING ARRESTERS of the non-arcing type for electromotive forces up to 66,000 volts are discussed in Bulletin E of the Lord Electric Company, 213 West Fortieth Street, New York.

SEWING-MACHINE MOTORS, of the direct-current and alternating-current types are illustrated and described in bulletin No. 3905, of the Emerson Electric Mfg. Company, St. Louis, Mo.

BOILER-CLEANING COMPOUND.—Information concerning Magic boiler-cleaning compound is given in a booklet isued by the H. W. Johns-Manville Company, 100 William Street, New York.

ELECTRIC FANS.—Direct-current and alternating-current fans for ceiling and desk use are well illustrated in a descriptive booklet issued by the Dayton Fan & Motor Company, Dayton, Ohio.

TELEPHONES.—Pamphlet No. 6 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., is devoted to magneto telephone switchboards and self-restoring gravity-drop signals.

ELECTRIC FANS for desk, ceiling and column use are well discussed in a neat folder, No. 4101, of the Westinghouse Electric & Mfg. Company, Pittsburg, Pa. The motors are of the direct-current type.

TRANSFORMERS.—The Wagner Electric Mfg. Company, St. Louis, Mo., has distributed mailing cards calling attention to its lines of transformers, motors and electrical measuring instruments.

SWITCHBOARDS.—In its bulletins Nos. 96 and 102, the Crocker-Wheeler Company, Ampere, N. J., gives detailed information concerning alternating-current switchboard panels for 1150 or 2300 volts.

DIRECT-CURRENT MACHINES.—Motors rated at from 50-hp to 275-hp and generators rated at from 45-kw to 225-kw are discussed in bulletin No. 101 of the Crocker-Wheeler Company, Ampere, N. J.

ELECTRICALLY-OPERATED DRILLS AND GRINDERS are illustrated and described in a bulletin issued by the Armorduct Manufacturing Company, Ltd., Farringdon Avenue, London, E. C., England. These tools are of either the polyphase induction or direct-current series type.

VENTILATING FANS.—An interesting article on ventilating fans, which first appeared in *The Engineering Magazine,* has been reprinted in bulletin No. 153 of the B. F. Sturtevant Company, Hyde Park, Mass.

MOTOR DRIVER.—In its bulletin entitled "Drive No. 3," the Peerless Electric Company presents some convincing arguments as to the advantages of electric motor drives in general and Peerless drives in particular.

SOUND DEADENER.—The H. W. Johns-Manville Company, 100 William Street, New York, has issued a folder calling attention to its hair insulator, which is used for preventing the transmission of heat, cold or sound.

"ELECTRICITY IN MINES" is the title of a neatly-executed bulletin issued by the British Thomson-Houston Company, Ltd., Rugby, England. Both direct-current and alternating-current motor installations are described and illustrated.

SWITCHES.—Publication No. 570, of Verity's, Ltd., Aston, Birmingham, England, is devoted to switch-gear and switchboards. Illustrations and descriptions are given of switches, fuses, iron-clad material, switchboard material, switchboards, starters and regulators.

BOILER TUBE CLEANERS.—Catalogue G, of the Lagonda Mfg. Company, Springfield, Ohio, describes briefly turbine and mechanical boiler-tube cleaners, reseating machines for cleaning nuts, heads and caps of boilers, boiler-tube cutters and automatic cut-off valves.

VENTILATING FANS driven by direct-current motors are treated in bulletin No. 90 of the B. F. Sturtevant Company, Boston, Mass. Bulletin No. 97 deals with ventilating sets of both the portable and convertible types. Propeller fans are well described in bulletin No. 146 of the same company.

ROLLER BEARINGS.—Bulletin No. 31 of the Hyatt Roller-Bearing Company, Newark, N. J., is a well-executed publication dealing with roller-bearing bushings. There are now offered to the trade more than 300 sizes of standard Hyatt bearings, each provided for a special condition of speed and load.

SINGLE-PHASE INDUCTION MOTORS.—In a booklet entitled "Vox Populi," the Wagner Electric Mfg. Co., St. Louis, Mo., presents convincing evidence that its single-phase induction motors have given satisfaction by printing numerous letters from customers that have used its motors for many years.

HYDRO-ELECTRIC DEVELOPMENT.—Bulletin No. 103, of the Crocker-Wheeler Company, Ampere, N. J., contains a well-prepared and appropriately illustrated description of the hydro-electric development made by the Sanitary District of Chicago, on the drainage canal where a 16,000-hp equipment has been installed.

TUNGSTEN LAMP FIXTURES designated as luminiers are dealt with in bulletin No. 1 of the Cleveland Gas & Electric Company, Cleveland, Ohio, and in Vol. 1, No. 7, of *Holophane,* issued by the Holophane Company, 227 Fulton Street, New York. The latter publication also describes so-called "Lexoliers"—fixtures for tungsten lamps.

MOTORS IN PRINTING ESTABLISHMENTS.—Bulletin No. 5910-5, the Western Electric Company, Chicago, Ill., contains much interesting and valuable information concerning the use of motors for driving printing machinery. An imposing list of printing offices where Western Electric equipments are used is also included.

VERTICAL SHAFT DIRECT-CURRENT MOTORS.—Roth Bros. & Co., Chicago, have just compiled a new bulletin No. 181, containing information and data relating to vertical shaft motors of their manufacture. One of the advantages of this type of motor is that it is particularly adaptable for displacing bevel gears and complicated drives.

ELECTRICAL SUPPLIES, including insulated wires and cables, conduits and fittings, outlet boxes, conduits, switches, fuses, panels, sockets, rosettes, tape, tungsten and carbon lamps, shades, fixtures, heating devices, electric fans, etc., are listed and described in the 1908 catalogue of the Zenco Electrical Supply Company, 94 West Van Buren Street, Chicago, Ill.

INDUCTION MOTORS FOR SHOP DRIVE.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has issued a well-illustrated bulletin devoted to the machine-tool equipment of the shops of the Wabash Railroad Company, at Decatur, Ill., where 440-volt, three-phase induction motors are used throughout. A particularly valuable feature of the bulletin is a complete list of the motors that have been selected for driving the individual machines and groups of machines.

VARIABLE SPEED MOTORS.—The Lincoln Motor Works Company has issued Bulletin No. 10 containing a full description of its variable speed motors, including detail drawings, speed and efficiency charts, table of ratings, etc. The bulletin describes fully the principle of operation of the company's type of motor and its peculiar advantages for all forms of individual drive requiring adjustable speeds. A few illustrations showing the applications of motors to machine tool drive are also included.

SINGLE-PHASE INDUCTION MOTORS.—Bulletin No. 3124, of the Emerson Electric Mfg. Company, St. Louis, Mo., is devoted to single-phase induction motors of the self-starting split-phase type rated at from 16-hp to 25-hp. These motors will start from rest under full-load torque. Motors of the same general type designed for starting under less severe conditions are described in bulletin No. 3125, while bulletin No. 3126 deals with motors similar to the above but rated at from .25-hp to .50-hp.

ENGINEERING SPECIALTIES.—The Schutte & Koerting Co., Philadelphia, has issued a new catalogue in three sections. One section relates to apparatus for the chemical industry; one to apparatus, steam and engineering specialties for use in power plants, etc., and a general catalogue illustrative and descriptive of their entire line.

G. E. FLAME ARC LAMP.—The General Electric Company, Schenectady, N. Y., describes in Bulletin No. 4586 a new lamp containing many novel mechanical features and of particularly simple construction. The lamp is of short length, being only 31 inches from top to bottom, and is intended for operation either in series or in multiple. Among some of the advantages are the elimination of clock mechanism, accessibility of parts when the shell is lowered to the trimming position and many special features of reliability inherent in the design.

INCANDESCENT LAMPS.—A publication that should be in the files of every illuminating engineer and every one interested in lighting is bulletin No. 7, of the Buckeye Electric Company, Cleveland, Ohio, which gives much reliable data relating to the candle-power and illumination obtained from the numerous forms of commercial illuminants, together with information concerning color effects, reflection from walls, and economy in the use of high-efficiency lamps. Bulletin No. 3 of the same company deals with the Gem carbon-filament lamp, which has a specific consumption of 2.5 watts per candle.

INDUSTRIAL PLANT.—W. S. Barstow & Company have just issued a neat and attractively illustrated bulletin, which is the first of a series describing plants typical of certain classes of work. The bulletin describes the plant and work of reconstruction of the Jamestown Worsted Mills. This establishment is typical of others which have grown up about a boiler and engine room and have become hampered with the difficulties of mechanical drive and so cramped for space as to be forced to install the more flexible system of electric motor drive. The equipment of the power plant was changed from low-pressure steam boilers and Corliss engines to high-pressure steam boilers and steam turbo-generator units, without in any way crippling the output during the period of reconstruction.

ELECTRICALLY HEATED HOUSEHOLD APPLIANCES.—The General Electric Company, Schenectady, N. Y., has issued a handsome pamphlet describing briefly its line of electric heating and cooking devices. The illustrations show flatirons of various types, water heaters, combination cereal cookers, tea kettles, percolators, chafing dishes. stoves, frying pans, grids, ovens, etc. Cooking and baking outfits, consisting of combinations of the most desirable apparatus, are also described, and such specialties as cigar lighters, shaving mugs, heating pads, corn poppers, etc., have their place in the booklet. New designs of luminous radiators and tubular air radiators are given. The booklet contains complete lists of catalogue numbers, with ratings, capacities, voltages, prices, etc., and forms a very satisfactory reference book of the present state of electric heating and cooking.

RAILWAY MOTORS.—Bulletin No. 4588, just issued by the General Electric Company, Schenectady, N. Y., describes the GE-202 railway motor, which is similar in design and construction to the latest standard GE railway motors, containing all their improvements and, in addition, being provided with commutating poles. The characteristics of the commutating-pole motor allow the overload to be considerably increased and at the same time a more rugged form of motor is obtained which will withstand the most severe service conditions and is less likely to be injured by misuse. The motor is, therefore, especially adapted for operation on heavy grades or with equipments geared for high speed work which have also to start and stop frequently in city service. The details of construction are given at some length in the bulletin, and an interesting article on rating, with suggestions for the proper selection, is included. Dimension diagrams, characteristic curves and a service data sheet for use in ordering complete the pamphlet.

TUNGSTEN ECONOMY DIFFUSERS.—Under the name of the "Tungsten Economy Diffuser" the General Electric Company, Schenectady, N. Y., is placing on the market a new form of illuminating device, which is described in Bulletin No. 4594. The two types described are designated respectively as the store type and mill type. They consist of a broad reflector or diffuser surrounding a frosted globe containing the lamps; they are made for five or six lamps and can be adjusted for tungsten, tantalum or carbon filament incandescent lamps in all the usual sizes. A special snap switch has been developed which allows different combinations of the lamps to be made with convenience. The bulletin contains photometric curves showing the light distribution under different combinations, connections and data as to the different styles manufactured.

ALUMINUM LIGHTNING ARRESTERS.—Bulletin No. 4595 of the General Electric Company has for its subject Form I, now being placed on the market. The arrester consists of a "stack" of concentric, inverted aluminum cones, insulated from each other and placed in a tank of oil. Before being placed in the oil the space between the cones is partially filled with a special electrolyte. The critical value at which the electrolyte breaks down is 420 volts for any two adjacent cones, and when this potential is reached the action is similar to that of a safety valve and a large amount of current allowed to flow during discharge. This action is produced by a thin film which forms on the aluminum plates by electrolyte action, and as soon as the discharge ceases the film immediately reforms. Illustrations of lightning arresters for different capacities, diagrams of dimensions and connections and other data are given in the bulletin, which is of timely interest to the managements of electrical installations.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

LAWRENCEBURG, TENN.—The city has purchased a 250-kw water wheel type alternator and exciter of the Allis-Chalmers Company, of Milwaukee, Wis., for the municipal electric light plant.

PRATT, KAN.—The Pratt Light & Ice Company has recently purchased of the Allis-Chalmers Company, of Milwaukee, Wis., a 100-kw and a 50-kw generator with exciters and a 50-hp motor.

ELBERON, N. J.—The New Jersey Consoliated Water & Light Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 175-kw belted generator for its plant at Elberon.

WILLIAMSPORT, PA.—The Citizens' Electric Company will install a 300-kw engine-type, Allis Chalmers generator unit in its plant.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 250-kw, three-phase, 2300-volt, 60-cycle elternator and a 6-kw, belt-driven exciter set to furnish electrical energy for the recently extended street lighting system.

SAND POINT, IDAHO.—The Pend d'Orielle Electric Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 225-kw engine-driven set with exciter and switchboard.

HARTFORD, WIS.—The City Council has decided to build a municipal electric light plant, the cost not to exceed $27,000. The plans provide for a 30 and 60-kw, 2300-volt, 60-kw, single-phase, alternating-current generators.

BEULAH, WYO.—Contracts have been awarded for excavating the canal and tunnels on the Sand Creek Canal to be constructed by Henry Keats and others, of Spearfish. The canal will furnish 1800-hp for operating an electric power plant at Beulah, which will furnish electricity to operate the mines in the Black Hills.

WAHOO, NEB.—Bids will be received until July 6 at the office of L. H. Lytle, city clerk, for furnishing machinery and apparatus and installing complete an electric light and water works system for the City of Wahoo. E. Lehmkuhl is mayor.

ALBANY, MINN.—The citizens are contemplating installing a municipal electric light plant, the cost not to exceed $3,500.

CHADWICK, ILL.—The village contemplates the purchase of a new engine for the municipal electric light plant. Asa Rogers is manager.

WAYNESBORO, PA.—New machinery is being installed in the substation of the Chambersburg, Greencastle & Gettysburg & Waynesboro Street Railway Company at Marion. The equipment consists of transformers, generators, etc. The extension from Greencastle to the county seat is nearly completed.

DAVENPORT, IA.—The Tri-City Railway & Light Company is contemplating the addition of a steam heating plant to its system.

HARTFORD, WIS.—The citzens have noted in favor of issuing $27,000 in bonds for the construction of a municipal electric plant to furnish electricity for commercial lighting as well as for street lamps.

NATCHEZ, MISS.—The contract for street lighting has been awarded to the Southern Light & Traction Company for a term of five years at the rate of $90 per lamp per year, which is a reduction of $13 per lamp on the price now paid by the city for street lamps. The street lighting system consists of 119 lamps. L. H. Dinkins is president of the company.

HELENA, MONT.—Plans are being made for the rebuilding of the Hauser Lake Dam of the Helena Power Transmission Company, which was recently washed away by the flood. Contracts for the work will soon be let; also for the construction of the new dam at Wolf Creek, which will make the third large dam the company owns on the Missouri River.

JERSEY CITY, N. J.—The Mutual Benefit Electric Light & Power Company announces that it will apply again to the Board of Aldermen for another franchise. The company was recently granted a franchise by the Council, which was vetoed by the Mayor.

ST. PAUL, MINN.—The Northern Heating & Electric Company has absorbed the plant and holdings of the Union Manufacturing Company, which has a franchise to supply the Midway District with electricity for lamps.

RICHMOND, UTAH.—The High Creek Electric Light & Power Company contemplates extending its transmission lines in the different towns covered by its system. The cost of the work is estimated at about $5,000.

ELIZABETHTOWN, PA.—The Elizabethtown & Florin Street Railway Company is contemplating the construction of a new power house, which will probably be located at either Tunnel Hill or at Rheems. Contracts for the construction of the power house will soon be let.

PATTON, PA.—The directors of the Northern Cambria Street Railway Company have decided to extend its railway from Barnesboro to Hastings, a distance of between four and/ five miles. James T. McNellis is superintendent.

ST. CLOUD, MINN.—Articles of incorporation have been filed for the Union Electric Power Company with a capital stock of $100,000. The company proposes to install an electric power plant in St. Cloud. The directors are A. G. Whitney and others.

HARDIN, MONT.—The Hardin Water & Power Company has been incorporated with a capital stock of $30,000, by Carl Rankin and others.

NEWPORT, ARK.—The People's Light, Water & Power Company has been incorporated with a capital stock of $25,000, by F. R. Suits, George O. Beebe and Henry Baldus.

Business Notes.

THE STANDARD ROLLER BEARING COMPANY, of Philadelphia, announces a further expansion of its sales organization by the opening of a branch office at 327 Jefferson Avenue, Detroit, in charge of Ernest L. Smith, recently appointed Western representative.

COOK WIRE JOINTS.—Frank B. Cook, Chicago, has received a large order for self-welding wire joints from the U. S. Government for use on transmission lines being installed in connection with reclamation work in the Northwest and Southwest. He has also closed a contract to supply wire joints to the Manitoba Government.

AUTOMOBILE IGNITION SUPPLIES.—The Manhattan Electrical Supply Company, 17 Park Place, New York, has just issued a 12-page folder showing the line of automobile supplies it manufactures, including spark coils, switches, battery connector, etc. A revised edition of its pocket size catalogue, 168 pages, "Something Electrical for Everybody," is also ready for distribution.

THE TRACY ENGINEERING COMPANY, formerly of 66 Beaver Street, New York City, has removed its headquarters from New York to Los Angeles, Cal. The company's offices will be in the Central Building, and in order not to conflict with a company of the same name already in Los Angeles, the name of the company has been changed to Blythe-Tracy Company. The new company is new in name only, and will continue the business formerly conducted by the Tracy Engineering Company, of New York City.

GAS ENGINES IN THE OIL FIELDS.—In the oil fields they are running gas engines twenty-four hours a day, seven days in the week, using Edison primary batteries, and engineers do not have to look to their ignition oftener than once or twice a year. Then a few minutes are required to renew the cells which at once become the same as new cells. The men in the oil fields praise the inventive genius of Thomas A. Edison whenever the ignition question is brought up. His primary batteries and spark coil are now met with on every hand.

DOSSERT CONNECTORS.—The Rio de Janeiro Tramway, Light & Power Company, Ltd., of Rio de Janeiro, Brazil, has received a large shipment of Dossert 2-way joints comprising 25 for 500,000 circ. mil. cable, 100 for 250,000 circ. mil. cable, 100 for No. 00 cable and 50 for No. 0 cable, from Dossert & Company, 242-244 West Forty-first Street, New York City. The order was placed through the New York office of the Rio tramway company. Additional large orders have been received for Dossert solderless 2-way connectors to be installed in the junction boxes used in the wiring of the new steel passenger cars now being completed by the Pressed Steel Car Company at McKees Rocks, Pa., for the Pennsylvania Railroad.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 16, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

890,592. PROTECTIVE DEVICE FOR HIGH-POTENTIAL SYSTEMS; Richard Apt, Berlin, Germany. App. filed Aug. 17, 1906. The combination of a grounded receptacle, a column of liquid communicating therewith and connected to a line conductor of an electrical system, and a second liquid column of lower resistance connected between said receptacle and said line conductor through a spark gap.

890,593. SYSTEM OF DISTRIBUTION; Albert H. Armstrong, Schenectady, N. Y. App. filed Sept. 13, 1907. In a railway system operated by alternating current, a trolley wire, a catenary suspension therefor and means for maintaining the catenary at a potential approximately equal but opposite to that of the trolley wire.

890,601. WINDING MACHINE; John G. Callan, Lynn, Mass. App. filed Jan. 19, 1905. Complete organized machine for automatically winding armatures of the type employed in electric meters of the motor type. Includes electrical stop motion devices which act at the completion of the various armature coils.

890,607. RAILWAY SIGNAL; Abra G. Clark, Schenectady, N. Y. App. filed Oct. 14, 1907. A quick break switch for controlling the driving motor of a semaphore signal. Makes use of a pair of spring blades which project into the path of a segment contact on the semaphore arm.

890,615. AUTOMOBILE; Albert G. Davis, Schenectady, N. Y. App. filed Feb. 8, 1904. Relates to complete features of a circuit controller for the transmission system of an automobile having a dynamo and a motor in alignment with one another in place of the usual transmission shaft.

890,617. ALTERNATING-CURRENT MOTOR; Max Deri, Vienna, Austria-Hungary. App. filed Dec. 16, 1902. In an alternating-current motor, a primary winding adapted to be connected to a source of current, a secondary winding provided with a commutator and brushes in inductive relation thereto, a transformer having its primary connected in series with one of said windings, and a magnetizing winding connected to the secondary of said transformer.

890,621. CIRCUIT CONTROLLING DEVICE; George H. Dorgeloh, Schenectady, N. Y. App. filed Oct. 5, 1907. Means whereby an electric motor may be stopped, started and generally controlled by a contact arm moving over segment contacts. Includes means by which the motor may be run at different speeds for use with printing presses and the like.

890,622. SYSTEM OF MOTOR CONTROL; Edgar F. Dutton, Schenectady, N. Y. App. filed Feb. 21, 1907. Has an electric motor and a controlling switch, a source of mechanical power and reversible gearing between the source and the switch, and means for controlling the gearing from a distance so as to drive the motor controlling switch in either direction to control the motor.

890,627. MOTOR CONTROL; Friedrich Eichberg, Berlin, Germany. App. filed Jan. 23, 1907. In combination with an alternating-current motor and a source of current therefor, a transformer having its primary winding connected to the source, a second transformer having its secondary winding connected to the motor, and means for connecting the other two windings of the two transformers to different points on each other.

890,638. VARIABLE VOLTAGE TRANSFORMER; Edward F. Gehrkens, Schenectady, N. Y. App. filed July 26, 1906. Variable voltage transformers of the type comprising a magnetic core, with primary and secondary coils thereon, and two movable magnetic members, one arranged to open the magnetic circuit threading both the primary and secondary coils and the other to close a magnetic circuit outside of the secondary coil.

890,661. TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Apr. 23, 1906. A means by which telegraphic messages may be received simultaneously at a series of stations connected in one circuit by the method of reversals.

890,664. TROLLEY WHEEL; Thomas Langen, Brooklyn, N. Y. App. filed April 8, 1907. The trolley wheel is made in separable sections, including side flanges and a central removable tread, which are held in place by a threaded tubular core.

890,670. CIRCUIT CLOSER FOR AUTOMATIC TRAIN STOPS; Joseph H. Lynch, Red Bank, N. J. App. filed May 2, 1907. Has a horizontally and vertically movable shoe on a vehicle and a specially constructed tappet device adapted to exert a composite cam function to impel the shoe laterally or vertically, as desired.

890,679. LIGHTNING ARRESTER; Ezra B. Merriam, Schenectady, N. Y. App. filed Nov. 8, 1906. A protective device having means for establishing a water jet to carry discharges from the line conductor and means for confining the expansion action of the water when a heavy discharge is transmitted thereby.

890,695. COMBINED SIGNAL AND SPRING-JACK; James L. McQuarrie, Oak Park, Ill. App. filed May 5, 1906. The combination with an electromagnet of a rocking arm pivoted intermediate its ends, a curved armature carried by one end of said arm in position to be attracted by said magnet to rock the arm, a signal carried by the opposite end of said arm and displayed when the arm is rocked, a catch for holding said armature in its attracted position, a spring-jack and a plug adapted when inserted in said spring-jack to release said catch.

890,697. PROTECTIVE DEVICE FOR UNIPOLAR MACHINES; Jakob E. Noeggerath, Schenectady, N. Y. App. filed Oct. 4, 1905. The patentee arranges a protective device for each of the stationary cross connections for the armature conductors of a unipolar generator.

890,699. METHOD OF OPERATING INDUCTION MOTORS; Robert H. Parker, Schenectady, N. Y. App. filed Dec. 4, 1905. The method of operating synchronously an induction motor having both rotor and stator coil-wound, which consists in producing two rotating fields in said motor, one rotating at synchronous speed with respect to the stator and the other rotating in the opposite direction at a speed with respect to the stator corresponding to the slip of the rotor below synchronous speed.

890,718. CIRCUIT BREAKER; Arthur Smith, Schenectady, N. Y. App. filed April 24, 1906. Relates to circuit breaker switches of the type operated by solenoids and controlled at a point remote from the main switch. Provides an indicating device which is actuated under certain abnormal conditions.

890,719. MOTOR STARTING PANEL; Arthur Smith, Schenectady, N. Y. App. filed Jan. 17, 1907. A means for controlling electric motor circuits, having a device whereby the main armature circuit is automatically opened by means external to the controlling device itself.

890,722. REGULATION OF DYNAMO ELECTRIC MACHINES; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 31, 1906. The combination of a dynamo electric machine, having a multiphase exciting winding and a multiphase generating winding, a low frequency exciting circuit connected to said exciting winding, resistances in said exciting circuit and means responsive to the voltage of said generating winding for controlling said resistance.

890,730. VARIABLE VOLTAGE TRANSFORMER; Matthew O. Troy, Schenectady, N. Y. App. filed July 26, 1906. Construction of variable voltage transformer, having a pair of movable members, one of which is pivoted to vary the reluctance of the magnetic circuit and the reluctance of a magnetic shunt for the secondary winding.

890,731. STARTING MERCURY-VAPOR APPARATUS; Matthew O. Troy, Schenectady, N. Y. App. filed Sept. 27, 1907. A means for starting mercury vapor lamps, comprising a starting device in which the starting is produced through the action of a heated surface, preferably oxid coated, in the vicinity of the cathode.

890,737. VARIABLE RESISTANCE COIL; Herbert A. Wallace, New York, N. Y. App. filed Aug. 9, 1907. Makes use of a cylindrical winding engaged by a pair of sliding spring contacts which are adjusted upon the cylinder by a thumb screw.

890,763. ARC LAMP; Richard Fleming, Lynn, Mass. App. filed May 18, 1904. Covers features of the feeding mechanism and means for disposing of the fumes from the arc and for ventilating the lamp mechanism.

890,770. FIXED POLARITY SEPARABLE ATTACHMENT PLUG; Harvey Hubbell, Bridgeport, Conn. App. filed Sept. 5, 1907. A separable attachment plug for high potential electrical service, so constructed that the parts can be attached in one way only, thereby fixing the polarity and preventing reversal of the current.

890,776. DAMPER FOR THE UPPER HARMONICS OF ALTERNATING ELECTRIC CURRENTS; Maurice Le Blanc, Paris, France. App. filed April 28, 1905. An alternating-current machine provided with an unscreened very high resistance harmonic-damper circuit, substantially as described.

890,781. ELECTRIC TRANSFORMER; Louis Maiche, Paris, France. App. filed Sept. 23, 1907. Makes use of a supporting core in the shape of a grooved pulley, within the groove of which the primary and secondary windings are contained.

890,783. SWITCHING ELECTRIC CURRENTS; Samuel W. Mauger, Schenectady, N. Y. App. filed June 26, 1902. Has means to prevent overloading the smaller switches, such as the feeder switches, in case of a short circuit. Has group circuit breakers, each supplying a number of feeders, and electro-responsive devices for tripping the circuit breakers at different loads in time intervals that are shorter for the heavier loads.

890,788. RETORT; Charles F. McKenna, New York, N. Y. App. filed April 22, 1903. Relates to apparatus for separating those constituents of substances which may be driven off by heat from those constituents which are not volatilized.

890,803. METHOD OF TUNING; Melvin L. Severy, Arlington Heights, and George B. Sinclair, Winthrop, Mass. App. filed Aug. 7, 1905. The patentees have a means for producing periodic currents of any predetermined frequencies and energizes a magnet in proximity to the piano wire to be tuned by these currents, so as to tune the wire in harmony with the vibrations.

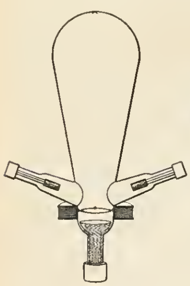
890,827. BATTERY; Adolph T. Vigneron, Providence, R. I. App. filed Jan. 16, 1907. A box for electric dry batteries designed to permit easy removal and replacement of the cells and so arranged that it is impossible to connect the cells in any way except straight series circuit.

890,840. POLE CHANGER; William E. Butler and Morgan L. Lane, Omaha, Neb. App. filed March 11, 1908. A means for transmitting to the ringing circuits of telephone lines different types of current impulses from a constant curve source, comprising circuits individually and positively coupled to the respective sides of the current source, and means for coupling either the positive or negative side of the current source to the said other circuit and the respective other side of the current source to ground.

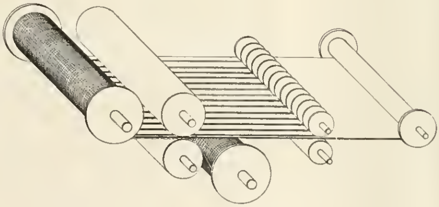
890,850. TELEPHONIC PROTECTOR AGAINST ELECTROMAGNETIC EFFECTS; Celio Duo, Buenos Ayres, Argentina. App. filed Nov. 30, 1906. In a telephone protector, a bobbin composed of a nucleus of metal, an insulated conductor wound around said nucleus, a second insulated conductor wound around that first named, a third insulated conductor wound around that second named and also wound in the opposite direction around its first winding, a fifth winding around that last mentioned and in continuation of that second named; a sixth winding around the fifth and in continuation of the first-named winding, and a telephone in circuit with the conductor of the second and third windings.

890,851. ELECTRIC METER AND SERVICE BOX; Charles G. Durfee, Rochester, N. Y. App. filed June 3, 1907. Complete mechanical and electrical features of electric meter and service box, designed to be compact and inaccessible to unauthorized persons.

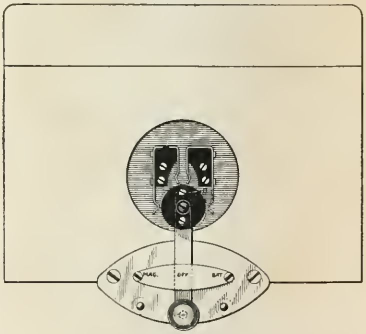
890,855. CULINARY APPARATUS; William S. Hadaway, Jr., East Orange, N. J. App. filed July 5, 1907. The combination with a fluid-containing vessel, and external means for imparting heat thereto, of a heat-insulating barrier located within the vessel for determining the fluid circulation.



890,731.—Starting Mercury-Vapor Apparatus.



890,988.—Electric Coil and Method of Producing Same.



891,017.—Coil Box Switch for Ignition Systems.

890,856. ELECTRIC HEATING DEVICE; William S. Hadaway, Jr., East Orange, N. J. App. filed July 3, 1907. A resistance element comprising a conducting ribbon having a plurality of groups of slots alternately open at opposite edges, said groups being separated by material lengths of ribbon having a relatively large current-conducting capacity.

890,857. CULINARY APPARATUS; William S. Hadaway, Jr., East Orange, N. J. App. filed Sept. 26, 1907. In a heating device the combination with a fluid-containing vessel, a second vessel with said fluid-containing vessel, a third vessel suspended in the second vessel, and means for supporting the third vessel at different heights, of means for heating the inside wall of the second vessel.

890,858. ELECTRIC HEATING DEVICE; William S. Hadaway, Jr., East Orange, N. J. App. filed Sept. 26, 1907. Electric heating device adapted for use with embossing presses which are subjected to heavy pressure and shock. Comprises a plurality of rods of heat-conducting material, which are assembled side by side and provided with electrical resistance units by which they are heated.

890,866. CONTACT BOX FOR ELECTRIC RAILWAYS; George H. McFeaters, Johnstown, Pa. App. filed June 6, 1905. Means for increasing the current carrying capacity of a contact box for electric railways of the type having a circuit closer magnetically actuated to complete the circuit of the box during the passage of the train.

890,882. PLATING RACK; Henry V. Smith, Bridgeport, Conn. App. filed Oct. 28, 1907. A plating rack comprising forms having supporting wires for the articles to be plated, a frame by which the forms are carried and insulating material on the frame to prevent deposition of metal thereon.

890,887. PROCESS OF RECOVERING COPPER FROM COPPER BEARING SOLUTIONS; Louis Amenábar, Coquimbo, Chile. App. filed Nov. 4, 1907. The process of recovering copper from a copper-bearing solution, which consists in subjecting the solution to the electrolytic action of a current of great density while in a circulating system, in which the solution is brought into and removed from the fluid of electrolytic action a number of times.

890,891. INSULATOR PIN; Conrad J. Dorff, Chicago, Ill. App. filed Nov. 18, 1907. A support for a pair of insulators, making use of an angle iron core, which engages a sheet metal part embossed with threads to enter the insulator.

890,911. PRINTING TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 19, 1905. The method of actuating a printing device at a receiving station of a submarine telegraph station, which consists in selecting through impulses of like duration and intensity following each other in unequal succession, the required printing type, and causing the receiving mechanism to return to its normal position by an additional impulse.

890,935. CONDUIT BOX; Warren S. Rounds and Daniel Holland, Saratoga Springs, N. Y. App. filed Sept. 26, 1907. Construction of conduit box, including an elongated body pole having its opposite ends provided with split clamping members pierced by aligned openings for the reception of the adjacent conduit sections, said sections being located within the box by contracting the clamping members at the split ends thereof.

890,942. ELECTRIC SWITCH THROWING MECHANISM; William Herbert Turner, Leeds, England. App. filed April 18, 1907. Includes an automatically closed iron casing, with a chamber having a solenoid and cam mechanism of such a type as to throw the switch point alternately by successive actuations of the solenoid.

890,960. ELECTRICALLY OPERATED ADDING MACHINE; Roy L. Burd, Detroit, Mich. App. filed Feb. 7, 1907. Comprises an electric motor having driving connections, including a normally restrained clutch, and manipulative means for releasing the clutch, and a lock for said means controlled by the speed of the motor.

890,979. MULTIPLE SERIES RELAY CONTROLLER; Clark T. Henderson, Milwaukee, Wis. App. filed Sept. 6, 1907. Provides means whereby contactor switches of a train-controlled system will respond successively, but their progressive operation will be arrested while there is an abnormal current.

890,982. ROTARY FIELD MAGNET; Jack Hissink, Berlin, Germany. App. filed May 17, 1906. A rotary field magnet provided with uniformly distributed recesses of uniform radial depth, but of a cross-section, increasing progressively from recess to recess, from the central portion of the poles to the pole ends.

890,988. ELECTRIC COIL AND METHOD OF PRODUCING SAME; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 11, 1907. The method of producing an electric coil, which consists in winding in coil form a sheet of insulating material having a series of independent conductors thereon, and then connecting the latter in series with respect to each other.

891,017. COIL-BOX SWITCH FOR IGNITION SYSTEMS; Richard Varley, Englewood, N. J. App. filed March 25, 1907. A form of foot switch designed to be applied directly to the face of a coil box in a motor vehicle so as to control the circuits of the battery and the magneto generators usually employed. The switch has three positions of throw corresponding to battery, magneto and inactive conditions.

891,039. ELECTRICAL CONTACT TERMINAL; Charles W. Clifford, Trenton, N. J. App. filed June 13, 1906. A form of fuse plug making use of a porcelain body having a fuse wire soldered to the threaded shell and received in a split portion of the central pin constituting the center contact.

891,049. CROSSING PROTECTOR FOR HIGH TENSION LINES; John Frank Dostal, Denver, Col. App. filed Feb. 27, 1906. A socket member for a crossing protector for high potential lines, comprising an elongated body portion adapted for rigid securement on an insulator and terminating in an oval, upwardly convex and downwardly open hood, provided with a spherical concave surface inside of its outer end.

891,112. SPARK PLUG PROTECTOR; Charles Henry Stuart, Newark, N. Y. App. filed Nov. 13, 1905. The patentee makes use of an insulating shell forming part of a terminal fastening and adapted to enclose the exposed portion of a spark plug so as to protect the same from rain and other moisture.

891,123. TROLLEY; John C. Wilkins, Swissvale, Pa. App. filed Oct. 27, 1906. The trolley harp has a pair of pivoted, hook-shaped arms, which close over the wire by spring pressure, but which are opened to permit disengagement of the wire by a downward pull on the controlling core.

891,221. TRAIN LIGHTING SYSTEM; Joseph Lester Woodbridge, Philadelphia, Pa. App. filed June 21, 1907. A complete controller system for a generator designed to be driven by the wheel axles of a train. Includes storage batteries for taking the load during the stopping periods.

891,223. PROCESS FOR MANUFACTURING THE FILAMENTS OF ELECTRIC INCANDESCENT LAMPS; Werner von Bolton, Charlottenberg, Germany. App. filed Feb. 24, 1906. The process of preparing incandescent bodies from pulverulent metallic tantalum, which consists in electrically heating such tantalum in a state of granular agglomeration in an indifferent environment until the several particles therof metallically unite to form a homogeneous mass and drawing down such mass into filament form

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